REPUBLIC OF BULGARIA
MINISTRY OF ENVIRONMENT AND WATER

EXECUTIVE ENVIRONMENT AGENCY

NATIONAL INVENTORY REPORT 2014

for Greenhouse Gas Emissions

Submission under the UNFCCC and the Kyoto Protocol

April, 2014

Reporting Entity

Executive Environment Agency at the Ministry of Environment and Water

136 "Tzar Boris III" Blvd.

Sofia 1618

Table of Contents

EXECUTIVE SUMMARY

ES 1 Background information on climate change

Over the past century, atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and halogenated hydrocarbons, i.e. greenhouse gases, have increased as a consequence of human activity. Greenhouse gases prevent the radiation of heat back to space and cause warming of the climate. According to the Fourth Assessment Report of the Intergovernmental Panel of Climate Change (AR4) (IPCC 2007)[1], the atmospheric concentrations of CO_2 have increased by 35%, CH_4 concentrations have more than doubled and N_2O concentration has risen by 18%, compared with the pre-industrial era.

Changing climate has effects on both human and natural systems (e.g. human settlements, human health, water and food resources, ecosystem and biodiversity). Some of the effects on environmental and socio-economic systems will be beneficial, some damaging. The larger changes and the rate of changes in climate, the more adverse effects will predominate. In Bulgaria the adverse impacts are related, for example, the winter tourism, increased floodings and droughts and the prevalence of pests and diseases. Positive impacts could be possible growth of productivity in agriculture and forestry and decreased need for heating energy. According to The "Fifth National Communication of Bulgaria on Climate Change"[2] from the year 2010 the average temperature in the country could rise. Extreme weather events, such as storms, droughts and heavy rains, are likely to increase.

According to the HadCM3[3] model significant summer warming in the Western Balkan countries were projected for 2080. Air temperatures during this time of the year are expected to increase between 5°C and 8°C over most of the countries in the peninsula. Summer precipitation is projected to decrease in the region.

Acknowledging the importance of the climate change issue and the need for international cooperation to address this problem, Bulgaria signed the UNFCCC in Rio de Janeiro in June 1992 and the Parliament ratified it in March 1995. In compliance with Article 4.6 and 4.2(b) of the UNFCCC, Bulgaria as a country in transition has adopted 1988[4] as a base year for the implementation of the Convention instead of 1990. As an Annex I Party of the UNFCCC the Republic of Bulgaria adopted the target to stabilize emissions of greenhouse gases by 2000 at a level not exceeded that in 1988. The same year was used when comparing, evaluating and projecting greenhouse gas emissions. The 2000 target was successfully achieved.

[1] Fourth Assessment Report of the Intergovernmental Panel of Climate Change (AR4) (IPCC 2007): Working Group I Report "The Physical Science Basis"; Working Group II Report "Impacts, Adaptation and Vulnerability"; Working Group III Report "Mitigation of Climate Change";

http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm

[2] http://unfccc.int/resource/docs/natc/bgr_nc5.pdf

[3] http://www.ipcc-data.org/sres/hadcm3_info.html

[4] FCCC/CP/1996/15/Add.1/Corr.17 June 1999 http://unfccc.int/resource/docs/cop2/15a01c01.pdf#page=1

The Kyoto Protocol (KP) is adopted at the III-rd Session of the Conference of the Parties (COP) to the Convention (December 1997, Kyoto). The KP is ratified by Bulgaria in August 2002. After Russia ratified the KP in November 2004, it entered into force on 16 February 2005.

With the KP, the Parties to the Convention took the commitment not only to stabilize the GHG emissions, but also to reduce them by percentage, defined with respect to the base year of each Party.

Bulgaria ratified the the KP in August 2002 taking the commitment to reduce its national GHG emissions for the first commitment period (2008-2012) by 8% compared to 1988 (base year). Under these international agreements Bulgaria is committed to provide annually information on its national anthropogenic greenhouse gas emissions by sources and removals by sinks for all greenhouse gases not controlled by the Montreal Protocol.

The inventories started with the country base year – 1988. The first inventories covered the period 1988-1994 as a part of the international project "Country Study to Address Climate Change[5]".

ES 2 Background information on greenhouse gas inventories

The annual inventory and reporting of greenhouse gas emissions and removals provide an information base for the planning and monitoring of climate policy. The Kyoto Protocol obliges its parties to establish a national greenhouse gas inventory system by the end of 2006. Bulgaria's National Greenhouse Gas Inventory System was set up at the beginning of 2007.

The national system produces data and background information on emissions and removals for the UNFCCC, the Kyoto Protocol and the EU Commission. In addition, the scope of the system covers the archiving of the data used in emission estimations, the publishing of the results, participation in inventory reviews and the quality management of the inventory.

The Decision[6] of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol obliges the Member States (MS) of the European Union (EU) to participate in the compilation of the EU's common greenhouse gas inventory and other climate policy, as well as in the monitoring and evaluation of its detailed measures. This procedure causes a two-phased submission of MS inventory reporting to the Commission with annual deadlines for submission 15 January and 15 March.

This National Inventory Report (NIR) of Bulgaria for the 2014 submission to the EU, the UNFCCC and the Kyoto Protocol includes data of the anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHG_S) not controlled by the Montreal

[5] http://www.gcrio.org/CSP/pdf/bulgaria_snap.pdf

[6] Decision No 280/2004/EC

Protocol, i.e. carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFC_S), hydrofluorocarbons (HFC_S) and sulphur hexafluoride (SF_6).

Each of these gases has a different warming effect. As an example, the gases HFCs, PFCs and SF_6 (so called F-gases) have much greater warming effect, in some cases over one hundred times, compared to methane (21), nitrous oxide (310) and carbon dioxide (1).[7]

Because of that, a common assessment criterion for the effect of each GHG on the atmosphere warming should be introduced. This criterion is the so-called Global Warming Potential (GWP), representing GHG emissions as CO_2-eq. emissions. It allows totalling the effect of all GHGs, adjusted to a common base.

For defining of GWP, the Parties to the Convention and Kyoto Protocol accept values, over a time horizon of 100 years, as mentioned in the IPCC Second Assessment Report of 1999[8].

Indirect CO_2 emissions resulting from atmospheric oxidation of CH_4 and NMVOC emissions from non-biogenic sources are also included in the inventory. These have been separately estimated for fugitive emissions in the Energy sector and sources in the Industrial Process and Solvent and Other Product Use sectors using the methodology given in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006, see Section 7.2.1.5). For fossil fuel combustion, indirect emissions are included in the methodology to estimate CO_2 emissions. The estimation and reporting of indirect CO_2 emissions are also addressed in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1997) and the UNFCCC reporting guidelines on annual inventories (UNFCCC 2006).

The NIR includes also estimates of so-called indirect greenhouse gases carbon monoxide (CO), nitrogen oxides (NO_X) and non-methane volatile organic compounds ($NMVOC_S$) and sulphur dioxide (SO_2) meaning sulphur oxides and other sulphur emissions calculated as SO_2. Indirect greenhouse gases and sulphur dioxide do not have a direct warming effect, but influence on the formation or destruction of direct greenhouse gases, such as troposheric ozone. These gases are not included in Annex A of the Kyoto Protocol.

Other gases have indirect warming effect to the atmosphere (as NO_X, CO and NMVOCs), or cooling effect as SO_X. These gases are precursors of the greenhouse gas – troposphere ozone, and are subject of regional control protocols. They do not have global effect on the climate changes as the main GHG. That is why in the NIR only the total GHG emissions – precursors, as well as the total SO_X emissions were reported.

The emission estimates and removals are presented by gas and by source category and refer to the year 2012. Full time series of the emissions and removals (with exception of F-gases) from 1988 to 2012 are included in the submission.

The structure of this NIR was reelaborated in order to follow the UNFCCC reporting guidelines on annual inventories (UNFCCC 2006). The annotated outline of the NIR'[9], and

[7] Global Warming Potential referenced to the updated decay response for the Bern carbon cycle model and future CO_2 atmospheric concentrations held constant at current levels. http://unfccc.int/ghg_data/items/3825.php

[8] http://www.ipcc.ch/pdf/climate-changes-1995/ipcc-2nd-assessment/2nd-assessment-en.pdf

the guidance contained therein, developed by the UNFCCC secretariat in 2009, has been followed. Chapter 1 provides an introduction to the background of greenhouse gas inventories and the inventory preparation process and Chapter 2 presents the overall emission trend in Bulgaria from the year 1988 to the year 2012. In Chapters 3 to 9 more detailed information of GHG emission estimates are given for the seven sectors:

- CRF 1: Energy
- CRF 2: Industrial processes
- CRF 3: Solvent and other product use
- CRF 4: Agriculture
- CRF 5: Land use, land-use change and forestry
- CRF 6: Waste
- CRF 7: Other

In Chapter 10 improvements and recalculations since the previous submission are summarised. Chapter 11 provides description of KP-LULUCF, Chapter 12 information on accounting of KYOTO units, Chapter 13 information on changes in national system and Chapter 14 information on changes in national registry. Chapter 15 gives information on minimisation of adverse impacts in accordance with Article 3, paragraph 14. Annex 1 contains the mandatory key category reporting tables. A national reference calculation for CO_2 emissions from energy combustion can be found in Annex 4 (Comparison of CO_2 emissions calculated from the Energy balance with fuel combustion emissions as reported in the CRF tables). Annex 7 contains the mandatory uncertainty reporting table (table 6.1 of Good Practice Guidance 2000). Annex 6 includes additional information to be considered as part of the annual inventory submission and the supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol or other useful reference information.

As an Annex I Party to the UNFCCC Bulgaria reports annually its GHG inventory from the base year to the year preceding the year of reporting.

Annex I Parties to the KP should report also additional elements as assigned amount information, changes in national system, changes in national registry and submission of information relating to activities under Articles 3, paragraphs 3, of the Kyoto Protocol.

The inventories are prepared according to the UNFCCC Guidelines[10], adopted at the 21st session of the SBSTA (December 2004, Buenos Aires) and establishing the NIR structure in compliance with the Revised IPCC Guidelines from 1996, the IPCC Good Practice Guidance (for National GHG Inventories) from 2000, the IPCC Guidelines 2006, GPG LULUCF 2003[11].

[9] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/reporting_requirements/application/pdf/annotated_nir_outline.pdf

[10] http://unfccc.int/resource/docs/2004/sbsta/08.pdf

[11] http://unfccc.int/methods_science/redd/methodologies/ipcc_guidance/items/4539.php

The general objective regarding the preparation of the annual GHG inventories is to improve „TACCC" in emission estimates. The Report presents the National GHG inventory for 2012. The following are described as well:

- Methods and indices for uncertainty assessment of the annual GHG emissions and trends;
- Key GHG emission category according to method of the type Tier 1 and Tier 2, specified in the Good Practice Guidance;
- Assessment of the quality assurance and control system;
- Activity data and emission tables for 1988-2011 in the Common Reporting Format (CRF) for annual GHG inventories are submitted together with the Report and are uploaded on:

http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php

http://cdr.eionet.europa.eu/bg/un/unfccc

http://cdr.eionet.europa.eu/bg/eu/colql41aa

ES 3 Background information on supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

Bulgaria has made a commitment to follow the UNFCCC that entered into force on 21 March 1994. The Kyoto Protocol negotiated in 1997 under the UN Framework. The Kyoto protocol took effect on 16 February 2005 and became legally binding.

The Kyoto Protocol (Article 5.1) requires that the parties have in place a National System by the end of 2006 at the latest for estimating anthropogenic greenhouse gas emissions by sources and removals by sinks not controlled by the Montreal Protocol. The guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (Decision 19/CMP.1[12]) provide the requirements for the general and specific functions of the national systems. Bulgaria's inventory system was reviewed as part of the review of the Bulgaria's initial report under Convention in 2007 (FCCC/IRR/2007/BGR)[13].

Under the UNFCCC and the Kyoto Protocol, Bulgaria is required to submit annually to secretariat of the Convention a national greenhouse gas inventory covering emissions and removals of direct greenhouse gases from the six sectors (Energy, Industrial processes, Solvent and other product use, Agriculture, Land Use, Land-Use change and Forestry and Waste) and for all years from the base year or period to the most recent year. The preparation and reporting of the inventories are guided by the UNFCCC guidelines (UNFCCC 2006) and are based on the following IPCC methodologies to ensure the transparency, accuracy, comparability, consistency and completeness of the inventories;

[12] http://www.ciesin.columbia.edu/repository/entri/docs/cop/Kyoto_COP001_019.pdf

[13] Report of the review of the initial report of Bulgaria: http://unfccc.int/resource/docs/2008/irr/bgr.pdf

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1996 IPCC GL)
IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories 2000 (GPG 2000)
IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry 2003 (GPG LULUCF 2003)
2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006 GL)[14]
EMEP/EEA air pollutant emission inventory guidebook – 2009.

The national greenhouse gas inventory for 2012 is submitted to the European Commission by Bulgarian Ministry of Environment and Water in fulfillment of Bulgaria's obligation under Article 7 of Regulation 525/2013[15] of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC. The purpose of this decision is to monitor all anthropogenic greenhouse gas emissions not controlled by the Montreal Protocol10 and to evaluate the progress towards meeting the greenhouse gas reduction commitments under the UNFCCC and the Kyoto Protocol.

[14] http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

[15]http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:165:0013:0040:EN:PDF

PART 1: ANNUAL INVENTORY SUBMISSION

1 INTRODUCTION

1.1 BACKGROUND INFORMATION ON GREENHOUSE GAS INVENTORIES, CLIMATE CHANGE AND SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1, OF THE KYOTO PROTOCOL

1.1.1 BACKGROUND INFORMATION ON CLIMATE CHANGE

Over the past century, atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and halogenated hydrocarbons, i.e. greenhouse gases, have increased as a consequence of human activity. Greenhouse gases prevent the radiation of heat back to space and cause warming of the climate. According to the Fourth Assessment Report of the Intergovernmental Panel of Climate Change (IPCC 2007), the atmospheric concentrations of CO_2 have increased by 35%, CH_4 concentrations have more than doubled and N_2O concentration has risen by 18%, compared with the pre-industrial era.

Changing climate has effects on both human and natural systems (e.g. human settlements, human health, water and food resources, ecosystem and biodiversity). Some of the effects on environmental and socio-economic systems will be beneficial, some damaging. The larger changes and the rate of changes in climate, the more adverse effects will predominate. In Bulgaria the adverse impacts are related, for example, to the winter tourism, increased floodings and droughts and the prevalence of pests and diseases. Positive impacts could be possible growth of productivity in agriculture and forestry and decreased need for heating energy. According to the Fifth National Communication of Bulgaria on Climate Change from the year 2010 the average temperature in the country could rise. Extreme weather events, such as storms, droughts and heavy rains, are likely to increase.

Significant summer warming in the western Balkan countries, were projected by the HadCM3 model for 2080. Air temperatures during this time of the year are expected to increase between 5ºC and 8ºC over most of the countries in the peninsula. Summer precipitation is projected to decrease in the region.

Acknowledging the importance of the climate change issue and the need for international cooperation to address this problem, Bulgaria signed the UNFCCC in Rio de Janeiro in June 1992 and the Parliament ratified it in March 1995. In compliance with Article 4.6 and 4.2(b) of the FCCC, Bulgaria as a country in transition has adopted 1988 as a base year for the implementation of the Convention instead of 1990. As an Annex I Party of the UNFCCC the Republic of Bulgaria adopted the target to stabilize emissions of greenhouse gases by 2000 at a level not exceeded that in 1988. The same year was used when comparing, evaluating and projecting greenhouse gas emissions. The 2000 target was successfully achieved.

The Kyoto Protocol (KP) is adopted at the III-rd Session of the Conference of the Parties to the Convention (December 1997, Kyoto). KP is ratified by Bulgaria in August 2002. After Russia ratified the KP in November 2004, it entered into force on 16 February 2005.

With the KP, the Parties to the Convention took the commitment not only to stabilize the GHG emissions, but also to reduce them by percentage, defined with respect to the base year of each Party.

Bulgaria ratified the KP in August 2002 taking the commitment to reduce its national GHG emissions for the first commitment period (2008-2012) by 8% compared to 1988 (base year). Under these international agreements Bulgaria is committed to provide annually information on its national anthropogenic greenhouse gas emissions by sources and removals by sinks for all greenhouse gases not controlled by the Montreal Protocol.

The inventories started with the country base year – 1988. The first inventories covered the period 1988-1994 as a part of the international project "Country Study to Address Climate Change".

1.1.2 BACKGROUND INFORMATION ON GREENHOUSE GAS INVENTORIES

The annual inventory and reporting of greenhouse gas emissions and removals provide an information base for the planning and monitoring of climate policy. The Kyoto Protocol obliges its parties to establish a national greenhouse gas inventory system by the end of 2006. Bulgaria's National Greenhouse Gas Inventory System was set up at the beginning of 2007.

The national system produces data and background information on emissions and removals for the UNFCCC, the Kyoto Protocol and the EU Commission. In addition, the scope of the system covers the archiving of the data used in emission estimations, the publishing of the results, participation in inventory reviews and the quality management of the inventory.

The regulation of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol obliges the Member States (MS) of the European Union (EU) to participate in the compilation of the EU's common greenhouse gas inventory and other climate policy, as well as in the monitoring and evaluation of its detailed measures. This procedure causes a two-phased submission of MS inventory reporting to the Commission with annual deadlines for submission 15 January and 15 March.

This National Inventory Report (NIR) of Bulgaria for the 2014 submission to the EU, the UNFCCC and the Kyoto Protocol includes data of the anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol, i.e. carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6).

Indirect CO_2 emissions resulting from atmospheric oxidation of CH_4 and NMVOC emissions from non-biogenic sources are also included in the inventory. These have been separately estimated for fugitive emissions in the Energy sector and sources in the Industrial Process and Solvent and Other Product Use sectors using the methodology given in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006, see Section 7.2.1.5). For fossil fuel combustion, indirect emissions are included in the methodology to estimate CO_2 emissions. The estimation and reporting of indirect CO_2 emissions are also addressed in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1997) and the UNFCCC reporting guidelines on annual inventories (UNFCCC 2006).

The NIR includes also estimates of so-called indirect greenhouse gases carbon monoxide (CO), nitrogen oxides (NOx) and non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO_2 meaning sulphur oxides and other sulphur emissions calculated as SO_2). Indirect greenhouse gases and sulphur dioxide do not have a direct warming effect, but influence on the formation or destruction of direct greenhouse gases, such as troposheric ozone. These gases are not included in Annex A of the Kyoto Protocol.

The emission estimates and removals are presented by gas and by source category and refer to the year 2012. Full time series of the emissions and removals (with exception of F-gases) from 1988 to 2012 are included in the submission.

The structure of this NIR was reelaborated in order to follow the UNFCCC reporting guidelines on annual inventories (UNFCCC 2006). The annotated outline of the NIR, and the guidance contained therein, developed by the UNFCCC secretariat in 2009, has been followed. Chapter 1 provides an introduction to the background of greenhouse gas inventories and the inventory preparation process and Chapter 2 presents the overall emission trend in Bulgaria from the year 1988 to the year 2012. In Chapters 3 to 9 more detailed information of GHG emission estimates are given for the seven sectors: (i) energy, (ii) industrial processes, (iii) solvent and other product use, (iv) agriculture, (v) land use, land-use change and forestry, (vi) waste, and (vii) other. In Chapter 10 improvements and recalculations since the previous submission are summarised. Chapter 11 provides description of KP-LULUCF, Chapter 12 information on accounting of KYOTO units, Chapter 13 information on changes in national system and Chapter 14 information on changes in national registry. Chapter 15 gives information on minimisation of adverse impacts in accordance with Article 3, paragraph 14.

Annex 1 contains the mandatory key category reporting tables. A national reference calculation for CO_2 emissions from energy combustion can be found in Annex 4 (Comparison of CO_2 emissions calculated from the Energy balance with fuel combustion emissions as reported in the CRF tables). Annex 7 contains the mandatory uncertainty reporting table (table 6.1 of Good Practice Guidance 2000). Annex 6 includes additional information to be considered as part of the annual inventory submission and the supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol or other useful reference information.

As an Annex I Party to the Convention Bulgaria reports annually its GHG inventory/emissions from the base year to the year preceding the year of reporting.

Annex I Parties to the KP should report also additional elements as assigned amount information, changes in national system, changes in national registry and voluntary submission of information relating to activities under Articles 3, paragraphs 3 and 4, of the Kyoto Protocol.

The main greenhouse gases to be reported pursuant to UNFCCC are as follows:

- Carbon dioxide - CO_2;
- Methane - CH_4;
- Nitrous oxide - N_2O;
- Hydrofluorocarbons – HFCs;
- Perfluorocarbons – PFCs;
- Sulphur hexafluoride - SF_6.

Each of these gases has a different warming effect. As an example, the gases HFCs, PFCs and SF_6 (so called F-gases) have much greater warming effect, in some cases over one hundred times, compared to methane (21), nitrous oxide (310) and carbon dioxide (1).

Because of that, a common assessment criterion for the effect of each GHG on the atmosphere warming should be introduced. This criterion is the so-called Global Warming Potential (GWP), representing GHG emissions as CO_2-eq. emissions. It allows totalling the effect of all GHGs, adjusted to a common base.

For defining of GWP, the Parties to the Convention and Kyoto Protocol accept values, over a time horizon of 100 years, as mentioned in the IPCC Second Assessment Report of 1999.

Other gases have indirect warming effect to the atmosphere (as NOx, CO and NMVOCs), or cooling effect as SOx. These gases are precursors of the greenhouse gas – troposphere ozone, and are subject of regional control protocols. They do not have global effect on the climate changes as the main GHG. That is why in the NIR only the total GHG emissions – precursors, as well as the total SOx emissions were reported.

The inventories are prepared according to the UNFCCC Guidelines, adopted at the 21st session of the SBSTA (December 2004, Buenos Aires) and establishing the NIR structure in compliance with the Revised IPCC Guidelines from 1996 and the IPCC Good Practice Guidance (for National GHG Inventories) from 2000.

The general objective regarding the preparation of the annual GHG inventories is to improve „TACCC" in emission estimates. The Report presents the National GHG inventory for 2012. The following are described as well:

- Methods and indices for uncertainty assessment of the annual GHG emissions and trends;
- Key GHG emission sources according to method of the type Tier 1 and Tier 2, specified in the Good Practice Guidance;
- Assessment of the quality assurance and control system.
- Activity data and emission tables for 1988-2012 in the Common Reporting Format (CRF) for annual GHG inventories are submitted together with the Report and are uploaded on:

http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php

http://cdr.eionet.europa.eu/bg/un/unfccc

http://cdr.eionet.europa.eu/bg/eu/colql41aa

1.1.3 BACKGROUND INFORMATION ON SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1, OF THE KYOTO PROTOCOL AND INTERNATIONAL AGREEMENTS

Bulgaria has made a commitment to follow the United Nations Framework Convention on Climate Change that entered into force on 21 March 1994. The Kyoto Protocol negotiated in 1997 under the UN Framework. The Kyoto protocol took effect on 16 February 2005 and became legally binding.

The Kyoto Protocol (Article 5.1) requires that the parties have in place a National System by the end of 2006 at the latest for estimating anthropogenic greenhouse gas emissions by sources and removals by sinks not controlled by the Montreal Protocol. The guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (Decision 19/CMP.1) provide the requirements for the general and specific functions of the national systems. Bulgaria's inventory system was reviewed successfully as part of the review of the Bulgaria's initial report under Protocol in 2007.

Under the UNFCCC and the Kyoto Protocol, Bulgaria is required to submit annually to secretariat of the Convention a national greenhouse gas inventory covering emissions and removals of direct greenhouse gases from the six sectors (Energy, Industrial processes, Solvent and other product use, Agriculture, Land use, Land use change and Forestry and Waste) and for all years from the base year or period to the most recent year. The preparation and reporting of the inventories are guided by the UNFCCC guidelines (UNFCCC 2006) and are based on the following IPCC methodologies to ensure the transparency, accuracy, consistency, comparability and completeness of the inventories:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1996 IPCC GL)
- IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories 2000 (GPG 2000)
- IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry 2003 (GPG LULUCF 2003)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC GL)
- EMEP/EEA air pollutant emission inventory guidebook – 2009.[15]

The national greenhouse gas inventory for 2012 is submitted to the European Commission by Bulgarian Ministry of Environment and Water in fulfillment of Bulgaria's obligation under Article 7 of Regulation 525/201315 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC. The purpose of this regulation is to monitor all anthropogenic greenhouse gas emissions not controlled by the Montreal Protocol 10 and to evaluate the progress towards meeting the greenhouse gas reduction commitments under the UNFCCC and the Kyoto Protocol.

[15] In the following refered as EMEP/EEA Guidebook (2009)

1.2 DESCRIPTION OF THE INSTITUTIONAL ARRANGEMENTS FOR INVENTORY PREPARATION, INCLUDING THE LEGAL AND PROCEDURAL ARRANGEMENTS FOR INVENTORY PLANNING, PREPARATION AND MANAGEMENT

1.2.1 NATIONAL GREENHOUSE GAS INVENTORY SYSTEM IN BULGARIA

REQUIREMENTS FOR NATIONAL SYSTEMS FOR GREENHOUSE GAS INVENTORIES AS SPECIFIED IN THE GUIDELINES FOR ARTICLE 5.1 OF THE KYOTO PROTOCOL

The Bulgarian National Inventory System (BGNIS) is developed following the requirements of the provisions of Decision 19/CMP.1 Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol.

In order to reinstate the eligibility under Kyoto Protocol a Compliance Action Plan for ensuring the effective and timely functioning of BGNIS in accordance with the requirements of Article 5.1 of the Kyoto Protocol and Decision 19/CMP.1 was developed and implemented in 2010.

The conclusions and recommendations of ERT set out in the Report of the individual review of the 2010 annual submission of Bulgaria (FCCC/ARR/2010/BGR) indicate that all activities for improvements of institutional, legal and procedural arrangements within the National Inventory System as well as for improvement of quality of inventory are adequately planned and implemented by the Bulgarian government in 2010.

The main results are written in the paragraph §203 from the annual review report FCCC/ARR/2010/BGR - "The ERT concludes that the national system of Bulgaria is performing its required general and specific functions, as set out in the annex to decision 19/CMP.1 with respect to the institutional, legal and procedural arrangements to perform these functions; that the institutional, legal and procedural arrangements established and formalized by the "Ordinance on the way and order of organization of the national inventories of hazardous substances from greenhouse gases in the ambient air" (Ordinance No. 215) that entered into force on 21 September 2010 are fully operational; and that Bulgaria has in place the institutional arrangements and the capacity, including the arrangements for the technical competence of staff involved in the national system, to plan, prepare and manage inventories on an annual basis". As a result from implemented activities for improvements "No questions of implementation were identified by the ERT during the review" (FCCC/ARR/2010/BGR § 207).

In accordance with Decision of Enforcement Branch CC-2010-1-17/Bulgaria/EB from 4 February 2011 Bulgaria is now fully eligible to participate in the mechanisms under Articles 6, 12, and 17 of the Kyoto Protocol.

The 2014 update of the Action Plan is presented in Chapter 1.4. The activities for improvement of quality of GHGs inventory are planned in order to implement the recommendations of the Expert Review Team set out in the annual review report FCCC/ARR/2013/BGR.

1.2.2 HISTORY OF GHGS INVENTORY PREPARATION

The Bulgarian National Inventory System changed over time two times because of decisions of the particular government. In the following table the national circumstances are outlined:

BGNIS until 2007 (submission 2007)	Present BGNIS (submission 2008-2014)	Prospected BGNIS
←	Centralized inventory	→
Single institute	Single agency	→
Out-sourced inventory	In-sourced inventory	→
Private consultants	**Public/Governmental** (submission with cooperation of consultants)	→
National Inventory Focal Point: Private consultants	National Inventory Focal Point: ExEA	→
←	National Focal Point: MoEW	→

Until 2007 the national emissions inventory as well as the relevant NIR under UNFCCC was prepared by an external company through an open tender procedure under the rules of the Public Procurement Law.

Since 2008 the Executive Environment Agency (ExEA) is responsible for the whole process of inventory planning, preparation and management.

The national system defines the "road map" in which Bulgaria prepares its inventory. This is outlined in the national inventory preparation cycle (see below part Fulfillment of paragraph 10(a) from Decision 19/CMP.1 Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol).

As it is illustrated in figure 1 and outlined in the following chapters the preparation of the inventory has an institutional "home" that is ultimately responsible for managing the process and has a legal authority to collect data and submit it on behalf of the Bulgaria.

Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are being administered by the MoEW. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MoEW.

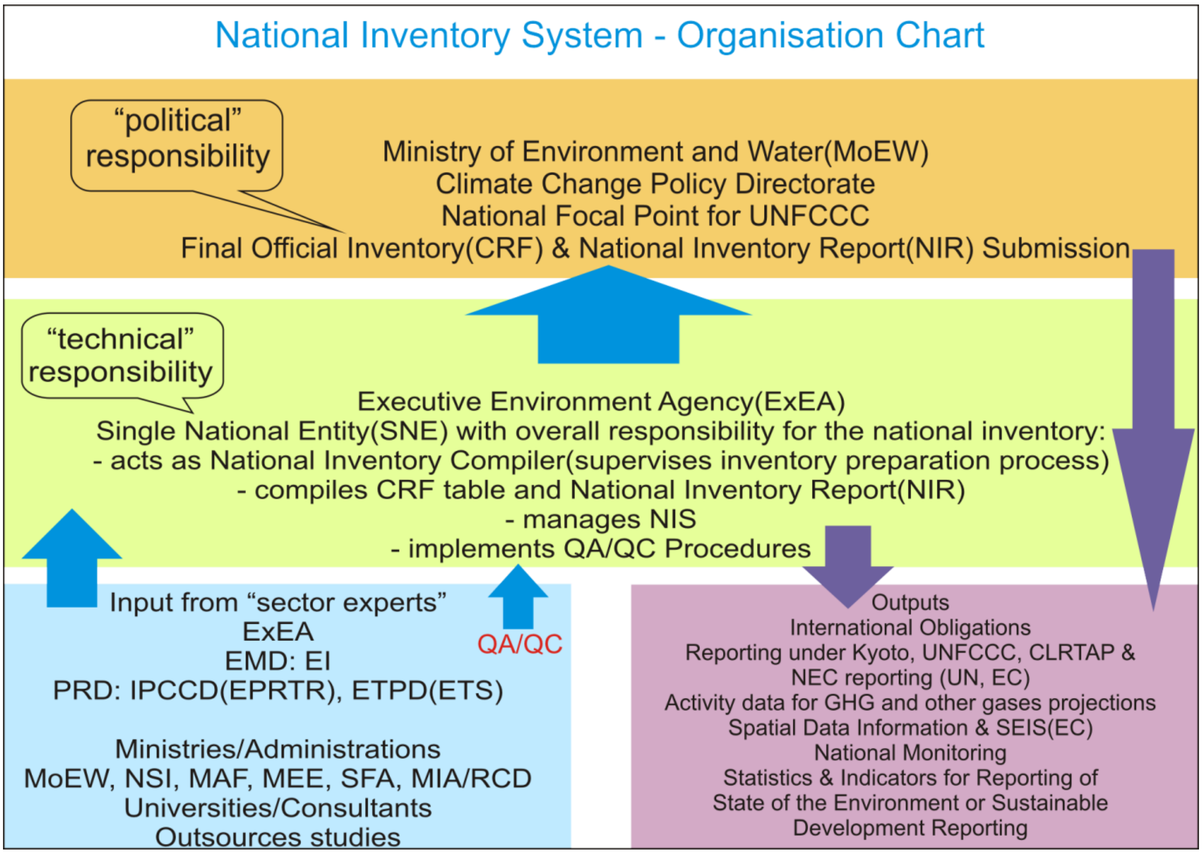


Figure 1 Organizational Chart of the Bulgarian National Inventory System

The Bulgarian Government by MoEW (Climate Change Policy Directorate) has the political responsibility for compliance with commitments under the UNFCCC and the Kyoto Protocol, including for functioning of BGNIS in accordance with the requirements of Decision 19/CMP.1 under Article 5, paragraph 1, of the Kyoto Protocol. In order to meet all challenges in this sphere, the Climate Change Policy has been transformed in a separate directorate and its staff has been increased with 6 experts. Now, it consists of 10 persons in total.

The following strategic goals in climate change area were achieved by the Ministry of Environment and Water:

Approval of the National Allocation Plan for emission trading in the period 2008 – 2012 by the European Commission (April 2010)

The new team succeeded to redevelop the National Allocation Plan through significant change in the methodology for allocation of allowances to the Bulgarian companies falling under the EU Emission Trading Scheme. The process was coordinated with all interested parties, including the business through Interdetartmental Work Group (IWG) created with an Order of the Minister of environment and water. In result, the European Commission has accepted the Plan in accordance to the requirements and criteria for approval. In 2010, 136 Bulgarian installations have received their allowances in their accounts in the National Registry.

Approval of the legal framework for establishment of Bulgarian Green Investment Scheme (2010)

Amendment of the Environmental Protection Act was developed and approved by the National Assembly in June 2010. The new legislation establishes the main legal framework of the Bulgarian Green Investment Scheme and allows Bulgarian government to participate in the International Emission Trading mechanism according to the article 17 of the Kyoto Protocol.

Approval of 6 JI projects

In 2012 two JI projects were approved according to the national JI Guidance and procedures.

Development of the Third National Action Plan on Climate Change

In 2011, the Ministry has coordinated the work of and an expert team for development of the Third National Action Plan on Climate Change for the period 2013-2020. The Plan was developed under a project for international cooperation funded by the Norwegian Cooperation Programme for Economic Growth and Sustainable Development in Bulgaria and was adopted in 2012 with decision of the Council of Ministers of Bulgaria.

The ExEA has been identified as the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity (see bellow Legal bases; Chapter 1.2.11).

The ExEA is represented and managed by an Executive Director. The organizational chart of the ExEA is presented in Figure 2.

The ExEA's directorates and departments, which are directly involved in operation of the BGNIS are

Environmental Monitoring Directorate with the Emission Inventory Department (EID), Air Monitoring Department (AMD), Waste Department (WD) and

Permit Regime Directorate with the **Integrated Pollution Prevention and Control Department** (IPPCD) and **Emission Trading Permit Department** (ETPD).

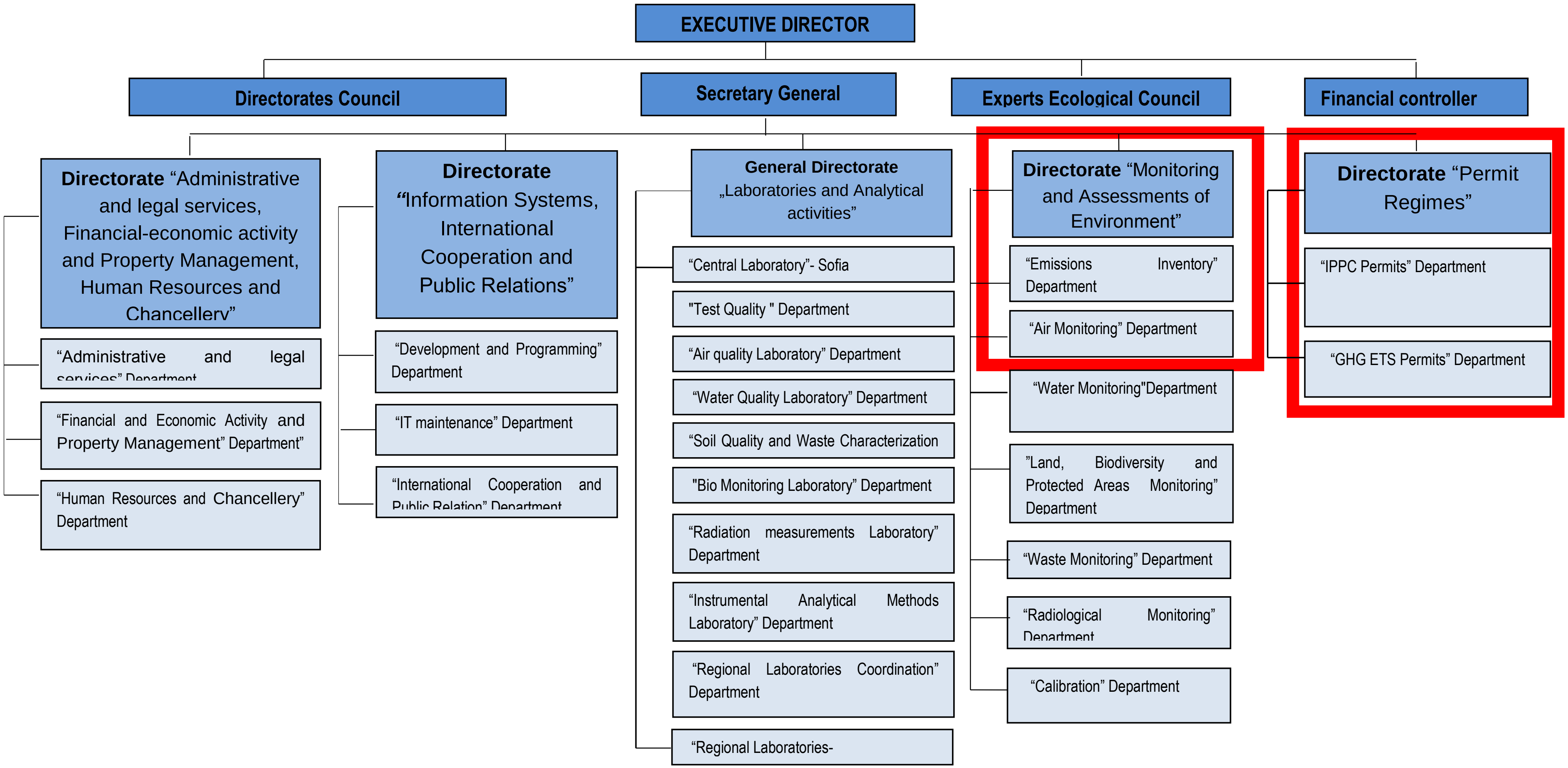


Figure 2 Organizational Chart of the Executive Environmental Agency (ExEA)

Since 1 January 2012, the Emissions Inventory Unit, responsible for preparation of the GHG Inventory, has been promoted as Emissions Inventory Department (see Figure 2).

The specific responsibilities of the different departments are presented below in part Legal arrangements of the Bulgarian National Inventory System (Figure 4: Bulgarian National Inventory System – Responsibilities).

The definitions provisions of Decision 19/CMP.1 Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol, which are taken directly from the IPCC Good Practice Guidance, are incorporated in BGNIS which is outlined below.

The overall objective of the BGNIS is annually to produce a high quality inventory (National CRF, Kyoto and SEF tables and NIR) for compliance with its Kyoto commitment and to submit it by the required deadline.

The objective of a BGNIS is annually to produce a high quality inventory, with "quality" being defined by the TCCCA criteria. (see also chapter 1.2.12)

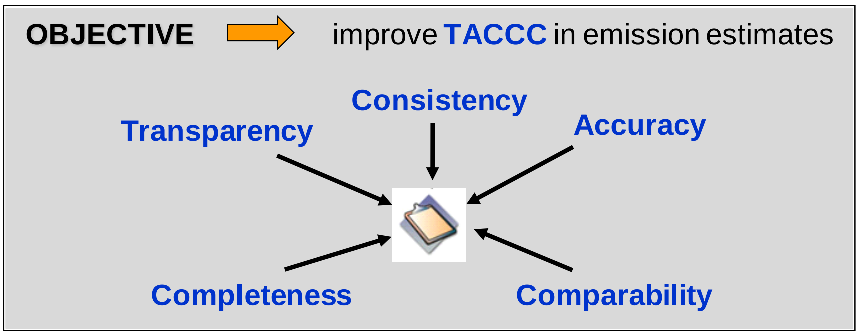


Figure 3 Objectives of the Bulgarian National Inventory System

1.2.3 LEGAL BASIS OF THE BGNIS - GENERAL FUNCTIONS

Fulfillment of paragraph 10(a)

The Republic of Bulgaria joined the UNFCCC in 1992 and the Parliament ratified it in March 1995. As an Annex I Party to the Convention, Bulgaria is committed to conduct annual inventories on greenhouse gas (GHG) emissions by sources and removals by sinks, using the GHG inventory methodology, approved by the UNFCCC. The inventories started with the country base year – 1988. The first inventories covered the period 1988-1994 as a part of the international project "Country Study to Address Climate Change".

Legal basis of the BGNIS

As illustrated in Figure 1 and outlined shortly the Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are being administered by the MoEW. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MoEW. The Bulgarian Government by MoEW has the political responsibility for compliance with commitments under the Kyoto Protocol, including for functioning of BGNIS in accordance with the requirements of Decision 19/CMP.1 under Article 5, paragraph 1, of the Kyoto Protocol:

National Focal Point;

QA experts from Climate Change Policy Directorate;

Approval of inventory;

Submission of CRF / NIR / Kyoto Tables / SEF.

The ExEA has been identified as the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity. ExEA has the technical responsibility for the national inventory:

- acts as National Inventory Compiler (supervises inventory preparation process);
- manages BGNIS;
- compiles CRF tables and NIR;
- coordinates the work of engaged consultants for supporting inventory;
- coordinates and implements the activity of National QA/QC Plan;
- National Inventory Focal Point.

The bases for BGNIS are:

Environmental Protection Act (EPA, State Gazette No. 91/25.09.2002; corrected, SG No. 96/2002; last amendment November 2012);

Statute on the organization and structure of ExEA (Decision of Council of ministers 162/03.08.2012 – final update 25.03.2014);

Order № 150/01.07.2013 by the Executive Director of ExEA (Sector experts/QC experts);

Order № RD-218/05.03.2010 by the Minister of Environment and Water (QA experts).

Regulation of the Council of Ministers 215/21.09.2010 SG 76/2010 on the way and order of organization of the National Inventories of hazardous substances and greenhouse gases in the ambient air

Add 1.

EPA (State Gazette No. 91/25.09.2002; corrected, SG No. 96/2002; last amendment November 2012), which establishes the National Environmental Monitoring System, make clear the responsibility for preparation inventories under both conventions and lists of its tasks:

Chapter One: GENERAL DISPOSITIONS

Article 11: The Minister of Environment and Water shall perform the following functions:

direct the National Environmental Monitoring System through the **Executive Environment Agency;**

Article 13:

The Executive Environment Agency with the Minister of Environment and Water shall direct the National Environmental Monitoring System.

The Executive Environment Agency shall be a legal person.

The Executive Environment Agency shall be managed and represented by an Executive Director.

The operation, the structure, the organization of work and the staffing of the Executive Environment Agency shall be determined by Rules of Organization adopted by the Council of Ministers.

Chapter Eight: NATIONAL ENVIRONMENTAL MONITORING SYSTEM

Article 144:

The National Environmental Monitoring System shall comprehend:

1. the national networks for:

2. a system for information on, and control of, air emissions and the state of waste waters;

Add 2.

EPA establishes the national Executive Environment Agency (ExEA) according to **Regulation on the organization and structure of ExEA** (Decision of Council of ministers 162/03.08.2012 - final update 25.03.2014), which regulate it's responsibilities for monitoring of environment as well as the responsibility for preparation of emission inventories.

The Emissions Inventory Department of ExEA prepares and annually updates the air emissions inventories [according to article 14 (12) of the above Regulation].

Add 3.

To increase the capacity in ExEA for adequate planning, preparation and management of emissions inventory an Order № 150/01.07.2013 by the Executive Director of ExEA has been issued. The order regulates the name and responsibilities of experts from different departments within the ExEA, which are engaged in preparation of National GHGs emission inventory (Sector experts/QC experts).

Add 4.

To assure the quality of information reported to UNFCCC and UNECE and to support the single national entity, the Minister of Environment and Water has issued an order № RD-218/05.03.2010. The order regulates the names and responsibilities of the MoEW and ExEA QA experts for implementation of the requirements of National QA/QC Plan in emission inventory of sectors Energy, Industry, Solvents, Agriculture, LULUCF and Waste.

Add 5.

The BGNIS has been enshrined in law through a special Regulation of the Council of Ministers 215/21.09.2010 SG 76/2010. The new regulation establishes and maintain the institutional, legal and procedural arrangements necessary to perform the general and specific functions of BGNIS, defined in Decision 19/CMP.1 for national systems. The new regulation reinforces the existing institutional agreements by specifying the roles of all data providers.

1.2.4 INSTITUTIONAL ARRANGEMENTS

In order to strengthen the institutional arrangements and to fulfil the required general and specific functions of BGNIS an official agreements between MoEW and the main data providers were signed in 2010:

National Statistical Institute (RD21-35/12.02.2010);

Ministry of Agriculture and Food and its body Executive Forest Agency (04-00-517/26.02.2010 and RD 50-47/15.03.2010);

Ministry of Economy, Energy and Tourism (14/06/2010);

Ministry of Interior (MI) (08/06/2010).

The agreements ensure the support from these organisations regarding the choice of the activity data and EFs and methods, in the compilation of emission estimates and QA/QC of these estimates.

The ExEA as Single National Entity coordinates all activities, related to collecting inventory data and aggregates the data relevant for GHG emissions on a national level by the following state authorities:

- National Statistics Institute (NSI);
- Ministry of Agriculture and Food (MAF) and their relevant services (Agrostatistic Directorate and Executive Forest Agency);
- Ministry of Economy and Energy (MEE);

- Ministry of Interior (MI);
- Ministry of Environment and Water (MoEW);
- Ministry of Transport, Information Technologies and Communications (MTITC).

1.2.5 OTHER ARRANGEMENT OF THE BULGARIAN NATIONAL INVENTORY SYSTEM

The Executive Environment Agency (ExEA) coordinates all activities, related to the large industrial plants and Branch Business Associations.

- Large industrial plants – official letters (questionnaire)
- Branch Business Associations – official letters (questionnaire)

For validation of the activity data we gather reliable country specific data from Branch Business Associations in Bulgaria and aggregate the data relevant for GHG emissions on a national level. Please see the list of all branch business associations in Bulgaria: http://www.bia-bg.com/memberCategory/278. The data must be representative for the whole period since 1988 (base year for Bulgaria).

1.2.6 DATA BASIS - COLLECTION OF ACTIVITY DATA BY EXEA:

The information is collected on the annual basis.

The ExEA sends every year letters with request for provision of the necessary activity data to every one of the information sources, including the deadline for response.

For NSI, MAF, MI and MEET the type of the necessary data, as well as the deadlines for submissions to ExEA are regulated by the official agreements mentioned above as well as by the Regulation of the Council of Ministers 215/21.09.2010 SG 76/2010.

The annual national energy and material balances as well as the data related to the solid waste generation and the wastewater treatment are prepared by NSI. NSI uses up-to-date statistical methods and procedures for data collection, summarizing and structuring that are harmonized with EUROSTAT.

The GHG inventory use data, received directly from large point sources in the energy sector and in the industry and these data are summarized by ExEA.

Table 1 Sources of activity data for preparation of national GHGs emission inventory

Sectors	Data Source of Activity Data	Activity Data supplier	
1. Energy			
1.A Fuel Combustion	Energy balance (IEA - EUROSTAT – UNECE Energy Questionnaire)	NSI	National Statistical Institute
1.A.3 Transport	Energy balance (IEA - EUROSTAT – UNECE Energy Questionnaire)	NSI	National Statistical Institute
	Statistics vehicle fleet	MI/RCD	Ministry of Interior/ Road Control Department
	Country specific parameters used in the COPERT IV related to car fleet and vehicle split.	MTITC	Ministry of Transport, Information Technologies and Communications
1.B Fugitive emissions	Energy balance (IEA - EUROSTAT – UNECE Energy Questionnaire)	NSI	National Statistical Institute
	National statistics	MEE	Ministry of Economy and Energy
2. Industrial processes	National production statistics	NSI	National Statistical Institute
	National registers (EPRTR and ETS)	ExEA	Executive Environment Agency
	National studies	MoEW /ExEA	Ministry of Environment and Water/ Executive Environment Agency
3. Solvents and Other product use	National production statistics National VOC register	NSI ExEA	National statistical Institute Executive Environment Agency
4. Agriculture	National agriculture statistics	MAF	Ministry of Agriculture and Food/Statistics Department
5. LULUCF	National Forest Inventory	EFA	Executive Forest Agency
6. Waste	National statistics	NSI	National Statistical Institute
	National studies	ExEA	Executive Environment Agency/ Waste Department

1.2.7 PROCEDURAL ARRANGEMENTS

The inventory preparation process covers:

- Identification key source categories[16];
- Prepare estimates[17] and ensure that appropriate methods are used to estimate emissions from key source categories;
- Collect sufficient activity data, process information, and emission factors as are necessary to support the methods selected for estimating anthropogenic GHG emissions by sources and removals by sinks;
- Make a quantitative estimate of inventory uncertainty[18] for each source category and for the inventory in total recalculations[19] of previously submitted estimates of anthropogenic GHG emissions by sources and removals by sinks;
- Compile the national inventory in accordance with Article 7, paragraph 1, and relevant decisions of the COP and/or COP/MOP;
- Implement general inventory QC procedures (tier 1) in accordance with its QA/QC plan following the IPCC good practice guidance;
- Apply source category specific QC procedures[20] (tier 2) for key source categories and for those individual source categories in which significant methodological and/or data revisions have occurred;
- Collection of all data collected together with emission estimates in a database (see below), where data sources are well documented for future reconstruction of the inventory.

The Figure 4 presents the general responsibilities of all engaged institutions in functioning of Bulgarian National Inventory System.

[16] following the methods described in the IPCC good practice guidance (chapter 7, section 7.2);

[17] in accordance with the methods described in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, as elaborated by the IPCC good practice guidance

[18] following the IPCC good practice guidance

[19] prepared in accordance with the IPCC good practice guidance and relevant decisions of the COP and/or COP/MOP;

[20] in accordance with the IPCC good practice guidance

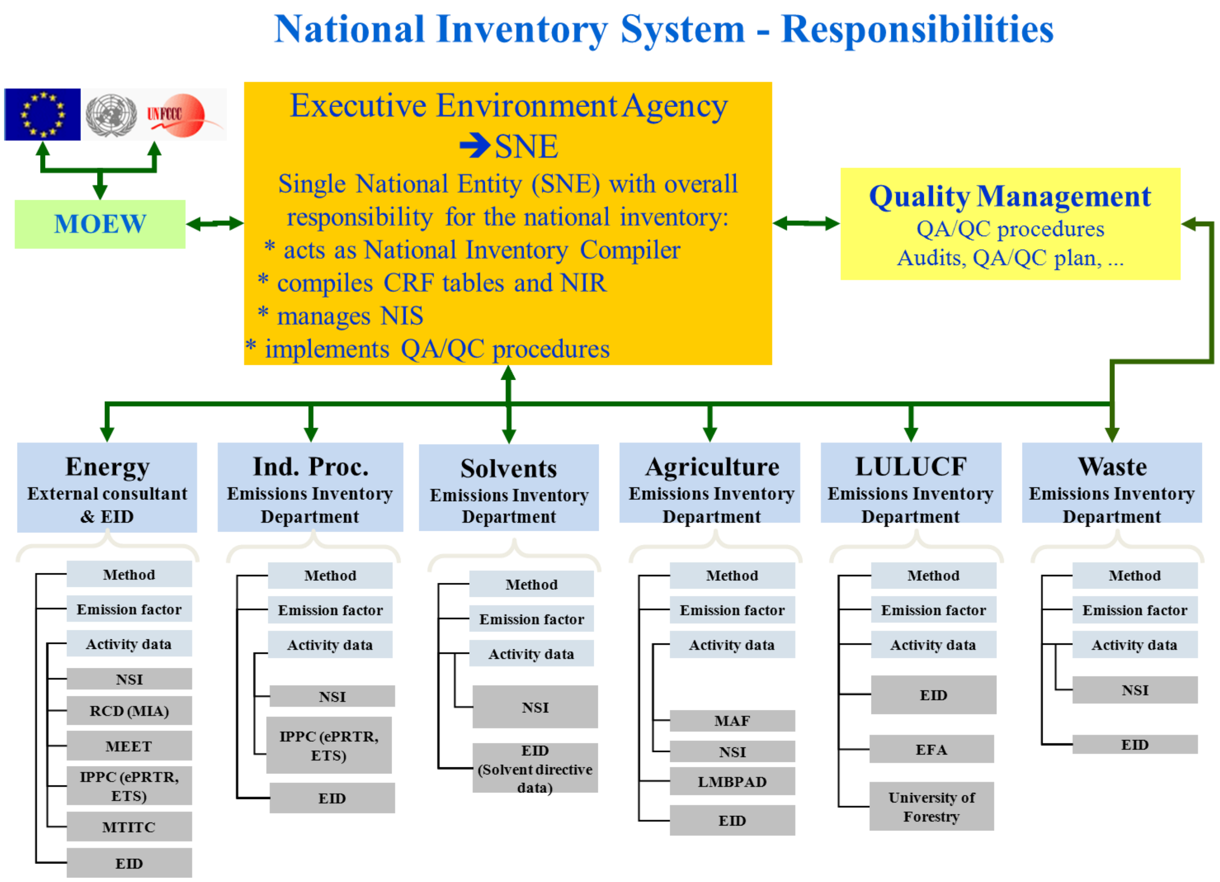


Figure 4 Bulgarian National Inventory System – Responsibilities

The following table presents the responsibilities of all engaged institutions for preparation of GHGs emission inventory for 2014 submission.

Table 2 Preparation of GHGs emission inventory for 2014 submission

Sector CRF	Activity data	Methodology and selection of emission factors	Preparation of Sector inventories
Energy CRF1A1 CRF1A2 CRF1A4	NSI	ExEA, NSI	External consultants
Energy/Transport CRF1A3	NSI MI MTITC	ExEA, NSI MI, MTITC	External consultants
Energy CRF1B	NSI MEE	ExEA, NSI, MEE	External consultants
Industry processes CRF2	NSI ExEA MOEW	ExEA, NSI, Branch chambers, Installations operators	Sector expert ExEA
Solvents use CRF3	NSI ExEA	ExEA, NSI	Sector expert ExEA
Agriculture CRF4	MAF	ExEA, MAF	Sector expert ExEA
LULUCF CRF5	EAF	ExEA, EAF	Sector expert ExEA
Waste CRF6	NSI ExEA	ExEA, NSI	Sector expert ExEA

The National Inventory Compiler compiles the national GHGs inventory (CRF-tables and NIR) for submission under UNFCCC.

1.2.8 EXPERT CAPACITY IN EXEA

Expert capacity in ExEA - Emission Inventory Department

The EID has the main role in BGNIS as National Inventory Compiler (supervises inventory preparation process, compiles CRF tables and NIR, manages BGNIS implements QA/QC procedures on a national level)

The responsibilities of the Sector experts

Within the inventory system specific responsibilities for the different emission source categories are defined ("sector experts"), as well as for all activities related to the preparation of the inventory, including QA/QC, data management and reporting.

The sector experts are in charge of specific responsibilities related to choice of methods, data collection, processing and archiving. Sector experts are also responsible for performing Quality Control (QC) activities that are incorporated in the Quality Management System (QMS) (see below).

Engaged departments within ExEA

In order to improve the capacity of the BGNIS in planning, preparation and managing its annual submissions the extension of the ExEA staff has been realised in the beginning of 2010.

Additionally to the existing experts in Emissions Inventory Department, there are one expert from Air Monitoring Department and two sector experts for "Energy" and "Industrial Processes" (from IPPCD and ETPD) available in the ExEA. Figure 5 presents the available staff/experts in ExEA, engaged in planning, preparation and management of emission inventory.

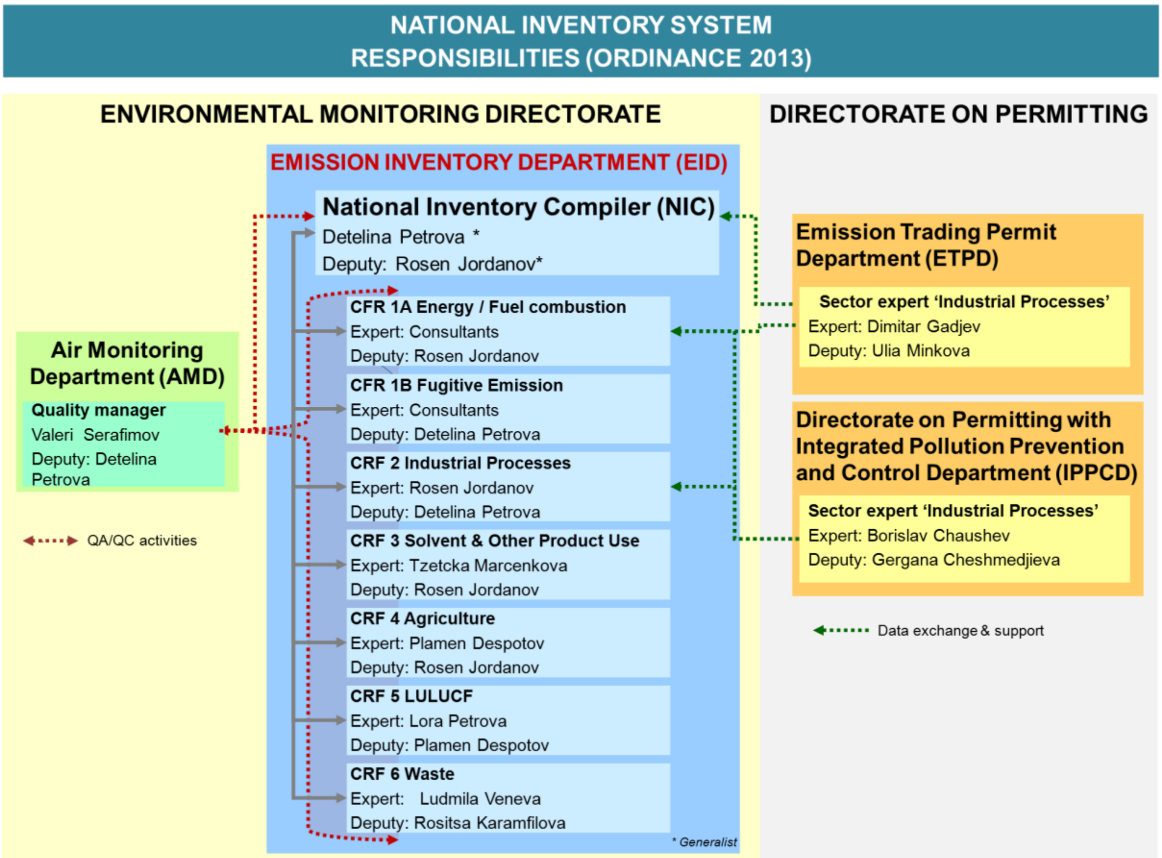


Figure 5 ExEA capacity for ensuring the function of BGNIS

As it is written above the distribution of responsibilities of different departments within the ExEA for inventory planning, preparation and management is according to Order № 150/01.07.2013 by the Executive Director of ExEA.

Collaboration with external Consultants for 2014 submission

In order to support ExEA staff in preparation of 2014 submission and to implement the recommendations of ERT for sustainable development of inventory the ExEA signed contracts with the same external consultants, which were engaged in preparation of the previous submission.

Table 3 Collaboration with external Consultants for 2014 submission

Consultant	Cooperation agreements	Responsibilities and outputs
Denkstatt	Preparation of 2014 GHG inventory in Sector Energy (including Transport). The contract № 2660 was signed on 28.11.2013, duration - 2 years.	Prepared CRF tables and respective chapters in NIR Training of ExEA's staff
External consultant In collaubouration with Executive Forest Agency	Revision of KP-LULUCF activity data. The contract № 2618 was signed on 20.08.2013	Support of ExEA staff in preparation of 2014 submission (KP-LULUCF tables)
External consultant	Preparation of 2014 uncertainty analysis of LULUCF sector. The contract № 2723 was	Support of ExEA staff in preparation of uncertainty analysis of LULUCF sector

	signed on 26.02.2014.	
Agricultural university of Plovdiv	Ash content of swine and poultry manure. The contracts № 2709 and № 2710 were signed on 13.02.2014.	Support of ExEA staff in preparation of 2014 submission

1.2.9 TECHNICAL CAPACITY

1.2.9.1 Training of Bulgarian experts

Workshops and Training on the job

To raise the technical competence of staff involved in the inventory development process, a training programme for Bulgarian inventory experts was updated within the Twinning project with the Federal Environment Agency of Austria[21]. The program covered all inventory sectors in a series of workshops realised in the period December 2009 to September 2010.

Further collaboration with Austrian Environment Agency for training of Bulgarian staff is envisaged for the next submissions.

Online training

To raise the technical competence of staff involved in the inventory development and review process, sector experts from ExEA applied for having an access to the Online training by the UNFCCC and GHG Management Institute (GHGMI)[22].

Basic Course[23]

This course covers technical aspects of the review of GHG inventories of Annex I Parties. It consists of seven modules: one general module, "Overview of UNFCCC Review Process and General IPCC Inventory Guidance" and individual modules on the review of individual IPCC sectors: Energy (Fuel Combustion and Fugitive Emissions), Industrial Processes, Agriculture, LULUCF and Waste. Each of the modules provides important background information and references for the sector, instruction on general procedures for review, exercises on key topics and specific emission categories, and practical case studies that simulate an actual review.

---

[21] The Twinning Partner "Austrian Federal Environment Agency" has already experience as supporting role / expert in preparing GHG and air emission inventory and reporting (UNFCCC, UNECE/LRTAP and NEC); FCCC/ARR/2008/LUX para 8: "…. The ERT noted that three relevant studies have been outsourced to external experts and that the improvements are mainly the result of research activities and intensive cooperation with the Austrian Federal Environment Agency."

[22] http://ghginstitute.org/2010/03/03/the-unfccc-expert-reviewer-training-programme-is-ongoing

[23] http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_training/items/2763.php
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_training/items/2764.php

The courses are also available to trainees all year round, without instructor.

Fulfilment of paragraph 10(c)

See above and below

1.2.10 UNFCCC REPORTING GUIDELINES AND SUPPLEMENTARY INFORMATION

Fulfilment of paragraph 10(d);

Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11"
(FCCC/SBSTA/2006/9) (http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf)

Supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol, with the inventory submission due under the Convention, in accordance with:

- Decision 15/CMP.1 Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol
- (FCCC/KP/CMP/2005/8/Add.2; http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf)
- Decision 19/CMP.1 Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol
- (FCCC/KP/CMP/2005/8/Add.3; http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf)
- Decision 6/CMP.3 Good practice guidance for land use, land-use change and forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (FCCC/KP/CMP/2007/9/Add.2; http://unfccc.int/resource/docs/2007/cmp3/eng/09a02.pdf)

Fulfilment of paragraph 10(c)

See below

1.2.11 LEGAL BASIS OF THE BGNIS - SPECIFIC FUNCTIONS

SINGLE NATIONAL ENTITY

Fulfilment of paragraph 12(a)

An overview of the general responsibilities in the inventory development and reporting process is given in Fulfilment of paragraph 10a.

Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are being administered by the Ministry of Environment and Water (MoEW). All activities on preparation of GHG inventories in Bulgaria are coordinated and managed on the state level by MoEW. The MoEW (Climate Change Policy Directorate) has the political responsibility for compliance with commitments under the Kyoto Protocol, including for functioning of BGNIS in accordance with the requirements of Decision 19/CMP.1 under Article 5, paragraph 1, of the Kyoto Protocol.

The Executive Environment Agency (ExEA) has been identified as the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity. ExEA has the technical responsibility for the national inventory:

- acts as National Inventory Compiler (supervises inventory preparation process);
- compiles CRF tables and NIR;
- manages BGNIS;
- implements QA/QC procedures.

Fulfilment of paragraph 12(b)

The postal and electronic addresses of the single national entity are:

Executive Environment Agency at the Ministry of Environment and Water

136 "Tzar Boris III" Blvd

Sofia 1618, Bulgaria

P.O.Box 251

Tel.:+359 2 9559011

Fax: +359 2 9559015

E-Mail: vgrigorova@eea.government.bg

E-mail: ncesd@eea.government.bg

http://eea.government.bg/eng

National Focal Point (NFP): Diana Todorova

Organization: Ministry of Environment and Water

Address: 22 "Maria Luiza" blvd., 1202 Sofia, Bulgaria

E-mail: dtodorova@moew.government.bg

Tel.: +359 2 940 62 85

National Inventory Focal Point (NIFP) & National Inventory Compiler (NIC):

Detelina Petrova

Emissions Inventory Department
Organization: Executive Environment Agency

Address: 136, "Tsar Boris III" blvd., 1618 Sofia, Bulgaria

e-mail: climatechange@eea.government.bg

Tel.: +359 2 940 64 88

Fax: +359 2 955 90 15

Head of Emission Inventory Department: Rosen Yordanov

Organization: Executive Environment Agency

Address: 136, "Tsar Boris III" blvd., 1618 Sofia, Bulgaria

e-mail: rosen@eea.government.bg

Tel.: +359 2 940 64 88

Fax: +359 2 955 90 15

Name of Quality Manager: Valeri Serafimov

Head of Air Monitoring Department
Organization: Executive Environment Agency

Address: 136, "Tsar Boris III" blvd., 1618 Sofia, Bulgaria

e-mail: serafimov@eea.government.bg

Tel.: +359 2 940 64 87

Fax: +359 2 955 90 15

Fulfilment of 12(c)

An overview of the general responsibilities in the inventory development and reporting process is given in Fulfilment of paragraph 10a. As mentioned before, the ExEA has the overall responsibility for the national inventory, comprising greenhouse gases as well as other air pollutants. Within the inventory system specific responsibilities for the different emission source categories are defined ("sector experts"), as well as for all activities related to the preparation of the inventory, including QA/QC, data management and reporting.

The sector experts are in charge of specific responsibilities related to choice of methods, data collection, processing and archiving. Sector experts are also responsible for performing Quality Control (QC) activities that are incorporated in the Quality Management System (QMS) (see below).

1.2.12 QUALITY MANAGEMENT SYSTEM

Fulfilment of paragraph 12(d)

As it is written above the Executive Environment Agency is responsible for the preparation of the GHGs Emission Inventory and the relevant National Inventory Reports under UNFCCC.

The ExEA is also responsible for coordination and implementation of QA/QC activities for the national inventory. A quality manger is in place.

The Bulgarian Quality Management System was established in the frame of project with Bulgarian Academy of Science, Geophysical Institute. The project was carried out and finished in 2008.

The QA/QC plan is an internal document to organise, plan and implement QA/QC activities. Once developed for the next submission, it is referenced and used in subsequent inventory preparation, or modified as appropriate.

The QA/QC plan has been updated in August 2010 in order to implement the new established legal, institutional and procedural arrangements within the BGNIS. The updated National QA/QC Plan was approved by the Ministry of Environment and Water in September 2010.

National QA/QC Plan includes following elements:

- Responsible institutions;
- Data collection;
- Preparation of inventory;
- QC Procedures;
- QA Procedures;
- Uncertainty evaluation;
- Organisation of the activities in quality management system;
- Documentation and archiving.

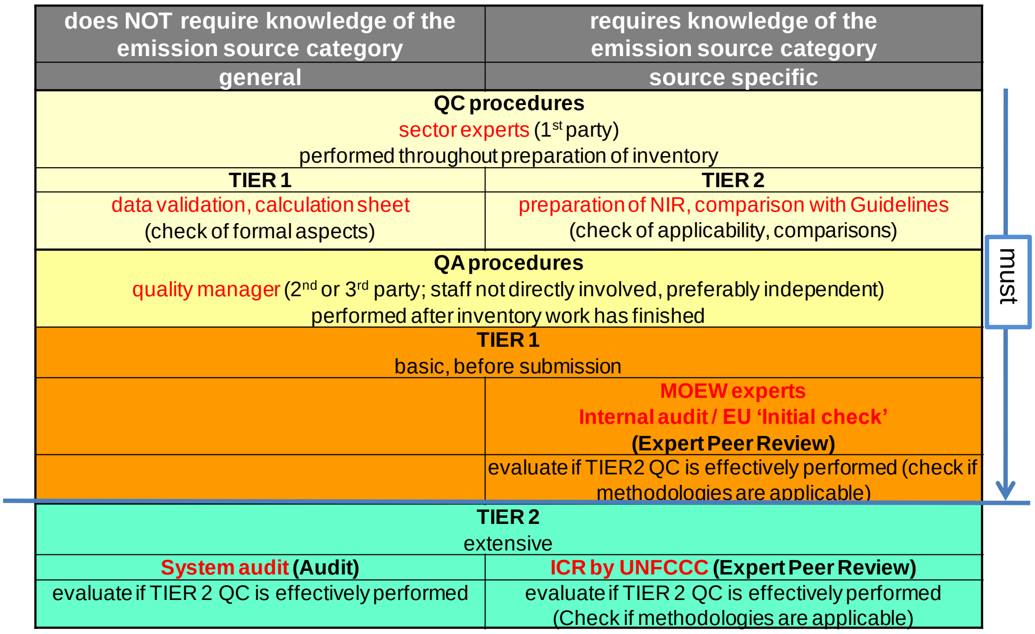


Figure 6 National quality assurance and quality control program

The legal and institutional arrangements within the BGNIS regulate the responsibilities of all engaged institutions for implementation of the requirements of the National QA/QC Plan.

The QC procedures are performed by the sectors, who are directly involved in the process of preparation of inventory with their specific responsibilities.

The QC procedures are implemented by all activity data provider and ExEA's sector experts (Order № 150/01.07.2013 by the Executive Director of ExEA) and/or external consultants.

Table 4 QC experts within the BGNIS

Responsibility	QC experts
Activity data	MAF, MI, MTITC, MEE, NSI, EAF, ExEA, MOEW
Methodology and selection of emission factors	ExEA, MAF, MI, MTITC, MEE, NSI, EAF, MOEW
Sector inventories preparation	Sector experts ExEA and/or external consultants

The QC experts are:

- experts, responsible for activity data provision;
- experts, involved in the choice of method and selection of emission factors;
- sector experts and/or consultants, who prepare the sector inventories, including preparation of reporting tables and respective chapters from the national reports;

All institutions, engaged in the functioning of BGNIS are responsible for quality of information, which are provided by their competence to the ExEA for preparation of national emission inventories. The institutions are obligated to implement all requirements of the international and national standards for collection, processing and provision of activity data from them competence.

Quality Assurance (QA) is a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. The quality assurance process includes expert review was conducted in two stages: a review of the initial set of emission estimates and, a review of the estimates and text of the Inventory Report.

QA experts could be:

- Sector experts from the MoEW, which are engaged through internal administrative order by the minister of environment and water ;
- Experts from research institutes in accordance with them competence;
- Other external reviewer (national and/or international).

The QA procedures include the following checks in accordance with FCCC/SBSTA/2006/9:

Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information;

Accuracy is a relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable. Appropriate methodologies should be used, in accordance with the IPCC good practice guidance, to promote accuracy in inventories.

Consistency means that an inventory should be internally consistent in all its elements with inventories of other years. An inventory is consistent if the same methodologies are used for the base and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. Under certain circumstances referred to in paragraphs 15 and 16, an inventory using different methodologies for different years can be considered to be consistent if it has been recalculated in a transparent manner, in accordance with the Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Good Practice Guidance for Land Use, Land-Use Change and Forestry;

Comparability means that estimates of emissions and removals reported by Annex I Parties in inventories should be comparable among Annex I Parties. For this purpose, Annex I Parties should use the methodologies and formats agreed by the COP for estimating and reporting inventories. The allocation of different source/sink categories should follow the split of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories,2 and the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, at the level of its summary and sectoral tables;

Completeness means that an inventory covers all sources and sinks, as well as all gases, included in the IPCC Guidelines as well as other existing relevant source/sink categories which are specific to individual Annex I Parties and, therefore, may not be included in the IPCC Guidelines. Completeness also means full geographic coverage of sources and sinks of an Annex I Party;

For 2014 submission the QA procedures are implemented by sector experts within the MoEW and experts from the ExEA, who are not directly involved in the preparation of inventory (Order № RD-218/05.03.2010 by the minister) or external reviewers.

The expert peer review present opportunity to uncover technical issues related to the application of methodologies, selection of activity data, or the development and choice of emission factors. The comments received during these processes are reviewed and, as appropriate, incorporated into the National Inventory Report or reflected in the inventory estimates.

The In-Country-Review (ICR) by the UNFCCC in 2010 can be seen as expert peer review.

1.2.12.1 Information of the QA/QC activities

According to the GPG (2000) the QA/QC system, that should be implemented for GHG Inventories consists of an inventory agency responsible for coordinating QA/QC activities, a QA/QC plan, general QC procedures (Tier 1), source category-specific QC procedures (Tier 2), QA review procedures as well as procedures regarding reporting, documentation and archiving.

The QA/QC plan is a basic element of the QA/QC system. The plan outlines QA/QC activities that are implemented and includes the scheduled time frame for inventory preparation from its initial development through the final reporting in any year. It contains an outline of the processes and schedule to review of all source categories.

The QA/QC plan is an internal document to organise, plan and implement QA/QC activities. Once developed for the next submission, it is referenced and used in subsequent inventory preparation, or modified as appropriate.

The main parts of the National QA/QC Plan for emissions inventories are presented in the next table:

Table 5 Comparison of IPCC GPG and ISO 9001

	IPCC GPG	ISO 9001
1. Scope	✓	✓
2. Definitions	✓	✓
3. Administrative requirements	✓	✓
4. Organisation and management	✓	✓
5. Quality system	✓	✓
6. Personnel	✓	✓
7. Facilities and equipment	✓	✓
8. Handling of inspection samples and items	✓	✓
9. Records	✓	✓
10. Reports	✓	✓
11. Sub-contracting	✓	✓
12. Complaints and appeals	✓	✓

The cycle of QA/QC activity for inventory consists of the following steps:

The QA/QC Manager prepares a Plan for implementation of QA/QC activities for the current submission. The check list with all specific QA/QC procedures are part of the plan;

The plan for QA/QC is sent to all engaged QC and QA experts for implementation;

In the process of preparation of inventory the QC experts (activity data provider and ExEA's sector experts) apply each of the specific procedures set in the check list for each of the sources categories they are responsible for.

The QA/QC Manager coordinate the exchange of the check lists between the QC experts for correction of the findings with input data for calculation of emissions (activity data and EF).

The QA/QC Manager send to the QA experts the prepared by ExEA's sector expert and/or external consultants CRF tables and respective chapters from NIR;

The QA/QC Manager coordinate the exchange of the check lists between the QA experts and ExEA's sector expert and/or external consultants for correction of the findings with quality of the inventory (CRF and NIR);

The QA/QC Manager prepares a summary of the results from implemented QA/QC checks.

The QA/QC Manager prepares an attendant file for implemented procedures;

The QA/QC Manager prepares a report to the executive director of the ExEA for results of the performed QA/QC procedures and improvement plan for the next reporting round;

The QA/QC Manager is responsible for documentation and archiving of all documents, related to performed QA/QC procedures in the national System for documentation and archiving of inventory in ExEA.

Documentation and data archiving

In August 2010 a new system for sector expert workflow organization, inventory documentation and data archiving has been implemented in the ExEA.

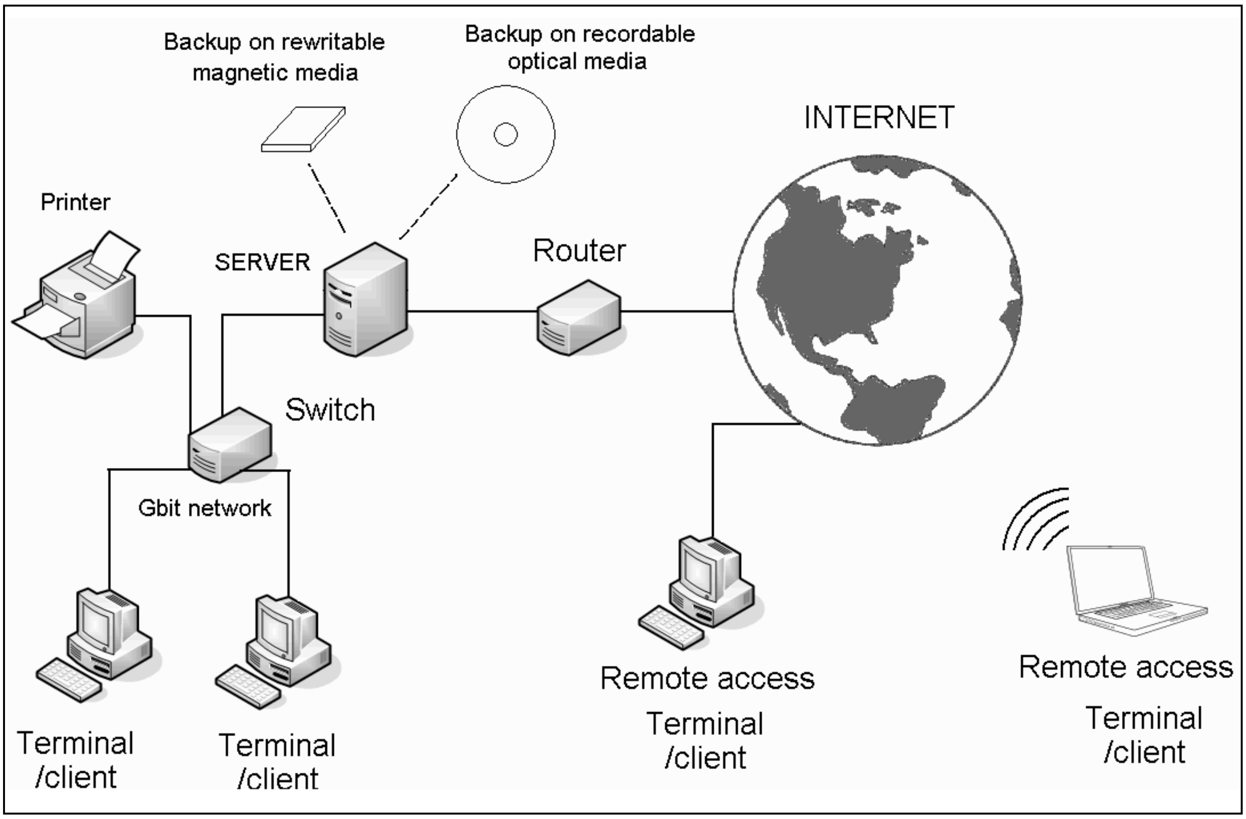


Figure 7 Documentation and data archiving in ExEA

1.2.12.1.1 QA/QC activities of data provider

The QA/QC Plan is provided for implementation to all institutions, which are engaged in the process of preparation of emissions inventories under UNFCCC as provision of the relevant activity data.

Based on the National QA/QC Plan each of the institutions has nominated experts, responsible for preparation of the required information as well as for implementation of QA/QC procedures.

The QC experts are all experts from the institutions, who are engaged to participate in the activity of BGNIS and to implement the requirements of National QA/QC Plan

All institutions, engaged in the functioning of BGNIS are responsible for quality of information, which are provided by their competence to the ExEA for preparation of national emission inventories. The institutions are obligated to implement all requirements of the international and national standards for collection, processing and provision of activity data from them competence.

The QC experts fill in a check-list, which is an annex to the National QA/QC plan. The QC experts fill the check-list for the sector they are responsible for and in the part "Review of input data for calculation of emissions", "Activity data" and/or "Method and EF".

The check list contains all general and specific procedures for QC. It consist information for carried out review by the QC experts, including findings and corrections made.

The check lists are filled in by QC experts in accordance with them responsibilities and for each category (CRF).

The check lists are exchange between QC experts for correction of the findings with input data for calculation of emissions in the respective sectors.

Table 6 Responsibilities in the exchange of check lists between QC experts for 2014 submission

Sector CRF	Activity data		Methodology/ emission factors		Emission calculations	
	Check	Correction	Check	Correction	Check	Correction
Energy CRF1	ExEA NSI MEE external consultant	NSI MEE	ExEA NSI MEE	external consultant	ExEA NSI MEE	external consultant
Transport CRF1A3	ExEA NSI MI MTITC external consultant	MTITC MI NSI	ExEA NSI MI MTITC	ExEA external consultant	ExEA NSI MI MTITC	Sector expert ExEA and external consultant
Industry processes CRF2	NSI ExEA	NSI ExEA	NSI ExEA	ExEA	NSI ExEA	Sector expert ExEA
Solvents use CRF3	NSI ExEA	NSI ExEA	NSI ExEA	NSI ExEA	NSI ExEA	Sector expert ExEA
Agriculture CRF4	ExEA MAF	MAF	ExEA MAF	ExEA	ExEA MAF	Sector expert ExEA
LULUCF CRF5	ExEA EAF	EAF	ExEA EAF	ExEA	ExEA EAF	Sector expert ExEA
Waste CRF6	NSI ExEA	NSI ExEA	NSI ExEA	ExEA	NSI ExEA	Sector expert ExEA

General (QC) procedures are described in Checklists that is part of QA/QC Plan.

As it is written above for 2014 submission the QA procedures are implemented by sector experts within the MoEW and experts from the ExEA, who are not directly involved in the preparation of inventory (Order № RD-218/05.03.2010 by the minister) or external reviewers

The QA experts fill a check list in the part "Review of reporting tables and National report" in the sector of them competence.

The check list contains all general and specific procedures for QA. It consist information for carried out review by the QA experts, including findings and corrections made.

The check lists are filled out by QA experts in accordance with them responsibilities for each category (CRF).

The check lists are exchanged between QA experts and sector expert in ExEA and/or external consultant for correction of the findings with reporting tables and respective chapters from national reports.

Table 7 Responsibilities in exchange of the check lists between QA experts and sector experts for 2014 submission

Sector - CRF	Reporting Tables - CRF		National Report - NIR	
	Check	**Correction**	**Check**	**Correction**
Energy CRF1	MOEW	external consultant	MOEW	external consultant
Industry processes CRF2	MOEW	Sector expert ExEA	MOEW	Sector expert ExEA
Solvents use CRF3	MOEW	Sector expert ExEA	MOEW	Sector expert ExEA
Agriculture CRF4	ExEA and/or external auditor	Sector expert ExEA	ExEA and/or external consultant	Sector expert ExEA
LULUCF CRF5	External auditor	Sector expert ExEA	External auditor	Sector expert ExEA
Waste CRF6	MOEW	Sector expert ExEA	MOEW	Sector expert ExEA

1.2.12.1.2 Quality Management of the Sources of Initial Data

Each organization – data source, solves the quality management issues in accordance with its internal rules and provisions. With some of the sources as NSI, MAF, etc., those rules follow strictly the international practices. For example, quality assessment/quality control procedures with NSI have been harmonized with the relevant instructions and provisions of EUROSTAT. Strict rules on data processing and storage, harmonized with international organizations. Some of the large enterprises – GHG emission sources, have well arranged and effective quality management systems. Most of them have introduced quality management systems on the basis of ISO 9001:2000 standard.

1.2.12.1.3 Official consideration and approval of the inventory

Fulfilment of paragraph 12(e)

Official consideration and approval of the inventory

Bulgaria’s reporting obligations to the UNFCCC, UNECE and EC are being administered by the MoEW. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MoEW. The ExEA is the responsible organization for preparation of Bulgaria’s National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity (see Figure 1 Organizational Chart of the Bulgarian National Inventory System).

1.2.12.1.4 Quality improvement

Fulfilment of paragraph 13

Since November 2011, a project for **“Improvement of National Quality Management System for GHG Inventories”** had been started together with the Austrian Environmental Agency. The project is funded by the **German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety** and **German Federal Environment Agency** with means of the Advisory Assistance Programme for Environmental Protection in the Countries of Central and Eastern Europe, the Caucasus and Central Asia.

The objectives of the project are:

Third-party audit[24] of the current QMS according to ISO 19011 Guidelines for quality and/or environmental management system auditing (and ISO 17020 General criteria for the operation of various types of bodies performing inspection):

- To analyze/review the current QMS (in accordance with the IPCC GPG)
    1. system audit
    2. procedures audit
- Identification of improvements
    1. QMS Manual
    2. Quality Policy
    3. Roles and responsibilities
    4. QC activities

[24] Audits are used to determine the extent to which the quality management system requirements are fulfilled. Audit findings are used to assess the effectiveness of the quality management system and to identify opportunities for improvement.

- First-party audits are conducted by, or on behalf of, the organization itself for internal purposes and can form the basis for an organization's self-declaration of conformity.
- Second-party audits are conducted by customers of the organization or by other persons on behalf of the customer.
- Third-party audits are conducted by external independent organizations.

Such organizations, usually accredited, provide certification or registration of conformity with requirements such as those of ISO 9001.

ISO 19011 provides guidance on auditing.

5. Quality assurance (QA) activities
6. Documentation and archiving System within NIS.
7. Development of Procedures and Checklists
8. Improvement plan for the QMS and GHG Inventory

- Proposal on implementation of the improvements
- Training of the quality manager and the sectoral experts (within the QMS) according to IPCC GPG Chapter 8 and following the ISO 9000 standards

The outcome of the project is development of an efficient and optimal aligned QMS, that fulfils every quality requirement of the IPCC GPG (1996, Chap. 8) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Chap. 6).

The project outcomes are implemented in Submission 2014.

1.2.13 INVENTORY PREPARATION

The ExEA coordinates all activities on preparation of inventory under UNFCCC.

The Executive director of the ExEA through internal administrative order and based on the Regulation on the organization and structure of ExEA appoints sector experts for preparation of emission inventory in Energy, Industrial process, Solvents and other products use, Agriculture, LULUCF and Waste.

The ExEA, agreed with the MoEW engages external consultants for preparation of tasks, which are out of competence of the Agency and are related with improvement of the inventory (see Table 10).

1.2.14 KEY CATEGORY ANALYSIS

Fulfilment of paragraph 14(a)

The method to identify key source categories follows the Tier 1 and Tier 2 method described in the Good Practice Guidance [IPCC-GPG, 2000], Chapter 7 Methodological Choice and Recalculation.

According to method of the type Tier 2 assessment of the key sources is made by identifying the uncertainty of each source. The uncertainty is the combined uncertainty of the assessment, which is a mean quadratic assessment of the uncertainty of the data and of the emission factors.

The key source identification of the Bulgarian inventory includes all reported greenhouse gases CO_2, CH_4, N_2O, HFC, PFC and SF_6, and all IPCC source categories, including LULUCF. The key source analysis is performed by the ExEA with data for greenhouse gas emissions of the corresponding current submission and comprises a level assessment for all years between 1988 and the last reported year and trend assessments for the trend of the latest reported years with respect to base year emissions.

Emissions and removals from LULUCF are included in the key category analysis which is performed according to the IPCC Good Practice Guidance for Land use, land-use change and forestry [GPG-LULUCF, 2003].

The key category analysis is used to prioritize improvements that should be taken into account for the next inventory submissions. First of all, it is important that emissions of key categories, being the most significant in terms of absolute weight and/or combined uncertainty, are estimated with a high level of accuracy.

The Key Category analysis Tier 1 and Tier 2 method including and excluding LULUCF is provided in Annex 1.

1.2.15 NATIONAL INVENTORY METHODOLOGY

Fulfilment of Para 14(b) (c) (e) (f)

The most recent greenhouse gas inventory for the period 1988 to 2012 (NIR 2014) was compiled according to the recommendations for inventories set out in the UNFCCC reporting guidelines according to Decision 18/CP.8, the Common Reporting Format (CRF)15 (version 1.01), Decision 13/CP.9, the new CRF for the Land Use Change and Forestry Sector, the IPCC 1996 Guidelines for National Greenhouse Gas Inventories, which specify the reporting obligations according to Articles 4 and 12 of the UNFCCC [IPCC Guidelines, 1997] as well as the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories [IPCC GPG, 2000] and Kyoto Tables

The GHG inventory represents a process, covering the following main activities:

Collecting, processing and assessment of input data on used fuels, produced output, materials and other GHG emission sources;

Selection and application of emission factors for estimating the emissions;

Determination of the basic (key) GHG emission sources and assessment of the results uncertainty.

Each year during inventory, some changes occur that affect directly the activities above enlisted. Important inventory stage is the process of data transformation into a form, suitable for CRF Tables format. During this process, aggregation of the fuels by type is made (solid, liquid and gaseous), and further data is added, regarding parameters and indices, specifying the systems for transportation and distribution of oil and natural gas, the systems for fertilizer processing, etc. These activities are just a part of additional data, filled in the CRF Tables.

National Inventory Methodology

According to Clean Air Act, article 25 (6) The Minister of Environment and Water in co-ordination with the interested ministers issues an order for the approval of a Methodology for the calculation, with balance methods, of the emissions of harmful substances (pollutants), emitted in the ambient air. The national Methodology (approved with Order RD 77 from 03.02.2006 of MEW) is harmonized with CORINAIR methodology for calculation of the emissions according to the UNECE/LRTAP Convention.

During 2007, MEW/ExEA had a project for development of Common methodology for emissions inventory under UNECE/LRTAP Convention and UNFCCC, i.e. to update the present Methodology under article 25 (6) CAA. (Approved with Order RD 40 from 22.01.2008 of MEW). The aim of the project was harmonization of the national Methodology with IPCC, including the three main greenhouse gases – CO_2, CH_4 and N_2O (plus relevant ODS and SF_6).

The Bulgarian national GHGs inventory and NIR are compiled according to requirements of the following documents:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1996 IPCC GL), which specify the reporting obligations according to Articles 4 and 12 of the UNFCCC (IPCC Guidelines, 1997)
- IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories 2000 (GPG 2000)
- IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry 2003 (GPG LULUCF 2003)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006 GL)25
- EMEP/EEA air pollutant emission inventory guidebook – 2009

The emission factors are mainly from:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1996 IPCC GL)
- IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories 2000 (GPG 2000)
- IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry 2003 (GPG LULUCF 2003)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006 GL)
- EMEP/EEA air pollutant emission inventory guidebook – 2013.
- Country-specific

The following tables summarise the 'Applied method' and 'Emission factor' of the inventory 2012, submission 2014 v1.3.

[25] http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

Table 8 Methods and the emission factors applied (CO_2, CH_4, N_2O)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	T1,T2	CR,CS,D	T1,T2	CR,D	T1,T2	CR,D
A. Fuel Combustion	T1,T2	CR,CS,D	T1,T2	CR,D	T1,T2	CR,D
1. Energy Industries	T1,T2	CS,D	T1	D	T1	D
2. Manufacturing Industries and Construction	T1,T2	CS,D	T1	D	T1	D
3. Transport	T1,T2	CR,CS,D	T1,T2	CR,D	T1,T2	CR,D
4. Other Sectors	T1,T2	CS,D	T1	D	T1	D
5. Other	NA	NA	NA	NA	NA	NA
B. Fugitive Emissions from Fuels	T1	D	T1	D	T1	D
1. Solid Fuels	NA	NA	T1	D	NA	NA
2. Oil and Natural Gas	T1	D	T1	D	T1	D
2. Industrial Processes	D,T1,T2	CS,D,PS	NA	NA	T3	PS
A. Mineral Products	T1,T2	CS,D,PS	NA	NA	NA	NA
B. Chemical Industry	D,T2	D,PS	NA	NA	T3	PS
C. Metal Production	D,T2	CS,D	NA	NA	NA	NA
D. Other Production	NA	NA				
E. Production of Halocarbons and SF_6						
F. Consumption of Halocarbons and SF_6						
G. Other	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	D,T1	D			D	CS,D
4. Agriculture			D,T1,T2	CS,D	D,T1,T1a,T1b	CS,D
A. Enteric Fermentation			T1,T2	CS,D		
B. Manure Management			T1,T2	CS,D	D	D
C. Rice Cultivation			D	CS		
D. Agricultural Soils			NA	NA	T1,T1a,T1b	D
E. Prescribed Burning of Savannas			NA	NA	NA	NA
F. Field Burning of Agricultural Residues			D	CS,D	D	CS,D
G. Other			NA	NA	NA	NA
5. LULUCF	T1,T2	CS,D	T1	D	T1,T2	CS,D
A. Forest Land	T1,T2	CS,D	T1	D	T1	D
B. Cropland	T1,T2	CS,D	NA	NA	T2	CS
C. Grassland	T1	CS	NA	NA	NA	NA
D. Wetlands	T1	CS	NA	NA	NA	NA
E. Settlements	T1	CS	NA	NA	NA	NA
F. Other Land	NA	NA	NA	NA	NA	NA
G. Other	NA	NA	NA	NA	NA	NA
6. Waste	T1	D	D,T1,T2	CS,D	D,T1	D
A. Solid Waste Disposal on Land	NA	NA	T2	CS,D		
B. Waste-water Handling			D	CS,D	D	D
C. Waste Incineration	T1	D	NA	NA	T1	D
D. Other	NA	NA	T1	D	T1	D
7. Other (specified in Summary 1.A)	NA	NA	NA	NA	NA	NA

Table 9 Methods and the emission factors applied: HFCs, PFCs, SF_6

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs		PFCs		SF_6	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
2. Industrial Processes	T2	D	T2	D	T2	D
A. Mineral Products						
B. Chemical Industry	NA	NA	NA	NA	NA	NA
C. Metal Production	NA	NA	NA	NA	NA	NA
D. Other Production						
E. Production of Halocarbons and SF_6	NA	NA	NA	NA	NA	NA
F. Consumption of Halocarbons and SF_6	T2	D	T2	D	T2	D
G. Other	NA	NA	NA	NA	NA	NA

The following notation keys were used to specify the method applied:		
D (IPCC default)	**T1a, T1b, T1c** (IPCC Tier 1a, Tier 1b and Tier 1c, respectively)	**CR** (CORINAIR)
RA (Reference Approach)	**T2** (IPCC Tier 2)	**CS** (Country Specific)
T1 (IPCC Tier 1)	**T3** (IPCC Tier 3)	**OTH** (Other)
If using more than one method within one source category, list all the relevant methods. Explanations regarding country-specific methods, other methods or any modifications to the default IPCC methods, as well as information regarding the use of different methods per source category where more than one method is indicated, should be provided in the documentation box. Also use the documentation box to explain the use of notation OTH.		
Use the following notation keys to specify the emission factor used:		
D (IPCC default)	**CS** (Country Specific)	**OTH** (Other)
CR (CORINAIR)	**PS** (Plant Specific)	

1.2.16 UNCERTAINTY

Fulfilment of Para 14(d) Make a quantitative estimate of inventory uncertainty for each source category and for the inventory in total, following the IPCC good practice guidance

As a whole, the uncertainty assessment of the GHG inventories follows the methodology of Good Practice Guidance. The overall uncertainty is closely related to the GHG emission sources data uncertainty (fuels, activities, processes, etc.) and to the emission factor uncertainty.

The uncertainties for all the emission sources (key and non-key) and emission factors are presented in Chapter 1.3.

Fulfilment of Para 15. As part of its inventory preparation, each Party included in Annex I should:

(a) Apply source-category-specific QC procedures (tier 2) for key source categories and for those individual source categories in which significant methodological and/or data revisions have occurred, in accordance with the IPCC good practice guidance;

(b) Provide for a basic review of the inventory by personnel that have not been involved in the inventory development, preferably an independent third party, before the submission of the inventory, in accordance with the planned QA procedures referred to in paragraph 12 (d) above;

(c) Provide for a more extensive review of the inventory for key source categories, as well as source categories where significant changes in methods or data have been made;

(d) Based on the reviews described in paragraph 15 (b) and (c) above and periodic internal evaluations of the inventory preparation process, re-evaluate the inventory planning process in order to meet the established quality objectives referred to in paragraph 12 (d).

1.2.17 QC PROCEDURES

Fulfilment of Para 14(g) and 15(a)

QC procedures

QC procedures follow the recommendations of IPCC-GPG chapter 8 on Quality Assurance and Quality Control and are part of the QMS. (see above QMS Figure 5 National quality assurance and quality control program).

1.2.18 WORK PLAN FOR SUBMISSION 2015

Fulfilment of Para 16(a) (b) (c) and 17 Inventory management

The next table presents the responsibilities of all engaged institutions for preparation of GHGs emission inventory for 2015 submission.

Table 10 Preparation of GHGs emission inventory for 2015 submission

Sector CRF	Activity data	Methodology and selection of emission factors	Preparation of Sector inventories
Energy CRF1A1 CRF1A2 CRF1A4	NSI	ExEA, NSI	External consultant
Energy/Transport CRF1A3	NSI MI MTITC	ExEA, NSI MI, MTITC	External consultant
Energy CRF1B	NSI MEE	ExEA, NSI, MEE	External consultant
Industry processes CRF2	NSI ExEA MOEW	ExEA, NSI, Branch chambers, Installations operators	Sector expert ExEA
Solvents use CRF3	NSI ExEA	ExEA, NSI	Sector expert ExEA
Agriculture CRF4	MAF	ExEA, MAF	Sector expert ExEA
LULUCF CRF5	EAF	ExEA, EAF	Sector expert ExEA External Consultants
Waste CRF6	NSI ExEA	ExEA, NSI	Sector expert ExEA

The Work plan for preparation and submission of National GHGs inventory in 2015 is presented in the next table.

Table 11 Work plan for GHGs inventory preparation and submission 2015

Action	Responsible organization	Initial Deadline	Final Deadline	Comment
Sending of statistic questionnaire to all enterprises in the country	NSI with its regional inspectorates	31.03.14	15.06.14	NSI uses statistical methods and procedures for data collection, sum-marizing and structuring that are harmonized with EUROSTAT
Sending of letters to the responsible organizations for provision of necessary activity data.	ExEA	31.03.14	15.06.14	
QA/QC Procedures - Implementation of the requirements of National QA/QC Plan.	NSI MAF, MEE, MEW, SFA, RCD	15.06.14	30.09.14	National QA/QC Plan
Provision of all collected activity data by questionnaires and other sources of information to ExEA	NSI MAF, MEE, MEW, EFA, MIA	30.09.14	30.10.14	
QA/QC Procedures - Implementation of the requirements of National QA/QC Plan	ExEA	30.10.14	15.11.14	QA/QC expert, responsible for implementation of all procedures laid down in the National QA/QC Plan
Provision of annual national energy and material balances to ExEA	NSI		30.11.14	
Preliminary estimation of emissions	ExEA, external consultants		15.12.14	
Provision of corrected activity data as a result of QA/QC procedures to ExEA	NSI MAF, MEET, MEW, EFA, MIA		20.12.14	
Recalculation of emissions, based on the corrected activity data of inventory in the required format for reporting	ExEA and external consultant		31.12.14	
Preparation of Preliminary national inventory report (NIR) to the EC.	ExEA		10.01.15	
Submission of national GHG inventory under the RMM with the short NIR.	ExEA		15.01.15	Delivered to Eionet Central Data Repository
Submission of final national GHG inventory	ExEA		15.03.15	Delivered to Eionet Central Data Repository

Action	Responsible organization	Initial Deadline	Final Deadline	Comment
and NIR.				
Submission of the final GHG inventory and NIR after the European Commission comments	MEW ExEA		15.04.15	Official submission to UNFCCC Delivered to Eionet Central Data Repository
Documentation and archiving of inventory. Preparation of inventory management report	ExEA		15.05.15	
Preparation of QA/QC plan for the next inventory.	ExEA		15.06.15	

1.2.19 VERIFICATION ACTIVITIES

In Chapter 1.2.2 'QMS' the procedure for Verification are described.

1.2.20 TREATMENT OF CONFIDENTIALITY ISSUES

ExEA ensures confidentiality of sensitive information that is data declared as confidential obtained in the course of preparing the national GHG inventory. ExEA is a member of the National Statistics Institute (NSI).

Confidentiality of statistics: The strict confidentiality provisions concerning handling of sensitive data relating to individuals and organisations are regulated by the Statistics Law.

Security of data: Confidentiality of sensitive data used to calculate the emissions is a legal obligation.

Furthermore a checklist with the following items is elaborated:

Outlines what information is to be treated as confidential;

Identify sectoral expert who is dealing with the information;

Identify the use to which the information can be put;

Specify the publishment of confidentiality data on an aggregated level.

1.3 GENERAL UNCERTAINTY EVALUATION, INCLUDING DATA ON THE OVERALL UNCERTAINTY FOR THE INVENTORY TOTALS

This section provides an overview of the approach to uncertainty analysis adopted for the Bulgarian inventory. The mandatory, detailed reporting table of the analysis for all the emission sources (key and non-key) and emission factors is provided in as 'Table 6.1' TIER 1 Uncertainty calculation and reporting'.

The present approach consists of two levels: screening and detailed analysis. Screening is done with Tier 1 uncertainty analysis. The screening and reporting of mandatory information is carried out on an annual basis, i.e. the analyses of Tier 1 uncertainty and Tier 2 key categories perform the Monte Carlo analysis are updated in submission 2014 and will be followed every two-years submission. The key categories are subject to further scrutiny. The key categories are discussed with the sectoral experts during the annual quality meetings.

Separate uncertainty calculation were performed using a spreadsheet prepared specifically according to the Tier 1 approach (IPCC, GPG, 2000). For the uncertainties of the national total emissions, estimated by Tier 2 analysis (the Monte Carlo approach) Bulgaria performs the Monte Carlo analysis every two-years since submission 2012.

1.3.1 GHG INVENTORY

As a whole, the uncertainty assessment of the GHG inventories follows the methodology of Good Practice Guidance.

The overall uncertainty is closely related to the GHG emission sources data uncertainty (fuels, activities, processes, etc.) and to the emission factor uncertainty.

The uncertainty of the GHG emission sources can be defined during data collection and processing and it is a part of procedures, applied by the statistical authorities, differences between the production, import, export and consumption of fuels, expert assessment, etc.

The uncertainty of emission factors depends on the origin of the factors applied. In case the emission factors result from direct periodical measurements, the uncertainty is determined by the relevant methodology, related to the measuring methods and apparatuses.

The overall uncertainty of the GHG inventory is determined by combining the emission sources uncertainty and the emission factors uncertainty.

Two rules are applied in this process:

Rule A - combination of the uncertainty by summing;

Rule B - combination of the uncertainty by multiplying.

Since the GHG inventories are sums of the products of emission sources, multiplied by emission factors, the two rules above can be used for determining the overall uncertainty of the inventory.

Rules A and B represent the foundation of the Tier 1 method, recommended in the Good Practice Guidance.

The uncertainties for all the emission sources (key and non-key) and emission factors are presented in Table 12.

Combined uncertainty as a part of overall emissions for 2012 for every source has been calculated as following equation:

$$MCU_i = (EM_i/EM_{total}) x\ CU_i$$

where MCUi – measured combined uncertainty,

EM_i - source emissions for 2012,

EM_{total} – total country emissions for 2012,

CN_i – combined uncertainty of the i-th source.

Uncertainty of the overall emissions trend for 2012 for every source has been calculated as HTi – overall emissions trend uncertainty brought in by the i-th source. This uncertainty calculates in column M of Table 6.1 of p.6.3.2 of the IPCC GPG 2000.

The calculated uncertainties, in %, of the overall national GHG emissions for the year 2012 (row 7, column H in Table 6.1 of the GPG), and the overall emission trend related to the base inventory year until 2012 (row 7, column M in Table 6.1.) are given in Table 12. The relevant data for the previous inventory for 2011 are given for comparison (NIR 2013 and NIR 2014).

Table 12 Uncertainty in total GHG emissions, %

Uncertainty	Uncertainty NIR 2013	Uncertainty NIR 2014
Uncertainty in total GHG emissions	13.35 %	15.84 %
Overall uncertainty into the trend in total GHG emissions	4.23 %	2.84 %

The respective sectoral uncertainties are documented in detail in the sectoral chapters of this report. The complete uncertainty information (IPCC GPG tables 6.1 and 6.2) and other background information are presented in Annex 7.

1.3.2 KP-LULUCF INVENTORY

An assessment of the uncertainties of emissions/removals of the ARD units based on Tier 2 method is presented in submission 2014 ANNEX 7.

1.4 GENERAL ASSESSMENT OF THE COMPLETENESS

1.4.1 GHG INVENTORY

Completeness by source and sink categories and gases

Bulgaria has provided estimates for all significant IPCC source and sink categories according to the detailed CRF classification. Estimates are provided for the following gases: CO_2, N_2O CH_4, F-gases (HFC, PFC and SF_6), NMVOC, NOx, CO and SO_2. In accordance with the IPCC Guidelines, international aviation and marine bunker fuel emissions are not included in national totals. However, CO_2, CH_4 and N_2O emissions from lubricants from International bunkers are included in emissions from feedstock and non-energy use of the fuels. Lubricants are not split between domestic and international, as only information on total sales of lubricants is available in fuel statistics.

CRF- Table 9 (Completeness) has been used to give information regarding completeness. An assessment of completeness for each sector is given in the Sector Overview part of the corresponding subchapters.

All sources and sinks included in the IPCC Guidelines are addressed. No additional sources and sinks specific to Bulgaria have been identified.

Completeness by geographical coverage

The geographic coverage is complete. There is no part of the Bulgarian territory not covered by the national inventory.

Completeness by timely coverage

A complete set of CRF tables are provided for all years and the estimates are calculated in a consistent manner.

Notation keys

The sources and sinks not considered in the inventory but included in the IPCC Guidelines are indicated, the reasons for such exclusion are explained. In addition, the notation keys presented below are used to fill in the blanks in all the tables in the CRF. Notation keys used in the NIR are consistent with those reported in the CRF. Notation keys are used according to the UNFCCC guidelines on reporting and review (FCCC/CP/2002/8).

Allocations to categories may differ from Party to Party. The main reasons for different category allocations are different allocations in national statistics, insufficient information on the national statistics, national methods, and the impossibility to disaggregate emission declarations.

IE (included elsewhere):

"IE" is used for emissions by sources and removals by sinks of greenhouse gases that have been estimated but included elsewhere in the inventory instead of the expected source/sink category. Where "IE" is used in the inventory, the CRF completeness table (Table 9) indicates where (in the inventory) these emissions or removals have been included. Such deviation from the expected category is explained.

NE (not estimated):

"NE" is used for emissions by sources and removals by sinks of greenhouse gases which have not been estimated. Where "NE" is used in an inventory for emissions or removals, both the NIR and the CRF completeness table indicate why emissions or removals have not been estimated.

NA (not applicable):

"NA" is used for activities in a given source/sink category that do not produce emissions or lead to removals of a specific gas.

C (confidential):

"C" is used for emissions which could lead to the disclosure of confidential information if reported at the most disaggregated level. In this case a minimum of aggregation is required to protect business information.

In the following table is presented completeness of submission 2014:

Table 13 Completeness of national inventory

Sources and sinks not estimated (NE)			
GHG	**Sector**	**Source/sink category**	**Explanation**
Carbon	5 LULUCF	5.E.1 Settlements remaining Settlements	Reporting is not obligatory
Carbon	5 LULUCF	5.D.1 lakes	Reporting is not obligatory
Carbon	5 LULUCF	5.D.1 reservoirs	Reporting is not obligatory
Carbon	5 LULUCF	5.D.1 rivers	Reporting is not obligatory
Carbon	5 LULUCF	5.D.1 marshlands	Reporting is not obligatory
CO_2	5 LULUCF	5.G Harvested Wood Products	Reporting is not obligatory

Sources and sinks reported elsewhere (IE)				
GHG	**Source/sink category**	**Allocation as per IPCC Guidelines**	**Allocation used by the Party**	**Explanation**
Carbon	coniferous	Forest sector 5 A	Forest sector 5 A	According to IPCC, Chapter 3.2 the area of forest land is categorized into forest type – coniferous and deciduous
Carbon	deciduous	Forest sector 5 A	Forest sector 5 A	According to IPCC, Chapter 3.2 the area of forest land is categorized into forest type –

Sources and sinks not estimated (NE)				
GHG	Sector	Source/sink category		Explanation
				coniferous and deciduous
CH_4	1.B.2.B.1 Exploration	Allocation per IPCC Guideline Considered in 1.B.2.a.i		Allocation per IPCC Guideline Considered in 1.B.2.a.i
CO_2	1.B.2.B.1 Exploration	Allocation per IPCC Guideline Considered in 1.B.2.a.i		Allocation per IPCC Guideline Considered in 1.B.2.a.i
CO_2	2.A.3 Limestone and Dolomite Use	2.A.3 Limestone and Dolomite Use		In order to eliminate double counting. IE in 2.A.1, 2.A.2, 2.A.7 Glass production and FGD (other non specified), 2.C.1.

1.4.2 KP-LULUCF INVENTORY

All activities according to Article 3.3 of the Kyoto Protocol are estimated. Bulgaria did not elect Article 3.4 activities (see also Chapter 15).

2 TRENDS IN GREENHOUSE GAS EMISSIONS

Description and interpretation of emission trends for aggregated greenhouse gas emissions

In 2012 Bulgaria's greenhouse gas emissions totalled 61 045,63Gg CO2 without reporting of sequestration from LULUCF sector. The emissions decreased by 49,9% compared with the base year and on 49.9% below the level of 122 000 Gg CO2 to which Bulgaria should limit its emissions during the Kyoto Protocol's first commitment period between 2008 and 2012. Emissions in 2012 were 7.5 % decrease in comparison with the emissions of the previous year.

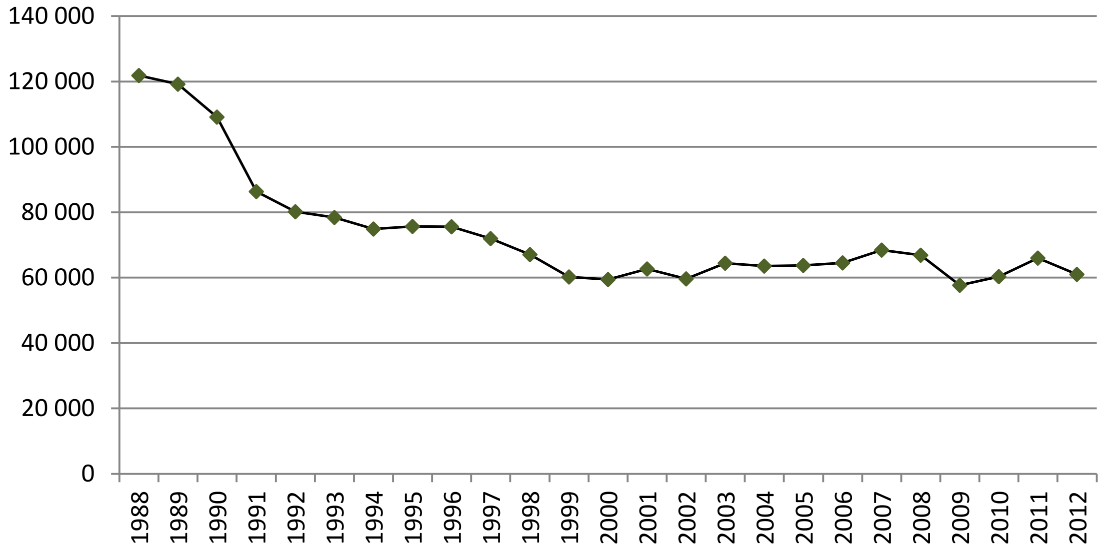


Figure 8 Total GHG emissions (without LULUCF) for 1988 – 2012, Gg CO2 eq.

The net emissions including reporting of sequestration from LULUCF sector were 52 838,14Gg CO2 eq. The emissions decreased by 51.1% compared with the base year.

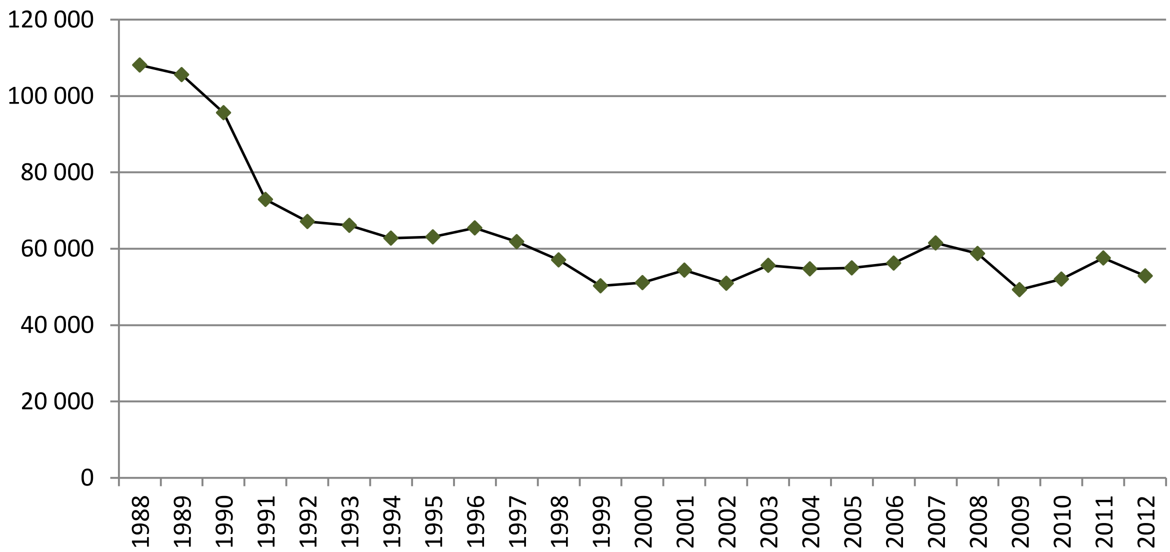


Figure 9 Total GHG emissions (with LULUCF) for 1988 – 2012, Gg CO_2 eq.

The main reasons for the declining GHG emission trend in Bulgaria are the structural economic changes due to the radical transition process from a centrally-planned economy to a market-based economy. This led to a decrease of power production from thermal power stations (and an increase of the shares of hydropower and nuclear power), structural changes in industry (including a decline in production by energy-intensive enterprises and energy-efficency improvments), introduction of energy efficiency measures in the residential sector and a shift form solid and liquid fuels to natural gas in energy consumption. This also led to a decrease in GHG emissions from the agricultural sector stemming from the decline in the cattle and sheep populations and the use of fertilizers.

Bulgaria experienced a steady declining population trend during the period 1990-2012, which resulted in the reduction of population by 16%.

2.1 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY GAS

The most important greenhouse gas in Bulgaria is carbon dioxide. The share of CO2 emissions from the total greenhouse gas emissions varies around 79% excluding LULUCF and 65% including LULUCF. In absolute terms CO_2 emissions have decreased 46.3% since 1988. Around 77% of total CO_2 eq emissions originate from the Energy sector. The amount of energy-related CO_2 emissions has fluctuated much according to the economic trend, the energy supply structure (including electricity exports) and climate conditions.

Methane emissions (CH_4) have decreased by 58,1% from the 1988 level. This is mainly due to the improvements in waste collection and treatment and a reduction in animal husbandry in the Agriculture sector. Correspondingly, emissions of nitrous oxide (N_2O) have also decreased by 66% which has been occasioned mostly by the reduced nitrogen fertilisation of agricultural fields, the biggest decline was in the beginning of time series.

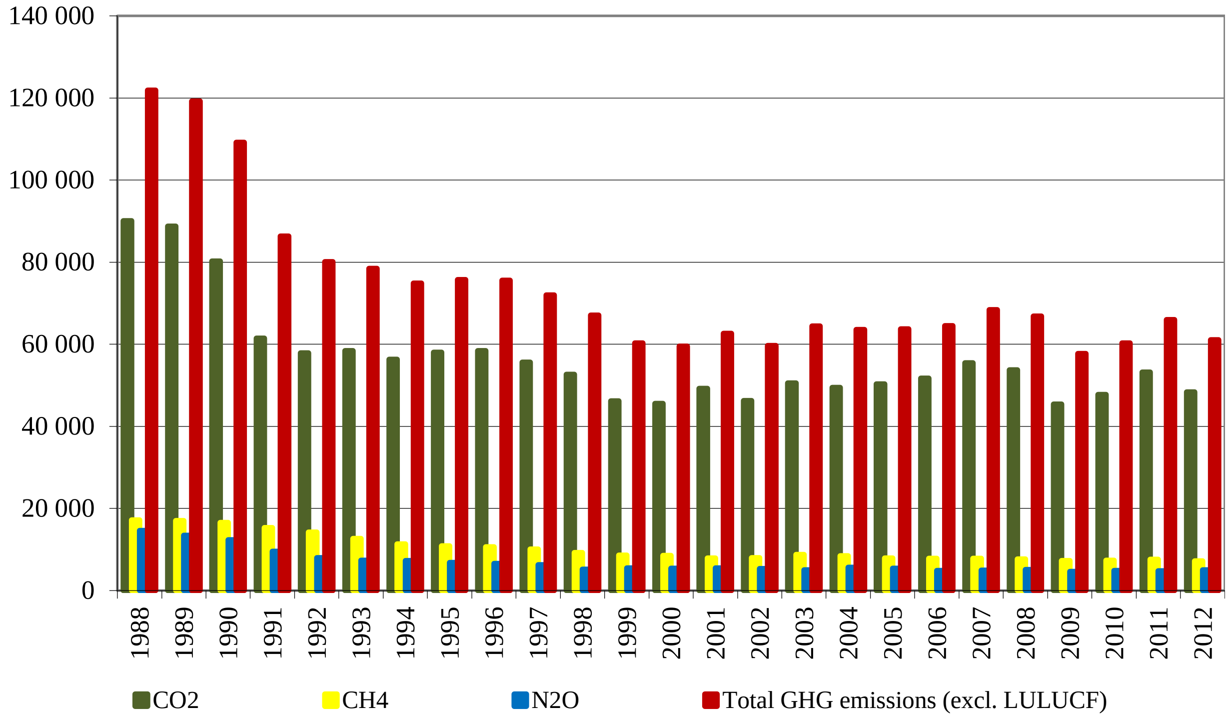


Figure 10 Total GHG emissions in Gg CO_2 eq. for 1988 – 2012.

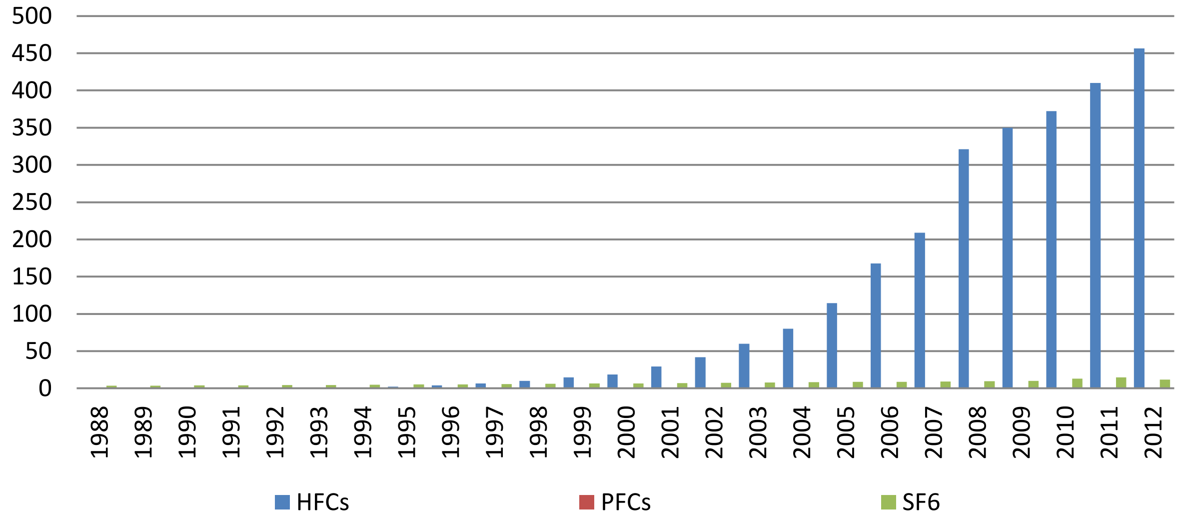


Figure 11 Actual emissins of HFCs, PFCs and SF6 for 1988 – 2012, Gg CO_2 eq.

The emissions of F-gases have increased over tenfold during 1995-2012. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications.

2.2 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY CATEGORY

Figure 12 below shows the GHG aggregated emission trends by IPCC sectors. The Energy sector, where GHG emissions come from fuel combustion, headed the list in 2012 with the biggest share – 77.3%. Sector Agriculture ranked the second place with 10.4% and sectors IP/Waste ranked the third place with 6.4%/5.9%.

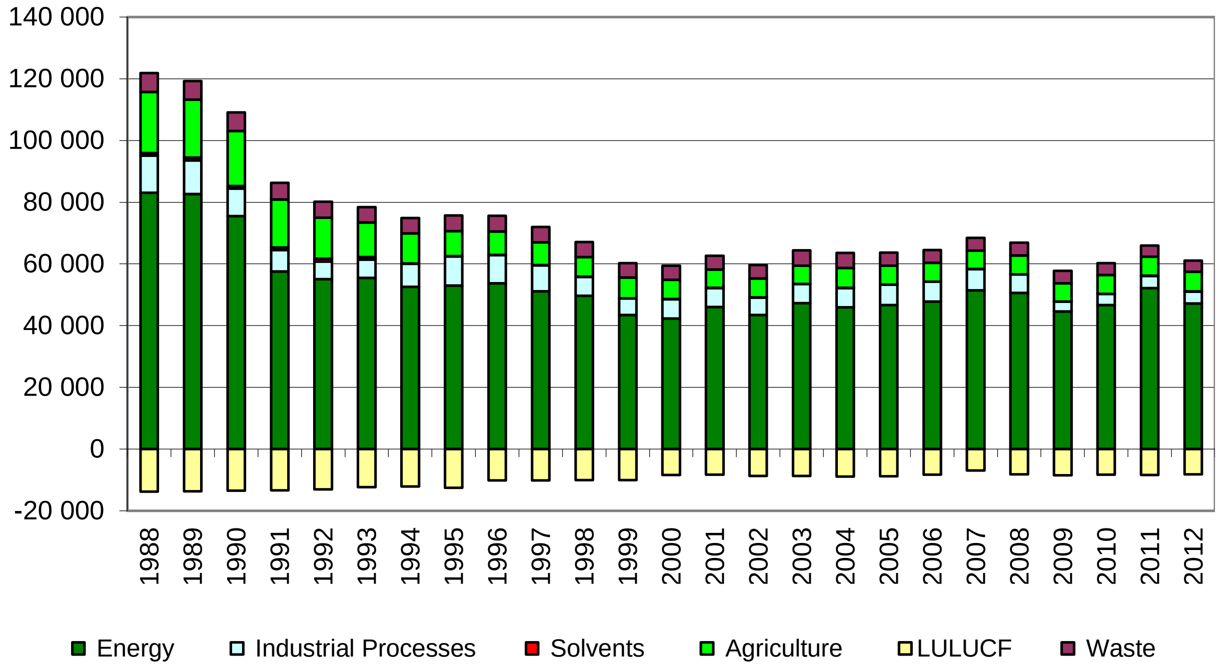


Figure 12 Total greenhouse gas emissions in CO_2-eq. per IPCC sector 1988-2012

Table 14 The reductions of GHG emissions by sectors by base year

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Change from base to latest reported year
1. Energy	-43,23
2. Industrial Processes	-67,43
3. Solvent and Other Product Use	-95,44
4. Agriculture	-68,05
5. Land Use, Land-Use Change and Forestry(5)	-40,47
6. Waste	-41,03
7. Other	0,00
Total (including LULUCF)	**-51,12**

Energy

Emissions from the energy sector in 2012 decreased by 43.23% compared to the base year (47 169,68Gg CO2e in 2012 compared to 83 091,51Gg CO2e in 1988), although there is an decrease of 10.6% compared to last year. Main source of emissions in the Energy sector is Fuel combustion of solid fuels, which is responsible for 62.4% of the emissions.

The main reasons for the decrease of the GHG emission trend in energy sector are the transition from a centrally-planned economy to a market-based economy, reconstructing of the economy and subsequent economic slowdown. This led to a sharp drop in demand for electricity production from thermal power production.

The trend of GHG emissions between 1988 and 2012 was defined by a substancial decrease of emissions from fuel combustion in energy industries (25%) and energy use in manufacturing industry and construction (81%) and in other sectors (64.5%), as well as a clear increase in GHG emissions from transport (14%).

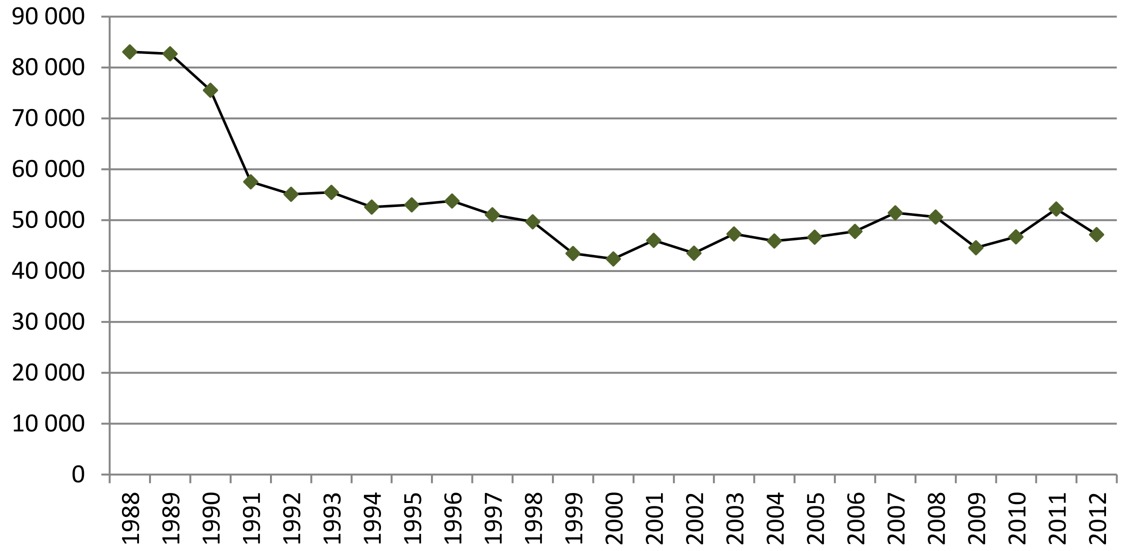


Figure 13 GHG emissions from Energy sector for 1988 – 2012, Gg CO_2 eq.

Chapter 3 of this Report contains a more detailed analysis of GHG emissions in the sector.

Industrial Processes

A steady trend towards emission reduction in this sector is observed since 1988. The emissions in 2012 decreased with 67% compared to the base year.

In the year 2012, 6.4% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes, compared to 11.1% in the base year 1988. In 2012, greenhouse gas emissions from Industrial Processes are 3 895,22Gg CO2 equivalent compared to 11 959,94Gg CO2 in the base year.

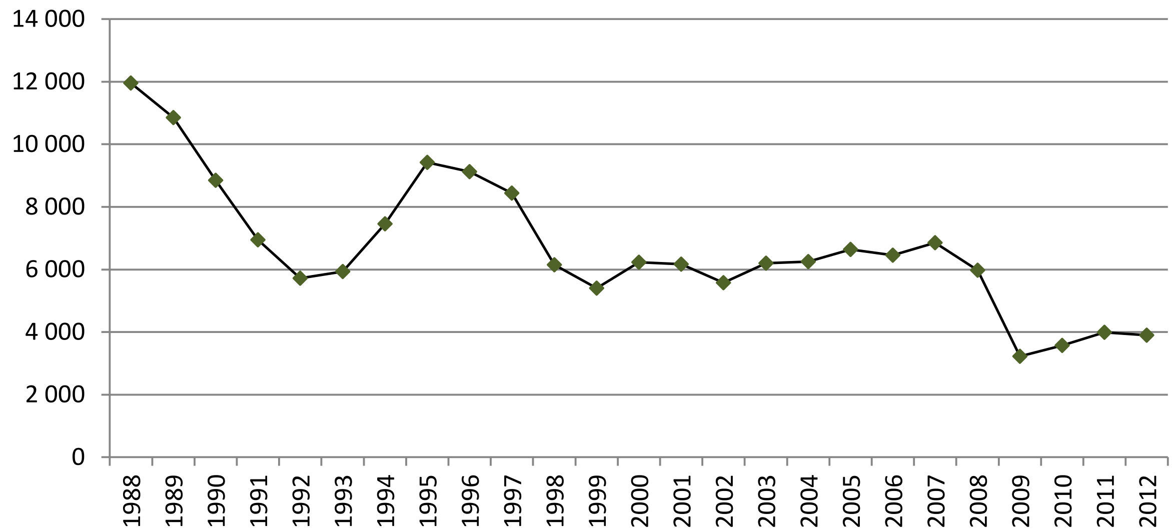


Figure 14 GHG emissions from Industrial processes sector for 1988 – 2012, Gg CO_2 eq.

In 2012 the most important emitting category is Mineral products (mainly production of clinker and quick lime), which share in the total Industrial processes emissions is 73.2%. The second category by share is Chemical Industry (ammonia and nitric acid production) with 13.4%, followed by Consumption of Halocarbons and SF6 with 13.3% share and finally Metal Production (steel) with 1.3%.

Greenhouse gas emissions from the Industrial Processes sector fluctuate during the period and reach a minimum in 2009. The reduction in 2012 for the whole sector is 67.4% while the biggest reduction (compared to the base year) can be seen in Metal Production category – 98.7%.

This is mainly due to economic crisis and in particular the world economic crisis in 2009. The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

The general reduction in the emissions in the later years of the time period is influenced also by the starting introduction of better technologies on plant level

Solvent and Other Product Use

The emissions in 2012 decreased with 95,44% compared to the base year.

Chapter 5 of this Report contains a more detailed analysis of GHG emissions in the sector.

Agriculture

The overall emission reduction in the sector has amounted to 68% since 1988. In the year 2012 the sector agriculture contributed 10.3% to the total of Bulgaria's greenhouse gas emissions (without LULUCF).

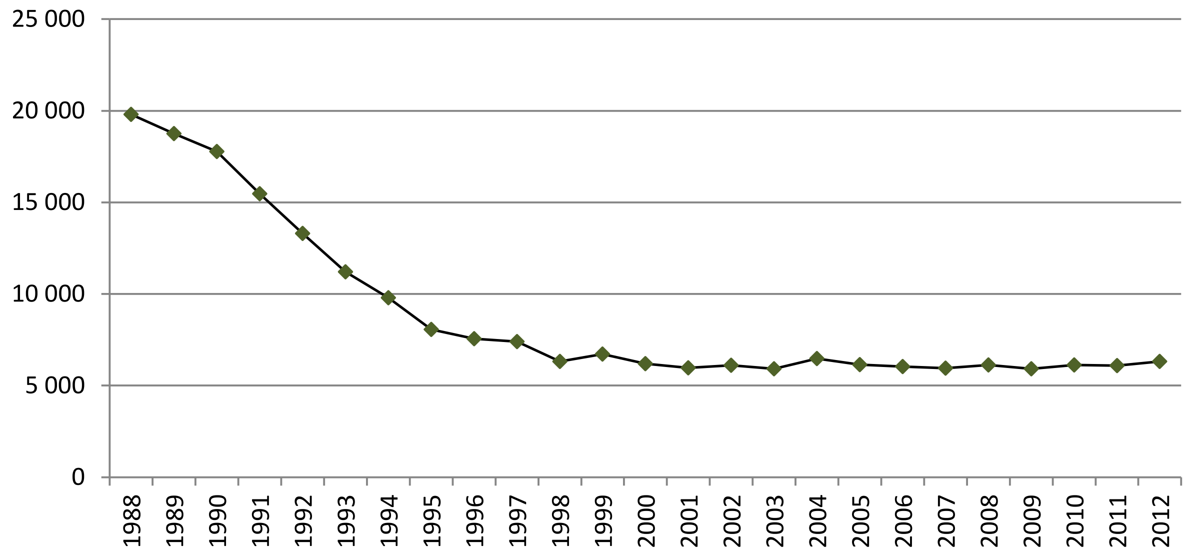


Figure 15 GHG emissions from Agriculture sector for 1988 – 2012, Gg CO_2 eq.

The emission reductions were mainly driven by systematic declines in the agricultural land area due to abandoning of arable lands and reduction in livestock population. Another driver for the emission reduction was the decline in the use of fertilizers.

Chapter 6 of this Report contains a more detailed analysis of GHG emissions in the sector.

Land-Use Change and Forestry

The LULUCF sector is serving as a sink of greenhouse gases for Bulgaria. The two categories – "Forest land" and "Grassland" are removals of CO_2. All other categories are sources of CO2 emissions. The trend of net CO_2 removals (CO_2 eq) from LULUCF decreases by 40.47% compared to the base year. The main reason for the overall decrease of the uptakes of CO_2 emissions from LULUCF is due to the fall in removals from category Forest land and the slight increase in emissions from CL, WL and SM categories. The key driver for the fall in removals from FL is the observed decline in the rate of forest growth as the average age of the forest stands increases steadily over the reporting period. In spite of the decrease observed, the share of the removals from the total GHG emissions (in CO_2eq) is still remarkable. The reason for this is that the emissions in the other sectors have dropped dramatically. The share of the removals in the base year has the figure of -11,3% from the total GHG emissions in CO_2-eq, while in the inventoried year the share is -13.5%.

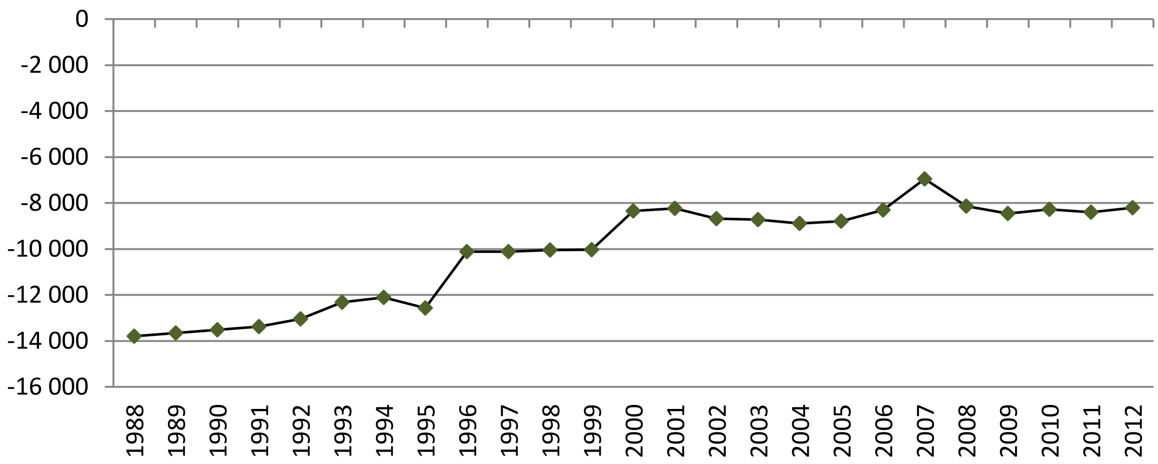


Figure 16 LULUCF emissions and removals for 1988 – 2012 CO_2 eq.

Comparing with the base year an increase in the emissions in croplands, settlements and wetlands is observed. The total emissions from croplands fluctuate during the whole time series. The emissions from Settlements increase last couple of years due to changes from other land uses to Settlements according to the risen infrastructural activities since Bulgaria's joined the EU.

Chapter 7 of this Report contains a more detailed analysis of GHG emissions in the sector.

Waste

The total sector emission reduction from the base year is 41.03 %. The decline was mainly driven by a steady population decline over the past 10 years.

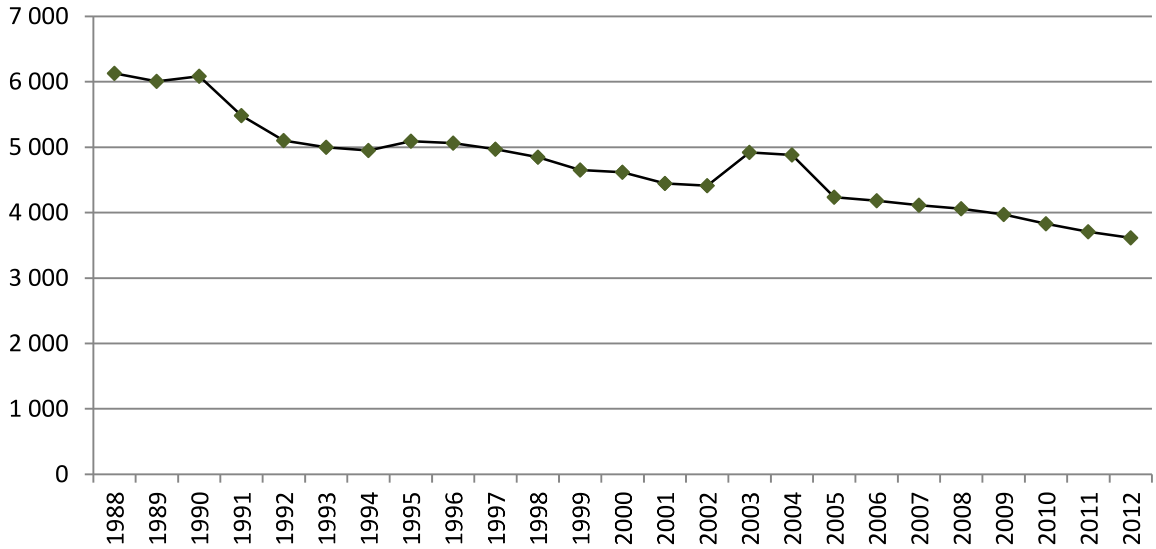


Figure 17 GHG emissions from Waste sector for 1988 – 2012, Gg CO_2 eq.

Chapter 8 of this Report contains a more detailed analysis of GHG emissions in the sector.

2.3 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS FOR INDIRECT GREENHOUSE GASES AND SO_2

Compared to the base year the emissions of non-GHGs emissions decreased as follows:

- NO_x with 44%
- CO with 60%
- SO_x with 7%
- NMVOC with 90%

2.4 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS FOR KP-LULUCF INVENTORY IN AGGREGATE AND BY ACTIVITY, AND BY GAS

Bulgaria is chosen to report under Article 3.3 of the Kyoto Protocol the coverage of carbon pools and emission sources reported under afforestation (A), reforestation (R) and deforestation (D). In accordance with Article 7 KP of the country will report in the National Inventories the following activities, as given in Decision 16/CMP.1 Land use, land-use change and forestry

Emissions and removals from KP-LULUCF activities are described in Chapter 11.

3 ENERGY (CRF SECTOR 1)

3.1 OVERVIEW OF SECTOR

All emissions originating from stationary fuel combustion activities in the energy and manufacturing industries, commercial, agricultural and residential sectors, mobile fuel combustion activities resulting from aviation, road transportation, railways and navigation (CRF category 1A), as well as fugitive emissions from fuels (CRF category 1B) are accounted in the Energy sector.

According to the IPCC guidelines, Energy sector consists of these categories:

- 1.A.1. Energy Industries
- 1.A.2. Manufacturing Industries and Construction
- 1.A.3. Transport
- 1.A.4. Other Sectors
- 1.A.5. Other
- 1.B. Fugitive Emissions from Fuels

Emissions from the energy sector are the main source of GHGs in Bulgaria: in 2012 the sector is responsible for 77.3% of national total GHGs emissions (47 170 Gg CO_2e from sector 1A of the total 61 046 Gg CO_2e excl. LULUCF).

3.2 EMISSION TREND

Emissions from the energy sector in 2012 decreased by 43.2% compared to the base year (47 170 Gg CO_2e in 2012 compared to 83 092 Gg CO_2e in 1988). The emissions in 2012, reach a decrease of 9.6% compared to previous year.

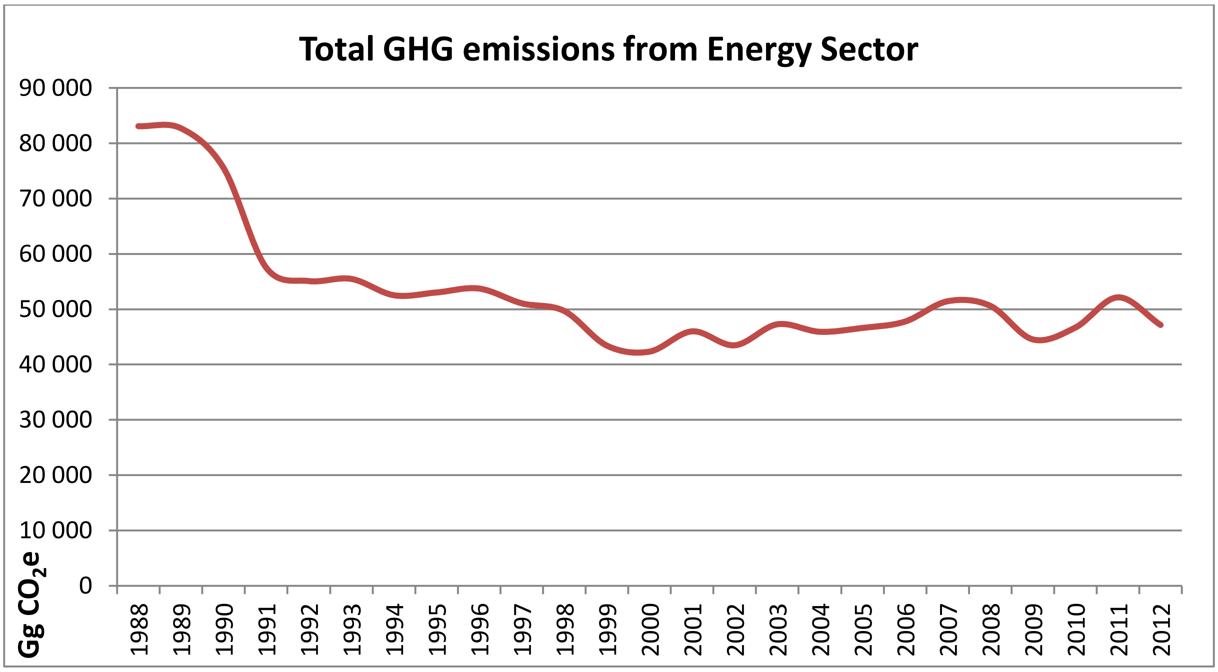


Figure 18 Total GHG emissions from Energy Sector

Main source of emissions in the energy sector is fuel combustion of solid fuels, which is responsible for 64.6% of the emissions from fuel combustion in 2012, followed by liquid fuels with 23.4% and gaseous fuels with 11.3%.

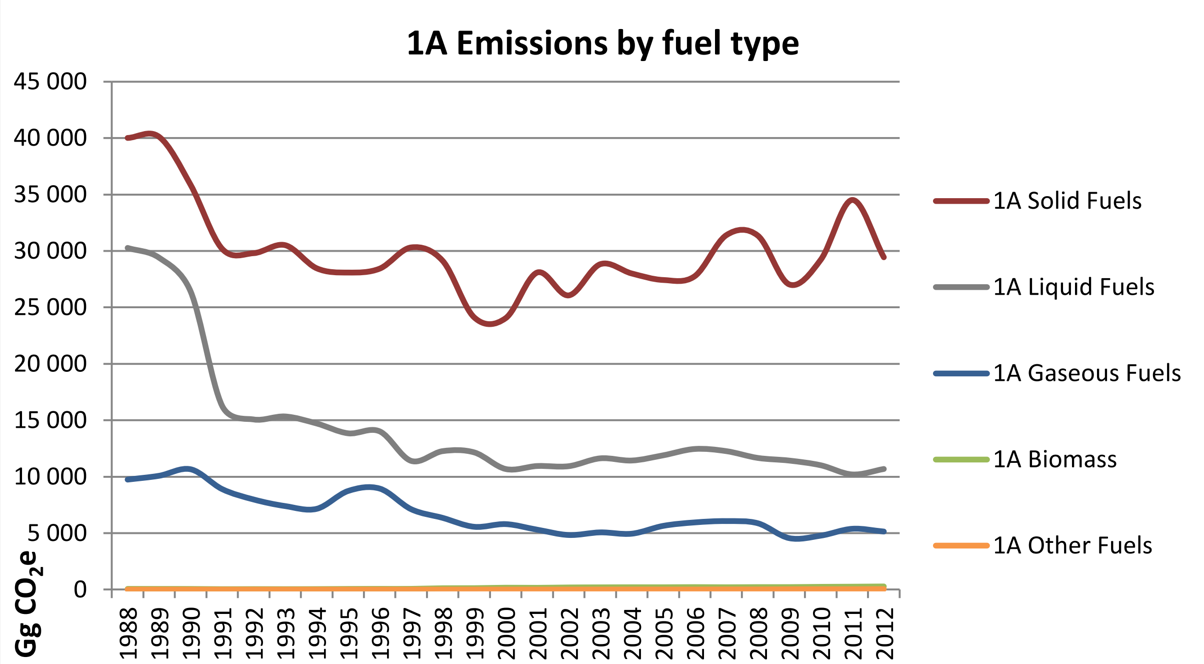


Figure 19 GHG emissions from fuel combustions by fuel type

On a subcategory level, energy industries is the major source of emissions, responsible for 69.3% of the emissions from fuel combustion, followed by transport with 18.5% and manufacturing industries and construction with 7.3%.

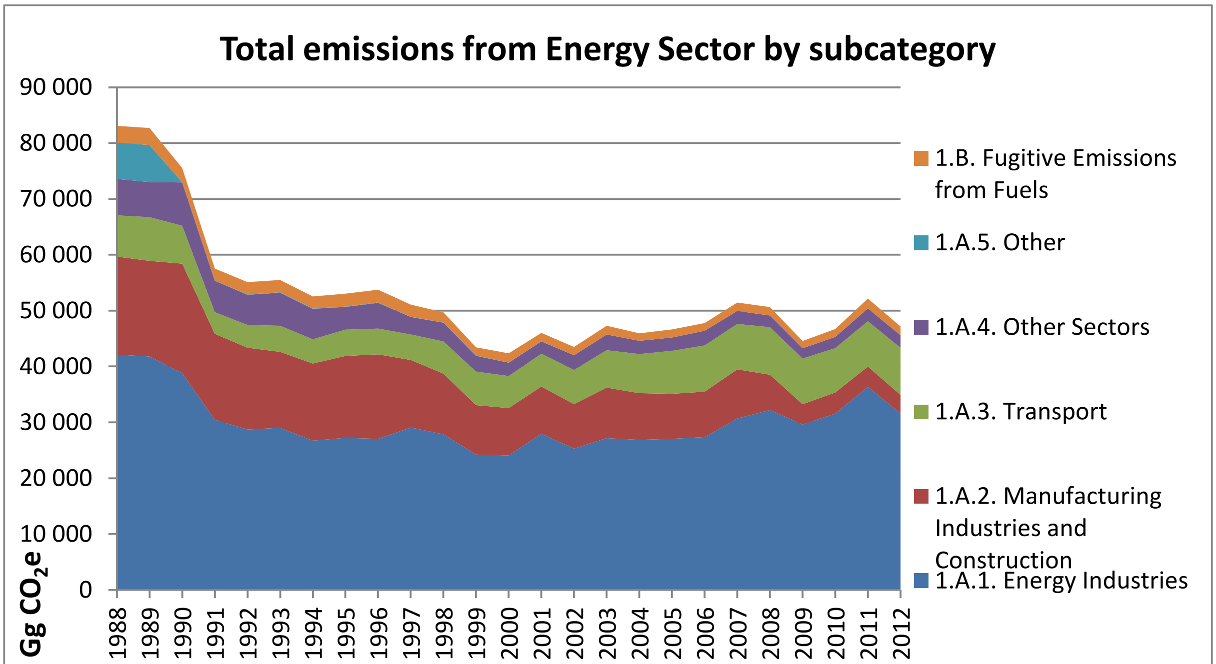


Figure 20 Total GHG emissions from Energy Sector by subcategory

Total emissions from energy sector mainly consist of CO_2; with total amount of 45 024.66 Gg for 2012, followed by CH_4 and N_2O, which only make up about 89.29 Gg and 0.87 Gg, respectively.

Table 15 Emissions of GHG and their trends for the years 1988 – 2012

Year	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Total GHG [Gg CO_2e]
1988	79 349.99	162.54	1.06	83 091.51
1989	78 911.86	164.83	1.07	82 703.98
1990	72 288.32	138.54	1.11	75 540.39
1991	54 892.63	114.41	0.77	57 534.51
1992	52 345.04	119.84	0.79	55 105.34
1993	52 636.24	120.32	1.07	55 493.87
1994	49 743.62	115.72	1.19	52 541.68
1995	50 031.31	121.93	1.45	53 040.63
1996	50 724.85	122.08	1.48	53 748.46
1997	48 293.58	114.97	1.21	51 083.29
1998	47 153.64	100.43	1.39	49 693.14
1999	41 315.71	81.58	1.30	43 432.80
2000	40 089.77	90.57	1.17	42 355.27
2001	43 938.14	82.19	1.13	46 015.59
2002	41 392.86	83.16	1.15	43 496.11
2003	45 063.61	88.67	1.18	47 290.28
2004	44 076.91	76.15	0.85	45 938.22
2005	44 669.04	81.08	0.85	46 636.58
2006	45 861.63	78.25	0.88	47 777.49
2007	49 414.94	83.81	0.90	51 454.85
2008	48 593.24	83.69	0.91	50 631.36
2009	42 772.68	73.59	0.79	44 562.89
2010	44 760.10	80.05	0.83	46 699.16
2011	49 831.86	97.65	0.91	52 163.00
2012	45 024.66	89.29	0.87	47 169.68

3.3 FUEL COMBUSTION (CRF 1.A)

3.3.1 COMPARISON OF THE SECTORAL APPROACH WITH THE REFERENCE APPROACH

Following the IPCC guidelines, two separate approaches are applied in order to estimate the emissions from fuel combustions activities: Reference approach (RA) and Sectoral approach (SA).

The Reference approach is a method for estimating CO_2 combustion emissions by a simplified top-down methodology, which uses the reported quantities of primary and secondary fuels from the national energy balance, taking into account the non-energy use of fuels. For the purpose of the RA, the apparent consumption of each fuel is calculated from the reported quantities for production, import, export, stock changes and international bunkers.

The Sectoral Approach (SA) is a more detailed bottom-up methodology, which uses the fuel consumption in each of the following subcategories:

- Energy Industries, including Public Electricity and Heat Production, Petroleum Refining and Manufacture of Solid Fuels and Other Energy Industries;

- Manufacturing Industries and Construction, including Iron and Steel, Non-Ferrous Metals, Chemicals, Pulp, Paper and Print, Food Processing, Beverages and Tobacco and Other
- Transport, including Civil Aviation, Road Transportation, Railways, Navigation and Other Transportation
- Other Sectors, including Commercial/Institutional, Residential, Agriculture/Forestry/Fisheries
- Other Stationary and Mobile sources

3.3.1.1 Methodology

Default methodologies are applied based on the fuel type and according to 1996 IPCC Reference manual, Ch. 1, p. 1.12, Table 1-1.

3.3.1.2 Results of the reference approach

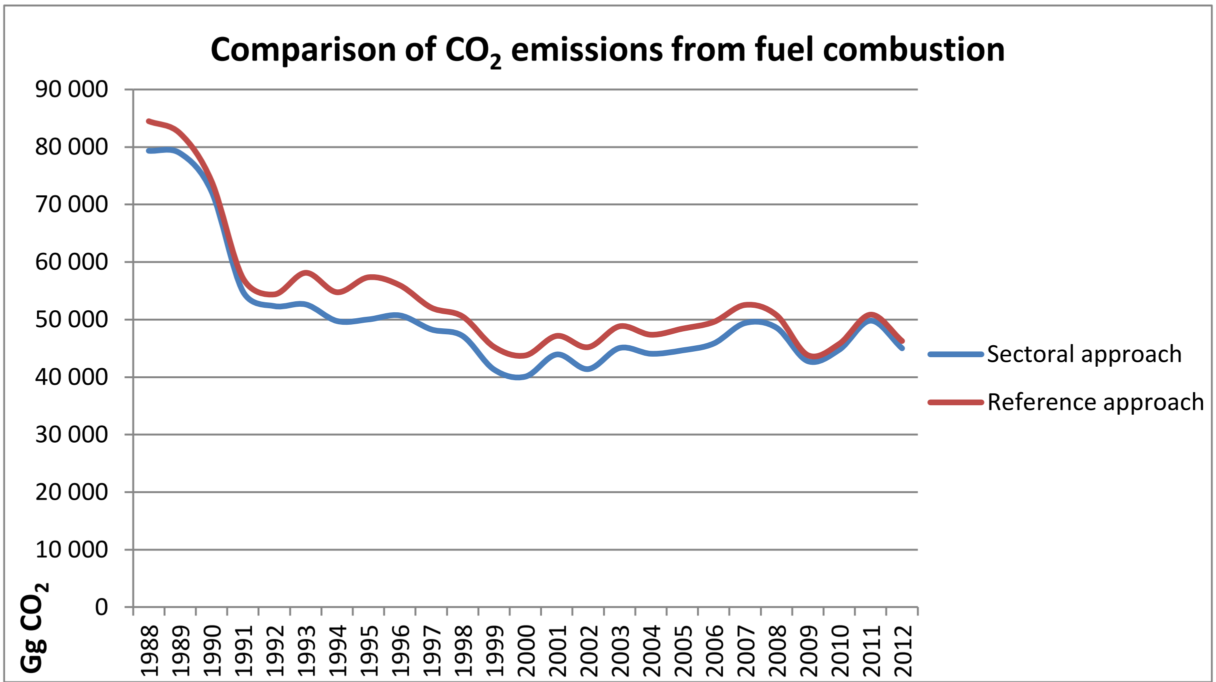


Figure 21 Comparison of the sectoral approach with the reference approach

The following tables compare the energy consumption and the emissions according to both approaches by fuel type.

Table 16 Comparison of the sectoral approach with the reference approach (all fuels)

Year	Energy consumption, PJ		Difference	CO_2 Emissions, Gg		Difference
	Reference approach	Sectoral approach		Reference approach	Sectoral approach	
1988	1043.03	972.03	7.30%	84485.70	79344.99	6.48%
1989	1021.29	967.73	5.53%	82346.54	78906.94	4.36%
1990	921.76	898.49	2.59%	74052.62	72284.18	2.45%
1991	704.41	677.91	3.91%	57195.97	54888.82	4.20%
1992	658.81	639.42	3.03%	54374.88	52340.35	3.89%
1993	702.87	640.84	9.68%	58132.23	52630.73	10.45%
1994	664.14	606.53	9.50%	54748.31	49739.00	10.07%
1995	705.59	618.86	14.01%	57351.48	50026.53	14.64%
1996	684.84	627.83	9.08%	55961.47	50721.00	10.33%

Year	Energy consumption, PJ		Difference	CO_2 Emissions, Gg		Difference
	Reference approach	Sectoral approach		Reference approach	Sectoral approach	
1997	615.83	576.17	6.88%	52072.25	48290.30	7.83%
1998	596.69	561.65	6.24%	50537.80	47150.39	7.18%
1999	536.41	499.03	7.49%	45247.51	41312.21	9.53%
2000	521.37	483.54	7.82%	43766.04	40086.68	9.18%
2001	551.66	517.49	6.60%	47161.17	43935.13	7.34%
2002	532.46	487.91	9.13%	45197.82	41389.84	9.20%
2003	570.17	528.88	7.81%	48826.02	45061.13	8.36%
2004	551.96	520.58	6.03%	47364.91	44060.69	7.50%
2005	574.45	534.30	7.52%	48418.97	44644.22	8.46%
2006	589.99	550.03	7.27%	49583.95	45837.61	8.17%
2007	618.15	583.64	5.91%	52543.75	49400.65	6.36%
2008	590.23	568.42	3.84%	50769.59	48582.38	4.50%
2009	510.26	500.29	1.99%	43807.97	42770.44	2.43%
2010	528.39	518.22	1.96%	45776.37	44755.51	2.28%
2011	581.37	569.99	2.00%	50858.73	49811.42	2.10%
2012	534.77	521.18	2.61%	46271.59	45006.44	2.81%

Table 17 Comparison of the sectoral approach with the reference approach (liquid fuels)

Year	Energy consumption, PJ		Difference	CO_2 Emissions, Gg		Difference
	Reference approach	Sectoral approach		Reference approach	Sectoral approach	
1988	459.41	402.65	14.10%	33500.93	30019.14	11.60%
1989	445.38	391.27	13.83%	32425.00	29139.33	11.28%
1990	362.86	353.05	2.78%	26531.69	26133.78	1.52%
1991	220.08	217.53	1.17%	16042.22	16121.04	-0.49%
1992	193.96	200.57	-3.30%	14259.68	14912.22	-4.38%
1993	220.56	203.98	8.13%	16063.03	15087.10	6.47%
1994	208.39	195.11	6.81%	15153.22	14424.81	5.05%
1995	222.87	182.91	21.84%	16193.17	13473.15	20.19%
1996	194.07	185.17	4.81%	14128.18	13647.13	3.52%
1997	154.76	150.76	2.65%	11299.47	11136.14	1.47%
1998	164.00	162.45	0.95%	11891.08	11944.05	-0.44%
1999	157.88	161.96	-2.52%	11479.29	11839.01	-3.04%
2000	145.58	142.42	2.22%	10549.62	10417.60	1.27%
2001	145.90	146.92	-0.70%	10565.80	10713.68	-1.38%
2002	164.26	145.29	13.06%	11960.10	10691.95	11.86%
2003	164.84	155.34	6.12%	12031.29	11395.17	5.58%
2004	157.07	155.97	0.70%	11466.56	11306.68	1.41%
2005	178.79	161.80	10.49%	13053.81	11765.14	10.95%
2006	184.99	169.06	9.42%	13500.87	12323.16	9.56%
2007	175.48	164.73	6.52%	12854.41	12139.23	5.89%
2008	167.22	157.56	6.13%	12190.56	11539.49	5.64%
2009	160.51	154.48	3.90%	11637.79	11322.69	2.78%
2010	152.70	146.84	4.00%	11181.95	10913.47	2.46%
2011	143.87	137.71	4.48%	10413.18	10105.45	3.05%
2012	150.97	143.37	5.30%	10988.04	10584.80	3.81%

Table 18 Comparison of the sectoral approach with the reference approach (solid fuels)

Year	Energy consumption, PJ		Difference	CO_2 Emissions, Gg		Difference
	Reference approach	Sectoral approach		Reference approach	Sectoral approach	
1988	406.48	392.24	3.63%	41255.08	39596.16	4.19%
1989	392.62	393.17	-0.14%	39853.85	39699.92	0.39%
1990	363.29	351.69	3.30%	36776.27	35508.01	3.57%
1991	319.10	298.59	6.87%	32078.08	29880.51	7.35%
1992	316.44	293.81	7.70%	31962.99	29460.95	8.49%
1993	342.98	302.43	13.41%	34416.23	30159.49	14.11%
1994	318.86	281.45	13.29%	32075.99	28175.31	13.84%
1995	318.20	277.17	14.80%	32121.49	27832.36	15.41%
1996	322.21	280.05	15.05%	32575.01	28142.06	15.75%
1997	329.43	296.05	11.28%	33542.09	30048.69	11.63%
1998	314.43	283.78	10.80%	32150.90	28866.34	11.38%
1999	274.83	235.98	16.47%	28072.65	23920.20	17.36%
2000	267.89	235.75	13.63%	27289.20	23881.16	14.27%
2001	304.18	274.16	10.95%	31015.88	27925.87	11.07%
2002	275.91	254.75	8.30%	28168.06	25871.30	8.88%
2003	308.62	281.45	9.65%	31482.54	28607.33	10.05%
2004	300.87	274.62	9.56%	30733.87	27809.28	10.52%
2005	289.51	269.92	7.26%	29534.14	27242.42	8.41%
2006	292.22	272.88	7.09%	29888.37	27574.24	8.39%
2007	325.92	308.55	5.63%	33278.65	31196.25	6.68%
2008	310.66	303.99	2.19%	32410.59	31170.76	3.98%
2009	264.45	262.87	0.60%	27481.51	26878.35	2.24%
2010	286.26	284.34	0.67%	29679.08	29048.18	2.17%
2011	336.90	334.27	0.79%	34914.00	34304.17	1.78%
2012	288.01	283.98	1.42%	30022.53	29251.03	2.64%

Table 19 Comparison of the sectoral approach with the reference approach (gaseous fuels)

Year	Energy consumption, PJ		Difference	CO_2 Emissions, Gg		Difference
	Reference approach	Sectoral approach		Reference approach	Sectoral approach	
1988	177.13	177.13	0.00%	9729.69	9729.69	0.00%
1989	183.29	183.29	0.00%	10067.68	10067.68	0.00%
1990	195.61	193.75	0.96%	10744.67	10642.38	0.96%
1991	165.23	161.80	2.12%	9075.67	8887.27	2.12%
1992	148.42	145.05	2.32%	8152.22	7967.18	2.32%
1993	139.33	134.43	3.64%	7652.97	7384.14	3.64%
1994	136.89	129.97	5.33%	7519.10	7138.89	5.33%
1995	164.52	158.77	3.62%	9036.82	8721.02	3.62%
1996	168.55	162.61	3.66%	9258.29	8931.82	3.66%
1997	131.64	129.36	1.76%	7230.69	7105.47	1.76%
1998	118.26	115.42	2.46%	6495.83	6340.01	2.46%
1999	103.69	101.10	2.57%	5695.57	5553.00	2.57%
2000	107.91	105.37	2.41%	5927.22	5787.91	2.41%
2001	101.58	96.41	5.36%	5579.49	5295.58	5.36%
2002	92.30	87.87	5.04%	5069.66	4826.59	5.04%
2003	96.71	92.10	5.01%	5312.19	5058.64	5.01%
2004	94.02	89.95	4.53%	5164.48	4941.27	4.52%
2005	106.16	102.54	3.53%	5831.02	5633.86	3.50%

Year	Energy consumption, PJ		Difference	CO_2 Emissions, Gg		Difference
	Reference approach	Sectoral approach		Reference approach	Sectoral approach	
2006	112.78	108.07	4.35%	6194.72	5938.57	4.31%
2007	116.75	110.25	5.90%	6410.69	6055.45	5.87%
2008	112.36	106.77	5.23%	6168.43	5864.39	5.18%
2009	85.31	82.68	3.18%	4688.67	4546.99	3.12%
2010	89.43	86.70	3.15%	4915.34	4768.75	3.07%
2011	100.60	97.70	2.97%	5531.56	5375.38	2.91%
2012	95.79	93.36	2.61%	5261.03	5130.46	2.54%

3.3.1.3 Explanation of differences

A comparison between the Reference Approach (RA) and the Sectoral Approach (RA) indicates a difference of 2.61% in terms of energy consumption and 2.81% in terms of CO_2 emissions for 2012.

One of the potential reasons for the difference in the emissions is the fact that the Reference Approach accounts part of the non-energy used fuels as oxidised. While this is generally true in the long term, the resulting emissions are excluded from the Sectoral approach and instead reported mostly in the IP sector. This could lead to a consistent difference between the two approaches, especially for gaseous fuels, where the default fraction of carbon stored from natural gas used as feedstock is rather low. Following a recommendation from the 2012 ARR, were revised the default assumptions about the fractions of carbon stored, which resulted in lower differences between the sectoral and the reference approach, compared to previous estimates. In addition, following ERT recommendations, the previously reported apparent consumption of fuels was corrected to exclude the non-energy use of fuels, which significantly reduced the difference between the reference and the sectoral approaches.

Additional reasons for differences between the two approaches are the significant statistical differences and losses reported for some of the years in the national energy balances. The highest differences are observed in the period 1993-1996, and most notably 1995. The analysis showed that the main reason for this are the differences in liquid fuels consumption resulting from the significant amounts of refinery loses reported (9.5% of total refinery intake in 1995 was reported as refinery losses, with an average of 3.9% for the period 1990-2012).

A special case for solid fuels used in blast furnaces in the Iron & Steel subcategory is an additional reason for differences between RA and SA for the period before 2008. In order to remove double counting between Energy and Industrial Processes categories (2C Metal production), part of the solid fuels reported in the Energy balance are not accounted in the Sectoral approach (details regarding exact fuel allocation are given in Annex II). This is the reason why after the closure of the biggest I&S plant in Bulgaria in 2008, the difference for solid fuels became much lower.

For liquid fuels (diesel fuel) there is an additional reason for difference, resulting from the blending of biodiesel. While in the sectoral approach the CO_2 emissions from the biodiesel component in the diesel fuel are accounted under biomass, in the reference approach all diesel fuel consumption is accounted as fossil.

On the other hand, the use of alternative fuels, which is accounted in the sectoral approach, is not accounted in the reference.

3.3.1.4 Quantification of differences

For 2012 the difference due to statistical differences and distribution losses for gaseous fuels is equal to 1207 TJ, which 1.1% if the total consumption of gaseous fuels. In terms of emissions this would be equivalent to 59.7 Gg CO_2. For liquid fuels, in 2012 the refinery losses are 3.2% of the refinery intake, which is equal to 8040 TJ or 583.7 Gg CO_2. The use of alternative fuels, which are accounted in the sectoral approach, is equal to 470 TJ or 40.1 Gg CO_2.

If all those quantified differences are accounted, the remaining difference between the reference and the sectoral approaches is equal to 0.92% in terms of energy consumption and 1.47% in terms of emissions.

3.3.2 INTERNATIONAL BUNKER FUELS

The International Bunkers represent the fuels and the emissions resulting from international air and marine transport of passengers and cargo. These GHG emissions are also a subject of the inventory and they are reported, but they are not included in the total sum of the emissions of the country. The Energy balance provides a split between the domestic and international fuel consumption.

Table 20 GHG Emissions from International bunker fuels

Year	Total [Gg CO_2e]	Aviation [Gg CO_2e]	Marine [Gg CO_2e]
1988	1 668.28	588.50	1 079.78
1989	1 555.18	441.37	1 113.80
1990	965.52	719.57	245.95
1991	1 633.91	471.79	1 162.12
1992	1 917.03	847.27	1 069.76
1993	2 176.02	1 135.76	1 040.26
1994	1 972.55	920.95	1 051.60
1995	1 997.56	914.29	1 083.27
1996	1 541.27	600.06	941.21
1997	472.03	443.53	28.50
1998	614.96	393.28	221.68
1999	239.59	213.26	26.34
2000	447.85	245.17	202.68
2001	621.76	316.74	305.02
2002	711.67	379.15	332.52
2003	918.78	484.92	433.86
2004	831.74	467.55	364.19
2005	921.86	573.50	348.36
2006	881.08	548.82	332.26
2007	718.87	554.20	164.68
2008	1 046.77	644.38	402.39
2009	1 176.58	463.94	712.64
2010	867.00	510.57	356.44
2011	786.60	516.87	269.73
2012	719.60	497.89	221.71

3.3.3 FEEDSTOCKS AND NON-ENERGY USE OF FUELS

Non-energy use of fuels is reported in the Energy balance for the following fuels:

- Lubricants
- Bitumen
- Naphtha
- Natural Gas as Feedstock
- Other Products
- Paraffin waxes
- White spirit
- Residual Fuel Oil
- Petroleum Coke
- Anthracite
- Coke Oven/Gas Coke

There are some fluctuations of the reported consumption of some of the fuels during the time series due to unstable trends in the exports, imports or production. The non-energy use of fuels is on average 5.89% of the total apparent energy consumption during the period 1988-2012 and 3.35% for 2012. The apparent consumption is calculated according to Table 1-1 p. 1.12 from the 1996 IPCC Guidelines.

Table 21 Non-energy use of fuels compared to total apparent energy consumption

Year	Non-energy use, PJ	Apparent energy consumption incl. non-energy use, PJ	%
1988	61.64	1104.66	5.58%
1989	60.46	1081.70	5.59%
1990	62.68	984.57	6.37%
1991	52.47	756.71	6.93%
1992	47.93	706.75	6.78%
1993	49.86	752.77	6.62%
1994	47.60	711.74	6.69%
1995	56.35	761.93	7.40%
1996	60.51	745.34	8.12%
1997	54.07	669.95	8.07%
1998	46.88	643.62	7.28%
1999	36.98	573.52	6.45%
2000	42.17	563.54	7.48%
2001	41.21	592.86	6.95%
2002	24.54	557.01	4.41%
2003	29.66	599.84	4.95%
2004	30.86	582.81	5.29%
2005	33.78	608.21	5.55%
2006	32.60	622.60	5.24%
2007	33.12	651.27	5.08%
2008	39.62	630.02	6.29%
2009	22.86	533.12	4.29%
2010	16.47	544.86	3.02%
2011	20.27	601.64	3.37%
2012	18.56	553.33	3.35%

The most significant fuels used as feedstock are bitumen and natural gas. The use of naphtha has been discontinued since 2010.

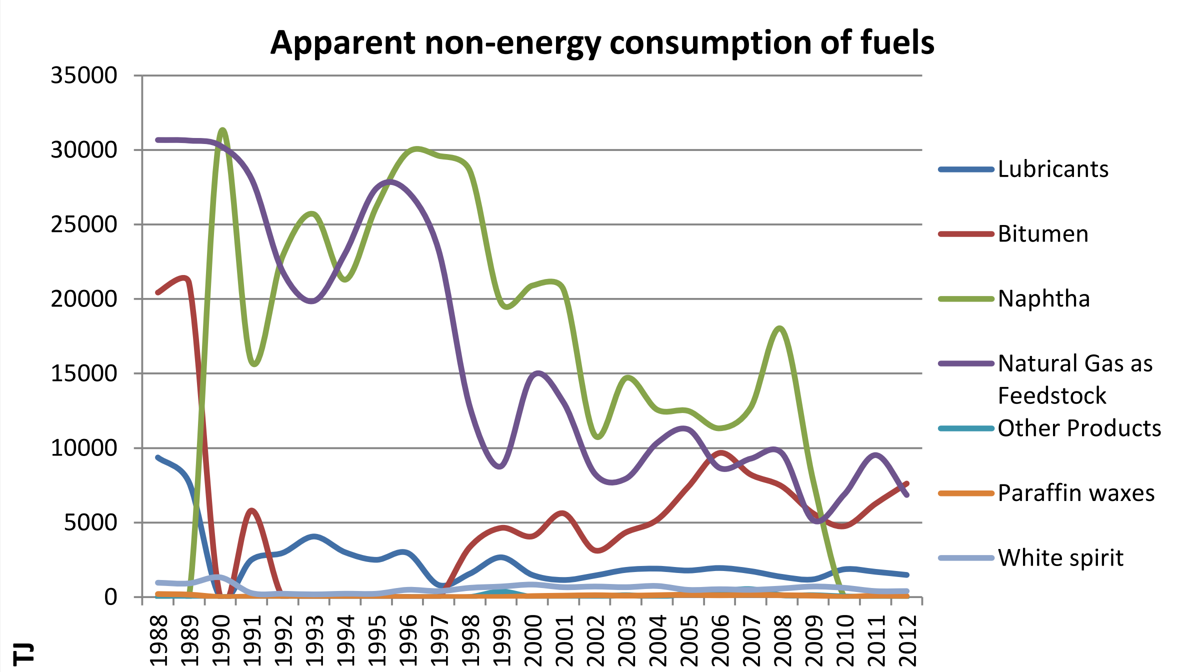


Figure 4 Apparent non-energy consumption of fuels

In general, most of the non-energy use of fuels is attributed to the industrial sector (lubricants, paraffin waxes), petrochemical industry (natural gas, naphtha, white spirit and other petroleum products) and construction (bitumen). All sources of emissions due to non-energy use of fuels (natural gas) are reported under category 2B Chemical Industry. The quantities of waste oils, which are used with energy recovery in the non-metallic minerals plants, are reported as other fuels under category 1.A.2.f Other industries.

Table 22 Apparent consumption of non-energy fuels

TJ	Lubricants	Bitumen	Naphtha	Natural Gas as Feedstock	Other Products	Paraffin waxes	White spirit	Residual Fuel Oil	Petroleum Coke	Anthracite	Coke Oven/Gas Coke
1988	9366	20436	NO	30674	NO	200	959	NO	NO	NO	NO
1989	7686	21060	NO	30636	NO	160	916	NO	NO	NO	NO
1990	NO	NO	31064	30294	NO	NO	1320	NO	NO	NO	NO
1991	2496	5806	15796	28077	NO	30	264	NO	NO	NO	NO
1992	2961	NO	22880	21843	NO	30	220	NO	NO	NO	NO
1993	4061	NO	25696	19868	NO	60	176	NO	NO	NO	NO
1994	3003	NO	21296	23054	NO	30	220	NO	NO	NO	NO
1995	2496	NO	26180	27421	NO	30	220	NO	NO	NO	NO
1996	2961	NO	29832	27230	NO	NO	484	NO	NO	NO	NO
1997	804	NO	29612	23262	NO	NO	396	NO	NO	NO	NO
1998	1565	3355	28600	12749	NO	NO	616	NO	NO	NO	NO
1999	2665	4637	19756	8773	364	NO	704	80	NO	NO	NO
2000	1481	4072	20900	14824	NO	60	836	NO	NO	NO	NO
2001	1142	5617	20636	13062	NO	90	660	NO	NO	NO	NO
2002	1438	3129	10868	8285	NO	120	704	NO	NO	NO	NO
2003	1819	4336	14696	7943	121	90	660	NO	NO	NO	NO

TJ	Lubricants	Bitumen	Naphtha	Natural Gas as Feedstock	Other Products	Paraffin waxes	White spirit	Residual Fuel Oil	Petroleum Coke	Anthracite	Coke Oven/Gas Coke
2004	1904	5177	12574	10341	NO	120	740	NO	NO	NO	NO
2005	1777	7402	12488	11245	243	150	479	NO	NO	NO	NO
2006	1946	9667	11321	8664	364	120	523	NO	NO	NO	NO
2007	1734	8219	12716	9287	526	150	484	NO	NO	NO	NO
2008	1354	7427	17952	9654	121	120	572	NO	NO	364	2052
2009	1184	5617	7832	5156	121	90	704	NO	31	328	1796
2010	1861	4750	NO	6885	40	NO	616	NO	NO	298	2024
2011	1692	6258	NO	9526	NO	90	396	NO	31	365	1910
2012	1481	7615	NO	6847	NO	60	396	NO	NO	340	1824

3.3.4 CO_2 CAPTURE FROM FLUE GASES AND SUBSEQUENT CO_2 STORAGE

CO_2 capture from flue gases and CO_2 storage is not occurring in Bulgaria.

3.3.5 COUNTRY-SPECIFIC ISSUES

Because of the country specific issues regarding the National statistics, two sources of information were used depending on the period. The Eurostat energy balances prepared by the National Statistics Institute were the most relevant source of information and they were used for estimating the emissions for the years 1990-2012. The National statistics have not prepared official balances in the Eurostat format for the years before 1990, so the IEA Energy balances were used for the years 1988 and 1989.

For 1988 and 1989 the fuel allocation by category is different and significant quantities are allocated to sector 'Other'.

3.3.6 KEY CATEGORIES

The methodology and results of the key category analysis is presented in Annex I. Table 23 presents the key source categories of 1 A Fuel Combustion Activities.

Table 23 Key subcategories in sector 1.A. Fuel combustion

IPCC Category	Source Categories	Key Category	
		GHG	KCA
1A1a – Liquid Fuels	Public Electricity and Heat Production	CO_2	LA, TA
1A1a – Solid Fuels	Public Electricity and Heat Production	CO_2	LA, TA
1A1a – Gaseous Fuels	Public Electricity and Heat Production	CO_2	LA, TA
1A1b – Liquid Fuels	Petroleum Refining	CO_2	LA
1A2a – Solid Fuels	Iron and Steel	CO_2	TA
1A2c – Solid Fuels	Chemicals	CO_2	LA
1A2c – Gaseous Fuels	Chemicals	CO_2	LA
1A2d – Liquid Fuels	Pulp, Paper and Print	CO_2	TA
1A2e – Liquid Fuels	Food Processing, Beverages and Tobacco	CO_2	TA
1A2e – Gaseous Fuels	Food Processing, Beverages and Tobacco	CO_2	LA

IPCC Category	Source Categories	Key Category	
		GHG	KCA
1A2f – Liquid Fuels	Other	CO_2	LA, TA
1A2f – Solid Fuels	Other	CO_2	LA, TA
1A2f – Gaseous Fuels	Other	CO_2	LA
1A3b – Liquid Fuels	Road Transportation	CO_2	LA, TA
1A3e – Gaseous Fuels	Other Transportation	CO_2	LA
1A4b – Liquid Fuels	Residential	CO_2	TA
1A4b – Solid Fuels	Residential	CO_2	LA, TA
1A4c – Liquid Fuels	Agriculture/Forestry/Fisheries	CO_2	LA, TA

*LA88 = Level Assessment 1988; LA12 = Level Assessment 2012; TA = Trend Assessment 1988–2012

3.3.7 COMPLETENESS

All occurring sources of emissions from 1.A Fuel combustion are estimated for solid, liquid, gaseous fuels, biomass and other fuels (industrial waste). All emissions from CO_2, CH_4 and N_2O were accounted.

3.3.8 METHODOLOGICAL ISSUES

3.3.8.1 Choice of Method

Tier 1 Methodology

The IPCC Tier 1 approach (Revised 1996 IPCC Guidelines) is used to calculate the emissions from fuel combustion in the sectors CRF 1.A.1, CRF 1.A.2., CRF 1.A.4 and CRF 1.A.5. The formula used in the calculations is the following:

CH_4 and N_2O:

$$E = F * EF_{(default)}$$

where *F = fuel consumption*

EF(fuel) = default (IPCC)

Tier 2 Methodology

The IPCC Tier 2 approach (Revised 1996 IPCC Guidelines) is used to calculate the emissions from fuel combustion in the sectors CRF 1.A.1, CRF 1.A.2., CRF 1.A.4 and CRF 1.A.5. The formula used in the calculations is the following:

CO_2:

$$E = F * EF_{(CS/default)}$$

where *F = fuel consumption*

EF(fuel) = CS (country specific)

EF(fuel) = default (IPCC)

3.3.8.2 Choice of Emission factor

3.3.8.2.1 Choice of emission factors for stationary sources

The default carbon emission factors according to the IPCC 1996 Guidelines, Vol. II, Ch. 1, Table 1-2, p.1.6 were used. The emission factors for CO_2 were calculated based on the default carbon content listed in Table 25 and default oxidation factors listed in Table 24 with the following equation:

EF for CO_2:

$$EF = \frac{C * 44 * O_x}{12},$$

where: *C – carbon content in t/TJ*

O_x - oxidation factor

Table 24 Oxidation factors

Oxidation factors	
Coal	0.98
Oil and Oil Products	0.99
Gas	0.995
Peat for electricity generation	0.99

The fraction of carbon oxidized is referenced in the IPCC 1996 Guidelines, Vol. II, Ch. 1, Table 1-4. The carbon emission factors are referenced in the IPCC 1996 Guidelines, Vol. II, Ch. 1, Table 1-2.

Table 25 Default Emission factors for CO_2 for different fuels

Fuel	Carbon content [t/TJ]	EF CO_2 [t/TJ] (excl. oxidation factor)	EF CO_2 [t/TJ] (incl. oxidation factor)
LIQUID FOSSIL			
Primary fuels			
Crude oil	20.0	73.3333	72.6000
Orimulsion	22.0	80.6667	79.8600
Natural Gas Liquids	17.2	63.0667	62.4360
Secondary fuels/products			
Gasoline	18.9	69.3000	68.6070
Jet Kerosene	19.5	71.5000	70.7850
Other Kerosene	19.6	71.8667	71.1480
Shale Oil	20.0	73.3333	72.6000
Gas/Diesel Oil	20.2	74.0667	73.3260
Residual Fuel Oil	21.1	77.3667	76.5930
LPG	17.2	63.0667	62.4360
Ethane	16.8	61.6000	60.9840
Naphtha	20.0	73.3333	72.6000
Bitumen	22.0	80.6667	79.8600
Lubricants	20.0	73.3333	72.6000
Petroleum Coke*	27.5	100.8333	99.8250
Refinery Feedstocks	20.0	73.3333	72.6000
Refinery Gas	18.2	66.7333	66.0660
Other Oil	20.0	73.3333	72.6000
SOLID FOSSIL			
Primary Fuels			
Anthracite*	26.8	98.2667	96.3013

Fuel	Carbon content [t/TJ]	EF CO_2 [t/TJ] (excl. oxidation factor)	EF CO_2 [t/TJ] (incl. oxidation factor)
Coking Coal	25.8	94.6000	92.7080
Other Bituminous Coal*	25.8	94.6000	92.7080
Sub-bituminous Coal	26.2	96.0667	94.1453
Lignite*	27.6	101.2000	99.1760
Oil Shale	29.1	106.7000	104.5660
Peat	28.9	105.9667	104.9070
Secondary Fuels/Products			
BKB & Patent Fuel	25.8	94.6000	92.7080
Coke Oven / Gas Coke	29.5	108.1667	106.0033
Coke Oven Gas	13.0	47.6667	47.4283
Blast Furnace Gas	66.0	242.0000	240.7900
GASEOUS FOSSIL			
Natural Gas (Dry)*	15.3	56.1000	55.8195
BIOMASS			
Solid Biomass	29.9	109.6333	107.4407
Liquid Biomass	20.0	73.3333	72.6000
Gas Biomass	30.6	112.2000	111.6390

The above default EFs were used for the calculations, except for the following fuels, for which country-specific EFs were derived:

- Anthracite
- Other bituminous coal (Black coal)
- Lignite
- Petroleum coke
- Natural gas
- The country-specific emission factors are listed in Table 27 and Table 28.

3.3.8.2.2 Country specific emission factors for CO_2 for solid fuels

Emission data reported under the European Emission Trading Scheme

A total of 161 operators have provided their verified CO_2 emission reports required under the EU ETS for the years 2007-2012. These emissions have been incorporated in the inventory to the extent possible (see respective subchapters for more information). Furthermore the background data for the emission calculations under the EU ETS were used for further QA/QC checks.

Data from the verified ETS reports was analysed in order to use a Tier 2 methodology for emission calculations. From all the operators, in 2012 only the largest 22 plants use plant specific methodologies, so it was possible to derive country specific EFs for the major solid fuels only. These country-specific emission factors are derived from the verified ETS reports as a weighted average from all operators, which have declared that they have used plant-specific emission factors (Tiers 2b or 3 according to the Methodology for monitoring GHG emissions of operators participating in the ETS). The EFs are calculated as the total sum of the verified CO_2 emissions divided by the total amount of the respective fuel as reported by the operators. For the years 2007 to 2012 are applied the respective annual emission factors and for the years 1988 to 2006 is applied an EF calculated as a weighted average.

The following country-specific carbon contents were calculated:

Table 26 Country-specific carbon content for solid fuels [t/TJ]

Fuel	1988-2006	2007	2008	2009	2010	2011	2012
Anthracite	27.4064	27.1402	28.0454	27.7332	27.1044	26.8847	**26.8010**
Lignite	29.4642	29.2070	29.7465	29.3712	29.4522	29.2734	**29.3215**
Other Bituminous Coal	26.6301	27.3644	26.7991	26.4847	26.0058	26.4590	**26.8396**
Petroleum Coke	26.3032	26.6389	26.4331	25.9058	26.1723	25.7028	**26.0246**

The following emission factors excluding oxidation factor were calculated:

Table 27 Country-specific EFs excl. oxidation factor for CO_2 for solid fuels [t/TJ]

Fuel	1988-2006	2007	2008	2009	2010	2011	2012
Anthracite	100.4900	99.5139	102.8330	101.6884	99.3830	98.5772	**98.2703**
Lignite	108.0354	107.0924	109.0704	107.6943	107.9913	107.3358	**107.5120**
Other Bituminous Coal	97.6439	100.3361	98.2634	97.1105	95.3546	97.0163	**98.4117**
Petroleum Coke	96.4450	97.6760	96.9214	94.9878	95.9651	94.2435	**95.4235**

The following country-specific emission factors including oxidation factor were used for the calculations of the emissions for all years and subcategories in CRF 1.A except CRF 1.A.3.

Table 28 Country-specific EFs incl. oxidation factor for CO_2 for solid fuels [t/TJ]

Fuel	1988-2006	2007	2008	2009	2010	2011	2012
Anthracite	98.4802	97.5236	100.7763	99.6547	97.3953	96.6057	**96.3049**
Lignite	105.8747	104.9506	106.8890	105.5404	105.8315	105.1891	**105.3618**
Other Bituminous Coal	95.6910	98.3294	96.2981	95.1683	93.4475	95.0759	**96.4435**
Petroleum Coke	94.5161	95.7225	94.9830	93.0881	94.0458	92.3586	**93.5150**

3.3.8.2.3 Country specific emission factors for CO_2 for gaseous fuels

As CO_2 emissions from natural gas are a key category in several subcategories and following the previous ARR (CC/ERT/ARR/2010/37, §82) recommendations, a new calculation for a country-specific emission factor for natural gas was performed. Additional data from the relevant companies was collected:

- "Bulgargaz" EAD, the sole public supplier of natural gas for the territory of the Republic of Bulgaria for the period 2007-2012
- "Melrose Resources" OOD and "Oil and Gas Exploration and Production" AD - the companies licensed for oil and gas extraction for the period 2004-2012 and 1999-2012

The companies provided the following parameters of the natural gas they supply or extract for the previous years:

- the percentages of methane, ethane, propane, i-butane, n-butane, i-pentane, n-pentane, neo-pentane, i-hexane, N_2 and CO_2 as molar percentage;
- density, NCV/GCV and quantities supplied or extracted at a temperature of 20°C (293.15 K) and an absolute pressure of 101.325 kPa (760 mm Hg)
- Using stoichiometric calculations and the above data it was possible to calculate a country specific emission factor for natural gas for each year and as a weighted average for the period 2007-2010.

The calculation showed that the average country-specific emission factor for natural gas is about 1.6% lower than the default emission factor, which was previously used.

Table 29 Country-specific carbon contents and EFs for CO_2 for gaseous fuels [t/TJ]

	1988-2006	2007	2008	2009	2010	2011	2012
Carbon content	15.0557	15.0501	15.0479	15.0647	15.0658	15.0717	**15.0542**
EF excl. oxidation factor	55.2044	55.1839	55.1758	55.2371	55.2413	55.2628	**55.1987**
EF incl. oxidation factor	54.9284	54.9079	54.8999	54.9609	54.9650	54.9865	**54.9227**

Since all gas companies report and account the quantities of natural gas at a temperature of 20°C (293.15 K) and an absolute pressure of 101.325 kPa, all calculations were performed considering those conditions. Since 2012 the National Statistics started to report to Eurostat the used quantities of natural gas in cubic meters at a temperature of 15°C, according to their requirements. In order to convert the values is used a conversion factor of 1.017 (e.g. $Q_{15} = Q_{20} / 1.017$ and $NCV_{15} = NCV_{20} * 1.017$).

For CH_4 are applied the default emission factors referenced in IPCC 1996 Reference Manual, Ch.1, Table 1-7, p. 1.35. For sludge gas and black liquor are used the new emission factors referenced in IPCC 2006 guidelines, Vol. II, Ch. 2, Table 2-2, Table 2-3, Table 2-4, Table 2-5, since emission factors for sludge gas and black liquor are not available in the 1996 Guidelines.

Table 30 Emission factors for CH_4 for different fuels

	CH_4 [kg/TJ]	Coal	Natural Gas	Oil	Wood/Wood Waste	Charcoal	Other Biomass and Wastes	Sludge gas	Black liquor
1.A.1	Energy Industries	1	1	3	30	200	30	1	3
1.A.2	Manufacturing Industries and Construction	10	5	2	30	200	30	1	3
1.A.4.a	Commercial/Institutional	10	5	10	300	200	300	5	3
1.A.4.b	Residential	300	5	10	300	200	300	5	3
1.A.4.c	Agriculture/Forestry/Fishing	300	5	10	300	200	300	5	3

For N_2O are applied the default emission factors referenced in IPCC 1996 Reference Manual, Ch.1, Table 1-8, p. 1.36. For sludge gas and black liquor are used the new emission factors referenced in IPCC 2006 guidelines, Vol. II, Ch. 2, Table 2-2, Table 2-3, Table 2-4, Table 2-5.

Table 31 Emission factors for N_2O for different fuels

	N_2O [kg/TJ]	Coal	Natural Gas	Oil	Wood/Wood Waste	Charcoal	Other Biomass and Wastes	Sludge gas	Black liquor
1.A.1	Energy Industries	1.4	0.1	0.6	4	4	4	0.1	2
1.A.2	Manufacturing Industries and Construction	1.4	0.1	0.6	4	4	4	0.1	2
1.A.4.a	Commercial/Institutional	1.4	0.1	0.6	4	1	4	0.1	2
1.A.4.b	Residential	1.4	0.1	0.6	4	1	4	0.1	2
1.A.4.c	Agriculture/Forestry/Fishing	1.4	0.1	0.6	4	1	4	0.1	2

3.3.8.2.4 Choice of emission factors for mobile sources

The emission factors for mobile sources are presented in Chapter 3.3.12.3.5.

3.3.8.3 Choice of activity data for stationary sources

The activity data required for calculation of the emissions from stationary combustion is based on the National Energy Balances, which provide information about the indigenous production, imports, exports and inland consumption by subcategory of all types of fuels.

The balances provide the consumption of fuels in natural units (mass or volume units – thousands of tons/Gg for solid and liquid fuels, cubic meters for gaseous fuels) and the net calorific values for each fuel per subcategory.

Following the recommendations, the energy balances prepared by the National Statistics Institute in the Eurostat format were used for estimating the emissions for the years 1990-2012. The National statistics have not prepared balances in the Eurostat format for the years before 1990, so the IEA Energy balances were used for the years 1988 and 1989.

Additionally, since it was found that the use of alternative fuels (industrial waste) is not reported in the energy balances for the full time series, the reports provided by the plant operators according to the Bulgarian waste legislation and the ETS reports were used, in order to calculate the GHG from waste incineration in the cement plants.

According to the sectoral approach methodology for stationary combustion, only the fuel quantities that are combusted are relevant and thus considered for the emission calculations. Reported quantities of fuels for non-energy use and feedstock use, international bunker fuels, transformation and distribution losses, transformations of fuels to other fuels and internal refinery processes which have been reported in the transformation sector of the energy balances were not considered.

The correspondence between the energy balance categories and CRF categories can be reviewed in detail in Annex II.

The national energy balance is provided by NSI. The energy balance presents also the net calorific values (NCVs) used for converting mass or volume units of the fuel quantities into energy units [TJ].

3.3.8.3.1 Choice of NCV

The corresponding Net Calorific Values (NCVs) from the Energy balances were used in order to convert the fuel consumption reported in natural units to energy units.

For solid fuels the balances provide NCVs for the following activities.

- NCV for produced fuels - applied to Indigenous Production subcategory
- NCV for imported fuels - applied to Total Imports subcategory
- NCV for exported fuels - applied to Total Exports subcategory
- NCV for fuels used in coke ovens - applied to Coke Ovens (Energy) subcategory
- NCV for fuels used in blast furnaces - applied to Blast Furnaces (Energy) subcategory
- NCV for fuels used in main activity plants - applied to:
    - Main Activity Producer Electricity Plants
    - Main Activity Producer CHP Plants
    - Main Activity Producer Heat Plants
    - Own Use in Electricity, CHP and Heat Plants
- NCV for fuels used in industry - applied to:
    - Autoproducer Electricity Plants

- Autoproducer CHP Plants
- Autoproducer Heat Plants
- Iron and Steel
- Chemical (including Petrochemical)
- Non-Ferrous Metals
- Non-Metallic Minerals
- Transport Equipment
- Machinery
- Mining and Quarrying
- Food, Beverages and Tobacco
- Paper, Pulp and Printing
- Wood and Wood Products
- Construction
- Textiles and Leather
- Non-specified (Industry)

- NCV for fuels used for other uses - applied to:
    - Commercial and Public Services
    - Residential
    - Agriculture/Forestry
    - Fishing
    - Non-specified (Other)

For the reference approach for solid fuels was calculated the weighted average NCV from the NCVs of production, imports and exports. The detailed NCVs used for the reference approach can be found in Annex III.

For liquid fuels the balances provide average NCVs, which were used in all calculations.

For gaseous fuels was used directly the amount in TJ as reported by the energy balances. Since the reported values are Gross Calorific Values, all numbers were multiplied by 90% in order to compute the NCV. (Revised 1996 IPCC GL: Reference manual, Ch. 1, p. 1.24, Table 1-4; IEA Energy Statistics Manual, p. 183, Table A3.12)

Table 32 Selected Net Calorific Values for 2012

Fuel	Public electricity and heat production [TJ/Gg]	Industry [TJ/Gg]
Liquid fuels		
Crude oil	42.538	
Gasoline	44.000	
Jet Kerosene	43.000	
Gas/Diesel Oil	42.300	
Residual Fuel Oil	40.000	
LPG	46.000	
Naphtha	44.000	
Bitumen	37.700	
Lubricants	42.300	
Petroleum Coke	31.400	
Refinery Feedstocks	42.500	
Refinery Gas	50.000	
White Spirit SBP	44.000	
Paraffin Wax	30.000	
Other Petroleum Products	40.447	
Solid fuels		

Anthracite	25.053	27.850
Coking Coal	-	-
Other Bituminous Coal	25.762	25.900
Lignite and Sub-bituminous Coal	6.894	18.238
BKB & Patent Fuel	11.589	16.822
Coke Oven / Gas Coke	-	28.500
Gaseous fuels		
Natural Gas, 20°C [TJ/1000 m3]	0.033738	
Natural Gas, 15°C [TJ/1000 m3]	0.034312	

For all NCVs please consult Annex III.

3.3.8.4 Biomass

A wide range of biomass sources can be used to produce bioenergy in a variety of forms. In Bulgaria all types of biomass, solid, liquid and gaseous, are consumed in the energy sector. Solid biofuels comprises the following:

- wood and wood waste combusted directly for energy purposes and biomass used for charcoal production
- black liquor - a concentrated residual from the pulp and paper industry
- other primary solid biomass - plant residues not included in the above mentioned black liquor and wood and wood waste
- charcoal - a product from destructive distillation and pyrolysis of wood and other vegetal material
- Liquid biofuels as biogasoline, biodiesel and other bioliquids are used mainly for transportation. This is further explained in the transport sector.

Landfill, sludge and other biogas are derived from anaerobic fermentation of biomass and solid wastes in landfills, from sludge and animal slurries and other sources, respectively. In addition, there is a biomass fraction from the municipal wastes. All these types are combusted to produce heat and/or power. However, CO_2 emissions released from these processes are reported as an information item, as the CO_2 is naturally captured from the air. That is not applicable for the methane and N_2O emissions that are reported and accounted for in the total inventory emissions.

3.3.8.5 Uncertainties in CRF 1.A

<u>**STATIONARY COMBUSTION**</u>

3.3.8.5.1 Uncertainty of AD

Solid fuels

About 92% of solid fuels consumption comes from national lignite production, another 8% of solid fuels (anthracite and bituminous coal) are imported predominantly from Russia and Ukraine. Except for electricity production, solid fuels are used in the chemical industry, as well as in the non-metallic minerals and iron and steel industry. The Eurostat format energy balances, which are prepared by NSI, are based on bottom-up and top-down approach.

There isn't always a consistent allocation between 'Transformation sector', 'Energy sector' and 'Total Final Consumption', and also between the subcategories for the early years, consumption tends to be allocated to the 'Other' categories (1.A.2.f and 1.A.5). Further reasons for uncertainties are the different coal qualities (ash, moisture, sulphur, and calorific value) even from the same mines. Finally coal is quantified on a mass basis and therefore conversion factors which are associated can cause uncertainties. Solid fuels which are used in the plants, which are participating in the ETS, have a considerably lower uncertainty compared to solid fuels which are used in any kind of small combustion plants.

Based on the above background information, the uncertainties are estimated as following:

- For CRF categories 1.A.1 and 1.A.2: 1%
- For CRF category 1.A.4 and 1.A.5: 2%

Natural gas

The supply, transmission and storage of natural gas are licensed to 'Bulgargaz' and 'Bulgartransgaz' according to the energy act. The gas transmission network consists of gas pipelines with high-pressure branches (1700 km), three compressor stations (total capacity of 49 MW), 68 gas pressure-reduction stations and 8 gas measuring stations. The gas transmission network for natural gas transit is not connected to the national gas transmission network. Furthermore, underground gas storage and a related compressor stations exist. Losses are mainly due to leakages, maintenance, old pipes, and varying pressure. Whereas the uncertainty of natural gas supplied to the industry can be assed as low, the uncertainty for natural gas consumed by households is higher due to the large number of licensed providers and network complexity. Further reason for uncertainty is related to GCV and conversion factor m^3 to TJ.

Based on the above background information, the uncertainties are estimated as following:

- For CRF categories 1.A.1 and 1.A.2: 1%
- For CRF category 1.A.4 and 1.A.5: 5%

Liquid fuels

In Bulgaria 5 main importers and distributors of petrol oil are operating about 3190 gas stations. Crude oil is more or less exclusively imported from Russia, Ukraine and other former Russian republics. Liquid fuels are either refined in the LUKOIL Neftochim refinery in Burgas or imported. Due to recent regulations the amounts of gasoline and diesel fuel, which are sold at gas stations are monitored in real-time since January 2011, which leads to low uncertainty. Nevertheless, before that period, there were occasional reports for small distributors not declaring the liquid fuels they have sold in order to avoid taxes. For some of the years the allocation of the various liquid fuels to the subcategories is not clear. Therefore a higher uncertainty is estimated for small combustion plants and engines.

Based on the above background information, the uncertainties are estimated as following:

- For CRF categories 1.A.1 and 1.A.2: 3%
- For CRF category 1.A.4 and 1.A.5: 5%

3.3.8.5.2 Uncertainty for EF

Since for some of the fuels were used the default EFs from the 1996 IPCC GL, the data on default uncertainties presented in "Table A1-1 Uncertainties due to emission factors and activity data" (1996 IPCC GL, p. D 1.4) is applicable. For energy sector the uncertainty for emission factor and activity data is 7%.

For the country-specific EFs for solid fuels were used the ETS verified reports, which have much lower uncertainty. Nevertheless, the conditions in which solid fuels are burnt are very different, especially considering the oxidation factors for solid fuels in households could cause higher uncertainty.

Based on the above background information, the uncertainties are estimated as following:

- For solid fuels in CRF categories 1.A.1 and 1.A.2: 2%
- For solid fuels in CRF category 1.A.4 and 1.A.5: 5%
- For liquid fuels: 7%
- For gaseous fuels: 2%

Quantitative uncertainty estimates are provided in Annex VII.

3.3.8.6 Source-specific QA/QC and verification

For the calculation of the emissions from CRF category 1A was developed an Excel based spreadsheet model, which was liked directly to the Eurostat format energy balances provided by the NSI.

Wherever it was possible, automated data validation was implemented within the model, but many manual checks were performed too.

Following a recommendation FCCC/ARR/2011/BGR, §65 was investigated the possibility of obtaining a correlation between the carbon content and the NCV of each fuel reported by the selected facilities that have used higher tier methods under the EU ETS. Recent scientific literature was consulted (Fott, 1999; Mazumdar, 2000; Mesroghli et al., 2009). Due to the fact that the number of samples is relatively low and coal in Bulgaria is both locally produced and imported in a varying proportion, it was found that there is a very low correlation between the NCV and the CO_2 emission factors for all types of coal (Anthracite, Other Bituminous Coal, Sub-Bituminous Coal, Lignite). This is mostly due to the fact that the NCV is also dependent on other parameters like hydrogen, oxygen and sulphur contents, also ash and water contents.

3.3.8.6.1 Activity data checks

Trend analysis was performed regarding the activity data for all subcategories and fuels separately. The most notable data peaks/drops were discussed with the NSI in order to have an explanation of the variations. Since the methodologies used by the National statistics changed several times during the years, there are several sectors with significant differences in fuel consumption throughout the different time periods. These differences are a result of reallocation of the consumption in different subcategories. An attempt to compare the reallocated quantities was made – i.e. if a significant decrease in the consumption is noticed in a subcategory, it was compared if equal amount is noticeable in another subcategory in which the consumption was reallocated in the following years.

Some changes in the activity data were necessary, because NCVs are not provided for some of the years for some fuels (most notably solid fuels for 1990-91 and 1998) by the NSI. All changes on the activity data were discussed with and approved by the data provider.

For some subcategories the activity data regarding the energy consumption and the data for the production were checked for correlation.

Activity data peaks/drops were discussed with industrial processes experts in order to identify sectoral restructuring (closing or opening of plants) or technological changes within specific plants, which result in fuel mix or energy consumption changes.

3.3.8.6.2 Calculations checks

Manual data checks are performed in order to prevent calculation errors:

- Unit conversion checks – activity data units are checked in order to verify that the proper unit conversions are applied.
- Calculation formulas checks – cell formulas are manually checked in order to ensure consistency.

In order to assure integrity of the calculations and to prevent possible errors due to incomplete activity data, the automatic data validation checks were implemented in the Excel model. Each cell with a validation rule is colored red in case there is a logical problem with the calculations:

- Conversion from natural units to energy units – ensure all non-negative values reported in natural units are properly converted to energy units.
- Calculation of the emissions – ensure the corresponding emissions are calculated from all non-zero values in energy units.
- Emission factors validation – ensure chosen emission factors are within the 2006 GL ranges
- The model itself and the calculations were validated by international experts, and by national experts as part of the QA procedures implemented.

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

Following the recommendation from the previous ARR (CC/ERT/ARR/2010/37, §72), a change in the calculation model was introduced. Until 2003, the National statistics provides only aggregated information regarding the consumption of anthracite coal and other bituminous coal – they are reported as other bituminous coal. Since the EF for anthracite coal is about 2% higher than the EF for other bituminous coal, in order to avoid underestimation of the emissions, it was decided to use the EF for anthracite coal to calculate the emissions from other bituminous coal.

Up to the 2011 submission, the country specific emission factors were calculated as a weighted average from the available ETS reports and applied to all the years in the time series, which was leading to an annual recalculation of the full time series. From the 2012 submission on, the country specific emission factors are calculated as a weighted average from all reports for 2007, 2008 2009 and 2010 and applied for the period 1988-2006, while for the years after 2007 is used the respective annual EF. The differences in the country-specific factors can be found in Table 26.

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

Following a recommendation of the previous ARR (CC/ERT/ARR/2010/37, §66), the calculation models were improved, so they could be directly linked to the activity data.

Currently the data from the calculation models is entered manually into CRF reporter. In order to ensure that there are no differences due to technical errors, additional comparisons are made between the data in the calculation models and the CRF tables generated by the CRF Reporter software.

3.3.9 EMISSION TREND

The fuel consumption in the following subcategories is included in this category:

- 1.A.1. Energy Industries
- 1.A.2. Manufacturing Industries and Construction
- 1.A.3. Transport
- 1.A.4. Other Sectors
- 1.A.5. Other

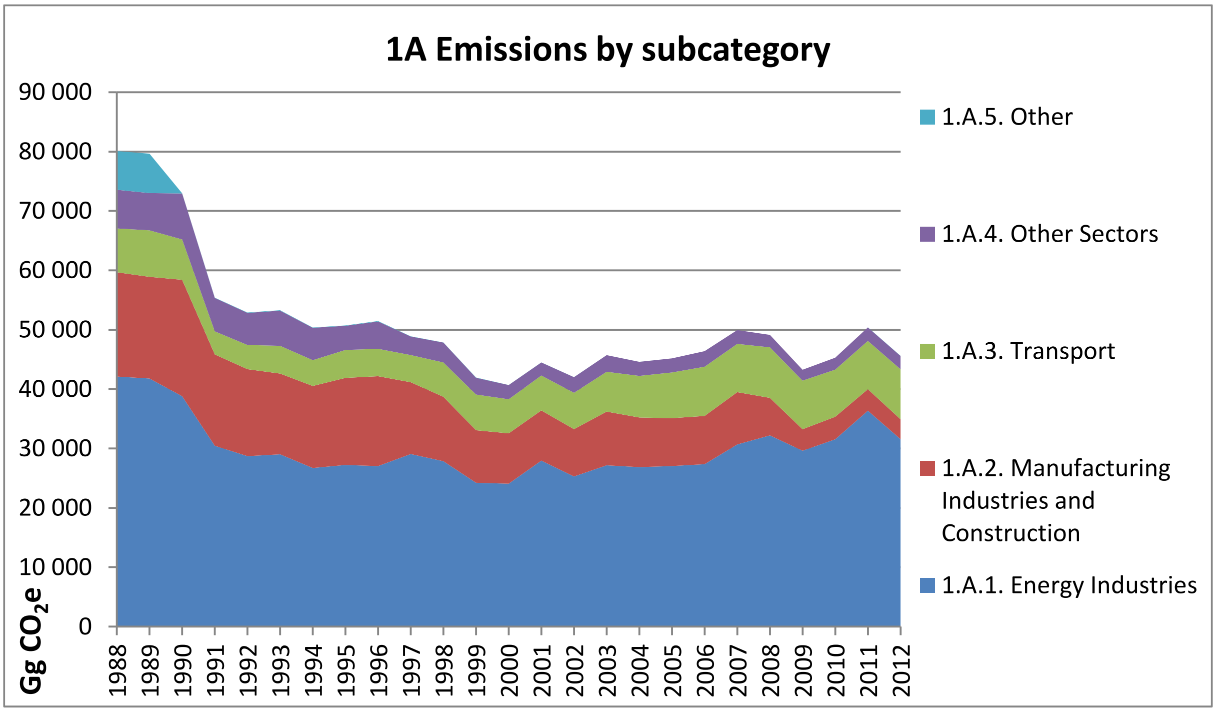


Figure 22 Total GHG emissions from Fuel combustion by subcategory

Energy Industries are the main source of GHG emissions from fuel combustion with 69.3% of the sector emissions for 2012. Transport is the second most important source with 18.5% of the sector emissions, followed by Manufacturing industries and construction with 7.3%.

The general trend shows a notable drop in the country emissions after 1990-1991 due to the transition from planned economy to market economy, which happened in the country. The decrease of the GHG emissions continued up to 1999, followed by a slow increase after 2000, after the national economy started to grow. In the recent years (2008-2009) due to the economic crisis the emissions decreased again, approaching the 2000 levels. In 2010 and 2011 there is an increasing trend of the emissions, which is mostly due to the increase in energy industries of 15.3% in 2011. In 2012 there is a drop in the country emissions mostly due to decrease of fossil fuels used for electricity generation and an increase in renewable energy sources. Compared to 2011, there is a decrease of the emissions from fuel combustion of 9.5% in 2012.

Manufacturing industry and construction is the sector, which changed drastically – compared to 1988 the emissions decreased by 80.9% in 2012. The significant decrease of the emissions after 2008 is mostly due to the restructuring of the Iron and steel industry in Bulgaria. The closure of Bulgaria's biggest I&S plant, which was the only plant in the country operating coke ovens and blast furnaces, decreased significantly the emissions from solid fuels and the emissions from the industry subcategory in general. The trend for solid fuels was reversed in 2011 mostly due to the opening of a new coal power plant and the general increase of electricity production from lignite coal in the country. However, the reduced electricity exports and the increased renewable energy production (solar, wind and biomass) in 2012 led to significant decrease of solid fuels usage and emissions.

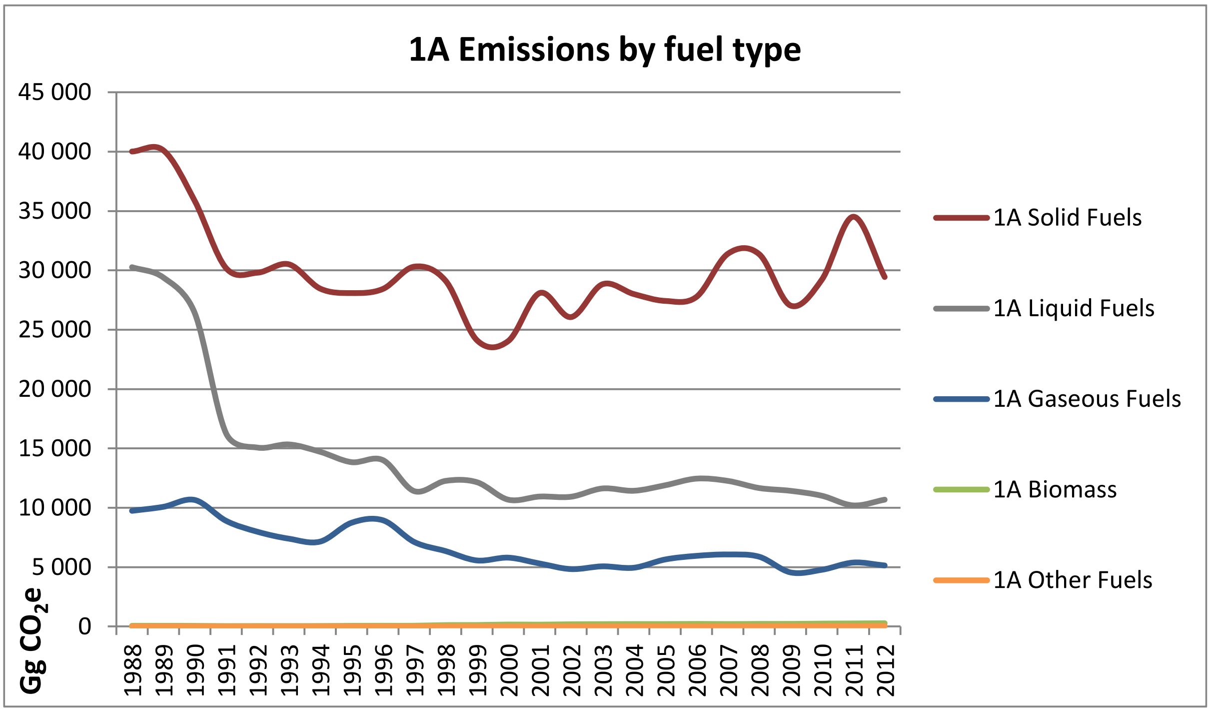


Figure 23 Total GHG emissions from Fuel combustion by fuel type

In 2012, 64.6% of the emissions from fuel combustion were from solid fuels, 23.4% were from liquid fuels, and 11.3% were from gaseous fuels.

The general trend shows an increase in the usage of solid fuels, mostly due to the energy industries growth, decrease in liquid fuels due to the decrease of the industry sector and increase of gaseous fuels due to the on-going gasification of industrial plants, residential sector and transport.

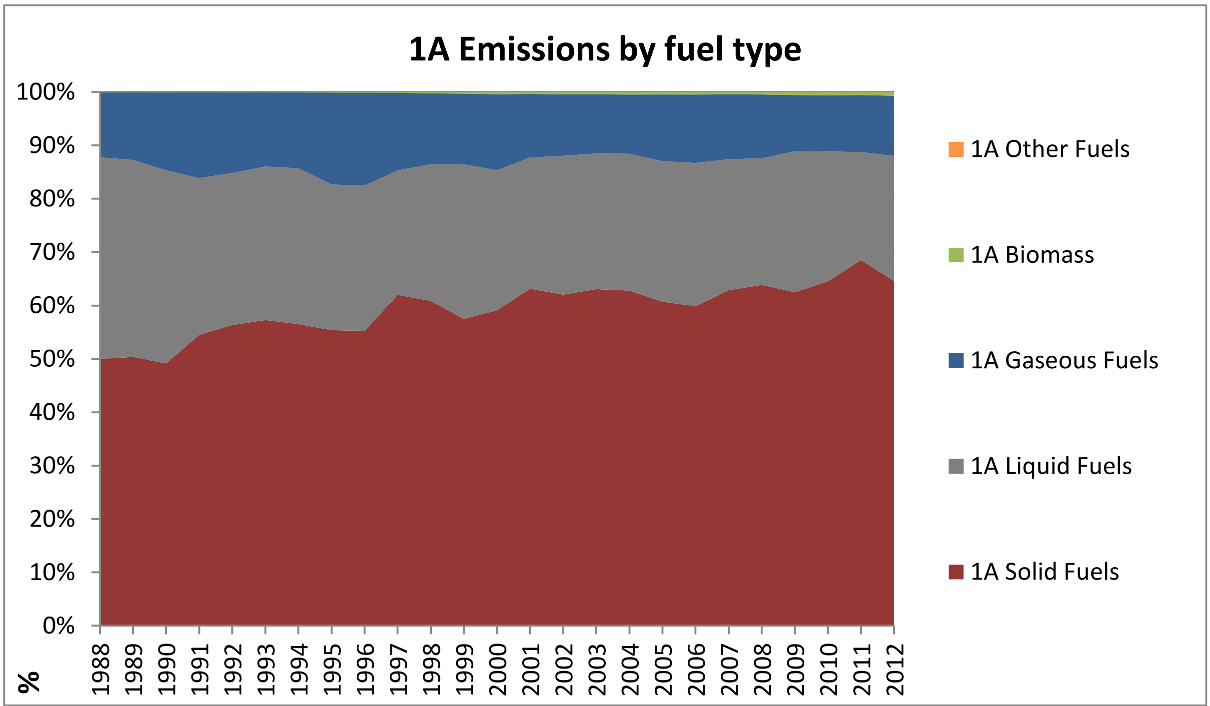


Figure 24 Total GHG emissions from Fuel combustion by fuel type

Table 33 CO_2 emissions in 1.A. Fuel Combustion

CO_2 (Gg)	1.A. Fuel Combustion	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	79 344.99	30 019.14	39 596.16	9 729.69	NO	NA,NO
1989	78 906.94	29 139.33	39 699.92	10 067.68	NO	NA,NO
1990	72 284.18	26 133.78	35 508.01	10 642.38	NO	NA,NO
1991	54 888.82	16 121.04	29 880.51	8 887.27	NO	NA,NO
1992	52 340.35	14 912.22	29 460.95	7 967.18	NO	NA,NO
1993	52 630.73	15 087.10	30 159.49	7 384.14	NO	NA,NO
1994	49 739.00	14 424.81	28 175.31	7 138.89	NO	NA,NO
1995	50 026.53	13 473.15	27 832.36	8 721.02	NO	NA,NO
1996	50 721.00	13 647.13	28 142.06	8 931.82	NO	NA,NO
1997	48 290.30	11 136.14	30 048.69	7 105.47	NO	NA,NO
1998	47 150.39	11 944.05	28 866.34	6 340.01	NO	NA,NO
1999	41 312.21	11 839.01	23 920.20	5 553.00	NO	NA,NO
2000	40 086.68	10 417.60	23 881.16	5 787.91	NO	NA,NO
2001	43 935.13	10 713.68	27 925.87	5 295.58	NO	NA,NO
2002	41 389.84	10 691.95	25 871.30	4 826.59	NO	NA,NO
2003	45 061.13	11 395.17	28 607.33	5 058.64	NO	NA,NO
2004	44 060.69	11 306.68	27 809.28	4 941.27	NO	3.4595
2005	44 644.22	11 765.14	27 242.42	5 633.86	NO	2.8073
2006	45 837.61	12 323.16	27 574.24	5 938.57	NO	1.6434
2007	49 400.65	12 139.23	31 196.25	6 055.45	NO	9.7319
2008	48 582.38	11 539.49	31 170.76	5 864.39	NO	7.7358
2009	42 770.44	11 322.69	26 878.35	4 546.99	NO	22.4192
2010	44 755.51	10 913.47	29 048.18	4 768.75	NO	25.1073
2011	49 811.42	10 105.45	34 304.17	5 375.38	NO	26.4157
2012	45 006.44	10 584.80	29 251.03	5 130.46	NO	40.1433
Decrease 1988-2012	43.3%	64.7%	26.1%	47.3%	-	-

CO_2 (Gg)	1.A. Fuel Combustion	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
Decrease 1990-2012	37.7%	59.5%	17.6%	51.8%	-	-
Decrease 2011-2012	9.6%	-4.7%	14.7%	4.6%	-	-52.0%

Table 34 CH_4 emissions in 1.A. Fuel Combustion

CH_4 (Gg)	1.A. Fuel Combustion	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	19.9206	5.0393	12.0849	0.4141	2.3823	NA,NO
1989	19.8701	5.3501	11.8071	0.4340	2.2788	NA,NO
1990	16.8200	4.6747	9.4714	0.5076	2.1663	NA,NO
1991	13.0710	2.4726	8.7751	0.4583	1.3650	NA,NO
1992	15.1707	2.6371	10.4671	0.4648	1.6017	NA,NO
1993	15.6141	2.8330	10.8671	0.4770	1.4370	NA,NO
1994	12.9588	2.6240	8.2000	0.4692	1.6657	NA,NO
1995	12.0172	2.5685	6.6886	0.5667	2.1933	NA,NO
1996	13.6105	2.2008	8.3880	0.5785	2.4431	NA,NO
1997	11.2148	1.5627	6.7966	0.4276	2.4278	NA,NO
1998	13.4681	1.8073	6.6481	0.3855	4.6272	NA,NO
1999	11.4577	1.7405	4.5363	0.3133	4.8676	NA,NO
2000	11.7855	1.4984	3.4283	0.3571	6.5017	NA,NO
2001	10.2872	1.4065	2.4343	0.3157	6.1307	NA,NO
2002	13.0704	1.3446	4.0834	0.2827	7.3597	NA,NO
2003	14.1676	1.3118	4.8510	0.2960	7.7089	NA,NO
2004	13.2515	1.1343	3.7967	0.3052	8.0140	0.0013
2005	12.8859	1.1071	3.4742	0.3747	7.9290	0.0010
2006	13.6084	1.0993	3.6889	0.4108	8.4089	0.0005
2007	12.7279	0.9928	3.3218	0.4285	7.9812	0.0035
2008	12.7859	0.8876	2.9991	0.4086	8.4878	0.0027
2009	11.8232	0.8489	2.1043	0.2929	8.5693	0.0077
2010	13.2164	0.7612	2.8098	0.3193	9.3159	0.0103
2011	14.3066	0.6803	3.4545	0.3599	9.8028	0.0091
2012	14.7958	0.6602	3.2976	0.3441	10.4799	0.0140
Decrease 1988-2012	25.7%	86.9%	72.7%	16.9%	-339.9%	-
Decrease 1990-2012	12.0%	85.9%	65.2%	32.2%	-383.8%	-
Decrease 2011-2012	-3.4%	2.9%	4.5%	4.4%	-6.9%	-53.2%

Table 35 N_2O emissions in 1.A. Fuel Combustion

N_2O (Gg)	1.A. Fuel Combustion	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	1.0586	0.4728	0.5364	0.0177	0.0318	NA,NO
1989	1.0668	0.4804	0.5377	0.0183	0.0304	NA,NO
1990	1.1054	0.5779	0.4792	0.0194	0.0289	NA,NO
1991	0.7719	0.3208	0.4113	0.0162	0.0236	NA,NO
1992	0.7861	0.3421	0.4032	0.0145	0.0262	NA,NO
1993	1.0672	0.6155	0.4145	0.0134	0.0237	NA,NO
1994	1.1866	0.7634	0.3833	0.0130	0.0270	NA,NO

N_2O (Gg)	1.A. Fuel Combustion	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1995	1.4477	1.0222	0.3758	0.0159	0.0338	NA,NO
1996	1.4833	1.0490	0.3814	0.0163	0.0367	NA,NO
1997	1.2110	0.7522	0.4032	0.0129	0.0427	NA,NO
1998	1.3886	0.9196	0.3884	0.0115	0.0690	NA,NO
1999	1.3029	0.8986	0.3222	0.0101	0.0720	NA,NO
2000	1.1727	0.7486	0.3200	0.0105	0.0935	NA,NO
2001	1.1335	0.6568	0.3764	0.0096	0.0906	NA,NO
2002	1.1509	0.6845	0.3494	0.0088	0.1083	NA,NO
2003	1.1761	0.6620	0.3861	0.0092	0.1188	NA,NO
2004	0.8453	0.3352	0.3769	0.0091	0.1240	0.0002
2005	0.8543	0.3475	0.3712	0.0106	0.1248	0.0001
2006	0.8793	0.3590	0.3763	0.0113	0.1325	0.0001
2007	0.9027	0.3396	0.4274	0.0118	0.1234	0.0005
2008	0.9055	0.3411	0.4230	0.0114	0.1296	0.0004
2009	0.7897	0.2839	0.3680	0.0092	0.1276	0.0010
2010	0.8325	0.2705	0.3981	0.0100	0.1525	0.0014
2011	0.9050	0.2629	0.4680	0.0110	0.1620	0.0012
2012	0.8709	0.2784	0.3976	0.0106	0.1824	0.0019
Decrease 1988-2012	17.7%	41.1%	25.9%	40.1%	-474.3%	-
Decrease 1990-2012	21.2%	51.8%	17.0%	45.2%	-531.6%	-
Decrease 2011-2012	3.8%	-5.9%	15.0%	3.3%	-12.6%	-53.2%

Table 36 GHG emissions in 1.A. Fuel Combustion

GHG (Gg)	TJ	1.A. Fuel Combustion	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	979 966.67	80 091.50	30 271.52	40 016.23	9 743.88	59.8751	NO
1989	975 325.76	79 654.91	29 400.60	40 114.56	10 082.48	57.2738	NO
1990	905 707.25	72 980.08	26 411.11	35 855.47	10 659.05	54.4463	NO
1991	683 814.37	55 402.60	16 272.42	30 192.28	8 901.91	35.9810	NO
1992	645 977.00	52 902.61	15 073.66	29 805.76	7 981.44	41.7608	NO
1993	646 758.66	53 289.45	15 337.41	30 516.21	7 398.32	37.5097	NO
1994	613 269.24	50 378.99	14 716.56	28 466.33	7 152.77	43.3408	NO
1995	627 304.17	50 727.68	13 843.98	28 089.33	8 737.85	56.5330	NO
1996	637 014.06	51 466.65	14 018.53	28 436.42	8 949.00	62.6966	NO
1997	586 833.10	48 901.22	11 402.14	30 316.41	7 118.46	64.2092	NO
1998	578 914.82	47 863.68	12 267.06	29 126.36	6 351.68	118.5736	NO
1999	517 040.22	41 956.71	12 154.12	24 115.34	5 562.71	124.5499	NO
2000	506 920.32	40 697.70	10 681.12	24 052.37	5 798.68	165.5310	NO
2001	540 136.32	44 502.54	10 946.83	28 093.68	5 305.20	156.8235	NO
2002	514 996.53	42 021.11	10 932.37	26 065.36	4 835.25	188.1370	NO
2003	558 579.02	45 723.24	11 627.94	28 828.89	5 067.71	198.7104	NO
2004	551 579.02	44 601.01	11 434.40	28 005.84	4 950.50	206.7317	3.5379
2005	565 494.59	45 179.66	11 896.12	27 430.45	5 645.03	205.1950	2.8704
2006	583 393.68	46 395.96	12 457.55	27 768.36	5 950.71	217.6758	1.6759
2007	614 596.50	49 947.77	12 265.37	31 398.50	6 068.09	205.8680	9.9483
2008	601 078.44	49 131.59	11 663.88	31 364.87	5 876.50	218.4236	7.9070
2009	532 483.01	43 263.55	11 428.51	27 036.62	4 556.01	219.5064	22.9014
2010	557 005.25	45 291.13	11 013.32	29 230.59	4 778.55	242.9120	25.7502

GHG (Gg)	TJ	1.A. Fuel Combustion	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2011	610 981.48	50 392.42	10 201.24	34 521.79	5 386.34	256.0643	26.9836
2012	568 530.10	45 587.13	10 684.97	29 443.53	5 140.98	276.6308	41.0134
Decrease 1988-2012	42.0%	43.1%	64.7%	26.4%	47.2%	-362.0%	-
Decrease 1990-2012	37.2%	37.5%	59.5%	17.9%	51.8%	-408.1%	-
Decrease 2011-2012	6.9%	9.5%	-4.7%	14.7%	4.6%	-8.0%	-52.0%

3.3.10 ENERGY INDUSTRIES (CRF 1.A.1)

The fuel consumption in the following subcategories is included in this category:

- Conventional electricity, CHP and heat plants (public and autoproducers),
- Petroleum refining plants,
- Solid fuel transformation plants,
- Oil and gas extraction and coal mining,
- Own consumption of the energy sector.

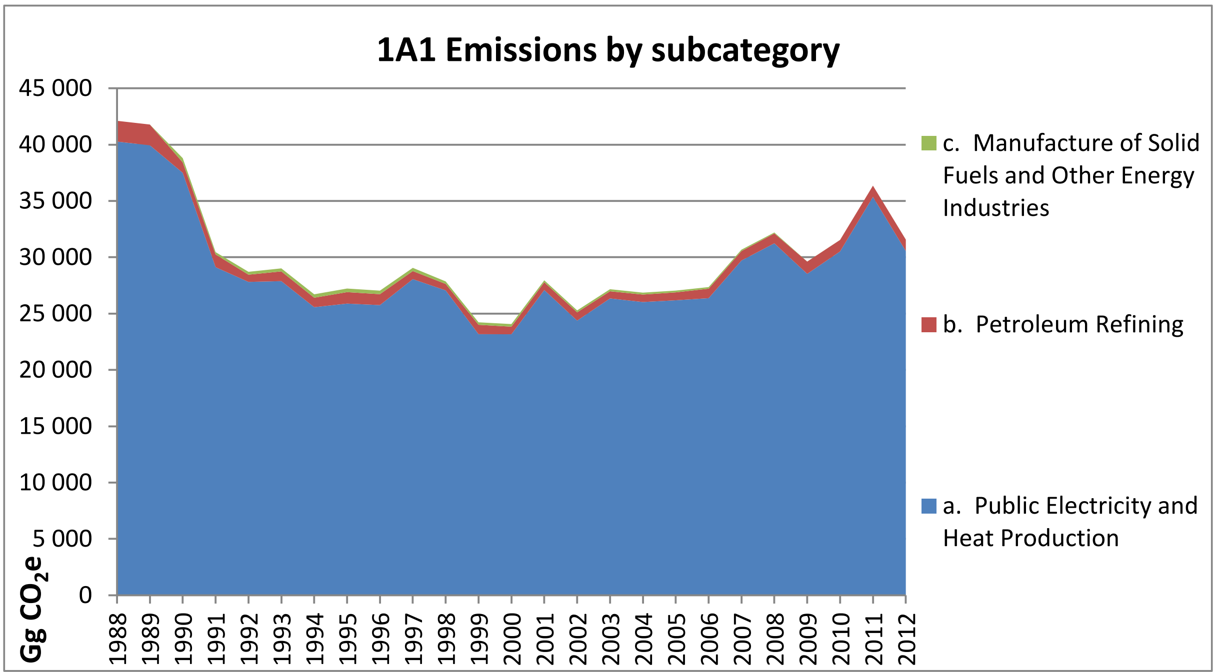


Figure 25 Total GHG emissions from 1.A.1 Energy industries by subcategory

For 2012 the general trend in CRF category 1.A.1 is a decrease in the emissions of 25.0% compared to base year and a decrease of 13.2% compared to last year.

3.3.10.1 Public Electricity and Heat Production (CRF 1.A.1.a)

Category 1.A.1.a Public Electricity and Heat Production cover emissions from fuel combustion in public power and heat plants.

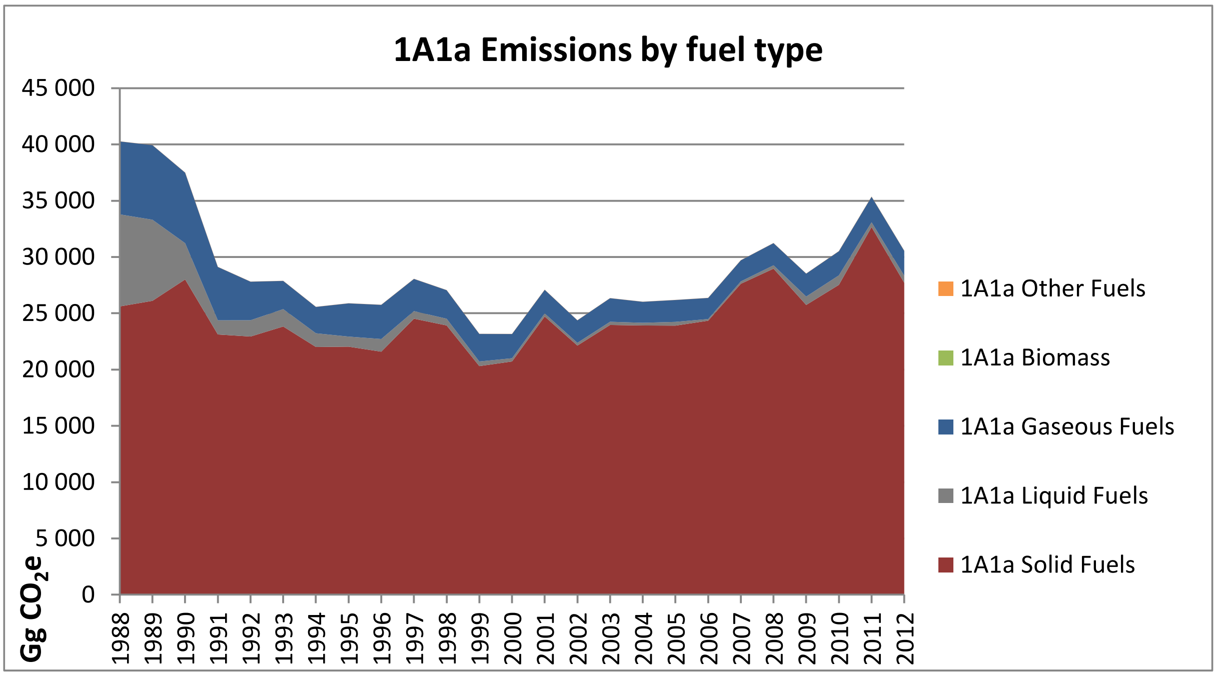


Figure 26 GHG emissions from 1.A.1.a Public Electricity and Heat Production

The share of CRF category 1.A.1.a from the total GHG emissions is 50.2% for the year 2012. The share of this subcategory from CRF category 1.A Fuel combustion is 67.0% for the year 2012.

Table 37 CO_2 emissions in 1.A.1.a. Public Electricity and Heat Production

CO_2 (Gg)	CRF 1.A.1.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	40 129.01	8 155.62	25 497.33	6 476.06	NO	NO
1989	39 800.03	7 181.36	25 994.31	6 624.36	NO	NO
1990	37 359.64	3 211.50	27 884.16	6 263.98	NO	NO
1991	29 010.52	1 253.44	23 016.65	4 740.42	NO	NO
1992	27 703.73	1 443.73	22 833.37	3 426.62	0.1120	NO
1993	27 768.10	1 538.44	23 720.90	2 508.75	0.1120	NO
1994	25 467.24	1 213.64	21 910.45	2 343.15	0.1120	NO
1995	25 785.90	891.88	21 938.02	2 956.00	0.1120	NO
1996	25 655.06	1 124.69	21 493.00	3 037.37	NO	NO
1997	27 948.16	671.15	24 414.10	2 862.91	0.1120	NO
1998	26 951.20	594.50	23 817.00	2 539.70	0.1120	NO
1999	23 082.14	410.65	20 219.29	2 452.20	NO	NO
2000	23 070.75	288.14	20 628.95	2 153.66	NO	NO
2001	26 982.34	269.76	24 605.04	2 107.54	NO	NO
2002	24 278.86	241.92	22 034.56	2 002.39	NO	NO
2003	26 239.71	283.60	23 858.41	2 097.70	NO	NO
2004	25 919.30	238.01	23 812.23	1 869.06	0.1120	NO
2005	26 076.14	332.89	23 798.45	1 944.79	NO	NO
2006	26 257.62	149.12	24 233.52	1 874.99	NO	NO
2007	29 590.40	210.56	27 500.21	1 879.63	NO	NO
2008	31 108.90	300.33	28 836.37	1 972.20	3.5840	NO
2009	28 411.32	744.30	25 627.14	2 039.88	4.1440	NO
2010	30 393.82	843.07	27 404.06	2 146.69	9.0720	NO
2011	35 214.50	424.91	32 516.16	2 273.42	30.4640	NO
2012	30 428.70	631.48	27 586.60	2 210.63	17.6960	NO
Decrease	24.2%	92.3%	-8.2%	65.9%	-	-

CO_2 (Gg)	CRF 1.A.1.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988-2012						
Decrease 1990-2012	18.6%	80.3%	1.1%	64.7%	-	-
Decrease 2011-2012	13.6%	-48.6%	15.2%	2.8%	41.9%	-

Table 38 CH_4 emissions in CRF 1.A.1.a. Public Electricity and Heat Production

CH_4 (Gg)	CRF 1.A.1.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.6820	0.3194	0.2446	0.1179	NO	NO
1989	0.6512	0.2813	0.2493	0.1206	NO	NO
1990	0.5102	0.1259	0.2702	0.1140	NO	NO
1991	0.3612	0.0491	0.2258	0.0863	NO	NO
1992	0.3417	0.0567	0.2226	0.0624	0.0000	NO
1993	0.3386	0.0603	0.2326	0.0457	0.0000	NO
1994	0.3035	0.0476	0.2133	0.0427	0.0000	NO
1995	0.3013	0.0350	0.2125	0.0538	0.0000	NO
1996	0.3073	0.0441	0.2079	0.0553	NO	NO
1997	0.3129	0.0263	0.2344	0.0521	0.0000	NO
1998	0.2982	0.0233	0.2286	0.0462	0.0000	NO
1999	0.2555	0.0161	0.1948	0.0446	NO	NO
2000	0.2491	0.0113	0.1985	0.0392	NO	NO
2001	0.2866	0.0106	0.2377	0.0384	NO	NO
2002	0.2588	0.0094	0.2129	0.0365	NO	NO
2003	0.2791	0.0108	0.2301	0.0382	NO	NO
2004	0.2739	0.0091	0.2307	0.0340	0.0000	NO
2005	0.2794	0.0121	0.2319	0.0354	NO	NO
2006	0.2762	0.0058	0.2363	0.0341	NO	NO
2007	0.3114	0.0079	0.2693	0.0342	NO	NO
2008	0.3269	0.0107	0.2792	0.0359	0.0010	NO
2009	0.3148	0.0265	0.2500	0.0371	0.0011	NO
2010	0.3365	0.0278	0.2671	0.0391	0.0024	NO
2011	0.3792	0.0141	0.3156	0.0413	0.0082	NO
2012	0.3318	0.0200	0.2668	0.0402	0.0047	NO
Decrease 1988-2012	51.4%	93.7%	-9.1%	65.9%	-	-
Decrease 1990-2012	35.0%	84.1%	1.3%	64.7%	-	-
Decrease 2011-2012	12.5%	-42.1%	15.5%	2.6%	41.9%	-

Table 39 N_2O emissions in 1.A.1.a. Public Electricity and Heat Production

N_2O (Gg)	CRF 1.A.1.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.4181	0.0639	0.3425	0.0118	NO	NO
1989	0.4174	0.0563	0.3491	0.0121	NO	NO
1990	0.4149	0.0252	0.3783	0.0114	NO	NO
1991	0.3345	0.0098	0.3161	0.0086	NO	NO
1992	0.3292	0.0113	0.3117	0.0062	0.0000	NO
1993	0.3423	0.0121	0.3256	0.0046	0.0000	NO

N_2O (Gg)	CRF 1.A.1.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1994	0.3123	0.0095	0.2986	0.0043	0.0000	NO
1995	0.3098	0.0070	0.2975	0.0054	0.0000	NO
1996	0.3054	0.0088	0.2911	0.0055	NO	NO
1997	0.3386	0.0053	0.3281	0.0052	0.0000	NO
1998	0.3294	0.0047	0.3201	0.0046	0.0000	NO
1999	0.2804	0.0032	0.2727	0.0045	NO	NO
2000	0.2842	0.0023	0.2780	0.0039	NO	NO
2001	0.3387	0.0021	0.3327	0.0038	NO	NO
2002	0.3036	0.0019	0.2981	0.0036	NO	NO
2003	0.3281	0.0022	0.3221	0.0038	NO	NO
2004	0.3283	0.0018	0.3230	0.0034	0.0000	NO
2005	0.3307	0.0024	0.3247	0.0035	NO	NO
2006	0.3354	0.0012	0.3308	0.0034	NO	NO
2007	0.3820	0.0016	0.3770	0.0034	NO	NO
2008	0.3967	0.0021	0.3909	0.0036	0.0001	NO
2009	0.3591	0.0052	0.3500	0.0037	0.0001	NO
2010	0.3837	0.0055	0.3740	0.0039	0.0003	NO
2011	0.4499	0.0028	0.4419	0.0041	0.0011	NO
2012	0.3821	0.0039	0.3735	0.0040	0.0006	NO
Decrease 1988-2012	8.6%	93.9%	-9.1%	65.9%	-	-
Decrease 1990-2012	7.9%	84.4%	1.3%	64.7%	-	-
Decrease 2011-2012	15.1%	-41.0%	15.5%	2.6%	41.9%	-

Table 40 GHG emissions in 1.A.1.a. Public Electricity and Heat Production

GHG (Gg)	TJ	CRF 1.A.1.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	469 001.13	40 272.96	8 182.14	25 608.64	6 482.19	NO	NO
1989	463 709.64	39 943.10	7 204.71	26 107.76	6 630.63	NO	NO
1990	426 234.80	37 498.97	3 221.95	28 007.12	6 269.91	NO	NO
1991	328 458.47	29 121.81	1 257.52	23 119.38	4 744.91	NO	NO
1992	303 886.86	27 812.97	1 448.44	22 934.67	3 429.87	0.0019	NO
1993	298 381.32	27 881.32	1 543.45	23 826.74	2 511.13	0.0019	NO
1994	271 779.96	25 570.44	1 217.59	22 007.49	2 345.36	0.0019	NO
1995	277 954.32	25 888.28	894.79	22 034.70	2 958.80	0.0019	NO
1996	277 920.40	25 756.20	1 128.35	21 587.60	3 040.24	NO	NO
1997	295 277.67	28 059.71	673.34	24 520.74	2 865.62	0.0019	NO
1998	282 637.44	27 059.57	596.44	23 921.03	2 542.11	0.0019	NO
1999	244 773.43	23 174.41	411.99	20 307.90	2 454.52	NO	NO
2000	241 526.54	23 164.07	289.08	20 719.29	2 155.70	NO	NO
2001	279 555.03	27 093.34	270.64	24 713.18	2 109.53	NO	NO
2002	252 527.38	24 378.41	242.70	22 131.43	2 004.28	NO	NO
2003	271 880.96	26 347.28	284.50	23 963.10	2 099.68	NO	NO
2004	267 811.25	26 026.82	238.77	23 917.22	1 870.83	0.0019	NO
2005	271 362.80	26 184.51	333.90	23 903.98	1 946.64	NO	NO
2006	272 358.76	26 367.39	149.60	24 341.03	1 876.77	NO	NO
2007	306 165.24	29 715.37	211.22	27 622.74	1 881.41	NO	NO
2008	319 212.67	31 238.75	301.20	28 963.42	1 974.06	0.0598	NO
2009	296 786.32	28 529.25	746.46	25 740.91	2 041.81	0.0692	NO

2010	315 983.41	30 519.84	845.36	27 525.61	2 148.72	0.1515	NO
2011	362 152.24	35 361.93	426.07	32 659.78	2 275.57	0.5086	NO
2012	314 348.18	30 554.11	633.11	27 707.98	2 212.72	0.2955	NO
Decrease 1988-2012	33.0%	24.1%	92.3%	-8.2%	65.9%	-	-
Decrease 1990-2012	26.2%	18.5%	80.3%	1.1%	64.7%	-	-
Decrease 2011-2012	13.2%	13.6%	-48.6%	15.2%	2.8%	41.9%	-

3.3.10.2 Petroleum refining (CRF 1.A.1.b)

Category 1.A.1.b Petroleum refining covers emissions from fuel combustion in petroleum refineries.

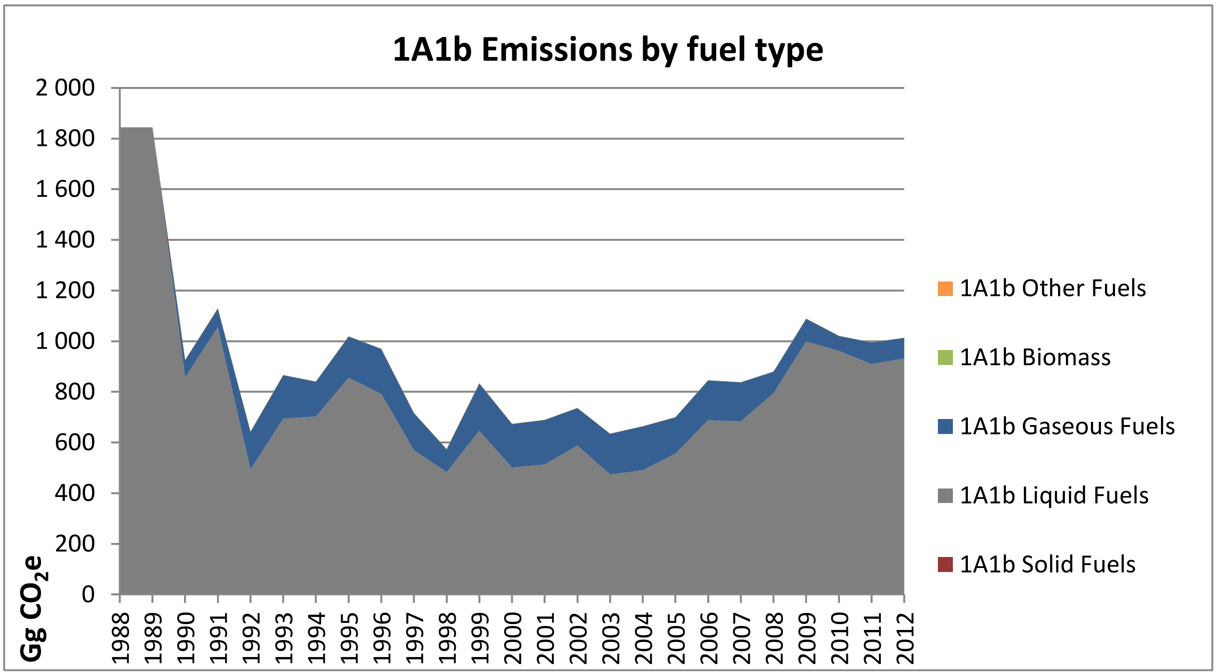


Figure 27 GHG emissions from CRF 1.A.1.b Petroleum refining

For the year 2012 the share of this subcategory from sector 1A Fuel Combustion is 2.2% while from the total GHGs emissions it is 1.7%.

Table 41 CO_2 emissions in CRF 1.A.1.b Petroleum refining

CO_2 (Gg)	CRF 1.A.1.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	1 838.23	1 838.23	NO	NO	NO	NO
1989	1 838.23	1 838.23	NO	NO	NO	NO
1990	923.95	855.63	NO	68.32	NO	NO
1991	1 126.98	1 052.08	NO	74.89	NO	NO
1992	641.52	492.13	NO	149.39	NO	NO
1993	864.70	692.91	NO	171.79	NO	NO
1994	839.07	701.14	NO	137.93	NO	NO
1995	1 016.90	853.66	NO	163.24	NO	NO
1996	967.85	790.13	NO	177.72	NO	NO
1997	714.83	567.86	NO	146.97	NO	NO
1998	572.64	482.03	NO	90.62	NO	NO
1999	831.91	644.64	NO	187.26	NO	NO

CO_2 (Gg)	CRF 1.A.1.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2000	672.21	499.93	NO	172.28	NO	NO
2001	688.09	512.00	NO	176.09	NO	NO
2002	735.08	586.83	NO	148.26	NO	NO
2003	633.64	472.38	NO	161.26	NO	NO
2004	662.85	489.43	NO	173.42	NO	NO
2005	698.36	554.55	NO	143.81	NO	NO
2006	844.19	686.68	NO	157.50	NO	NO
2007	836.58	681.85	NO	154.73	NO	NO
2008	878.39	793.06	NO	85.33	NO	NO
2009	1 087.03	997.40	NO	89.63	NO	NO
2010	1 019.53	959.97	NO	59.56	NO	NO
2011	993.44	908.18	NO	85.27	NO	NO
2012	1 011.89	930.18	NO	81.71	NO	NO
Decrease 1988-2012	45.0%	49.4%	-	-	-	-
Decrease 1990-2012	-9.5%	-8.7%	-	-19.6%	-	-
Decrease 2011-2012	-1.9%	-2.4%	-	4.2%	-	-

Table 42 CH_4 emissions in CRF 1.A.1.b Petroleum refining

CH_4 (Gg)	CRF 1.A.1.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.0720	0.0720	NO	NO	NO	NO
1989	0.0720	0.0720	NO	NO	NO	NO
1990	0.0223	0.0211	NO	0.0012	NO	NO
1991	0.0320	0.0307	NO	0.0014	NO	NO
1992	0.0163	0.0136	NO	0.0027	NO	NO
1993	0.0199	0.0168	NO	0.0031	NO	NO
1994	0.0200	0.0175	NO	0.0025	NO	NO
1995	0.0256	0.0226	NO	0.0030	NO	NO
1996	0.0262	0.0229	NO	0.0032	NO	NO
1997	0.0175	0.0148	NO	0.0027	NO	NO
1998	0.0141	0.0125	NO	0.0016	NO	NO
1999	0.0221	0.0187	NO	0.0034	NO	NO
2000	0.0164	0.0133	NO	0.0031	NO	NO
2001	0.0160	0.0128	NO	0.0032	NO	NO
2002	0.0160	0.0133	NO	0.0027	NO	NO
2003	0.0149	0.0120	NO	0.0029	NO	NO
2004	0.0160	0.0129	NO	0.0032	NO	NO
2005	0.0174	0.0148	NO	0.0026	NO	NO
2006	0.0189	0.0160	NO	0.0029	NO	NO
2007	0.0191	0.0163	NO	0.0028	NO	NO
2008	0.0198	0.0182	NO	0.0016	NO	NO
2009	0.0244	0.0227	NO	0.0016	NO	NO
2010	0.0224	0.0213	NO	0.0011	NO	NO
2011	0.0216	0.0200	NO	0.0016	NO	NO
2012	0.0218	0.0204	NO	0.0015	NO	NO
Decrease 1988-2012	69.7%	71.7%	-	-	-	-
Decrease	2.0%	3.3%	-	-19.6%	-	-

CH_4 (Gg)	CRF 1.A.1.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1990-2012						
Decrease 2011-2012	-1.1%	-1.5%	-	4.1%	-	-

Table 43 N_2O emissions in CRF 1.A.1.b Petroleum refining

N_2O (Gg)	CRF 1.A.1.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.0144	0.0144	NO	NO	NO	NO
1989	0.0144	0.0144	NO	NO	NO	NO
1990	0.0035	0.0034	NO	0.0001	NO	NO
1991	0.0056	0.0055	NO	0.0001	NO	NO
1992	0.0026	0.0024	NO	0.0003	NO	NO
1993	0.0030	0.0027	NO	0.0003	NO	NO
1994	0.0031	0.0029	NO	0.0003	NO	NO
1995	0.0041	0.0038	NO	0.0003	NO	NO
1996	0.0044	0.0041	NO	0.0003	NO	NO
1997	0.0028	0.0025	NO	0.0003	NO	NO
1998	0.0022	0.0021	NO	0.0002	NO	NO
1999	0.0037	0.0033	NO	0.0003	NO	NO
2000	0.0026	0.0023	NO	0.0003	NO	NO
2001	0.0024	0.0021	NO	0.0003	NO	NO
2002	0.0023	0.0021	NO	0.0003	NO	NO
2003	0.0023	0.0020	NO	0.0003	NO	NO
2004	0.0025	0.0021	NO	0.0003	NO	NO
2005	0.0027	0.0025	NO	0.0003	NO	NO
2006	0.0028	0.0025	NO	0.0003	NO	NO
2007	0.0029	0.0026	NO	0.0003	NO	NO
2008	0.0030	0.0028	NO	0.0002	NO	NO
2009	0.0037	0.0036	NO	0.0002	NO	NO
2010	0.0034	0.0033	NO	0.0001	NO	NO
2011	0.0033	0.0031	NO	0.0002	NO	NO
2012	0.0033	0.0032	NO	0.0001	NO	NO
Decrease 1988-2012	77.1%	78.1%	-	-	-	-
Decrease 1990-2012	6.9%	7.9%	-	-19.6%	-	-
Decrease 2011-2012	-0.9%	-1.2%	-	4.1%	-	-

Table 44 GHG emissions in CRF 1.A.1.b Petroleum refining

GHG (Gg)	TJ	CRF 1.A.1.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	24 000.00	1 844.21	1 844.21	NO	NO	NO	NO
1989	24 000.00	1 844.21	1 844.21	NO	NO	NO	NO
1990	13 493.80	925.52	857.13	NO	68.38	NO	NO
1991	16 013.50	1 129.39	1 054.42	NO	74.97	NO	NO
1992	9 639.80	642.68	493.14	NO	149.54	NO	NO
1993	13 067.50	866.05	694.10	NO	171.95	NO	NO
1994	12 531.00	840.45	702.40	NO	138.06	NO	NO
1995	15 051.80	1 018.72	855.33	NO	163.39	NO	NO

GHG (Gg)	TJ	CRF 1.A.1.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1996	14 245.50	969.76	791.87	NO	177.89	NO	NO
1997	10 735.70	716.05	568.94	NO	147.11	NO	NO
1998	8 499.70	573.64	482.94	NO	90.70	NO	NO
1999	12 389.20	833.51	646.07	NO	187.44	NO	NO
2000	10 206.50	673.36	500.91	NO	172.45	NO	NO
2001	10 515.80	689.18	512.92	NO	176.26	NO	NO
2002	11 199.10	736.14	587.74	NO	148.40	NO	NO
2003	9 833.96	634.66	473.24	NO	161.41	NO	NO
2004	10 281.31	663.95	490.36	NO	173.58	NO	NO
2005	10 679.95	699.57	555.63	NO	143.94	NO	NO
2006	12 966.96	845.44	687.79	NO	157.65	NO	NO
2007	12 821.87	837.86	682.99	NO	154.87	NO	NO
2008	13 229.61	879.73	794.31	NO	85.41	NO	NO
2009	15 603.89	1 088.70	998.98	NO	89.72	NO	NO
2010	14 447.43	1 021.07	961.45	NO	59.62	NO	NO
2011	14 166.62	994.91	909.56	NO	85.35	NO	NO
2012	14 371.82	1 013.37	931.59	NO	81.79	NO	NO
Decrease 1988-2012	40.1%	45.1%	49.5%	-	-	-	-
Decrease 1990-2012	-6.5%	-9.5%	-8.7%	-	-19.6%	-	-
Decrease 2011-2012	-1.4%	-1.9%	-2.4%	-	4.2%	-	-

3.3.10.3 Manufacture of Solid Fuels and Other Energy Industries (CRF 1.A.1.c.)

Category 1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries covers emissions from fuel combustion in Coal Mines, Patent Fuel Plants (Energy), Coke Ovens (Energy) and BKB Plants (Energy).

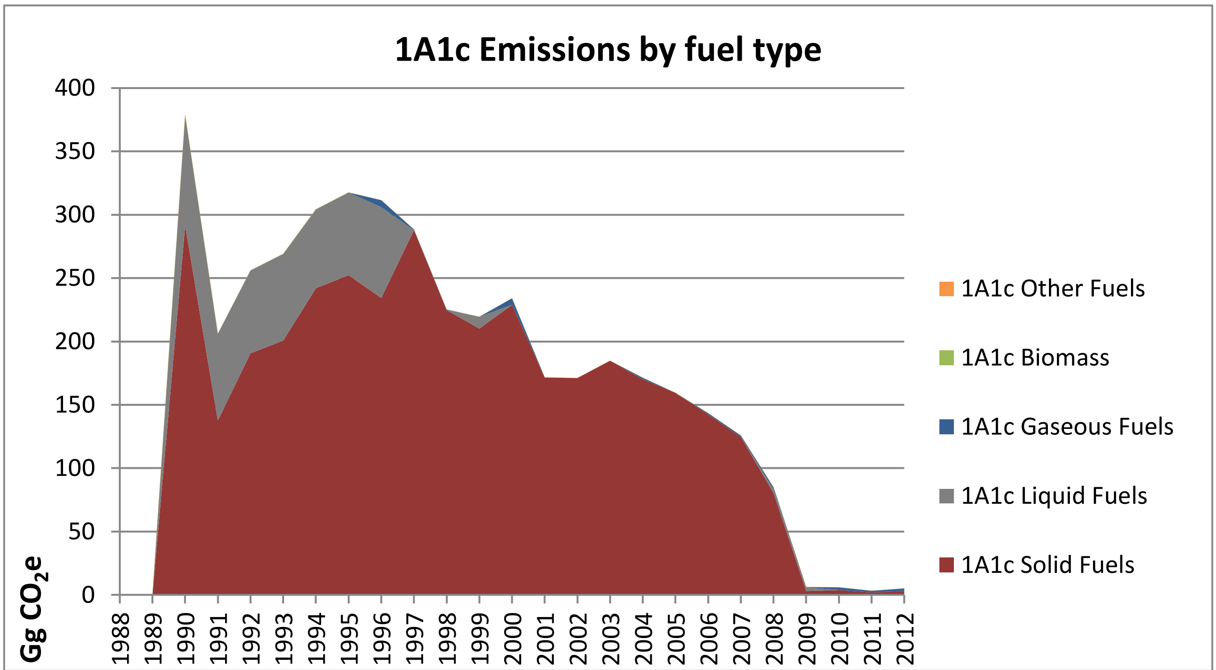


Figure 28 GHG emissions from 1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries

This sector has shrunk drastically due to the closure of the only I&S plant in Bulgaria, which was operating coke ovens and currently is responsible for 0.01% of the emissions from fuel combustion. This results also in a change in the fuel mix used in this category, which from mostly coke oven gas used in coke ovens in the previous years has now shifted to small quantities of natural gas.

Table 45 CO_2 emissions in CRF 1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries

CO_2 (Gg)	CRF 1.A.1.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	377.88	86.85	291.03	NO	NO	NO
1991	205.68	68.24	137.45	NO	NO	NO
1992	255.53	65.14	190.39	NO	NO	NO
1993	268.58	68.24	200.34	NO	0.1120	NO
1994	303.69	62.03	241.66	NO	0.1120	NO
1995	317.03	65.14	251.90	NO	NO	NO
1996	310.90	71.34	233.97	5.59	0.1120	NO
1997	287.92	NO	287.28	0.64	NO	NO
1998	224.81	NO	224.32	0.49	NO	NO
1999	219.13	9.31	209.82	NO	NO	NO
2000	233.75	NO	228.51	5.24	NO	NO
2001	171.39	NO	171.39	NO	0.1120	NO
2002	170.94	NO	170.94	NO	NO	NO
2003	184.60	NO	184.60	NO	NO	NO
2004	171.19	NO	169.95	1.24	0.1120	NO
2005	159.30	NO	159.30	NO	NO	NO
2006	143.27	NO	142.24	1.04	NO	NO
2007	125.63	NO	124.39	1.24	NO	NO
2008	84.89	2.87	80.39	1.63	NO	NO
2009	6.22	2.87	3.00	0.35	NO	NO
2010	5.98	NO	3.85	2.13	NO	NO
2011	3.28	NO	1.95	1.34	NO	NO
2012	5.13	NO	3.05	2.08	NO	NO
Decrease 1988-2012	-	-	-	-	-	-
Decrease 1990-2012	98.6%	-	99.0%	-	-	-
Decrease 2011-2012	-56.2%	-	-56.8%	-55.4%	-	-

Table 46 CH_4 emissions in CRF 1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries

CH_4 (Gg)	CRF 1.A.1.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	0.00935	0.00355	0.00580	NO	NO	NO
1991	0.00569	0.00279	0.00290	NO	NO	NO
1992	0.00636	0.00266	0.00370	NO	NO	NO
1993	0.00673	0.00279	0.00391	NO	0.00003	NO

CH_4 (Gg)	CRF 1.A.1.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1994	0.00735	0.00254	0.00478	NO	0.00003	NO
1995	0.00770	0.00266	0.00504	NO	NO	NO
1996	0.00764	0.00292	0.00459	0.00010	0.00003	NO
1997	0.00535	NO	0.00534	0.00001	NO	NO
1998	0.00417	NO	0.00416	0.00001	NO	NO
1999	0.00442	0.00038	0.00404	NO	NO	NO
2000	0.00455	NO	0.00445	0.00010	NO	NO
2001	0.00342	NO	0.00339	NO	0.00003	NO
2002	0.00342	NO	0.00342	NO	NO	NO
2003	0.00378	NO	0.00378	NO	NO	NO
2004	0.00356	NO	0.00351	0.00002	0.00003	NO
2005	0.00327	NO	0.00327	NO	NO	NO
2006	0.00289	NO	0.00287	0.00002	NO	NO
2007	0.00252	NO	0.00249	0.00002	NO	NO
2008	0.00171	0.00005	0.00164	0.00003	NO	NO
2009	0.00008	0.00005	0.00003	0.00001	NO	NO
2010	0.00008	NO	0.00004	0.00004	NO	NO
2011	0.00004	NO	0.00002	0.00002	NO	NO
2012	0.00007	NO	0.00003	0.00004	NO	NO
Decrease 1988-2012	-	-	-	-	-	-
Decrease 1990-2012	99.3%	-	99.4%	-	-	-
Decrease 2011-2012	-57.3%	-	-59.4%	-55.6%	-	-

Table 47 N_2O emissions in CRF 1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries

N_2O (Gg)	CRF 1.A.1.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	0.001661	0.000711	0.000950	NO	NO	NO
1991	0.000848	0.000558	0.000290	NO	NO	NO
1992	0.001301	0.000533	0.000768	NO	NO	NO
1993	0.001332	0.000558	0.000770	NO	0.000004	NO
1994	0.001379	0.000508	0.000868	NO	0.000004	NO
1995	0.001379	0.000533	0.000846	NO	NO	NO
1996	0.001479	0.000584	0.000881	0.000010	0.000004	NO
1997	0.001321	NO	0.001320	0.000001	NO	NO
1998	0.001045	NO	0.001044	0.000001	NO	NO
1999	0.000909	0.000076	0.000833	NO	NO	NO
2000	0.000854	NO	0.000844	0.000010	NO	NO
2001	0.000590	NO	0.000586	NO	0.000004	NO
2002	0.000546	NO	0.000546	NO	NO	NO
2003	0.000504	NO	0.000504	NO	NO	NO
2004	0.000445	NO	0.000439	0.000002	0.000004	NO
2005	0.000431	NO	0.000431	NO	NO	NO
2006	0.000444	NO	0.000442	0.000002	NO	NO
2007	0.000425	NO	0.000423	0.000002	NO	NO
2008	0.000246	0.000005	0.000238	0.000003	NO	NO

N_2O (Gg)	CRF 1.A.1.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2009	0.000049	0.000005	0.000044	0.000001	NO	NO
2010	0.000059	NO	0.000055	0.000004	NO	NO
2011	0.000031	NO	0.000028	0.000002	NO	NO
2012	0.000049	NO	0.000045	0.000004	NO	NO
Decrease 1988-2012	-	-	-	-	-	-
Decrease 1990-2012	97.1%	-	95.3%	-	-	-
Decrease 2011-2012	-59.1%	-	-59.4%	-55.6%	-	-

Table 48 GHG emissions in 1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries

GHG (Gg)	TJ	CRF 1.A.1.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	NO	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO	NO
1990	6 985.19	378.59	87.14	291.45	NO	NO	NO
1991	3 828.60	206.07	68.47	137.60	NO	NO	NO
1992	4 586.81	256.07	65.36	190.71	NO	NO	NO
1993	4 844.79	269.13	68.47	200.66	NO	0.0019	NO
1994	5 631.36	304.28	62.24	242.03	NO	0.0019	NO
1995	5 928.39	317.62	65.36	252.27	NO	NO	NO
1996	5 667.93	311.52	71.58	234.34	5.59	0.0019	NO
1997	5 353.00	288.44	NO	287.80	0.64	NO	NO
1998	4 170.80	225.23	NO	224.73	0.49	NO	NO
1999	4 164.84	219.50	9.34	210.17	NO	NO	NO
2000	4 549.15	234.11	NO	228.87	5.25	NO	NO
2001	3 392.56	171.64	NO	171.64	NO	0.0019	NO
2002	3 423.32	171.18	NO	171.18	NO	NO	NO
2003	3 781.93	184.84	NO	184.84	NO	NO	NO
2004	3 532.26	171.40	NO	170.16	1.24	0.0019	NO
2005	3 268.80	159.50	NO	159.50	NO	NO	NO
2006	2 889.12	143.47	NO	142.43	1.04	NO	NO
2007	2 516.02	125.81	NO	124.58	1.24	NO	NO
2008	1 713.96	85.01	2.87	80.50	1.63	NO	NO
2009	83.73	6.24	2.87	3.02	0.35	NO	NO
2010	78.26	6.00	NO	3.87	2.13	NO	NO
2011	44.36	3.29	NO	1.96	1.34	NO	NO
2012	69.77	5.15	NO	3.07	2.08	NO	NO
Decrease 1988-2012	-	-	-	-	-	-	-
Decrease 1990-2012	99.0%	98.6%	-	98.9%	-	-	-
Decrease 2011-2012	-57.3%	-56.2%	-	-56.8%	-55.4%	-	-

3.3.11 MANUFACTURING INDUSTRIES AND CONSTRUCTION (1.A.2)

Sub-sector Manufacturing Industries and Construction includes the following groups:

- Iron and Steel (1.A.2.a);
- Non-ferrous metal (1.A.2.b);
- Chemical Industry (1.A.2.c);
- Pulp and Paper (1.A.2.d);
- Food Industry (1.A.2.e);
- Other (1.A.2.f).

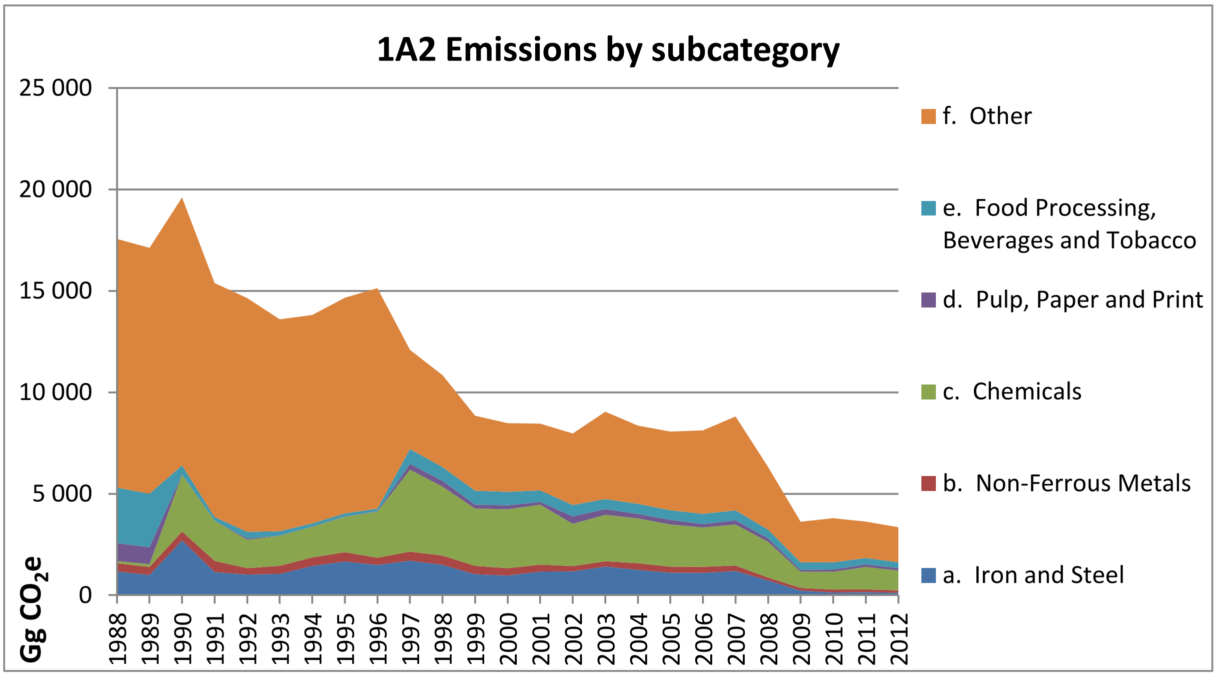


Figure 29 Total GHG emissions from 1.A.2 Manufacturing Industries and Construction by subcategory

Following the restructuring of the industry sector on the country, the general trend in CRF category 1.A.2 shows a decrease of 80.9% compared to base year and a decrease of 7.6% compared to last year. Practically all subcategories within the industry sector are decreasing steadily through the whole time series.

3.3.11.1 Iron and Steel (CRF 1.A.2.a.)

Category 1.A.2.a. Iron and Steel covers emissions from fuel combustion in Iron and steel industry.

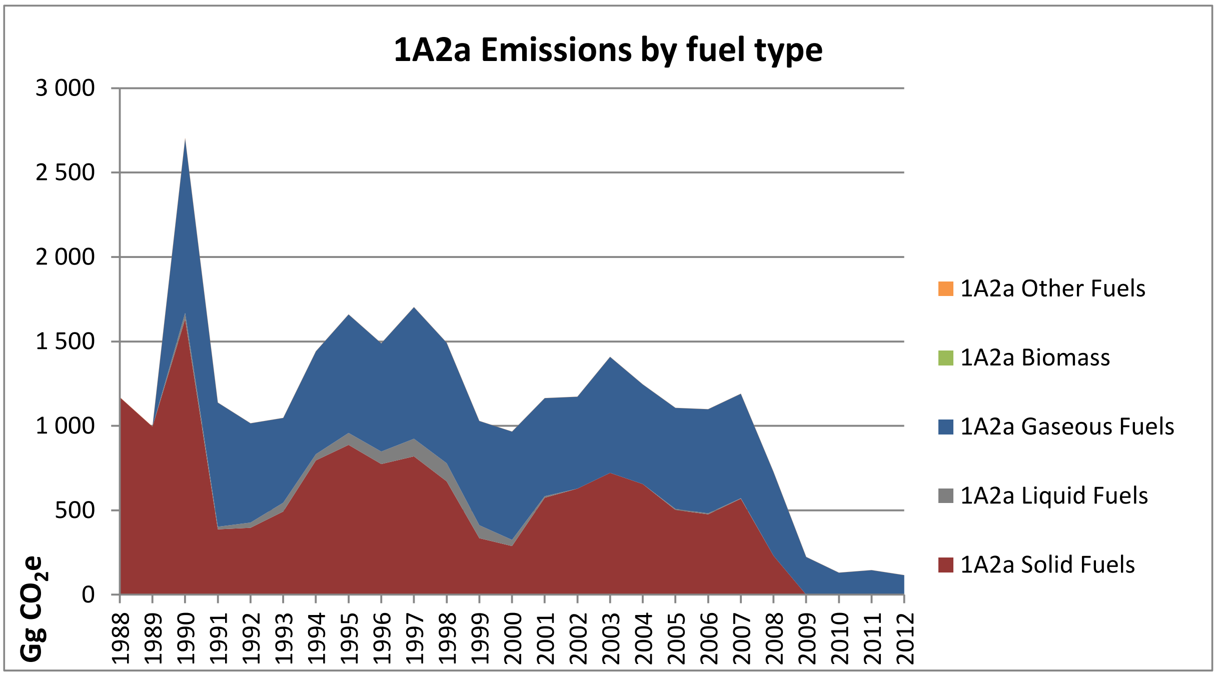


Figure 30 GHG emissions from 1.A.2.a. Iron and Steel

For the year 2012 the share of this subcategory from sector 1A Fuel Combustion is 0.3% while from the total GHGs emissions it is 0.2%. The drastic decrease in the emissions since 2009 in this subcategory is due to the closure of the biggest iron and steel plant in Bulgaria at the end of 2008.

Table 49 CO_2 emissions in CRF 1.A.2.a. Iron and Steel

CO_2 (Gg)	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	1 164.20	NO	1 164.20	NO	NO	NO
1989	990.91	NO	990.91	NO	NO	NO
1990	2 690.92	36.95	1 622.14	1 031.82	NO	NO
1991	1 133.98	15.43	384.88	733.67	NO	NO
1992	1 011.70	30.90	394.05	586.75	0.1120	NO
1993	1 042.90	52.35	489.57	500.98	0.1120	NO
1994	1 435.71	37.03	790.72	607.96	0.2240	NO
1995	1 653.13	70.81	882.02	700.30	0.3360	NO
1996	1 482.96	73.95	769.27	639.75	0.2240	NO
1997	1 696.39	104.17	814.41	777.82	0.2240	NO
1998	1 487.03	107.27	667.35	712.42	NO	NO
1999	1 025.48	76.63	332.79	616.07	0.2240	NO
2000	963.05	36.80	286.50	639.75	0.3360	NO
2001	1 159.62	9.19	570.79	579.63	0.7840	NO
2002	1 167.84	NO	624.50	543.35	0.5600	NO
2003	1 402.97	NO	717.25	685.72	0.6720	NO
2004	1 240.52	NO	651.44	589.07	0.5600	NO
2005	1 102.20	6.17	499.00	597.03	0.5600	NO
2006	1 094.43	6.14	473.11	615.18	0.3360	NO
2007	1 185.50	3.10	565.13	617.27	0.4480	NO
2008	724.84	NO	229.26	495.58	0.4480	NO
2009	223.14	NO	NO	223.14	0.3360	NO
2010	130.30	NO	NO	130.30	0.2240	NO
2011	145.35	NO	NO	145.35	0.2240	NO

CO_2 (Gg)	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2012	115.67	NO	NO	115.67	NO	NO
Decrease 1988-2012	90.1%	-	-	-	-	-
Decrease 1990-2012	95.7%	-	-	88.8%	-	-
Decrease 2011-2012	20.4%	-	-	20.4%	-	-

Table 50 CH_4 emissions in CRF 1.A.2.a. Iron and Steel

CH_4 (Gg)	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.11498	NO	0.11498	NO	NO	NO
1989	0.09863	NO	0.09863	NO	NO	NO
1990	0.24896	0.00098	0.15405	0.09392	NO	NO
1991	0.10419	0.00041	0.03699	0.06678	NO	NO
1992	0.09219	0.00083	0.03791	0.05341	0.00003	NO
1993	0.09371	0.00139	0.04668	0.04560	0.00003	NO
1994	0.13224	0.00099	0.07585	0.05534	0.00006	NO
1995	0.15043	0.00188	0.08472	0.06375	0.00009	NO
1996	0.13396	0.00197	0.07369	0.05823	0.00006	NO
1997	0.15595	0.00272	0.08237	0.07080	0.00006	NO
1998	0.13523	0.00280	0.06758	0.06485	NO	NO
1999	0.09400	0.00200	0.03585	0.05608	0.00006	NO
2000	0.08999	0.00096	0.03070	0.05823	0.00009	NO
2001	0.11103	0.00024	0.05781	0.05276	0.00021	NO
2002	0.11184	NO	0.06223	0.04946	0.00015	NO
2003	0.13378	NO	0.07118	0.06242	0.00018	NO
2004	0.11825	NO	0.06448	0.05362	0.00015	NO
2005	0.10486	0.00017	0.05020	0.05435	0.00015	NO
2006	0.10377	0.00017	0.04752	0.05600	0.00009	NO
2007	0.11176	0.00008	0.05534	0.05621	0.00012	NO
2008	0.06792	NO	0.02266	0.04514	0.00012	NO
2009	0.02039	NO	NO	0.02030	0.00009	NO
2010	0.01191	NO	NO	0.01185	0.00006	NO
2011	0.01328	NO	NO	0.01322	0.00006	NO
2012	0.01053	NO	NO	0.01053	NO	NO
Decrease 1988-2012	90.8%	-	-	-	-	-
Decrease 1990-2012	95.8%	-	-	88.8%	-	-
Decrease 2011-2012	20.7%	-	-	20.3%	-	-

Table 51 N_2O emissions in CRF 1.A.2.a. Iron and Steel

N_2O (Gg)	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.010218	NO	0.010218	NO	NO	NO
1989	0.007928	NO	0.007928	NO	NO	NO
1990	0.022789	0.000295	0.020615	0.001878	NO	NO

N_2O (Gg)	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1991	0.005904	0.000124	0.004444	0.001336	NO	NO
1992	0.005784	0.000250	0.004462	0.001068	0.000004	NO
1993	0.007299	0.000418	0.005965	0.000912	0.000004	NO
1994	0.011176	0.000298	0.009763	0.001107	0.000008	NO
1995	0.012435	0.000564	0.010583	0.001275	0.000012	NO
1996	0.011158	0.000591	0.009394	0.001165	0.000008	NO
1997	0.012043	0.000816	0.009803	0.001416	0.000008	NO
1998	0.010239	0.000841	0.008101	0.001297	NO	NO
1999	0.005537	0.000601	0.003806	0.001122	0.000008	NO
2000	0.004164	0.000289	0.002698	0.001165	0.000012	NO
2001	0.008117	0.000072	0.006962	0.001055	0.000028	NO
2002	0.008606	NO	0.007596	0.000989	0.000020	NO
2003	0.010051	NO	0.008778	0.001248	0.000024	NO
2004	0.009002	NO	0.007910	0.001072	0.000020	NO
2005	0.007255	0.000051	0.006097	0.001087	0.000020	NO
2006	0.007031	0.000050	0.005849	0.001120	0.000012	NO
2007	0.008349	0.000025	0.007184	0.001124	0.000016	NO
2008	0.003888	NO	0.002970	0.000903	0.000016	NO
2009	0.000418	NO	NO	0.000406	0.000012	NO
2010	0.000245	NO	NO	0.000237	0.000008	NO
2011	0.000272	NO	NO	0.000264	0.000008	NO
2012	0.000211	NO	NO	0.000211	NO	NO
Decrease 1988-2012	97.9%	-	-	-	-	-
Decrease 1990-2012	99.1%	-	-	88.8%	-	-
Decrease 2011-2012	22.7%	-	-	20.3%	-	-

Table 52 GHG emissions in CRF 1.A.2.a. Iron and Steel

GHG (Gg)	TJ	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	16 396.80	1 169.78	NO	1 169.78	NO	NO	NO
1989	14 763.20	995.44	NO	995.44	NO	NO	NO
1990	35 474.30	2 703.21	37.07	1 631.77	1 034.37	NO	NO
1991	17 874.74	1 138.00	15.48	387.03	735.49	NO	NO
1992	15 595.66	1 015.43	31.00	396.23	588.20	0.0019	NO
1993	14 961.67	1 047.13	52.51	492.40	502.22	0.0019	NO
1994	19 863.32	1 441.95	37.14	795.34	609.46	0.0037	NO
1995	23 228.68	1 660.15	71.02	887.08	702.04	0.0056	NO
1996	20 772.27	1 489.23	74.17	773.73	641.33	0.0037	NO
1997	25 199.82	1 703.40	104.48	819.17	779.74	0.0037	NO
1998	22 262.85	1 493.04	107.59	671.28	714.18	NO	NO
1999	16 816.96	1 029.17	76.86	334.72	617.59	0.0037	NO
2000	16 535.12	966.23	36.91	287.98	641.33	0.0056	NO
2001	17 404.29	1 164.46	9.22	574.17	581.07	0.0131	NO
2002	17 050.10	1 172.86	NO	628.16	544.69	0.0094	NO
2003	20 596.93	1 408.90	NO	721.47	687.42	0.0112	NO
2004	18 109.01	1 245.79	NO	655.25	590.53	0.0094	NO
2005	16 753.11	1 106.65	6.19	501.94	598.51	0.0094	NO

GHG (Gg)	TJ	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2006	16 707.38	1 098.78	6.16	475.92	616.70	0.0056	NO
2007	17 293.10	1 190.43	3.11	568.52	618.80	0.0075	NO
2008	11 466.12	727.47	NO	230.65	496.81	0.0075	NO
2009	4 062.90	223.69	NO	NO	223.69	0.0056	NO
2010	2 372.60	130.63	NO	NO	130.62	0.0037	NO
2011	2 645.30	145.71	NO	NO	145.71	0.0037	NO
2012	2 106.00	115.95	NO	NO	115.95	NO	NO
Decrease 1988-2012	87.2%	90.1%	-	-	-	-	-
Decrease 1990-2012	94.1%	95.7%	-	-	88.8%	-	-
Decrease 2011-2012	20.4%	20.4%	-	-	20.4%	-	-

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

In 2012 after a discussion regarding the non-energy use of Coke Oven Coke in the iron and steel industry, the National Statistics Institute initiated talks with the plant operators in order to clarify the situation, which led to the revision of the national energy balances. The quantities of Coke Oven Coke, which were previously reported under energy use are now accounted as non-energy use.

In addition, following the recommendation of the Technical review of GHG inventories under the EU Effort Sharing Decision (ESD) in 2012, we revised the methodology concerning Iron & Steel sector in order to remove the double counting with the IP sector. The quantities of coke oven gas reported under blast furnaces; blast furnace gas reported under blast furnaces, autoproducers and Iron and Steel; coke oven coke in blast furnaces were disregarded from the Energy sector.

3.3.11.2 Non-Ferrous Metals (CRF 1.A.2.b.)

Category 1.A.2.b Non-Ferrous Metals enfolds emissions from fuel combustion in non-ferrous metal industry.

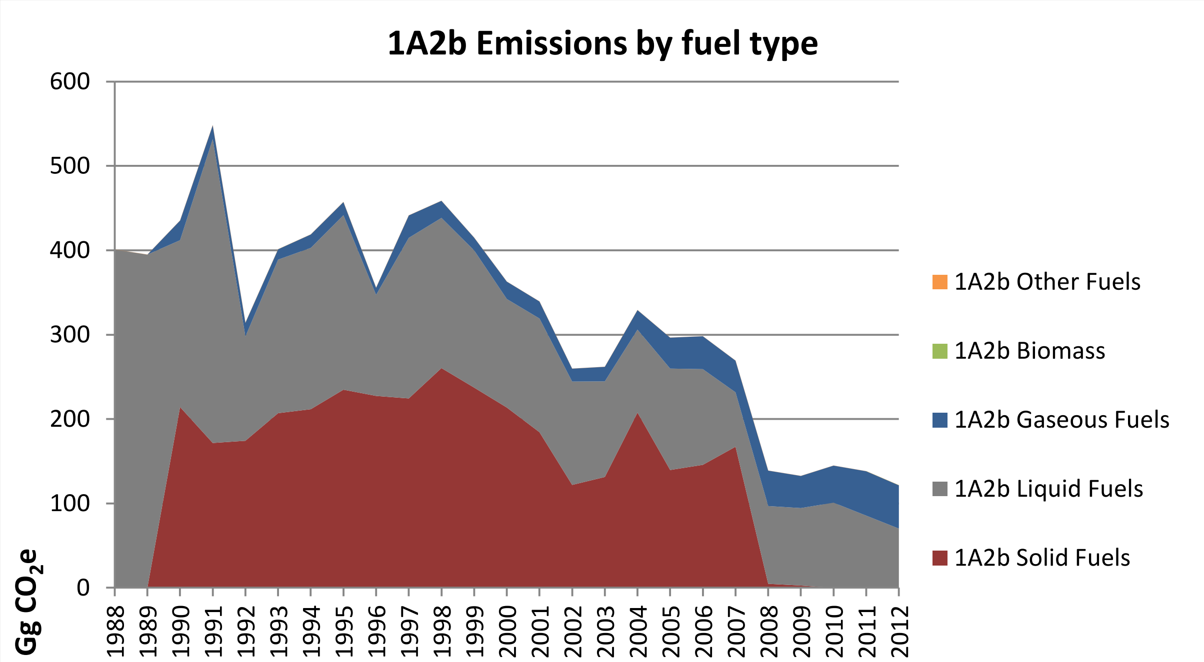


Figure 31 GHG emissions from CRF 1.A.2.b. Non-Ferrous Metals

The share of this subcategory from sector 1.A is 0.3% for the year 2012, while the share from the total GHG emissions is 0.2%.

Table 53 CO_2 emissions in CRF 1.A.2.b.Non-Ferrous Metals

CO_2 (Gg)	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	399.84	399.84	NO	NO	NO	NO
1989	393.78	393.78	NO	NO	NO	NO
1990	433.41	197.22	212.91	23.28	NO	NO
1991	546.18	359.14	170.58	16.46	NO	NO
1992	312.72	123.27	173.18	16.26	2.5760	NO
1993	399.48	181.48	205.70	12.31	2.3520	NO
1994	416.94	190.67	210.35	15.92	1.5680	NO
1995	455.23	206.25	233.35	15.62	1.9040	NO
1996	353.95	119.41	226.04	8.50	0.3360	NO
1997	439.44	189.83	223.06	26.55	0.4480	NO
1998	456.61	177.54	258.80	20.27	0.5600	NO
1999	413.17	162.22	235.82	15.13	0.4480	NO
2000	361.25	128.29	212.34	20.61	0.2240	NO
2001	337.84	134.42	183.25	20.17	0.1120	NO
2002	258.66	122.17	121.17	15.33	NO	NO
2003	260.80	113.05	130.49	17.25	NO	NO
2004	327.62	98.04	206.39	23.19	0.6720	NO
2005	295.27	119.88	138.75	36.63	NO	NO
2006	296.91	113.13	144.82	38.96	NO	NO
2007	267.96	64.34	166.16	37.46	0.1120	NO
2008	138.50	91.91	4.64	41.95	NO	NO
2009	132.21	91.57	2.60	38.04	NO	NO
2010	144.44	100.57	NO	43.88	0.1120	NO
2011	137.80	85.25	NO	52.56	NO	NO
2012	121.19	69.93	NO	51.26	NO	NO
Decrease	69.7%	82.5%	-	-	-	-

CO_2 (Gg)	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988-2012						
Decrease 1990-2012	72.0%	64.5%	-	-120.1%	-	-
Decrease 2011-2012	12.1%	18.0%	-	2.5%	-	-

Table 54 CH_4 emissions in CRF 1.A.2.b. Non-Ferrous Metals

CH_4 (Gg)	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.01054	0.01054	NO	NO	NO	NO
1989	0.01038	0.01038	NO	NO	NO	NO
1990	0.02752	0.00526	0.02014	0.00212	NO	NO
1991	0.02721	0.00962	0.01609	0.00150	NO	NO
1992	0.02199	0.00346	0.01636	0.00148	0.00069	NO
1993	0.02615	0.00498	0.01942	0.00112	0.00063	NO
1994	0.02700	0.00522	0.01991	0.00145	0.00042	NO
1995	0.02965	0.00565	0.02206	0.00142	0.00051	NO
1996	0.02547	0.00328	0.02132	0.00077	0.00009	NO
1997	0.02870	0.00512	0.02104	0.00242	0.00012	NO
1998	0.03120	0.00479	0.02441	0.00185	0.00015	NO
1999	0.02821	0.00439	0.02232	0.00138	0.00012	NO
2000	0.02563	0.00366	0.02003	0.00188	0.00006	NO
2001	0.02297	0.00382	0.01729	0.00184	0.00003	NO
2002	0.01633	0.00350	0.01143	0.00140	NO	NO
2003	0.01715	0.00327	0.01231	0.00157	NO	NO
2004	0.02432	0.00256	0.01947	0.00211	0.00018	NO
2005	0.01991	0.00348	0.01309	0.00333	NO	NO
2006	0.02051	0.00331	0.01366	0.00355	NO	NO
2007	0.02080	0.00168	0.01568	0.00341	0.00003	NO
2008	0.00670	0.00240	0.00048	0.00382	NO	NO
2009	0.00644	0.00270	0.00027	0.00346	NO	NO
2010	0.00712	0.00309	NO	0.00399	0.00003	NO
2011	0.00747	0.00269	NO	0.00478	NO	NO
2012	0.00696	0.00229	NO	0.00467	NO	NO
Decrease 1988-2012	33.9%	78.2%	-	-	-	-
Decrease 1990-2012	74.7%	56.4%	-	-120.2%	-	-
Decrease 2011-2012	6.9%	14.8%	-	2.4%	-	-

Table 55 N_2O emissions in CRF 1.A.2.b. Non-Ferrous Metals

N_2O (Gg)	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.003161	0.003161	NO	NO	NO	NO
1989	0.003114	0.003114	NO	NO	NO	NO
1990	0.004439	0.001577	0.002820	0.000042	NO	NO
1991	0.005103	0.002820	0.002253	0.000030	NO	NO
1992	0.003385	0.000974	0.002290	0.000030	0.000092	NO

N_2O (Gg)	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1993	0.004255	0.001430	0.002719	0.000022	0.000084	NO
1994	0.004375	0.001502	0.002788	0.000029	0.000056	NO
1995	0.004817	0.001631	0.003089	0.000028	0.000068	NO
1996	0.003934	0.000921	0.002985	0.000015	0.000012	NO
1997	0.004482	0.001471	0.002946	0.000048	0.000016	NO
1998	0.004849	0.001374	0.003418	0.000037	0.000020	NO
1999	0.004422	0.001254	0.003124	0.000028	0.000016	NO
2000	0.003819	0.000969	0.002804	0.000038	0.000008	NO
2001	0.003478	0.001017	0.002420	0.000037	0.000004	NO
2002	0.002549	0.000921	0.001600	0.000028	NO	NO
2003	0.002607	0.000852	0.001723	0.000031	NO	NO
2004	0.003560	0.000768	0.002726	0.000042	0.000024	NO
2005	0.002798	0.000898	0.001833	0.000067	NO	NO
2006	0.002829	0.000846	0.001913	0.000071	NO	NO
2007	0.002771	0.000504	0.002195	0.000068	0.000004	NO
2008	0.000864	0.000720	0.000067	0.000076	NO	NO
2009	0.000790	0.000683	0.000038	0.000069	NO	NO
2010	0.000819	0.000735	NO	0.000080	0.000004	NO
2011	0.000711	0.000615	NO	0.000096	NO	NO
2012	0.000589	0.000495	NO	0.000093	NO	NO
Decrease 1988-2012	81.4%	84.3%	-	-	-	-
Decrease 1990-2012	86.7%	68.6%	-	-120.2%	-	-
Decrease 2011-2012	17.2%	19.5%	-	2.4%	-	-

Table 56 GHG emissions in CRF 1.A.2.b. Non-Ferrous Metals

GHG (Gg)	TJ	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	5 267.60	401.04	401.04	NO	NO	NO	NO
1989	5 190.20	394.96	394.96	NO	NO	NO	NO
1990	5 066.91	435.36	197.82	214.20	23.34	NO	NO
1991	6 647.78	548.33	360.21	171.61	16.50	NO	NO
1992	3 615.94	314.23	123.64	174.24	16.30	0.0430	NO
1993	4 608.63	401.35	182.03	206.95	12.34	0.0393	NO
1994	4 836.30	418.87	191.25	211.64	15.96	0.0262	NO
1995	5 264.94	457.34	206.88	234.77	15.66	0.0318	NO
1996	3 863.12	355.71	119.76	227.42	8.52	0.0056	NO
1997	5 082.17	441.43	190.40	224.41	26.61	0.0075	NO
1998	5 143.72	458.77	178.07	260.37	20.32	0.0094	NO
1999	4 639.30	415.13	162.70	237.25	15.16	0.0075	NO
2000	4 072.44	362.97	128.67	213.63	20.67	0.0037	NO
2001	3 868.90	339.40	134.82	184.36	20.22	0.0019	NO
2002	3 034.09	259.80	122.52	121.91	15.36	NO	NO
2003	3 041.72	261.96	113.38	131.29	17.30	NO	NO
2004	3 655.13	329.23	98.33	207.65	23.24	0.0112	NO
2005	3 560.36	296.55	120.23	139.60	36.72	NO	NO
2006	3 571.75	298.21	113.46	145.70	39.05	NO	NO
2007	3 090.70	269.25	64.53	167.17	37.55	0.0019	NO

GHG (Gg)	TJ	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2008	2 012.27	138.91	92.19	4.67	42.05	NO	NO
2009	1 933.74	132.59	91.83	2.62	38.13	NO	NO
2010	2 139.60	144.85	100.86	NO	43.99	0.0019	NO
2011	2 096.10	138.18	85.49	NO	52.69	NO	NO
2012	1 873.60	121.52	70.13	NO	51.39	NO	NO
Decrease 1988-2012	64.4%	69.7%	82.5%	-	-	-	-
Decrease 1990-2012	63.0%	72.1%	64.5%	-	-120.1%	-	-
Decrease 2011-2012	10.6%	12.1%	18.0%	-	2.5%	-	-

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

After a discussion regarding the non-energy use of Coke Oven Coke in the non-ferrous metals industry, the National Statistics Institute initiated talks with the plant operators in order to clarify the situation, which led to the revision of the national energy balances. The quantities of Coke Oven Coke, which were previously reported under energy use are now accounted as non-energy use.

3.3.11.3 Chemicals (CRF 1.A.2.c.)

Category 1.A.2.c Chemicals enfolds emissions from fuel combustion in chemical and petrochemical industries.

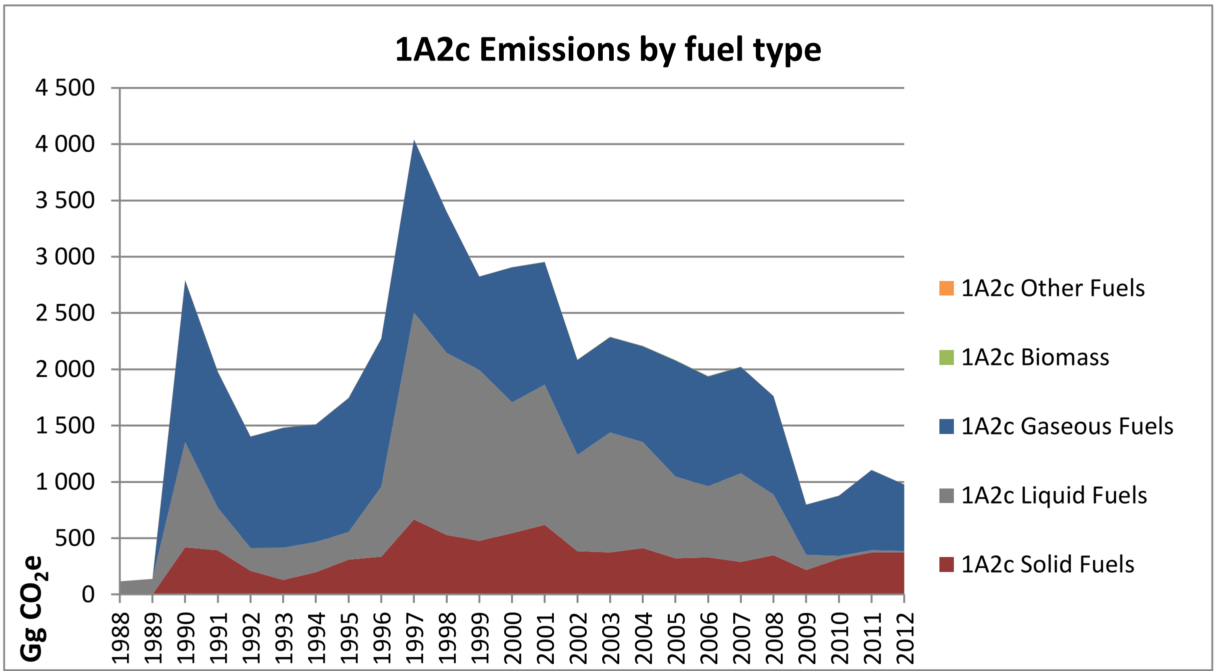


Figure 32 GHG emissions from CRF 1.A.2.c. Chemicals

The share of this subcategory from sector 1.A is 2.1% for the year 2012, while from the total GHG emissions it is 1.6%.

The trend analysis showed some significant variability in the fuel consumption in this category – after 1997 there is an increase in the liquid fuels and a decrease in the gaseous fuels. Additional checks revealed two separate factors contributing to this trend – after 1997 the National Statistics changed the methodologies for fuel allocation: fuels consumed by autoproducer electricity, CHP and heat plants were reallocated from transformation sector to the respective industry sector. The second factor, responsible for the decrease in gaseous fuel consumption is the long-term crisis in the fertilizer production industry in Bulgaria, which has caused the gradual closure of two of the plants around 2001.

Table 57 CO_2 emissions in CRF 1.A.2.c. Chemicals

CO_2 (Gg)	CRF 1.A.2.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	115.58	115.58	NO	NO	NO	NO
1989	137.44	137.44	NO	NO	NO	NO
1990	2 783.49	930.31	415.79	1 437.39	NO	NO
1991	1 972.21	376.35	390.18	1 205.68	NO	NO
1992	1 398.32	202.03	208.33	987.97	0.56	NO
1993	1 476.71	284.22	128.44	1 064.05	0.11	NO
1994	1 506.46	267.74	195.88	1 042.84	0.22	NO
1995	1 739.82	243.57	307.62	1 188.63	0.22	NO
1996	2 265.55	619.34	333.30	1 312.91	0.78	NO
1997	4 028.59	1 832.51	661.85	1 534.23	6.27	NO
1998	3 389.24	1 612.53	524.60	1 252.10	2.80	NO
1999	2 815.30	1 514.70	472.75	827.85	3.25	NO
2000	2 897.19	1 158.24	541.13	1 197.82	7.95	NO
2001	2 943.27	1 241.80	614.04	1 087.43	104.61	NO
2002	2 076.40	851.79	382.17	842.43	100.80	NO
2003	2 279.13	1 061.93	371.17	846.04	155.23	NO
2004	2 198.05	939.12	409.03	849.90	170.24	NO
2005	2 072.10	724.30	318.80	1 029.00	189.39	NO
2006	1 930.42	629.71	327.33	973.39	194.66	NO
2007	2 014.94	784.60	287.31	943.03	128.91	NO
2008	1 756.52	537.08	346.21	873.22	0.11	NO
2009	795.12	134.28	215.71	445.13	0.11	NO
2010	873.68	25.27	313.81	534.61	0.22	NO
2011	1 101.27	19.14	370.59	711.54	0.11	NO
2012	972.80	12.33	370.47	590.00	0.22	NO
Decrease 1988-2012	-741.7%	89.3%	-	-	-	-
Decrease 1990-2012	65.1%	98.7%	10.9%	59.0%	-	-
Decrease 2011-2012	11.7%	35.6%	0.0%	17.1%	-100.0%	-

Table 58 CH_4 emissions in CRF 1.A.2.c. Chemicals

CH_4 (Gg)	CRF 1.A.2.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.00315	0.00315	NO	NO	NO	NO
1989	0.00375	0.00375	NO	NO	NO	NO
1990	0.22492	0.05439	0.03968	0.13084	NO	NO
1991	0.16671	0.02001	0.03695	0.10975	NO	NO

CH_4 (Gg)	CRF 1.A.2.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1992	0.11896	0.00895	0.01993	0.08993	0.00015	NO
1993	0.12235	0.01320	0.01226	0.09686	0.00003	NO
1994	0.12566	0.01196	0.01871	0.09493	0.00006	NO
1995	0.14672	0.00920	0.02926	0.10820	0.00006	NO
1996	0.17162	0.02023	0.03167	0.11951	0.00021	NO
1997	0.26395	0.05742	0.06520	0.13966	0.00168	NO
1998	0.22252	0.05638	0.05140	0.11398	0.00075	NO
1999	0.19206	0.06942	0.04641	0.07536	0.00087	NO
2000	0.22268	0.05867	0.05284	0.10904	0.00213	NO
2001	0.24840	0.06161	0.05978	0.09899	0.02802	NO
2002	0.17355	0.03328	0.03659	0.07668	0.02700	NO
2003	0.19977	0.04539	0.03579	0.07701	0.04158	NO
2004	0.20590	0.04192	0.04101	0.07736	0.04560	NO
2005	0.21264	0.03601	0.03223	0.09367	0.05073	NO
2006	0.20797	0.03399	0.03323	0.08861	0.05214	NO
2007	0.19419	0.04433	0.02946	0.08587	0.03453	NO
2008	0.14841	0.03449	0.03435	0.07953	0.00003	NO
2009	0.07158	0.00940	0.02165	0.04050	0.00003	NO
2010	0.08207	0.00115	0.03222	0.04863	0.00006	NO
2011	0.10409	0.00099	0.03836	0.06470	0.00003	NO
2012	0.09254	0.00033	0.03844	0.05371	0.00006	NO
Decrease 1988-2012	-2835.6%	89.6%	-	-	-	-
Decrease 1990-2012	58.9%	99.4%	3.1%	58.9%	-	-
Decrease 2011-2012	11.1%	66.9%	-0.2%	17.0%	-100.0%	-

Table 59 N_2O emissions in CRF 1.A.2.c. Chemicals

N_2O (Gg)	CRF 1.A.2.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.000946	0.000946	NO	NO	NO	NO
1989	0.001125	0.001125	NO	NO	NO	NO
1990	0.011685	0.003512	0.005556	0.002617	NO	NO
1991	0.009037	0.001669	0.005173	0.002195	NO	NO
1992	0.005754	0.001145	0.002790	0.001799	0.000020	NO
1993	0.005173	0.001516	0.001716	0.001937	0.000004	NO
1994	0.006018	0.001492	0.002620	0.001899	0.000008	NO
1995	0.007839	0.001570	0.004097	0.002164	0.000008	NO
1996	0.011452	0.004599	0.004434	0.002390	0.000028	NO
1997	0.025590	0.013445	0.009128	0.002793	0.000224	NO
1998	0.020751	0.011175	0.007197	0.002280	0.000100	NO
1999	0.016348	0.008227	0.006498	0.001507	0.000116	NO
2000	0.015424	0.005561	0.007398	0.002181	0.000284	NO
2001	0.020249	0.006164	0.008369	0.001980	0.003736	NO
2002	0.015619	0.005363	0.005123	0.001534	0.003600	NO
2003	0.018572	0.006477	0.005010	0.001540	0.005544	NO
2004	0.018852	0.005483	0.005742	0.001547	0.006080	NO
2005	0.016860	0.003710	0.004513	0.001873	0.006764	NO
2006	0.016228	0.002852	0.004652	0.001772	0.006952	NO

N_2O (Gg)	CRF 1.A.2.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2007	0.013734	0.003288	0.004125	0.001717	0.004604	NO
2008	0.008072	0.001668	0.004810	0.001591	0.000004	NO
2009	0.004146	0.000301	0.003030	0.000810	0.000004	NO
2010	0.005628	0.000136	0.004511	0.000973	0.000008	NO
2011	0.006757	0.000088	0.005371	0.001294	0.000004	NO
2012	0.006563	0.000099	0.005382	0.001074	0.000008	NO
Decrease 1988-2012	-593.9%	89.6%	-	-	-	-
Decrease 1990-2012	43.8%	97.2%	3.1%	58.9%	-	-
Decrease 2011-2012	2.9%	-11.7%	-0.2%	17.0%	-100.0%	-

Table 60 GHG emissions in CRF 1.A.2.c. Chemicals

GHG (Gg)	TJ	CRF 1.A.2.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	1 576.20	115.94	115.94	NO	NO	NO	NO
1989	1 874.40	137.87	137.87	NO	NO	NO	NO
1990	43 612.47	2 791.83	932.54	418.35	1 440.95	NO	NO
1991	31 006.86	1 978.52	377.28	392.56	1 208.67	NO	NO
1992	22 808.99	1 402.61	202.57	209.61	990.42	0.0094	NO
1993	24 579.72	1 480.88	284.96	129.23	1 066.69	0.0019	NO
1994	24 592.26	1 510.96	268.45	197.08	1 045.42	0.0037	NO
1995	27 893.19	1 745.33	244.25	309.51	1 191.57	0.0037	NO
1996	35 617.14	2 272.71	621.19	335.34	1 316.16	0.0131	NO
1997	59 165.91	4 042.06	1 837.88	666.05	1 538.03	0.1047	NO
1998	50 002.79	3 400.34	1 617.18	527.91	1 255.20	0.0468	NO
1999	40 953.29	2 824.40	1 518.71	475.74	829.90	0.0542	NO
2000	43 597.71	2 906.65	1 161.19	544.53	1 200.79	0.1328	NO
2001	44 315.76	2 954.76	1 245.00	617.89	1 090.13	1.7466	NO
2002	31 583.80	2 084.88	854.15	384.53	844.52	1.6830	NO
2003	35 412.86	2 289.08	1 064.89	373.47	848.13	2.5918	NO
2004	34 454.76	2 208.22	941.70	411.67	852.00	2.8424	NO
2005	34 052.74	2 081.80	726.21	320.87	1 031.55	3.1622	NO
2006	31 907.55	1 939.82	631.30	329.47	975.80	3.2501	NO
2007	32 710.64	2 023.28	786.55	289.21	945.36	2.1524	NO
2008	27 289.28	1 762.14	538.33	348.42	875.38	0.0019	NO
2009	12 267.00	797.91	134.57	217.11	446.24	0.0019	NO
2010	13 302.58	877.15	25.33	315.88	535.93	0.0037	NO
2011	17 049.65	1 105.55	19.19	373.06	713.30	0.0019	NO
2012	14 752.95	976.78	12.37	372.94	591.46	0.0037	NO
Decrease 1988-2012	-836.0%	-742.5%	89.3%	-	-	-	-
Decrease 1990-2012	66.2%	65.0%	98.7%	10.9%	59.0%	-	-
Decrease 2011-2012	13.5%	11.6%	35.5%	0.0%	17.1%	-100.0%	-

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

Following the recommendation of the Technical review of GHG inventories under the EU Effort Sharing Decision (ESD) in 2012, we revised the methodology concerning Chemical sector in order to remove the double counting with the IP sector. The National Statistics Institute initiated talks with the plant operators in order to clarify the situation, but the revision of the national energy balances is still pending due to disagreement of some of the reporting companies. This mandates a correction of the National Energy Balance for the purpose of the elaboration of the National GHG inventory. Using on a stoichiometric calculation based on the production of ammonia, were estimated the actual quantities of natural gas as non-energy use in the chemical industry. The remaining quantities of natural gas, which were reported under Chemical industry were considered as energy used and accounted in the Energy sector.

1.A.2.d. Pulp, Paper and Print

Category 1.A.2.d Pulp, Paper and Print enfolds emissions from the fuel combustion in pulp, paper and print industries.

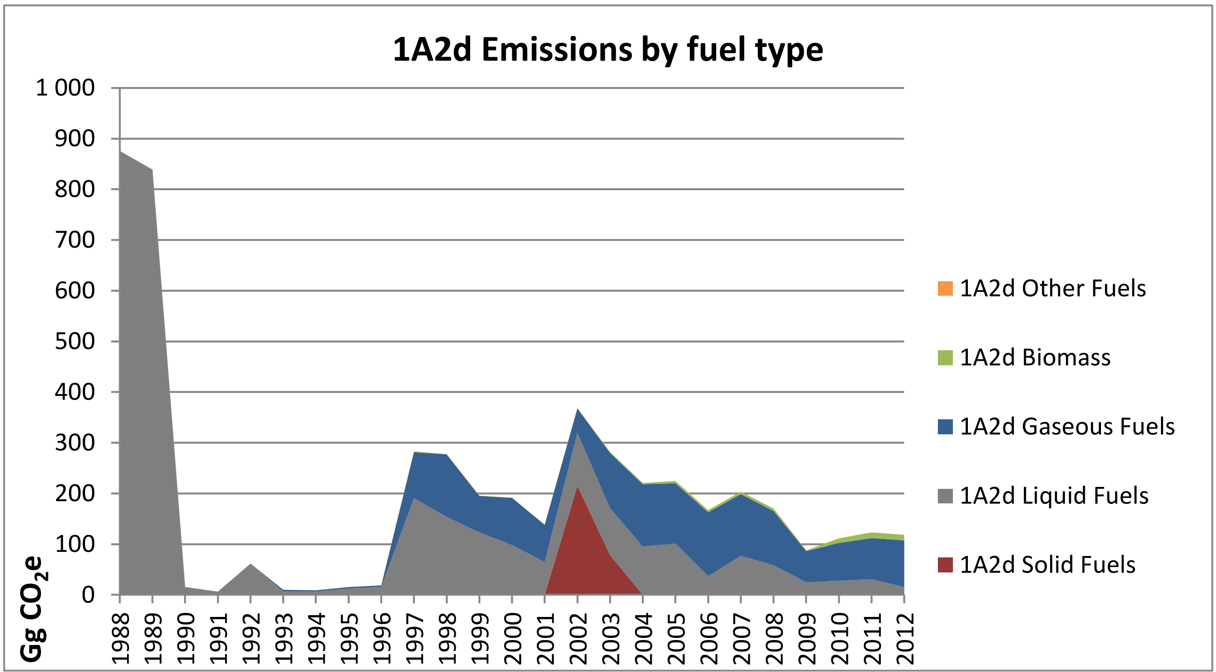


Figure 33 GHG emissions from CRF 1.A.2.d. Pulp, Paper and Print

The share of this subcategory from sector 1.A is 0.3% for 2012, while from the total GHGs emissions it is 0.2%.

Table 61 CO_2 emissions in CRF 1.A.2.d. Pulp, Paper and Print

CO_2 (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	873.16	873.16	NO	NO	NO	NO
1989	836.40	836.40	NO	NO	NO	NO
1990	15.39	15.39	NO	NO	NO	NO
1991	6.20	6.20	NO	NO	NO	NO
1992	61.35	61.35	NO	NO	NO	NO
1993	9.86	6.20	NO	3.66	NO	NO

CO_2 (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1994	8.87	6.20	NO	2.67	0.1120	NO
1995	15.25	12.33	NO	2.92	0.2240	NO
1996	18.56	15.39	NO	3.16	0.1120	NO
1997	280.60	189.99	NO	90.62	90.2720	NO
1998	276.37	153.22	NO	123.14	12.8800	NO
1999	194.71	122.59	NO	72.13	7.6160	NO
2000	190.57	98.08	NO	92.49	38.8640	NO
2001	137.74	64.38	NO	73.36	3.4720	NO
2002	366.07	104.20	213.47	48.40	12.2080	NO
2003	278.72	91.99	77.87	108.86	118.8320	NO
2004	217.73	94.98	NO	122.75	132.8320	NO
2005	219.56	101.11	NO	118.45	263.3120	NO
2006	162.44	36.57	NO	125.86	253.6800	NO
2007	198.16	76.59	NO	121.57	270.9280	NO
2008	164.99	58.21	NO	106.77	290.1920	NO
2009	86.04	24.51	NO	61.53	86.6880	NO
2010	102.02	27.57	NO	74.45	540.8480	NO
2011	111.75	30.64	NO	81.11	660.2400	NO
2012	107.16	15.32	NO	91.84	649.7120	NO
Decrease 1988-2012	87.7%	98.2%	-	-	-	-
Decrease 1990-2012	-596.1%	0.5%	-	-	-	-
Decrease 2011-2012	4.1%	50.0%	-	-13.2%	1.6%	-

Table 62 CH_4 emissions in CRF 1.A.2.d. Pulp, Paper and Print

CH_4 (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.02280	0.02280	NO	NO	NO	NO
1989	0.02184	0.02184	NO	NO	NO	NO
1990	0.00041	0.00041	NO	NO	NO	NO
1991	0.00017	0.00017	NO	NO	NO	NO
1992	0.00161	0.00161	NO	NO	NO	NO
1993	0.00050	0.00017	NO	0.00033	NO	NO
1994	0.00044	0.00017	NO	0.00024	0.00003	NO
1995	0.00065	0.00033	NO	0.00027	0.00006	NO
1996	0.00073	0.00041	NO	0.00029	0.00003	NO
1997	0.03739	0.00496	NO	0.00825	0.02418	NO
1998	0.01866	0.00400	NO	0.01121	0.00345	NO
1999	0.01181	0.00320	NO	0.00657	0.00204	NO
2000	0.02139	0.00256	NO	0.00842	0.01041	NO
2001	0.00929	0.00168	NO	0.00668	0.00093	NO
2002	0.03208	0.00272	0.02168	0.00441	0.00327	NO
2003	0.05206	0.00241	0.00791	0.00991	0.03183	NO
2004	0.04924	0.00248	NO	0.01117	0.03558	NO
2005	0.08396	0.00264	NO	0.01078	0.07053	NO
2006	0.08037	0.00096	NO	0.01146	0.06795	NO
2007	0.08564	0.00200	NO	0.01107	0.07257	NO
2008	0.08897	0.00152	NO	0.00972	0.07773	NO

CH_4 (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2009	0.02946	0.00064	NO	0.00560	0.02322	NO
2010	0.15236	0.00072	NO	0.00677	0.14487	NO
2011	0.18503	0.00080	NO	0.00738	0.17685	NO
2012	0.18279	0.00040	NO	0.00836	0.17403	NO
Decrease 1988-2012	-701.7%	98.2%	-	-	-	-
Decrease 1990-2012	-44570.3%	2.2%	-	-	-	-
Decrease 2011-2012	1.2%	50.0%	-	-13.4%	1.6%	-

Table 63 N_2O emissions in CRF 1.A.2.d. Pulp, Paper and Print

N_2O (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.006840	0.006840	NO	NO	NO	NO
1989	0.006552	0.006552	NO	NO	NO	NO
1990	0.000123	0.000123	NO	NO	NO	NO
1991	0.000051	0.000051	NO	NO	NO	NO
1992	0.000483	0.000483	NO	NO	NO	NO
1993	0.000057	0.000051	NO	0.000007	NO	NO
1994	0.000060	0.000051	NO	0.000005	0.000004	NO
1995	0.000112	0.000099	NO	0.000005	0.000008	NO
1996	0.000133	0.000123	NO	0.000006	0.000004	NO
1997	0.004878	0.001489	NO	0.000165	0.003224	NO
1998	0.001886	0.001201	NO	0.000224	0.000460	NO
1999	0.001365	0.000961	NO	0.000131	0.000272	NO
2000	0.002326	0.000769	NO	0.000168	0.001388	NO
2001	0.000763	0.000505	NO	0.000134	0.000124	NO
2002	0.004376	0.000817	0.003035	0.000088	0.000436	NO
2003	0.006272	0.000723	0.001107	0.000198	0.004244	NO
2004	0.005713	0.000745	NO	0.000223	0.004744	NO
2005	0.010413	0.000793	NO	0.000216	0.009404	NO
2006	0.009577	0.000288	NO	0.000229	0.009060	NO
2007	0.010497	0.000600	NO	0.000221	0.009676	NO
2008	0.011014	0.000456	NO	0.000194	0.010364	NO
2009	0.003400	0.000192	NO	0.000112	0.003096	NO
2010	0.019667	0.000216	NO	0.000135	0.019316	NO
2011	0.023968	0.000240	NO	0.000148	0.023580	NO
2012	0.023491	0.000120	NO	0.000167	0.023204	NO
Decrease 1988-2012	-243.4%	98.2%	-	-	-	-
Decrease 1990-2012	-19035.9%	2.2%	-	-	-	-
Decrease 2011-2012	2.0%	50.0%	-	-13.4%	1.6%	-

Table 64 GHG emissions in CRF 1.A.2.d. Pulp, Paper and Print

GHG (Gg)	TJ	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels

GHG (Gg)	TJ	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	11 400.00	875.76	875.76	NO	NO	NO	NO
1989	10 920.00	838.89	838.89	NO	NO	NO	NO
1990	204.60	15.44	15.44	NO	NO	NO	NO
1991	84.60	6.22	6.22	NO	NO	NO	NO
1992	804.60	61.53	61.53	NO	NO	NO	NO
1993	151.20	9.89	6.22	NO	3.67	NO	NO
1994	134.20	8.90	6.22	NO	2.68	0.0019	NO
1995	219.70	15.30	12.37	NO	2.92	0.0037	NO
1996	263.20	18.61	15.44	NO	3.17	0.0019	NO
1997	4 938.00	282.90	190.55	NO	90.84	1.5072	NO
1998	4 359.20	277.34	153.68	NO	123.45	0.2151	NO
1999	2 983.40	195.38	122.95	NO	72.31	0.1272	NO
2000	3 313.20	191.74	98.37	NO	92.72	0.6489	NO
2001	2 208.90	138.17	64.57	NO	73.54	0.0580	NO
2002	4 520.03	368.10	104.52	214.86	48.52	0.2038	NO
2003	5 038.15	281.76	92.26	78.38	109.13	1.9841	NO
2004	4 662.57	220.53	95.26	NO	123.05	2.2178	NO
2005	5 829.27	224.55	101.41	NO	118.74	4.3964	NO
2006	5 035.71	167.09	36.68	NO	126.17	4.2356	NO
2007	5 633.00	203.21	76.82	NO	121.87	4.5235	NO
2008	5 295.90	170.27	58.38	NO	107.04	4.8452	NO
2009	2 213.60	87.72	24.58	NO	61.69	1.4474	NO
2010	6 543.50	111.32	27.66	NO	74.63	9.0302	NO
2011	7 770.10	123.06	30.73	NO	81.31	11.0237	NO
2012	7 673.20	118.28	15.36	NO	92.07	10.8479	NO
Decrease 1988-2012	32.7%	86.5%	98.2%	-	-	-	-
Decrease 1990-2012	-3650.3%	-666.0%	0.5%	-	-	-	-
Decrease 2011-2012	1.2%	3.9%	50.0%	-	-13.2%	1.6%	-

3.3.11.4 Food Processing, Beverages and Tobacco (CRF 1.A.2.e.)

Category 1.A.2.e Food Processing, Beverages and Tobacco enfolds emissions from fuel combustion in food processing, beverages and tobacco industry.

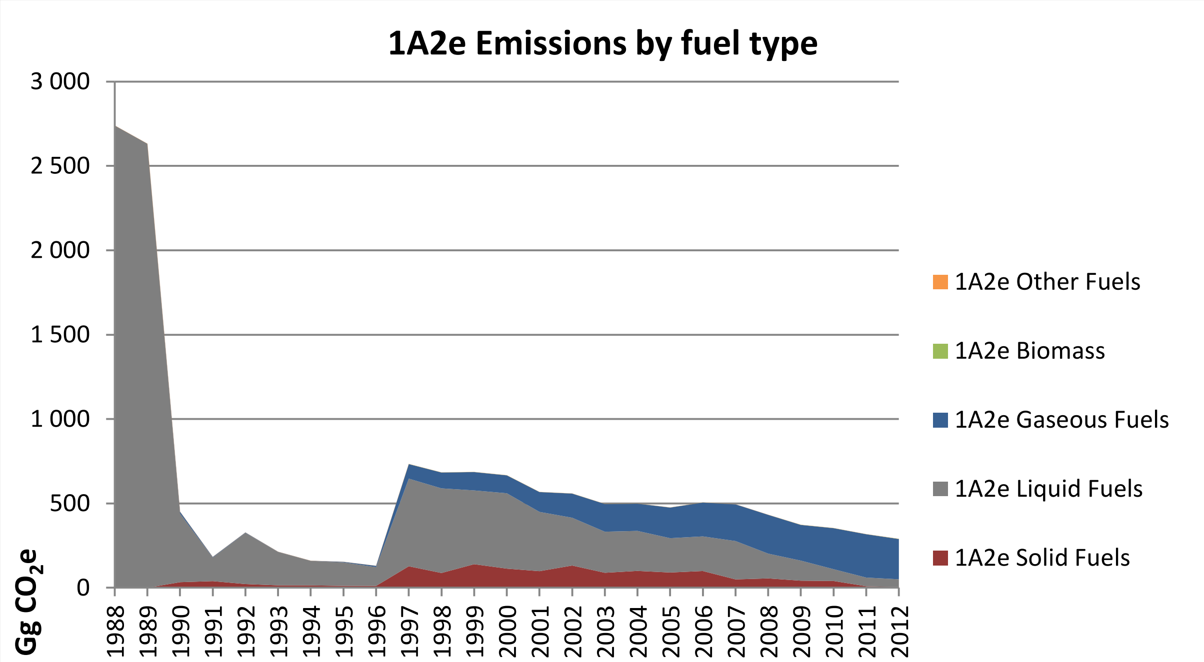


Figure 34 GHG emissions from 1.A.2.e. Food Processing, Beverages and Tobacco

The share of this subcategory from sector 1.A is 0.6% for 2012 and the share from total GHGs emissions is 0.5%.

Table 65 CO_2 emissions in CRF 1.A.2.e. Food Processing, Beverages and Tobacco

CO_2 (Gg)	CRF 1.A.2.e.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	2 731.92	2 731.92	NO	NO	NO	NO
1989	2 624.15	2 624.15	NO	NO	NO	NO
1990	449.09	404.99	32.72	11.37	NO	NO
1991	181.94	139.58	38.85	3.51	NO	NO
1992	326.59	302.03	21.74	2.82	3.2480	NO
1993	212.64	197.48	14.07	1.09	0.7840	NO
1994	159.58	145.13	13.80	0.64	0.8960	NO
1995	153.26	138.85	10.99	3.41	1.9040	NO
1996	129.40	110.98	10.91	7.51	3.0240	NO
1997	730.44	517.88	126.39	86.17	44.2400	NO
1998	680.91	500.26	86.82	93.83	30.5760	NO
1999	683.32	436.02	138.69	108.61	26.7680	NO
2000	663.96	445.48	112.54	105.94	36.8480	NO
2001	565.39	350.41	97.57	117.41	22.0640	NO
2002	556.25	282.62	130.72	142.92	24.7520	NO
2003	494.91	242.78	88.16	163.98	22.8480	NO
2004	497.03	236.56	99.02	161.46	25.6480	NO
2005	473.70	202.80	89.76	181.13	19.4880	NO
2006	503.48	204.77	98.40	200.31	24.8640	NO
2007	493.01	226.70	49.12	217.19	6.2720	NO
2008	430.97	146.44	55.07	229.46	9.6320	NO
2009	371.35	118.68	41.50	211.17	45.2480	NO
2010	352.24	69.85	39.74	242.64	33.0400	NO
2011	316.47	51.28	8.85	256.35	24.7520	NO
2012	288.11	45.53	4.42	238.16	60.9280	NO
Decrease 1988-2012	89.5%	98.3%	-	-	-	-

CO_2 (Gg)	CRF 1.A.2.e.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
Decrease 1990-2012	35.8%	88.8%	86.5%	-1994.6%	-	-
Decrease 2011-2012	9.0%	11.2%	50.1%	7.1%	-146.2%	-

Table 66 CH_4 emissions in 1.A.2.e. Food Processing, Beverages and Tobacco

CH_4 (Gg)	CRF 1.A.2.e.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.0720	0.0720	NO	NO	NO	NO
1989	0.0692	0.0692	NO	NO	NO	NO
1990	0.0151	0.0109	0.0032	0.0010	NO	NO
1991	0.0079	0.0038	0.0038	0.0003	NO	NO
1992	0.0113	0.0081	0.0021	0.0003	0.0009	NO
1993	0.0069	0.0053	0.0013	0.0001	0.0002	NO
1994	0.0056	0.0039	0.0014	0.0001	0.0002	NO
1995	0.0056	0.0037	0.0011	0.0003	0.0005	NO
1996	0.0057	0.0031	0.0011	0.0007	0.0008	NO
1997	0.0461	0.0137	0.0127	0.0078	0.0119	NO
1998	0.0390	0.0135	0.0087	0.0085	0.0082	NO
1999	0.0429	0.0118	0.0140	0.0099	0.0072	NO
2000	0.0428	0.0119	0.0114	0.0096	0.0099	NO
2001	0.0359	0.0094	0.0099	0.0107	0.0059	NO
2002	0.0407	0.0078	0.0132	0.0130	0.0066	NO
2003	0.0365	0.0066	0.0089	0.0149	0.0061	NO
2004	0.0384	0.0066	0.0102	0.0147	0.0069	NO
2005	0.0367	0.0057	0.0093	0.0165	0.0052	NO
2006	0.0408	0.0057	0.0102	0.0182	0.0067	NO
2007	0.0327	0.0063	0.0049	0.0198	0.0017	NO
2008	0.0336	0.0045	0.0056	0.0209	0.0026	NO
2009	0.0395	0.0039	0.0043	0.0192	0.0121	NO
2010	0.0376	0.0025	0.0042	0.0221	0.0089	NO
2011	0.0330	0.0021	0.0009	0.0233	0.0066	NO
2012	0.0401	0.0017	0.0004	0.0217	0.0163	NO
Decrease 1988-2012	44.3%	97.7%	-	-	-	-
Decrease 1990-2012	-165.2%	84.7%	86.1%	-1994.8%	-	-
Decrease 2011-2012	-21.7%	21.6%	50.1%	7.0%	-146.2%	-

Table 67 N_2O emissions in 1.A.2.e. Food Processing, Beverages and Tobacco

N_2O (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.021607	0.021607	NO	NO	NO	NO
1989	0.020753	0.020753	NO	NO	NO	NO
1990	0.003740	0.003276	0.000443	0.000021	NO	NO
1991	0.001677	0.001142	0.000529	0.000006	NO	NO
1992	0.002833	0.002417	0.000295	0.000005	0.000116	NO
1993	0.001805	0.001587	0.000188	0.000002	0.000028	NO

N_2O (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1994	0.001393	0.001169	0.000191	0.000001	0.000032	NO
1995	0.001340	0.001116	0.000150	0.000006	0.000068	NO
1996	0.001152	0.000876	0.000154	0.000014	0.000108	NO
1997	0.007568	0.004048	0.001784	0.000157	0.001580	NO
1998	0.006405	0.003919	0.001224	0.000171	0.001092	NO
1999	0.006532	0.003419	0.001960	0.000198	0.000956	NO
2000	0.006615	0.003513	0.001593	0.000193	0.001316	NO
2001	0.005152	0.002767	0.001384	0.000214	0.000788	NO
2002	0.005206	0.002212	0.001850	0.000260	0.000884	NO
2003	0.004269	0.001911	0.001244	0.000299	0.000816	NO
2004	0.004476	0.001836	0.001430	0.000294	0.000916	NO
2005	0.003886	0.001563	0.001297	0.000330	0.000696	NO
2006	0.004256	0.001574	0.001429	0.000365	0.000888	NO
2007	0.003063	0.001751	0.000692	0.000396	0.000224	NO
2008	0.002629	0.001080	0.000787	0.000418	0.000344	NO
2009	0.003444	0.000845	0.000599	0.000384	0.001616	NO
2010	0.002688	0.000480	0.000587	0.000441	0.001180	NO
2011	0.001791	0.000317	0.000124	0.000466	0.000884	NO
2012	0.002979	0.000307	0.000062	0.000434	0.002176	NO
Decrease 1988-2012	86.2%	98.6%	-	-	-	-
Decrease 1990-2012	20.4%	90.6%	86.1%	-1994.8%	-	-
Decrease 2011-2012	-66.4%	2.9%	50.1%	7.0%	-146.2%	-

Table 68 GHG emissions in 1.A.2.e. Food Processing, Beverages and Tobacco

GHG (Gg)	TJ	CRF 1.A.2.e.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	36 011.40	2 740.13	2 740.13	NO	NO	NO	NO
1989	34 588.00	2 632.03	2 632.03	NO	NO	NO	NO
1990	5 984.34	450.56	406.24	32.93	11.40	NO	NO
1991	2 344.95	182.62	140.01	39.09	3.52	NO	NO
1992	4 319.24	327.71	302.95	21.88	2.82	0.0542	NO
1993	2 806.06	213.34	198.09	14.15	1.09	0.0131	NO
1994	2 104.79	160.12	145.58	13.89	0.64	0.0150	NO
1995	2 045.98	153.79	139.28	11.06	3.42	0.0318	NO
1996	1 772.86	129.88	111.31	10.98	7.53	0.0505	NO
1997	10 022.26	733.75	519.42	127.21	86.38	0.7387	NO
1998	9 463.30	683.71	501.75	87.38	94.06	0.5105	NO
1999	9 391.03	686.24	437.33	139.59	108.88	0.4469	NO
2000	9 289.09	666.91	446.82	113.27	106.20	0.6152	NO
2001	7 972.40	567.74	351.47	98.20	117.70	0.3684	NO
2002	7 908.14	558.72	283.47	131.57	143.27	0.4133	NO
2003	7 301.38	497.01	243.51	88.73	164.38	0.3815	NO
2004	7 337.51	499.23	237.26	99.68	161.86	0.4282	NO
2005	7 090.76	475.67	203.41	90.36	181.58	0.3254	NO
2006	7 600.79	505.66	205.37	99.06	200.81	0.4151	NO
2007	7 501.24	494.65	227.37	49.44	217.73	0.1047	NO
2008	6 780.69	432.49	146.87	55.43	230.03	0.1608	NO

GHG (Gg)	TJ	CRF 1.A.2.e.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2009	6 273.22	373.24	119.02	41.78	211.69	0.7555	NO
2010	6 082.06	353.86	70.05	40.02	243.24	0.5517	NO
2011	5 690.71	317.72	51.42	8.91	256.98	0.4133	NO
2012	5 551.54	289.87	45.66	4.45	238.75	1.0173	NO
Decrease 1988-2012	84.6%	89.4%	98.3%	-	-	-	-
Decrease 1990-2012	7.2%	35.7%	88.8%	86.5%	-1994.6%	-	-
Decrease 2011-2012	2.4%	8.8%	11.2%	50.1%	7.1%	-146.2%	-

3.3.11.5 Other industries (CRF 1.A.2.f.)

Category 1.A.2.f Other industries enfolds emissions from fuel combustion from all activities which were not classified in any of the other subcategories from 1.A.2 subcategory.

Most notably these are:

- Autoproducer Electricity Plants
- Autoproducer CHP Plants
- Autoproducer Heat Plants
- Non-Metallic Minerals
- Transport Equipment
- Machinery
- Mining and Quarrying
- Wood and Wood Products
- Construction
- Textiles and Leather
- Non-specified (Industry)

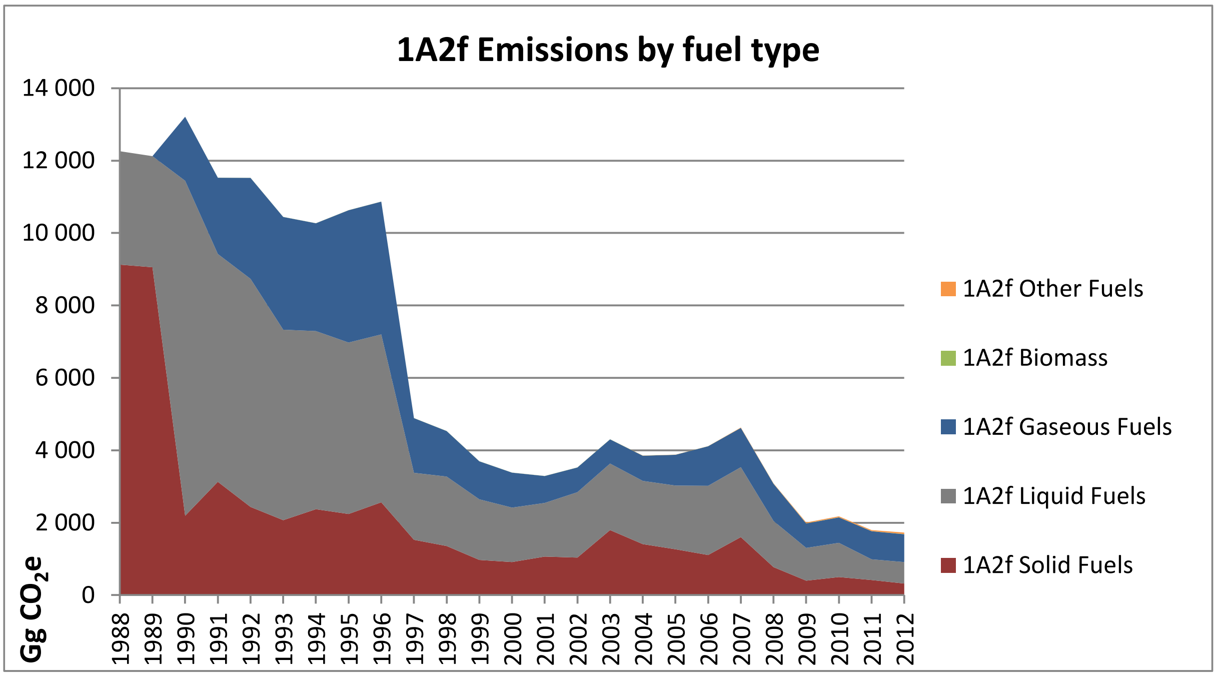


Figure 35 GHG emissions from 1.A.2.f. Other industries

The share of this subcategory from sector 1.A is 3.8% for 2012, while the share from total GHGs emissions is 2.8%.

Up to 1997 there was a significantly higher consumption in this sector, due to the fact that the total amount of fuels used by autoproducers CHP and heat plants was reported under autoproducers instead of reporting only the quantities sold to third parties. The National statistics changed their methodologies after 1997 and reallocated fuels used for the production of electricity and heat for own use to the respective subcategories from category 1.A.2. This sector also includes the emissions from the use of alternative fuels (e.g. SRF/RDF, waste oils and tyres, etc.) in the cement industry, which started after 2004.

Table 69 CO_2 emissions in 1.A.2.f. Other industries

CO_2 (Gg)	CRF 1.A.2.f.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	12 192.34	3 122.90	9 069.45	NO	NO	NO
1989	12 055.81	3 058.02	8 997.78	NO	NO	NO
1990	13 166.47	9 223.84	2 178.43	1 764.21	NO	NO
1991	11 483.98	6 273.56	3 109.26	2 101.16	168.00	NO
1992	11 482.56	6 281.37	2 419.75	2 781.44	144.48	NO
1993	10 407.60	5 244.81	2 056.65	3 106.13	136.30	NO
1994	10 233.06	4 904.60	2 357.59	2 970.88	144.93	NO
1995	10 592.78	4 721.59	2 226.50	3 644.68	136.53	NO
1996	10 828.20	4 623.00	2 546.88	3 658.33	125.10	NO
1997	4 868.98	1 844.74	1 517.98	1 506.25	178.53	NO
1998	4 513.61	1 912.64	1 347.33	1 253.64	181.55	NO
1999	3 681.67	1 669.52	965.26	1 046.90	183.68	NO
2000	3 369.76	1 499.04	907.17	963.55	128.80	NO
2001	3 276.05	1 476.99	1 057.63	741.43	143.81	NO
2002	3 511.14	1 800.72	1 029.90	680.53	179.09	NO
2003	4 283.25	1 832.28	1 784.23	666.74	200.14	NO
2004	3 837.44	1 741.26	1 399.34	693.38	203.15	3.46
2005	3 862.56	1 755.03	1 257.70	847.03	120.73	2.81
2006	4 097.50	1 906.98	1 100.06	1 088.82	141.93	1.64
2007	4 609.41	1 925.30	1 591.90	1 082.48	113.41	9.73
2008	3 072.40	1 271.13	767.64	1 025.90	225.82	7.74
2009	1 993.93	902.71	396.18	672.62	286.31	22.42
2010	2 164.44	943.14	495.32	700.87	243.23	25.11
2011	1 785.62	570.95	413.92	774.34	216.35	26.42
2012	1 715.42	590.84	317.63	766.81	339.52	40.14
Decrease 1988-2012	85.9%	81.1%	96.5%	-	-	-
Decrease 1990-2012	87.0%	93.6%	85.4%	56.5%	-	-
Decrease 2011-2012	3.9%	-3.5%	23.3%	1.0%	-56.9%	-52.0%

Table 70 CH_4 emissions in 1.A.2.f. Other industries

CH_4 (Gg)	CRF 1.A.2.f.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.9897	0.0835	0.9062	NO	NO	NO
1989	0.9808	0.0815	0.8992	NO	NO	NO
1990	0.6296	0.2531	0.2160	0.1606	NO	NO

CH_4 (Gg)	CRF 1.A.2.f.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1991	0.7214	0.1721	0.3131	0.1913	0.0450	NO
1992	0.7057	0.1706	0.2433	0.2532	0.0387	NO
1993	0.6682	0.1418	0.2071	0.2827	0.0365	NO
1994	0.6807	0.1337	0.2377	0.2704	0.0388	NO
1995	0.7227	0.1300	0.2244	0.3318	0.0366	NO
1996	0.7499	0.1258	0.2576	0.3330	0.0335	NO
1997	0.3861	0.0503	0.1509	0.1371	0.0478	NO
1998	0.3510	0.0522	0.1361	0.1141	0.0486	NO
1999	0.2895	0.0467	0.0984	0.0953	0.0492	NO
2000	0.2540	0.0387	0.0930	0.0877	0.0345	NO
2001	0.2527	0.0387	0.1080	0.0675	0.0385	NO
2002	0.2598	0.0451	0.1048	0.0619	0.0480	NO
2003	0.3423	0.0463	0.1817	0.0607	0.0536	NO
2004	0.3091	0.0453	0.1450	0.0631	0.0544	0.0013
2005	0.2853	0.0447	0.1301	0.0771	0.0323	0.0010
2006	0.2993	0.0476	0.1141	0.0991	0.0380	0.0005
2007	0.3431	0.0482	0.1625	0.0986	0.0304	0.0035
2008	0.2661	0.0316	0.0778	0.0934	0.0605	0.0027
2009	0.2082	0.0222	0.0405	0.0612	0.0766	0.0077
2010	0.2121	0.0220	0.0518	0.0638	0.0642	0.0103
2011	0.1936	0.0142	0.0430	0.0704	0.0568	0.0091
2012	0.2213	0.0139	0.0328	0.0698	0.0909	0.0140
Decrease 1988-2012	77.6%	83.4%	96.4%	-	-	-
Decrease 1990-2012	64.8%	94.5%	84.8%	56.5%	-	-
Decrease 2011-2012	-14.4%	2.0%	23.8%	0.9%	-60.0%	-53.2%

Table 71 N_2O emissions in 1.A.2.f. Other industries

N_2O (Gg)	CRF 1.A.2.f.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.1519	0.0250	0.1269	NO	NO	NO
1989	0.1504	0.0245	0.1259	NO	NO	NO
1990	0.1034	0.0718	0.0284	0.0032	NO	NO
1991	0.1015	0.0484	0.0432	0.0038	0.0060	NO
1992	0.0923	0.0488	0.0332	0.0051	0.0052	NO
1993	0.0790	0.0408	0.0276	0.0057	0.0049	NO
1994	0.0805	0.0381	0.0319	0.0054	0.0052	NO
1995	0.0779	0.0364	0.0299	0.0066	0.0049	NO
1996	0.0819	0.0362	0.0346	0.0067	0.0045	NO
1997	0.0439	0.0143	0.0205	0.0027	0.0064	NO
1998	0.0422	0.0149	0.0185	0.0023	0.0065	NO
1999	0.0348	0.0129	0.0134	0.0019	0.0066	NO
2000	0.0301	0.0112	0.0125	0.0018	0.0046	NO
2001	0.0323	0.0110	0.0148	0.0013	0.0051	NO
2002	0.0350	0.0129	0.0144	0.0012	0.0064	NO

N_2O (Gg)	CRF 1.A.2.f.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2003	0.0468	0.0133	0.0252	0.0012	0.0071	NO
2004	0.0411	0.0125	0.0200	0.0013	0.0073	0.0002
2005	0.0361	0.0122	0.0180	0.0015	0.0043	0.0001
2006	0.0360	0.0131	0.0158	0.0020	0.0051	0.0001
2007	0.0421	0.0130	0.0226	0.0020	0.0041	0.0005
2008	0.0295	0.0083	0.0108	0.0019	0.0081	0.0004
2009	0.0245	0.0063	0.0057	0.0012	0.0102	0.0010
2010	0.0247	0.0062	0.0072	0.0013	0.0086	0.0014
2011	0.0202	0.0039	0.0060	0.0014	0.0076	0.0012
2012	0.0239	0.0040	0.0046	0.0014	0.0121	0.0019
Decrease 1988-2012	84.2%	84.1%	96.4%	-	-	-
Decrease 1990-2012	76.9%	94.5%	83.9%	56.5%	-	-
Decrease 2011-2012	-18.8%	-1.2%	23.8%	0.9%	-60.0%	-53.2%

Table 72 GHG emissions in CRF 1.A.2.f. Other industries

GHG (Gg)	TJ	CRF 1.A.2.f.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	132 354.36	12 260.22	3 132.41	9 127.81	NO	NO	NO
1989	130 696.10	12 123.01	3 067.32	9 055.69	NO	NO	NO
1990	177 324.69	13 211.76	9 251.41	2 191.78	1 768.57	NO	NO
1991	154 228.05	11 530.58	6 292.19	3 129.22	2 106.36	2.8050	NO
1992	159 741.11	11 525.98	6 300.09	2 435.15	2 788.33	2.4123	NO
1993	148 694.61	10 446.13	5 260.45	2 069.57	3 113.82	2.2758	NO
1994	144 990.70	10 272.32	4 919.21	2 372.46	2 978.23	2.4198	NO
1995	153 503.52	10 632.10	4 735.62	2 240.49	3 653.71	2.2795	NO
1996	155 937.70	10 869.34	4 636.86	2 563.01	3 667.39	2.0888	NO
1997	68 938.13	4 890.70	1 850.23	1 527.50	1 509.98	2.9808	NO
1998	63 761.72	4 534.06	1 918.36	1 355.93	1 256.74	3.0313	NO
1999	52 982.05	3 698.54	1 674.50	971.49	1 049.49	3.0668	NO
2000	47 380.12	3 384.41	1 503.33	913.00	965.93	2.1505	NO
2001	44 575.21	3 291.36	1 481.21	1 064.48	743.27	2.4011	NO
2002	46 623.80	3 527.43	1 805.67	1 036.56	682.21	2.9901	NO
2003	54 829.43	4 304.95	1 837.37	1 795.85	668.39	3.3417	NO
2004	50 712.01	3 856.69	1 746.08	1 408.58	695.10	3.3919	3.5379
2005	50 794.05	3 879.76	1 759.75	1 266.00	849.13	2.0157	2.8704
2006	55 156.45	4 114.93	1 912.02	1 107.35	1 091.51	2.3697	1.6759
2007	59 728.81	4 629.67	1 930.34	1 602.32	1 085.16	1.8935	9.9483
2008	43 194.57	3 087.13	1 274.38	772.63	1 028.44	3.7705	7.9070
2009	29 651.90	2 005.89	905.14	398.78	674.29	4.7733	22.9014
2010	31 087.02	2 176.55	945.54	498.66	702.60	4.0035	25.7502
2011	27 403.66	1 795.93	572.46	416.69	776.25	3.5409	26.9836
2012	27 482.07	1 727.49	592.36	319.74	768.71	5.6661	41.0134
Decrease 1988-2012	79.2%	85.9%	81.1%	96.5%	-	-	-

GHG (Gg)	TJ	CRF 1.A.2.f.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
Decrease 1990-2012	84.5%	86.9%	93.6%	85.4%	56.5%	-	-

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

There is a specific case for other fuels used in the cement industry, for which a separate calculation model was developed. Due to the fact that all cement plants participate in the ETS, their verified reports were used in order to calculate the country-specific EFs for the following fuels:

- SRF/RDF
- Waste oils
- Tyres
- Filters
- Biomass

Data from the reports submitted according to the Bulgarian waste legislation was used in order to calculate the emissions based on specific waste type.

The model accounts separately the emissions from biomass fraction and non-biological fraction, as CO_2 emissions from biomass fraction should not be included in the national totals.

In Bulgaria biomass is used as an energy source primarily for the production of heat in transformation sector (autoproducer heat and CHP; main activity producer heat plants), industry, residential, commercial and public services sector, agriculture and other sector.

Mostly solid biomass is combusted during the years in the following activities:

- Energy industries (main activity producer heat plants, own use in electricity, CHP and heat plants)
- Manufacturing Industries and construction (iron and steel, chemical and petrochemical, non-ferrous metals, non-metallic minerals, transport equipment, machinery, mining and quarrying, food and tobacco, paper, pulp and print, wood and wood products, construction, textile and leather and non-specified (industry); autoproducer CHP plants and autoproducer heat plants
- Other sector (residential, commercial/institutional, agriculture/forestry/fishing, non-specified (other))
- Regarding the liquid and gaseous types, only biodiesel and sludge gas are utilized for various activities. The amount is limited and consumed in commercial and public services and heat plants for both sludge gas and charcoal. Data for those sources is reported for 2009 and 2008-2009, respectively.

During the 2014 submission was identified a calculation error for the CH_4 and N_2O emissions resulting from the use of alternative fuels, which was leading to double counting of the emissions (they were reported both under 'Biomass' and 'Other fuels'). Since the alternative fuels contain both a biomass and a fossil fraction, the resulting emissions from the biomass fraction are currently reported under biomass, while the emissions from the fossil fraction are reported under 'Other fuels'.

3.3.12 TRANSPORT (CRF 1.A.3)

The GHG emissions in Transport (CRF 1.A.3) are estimated following the recommendations of ERT set out in FCCC/ARR/2010/BGR, IPCC 1996, IPCC 2006 and IPCC-GPG guidelines.

3.3.12.1 Source category description

The IPCC source category for transport covers all types of mobile sources and the range of characteristics that affect the emission factors and consequently the emissions. Those are compiled according to the source in five categories.

Table 73 Transport sector categories

Number	Category	CO_2	CH_4	N_2O	Method
CRF 1.A.3.a	Civil aviation (domestic)	✓	✓	✓	TIER 2
CRF 1.A.3.b	Road transport	✓	✓	✓	TIER 2
CRF 1.A.3.c	Railways	✓	✓	✓	TIER 1
CRF 1.A.3.d	Navigation	✓	✓	✓	TIER 1
CRF 1.A.3.e	Other Transport	✓	✓	✓	TIER 1

The main emissions from transport discussed are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), as for the calculation of each the most appropriate method has been chosen based on the type of emission, transport category, data availability. The uncertainty of the main inputs regarding the emission type is considered and evaluated. Further, for the GHG inventory compilation, the recommendations of ERT set out in FCCC/ARR/2012/BGR are followed.

Emission trends over the years depend significantly on the amount of fuel consumed. The fuel quantities used in the CRF 1.A.3 Transport for 1988 – 2012 are shown below.

Table 74 Fuels for CRF 1.A.3 Transport in TJ 1988 - 2012

CRF 1A3 Transport	a. Civil Aviation	b. Road Transportation	c. Railways	d. Navigation	e. Other Transport
	TJ				
1988	2937	96173	NA,NO	NA,NO	NO
1989	3134	102096	NA,NO	NA,NO	NO
1990	1899	81973	4357	761	1777
1991	1511	47124	3134	42	NO
1992	1519	48787	4080	85	NO
1993	1395	55426	4689	129	40
1994	1404	51629	3445	171	40
1995	1280	56070	3066	171	40
1996	1156	55898	1850	254	40
1997	1076	56439	1819	85	472
1998	904	70062	1734	129	3719
1999	2239	72408	1607	217	3296
2000	860	68599	1607	85	6887
2001	1893	71090	1396	77	5777
2002	1119	75330	1311	114	5821
2003	990	85180	1184	141	3665
2004	820	91021	1200	132	5631
2005	561	98606	1227	153	9042
2006	1035	105874	1214	161	9538
2007	1720	100379	1058	179	10974
2008	560	106416	1354	207	10808
2009	990	106353	846	152	5846
2010	646	104200	846	117	5896
2011	904	104123	761	127	8528
2012	474	111430	931	115	8519

The fuel consumption for navigation in the years mentioned with notation key NO, NA is explained in section CRF 1.A.3.d Navigation and CRF 1.A.3.c Railways.

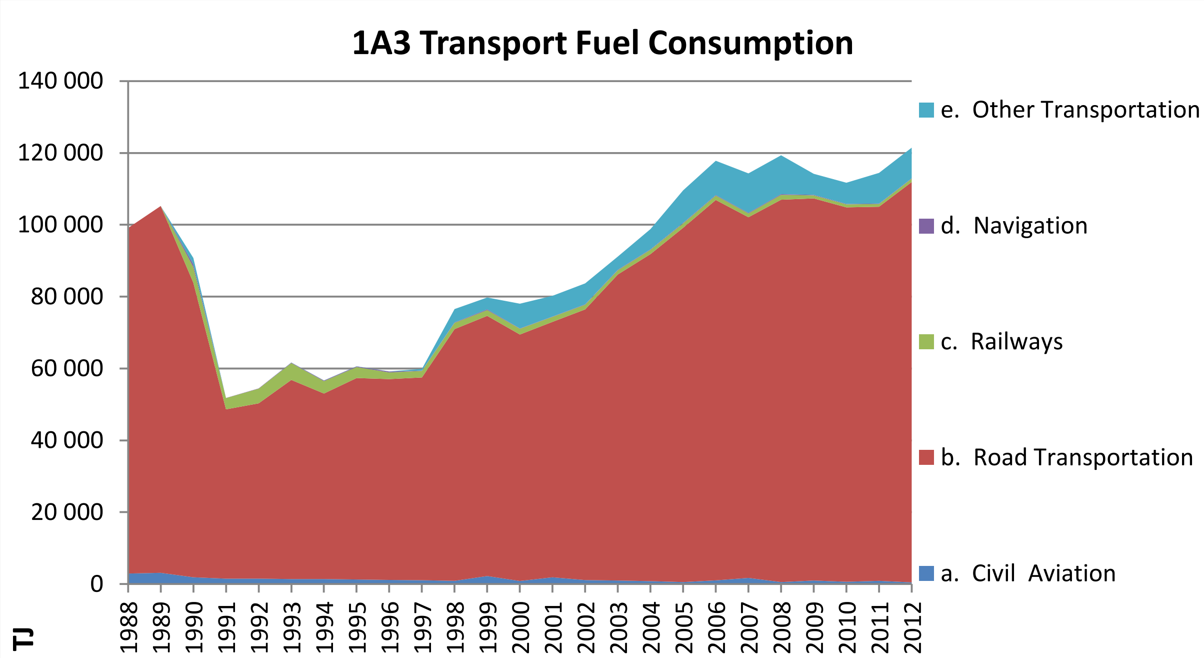


Figure 36 Fuels for CRF 1.A.3 transport for 1988 - 2012

In period 1988 to 1991 the fuel consumption decreased by 47%. But since 1991 the fuel consumption increased by 134% mainly due to road transport. The share of the transport categories is for the period of the inventory is the following:

Table 75 Share of fuel consumption in 1A3 Transport fuel

Number	Category	2007	2008	2009	2010	2011	2012
CRF 1.A.3.a	Civil aviation (domestic)	2%	0%	1%	1%	1%	0%
CRF 1.A.3.b	Road transport	88%	89%	93%	93%	91%	92%
CRF 1.A.3.c	Railways	1%	1%	1%	1%	1%	1%
CRF 1.A.3.d	Navigation	0%	0%	0%	0%	0%	0%
CRF 1.A.3.e	Other Transport	10%	9%	5%	5%	7%	7%

3.3.12.2 CRF 1.A.3.a Civil Aviation

3.3.12.2.1 Source description

The IPCC source category for civil aviation includes emissions from all civil commercial use of airplanes (international and domestic) consisting of scheduled and charter traffic for passengers and freight as well as general aviation. Emissions from aviation come from the combustion of jet kerosene and aviation gasoline. Aircrafts emit carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), as well as carbon monoxide (CO), Non-methane Volatile Organic Compounds (NMVOCs), sulfur dioxide (SO_2), particulate matter (PM) and nitrogen oxides (NOx). Domestic aviation is related to the transport of passenger and cargos (i.e. mail) as well as general aviation. The type of flights include both scheduled and non-scheduled. The international aviation is differentiated from the domestic aviation based on the departure and landing locations.

3.3.12.2.2 Emission trend

For 2012 there is a decrease of 83.7% in the emissions from civil aviation compared to the base year, and an increase of 47.4% compared to last year. In 2012 the sector is responsible for 0.1% from the emissions allocated to 1.A Fuel combustion and for 0.1% from the total GHG emissions (excluding LULUCF).

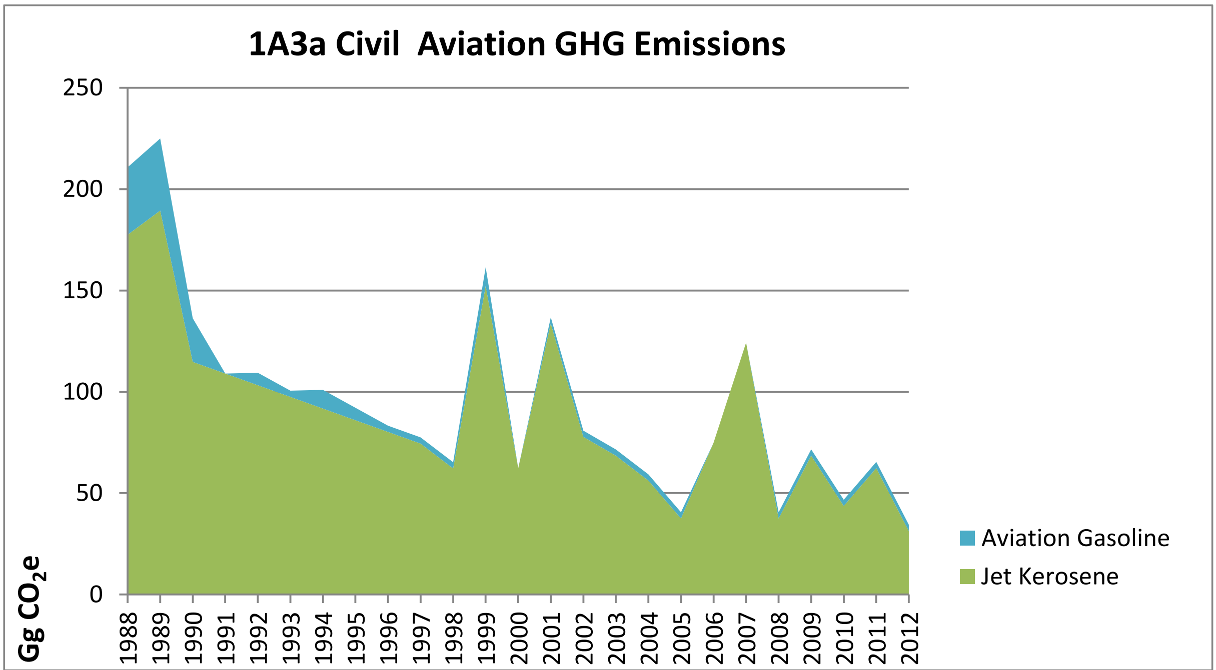


Figure 37 GHG emission in CRF 1.A.3.a Civil aviation – domestic (1988 - 2012)

Table 76 Fuel consumption and emissions from Civil aviation - all fuels

Year	TJ	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Total GHG [Gg CO_2e]
1988	2 936.74	208.93	0.0015	0.0059	210.78
1989	3 134.41	222.99	0.0016	0.0063	224.97
1990	1 899.00	135.10	0.0009	0.0038	136.30
1991	1 511.14	108.05	0.0008	0.0030	109.00
1992	1 519.29	108.44	0.0008	0.0030	109.39
1993	1 395.43	99.68	0.0007	0.0028	100.56
1994	1 403.57	100.06	0.0007	0.0028	100.95
1995	1 279.71	91.31	0.0006	0.0026	92.11
1996	1 155.86	82.55	0.0006	0.0023	83.28
1997	1 076.00	76.84	0.0005	0.0022	77.52
1998	904.00	64.67	0.0009	0.0019	65.26
1999	2 239.00	160.01	0.0018	0.0045	161.45
2000	860.00	61.73	0.0018	0.0018	62.32
2001	1 893.00	135.49	0.0029	0.0039	136.74
2002	1 119.00	80.10	0.0019	0.0023	80.85
2003	990.00	70.89	0.0018	0.0020	71.55
2004	820.12	58.69	0.0015	0.0017	59.25
2005	561.40	40.20	0.0011	0.0012	40.59
2006	1 034.88	74.14	0.0009	0.0022	74.82

Year	TJ	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Total GHG [Gg CO_2e]
2007	1 720.00	123.14	0.0013	0.0035	124.26
2008	560.00	40.15	0.0011	0.0013	40.56
2009	990.00	70.92	0.0010	0.0021	71.60
2010	646.00	46.30	0.0008	0.0014	46.76
2011	904.00	64.77	0.0012	0.0020	65.42
2012	474.00	34.05	0.0008	0.0011	34.41

Table 77 Fuel consumption and emissions from Civil aviation - jet kerosene

Year	TJ	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Total GHG [Gg CO_2e]
1988	2 460.43	175.92	0.0012	0.0049	177.47
1989	2 626.04	187.76	0.0013	0.0053	189.42
1990	1 591.00	113.76	0.0008	0.0032	114.76
1991	1 511.14	108.05	0.0008	0.0030	109.00
1992	1 431.29	102.34	0.0007	0.0029	103.24
1993	1 351.43	96.63	0.0007	0.0027	97.48
1994	1 271.57	90.92	0.0006	0.0025	91.72
1995	1 191.71	85.21	0.0006	0.0024	85.96
1996	1 111.86	79.50	0.0006	0.0022	80.20
1997	1 032.00	73.79	0.0005	0.0021	74.44
1998	860.00	61.62	0.0008	0.0018	62.19
1999	2 107.00	150.86	0.0017	0.0043	152.22
2000	860.00	61.73	0.0018	0.0018	62.32
2001	1 849.00	132.44	0.0029	0.0038	133.67
2002	1 075.00	77.05	0.0019	0.0022	77.77
2003	946.00	67.84	0.0018	0.0019	68.48
2004	776.16	55.64	0.0015	0.0016	56.18
2005	517.44	37.15	0.0010	0.0011	37.52
2006	1 034.88	74.14	0.0009	0.0022	74.82
2007	1 720.00	123.14	0.0013	0.0035	124.26
2008	516.00	37.10	0.0011	0.0012	37.49
2009	946.00	67.87	0.0010	0.0020	68.52
2010	602.00	43.25	0.0008	0.0014	43.68
2011	860.00	61.73	0.0012	0.0019	62.34
2012	430.00	30.96	0.0007	0.0010	31.29

Table 78 Fuel consumption and emissions from Civil aviation – aviation gasoline

Year	TJ	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Total GHG [Gg CO_2e]
1988	476.31	33.01	0.00024	0.0010	33.31
1989	508.37	35.23	0.00025	0.0010	35.55
1990	308.00	21.34	0.00015	0.0006	21.54
1991	NO	NO	NO	NO	0.00
1992	88.00	6.10	0.00004	0.0002	6.15
1993	44.00	3.05	0.00002	0.0001	3.08
1994	132.00	9.15	0.00007	0.0003	9.23
1995	88.00	6.10	0.00004	0.0002	6.15
1996	44.00	3.05	0.00002	0.0001	3.08
1997	44.00	3.05	0.00002	0.0001	3.08
1998	44.00	3.05	0.00002	0.0001	3.08
1999	132.00	9.15	0.00007	0.0003	9.23
2000	NO	NO	NO	NO	0.00
2001	44.00	3.05	0.00002	0.0001	3.08
2002	44.00	3.05	0.00002	0.0001	3.08

Year	TJ	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Total GHG [Gg CO_2e]
2003	44.00	3.05	0.00002	0.0001	3.08
2004	43.96	3.05	0.00002	0.0001	3.07
2005	43.96	3.05	0.00002	0.0001	3.07
2006	NO	NO	NO	NO	0.00
2007	NO	NO	NO	NO	0.00
2008	44.00	3.05	0.00002	0.0001	3.08
2009	44.00	3.05	0.00002	0.0001	3.08
2010	44.00	3.05	0.00002	0.0001	3.08
2011	44.00	3.05	0.00002	0.0001	3.08
2012	44.00	3.09	0.00002	0.0001	3.12

3.3.12.2.3 Methods

Civil aviation is considered a minor contributor to the emissions from the Transport sector as a result of the small quantities fuel consumed, as reported by the NSI. Nevertheless, following a planned improvement the emission estimates for domestic aviation were calculated according to Tier 2 and following the 1996 IPCC GL and 2006 IPCC GL.

The Tier 2 method requires as a first step to perform a calculations based on landing and take-off cycles per aircraft type per year, separately for domestic and international flights. For each LTO per aircraft type are applied the corresponding emission factors and fuel consumption factors according to the following equations:

LTO Emissions = Number of LTOs • Emission Factor LTO

LTO Fuel Consumption = Number of LTOs • Fuel Consumption per LTO

As a second step the total amount of fuel consumed in all LTOs is subtracted from the total fuel reported in order to calculate the cruise fuel consumption and are applied the appropriate cruise emission factors by the following equation:

Cruise Emissions = (Total Fuel Consumption – LTO Fuel Consumption) • Emission Factor Cruise

The final step includes the sum of LTOs and cruise emissions in order to calculate the total emissions from aviation by the following equation:

Total Emissions = LTO Emissions + Cruise Emissions

3.3.12.2.4 Activity data

Total fuel consumption is obtained from Energy balance and converted into energy units using the CS NCV.

The LTOs per aircraft type per year were obtained from Eurocontrol for the period 1996-2012 with the note that data for 1996 and 1997 is incomplete, since Bulgaria became a Eurocontrol member on 1st June 1997. The primary data for all years consists of 469 airplane types classified by ICAO code. The data was matched with the information from ICAO DOC 8643 Aircraft Type Designators document, which currently consists of 9463 type designators in order to identify the manufacturer, model, engine type, engine count and wake turbulence category. About 91 of the ICAO type designators, which were reported by

Eurocontrol were not present in the ICAO DOC 8643. For those airplanes was performed a manual search in order to identify the exact type of airplane.

As a second step all 469 aircraft type designators were manually matched to the appropriate aircraft types from 2006 IPCC GL, Vol.2, Ch. 3, Table 3.6.9. The choice of the 2006 IPCC GL was mandated by the fact that they provide information about much greater number of aircraft types, while the 1996 IPCC GL do not provide emission factors for almost none of the modern aircrafts currently in operation.

Since the IPCC guidelines provide information for only about 50 different aircraft types, the following correspondence table was used for the remaining aircrafts for which it was not possible to manually match the aircrafts based on their model:

Table 79 Correspondence between aircraft characteristics and generic aircraft types

WTC	Engine number	Engine type	Generic aircraft type	ICAO
L	1	Turboprop	King Air	BE30
L	1	Jet	Dornier 328 Jet	D328
L	2	Turboprop	BEECHCRAFT King Air	BE30
L	2	Jet	Dornier 328 Jet	D328
M	1	Jet	Gulfstream IV	G550
M	2	Turboprop	ATR72-500	ATR75
M	2	Jet	Fokker 100/70/28	F100
M	3	Turboprop	Dornier 328 Jet	D328
M	3	Jet	Yak-42M	YK42
M	4	Turboprop	BAE146	B463
M	4	Jet	BAE146	B463
H	2	Jet	Average fleet (B767)	B767
H	3	Jet	Lockheed Tristar	L1011
H	4	Jet	A340-300	A343
H	6	Jet	Old Fleet747-100	B741

The outcome of the updated Tier 2 methodology results in increase of the GHG emissions from jet kerosene by 0.2% for the beginning of the period and 0.9% for 2012.

3.3.12.2.5 Emission factors

The default Tier 2 emissions factors for jet kerosene from 2006 IPCC GL, Vol.2, Ch. 3, Table 3.6.9 were used.

3.3.12.2.6 Uncertainties

Since the default emission factors are used, the following default uncertainties are assumed (2006 IPCC GL):

AD: 5 %

EF CO_2: ±5 %

EF N_2O (for all fuel): -70 %/ +150 %

EF CH_4 (for all fuel): -57 % / +100 %

3.3.12.2.7 Source-specific QA/QC and verification

All activities regarding QC as described in QA/QC System have been undertaken.

The following sector specific QA/QC procedures have been carried out:

- Check of methodology, CO_2 emissions, emission factors and IEF (time series);
- Time series consistency;
- Plausibility checks of dips and jumps;
- Documentation and archiving of all information required in NIR, background documentation and archive;
- Comparison of Tier 1 and Tier 2 approach.

3.3.12.2.8 Source-specific recalculations

Recalculations have been done of the entire time series for 2014 submission.

The emissions for the whole period from 1996 to 2012 are calculated using Tier 2 approach based on:

- National energy balance
- LTOs information provided by Eurocontrol for the period 1996-2012

3.3.12.2.9 Source-specific planned improvements

At this stage no improvements are planned for next submission.

3.3.12.3 CRF 1.A.3.b Road transport

3.3.12.3.1 Source description

The IPCC source category for road transport includes emissions from all types of vehicles, light-duty vehicles such as automobiles and light trucks, and heavy-duty vehicles such as tractor trailers and buses, and on-road motorcycles (including mopeds, scooters, and three-wheelers). Road transport emits significant amounts of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), as well as several other pollutants.

Road transport is defined as a key category, as a result of the considerable amount of CO_2 emissions from the use of diesel, gasoline, LPG presented below.

Special feature of Bulgarian vehicle fleet is its age structure. In 2012 more than 60% from the vehicles are above 10 years old. The new vehicles are 11,8% from the total in 2012 and 20,4% are up to 10 years old.

The total number of registered vehicles in Bulgaria for the period 1988 – 2012 is presented in the next table.

Table 80 Number of vehicles, 1988 – 2012

Vehicle type	Trucks	Special cars	Trucks Trailer	Busses	Passenger cars	Motor-cycles	Mopeds
1988				32045	1220785	217360	276901
1989	139123	38265	15277	32893	1269959	221416	279077
1990	146128	39857	15502	33763	1317436	225533	281270
1991	157841	40124	16357	35561	1358976	226853	282137
1992	170232	40092	17194	37085	1411280	228335	282792
1993	185824	40282	18118	39279	1505453	230635	283963
1994	195786	40427	18970	40610	1587871	232386	284571
1995	203257	40605	19920	41019	1647570	233364	285901
1996	207858	40247	21982	40835	1707022	234949	286760
1997	210960	40051	21806	40418	1730504	236260	288690
1998	220948	41078	21320	41486	1809349	233953	281749
1999	230131	41332	21399	41970	1908390	235182	284031
2000	237655	41798	21735	42309	1992751	236327	286047
2001	245962	42464	23624	42871	2085734	237755	288290
2002	255412	43241	24446	43173	2174082	239632	290631
2003	268098	44408	25389	43686	2309344	242441	293228
2004	296001	34597	21680	35998	2438384	93269	44686
2005	311038	35736	22828	37157	2538094	97851	48846
2006*	208295	24012	17797	22129	1767739	42880	33375
2007	239769	26974	21547	23267	2081517	50920	39400
2008	273570	29568	25591	24619	2366192	60111	46801
2009	290784	30613	27024	24446	2502019	66331	51266
2010	304436	31329	29021	23855	2602401	70388	54983
2011	315505	31779	32056	23097	2694822	73800	58020
2012	331763	32871	35266	22792	2806816	77972	61841

Source of information: National Statistics Institute

The rapid decrease of the number of the vehicles, mentioned above for 2006 is due to the officially terminated registration of the vehicles, which are not re-registered

The road transport has the biggest share in total consumption of the fuels in Transport. In 2012 the road transport consumed 92% from the total energy in the sector.

Since 2004 there is only unleaded gasoline in Bulgaria (National Program to phase out lead in petrol).

3.3.12.3.2 Emission trend

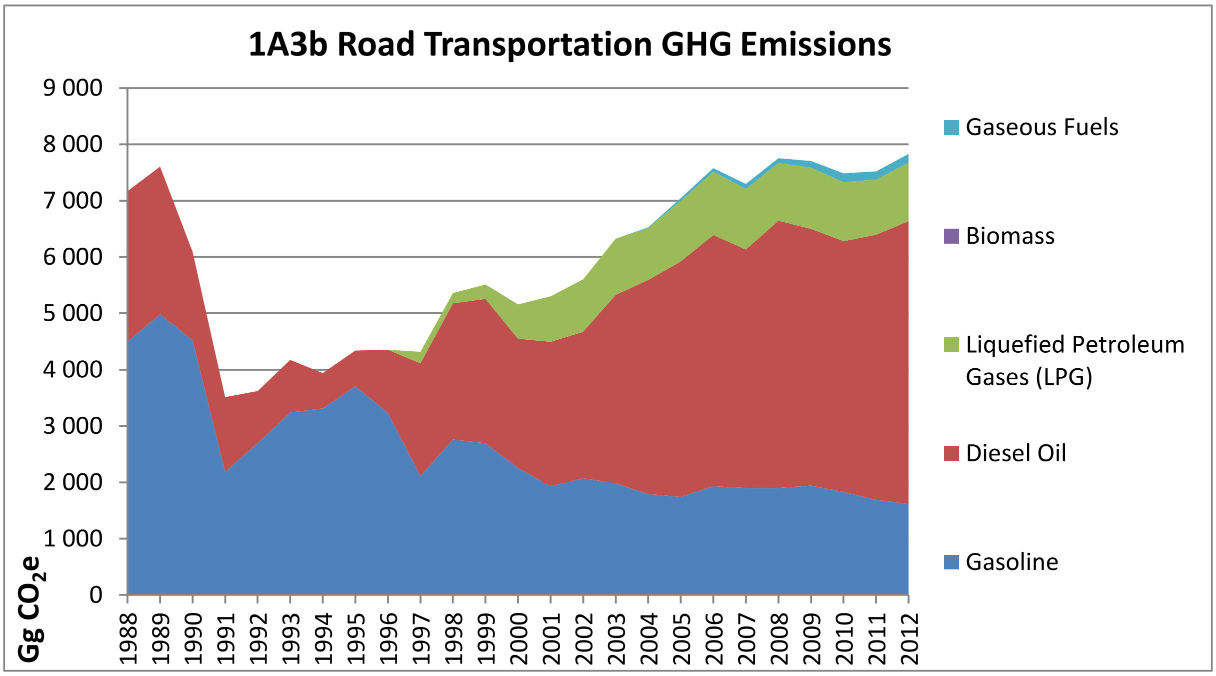


Figure 38 GHG emissions in CRF 1.A.3.b Road transport 1988 - 2012

Following a steep decline in 1989 as a result of the political and economic crisis, a distinct uptrend of GHGs emissions could be noticed since 2000 to present. The main contributing gas is CO_2, followed by CH_4 and N_2O.The CO_2 emission trend reflects the fuel consumption and therefore shows a decrease in the period 1990-2000. However, with the reviving economy CO_2 emissions grew constantly to 2006. Afterwards, a period of stabilization began and continued to 2009 when there was a slight drop in the emissions mainly related to the economic crisis and the consequent decline in transportation.

Overall, the GHG emissions from road transport increased by 9.2% compared to base year levels being 7 169.7 Gg CO_2e in 1988 and reached levels of 7 831.4 Gg CO_2e in 2012. However, that growth in 2012 compared to 1991 is calculated at 123%. This sudden change was brought with the economic recovery, preceded by the introduction of a currency board regime in 1997 and rigorous economic and political reforms.

The most significant contributor to GHG emissions is passenger cars, followed by heavy-duty vehicles, light-duty vehicles and motorcycles and mopeds. As it can be noticed from the following figure, in 2012, passenger cars and heavy duty vehicles account for 60.8% and 19.3% of total GHG CO_2e emissions respectively, dependent on the intensification of passenger and goods transportation. The remaining 19.8% were shared among light-duty vehicles, buses and mopeds and motorcycles.

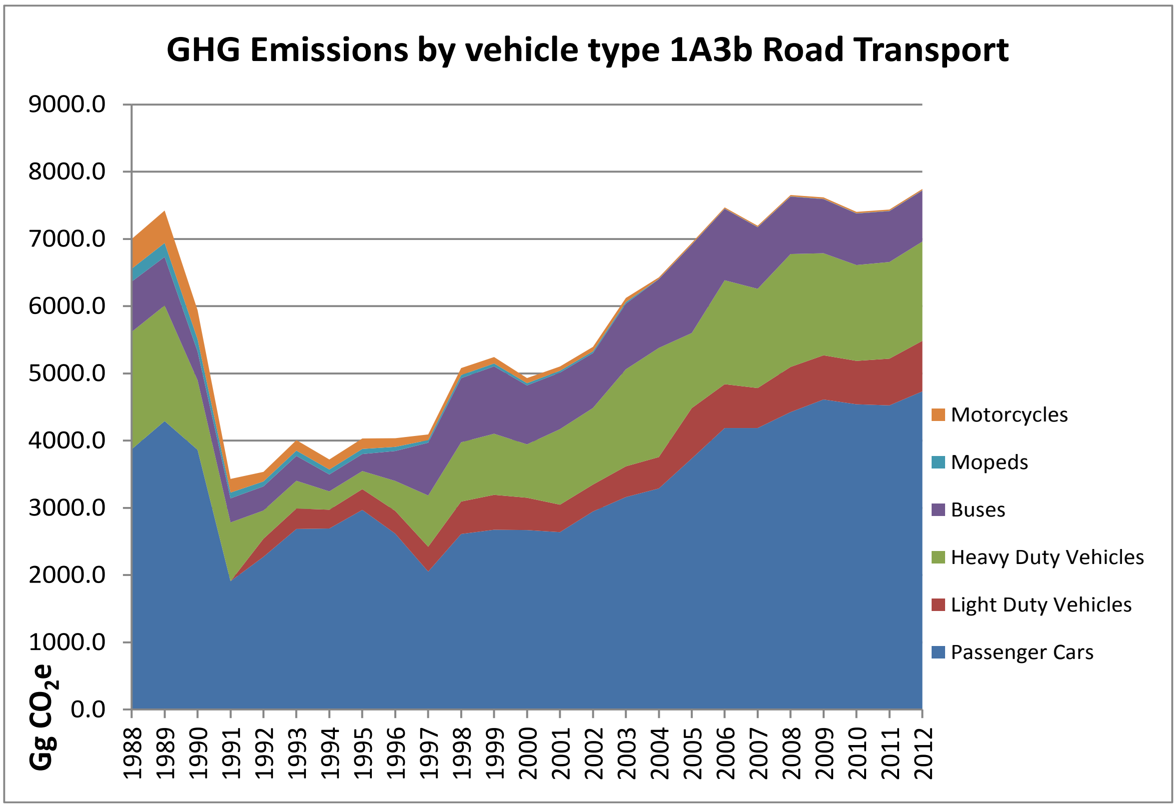


Figure 39 Emissions allocated to vehicle categories for the period 1988-2012

Whereas CO_2 emissions are closely linked to fuel consumption, CH_4 and N_2O emissions are considerably impacted by the technology split. Nitrous oxide emissions have a higher global warming potential compared to CH_4, hence, a slight increase in their release in the environment leads to a greater impact. As it can be observed in the following figure N_2O emissions tend to fluctuate for the period of the inventory. However, there is an increase in the years 2003-2004 which is closely related to the introduction of Euro 1 vehicles. This category is known for the higher N_2O emissions. As the technology improves with time, there is a noticeable decrease moving from Euro 1 to Euro 3, which could be detected clearly after 2003.

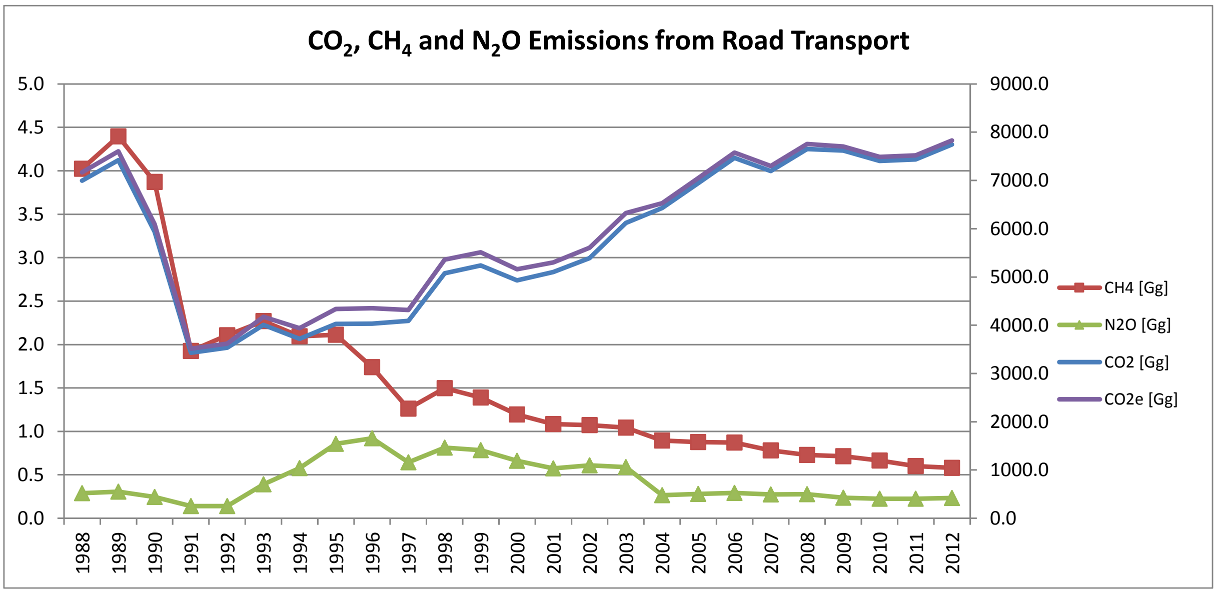


Figure 40 CO_2, CO_2-eq, CH_4 and N_2O emissions trends for the period 1998-2012

CH_4 emissions fall steeply following the gasoline consumption pattern, as the main source of those emissions proves to be gasoline passenger cars. After the crises in the beginning of the 90s, a slight increase during 1992 – 1995 can be observed, followed by downward trend. Compliance with tight emission standards influences significantly the CH_4 emissions and thus results in decreased levels of methane. In addition, market diffusion of Euro 2 and Euro 3 catalyst cars of better environmental performance with respect to methane emissions influences the methane emissions curve.

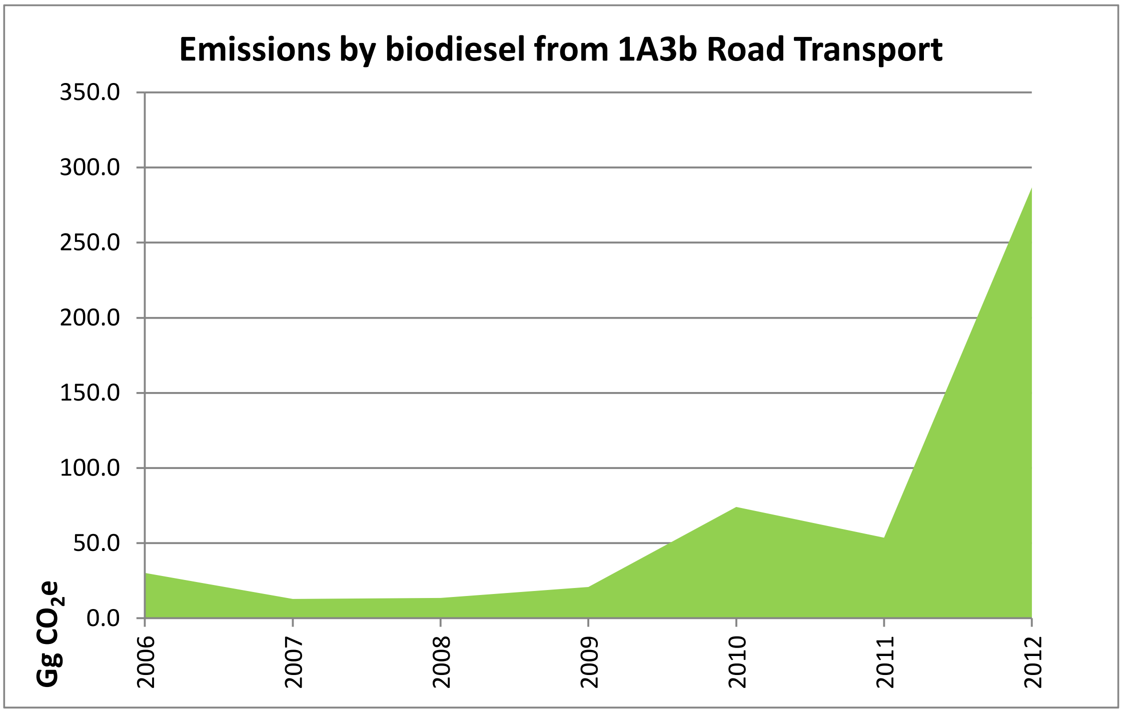


Figure 41 Emissions by biodiesel from Road Transport for the period 2006-2012

Tier 2 is applied to calculate the emissions from biodiesel. Transport diesel sold at the market already contains a percentage of biodiesel, reported in the Energy balances as biodiesel for blending. The approach is based on difference between total diesel, including biodiesel, and only mineral diesel. Biofuel reported as "Other liquid biofuels" for road transport is also subtracted from the total amount of diesel since the vehicle fleet represents conventional vehicles that are not adjusted to run on biodiesel only. COPERT is run twice to calculate the emissions from the total amount of diesel and second time to deliver the emissions related only to mineral diesel. The difference in the emissions is allocated to biodiesel. Cross check of emissions of tier 1 and 2 was performed. An upward trend can be noticed due to an increase in biodiesel production by approximately four times for the period 2011-2012.

3.3.12.3.3 Methods

Emissions of CO_2 are best calculated based on the amount and type of fuel combusted and its carbon content. Emissions of CH_4 and N_2O are more complicated to be estimated accurately because emission factors depend on vehicle technology, fuel and operating characteristics.

The road transport as a source of CO_2 is a key category. With respect to the Review Report FCCC/ARR/2010/BGR, the emission calculations of road transport have been performed with the use of the European COPERT, Version 10.0, model methodology corresponding to Tier 2, according to the 2006 IPCC GL and IPCC GPG 2000. Since country-specific technology based emission factors are not available, default fuel based emission factors of the new version have been applied instead.

In the new version of COPERT there have been made a number of changes regarding new passenger cars subsectors and emissions update.

Two new subsectors for both diesel and gasoline have been added - Gasoline<0.8l and Diesel<1.4l, while Gasoline<1.4l subsector becomes Gasoline 0.8-1.4l and Diesel <2.0l subsector becomes Diesel 1.4-2.0l. In the case of Mopeds classification, separate emission factors have been introduced for 2-stroke and 4-stroke vehicle configurations while the database is based on literature data (2012, Ntziachristos et all.).

COPERT version 9 includes the same Euro 4 methane emission factor for Euro 5 and Euro 6 for Gasoline passenger cars. Hot methane emissions also differ, while COPERT deems that there are no CH_4 highway hot emissions while some studies show that highway methane emissions are in fact higher than urban and rural emissions. As a result in version 10 hot emissions factors for CH_4 for Euro 4,5,6 on urban, rural and highway are updated with new values to reflect these findings (as described in the table below).

Table 81 Gasoline CH_4 hot emissions (g/km)

COPERT Version	Urban	Rural	Highway
Version 9	0.00196	0.00200	0.00000
Version 10 EURO 4/5/6	0.00287	0.00269	0.00508

In the model emissions were calculated through the input of detailed data on average daily trip distance and time, fuel Reid Vapour Pressure (RVP), monthly minimum and maximum temperatures, consumption and fuel specifications, vehicle fleet categorized in sectors, subsectors and technology (standard), vehicle stock and annual mileage, speed and driving shares. Comparison of Tier 2 with Tier 1 is performed as a verification cross-check.

3.3.12.3.4 Activity data

Fuel consumption (liquid, gaseous and biofuels) is obtained from the Energy balance and converted into energy units using the CS NCV (as recommended by the ERT (FCCC/ARR/2013/BGR). As recommended by the ERT (FCCC/ARR/2011/BGR), CO_2 emissions are calculated based on total fuels sold in the country. The total amount of fuels sold is compared to the calculated amount of fuel according to the model, as the difference is used for mileage adjustment to correspond to the fuel quantities from the Energy balance, as explained under "Mileage" below.

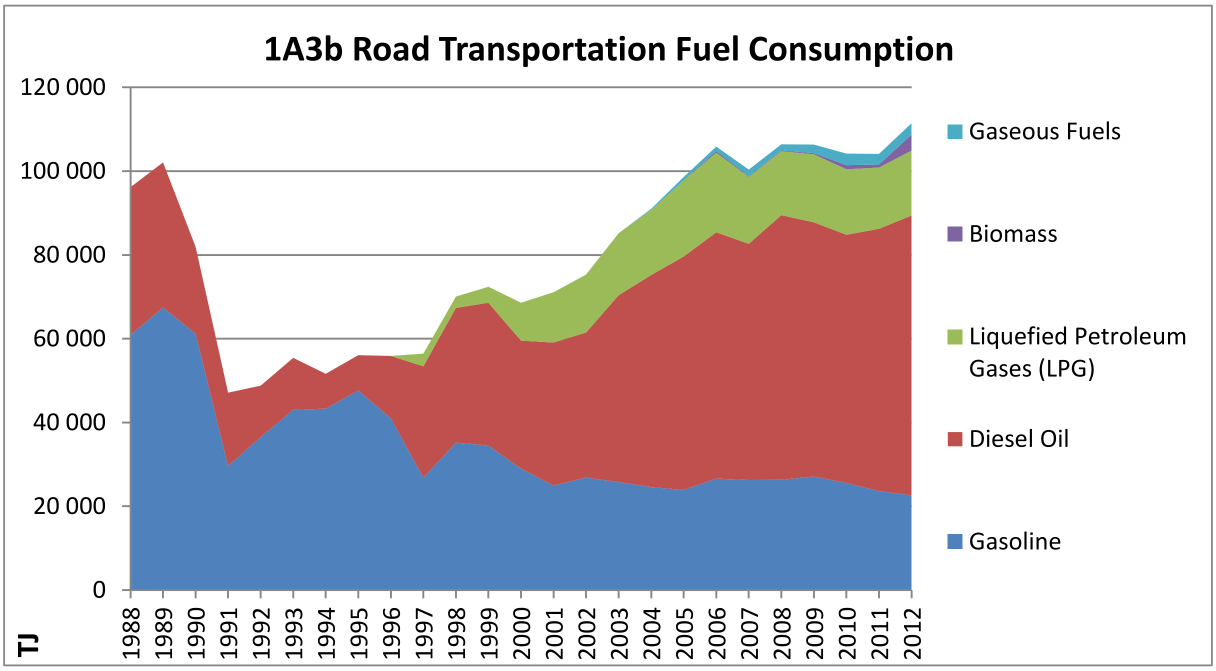


Figure 42 Fuel consumption in CRF 1.A.3.b Road transport (1988 - 2012)

The other data, necessary for implementation of model COPERT have been provided by national institutions and companies (National Statistical Institute, National Institute of Meteorology and Hydrology, Ministry of Internal affairs, Department Traffic police, Lukoil Neftohim – Burgas, State Agency For Metrological And Technical Surveillance). However, in some cases the completeness and quality of the information submitted was not of the required detail. When directly related data was not available, surrogate data from various sources was used to fulfil the missing gaps and ensure the representativeness of the inputs to COPERT programme. A degree of expert judgment was necessitating as well.

The following input data is compiled for the emission calculations with the use of COPERT 4:

Average daily trip distance

Average daily trip distance was calculated through www.bgmaps.com, one of the most popular websites for maps, routes, records and services to find individual addresses, locations and other information on the maps. Analysis of the major cities population and plausible daily journeys was performed and available data lead to an estimation of 15.1 km as average daily trip distance. Though, the average European value of 12.4 km (Samaras et al. 2000) is slightly lower, the calculated number seems to be more appropriate for the Bulgarian conditions and driving culture. Time trip duration is estimated at 0.42 hour.

Minimum and maximum temperatures

Complete, country-specific data on monthly average minimum and maximum temperatures for the whole period of 1988 to 2012 was compiled by the National Institute of Meteorology and Hydrology.

Fuel specifications

Fuel specifications of liquid fuels were taken from Lukoil Neftohim – Burgas, as the major part of the liquid fuels present at the national market are produced by Lukoil, and the State

Agency For Metrological And Technical Surveillance (SAMTS). The later organization performs a quality check of the liquid fuels, placed on the market according to the national legislation requirements in an accredited laboratory. Since, fuel sold at the stations in the country is sampled regularly, it is considered that the quality of the fuels represent the fuel products characteristics delivered to the final customer and utilized in the national fleet. Country specific data for diesel and gasoline for some of the fuel specifications is provided for the years 2005-2012 by Lukoil Neftohim – Burgas and the State Agency For Metrological And Technical Surveillance (SAMTS). Data on LPG, biodiesel and CNG was not obtained. Hence, literature information and regulatory technical requirements were used instead. Whereas appropriate, default values provided by COPERT 4, version 10 and extrapolation of the existing numbers were applied to fill the gaps in the available data (Samaras 2000). It is important to be noted that there has been only unleaded gasoline in Bulgaria (National Program to phase out lead in petrol) since 2004. The years before, the percentage of leaded and unleaded gasoline varies as in 2003 the leaded gasoline share was only 2% (National Statistical Institute). Investigation of obligatory measurements shows that values for H:C and O:C are not measured as a required fuel quality parameter in Bulgaria. Thus country specific data on H:C and O:C values cannot be obtained at this stage (FCCC/ARR/2013/BGR). Further, as fuels sold in Bulgaria comply with fuel quality requirements it is assumed that default values are applicable.

Values for fuel volatility (RVP – Reid Vapour Pressure) are available for the period 2006-2012 provided by Lukoil Neftohim – Burgas. For the previous periods a summer and winter range is specified according to the technical requirements. Therefore, RVP data for the years 2000-2005 is estimated based on the available values and the legal requirements. RVP of 62 kPa (summer) and 67 kPa (winter) for the period 1988 -1999 is applied, based on the market average for 1996 (Samaras et al. et al. 2000) and the ratio legal requirements to measured data, submitted for the recent years.

Speed

Infrastructure and vehicle stock differ significantly from city to city. Vehicle speed varies from big and small cities during the day, being quite low in the rush hours, especially in the densely populated areas. However, detailed data for speed variations is not available for the whole period. Krzywkowska et al. (2004) report approximate value of 24 km/h for mini buses in the urban region of Sofia. Additionally, a number of studies (André, 2006, Samaras et al. 2002, Coronas Metropolitanas 2006) documenting various average speeds for several European cities and private measurement of passenger cars average speed per day were considered. Further, average urban speed of 36.2 km/h was calculated via www.bgmaps.com, applying the same method as for average daily trip distance calculation. The latter value is preferred for the inventory, in relation to the traffic conditions in urban areas and literature research. A slightly higher value of 37 km/h is estimated for the period 1989-2000 regarding the traffic conditions in the past and fluctuation in bus speed.

Considering public transport, buses are the most developed mode of transport in Sofia (MottMacDonald 2009), as that is the case for the other large cities (exp. Plovdiv, Varna). Trams and trolleybuses occupy the second and third place, as trams are disseminated only in the capital and are not subject of road transport category. Bus transport remains the preferred method of public and for long-distance transportation as well. Average public transport speed for buses in Sofia is 19.4 km/h (Krzywkowska 2004), and for trolleybuses – 14.4 km/h (MottMacDonald 2009). These numbers vary back in the years as shows (Breshkov, 2005).

Table 82 Average operational speed (km/h)

Vehicle type/ Year	2009	2006	2002	1995	1989
Urban bus	19.4	19.65	18.1	18.1	19.5

Since, bus lines are limited only to some areas, traffic jams frequently impede the free flow not only of private cars, but as well as of buses and trolleys. Nevertheless, the average speed of private cars is expected to be higher and thus making the car one of the most preferred ways of city transport.

Speed values for rural and highway roads depend not only on the vehicle type and purpose of the trip, but also on the road quality. In Bulgaria, there are four classes of road classification: Motorway, Class I, II and III, as the latter represents 60% of the total length and it is characterized with the highest poor quality percentage compared to the other classes. Hence, free flow speed variation in relation to the above mentioned classes is the following (AECOM 2010):

Table 83 Average free flow speed (km/h) per type of road class

Road Class	Average free flow speed (km/h)
Class I	79
Class II	70
Class III	55
Motorway (Highway)	110

Given these data, for the emission calculations average speed was estimated to be 68km/h for rural areas for all types of vehicles (except for mopeds) and 110km/h for motorway, except for coaches. Whereas inappropriate and/or data was missing, the legal requirement speed limit was applied instead the above mentioned numbers. Moreover, a comparison of road classes for the years 2010-2002 revealed a negligible change in relation to rural speed variation. Therefore, identical value of 68km/h was used for all years.

Driving share

The density of the Bulgarian road network is similar to the average density for the other EU member states, excluding highways. In terms of high speed roads and motorways the country lags far behind – 3.8 km/1000 sq km compared to Austria - 19 km/1000 sq km in Slovenia - 14 km/1000 sq km, and in Lithuania - 6 km/1000 sq km (MRDPW 2010).

Due to lack of data for Bulgaria on mileage split between urban, rural and highway driving, literature survey of driving cycles (André, 2006) based on information from 80 representative European private cars in France, the UK, Germany and Greece was performed. Additionally, comparison of road statistics for Slovakia and Bulgaria shows a number of similarities related to road classes' ratio, length of network, geography and GDP trends. Taking into account the mentioned surveys, the driving share split for Slovakia was adopted. Where necessary data gaps for some years and categories were filled in by extrapolating the existing values.

Vehicle fleet

Corresponding to the COPERT methodology, detailed knowledge of the structure of the vehicle fleet is required. Main sources of data on vehicle stock and classifications are National Statistical Institute and Ministry of Internal affairs. However, apart from the total numbers for the main vehicle categories, only partial data considering distribution into fuel, weight, technology classes and age was provided for this submission as well. As a consequence the planned vehicle fleet matrix improvement is postponed till appropriate information becomes available (FCCC/ARR/2013/BGR)

Since only aggregated data regarding the total number of vehicle types was available, the technology mix for the Slovakian fleet was used for the distribution of the main categories into fuel and weight classes for the whole period. Matrix choice was determined by careful examination of a number of technological matrixes (Romania, Greece, Italy, Poland) and evaluation of technology split. Additionally, the available Slovakian fleet matrix provided estimates for the full timeseries, while only partial information was available for the other countries, which were compared. Further, the decision was influenced by an expert judgment.

Regarding the new passenger cars subsectors of COPERT 4, version 10, no changes have been introduced. The reason for this is that a car fleet research showed a limited number of vehicles that could be allocated to these two new subsectors, still without a technology break. Therefore, in the current technology mix, these two categories have been neglected and all passenger cars are distributed in the upper class categories.

Mopeds classification to 2-sroke and 4-stroke engines is another area of change in COPERT 4, version 10. It is assumed, based on expert judgement, that 4-stroke mopeds are very rare and applicable for the matrix of some countries (e.g. Italy). Thus, this subsector is considered irrelevant in the current matrix.

The Slovenian vehicle distribution does not include LPG driven passenger cars for the period before 2008 and CNG driven passenger cars. In Bulgaria, the LPG consumption for road transport started in 1997. The ratio LPG/Gasoline for the period 1997-2012, as reported by the Ministry of inferior, for each year in the period 2006-2012, was applied to each technology category of the passenger cars on gasoline with the purpose to shift a number of those vehicles to the respective LPG category. The same approach is applied for passenger cars (Euro 4 and 5) running on CNG for the period 2004-2012. As a result emissions from CNG are calculated following a Tier 2 method.

Mileage

As only basic information on mileage per urban buses and coaches, heavy duty vehicles (>6t) was obtained from the National Statistics Institute, mileage for 2005 was estimated from the average for 16 European countries that provided such data (Ntziachristos et al. 2008). However, the average EU15 mileage data may lead to overestimations of emissions. A recommendation by Ntziachristos et al. (2008) to tune the mileage values in order to better match the statistical fuel consumption (actual fuel sold) was followed. This was performed in relation to the fact that CO_2 emissions are calculated on the basis of fuel consumption (Ntziachristos et al., 2008) and that CO_2 emissions from road transport are indicated as a key category. The calibration procedure aimed to exactly match the statistical with the calculated fuel consumption. The COPERT model run has been performed twice. The first run of the model was done with the actual vehicle numbers and mean European mileage per vehicle type. The resulting fuel consumption for each type of fuel was compared with that reported in the energy balance and then the mileage was corrected with an appropriate factor to reconcile the two estimates of fuel consumption. The calibration procedure ensures that CO_2 emission estimates are prepared based on the quantities of fuel sold, according to the IPCC guidelines.

All the other required data (Fuel Injection, Evaporation Control, Evaporation distribution, Slope factor, Load factor) used for calculation of emissions using COPERT 4, version 10 program are input as default according to the COPERT.

3.3.12.3.5 Emission factors

According to the Revised 1996 IPCC GL, an emission factor is defined as the average emission rate of a given GHG for a given source, relative to units of activity. Whereas, an implied emission factor (IEF) is defined as emissions divided by the relevant measure of activity:

IEF = Emissions / Activity data

IEF are not equivalent to the emissions factors for emissions calculations. IEF are more as of results providing average values for complex categories, such as the vehicle fleet distribution.

Emission factors used for the calculations of GHG emissions form road transport subsector are based on the algorithms of COPERT 4, version 10. The emission factors are internal parameters that depend both on the input data (average trip distance, driving and climatic conditions, etc.) and COPERT algorithms. However, COPERT model uses different emission factors for each vehicle category and technology. Thus, it is only possible to provide the implied emission factors which take into account the calculated emissions of greenhouse gases per fuel by the model related to the reported fuel consumption.

There is a significant decrease in the CH_4 implied emission factor (IEF) for gasoline between 2003 and 2004 (–22.1 per cent) as a result of significant increase in the number of vehicles that meet the standards set out in the EU directive on emissions from motor vehicles (mostly Euro 2 and Euro 3), which was introduced in the country and contributed to replace the older technologies.

Table 84 Implied emission factors of CO_2, N_2O and CH_4 by fuel types

Fuel type	Gasoline			Diesel		
Emissions	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
Year	t/TJ	kg/TJ	kg/TJ	t/TJ	kg/TJ	kg/TJ
1988	71.72	60.74	2.93	74.50	9.24	3.13
1989	71.72	60.43	2.93	74.50	9.25	3.13
1990	71.72	60.12	2.94	74.50	9.26	3.14
1991	71.72	59.58	2.92	74.50	9.20	3.10
1992	71.72	54.94	3.03	74.50	8.10	2.33
1993	71.60	50.40	8.44	74.50	8.05	2.26
1994	71.51	46.86	12.91	74.50	8.01	2.17
1995	71.40	42.95	17.62	74.50	7.97	2.09
1996	71.30	39.54	21.71	74.50	7.86	2.00
1997	71.22	37.12	21.81	74.50	7.69	1.92
1998	71.13	34.17	21.17	74.50	7.46	1.82
1999	71.04	31.07	20.61	74.50	7.21	1.72
2000	70.97	28.33	19.95	74.50	6.92	1.63
2001	70.92	26.13	19.06	74.50	6.63	1.56
2002	70.87	23.61	18.71	74.50	6.10	1.49
2003	70.83	21.76	18.07	74.50	5.62	1.46
2004	70.82	16.98	5.61	74.50	5.22	1.45
2005	70.78	15.62	5.41	74.50	4.56	1.53
2006	70.75	14.18	4.89	75.27	4.07	1.62
2007	70.66	13.11	4.53	74.50	3.46	1.68
2008	70.65	12.33	4.14	74.50	2.88	1.79
2009	70.64	11.72	2.36	74.50	2.63	1.89
2010	70.63	11.19	2.15	74.50	2.37	1.98
2011	70.62	10.77	1.96	74.50	2.12	2.10
2012	70.62	10.39	1.80	74.50	1.90	2.21

Table 85 Implied emission factors of CO_2, N_2O and CH_4 by fuel types

Fuel type	LPG			CNG		
Emissions	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
Year	t/TJ	kg/TJ		t/TJ	kg/TJ	
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	65.73	20.49	3.08	NO	NO	NO
1998	65.73	19.66	3.32	NO	NO	NO
1999	65.73	18.74	3.59	NO	NO	NO
2000	65.73	17.84	3.78	NO	NO	NO
2001	65.73	17.08	3.85	NO	NO	NO
2002	65.73	16.32	3.89	NO	NO	NO
2003	65.73	15.68	3.92	NO	NO	NO
2004	57.87	13.25	3.49	56.92	22.47	0.58
2005	57.87	12.68	3.48	57.14	22.65	0.59
2006	57.87	12.09	3.42	57.11	22.52	0.59
2007	65.73	13.07	3.77	56.26	21.53	0.57

Fuel type	LPG			CNG		
Emissions	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
Year	t/TJ	kg/TJ		t/TJ	kg/TJ	
2008	65.73	12.45	3.61	56.60	21.89	0.58
2009	65.73	11.84	3.43	56.23	21.79	0.57
2010	65.73	11.26	3.23	56.23	21.85	0.57
2011	65.73	10.78	3.05	56.22	21.94	0.57
2012	65.73	10.29	2.88	56.05	21.37	0.57

3.3.12.3.6 Uncertainties

The following default uncertainties are assumed (IPCC 2006 GLs, Ch. 3.2.2 Uncertainty Assessment, page 3.29 – 3.30):

AD	+/-5 %		EF CO_2	EF N_2O	EF CH_4
		Motor Gasoline	5% / -3%	244% / -70%	233% / -71%
		Gas / Diesel Oil	1% / -2%	208% / -67%	144% / -59%
		LPG	4% / -2%	200% / -68%	238% / -70%

Except for the above mentioned uncertainty values, the inherited uncertainty of COPERT is associated with model formulation and input data. The main internal parameter is the emission factors, whose uncertainty comes from the experimental data. Information on the vehicle fleet and related data on vehicle movements are the most probable source of uncertainties with respect to inputs. Monte Carlo simulations reveal that 16 and 17 items of total 51 internal parameters and inputs variables are responsible for more than 90% of the total uncertainty in countries with good and poor statistics, respectively. In our case, as a country with relatively poor transport statistics, the most probable factors, according to this research, could be hot and cold-start emission factors, technology distribution, mileage, mean trip distance. Further, coefficient of variation for the following was estimated (Kioutsioukisa et al., 2010):

Parameter	Uncertainty for countries with poor transport statistics (%)
Fuel consumption and CO_2	<10
CH_4	>20
N_2O	>20

3.3.12.3.7 Source-specific QA/QC and verification

All activities regarding QC as described in QA/QC System have been undertaken.

The following sector specific QA/QC procedures have been carried out:

- Check of methodology, CO_2 emissions, emission factors and IEF (time series)
- Time series consistency
- Plausibility checks of dips and jumps (this is due to the Energy balance)
- Documentation and archiving of all information required in NIR, background documentation and archive.

3.3.12.3.8 Source-specific recalculations

Following a recommendation from FCCC/ARR/2010/BGR §79, a recalculation of the entire time series is undertaken due to implementation of higher tier method and incorporation of model COPERT, version 10 into the national road transport inventory.

Following a recommendation from FCCC/ARR/2010/BGR §76 is continued the allocation of activity data for consumption of residual fuel oil from road transport in 1A3c Railway for the period 1991–1996.

Regarding recommendation from FCCC/ARR/2011/BGR §70, a detailed review of the activity data and parameters used in the COPERT model was undertaken. We believe that the main cause for the decrease of the implied emission factor fog gasoline is the significant increase of EURO-standard vehicles (mostly EURO 2 and EURO 3), introduced in the country, which replaced the older Pre-ECE and ECE vehicles. As the CH_4 EF of the Pre-ECE and ECE vehicles is 5 times higher than the EURO vehicles, a significant drop in the IEF is observed. This is also the reason the generally stable downwards trend in the IEF.

3.3.12.3.9 Source-specific planned improvements

Investigation of the country specific parameters used in the COPERT IV model concerning the car fleet and vehicle split.

3.3.12.4 Railways (CRF 1.A.3.c)

3.3.12.4.1 Source category description

Railways transport, CO_2 emissions, is defined as a key category and represents the third contributor to the Transport sector emissions in 2012.

3.3.12.4.2 Emission trend

Fuel consumption from Railway transport constitute 0.9% of the total Transport sector and thus as a category does not contribute significantly to the total emissions from the Transport sector in Bulgaria. Railways related GHG emissions are quite low in Bulgaria, due to the decreased transport of passengers and freight. A clear downwards trend of the GHG emissions in recent years is shown in following figures.

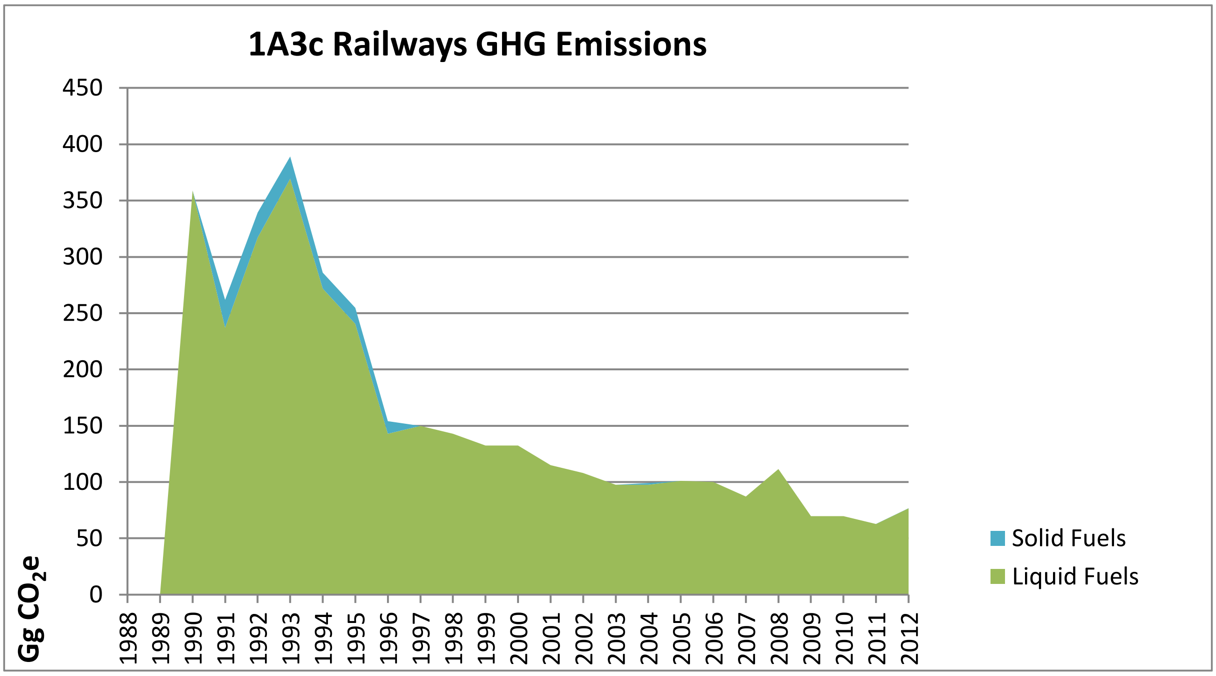


Figure 43 GHG emissions in CRF 1.A.3.c Railway transport (1988 - 2012)

As it can be observed from the figure above, emissions from Railway transport decreased steeply since 1993 with 80% to 2012. The emissions are mainly due to the consumption of liquid fuels (Gas-Diesel Oil). As for the years 1988-1989, there are no quantities for fuels consumed in the Railways category reported, the data entries are marked as NO. However, it is assumed that the relevant quantities are reported under CRF 1.A.5 Other.

3.3.12.4.3 Methods

Following the recommendations of ERT set out in FCCC/ARR/2010/BGR §75 the emissions from Railway are calculated based on Revised 1996 IPCC GL and IPCC GPG 2000. Where there are no emission factors in the Revised 1996 IPCC GL, the 2006 IPCC GL is used.

The Tier 1 approach has been applied.

GENERAL METHOD FOR EMISSIONS FROM LOCOMOTIVES

$$Emissions = \sum_j \left(Fuel_j \bullet EF_j\right)$$

Where:

Emissions = emissions (kg)

Fuel j = fuel type j consumed (as represented by fuel sold) in (TJ)

EF j = emission factor for fuel type j, (kg/TJ)

j = fuel type

For Tier 1, emissions are estimated using fuel-specific default emission factors, assuming that for each fuel type the total fuel is consumed by a single locomotive type.

3.3.12.4.4 Activity data

Fuel consumption (liquid and solid) is obtained from Eurostat Energy balance and converted into energy units using the CS NCV. The energy balance provides activity data for consumption of residual fuel oil in road transport in the period 1991 – 1996. This is an improbable allocation and following the recommendations of ERT set out in FCCC/ARR/2010/BGR §76, quantities of this fuel reported under road transport is allocated in 1A3c Railway.

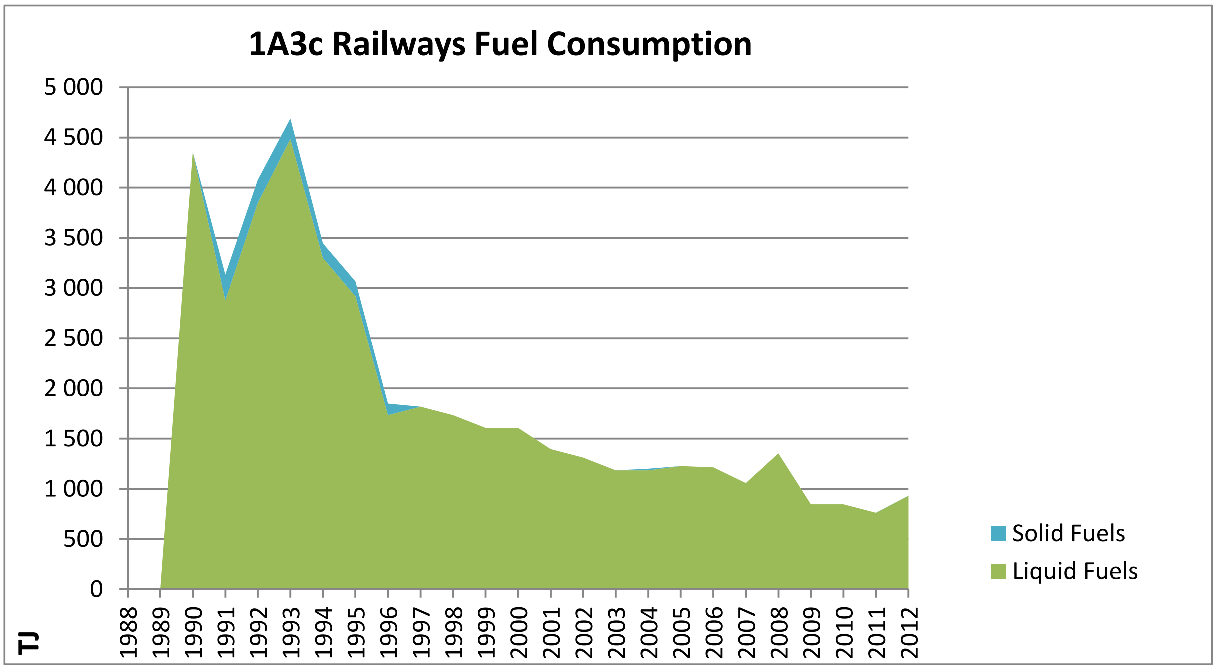


Figure 44 Fuel consumption in CRF 1.A.3.c Railway transport (1988 - 2012)

Table 86 Activity data of Gas-Diesel Oil, emissions and emission factors for IPCC Sub-category 1A3c – Railways

	Gas-Diesel Oil			EF* CO_2	CO_2 emission	EF* N_2O	N_2O emission	EF* CH_4	CH_4 emission
	Gg	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	0	IE	42	73	IE	0.03	IE	0.004	IE
1989	0	IE	42	73	IE	0.03	IE	0.004	IE
1990	103	4 357	42	73	318	0.03	0.131	0.004	0.018
1991	68	2 876	42	73	210	0.03	0.086	0.004	0.012
1992	91	3 849	42	73	281	0.03	0.115	0.004	0.016
1993	106	4 484	42	73	327	0.03	0.135	0.004	0.019
1994	78	3 299	42	73	241	0.03	0.099	0.004	0.014
1995	69	2 919	42	73	213	0.03	0.088	0.004	0.012
1996	41	1 734	42	73	127	0.03	0.052	0.004	0.007
1997	43	1 819	42	73	133	0.03	0.055	0.004	0.008
1998	41	1 734	42	73	127	0.03	0.052	0.004	0.007

1999	38	1 607	42	73	117	0.03	0.048	0.004	0.007
2000	38	1 607	42	73	117	0.03	0.048	0.004	0.007
2001	33	1 396	42	73	102	0.03	0.042	0.004	0.006
2002	31	1 311	42	73	96	0.03	0.039	0.004	0.005
2003	28	1 184	42	73	86	0.03	0.036	0.004	0.005
2004	28	1 184	42	73	86	0.03	0.036	0.004	0.005
2005	29	1 227	42	73	90	0.03	0.037	0.004	0.005
2006	29	1 214	42	73	89	0.03	0.036	0.004	0.005
2007	25	1 058	42	73	77	0.03	0.032	0.004	0.004
2008	32	1 354	42	73	99	0.03	0.041	0.004	0.006
2009	20	846	42	73	62	0.03	0.025	0.004	0.004
2010	20	846	42	73	62	0.03	0.025	0.004	0.004
2011	18	761	42	73	56	0.03	0.023	0.004	0.003
2012	22	931	42	73	68	0.03	0.028	0.004	0.004

** Revised 1996 IPCC Guidelines, Table 1-49*

3.3.12.4.5 Emission factors

The Revised 1996 IPCC GL and the 2006 IPCC GL default GHG EFs for liquid and solid fuels have been applied.

3.3.12.4.6 Uncertainties

The following default uncertainties are assumed (2006 IPCC GL, Ch. 3.4.1.6 Uncertainty Assessment, page 3.45 – 3.46):

	EF CO_2	EF N_2O	EF CH_4
Diesel	1.5%	58%	60%
AD	+/-5 %		

3.3.12.4.7 Source-specific QA/QC and verification

All activities regarding QC as described in QA/QC System have been undertaken.

- Check of methodology, CO_2 emissions, emission factors and IEF (time series)
- Time series consistency
- Plausibility checks of dips and jumps (due to the Energy balance)
- Documentation and archiving of all information required in NIR, Background documentation and archive.

3.3.12.4.8 Source-specific recalculations

Following a recommendation made by FCCC/ARR/2013/BGR emissions from residual fuel oil in the railways subcategory are reallocated to the category commercial/institutional for the entire time series.

3.3.12.5 Navigation (CRF 1.A.3.d)

GHG emissions from navigation are not defined as key source.

3.3.12.5.1 Source category description

In Bulgaria the navigation is used mostly for transportation of freights. However, the consumption patterns are limited since 2000, as it can be observed from the figures below.

The previous assumption regarding residual fuel oil and gas/diesel oil consumed by navigation and marine transport was that it was reported in the industry sector, since there were some discussions regarding erroneously allocated quantities. In addition, in the earlier years NSI reported in the energy balances all amounts of fuels loaded on Bulgarian ships regardless on the port the fuel was loaded on. This explains the large quantities reported for the years before 1997. Recently, it was clarified by the NSI that the marine vessels do not load at our ports because of the low fuel quality and higher prices.

It is said that predominantly the cargo is transported on international cruises. Very limited amount is believed to be transported within Bulgaria and this usually happens as part of an international route. Still, there is high uncertainty how the loading of fuel is accounted in this particular scenario – it is assumed that the logistic companies mainly prefer to load outside BG – either in RO or on their way in another country.

3.3.12.5.2 Emission trend

Navigation is a very minor source of emissions for Bulgaria.

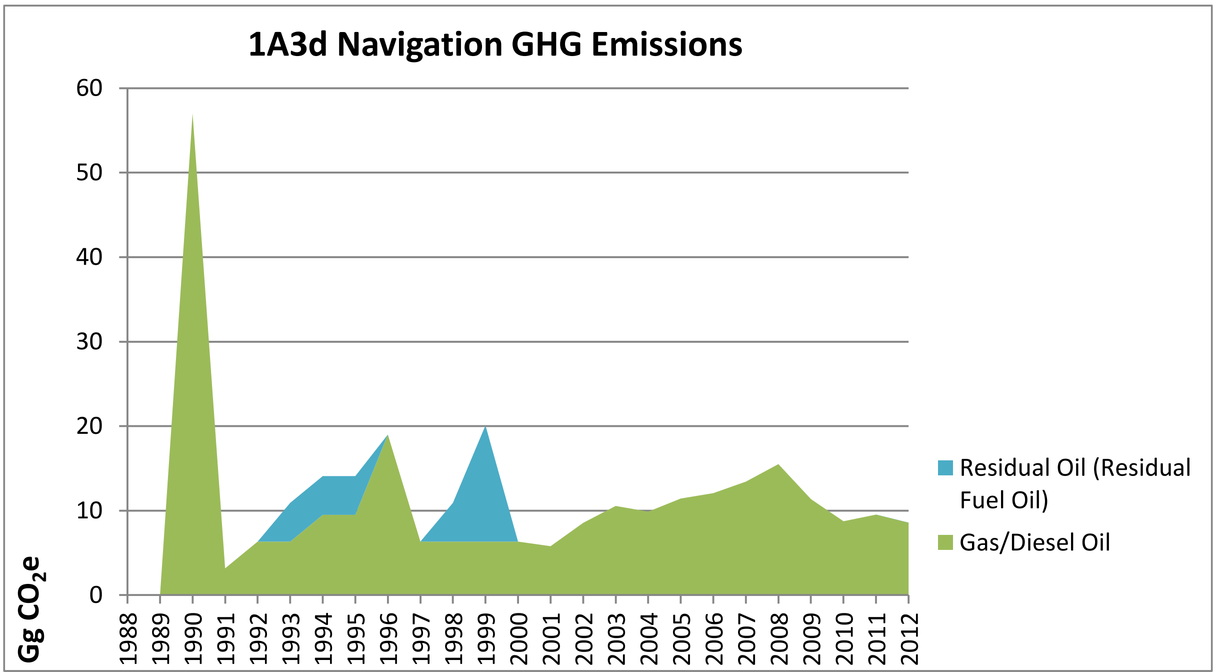


Figure 45 GHG emissions in CRF 1.A.3.d Navigation (1988 - 2012)

3.3.12.5.3 Methods

The 2006 IPCC Guidelines Tier 1 approach has been applied (Equation 3.5.1. Water-Borne Navigation Equation)

$$Emissions = \Sigma(Fuel\ Consumed_{ab} \bullet Emission\ Factor_{ab})$$

Where:

a = fuel type (diesel, gasoline, LPG, bunker, etc.)

b = water-borne navigation type (i.e., ship or boat, and possibly engine type.) (Only at Tier 2 is the fuel used differentiated by type of vessel so b can be ignored at Tier 1)

3.3.12.5.4 Activity data

Considering the fuel consumption fluctuations described above, in order to avoid underestimation of the emissions from navigation, the amount of fuel consumed is calculated based on the cargo transported inland (domestic transport of goods) for the period 2001-2012. Data on transported cargo inland is obtained from the National Statistics Institute (NSI) and Danube Commission (DC). Data on transported goods for previous years (1988 – 2000) is not available, thus the reported quantities of fuel sold are used for the emission estimates.

Average distance is calculated based on 410 km distance between western and eastern Bulgaria ports. Further, distance in tonne kilometres travelled goods (tkm) is derived from the average distance and domestic goods transported.

Fuel economy for barge operation (kg/tkm) estimated as average European data from Ecoinvent 2.2 database is applied to calculate the tonnes of fuel consumed.

Table 87 Data on transported goods and fuel consumed for transportation

Year	Transported goods (DC)	Transported goods (NSI)	Transported goods (domestic)	Average distance	Distance	Fuel economy	Fuel consumed
Unit	1000t			km	tkm	kg diesel/tkm	t
2001	950	0	950	205	194647500	0.00939	1828
2002	1402	0	1402	205	287410000	0.00939	2699
2003	1731	0	1731	205	354855000	0.00939	3332
2004	1621	0	1621	205	332202500	0.00939	3119
2005	1741	1875	1875	205	384375000	0.00939	3609
2006	1001	2000	2000	205	410000000	0.00939	3850
2007	1130	2203	2203	205	451615000	0.00939	4241
2008	1392	2543	2543	205	521315000	0.00939	4895
2009	842	1864	1864	205	382120000	0.00939	3588
2010	390	1434	1434	205	293970000	0.00939	2760
2011	390	1563	1563	205	320415000	0.00939	3009
2012	0	1407	1407	205	288435000	0.00939	2708

3.3.12.5.5 Emission factors

The 1996 IPCC Guidelines default GHG EFs for Gas-Diesel Oil and Residual Fuel Oil have been applied (assuming an oxidation factor of 1). The emission factors are provided in the following tables:

Table 88 Activity data, emissions and emission factors for IPCC Sub-category 1A3d – Navigation: 1988-2012

	Gas-Diesel Oil			EF* CO_2	CO_2 emission	EF* N_2O	N_2O emission	EF* CH_4	CH_4 emission
	Gg	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	Gg	Gg
1988	0	NO	42.3	74.1	NO	0.002	NO	0.007	NO
1989	0	NO	42.3	74.1	NO	0.002	NO	0.007	NO
1990	18	761.4	42.3	74.1	56.4	0.002	0.0015	0.007	0.0053
1991	1	42.3	42.3	74.1	3.1	0.002	0.0001	0.007	0.0003
1992	2	84.6	42.3	74.1	6.3	0.002	0.0002	0.007	0.0006
1993	2	84.6	42.3	74.1	6.3	0.002	0.0002	0.007	0.0006
1994	3	126.9	42.3	74.1	9.4	0.002	0.0003	0.007	0.0009
1995	3	126.9	42.3	74.1	9.4	0.002	0.0003	0.007	0.0009
1996	6	253.8	42.3	74.1	18.8	0.002	0.0005	0.007	0.0018
1997	2	84.6	42.3	74.1	6.3	0.002	0.0002	0.007	0.0006
1998	2	84.6	42.3	74.1	6.3	0.002	0.0002	0.007	0.0006
1999	2	84.6	42.3	74.1	6.3	0.002	0.0002	0.007	0.0006
2000	2	84.6	42.3	74.1	6.3	0.002	0.0002	0.007	0.0006
2001	2	77.3	42.3	74.1	5.7	0.002	0.0002	0.007	0.0005
2002	3	114.2	42.3	74.1	8.5	0.002	0.0002	0.007	0.0008
2003	3	140.9	42.3	74.1	10.4	0.002	0.0003	0.007	0.0010
2004	3	131.9	42.3	74.1	9.8	0.002	0.0003	0.007	0.0009
2005	4	152.7	42.3	74.1	11.3	0.002	0.0003	0.007	0.0011
2006	4	161.2	41.87	74.1	11.9	0.002	0.0003	0.007	0.0011
2007	4	179.4	42.3	74.1	13.3	0.002	0.0004	0.007	0.0013
2008	5	207.1	42.3	74.1	15.3	0.002	0.0004	0.007	0.0014
2009	4	151.8	42.3	74.1	11.2	0.002	0.0003	0.007	0.0011
2010	3	116.8	42.3	74.1	8.7	0.002	0.0002	0.007	0.0008
2011	3	127.3	42.3	74.1	9.4	0.002	0.0003	0.007	0.0009
2012	3	114.6	42.3	74.1	8.5	0.002	0.0002	0.007	0.0008

Table 89 Activity data, emissions and emission factors for IPCC Sub-category 1A3d – Navigation

	Residual Fuel Oil			EF* CO_2	CO_2 emission	EF* N_2O	N_2O emission	EF* CH_4	CH_4 emission
	Gg	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	t	Gg	t
1988	0	NO	44	77.4	NO	0.086	NO	0.01	NO
1989	0	NO	44	77.4	NO	0.086	NO	0.01	NO
1990	0	NO	44	77.4	NO	0.086	NO	0.01	NO
1991	0	NO	44	77.4	NO	0.086	NO	0.01	NO
1992	0	NO	44	77.4	NO	0.086	NO	0.01	NO
1993	1	44	44	77.4	3.406	0.086	0.004	0.01	0.0005
1994	1	44	44	77.4	3.406	0.086	0.004	0.01	0.0005
1995	1	44	44	77.4	3.406	0.086	0.004	0.01	0.0005
1996	0	NO	44	77.4	NO	0.086	NO	0.01	NO
1997	0	NO	44	77.4	NO	0.086	NO	0.01	NO
1998	1	44	44	77.4	3.406	0.086	0.004	0.01	0.0005

1999	3	132	44	77.4	10.217	0.086	0.011	0.01	0.0014
2000	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2001	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2002	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2003	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2004	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2005	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2006	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2007	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2008	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2009	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2010	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2011	0	NO	44	77.4	NO	0.086	NO	0.01	NO
2012	0	NO	44	77.4	NO	0.086	NO	0.01	NO

For N_2O *and* CH_4 *an upper values from table 3.4.1 IPCC 2006 GL are used.*

3.3.12.5.6 Uncertainties

The following default uncertainties are assumed (2006 IPCC GL, Ch. 3.5.1.7 Uncertainty Assessment, page 3.54):

	EF CO_2	EF N_2O	EF CH_4
Diesel	± -1.5 %	-40%/+140%	±50%
Residual Fuel Oil	± -3 %		
AD	+/-50 %		

3.3.12.5.7 Source-specific QA/QC and verification

All activities regarding QC as described in QA/QC System have been undertaken.

The following sector specific QA/QC procedures have been carried out:

- Check of methodology, CO_2 emissions, emission factors and IEF (time series)
- Time series consistency
- Plausibility checks of dips and jumps (this is due to the Energy balance at this stage not possible / see trend description)
- Documentation and archiving of all information required in NIR, Background documentation and archive.

3.3.12.5.8 Source-specific planned improvements

No specific improvements for this subcategory are planned.

3.3.12.6 Other (CRF 1.A.3.e)

3.3.12.6.1 Source category description

The category (1.A.3.e) includes emissions from all remaining transport activities including pipeline transportation, related to the operation of pump stations and maintenance of pipelines. This is a key category for 2012, mainly because of the significant volume of natural gas consumed for pipeline transport.

3.3.12.6.2 Emission trend

Quantities of liquid fuels are reported at the beginning of the timeseries, but in general natural gas remains the main source of emissions from this category. Data regarding the consumption is provided in the energy balance.

Table 90 Activity data, emissions and emission factors for gas-diesel oil

	Gas-Diesel Oil			EF CO_2	CO_2 emission	EF N_2O	N_2O emission	EF CH_4	CH_4 emission
	Gg	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1989	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1990	42	1 777	42.3	74.1	131.65	0.029	0.051	0.004	0.0074
1991	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1992	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1993	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1994	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1995	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1996	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1997	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1998	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
1999	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2000	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2001	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2002	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2003	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2004	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2005	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2006	0	NO	41.87	74.1	NO	0.029	NO	0.004	NO
2007	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2008	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2009	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2010	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2011	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO
2012	0	NO	42.3	74.1	NO	0.029	NO	0.004	NO

Table 91 Activity data, emissions and emission factors for residual fuel oil

	Residual fuel oil			EF CO_2	CO_2 emission	EF N_2O	N_2O emission	EF CH_4	CH_4 emission
	Gg	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	0	NO	40	77.4	NO	0.086	NO	0.01	NO
1989	0	NO	40	77.4	NO	0.086	NO	0.01	NO
1990	0	NO	40	77.4	NO	0.086	NO	0.01	NO
1991	0	NO	40	77.4	NO	0.086	NO	0.01	NO

1992	0	NO	40	77.4	NO	0.086	NO	0.01	NO
1993	1	40	40	77.4	3.10	0.086	0.003	0.01	0.0004
1994	1	40	40	77.4	3.10	0.086	0.003	0.01	0.0004
1995	1	40	40	77.4	3.10	0.086	0.003	0.01	0.0004
1996	1	40	40	77.4	3.10	0.086	0.003	0.01	0.0004
1997	0	NO	40	77.4	NO	0.086	NO	0.01	NO
1998	0	NO	40	77.4	NO	0.086	NO	0.01	NO
1999	2	80	40	77.4	6.19	0.086	0.007	0.01	0.0008
2000	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2001	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2002	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2003	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2004	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2005	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2006	0	NO	39.77	77.4	NO	0.086	NO	0.01	NO
2007	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2008	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2009	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2010	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2011	0	NO	40	77.4	NO	0.086	NO	0.01	NO
2012	0	NO	40	77.4	NO	0.086	NO	0.01	NO

Table 92 Activity data, emissions and emission factors for natural gas

	Natural gas	EF CO_2	CO_2 emission	EF N_2O	N_2O emission	EF CH_4	CH_4 emission
	TJ	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	NO	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO	NO
1997	524	54.93	25.90	0.1	0.0000	5	0.0024
1998	4132	54.93	204.27	0.1	0.0004	5	0.0186
1999	3573	54.93	176.63	0.1	0.0003	5	0.0161
2000	7652	54.93	378.28	0.1	0.0007	5	0.0344
2001	6419	54.93	317.33	0.1	0.0006	5	0.0289
2002	6468	54.93	319.75	0.1	0.0006	5	0.0291
2003	4072	54.93	201.30	0.1	0.0004	5	0.0183
2004	6257	54.93	309.32	0.1	0.0006	5	0.0282
2005	10047	54.93	496.68	0.1	0.0009	5	0.0452
2006	10598	54.93	523.92	0.1	0.0010	5	0.0477
2007	12193	54.91	602.54	0.1	0.0011	5	0.0549

2008	12009	54.9	593.36	0.1	0.0011	5	0.0540
2009	6495	54.96	321.27	0.1	0.0006	5	0.0292
2010	6551	54.97	324.07	0.1	0.0006	5	0.0295
2011	9475	54.99	468.90	0.1	0.0009	5	0.0426
2012	9465	54.99	467.86	0.1	0.0009	5	0.0426

3.3.12.6.3 Methods

The 1996 IPCC Guidelines Tier 1 approach has been applied.

3.3.12.6.4 Activity data

The National energy balances have been used to obtain the fuel consumption and net calorific values.

3.3.12.6.5 Emission factors

The default EFs from the 1996 IPCC Guidelines for Gas-Diesel Oil and Residual Fuel Oil has been applied. For the calculation of pipeline transport emissions are used the country-specific emission factors.

3.3.12.6.6 Uncertainties

Greenhouse gas emissions from other transport sources are typically much smaller than those from road transportation, but activities in this category are diverse and are thus typically associated with higher uncertainties because of the additional uncertainty in activity data.

The types of equipment and their operating conditions are typically more diverse than that for road transportation, and this may give rise to a larger variation in emission factors and thus to larger uncertainties. However, the uncertainty estimate is likely to be dominated by the activity data for natural gas, and so it is reasonable to assume as a default that the values for gaseous fuels apply.

Uncertainty in activity data is determined by the accuracy of the surveys or bottom-up models on which the estimates of fuel usage by off-road source and fuel type are based. This will be very case-specific, but factor of 2 uncertainties are certainly possible, unless if there is evidence to the contrary from the survey design.

The following default uncertainties are assumed based on the lower and higher values of the EFs (2006 IPCC GL, Ch. 3, Table 3.2.2 Uncertainty Assessment):

AD	+/-5 %		EF CO_2	EF N_2O	EF CH_4
		Natural gas	1% / -2%	208% / -67%	144% /-59%

3.3.12.6.7 Source specific QA/QC and verification

All activities regarding QC as described in QA/QC System have been undertaken.

The following sector specific QA/QC procedures have been carried out:

- Check of methodology, CO_2 emissions, emission factors and IEF (time series)
- Time series consistency
- Plausibility checks of dips and jumps (this is due to the Energy balance at this stage not possible / see trend description)
- Documentation and archiving of all information required in NIR, background documentation and archive.

3.3.13 OTHER SECTORS (CRF 1.A.4)

Other sectors include the following subcategories:

- Commercial / Institutional (1.A.4.a);
- Residential (1.A.4.b);
- Agriculture / Forestry / Fisheries (1.A.4.c).

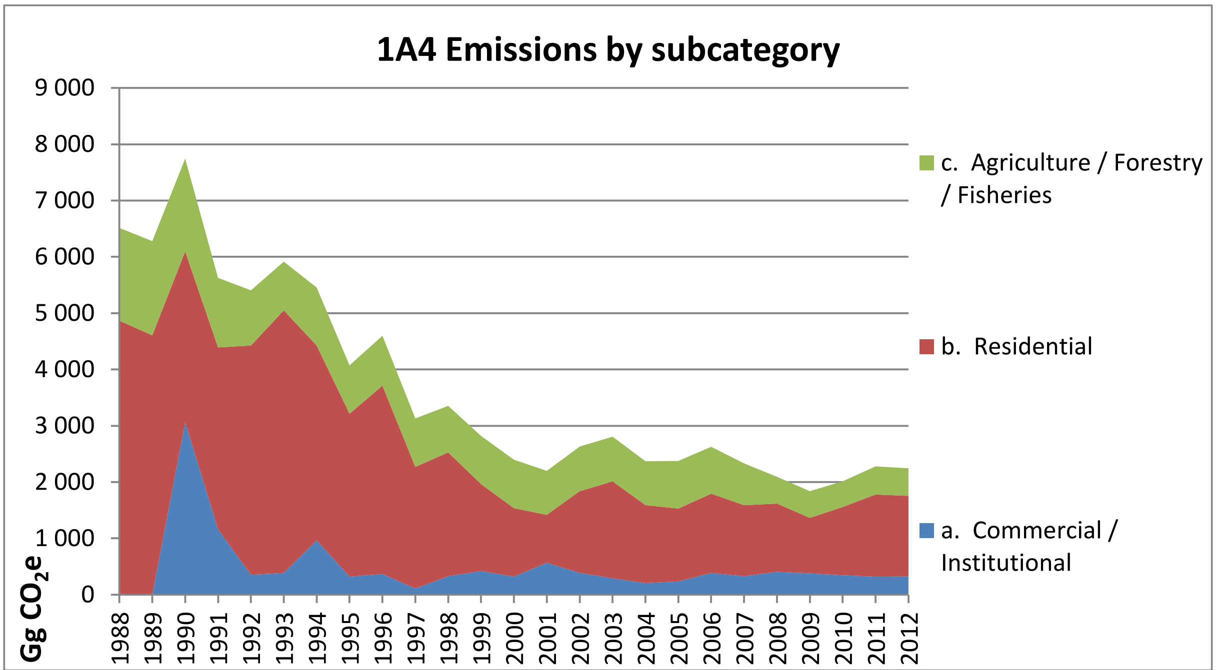


Figure 46 Total GHG emissions from 1.A.4 Other Sectors

The general trend in CRF category 1.A.4 is a decrease of 65.5% compared to base year and a decrease of 1.5% compared to last year.

3.3.13.1 Commercial/Institutional (CRF 1.A.4.a.)

Category 1.A.4.a. Commercial/Institutional covers emissions from fuel combustion in the commercial and Institutional sectors.

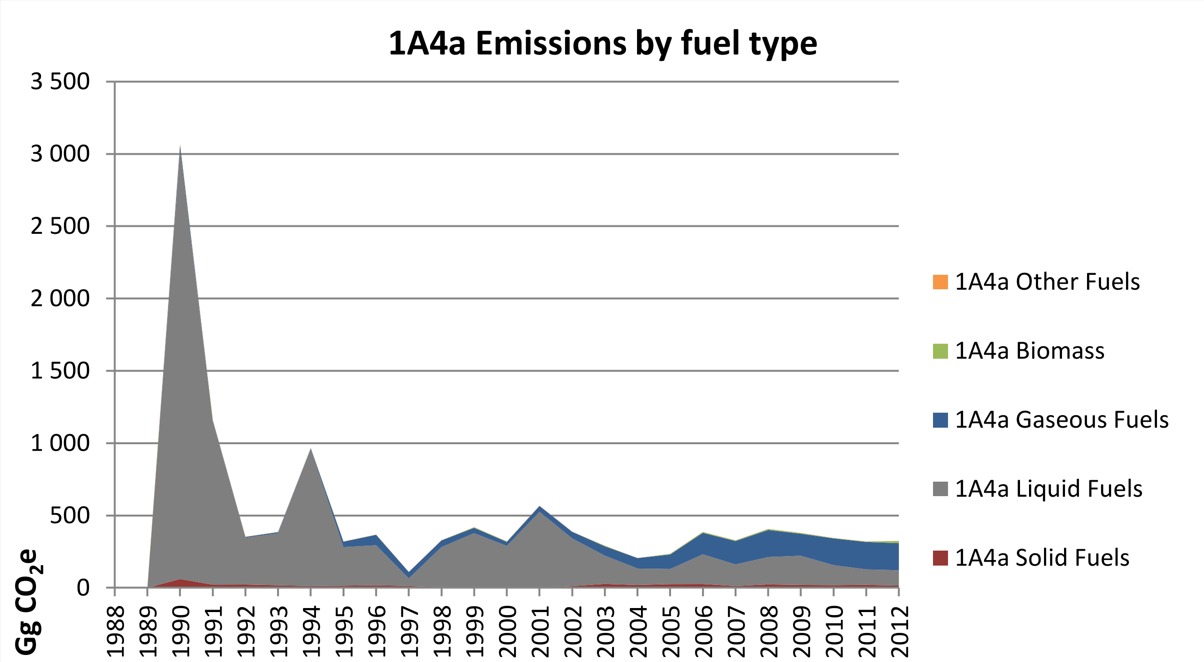


Figure 47 GHG emissions from CRF 1.A.4.a. Commercial/Institutional

The share of this subcategory from sector 1.A is 0.7% for 2012, while the share from the total GHG emissions is 0.5%.

For the years before 1990 no consumption is reported in this subcategory, instead it is reported under category 1.A.5.

Table 93 CO_2 emissions in CRF 1.A.4.a. Commercial/Institutional

CO_2 (Gg)	CRF 1.A.4.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	3 052.88	2 954.43	59.69	38.76	NO	NO
1991	1 155.46	1 128.98	21.09	5.39	4.4800	NO
1992	349.84	321.97	21.79	6.08	18.8160	NO
1993	383.15	358.39	16.75	8.01	12.8800	NO
1994	960.86	940.38	12.07	8.40	13.6640	NO
1995	317.68	265.83	14.08	37.77	13.3280	NO
1996	364.72	275.44	16.81	72.47	12.5440	NO
1997	108.60	52.24	12.21	44.15	NO	NO
1998	326.35	275.10	4.98	46.27	NO	NO
1999	412.23	370.80	4.56	36.88	63.9520	NO
2000	315.68	287.51	NO	28.18	45.4720	NO
2001	563.11	522.77	NO	40.34	NO	NO
2002	385.23	327.98	11.42	45.83	NO	NO
2003	285.17	194.65	26.06	64.46	60.7040	NO
2004	204.38	113.89	18.51	71.98	NO	NO
2005	229.04	104.30	24.54	100.21	63.5040	NO
2006	378.01	204.58	25.08	148.36	85.3440	NO
2007	321.48	148.31	11.83	161.35	70.0000	NO
2008	397.73	188.56	22.50	186.67	99.5680	NO
2009	371.94	201.19	18.79	151.96	70.5516	NO
2010	339.90	138.16	17.32	184.42	50.7290	NO
2011	315.52	106.88	19.35	189.29	52.1136	NO

CO_2 (Gg)	CRF 1.A.4.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2012	307.20	105.62	14.68	186.90	231.2772	NO
Decrease 1988-2012	-	-	-	-	-	-
Decrease 1990-2012	89.9%	96.4%	75.4%	-382.2%	-	-
Decrease 2011-2012	2.6%	1.2%	24.1%	1.3%	-343.8%	-

Table 94 CH_4 emissions in CRF 1.A.4.a. Commercial/Institutional

CH_4 (Gg)	CRF 1.A.4.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	0.0894	0.0799	0.0060	0.0035	NO	NO
1991	0.0481	0.0334	0.0022	0.0005	0.0120	NO
1992	0.0789	0.0257	0.0023	0.0006	0.0504	NO
1993	0.0657	0.0288	0.0017	0.0007	0.0345	NO
1994	0.0810	0.0424	0.0012	0.0008	0.0366	NO
1995	0.0548	0.0142	0.0015	0.0034	0.0357	NO
1996	0.0664	0.0245	0.0017	0.0066	0.0336	NO
1997	0.0066	0.0014	0.0012	0.0040	NO	NO
1998	0.0227	0.0180	0.0005	0.0042	NO	NO
1999	0.2250	0.0499	0.0005	0.0034	0.1713	NO
2000	0.1631	0.0387	NO	0.0026	0.1218	NO
2001	0.0741	0.0704	NO	0.0037	NO	NO
2002	0.0496	0.0443	0.0011	0.0042	NO	NO
2003	0.1973	0.0261	0.0027	0.0059	0.1626	NO
2004	0.0234	0.0149	0.0019	0.0066	NO	NO
2005	0.1957	0.0140	0.0025	0.0091	0.1701	NO
2006	0.2718	0.0271	0.0026	0.0135	0.2286	NO
2007	0.2234	0.0200	0.0012	0.0147	0.1875	NO
2008	0.3324	0.0254	0.0023	0.0170	0.2877	NO
2009	0.2491	0.0272	0.0019	0.0138	0.2061	NO
2010	0.1570	0.0179	0.0018	0.0168	0.1205	NO
2011	0.1584	0.0135	0.0020	0.0172	0.1257	NO
2012	0.6382	0.0124	0.0015	0.0170	0.6072	NO
Decrease 1988-2012	-	-	-	-	-	-
Decrease 1990-2012	-613.7%	84.4%	74.7%	-382.3%	-	-
Decrease 2011-2012	-303.0%	7.7%	25.0%	1.2%	-383.1%	-

Table 95 N_2O emissions in CRF 1.A.4.a. Commercial/Institutional

N_2O (Gg)	CRF 1.A.4.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	0.0248	0.0238	0.0008	0.0001	NO	NO

N_2O (Gg)	CRF 1.A.4.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1991	0.0094	0.0090	0.0003	0.0000	0.0002	NO
1992	0.0036	0.0026	0.0003	0.0000	0.0007	NO
1993	0.0036	0.0029	0.0002	0.0000	0.0005	NO
1994	0.0081	0.0074	0.0002	0.0000	0.0005	NO
1995	0.0029	0.0021	0.0002	0.0001	0.0005	NO
1996	0.0031	0.0022	0.0002	0.0001	0.0004	NO
1997	0.0007	0.0004	0.0002	0.0001	NO	NO
1998	0.0024	0.0022	0.0001	0.0001	NO	NO
1999	0.0054	0.0030	0.0001	0.0001	0.0023	NO
2000	0.0040	0.0023	NO	0.0001	0.0016	NO
2001	0.0043	0.0042	NO	0.0001	NO	NO
2002	0.0029	0.0026	0.0002	0.0001	NO	NO
2003	0.0042	0.0016	0.0004	0.0001	0.0022	NO
2004	0.0013	0.0009	0.0003	0.0001	NO	NO
2005	0.0036	0.0008	0.0004	0.0002	0.0023	NO
2006	0.0053	0.0016	0.0004	0.0003	0.0030	NO
2007	0.0042	0.0012	0.0002	0.0003	0.0025	NO
2008	0.0051	0.0015	0.0003	0.0003	0.0029	NO
2009	0.0041	0.0016	0.0003	0.0003	0.0020	NO
2010	0.0031	0.0010	0.0003	0.0003	0.0015	NO
2011	0.0030	0.0008	0.0003	0.0003	0.0016	NO
2012	0.0091	0.0006	0.0002	0.0003	0.0079	NO
Decrease 1988-2012	-	-	-	-	-	-
Decrease 1990-2012	63.3%	97.3%	74.7%	-382.3%	-	-
Decrease 2011-2012	-207.6%	14.4%	25.0%	1.2%	-400.5%	-

Table 96 GHG emissions in CRF 1.A.4.a. Commercial/Institutional

GHG (Gg)	TJ	CRF 1.A.4.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	NO	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO	NO
1990	41 122.92	3 062.43	2 963.50	60.08	38.85	NO	NO
1991	15 313.66	1 159.40	1 132.46	21.23	5.40	0.3016	NO
1992	4 867.14	352.62	323.32	21.94	6.10	1.2667	NO
1993	5 271.79	385.65	359.89	16.86	8.03	0.8671	NO
1994	12 832.11	965.08	943.58	12.16	8.42	0.9199	NO
1995	4 534.36	319.73	266.80	14.17	37.86	0.8973	NO
1996	5 332.80	367.07	276.65	16.92	72.65	0.8445	NO
1997	1 615.93	108.94	52.39	12.29	44.26	NO	NO
1998	4 620.85	327.57	276.16	5.02	46.39	NO	NO
1999	6 295.98	418.63	372.77	4.59	36.97	4.3053	NO
2000	4 812.90	320.35	289.04	NO	28.25	3.0612	NO
2001	7 868.00	565.99	525.55	NO	40.44	NO	NO
2002	5 400.48	387.16	329.73	11.49	45.94	NO	NO
2003	4 620.54	290.62	195.68	26.23	64.62	4.0867	NO
2004	3 046.52	205.27	114.48	18.63	72.16	NO	NO
2005	4 042.48	234.28	104.85	24.70	100.45	4.2752	NO

GHG (Gg)	TJ	CRF 1.A.4.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2006	6 430.04	385.37	205.65	25.24	148.72	5.7455	NO
2007	5 681.36	327.46	149.10	11.90	161.75	4.7125	NO
2008	7 061.22	406.29	189.56	22.65	187.13	6.9488	NO
2009	6 313.79	378.46	202.27	18.92	152.33	4.9384	NO
2010	5 916.11	344.15	138.86	17.43	184.88	2.9832	NO
2011	5 621.74	319.76	107.39	19.48	189.76	3.1283	NO
2012	7 115.57	323.42	106.08	14.78	187.36	15.1992	NO
Decrease 1988-2012	-	-	-	-	-	-	-
Decrease 1990-2012	82.7%	89.4%	96.4%	75.4%	-382.2%	-	-
Decrease 2011-2012	-26.6%	-1.1%	1.2%	24.1%	1.3%	-385.9%	-

3.3.13.2 Residential (CRF 1.A.4.b.)

Category 1.A.4.b. Residential covers emissions from fuel combustion in the residential sector.

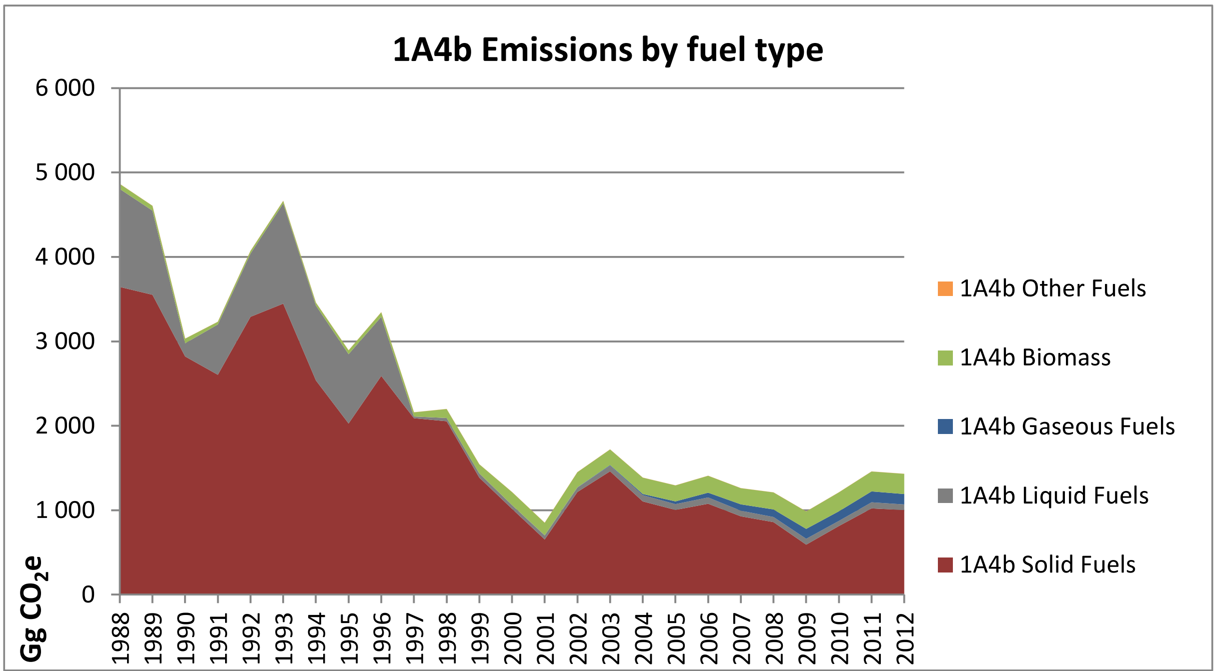


Figure 48 GHG emissions from CRF 1.A.4.b. Residential

The share of this subcategory from sector 1.A is 3.1% for 2012, while the share from the total GHG emissions is 2.4%. The emissions from this category decreased by 70.6% compared to base year. There are two separate trends contributing to this decrease – at the beginning of the period due to economic reasons happened a transition from liquid fuels, which were previously used for heating, to electricity. Some social groups also drastically reduced the energy for heating due to their very low income. The second trend is the increase of the use of biomass – in 2012 was used 4 times more biomass by the residential sector compared to 1988. This trend is also supported by the increasing gasification of the households, although by a much smaller extent.

Table 97 CO_2 emissions in CRF 1.A.4.b. Residential

CO_2 (Gg)	CRF 1.A.4.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	4 558.54	1 155.57	3 402.98	NO	889.3920	NO
1989	4 308.57	993.04	3 315.52	NO	850.7520	NO
1990	2 790.84	156.03	2 634.81	NO	808.7520	NO
1991	3 023.36	594.20	2 429.16	NO	469.2800	NO
1992	3 816.52	745.06	3 071.47	NO	480.1440	NO
1993	4 397.35	1 181.59	3 215.76	NO	440.4960	NO
1994	3 250.59	883.49	2 367.11	NO	506.5760	NO
1995	2 707.83	817.25	1 890.58	NO	674.9120	NO
1996	3 113.61	697.20	2 416.41	NO	805.3920	NO
1997	1 970.79	20.10	1 950.68	NO	741.6640	NO
1998	1 955.13	38.71	1 916.41	NO	1 581.6640	NO
1999	1 343.45	49.97	1 293.47	NO	1 604.4000	NO
2000	993.07	44.00	948.62	0.44	2 292.0800	NO
2001	658.80	46.64	610.33	1.83	2 212.7840	NO
2002	1 190.06	52.39	1 134.75	2.92	2 667.1680	NO
2003	1 438.29	66.75	1 364.43	7.12	2 752.7360	NO
2004	1 118.77	74.46	1 031.07	13.25	2 880.6400	NO
2005	1 037.99	68.32	937.30	32.38	2 812.4320	NO
2006	1 136.35	74.65	1 005.44	56.26	2 977.7440	NO
2007	1 008.91	66.29	867.31	75.31	2 846.4800	NO
2008	952.51	60.54	802.54	89.43	2 998.1280	NO
2009	739.46	69.39	553.19	116.89	3 062.6400	NO
2010	932.64	60.77	758.33	113.53	3 334.1280	NO
2011	1 155.06	72.03	954.21	128.82	3 502.6880	NO
2012	1 125.68	66.29	936.51	122.88	3 557.9040	NO
Decrease 1988-2012	75.3%	94.3%	72.5%	-	-300.0%	-
Decrease 1990-2012	59.7%	57.5%	64.5%	-	-339.9%	-
Decrease 2011-2012	2.5%	8.0%	1.9%	4.6%	-1.6%	-

Table 98 CH_4 emissions in CRF 1.A.4.b. Residential

CH_4 (Gg)	CRF 1.A.4.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	13.288	0.133	10.772	NO	2.3823	NO
1989	12.908	0.110	10.519	NO	2.2788	NO
1990	10.473	0.013	8.294	NO	2.1663	NO
1991	9.102	0.061	7.783	NO	1.2570	NO
1992	11.149	0.098	9.765	NO	1.2861	NO
1993	11.620	0.155	10.286	NO	1.1799	NO
1994	9.041	0.111	7.572	NO	1.3569	NO
1995	7.983	0.102	6.074	NO	1.8078	NO
1996	9.992	0.086	7.749	NO	2.1573	NO
1997	8.173	0.002	6.184	NO	1.9866	NO
1998	10.347	0.004	6.106	NO	4.2366	NO
1999	8.404	0.005	4.102	NO	4.2975	NO
2000	9.148	0.004	3.004	0.00004	6.1395	NO
2001	7.861	0.004	1.930	0.00017	5.9271	NO

CH_4 (Gg)	CRF 1.A.4.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2002	10.739	0.005	3.590	0.00027	7.1442	NO
2003	11.662	0.006	4.282	0.00065	7.3734	NO
2004	10.970	0.006	3.247	0.00121	7.7160	NO
2005	10.484	0.006	2.942	0.00295	7.5333	NO
2006	11.139	0.006	3.152	0.00512	7.9761	NO
2007	10.317	0.005	2.680	0.00686	7.6245	NO
2008	10.537	0.005	2.493	0.00815	8.0307	NO
2009	9.942	0.006	1.722	0.01063	8.2035	NO
2010	11.349	0.005	2.403	0.01033	8.9307	NO
2011	12.394	0.006	2.994	0.01171	9.3822	NO
2012	12.449	0.005	2.903	0.01119	9.5301	NO
Decrease 1988-2012	6.3%	95.9%	73.1%	-	-300.0%	-
Decrease 1990-2012	-18.9%	59.1%	65.0%	-	-339.9%	-
Decrease 2011-2012	-0.4%	7.7%	3.1%	4.5%	-1.6%	-

Table 99 N_2O emissions in CRF 1.A.4.b. Residential

N_2O (Gg)	CRF 1.A.4.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.08848	0.00645	0.05027	NO	0.03176	NO
1989	0.08451	0.00504	0.04909	NO	0.03038	NO
1990	0.06794	0.00035	0.03870	NO	0.02888	NO
1991	0.05560	0.00252	0.03632	NO	0.01676	NO
1992	0.06836	0.00564	0.04557	NO	0.01715	NO
1993	0.07263	0.00889	0.04800	NO	0.01573	NO
1994	0.05960	0.00617	0.03534	NO	0.01809	NO
1995	0.05798	0.00553	0.02834	NO	0.02410	NO
1996	0.06955	0.00463	0.03616	NO	0.02876	NO
1997	0.05538	0.00003	0.02886	NO	0.02649	NO
1998	0.08517	0.00018	0.02849	NO	0.05649	NO
1999	0.07662	0.00018	0.01914	NO	0.05730	NO
2000	0.09603	0.00015	0.01402	0.000001	0.08186	NO
2001	0.08817	0.00014	0.00901	0.000003	0.07903	NO
2002	0.11216	0.00015	0.01675	0.000005	0.09526	NO
2003	0.11848	0.00017	0.01998	0.000013	0.09831	NO
2004	0.11824	0.00018	0.01515	0.000024	0.10288	NO
2005	0.11436	0.00013	0.01373	0.000059	0.10044	NO
2006	0.12132	0.00016	0.01471	0.000102	0.10635	NO
2007	0.11443	0.00013	0.01251	0.000137	0.10166	NO
2008	0.11899	0.00012	0.01164	0.000163	0.10708	NO
2009	0.11778	0.00015	0.00803	0.000213	0.10938	NO
2010	0.13063	0.00014	0.01121	0.000207	0.11908	NO
2011	0.13944	0.00014	0.01397	0.000234	0.12510	NO
2012	0.14096	0.00013	0.01355	0.000224	0.12707	NO
Decrease 1988-2012	-59.3%	98.0%	73.1%	-	-300.0%	-
Decrease 1990-2012	-107.5%	64.3%	65.0%	-	-339.9%	-

N_2O (Gg)	CRF 1.A.4.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
Decrease 2011-2012	-1.1%	6.8%	3.1%	4.5%	-1.6%	-

Table 100 GHG emissions in CRF 1.A.4.b. Residential

GHG (Gg)	TJ	CRF 1.A.4.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	61 036.20	4 865.01	1 160.36	3 644.78	NO	59.8751	NO
1989	57 574.80	4 605.84	996.92	3 551.64	NO	57.2738	NO
1990	37 335.50	3 031.84	156.42	2 820.97	NO	54.4463	NO
1991	39 201.46	3 231.74	596.28	2 603.87	NO	31.5926	NO
1992	47 162.73	4 071.84	748.86	3 290.65	NO	32.3240	NO
1993	54 614.84	4 663.89	1 187.59	3 446.64	NO	29.6548	NO
1994	42 196.30	3 458.92	887.74	2 537.08	NO	34.1034	NO
1995	37 833.80	2 893.45	821.09	2 026.92	NO	45.4360	NO
1996	42 918.43	3 345.01	700.44	2 590.35	NO	54.2201	NO
1997	27 558.82	2 159.58	20.15	2 089.50	NO	49.9299	NO
1998	35 051.27	2 198.81	38.86	2 053.47	NO	106.4799	NO
1999	28 760.27	1 543.68	50.13	1 385.54	NO	108.0105	NO
2000	31 163.18	1 214.95	44.14	1 016.06	0.45	154.3061	NO
2001	26 947.85	851.22	46.77	653.65	1.83	148.9678	NO
2002	36 649.13	1 450.34	52.53	1 215.33	2.92	179.5576	NO
2003	40 028.66	1 719.93	66.92	1 460.55	7.14	185.3181	NO
2004	37 954.10	1 385.80	74.65	1 103.94	13.28	193.9288	NO
2005	36 595.41	1 293.62	68.47	1 003.34	32.46	189.3369	NO
2006	39 298.38	1 407.89	74.83	1 076.19	56.40	200.4660	NO
2007	36 773.38	1 261.03	66.44	927.46	75.50	191.6291	NO
2008	37 671.27	1 210.68	60.68	858.50	89.65	201.8383	NO
2009	36 307.24	984.75	69.56	591.83	117.17	206.1813	NO
2010	40 801.64	1 211.46	60.92	812.26	113.81	224.4583	NO
2011	44 743.19	1 458.56	72.20	1 021.42	129.14	235.8060	NO
2012	44 734.15	1 430.82	66.44	1 001.67	123.19	239.5232	NO
Decrease 1988-2012	26.7%	70.6%	94.3%	72.5%	-	-300.0%	-
Decrease 1990-2012	-19.8%	52.8%	57.5%	64.5%	-	-339.9%	-
Decrease 2011-2012	0.0%	1.9%	8.0%	1.9%	4.6%	-1.6%	-

3.3.13.3 Agriculture/Forestry/Fisheries (CRF 1.A.4.c.)

Category 1.A.4.c. Agriculture/Forestry/Fisheries covers emissions from fuel combustion in the agriculture, forestry and fisheries sectors.

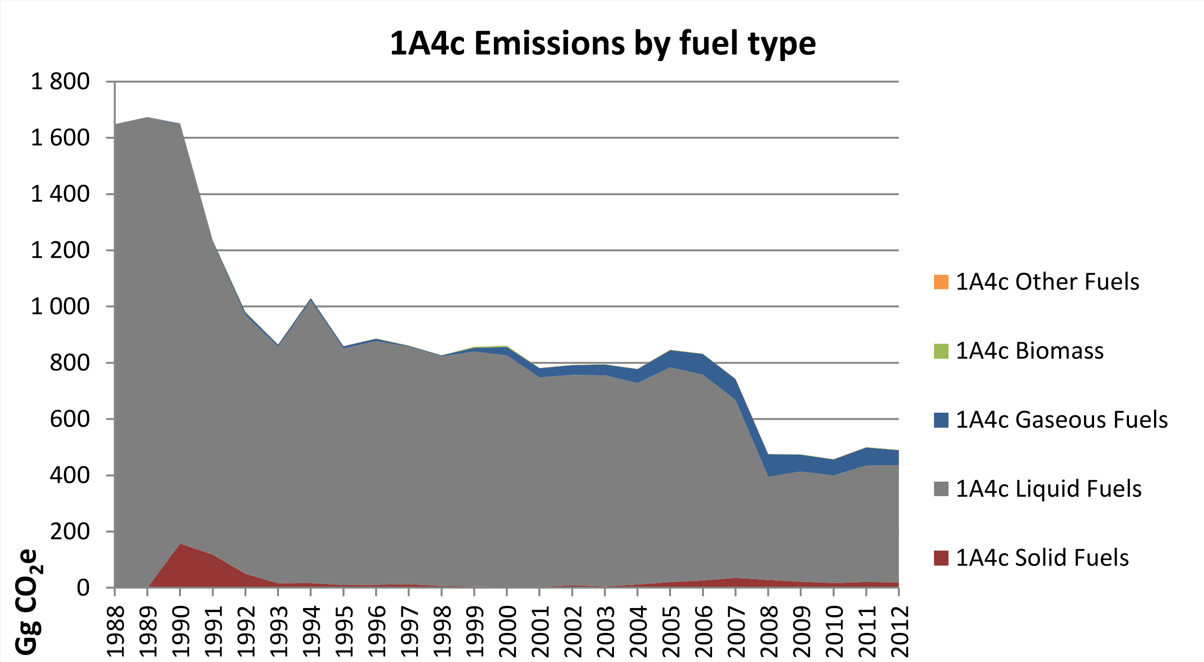


Figure 49 GHG emissions from CRF 1.A.4.c. Agriculture/Forestry/Fisheries

The share of this subcategory from sector 1.A is 1.1% for 2012, while the share from the total GHG emissions is 0.8%.

Table 101 CO_2 emissions in CRF 1.A.4.c. Agriculture/Forestry/Fisheries

CO_2 (Gg)	CRF 1.A.4.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	1 639.94	1 639.94	NO	NO	NO	NO
1989	1 664.93	1 664.93	NO	NO	NO	NO
1990	1 632.69	1 482.44	146.99	3.26	NO	NO
1991	1 220.37	1 104.20	110.09	6.08	16.8000	NO
1992	970.79	914.39	46.57	9.84	32.2560	NO
1993	859.00	836.70	14.94	7.37	4.3680	NO
1994	1 023.25	999.23	15.52	8.50	17.2480	NO
1995	853.76	836.39	8.91	8.45	4.1440	NO
1996	880.30	861.97	9.83	8.50	10.3040	NO
1997	854.67	839.68	11.73	3.26	25.0880	NO
1998	821.50	812.07	6.17	3.26	4.7040	NO
1999	848.42	830.42	4.65	13.35	52.8640	NO
2000	851.30	817.93	3.71	29.66	68.4320	NO
2001	776.71	740.58	3.11	33.02	7.2800	NO
2002	786.89	743.83	8.55	34.51	11.3120	NO
2003	789.50	746.63	4.65	38.21	14.7840	NO
2004	772.69	712.53	10.73	49.44	15.9040	NO
2005	839.35	759.48	18.82	61.05	24.8640	NO
2006	825.63	727.78	24.24	73.61	14.1120	NO
2007	736.38	628.92	32.89	74.57	10.9760	NO
2008	471.08	365.08	26.15	79.85	10.0800	NO
2009	469.61	389.63	20.23	59.75	17.1360	NO
2010	452.95	380.82	15.74	56.39	15.6800	NO
2011	495.11	411.84	19.13	64.14	16.8000	NO
2012	485.43	415.17	17.67	52.59	18.7040	NO
Decrease 1988-2012	70.4%	74.7%	-	-	-	-

CO_2 (Gg)	CRF 1.A.4.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
Decrease 1990-2012	70.3%	72.0%	88.0%	-1512.0%	-	-
Decrease 2011-2012	2.0%	-0.8%	7.6%	18.0%	-11.3%	-

Table 102 CH_4 emissions in CRF 1.A.4.c. Agriculture/Forestry/Fisheries

CH_4 (Gg)	CRF 1.A.4.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.224	0.224	NO	NO	NO	NO
1989	0.227	0.227	NO	NO	NO	NO
1990	0.662	0.202	0.460	0.00030	NO	NO
1991	0.544	0.151	0.348	0.00055	0.0450	NO
1992	0.359	0.124	0.147	0.00090	0.0864	NO
1993	0.173	0.114	0.047	0.00067	0.0117	NO
1994	0.232	0.135	0.050	0.00077	0.0462	NO
1995	0.154	0.114	0.028	0.00077	0.0111	NO
1996	0.177	0.117	0.031	0.00077	0.0276	NO
1997	0.218	0.114	0.036	0.00030	0.0672	NO
1998	0.143	0.110	0.019	0.00030	0.0126	NO
1999	0.270	0.113	0.014	0.00122	0.1416	NO
2000	0.309	0.111	0.012	0.00270	0.1833	NO
2001	0.133	0.101	0.009	0.00301	0.0195	NO
2002	0.160	0.101	0.025	0.00314	0.0303	NO
2003	0.159	0.101	0.014	0.00348	0.0396	NO
2004	0.178	0.097	0.034	0.00450	0.0426	NO
2005	0.234	0.103	0.059	0.00556	0.0666	NO
2006	0.220	0.099	0.077	0.00670	0.0378	NO
2007	0.223	0.085	0.101	0.00679	0.0294	NO
2008	0.165	0.049	0.082	0.00727	0.0270	NO
2009	0.168	0.052	0.064	0.00544	0.0459	NO
2010	0.149	0.051	0.050	0.00513	0.0420	NO
2011	0.167	0.056	0.061	0.00583	0.0450	NO
2012	0.166	0.056	0.055	0.00479	0.0501	NO
Decrease 1988-2012	25.7%	74.8%	-	-	-	-
Decrease 1990-2012	74.9%	72.2%	88.0%	-1512.1%	-	-
Decrease 2011-2012	0.5%	-1.1%	9.2%	17.9%	-11.3%	-

Table 103 N_2O emissions in CRF 1.A.4.c. Agriculture/Forestry/Fisheries

N_2O (Gg)	CRF 1.A.4.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.01342	0.01342	NO	NO	NO	NO
1989	0.01362	0.01362	NO	NO	NO	NO
1990	0.01429	0.01213	0.00215	0.000006	NO	NO
1991	0.01127	0.00904	0.00162	0.000011	0.00060	NO
1992	0.00932	0.00747	0.00069	0.000018	0.00115	NO
1993	0.00722	0.00683	0.00022	0.000013	0.00016	NO

N_2O (Gg)	CRF 1.A.4.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1994	0.00897	0.00810	0.00023	0.000015	0.00062	NO
1995	0.00711	0.00681	0.00013	0.000015	0.00015	NO
1996	0.00757	0.00704	0.00015	0.000015	0.00037	NO
1997	0.00792	0.00685	0.00017	0.000006	0.00090	NO
1998	0.00689	0.00663	0.00009	0.000006	0.00017	NO
1999	0.00875	0.00677	0.00007	0.000024	0.00189	NO
2000	0.00921	0.00665	0.00005	0.000054	0.00244	NO
2001	0.00639	0.00603	0.00004	0.000060	0.00026	NO
2002	0.00664	0.00606	0.00012	0.000063	0.00040	NO
2003	0.00672	0.00606	0.00007	0.000070	0.00053	NO
2004	0.00663	0.00581	0.00016	0.000090	0.00057	NO
2005	0.00740	0.00613	0.00028	0.000111	0.00089	NO
2006	0.00690	0.00590	0.00036	0.000134	0.00050	NO
2007	0.00610	0.00510	0.00047	0.000136	0.00039	NO
2008	0.00381	0.00292	0.00038	0.000145	0.00036	NO
2009	0.00411	0.00309	0.00030	0.000109	0.00061	NO
2010	0.00396	0.00306	0.00023	0.000103	0.00056	NO
2011	0.00431	0.00331	0.00028	0.000117	0.00060	NO
2012	0.00438	0.00336	0.00026	0.000096	0.00067	NO
Decrease 1988-2012	67.4%	75.0%	-	-	-	-
Decrease 1990-2012	69.3%	72.3%	88.0%	-1512.1%	-	-
Decrease 2011-2012	-1.6%	-1.4%	9.2%	17.9%	-11.3%	-

Table 104 GHG emissions in CRF 1.A.4.c. Agriculture/Forestry/Fisheries

GHG (Gg)	TJ	CRF 1.A.4.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	22 365.00	1 648.79	1 648.79	NO	NO	NO	NO
1989	22 705.80	1 673.92	1 673.92	NO	NO	NO	NO
1990	21 815.07	1 651.03	1 490.45	157.31	3.27	NO	NO
1991	16 479.06	1 235.29	1 110.16	117.90	6.10	1.1310	NO
1992	13 398.16	981.21	919.32	49.86	9.86	2.1715	NO
1993	11 705.68	864.88	841.20	16.00	7.38	0.2941	NO
1994	13 978.14	1 030.89	1 004.57	16.64	8.52	1.1612	NO
1995	11 641.80	859.19	840.89	9.55	8.47	0.2790	NO
1996	12 091.92	886.36	866.62	10.53	8.52	0.6937	NO
1997	11 814.54	861.70	844.20	12.54	3.27	1.6890	NO
1998	11 213.70	826.64	816.45	6.60	3.27	0.3167	NO
1999	12 049.00	856.80	834.89	4.98	13.38	3.5589	NO
2000	12 319.45	860.64	822.33	3.97	29.73	4.6069	NO
2001	10 781.05	781.48	744.56	3.32	33.10	0.4901	NO
2002	10 949.05	792.31	747.84	9.12	34.59	0.7615	NO
2003	11 052.14	794.92	750.64	4.98	38.31	0.9953	NO
2004	10 843.06	778.48	716.36	11.48	49.56	1.0707	NO
2005	11 875.71	846.56	763.53	20.15	61.20	1.6739	NO
2006	11 648.14	832.39	731.69	25.96	73.79	0.9500	NO
2007	10 371.47	742.95	632.29	35.16	74.76	0.7389	NO
2008	6 805.72	475.73	367.02	27.99	80.04	0.6786	NO

GHG (Gg)	TJ	CRF 1.A.4.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2009	6 799.60	474.40	391.68	21.66	59.90	1.1536	NO
2010	6 546.86	457.30	382.85	16.87	56.53	1.0556	NO
2011	7 155.14	499.95	414.03	20.49	64.29	1.1310	NO
2012	6 983.39	490.28	417.39	18.91	52.72	1.2592	NO
Decrease 1988-2012	68.8%	70.3%	74.7%	-	-	-	-
Decrease 1990-2012	68.0%	70.3%	72.0%	88.0%	-1512.0%	-	-
Decrease 2011-2012	2.4%	1.9%	-0.8%	7.7%	18.0%	-11.3%	-

3.4 FUGITIVE EMISSIONS FROM SOLID FUELS AND OIL AND NATURAL GAS (CRF 1.B)

Fugitive emissions from fuels are responsible for 2.6% of total GHG emissions for 2012. The fugitive emissions from gas and oil have a share of approx. 1.1% of total GHG emissions, while the fugitive emissions from solid fuels are approx. 1.5% of total GHG emissions.

3.4.1 COAL MINING (CRF 1.B.1)

This category includes fugitive methane emissions from coal mining and handling activities in underground and surface mines as well as emissions from solid fuel transformation.

The coal mining in Bulgaria is being carried out by both surface mining and underground mining. The main domestic solid fuels are lignite and sub-bituminous coal and they are mined mostly by surface mining in the Maritza Iztok mining complex. At the beginning of the time series the quantities of coal produced trough underground mining were equal to about 12% of the total production of coal, but since many of the mines were subsequently closed down, the percentage dropped down to about 2% in 2012. The annual production amounts to 33.4 million tons in 2012, of which 680 thousand tons were produced by underground mining.

Solid fuel transformation is also a source of fugitive emissions, although the IPCC guidelines are not very explicit regarding this subcategory. In Bulgaria until 2008 the operation of coke ovens was a source of fugitive emissions, while the annual amount of coking coal was varying between 1.4 Mt at the beginning of the time series and 434 kt at the end. For the 2014 submission was identified an additional source of fugitive emissions – charcoal production and the emissions were estimated for the full time series. The indigenous production of charcoal decreases from 18 kt at the beginning of the timeseries to 4 kt in 2012. The activity data and the emission estimates are presented in Table 106.

3.4.2 EXTRACTION, REFINING, TRANSPORTATION AND DISTRIBUTION OF OIL AND NATURAL GAS (CRF 1.B.2)

Unlike fugitive emissions from coal mining, the emissions from Oil and Gas are a lot more complex because of the various sources involved and different types of activity data. The emission estimates for this category cover methane, carbon dioxide and nitrous oxide fugitive emissions from exploration, production and processing, refining and storage, transport, transmission and distribution of oil and natural gas.

The trends of methane fugitive emissions from oil and gas systems are presented in Table 107 and Table 108.

The natural gas consumption was reduced more than twice in 2012, compared to 1988, due to the collapse of industrial sector (mostly fertilizer production and iron & steel industry), which could not be compensated by the increasing gas consumption of commercial and residential sectors in the last years.

Natural gas production in Bulgaria peaked in the interval 2004-2008, following the development of the new field (Galata), which was expended in 2009. Since 2010 there are new fields developed (Kaliakra and Kavarna), which has again increased the domestic production of natural gas and is expected to be developed until 2017. As a requirement from the National Statistics Institute, due to the limited number of oil and natural gas production companies in the country, the indigenous production data is notated as confidential and not presented in this report.

The CH_4 fugitive emissions from the transmission and distribution gas networks in the industry and households are estimated based on the length of pipelines. The distribution network length is growing steadily due to the increasing gasification of municipalities in Bulgaria, while the transmission network is stays constant.

The production of crude oil in Bulgaria is in very small amounts (0.4%) compared to the total consumption and only one company is producing. Generally, there is a decreasing trend in the local production of crude oil.

Table 105 Activity data and CH_4 emissions from CRF 1.B.1 Coal mining and Handling

Year	1.B.1.a Coal Mining and Handling						1.B.1.b Solid Fuel Transformation			
	i. Underground Mines			ii. Surface Mines			Coking coal		Charcoal	
	AD	Post-mining emissions	Mining emissions	AD	Post-mining emissions	Mining emissions	AD	Emissions	AD	Emissions
	kt	Gg	Gg	kt	Gg	Gg	kt	Gg	kt	Gg
1988	4098	6.86	49.42	30049	2.01	30.20	1400	0.07	18	0.48
1989	4116	6.89	49.64	30182	2.02	30.33	1208	0.06	19	0.48
1990	3848	6.45	46.41	27827	1.86	27.97	1854	0.09	20	0.52
1991	3159	5.29	38.10	25231	1.69	25.36	1004	0.05	21	0.54
1992	3589	6.01	43.28	26735	1.79	26.87	1161	0.06	23	0.59
1993	3682	6.17	44.40	25350	1.70	25.48	1295	0.06	23	0.59
1994	3328	5.57	40.14	25429	1.70	25.56	1519	0.07	21	0.54
1995	3381	5.66	40.77	27449	1.84	27.59	1693	0.08	20	0.52
1996	3198	5.36	38.57	28104	1.88	28.24	1491	0.07	21	0.54
1997	2779	4.65	33.51	26929	1.80	27.06	1656	0.08	21	0.55
1998	1970	3.30	23.76	28141	1.89	28.28	1189	0.06	3	0.08
1999	1458	2.44	17.58	23840	1.60	23.96	1090	0.05	3	0.08
2000	1621	2.72	19.55	24811	1.66	24.94	1325	0.06	8	0.21
2001	1248	2.09	15.05	25363	1.70	25.49	1148	0.06	21	0.55
2002	1354	2.27	16.33	24664	1.65	24.79	1072	0.05	25	0.65
2003	1560	2.61	18.81	25739	1.72	25.87	1188	0.06	25	0.65
2004	383	0.64	4.62	26102	1.75	26.23	1174	0.06	24	0.62
2005	585	0.98	7.06	24110	1.62	24.23	1051	0.05	24	0.62
2006	161	0.27	1.94	25517	1.71	25.64	947	0.05	43	1.12
2007	475	0.80	5.73	27978	1.87	28.12	751	0.04	25	0.65
2008	556	0.93	6.71	28233	1.89	28.37	434	0.02	17	0.44
2009	698	1.17	8.42	26488	1.77	26.62	0	0.00	16	0.42
2010	756	1.27	9.12	28649	1.92	28.79	0	0.00	17	0.44
2011	878	1.47	10.59	36250	2.43	36.43	0	0.00	16	0.42
2012	695	1.16	8.38	32732	2.19	32.90	0	0.00	4	0.10

Table 106 Activity data from oil and gas

Year	1. B. 2. a. Oil			1. B. 2. b. Natural Gas						1. B. 2. c. Venting and Flaring			
								v. Other Leakage		1. B. 2. c. 1 Venting		1. B. 2. c. 2 Flaring	
	i. Exploration	ii. Production	iv. Refining / Storage	ii. Production / Processing	iii. Transmission	iv. Distribution		at industrial plants and power stations	in residential and commercial sectors	i. Oil	ii. Gas	i. Oil	ii. Gas
	10^3m^3	PJ	PJ	PJ	km	10^6m^3	km	PJ	PJ	10^3m^3	10^6m^3	10^3m^3	10^6m^3
1988	C	C	559.1	C	1234.0	6152.2	50.0	175.2	0.4	C	C	C	C
1989	C	C	559.1	C	1350.0	6333.2	50.0	181.2	0.5	C	C	C	C
1990	C	C	352.8	C	1469.0	6717.0	50.0	120.0	0.9	C	C	C	C
1991	C	C	191.6	C	1619.0	5661.0	50.0	90.6	0.2	C	C	C	C
1992	C	C	107.2	C	1644.0	5012.0	50.0	74.8	0.3	C	C	C	C
1993	C	C	242.3	C	1769.0	4670.0	50.0	73.5	0.3	C	C	C	C
1994	C	C	296.0	C	1919.0	4674.0	50.0	82.9	0.3	C	C	C	C
1995	C	C	340.0	C	2044.0	5638.0	50.0	96.6	0.9	C	C	C	C
1996	C	C	295.8	C	2205.0	5761.0	50.0	96.9	1.6	C	C	C	C
1997	C	C	253.7	C	2370.0	4599.0	60.0	104.3	1.0	C	C	C	C
1998	C	C	236.3	C	2410.0	3848.0	100.0	80.7	1.0	C	C	C	C
1999	C	C	240.4	C	2540.0	3322.0	200.0	60.5	1.0	C	C	C	C
2000	C	C	226.0	C	2645.0	3616.0	300.0	78.3	1.2	C	C	C	C
2001	C	C	227.6	C	2540.0	3361.0	500.0	69.1	1.5	C	C	C	C
2002	C	C	222.1	C	2645.0	2935.0	700.0	58.2	1.7	C	C	C	C
2003	C	C	214.3	C	2645.0	3058.0	911.0	59.4	2.2	C	C	C	C
2004	C	C	224.7	C	2645.0	3092.0	1268.0	63.5	2.7	C	C	C	C
2005	C	C	263.1	C	2645.0	3466.0	1577.0	74.1	3.9	C	C	C	C
2006	C	C	302.4	C	2645.0	3539.0	1870.0	73.9	5.6	C	C	C	C
2007	C	C	301.8	C	2645.0	3582.0	2290.0	77.9	6.3	C	C	C	C
2008	C	C	304.0	C	2645.0	3508.0	2710.0	74.7	7.2	C	C	C	C
2009	C	C	265.7	C	2645.0	2609.0	3164.0	46.8	6.6	C	C	C	C
2010	C	C	232.9	C	2645.0	2795.0	3493.0	51.0	7.2	C	C	C	C
2011	C	C	216.2	C	2645.0	3188.0	3656.0	63.2	7.7	C	C	C	C
2012	C	C	250.7	C	2645.0	2970.0	3873.0	56.3	7.3	C	C	C	C

Table 107 CH_4 fugitive emissions from oil and gas

Year	1. B. 2. a. Oil				1. B. 2. b. Natural Gas					1. B. 2. c. Venting and Flaring			
								v. Other Leakage		1. B. 2. c. 1 Venting		1. B. 2. c. 2 Flaring	
	i. Exploration	ii. Production	iii. Transport	iv. Refining / Storage	ii. Production / Processing	iii. Transmission	iv. Distribution	at industrial plants and power stations	in residential and commercial sectors	i. Oil	ii. Gas	i. Oil	ii. Gas
1988	0.0181	0.0090	0.0023	0.4920	0.0888	3.0850	0.0335	48.9703	0.0619	0.8112	0.0019	0.0020	0.0000
1989	0.0181	0.0090	0.0023	0.4920	0.0708	3.3750	0.0335	50.6504	0.0637	0.8112	0.0015	0.0020	0.0000
1990	0.0136	0.0068	0.0017	0.3105	0.1192	3.6725	0.0335	33.5389	0.1186	0.6084	0.0025	0.0015	0.0000
1991	0.0131	0.0065	0.0017	0.1686	0.0851	4.0475	0.0335	25.3291	0.0324	0.5881	0.0018	0.0014	0.0000
1992	0.0120	0.0060	0.0015	0.0943	0.3151	4.1100	0.0335	20.8993	0.0449	0.5374	0.0067	0.0013	0.0001
1993	0.0097	0.0048	0.0013	0.2132	0.5759	4.4225	0.0335	20.5564	0.0434	0.4360	0.0124	0.0011	0.0001
1994	0.0081	0.0041	0.0010	0.2605	0.4797	4.7975	0.0335	23.1770	0.0477	0.3650	0.0102	0.0009	0.0001
1995	0.0097	0.0048	0.0013	0.2992	0.4179	5.1100	0.0335	26.9955	0.1304	0.4360	0.0091	0.0011	0.0001
1996	0.0072	0.0036	0.0009	0.2603	0.3482	5.5125	0.0335	27.0838	0.2285	0.3245	0.0076	0.0008	0.0001
1997	0.0063	0.0032	0.0008	0.2233	0.2967	5.9250	0.0402	29.1636	0.1338	0.2839	0.0064	0.0007	0.0001
1998	0.0075	0.0037	0.0010	0.2079	0.2470	6.0250	0.0670	22.5612	0.1398	0.3346	0.0053	0.0008	0.0001
1999	0.0090	0.0045	0.0012	0.2115	0.2247	6.3500	0.1340	16.9212	0.1417	0.4056	0.0049	0.0010	0.0001
2000	0.0095	0.0047	0.0012	0.1989	0.1301	6.6125	0.2010	21.8971	0.1645	0.4259	0.0027	0.0010	0.0000
2001	0.0077	0.0038	0.0010	0.2003	0.1936	6.3500	0.3350	19.3202	0.2122	0.3448	0.0042	0.0008	0.0000
2002	0.0084	0.0042	0.0011	0.1954	0.1707	6.6125	0.4690	16.2786	0.2349	0.3752	0.0036	0.0009	0.0000
2003	0.0068	0.0034	0.0009	0.1886	0.1355	6.6125	0.6104	16.5998	0.3098	0.3042	0.0029	0.0007	0.0000
2004	0.0068	0.0034	0.0009	0.1978	2.8221	6.6125	0.8496	17.7415	0.3800	0.3042	0.0601	0.0007	0.0007
2005	0.0068	0.0034	0.0009	0.2315	4.0597	6.6125	1.0566	20.7188	0.5464	0.3042	0.0957	0.0007	0.0011
2006	0.0063	0.0032	0.0008	0.2662	3.9478	6.6125	1.2529	20.6595	0.7851	0.2839	0.0928	0.0007	0.0010
2007	0.0059	0.0029	0.0008	0.2656	2.4893	6.6125	1.5343	21.7742	0.8786	0.2636	0.0528	0.0006	0.0006
2008	0.0054	0.0027	0.0007	0.2675	1.6510	6.6125	1.8157	20.8912	1.0050	0.2434	0.0389	0.0006	0.0004
2009	0.0057	0.0028	0.0007	0.2338	0.1382	6.6125	2.1199	13.0708	0.9267	0.2535	0.0031	0.0006	0.0000
2010	0.0052	0.0026	0.0007	0.2049	0.6240	6.6125	2.3403	14.2565	0.9992	0.2332	0.0133	0.0006	0.0001
2011	0.0050	0.0025	0.0006	0.1903	3.7037	6.6125	2.4495	17.6585	1.0775	0.2231	0.0794	0.0005	0.0009
2012	0.0054	0.0027	0.0007	0.2206	3.2554	6.6125	2.5949	15.7238	1.0227	0.2434	0.0697	0.0006	0.0008

3.4.3 METHODOLOGICAL ISSUES

Fugitive emissions from coal mining were estimated by IPCC Tier 1 method.

Relevant values between emission factors from IPCC Guidelines are chosen considering that the underground mines have average depth not more than 400 m, and the surface mines for lignite coals have depth more than 25 m.

Emissions = Coal Production (Surface or Underground) • Emission Factor

EQUATION 2.12 (IPCC GPG 2000, Chapter Energy, p.2.74)

Calculation of CO_2, CH_4 and N_2O fugitive emissions from gas and oil systems was estimated by methods and emission factors in IPCC – Tier 1.

Emissions = gas/oil network • Emission Factor

1. B. 2. a. Oil			
i. Exploration		**iii. Transport**	
AD	National Energy Balance	AD	National Energy Balance
EF	2006 IPCC Guidelines	EF	2006 IPCC Guidelines
Em = EF x AD			Em = EF x AD
ii. Production		**iv. Refining / Storage**	
AD	National Energy Balance	AD	National Energy Balance
EF	Revised 1996 IPPC Guidelines	EF	Revised 1996 IPCC Guidelines
Em = EF x AD			Em = EF x AD

1. B. 2. b. Natural Gas			
ii. Production / Processing		**v. Other Leakage**	
AD	National Energy Balance		at industrial plants and power stations
EF	Revised 1996 IPCC Guidelines	AD	National Energy Balance
Em = EF x AD		EF	Revised 1996 IPCC Guidelines
iii. Transmission			Em = EF x AD
AD	State energy and water regulatory commission		in residential and commercial sectors
EF	2000 IPCC GPG	AD	National Energy Balance
Em = EF x AD		EF	Revised 1996 IPCC Guidelines
iv. Distribution			Em = EF x AD
AD	State energy and water regulatory commission		
EF	2006 IPCC Guidelines		
Em = EF x AD			

1. B. 2. c. Venting and Flaring			
1. B. 2. c. 1 Venting		**1. B. 2. c. 2 Flaring**	
i. Oil		**i. Oil**	
AD	National Energy Balance	AD	National Energy Balance
EF	2006 IPCC Guidelines	EF	Revised 1996 IPCC Guidelines
Em = EF x AD			Em = EF x AD

ii. Gas		ii. Gas	
AD	National Energy Balance	AD	National Energy Balance
EF	Revised 1996 IPCC Guidelines	EF	2006 IPCC Guidelines
Em = EF x AD			Em = EF x AD

1.B.1.a Coal Mining and Handling	
i. Underground Mines	
AD	National Energy Balance
EF	2006 IPCC Guidelines
Em = EF x Conv. Factor x AD	
ii. Surface Mines	
AD	National Energy Balance
EF	2000 IPCC GPG
Em = EF x Conv. Factor x AD	
1.B.1.b Solid Fuel Transformation	
AD	National Energy Balance
EF	1996 IPCC Guidelines
Em = EF x AD	

Generally, the emission factors used in calculations are from Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Chapter 1 Table 1-58. Values in this table are grouped for different countries with similar energy standards. Bulgarian NIR has used EF for Former USSR countries, Central and Eastern Europe and if not available – EF for Western Europe and USA. For the subcategories, for which there are no EF available in the 1996 IPCC Guidelines and 2000 IPCC GPG are used the appropriate EF from the 2006 IPCC Guidelines.

Activity data for crude oil and natural gas has taken from the Energy balance of the country, where it was aggregated on a national level.

3.4.4 UNCERTAINTIES

The uncertainty of this emission source category was estimated as follows:

200 % for coal mining;

50 % for oil and natural gas systems.

3.4.5 SOURCE-SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken.

3.4.6 SOURCE-SPECIFIC RECALCULATIONS, INCLUDING CHANGES MADE IN RESPONSE TO THE REVIEW PROCESS

For category 1.B.1.a.2.1 Fugitive emissions from surface mines, the previous emission factor of 1.2 m^3/t was changed to 1.5 m^3/t (IPCC GPG 2000, p.2.75), following a recommendation of the ERT during the Centralised review in 2012.

For category 1.B.2.b.3 Fugitive emissions from gas transmission, the previous emission factor of 1340 $kgCH_4/km$ was changed to 2500 $kgCH_4/km$ (IPCC GPG 2000, Table 2.16, p.2.86), following a recommendation of the ERT during the Centralised review in 2012.

As a result of ERT recommendation during the 2013 review cycle, the emission inventory was improved by adding emission estimates for category 1.B.2.a.iii. Oil transport. The activity data for the estimate is provided by the National energy balance, while the emission factors are taken from Table 2.16 IPCC 2000 GPG and are equal to 0.000025 $GgCH_4/10^3m^3$ and 0.0000023 $GgCO_2/10^3m^3$ produced crude oil.

3.4.7 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

No specific improvements are planned.

4 INDUSTRIAL PROCESSES (CRF SECTOR 2)

4.1 OVERVIEW OF SECTOR

This chapter includes information on and descriptions of methodologies used for estimating greenhouse gas emissions as well as references for activity data and emission factors reported under IPCC Category 2 Industrial Processes for the period from 1988 to 2012.

Emissions from this category comprise emissions from the following sub categories:

- Mineral Products
- Chemical Industry
- Metal Production
- Consumption of Halocarbons and SF_6.

Only process related emissions are considered in this sector.

Emission Trends

This section briefly describes the emission trends from 1988 to 2012 for each of the IPCC Categories under CRF Sector 2 for which GHG emissions are reported – i.e. categories

2A – Mineral Products,
2B - Chemical Industry,
2C – Metal Production and
2F - Consumption of Halocarbons and SF_6.
Industrial process emissions include emissions from industrial installations and from consumption of halocarbons and SF_6 (the fluorinated gases or F-gases).

In 2012 the most important emitting category is Mineral products (94% of which are from clinker/cement production (35%), quick lime production (35%) and lime stone used for DeSOx instalation of LCP/TPP (24%)) which share in the total Industrial processes emissions is 73.3%. The second category by share is Chemical Industry (ammonia and nitric acid production) with 13.4%, followed by Consumption of Halocarbons and SF_6 with 12.0% share and finally Metal Production (steel) with 1,3%.

These results are presented in the following table:

Table 108 GHG Emission trends in CRF 2 Industrial processes, 1988 - 2012

IPCC category	Emissions [Gg CO_2 eq]		Share [%]		Trend
	Base year*	2012	Base year*	2012	1988 – 2012 [%]
2 Industrial processes	11959,94	3895,22	100,00	100,00	-67,43
2.A Mineral products	4373,68	2853,48	36,57	73,26	-34,76
2.B Chemical Industry	3801,62	522,97	31,79	13,43	-86,24
2.C Metal Production	3773,56	50,36	31,55	1,29	-98,67
2.F Consumption of Halocarbons and SF_6	3,46	468,41	0,03	12,03	13441,02

* Base year 1988

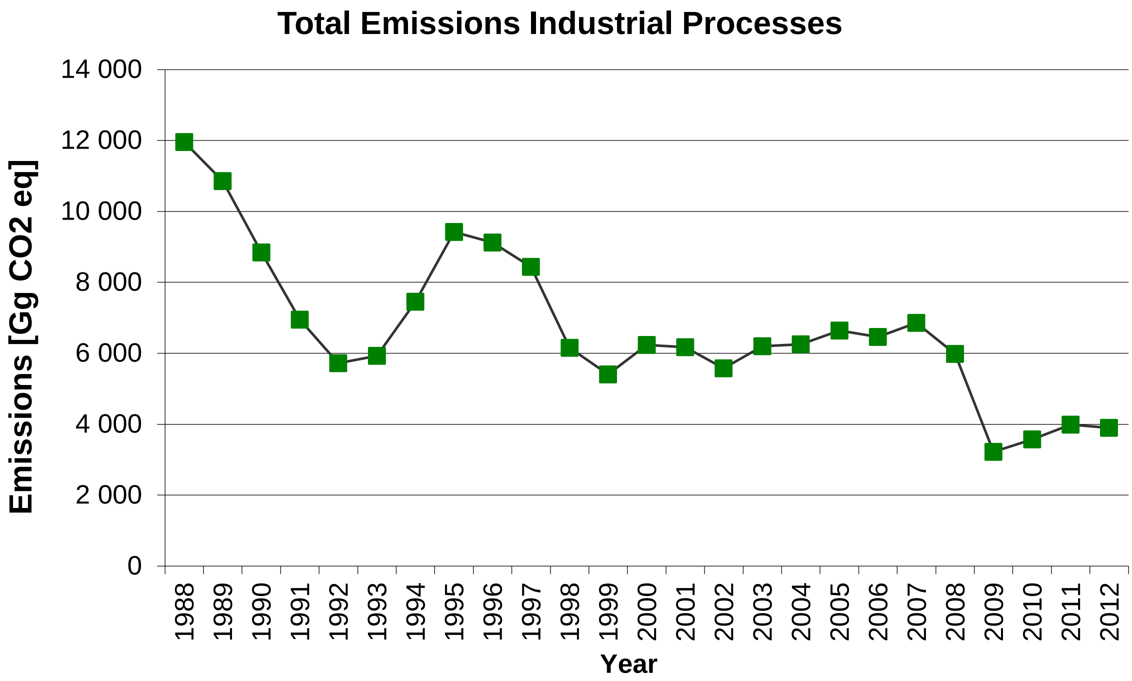


Figure 50 CO_2 Emission trends for CRF Sector 2 Industrial Processes for 1988-2012

In the year 2012, 6,37% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes, compared to 9,73% in the base year 1988. In 2012, greenhouse gas emissions from Category 2 Industrial Processes are 3 859.22 Gg CO_2 equivalent compared to 11 959.94 Gg in the base year.

Greenhouse gas emissions from the Industrial Processes sector fluctuate during the period and reach a minimum in 2009. The reduction for the whole sector is 67.43% in 2012 while the biggest reduction (compared to the base year) is in Metal Production category – 98.67%.

This is mainly due to economic crisis and in particular the world economic crisis in 2009. The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation. In 2009 – 2012 the market had recovered.

The general reduction in the emissions in the later years of the time period is influenced also by the starting introduction of better technologies on plant level.

Emission trends by gas

The following table presents greenhouse gas emissions of the industrial processes sector as well as their share in total greenhouse gas emissions from that sector in the base year and in 2012.

Table 109 GHG emissions from CRF 2 Industrial Processes by gas in 1988 and 2012

GHG	Base year*	2012	Base year*	2012
	CO_2 equivalent [Gg CO_2 eq]		[%]	
Total	11959,94	3895,22	100,00	100,00
CO_2	9856,62	3296,28	82,41	84,62
CH_4	90,04	0,00	0,75	0,00
N_2O	2009,83	130,53	16,80	3,35
HFCs	0,00	456,41	0,00	11,72
PFCs	0,00	0,04	0,00	0,001
SF_6	3,46	11,96	0,03	0,31

*1988 for: CO_2, CH_4, N_2O.

*1995 for: HFCs, PFCs and SF_6.

The most important GHG of the industrial processes sector is CO_2 with 84.6% of the total emissions from this category in 2012, followed by HFCs with 11.7%, N_2O with 3.4 %, SF_6 with 0.3%, PFCs with 0,001% and finally CH_4 with 0.00%.

Table 110 GHG Emissions from CRF 2 Industrial Processes by gases 1988 - 2012

GHG emissions [Gg CO_2 eq]							
Year	**Total**	**CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**
1988	11 959,94	9 856,62	90,04	2 009,83	0,00	0,00	3,46
1989	10 853,96	8 973,30	89,60	1 787,41	0,00	0,00	3,66
1990	8 846,52	7 058,42	70,47	1 713,76	0,00	0,00	3,87
1991	6 947,67	5 713,25	51,64	1 177,96	0,72	0,00	4,10
1992	5 720,01	4 673,96	48,92	992,79	0,00	0,00	4,33
1993	5 929,70	4 993,56	56,80	874,75	0,01	0,00	4,59
1994	7 456,86	6 435,46	73,86	942,67	0,02	0,00	4,85
1995	9 421,59	7 926,00	81,21	1 406,85	2,39	0,00	5,13
1996	9 123,97	7 591,99	76,08	1 446,26	4,20	0,00	5,43
1997	8 440,52	7 266,73	81,26	1 080,40	6,40	0,00	5,75
1998	6 151,24	5 421,51	65,43	647,99	10,24	0,00	6,08
1999	5 407,24	4 793,13	55,87	537,23	14,58	0,00	6,43
2000	6 235,08	5 338,63	56,81	814,39	18,44	0,00	6,80
2001	6 168,43	5 260,43	55,27	816,37	29,16	0,00	7,20
2002	5 579,05	4 810,96	48,36	670,14	41,98	0,00	7,62
2003	6 200,60	5 372,86	59,26	700,52	59,91	0,00	8,06
2004	6 249,82	5 268,82	49,63	842,78	80,06	0,00	8,53
2005	6 639,32	5 555,57	46,98	913,86	114,34	0,00	8,56
2006	6 458,57	5 746,87	45,01	489,98	167,82	0,00	8,89
2007	6 854,77	5 990,37	40,47	605,61	209,08	0,00	9,24
2008	5 978,73	5 045,63	21,54	580,65	321,32	0,00	9,60
2009	3 219,43	2 585,79	1,35	272,58	349,72	0,02	9,97
2010	3 574,41	2 921,58	0,00	267,51	372,20	0,04	13,07
2011	3 992,23	3 332,83	0,00	234,44	410,04	0,05	14,87
2012	3 895,22	3 296,28	0,00	130,53	456,41	0,04	11,96

The emission trends of the three GHG – CO_2, CH_4 and N_2O, are presented on the following figure.

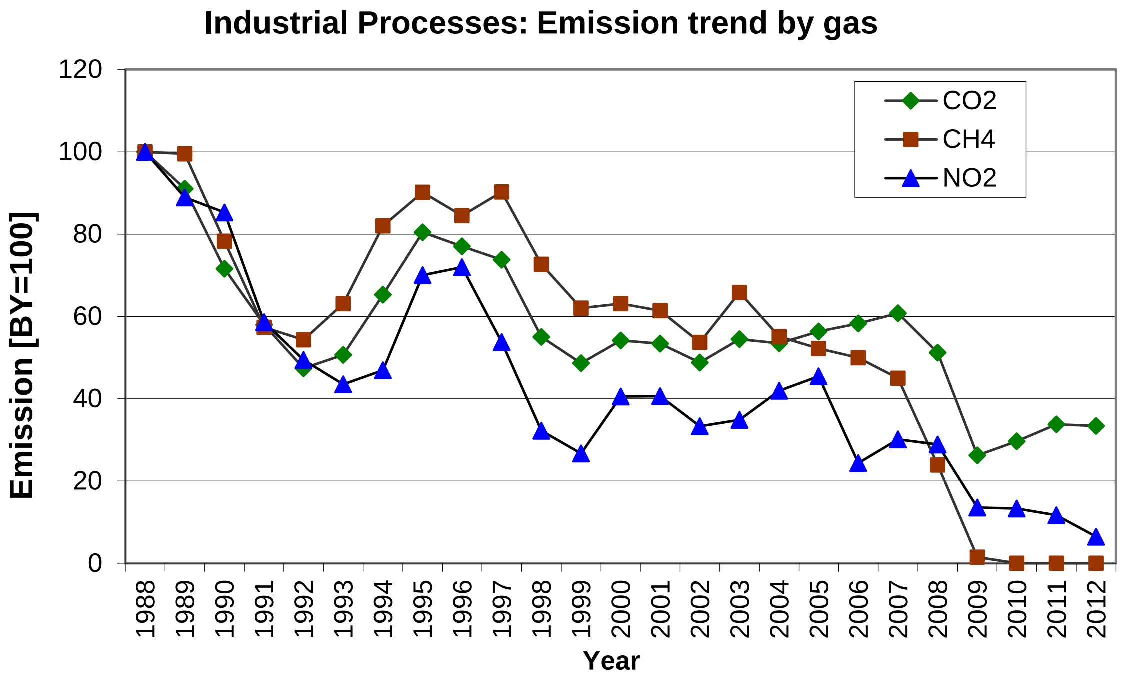


Figure 51 Industrial Processes: Emission trend by gas – CO_2, N_2O, CH_4

Emission trends by sources

The main sources of greenhouse gas emissions in the industrial processes sector are Mineral Products and Chemical Industry, which cause about 73.3% and 13.4%, respectively, of the emissions from this sector in 2012.

Table 111 GHG Emissions from CRF 2 Industrial Processes by sector 1988 to 2012

GHG emissions [Gg CO_2 eq]				
Year	Mineral Products	Chemical Industry	Metal Production	Consumption of Halocarbons and SF_6
1988	4373,68	3801,62	3773,56	3,46
1989	4256,89	3596,73	2989,78	3,66
1990	3906,81	3490,00	1440,62	3,87
1991	2586,34	2794,87	1558,59	4,82
1992	2008,83	2246,83	1457,05	4,34
1993	1962,88	2007,55	1951,22	4,59
1994	2408,68	2252,36	2787,10	4,87
1995	3239,55	2962,79	3207,60	7,52
1996	3238,07	2990,23	2881,76	9,63
1997	2621,89	2403,45	3398,84	12,15
1998	1991,95	1378,32	2760,84	16,31
1999	1816,01	1039,19	2529,52	21,01
2000	2120,11	1650,29	2439,43	25,25
2001	2256,93	1549,89	2325,25	36,36
2002	2272,35	1140,20	2116,91	49,59
2003	2343,27	1153,00	2636,36	67,96
2004	2594,58	1442,27	2124,38	88,59
2005	2808,80	1564,67	2142,95	122,90
2006	2939,66	994,10	2348,10	176,71
2007	3460,41	1140,84	2035,19	218,32

GHG emissions [Gg CO_2 eq]				
Year	**Mineral Products**	**Chemical Industry**	**Metal Production**	**Consumption of Halocarbons and SF_6**
2008	3474,00	1136,69	1037,12	330,92
2009	2205,85	573,41	80,46	359,71
2010	2468,47	665,59	55,03	385,32
2011	2720,81	778,04	68,42	424,97
2012	2853,48	522,97	50,36	468,41

Figure 42 presents greenhouse gas emissions from IPCC Category 2 Industrial Processes by sub category for the years 1988 to 2012.

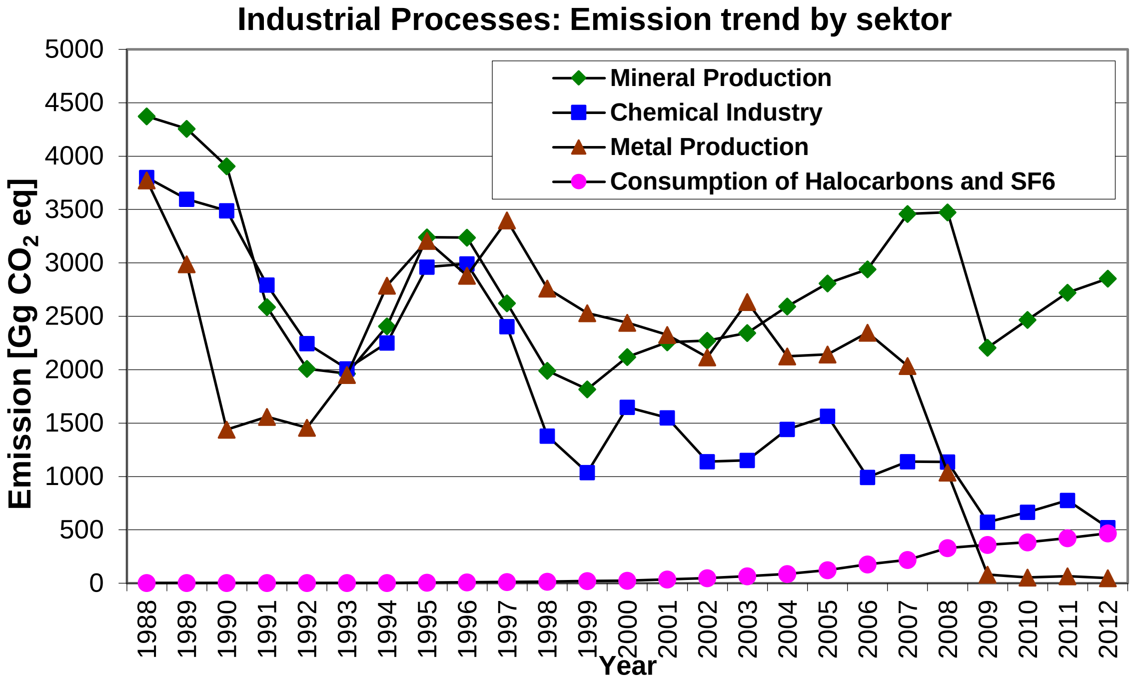


Figure 52 CRF 2 Industrial Processes: Emission trend by sector – [Gg CO_2 eq]

There is general reduction of the total emission in the Industrial Processes sector in 2012 compared to the base year. This is mainly due to the world economic crisis in the last years.

The emissions reduction during the whole time period from 1988 to 2012 is due to mainly economic reasons (economic crisis). There are another two such periods – around 1989 - 1991 and 1997 – 1999. The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

The general reduction in the emissions in the later years of the time period is influenced also by the starting introduction of better technologies on plant level.

Greenhouse gas emissions from the Industrial Processes sector fluctuate during the period and reach a minimum in 2009. The reduction for the whole sector is 67.4% in 2012 while the biggest reduction (compared to the base year) is in Metal Production category – 98.7%, followed by Chemical Industry with 86.2% and Mineral Products with 34.8%.

One of the most important factors leading to emission reduction in Metal Production sector is that the biggest plant from this sector (which share in the steel production before 2008 was more than 50%) ceased operation of its pig iron and the following steel making in BOF in November 2008. The total reduction in the sector production comparing the years of 2008 and 2012 is about 50%.

Ceased operation of existing ammonia and nitric acid plants is the main reason for the emission reduction in Chemical Industry category, too. That led to a reduction of the emissions in the period 1999/2002 for the Chemical Industry as a whole. In 2012 the market was recovered.

In 2012 a slight increase in emissions is observed for the entire industrial processes sector. This is mainly due to increase in mineral products category. There is a slight increase in the Chemical products category, which indicates that the chemical plants start to recover from the effects of the world economic crisis in 2008. In 2012 there is some increase observed in one sectors while there is a decrease in others.

Methodology

The general method for estimating emissions for the industrial processes sector, as recommended by the IPCC, involves multiplying production data for each process by an emission factor per unit of production. For some sub-sectors (for example ammonia production, nitric acid production, etc.) higher tier, i.e. tier 2 or tier 3, are used.

In some categories emission and production data were reported directly by industry or ETS, IPPC and/or E-PRTR reports thus represent plant and country specific data. Methodologies are described for all IPCC categories.

Detailed information on the methodology can be found in the corresponding subchapters.

Emission data reported under the European Emission Trading Scheme - EU ETS

Verified CO_2 emissions reported under the EU ETS were available for the years 2007-2012. These emissions have been incorporated in the inventory as far as possible (see respective subchapters for more information). Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Uncertainty Assessment

For the sector Industrial processes uncertainties are estimated taking into account the recommendations of 1996 IPCC guidelines and Good Practice Guidance as well as some specific recommendations from 2006 IPCC Guidelines.

For all the sub-sectors uncertainties for the emission factors and activity data as well as combined uncertainty are estimated. When doing so the methods for obtaining the activity data and estimating the emission factors (plant specific, country specific, national statistics) were considered.

Quality Assurance and Quality Control (QA/ QC)

Emission estimations as well as activity data and emission factors are compared with EU ETS verified emission reports, IPPC reports as well as E-PRTR reports where available.

The availability of quality management systems, such as ISO 9001, ISO 14001 and EMAS, are available for is also taken into account that.

Monitoring data are used in some emissions estimation.

Planned Improvements

All planned improvements (described in the following sub-chapters) have been implemented in this sector.

4.2 MINERAL PRODUCTS (CRF 2.A)

4.2.1 CEMENT PRODUCTION (CRF 2.A.1)

4.2.1.1 Source category description

Since 1997 until present there are only 5 existing/operational cement plants in Bulgaria (respectively, 2 within HOLCIM Group, 2 within ITALCEMENTI Group and 1 within TITAN CEMENT Group). All 5 plants are covered by the EU ETS and the IPPC Directive and have been modernized accordingly during the last 10 years. In addition all plant sites are certified at present according to ISO 9001 and 14 001 standards. One more (6th) installation was operational from 1988 till 1996 and decommissioned finally during that last year. One from the 5th existing/operational installation was the decrease substantially its production during 2010. In 2011 this factory completely ceases operation and all equipment is decommissioned. At present there are only 4 operating plants, one of which has significantly reduced production with tendency to cease it completely. During 2012 cement produced 99.1% are Portland cement, i.e. the other types of cement are only 0.9% from the total annual national production. All types of produced cements are according to BSS EN 197-126.

Additional information on the above installations (operators) may be obtained through the Bulgarian Association of Cement Industry (BACI) at www.bacibg.org and/or their own internet sites.

4.2.1.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is

[26] Cement. Composition, specifications and conformity criteria for low heat common cements

followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

There is general increase of the total emission in the sector in 2012 compared to 2011. It is due to the increased production in three out of four plants, despite the fourth almost ceased production.

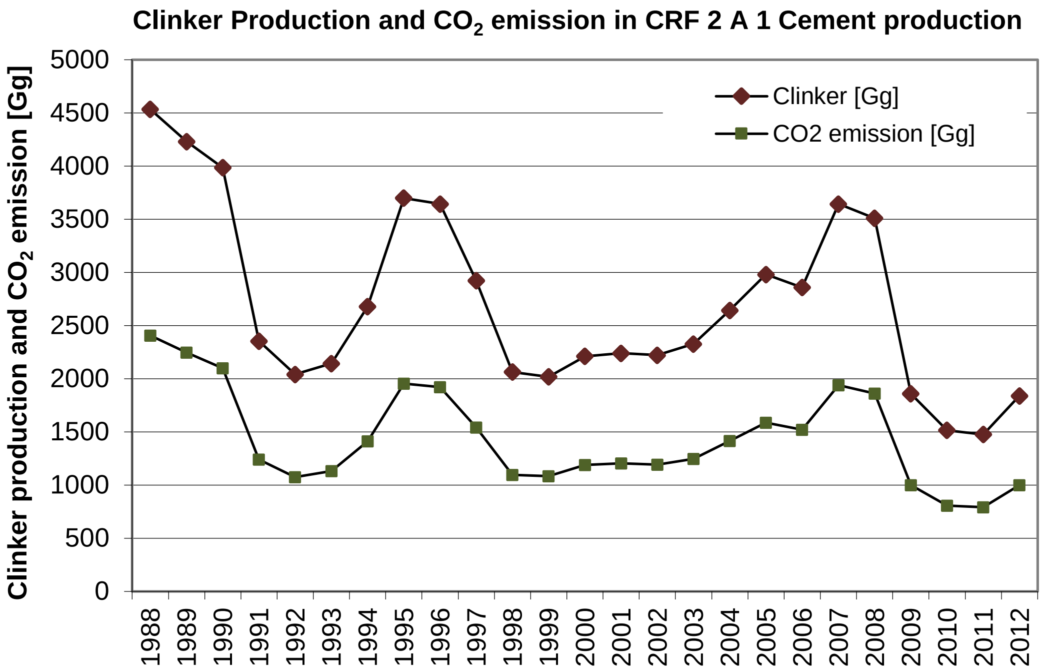


Figure 53 Clinker Production and CO_2 emission in CRF 2 A 1 Cement production

4.2.1.3 Methodological issues

The GHG emissions from the sector are calculated by using a clinker production data and a country specific method, similar to a Tier 2 Method according to item 3.1.1 from the IPCC GPG 2000. The aggregated national clinker production (CP) data in t/y are provided by the NSI.

The emission calculations and the applied emission factor are respectively according to equations 3.1 and 3.3 on pages 3.10 and 3.12 from item 3.1.1 (IPCC GPG 2000):

$$\textbf{Emissions} = \textbf{EF}_{\textbf{clinker}} \bullet \textbf{CP} \bullet \textbf{CKD Correction Factor}$$

$$\textbf{EF}_{\textbf{clinker}} = \sum \textbf{M} \bullet \textbf{C}_{\textbf{(MeO)}}$$

$$\textbf{C}_{\textbf{(MeO)}} = ((\sum \textbf{Cn}_{\textbf{(MeO)}}) \bullet \textbf{CPn}) / \textbf{CP})/100$$

Where:

CKD Correction Factor = 1.00

M - Molecular Weight CO_2/ Molecular Weight Me-oxide

$C_{(MeO)}$ – Content (Weight Fraction) in Clinker [%]

CP – clinker production [Gg]

Me – Ca, Mg, other

n – Cement plants (1-5)

The above assumption for the CKD Correction Factor is based on the modern status of all 5 operational cement plants and the total (100%) recycling of their CKD as a raw material. Respectively, the approach is according to paragraph 1 on p.3.12 from item 3.1.1 (IPCC GPG 2000 - van Oss, 1988).

In addition, the above calculations are based on the conservative assumption that all of the lime (MeO) comes from a carbonate sources (e.g. limestone/MeCO3) in the lack of reliable data on the use of non-carbonate sources, i.e. assuming 100% calcinations of the carbonate sources present in the raw materials mixture.

Taking into account the above, the final equation is as follows:

Emissions = 0,543 • CP • 1.0 = 0,543 • CP **(for 2012)**

The 2012 CO_2 emissions are taken from the operators EU ETS reports. In their reports $CaCO_3$, $MgCO_3$ and other carbonates content in the raw materials used is taken into account.

The aggregated national clinker production (CP) data provided by the NSI and plants cover the period from 1988 to 2012. They are presented in the table below together with the relevant coefficients and the calculated CO_2 emissions:

Table 112 Clinker production, weight fraction and CO_2 emission

Clinker Production Data		Molecular Weight Fraction CO_2/CaO	CaO Weight Fraction	Molecular Weight Fraction CO_2/MgO	MgO Weight Fraction	IEF [kt CO_2/kt CP]	CO_2 Emissions [kt/y]
Year	[kt/y]						
1988	4535,24	0,785	0,659	1,092	0,012	0,531	2 406,34
1989	4232,71	0,785	0,659	1,092	0,012	0,531	2 245,82
1990	3986,62	0,785	0,655	1,092	0,012	0,527	2 100,42
1991	2354,10	0,785	0,655	1,092	0,012	0,527	1 239,97
1992	2041,10	0,785	0,656	1,092	0,011	0,527	1 075,59
1993	2143,81	0,785	0,655	1,092	0,012	0,528	1 131,18
1994	2680,61	0,785	0,654	1,092	0,012	0,527	1 412,45
1995	3700,60	0,785	0,656	1,092	0,012	0,528	1 953,59
1996	3645,10	0,785	0,655	1,092	0,012	0,527	1 922,09
1997	2921,99	0,785	0,656	1,092	0,012	0,528	1 542,17
1998	2063,45	0,785	0,660	1,092	0,012	0,531	1 096,51
1999	2018,72	0,785	0,666	1,092	0,013	0,537	1 084,76
2000	2211,23	0,785	0,668	1,092	0,012	0,537	1 187,81
2001	2239,65	0,785	0,668	1,092	0,012	0,538	1 204,32
2002	2222,32	0,785	0,666	1,092	0,012	0,536	1 190,90
2003	2327,30	0,785	0,665	1,092	0,013	0,536	1 247,57
2004	2644,37	0,785	0,664	1,092	0,013	0,535	1 415,94
2005	2981,62	0,785	0,660	1,092	0,013	0,532	1 586,36
2006	2859,79	0,785	0,659	1,092	0,013	0,531	1 519,30
2007	3644,85	0,785	0,660	1,092	0,013	0,532	1 940,55
2008	3509,82	0,785	0,658	1,092	0,013	0,531	1 862,44
2009	1858,85	0,785	0,657	1,092	0,012	0,538	999,70
2010	1514,55	0,785	0,660	1,092	0,012	0,532	805,21

Clinker Production Data		Molecular Weight Fraction CO_2/CaO	CaO Weight Fraction	Molecular Weight Fraction CO_2/MgO	MgO Weight Fraction	IEF [kt CO_2/kt CP]	CO_2 Emissions [kt/y]
Year	[kt/y]						
2011	1475,70	0,785	0,659	1,092	0,012	0,536	790,75
2012	1839,27	0,785	0,660	1,092	0,013	0,543	997,83
Plant specific data		Statistical data					

4.2.1.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

AD = 2 %

CKD = 10 %

CaO Weight Fraction = 1-2%

MgO Weight Fraction = 1-2%

Quantitative uncertainty estimates are provided in Annex 7.

4.2.1.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

As a part from the QA activities the aggregated national clinker production data provided by the NSI were compared with the production data reported by the cement plants in the annual reports for compliance with their IPPC permits (EPRTR data), as well as in their verified emission reports within the EU ETS.

The last were also used to check the overall CO_2 emissions from the category.

The verified (process) CO_2 emissions from all 5 cement plants for 2008 were 1862.44 kt or with 11.39 kt (0.61%) higher compared to the 1 873.83 kt calculated following the applied national inventory approach and reported within NIR 2010.

The verified (process) CO_2 emissions from all 5 cement plants for 2009 were 999.70 kt or with 16.73 kt (1.7%) higher compared to the 982.96 kt calculated following the applied national inventory approach and reported within NIR 2011.

The verified (process) CO_2 emissions from all 5 cement plants for 2010 were 805.21 kt or with 0.8 kt (0.1%) higher compared to the 804.41 kt calculated following the applied national inventory approach and reported within NIR 2012.

The verified (process) CO_2 emissions from all 4 cement plants for 2011 were 790,75 kt or with 7,14 kt (0.91%) higher compared to the 783,61 kt calculated following the applied national inventory approach and reported within NIR 2013.

The verified (process) CO_2 emissions from all 4 cement plants for 2012 were 997,83kt or with 19,89 kt (2,03%) higher compared to the 977,94kt calculated following the applied national inventory approach and reported within NIR 2014.

All 23 verification reports (for 2008, 2009, 2010, 2011 and 2012) are public available at http://eea.government.bg/eea/main-site/bg/rr/r-te/dokladi-1r.html http://eea.government.bg/eea/main-site/bg/rr/r-te/dokladi-1.html .

The following improvements were undertaken

Improvements with regard to TACCC of method, EF and relevant other parameters used to estimate these emissions were made.

4.2.1.6 Source specific recalculations

No source specific recalculation.

4.2.1.7 Source specific planned improvements

No source specific improvements are planned.

4.2.2 LIME PRODUCTION (CRF 2.A.2)

4.2.2.1 Source category description

The production of lime involves a series of steps comparable to those used in the production of Portland cement clinker. These include quarrying the raw materials, crushing and sizing, calcining (i.e., high temperature heat processing ~ 1100° C) the raw materials to produce lime, hydrating the lime to calcium hydroxide followed by miscellaneous transfer, storage and handling operations (1996 IPCC Guidelines, p. 2.5).

Calcium oxide (CaO or quicklime) is formed by heating limestone to decompose the carbonates. This is usually done in shaft or rotary kilns at high temperatures and the process releases CO_2. Depending on the product requirements (e.g., metallurgy, pulp and paper, construction materials, effluent treatment, water softening, pH control, and soil stabilisation), primarily high calcium limestone (calcite) is utilized in accordance with the following reaction (2006 IPCC Guidelines):

$CaCO_3$ (high-purity limestone) + heat = CaO (quicklime) + CO_2

Currently there are 5 lime producing plants in Bulgaria which fall under IPPC and EU ETS. They produce high calcium quicklime. After the largest metallurgic plant ceases operation in 2008 there is virtually no production of dolomitic lime. In 2012 letters were sent to all quicklime producing plants (including the ones producing quicklimes for their own needs) and all of them declared that they do not produce dolomitic lime.

4.2.2.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

There is decrease of the total emission in the sector in 2012 compared to 2011, which is due to the reduced demand for quick lime.

The reduction in 2009 are ceased operation (in November 2008) of one of the lime producers (integrated steel making plant), reduction in the construction works and other quicklime consuming production processes and world economical crises.

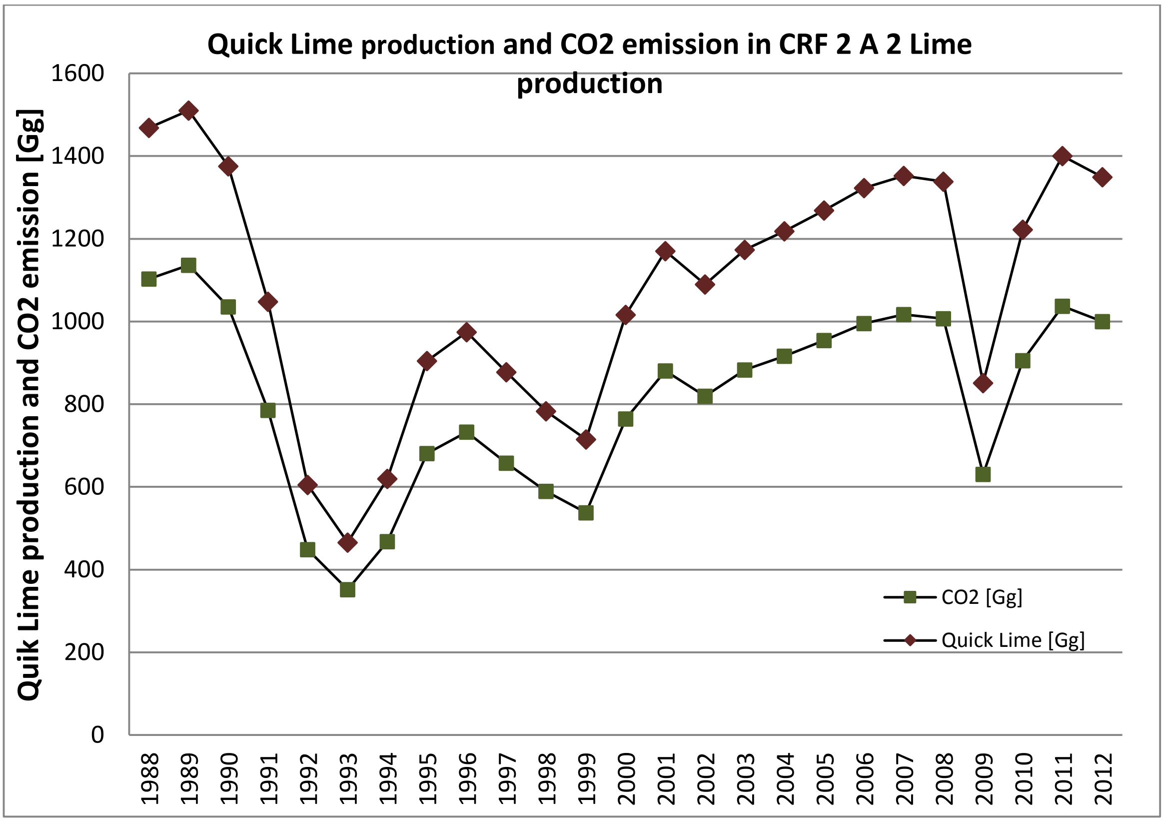


Figure 54 Lime Production and CO_2 emission in CRF 2.A.2 Lime production

4.2.2.3 Methodological issues

4.2.2.3.1 Method

The emissions from the sector are calculated using country specific data on the total amount of lime produced provided by NSI. Default emission factor is applied.

The emissions are estimated following the general approach recommended in 1996 IPCC Guidelines and using the following equation from IPCC GPG 2000 (p.3.19):

EQUATION 3.4

CO_2 Emissions = Emission Factor (EF) • Lime Production

The following is taken into account:

1996 IPCC Guidelines (Table 2-1p. 2.5) recommend a default emission factor of 0.79 tonnes CO_2/tonne quicklime produced and 0.91 tonnes CO_2/tonne dolomitic lime produced.

According to IPCC GPG 2000 the default emission factors in the IPCC Guidelines mentioned under Equation 3.4 correspond to 100% of CaO (or CaO·MgO) in lime (stoichiometric ratio) and can lead to an overestimation of emissions since the CaO and (if present) MgO content may be less than 100%. It is good practice to apply Equation 3.5A or Equation 3.5B, or both, to adjust the emission factors and to account for the CaO or the CaO·MgO content (see Table 3.4, Basic Parameters for Calculation of Emission Factors):

EQUATION 3.5A

$$EF_1 = \text{Stoichiometric ratio } (CO_2 / CaO) \bullet \text{CaO content}$$

Where: EF_1 = emission factor for quicklime

EQUATION 3.5B

$$EF_2 = \text{Stoichiometric ratio } (CO_2 / CaO{\cdot}MgO) \bullet (CaO{\cdot}MgO) \text{ content}$$

Where: EF_2 = emission factor for dolomitic quicklime

The above equations are used to estimate the emission factor, taking into account CaO and MgO content in the lime produced. The metal oxides content is taken as default from Table 3.4, p. 3.21, GPG, as lower values due to it being closer to the available data.

Thus an approach in line with Tier 2 method (2006 IPCC Guidelines, p.2.19) is used to estimate CO_2 emissions from lime production.

4.2.2.3.2 Emission factor

According to 2000 GPG it is good practice to apply Equation 3.5A or Equation 3.5B, or both, to adjust the emission factors and to account for the CaO or the CaO·MgO content (see Table 3.4, Basic Parameters for Calculation of Emission Factors):

EQUATION 3.5A

$$EF1 = \text{Stoichiometric ratio } (CO_2 / CaO) \bullet \text{CaO content}$$

Where: EF1 = emission factor for quicklime

EQUATION 3.5B

$$EF2 = \text{Stoichiometric ratio } (CO_2/ CaO{\cdot}MgO) \bullet (CaO{\cdot}MgO) \text{ content}$$

Where: EF2 = emission factor for dolomitic quicklime

The above equations are used to estimate the emission factor.

4.2.2.3.3 Activity data

Country specific data on the total lime production (quicklime) are provided by NSI.

The following is taken into consideration: It is good practice to assess the available national statistics for completeness, and for the ratio of limestone to dolomite used in lime production (2006 IPCC Guidelines).

Thus statistical data on total amount of lime produced are used to estimate the emissions of CO_2 from lime production.

Issues of double counting:

CO_2 emissions from Lime production are reported in this chapter and are not included in Limestone and dolomite use chapter.

Table 113 Lime production and CO_2 emissions

Year	Lime Production [kt/y]	Emission Factor [kt CO_2/ kt production]	CO_2 Emissions [kt CO_2]
1988	1468,86	0,751	1103,26
1989	1510,14	0,752	1136,36
1990	1375,68	0,753	1035,31
1991	1048,16	0,749	785,17
1992	604,82	0,742	448,60
1993	465,90	0,755	351,97
1994	619,53	0,755	468,04
1995	904,63	0,753	680,79
1996	974,65	0,752	733,14
1997	877,79	0,749	657,68
1998	783,32	0,752	589,25
1999	714,68	0,752	537,62
2000	1016,47	0,752	764,64
2001	1170,42	0,752	880,44
2002	1089,51	0,752	819,58
2003	1173,47	0,752	882,74
2004	1218,22	0,752	916,40
2005	1268,95	0,752	954,57
2006	1322,81	0,752	995,08
2007	1352,19	0,752	1017,18
2008	1338,51	0,752	1006,89
2009	851,60	0,741	630,85
2010	1222,43	0,741	905,55
2011	1400,20	0,741	1037,24
2012	1349,58	0,741	999,75

4.2.2.3.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	2.8 %
AD	2 %
EF	2%

Uncertainty for AD:

The following is taken into account (2006 IPCC GL, p. 2.25, see also Table 2.5):

The uncertainty for the activity data is likely to be much higher than for the emission factors, based on experience in gathering lime data.

Uncertainty for EF:

The following is taken into account (2006 IPCC GL, p. 2.25, see also Table 2.5):

In Tier 2 and Tier 1, the stoichiometric ratio is an exact number and therefore the uncertainty of the emission factor is the uncertainty of lime composition.

There is uncertainty associated with determining the CaO content and/or the CaO•MgO content of the lime produced.

Quantitative uncertainty estimates are provided in Annex 7.

4.2.2.4 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

Emissions estimated using default emission factor described in 1996 IPCC GL, Table 2-1, p. 2.5.

4.2.2.5 Source specific recalculations

No source specific recalculations.

4.2.2.6 Source specific planned improvements

No source specific improvements are planned.

4.2.3 LIMESTONE AND DOLOMITE USE (CRF 2.A.3)

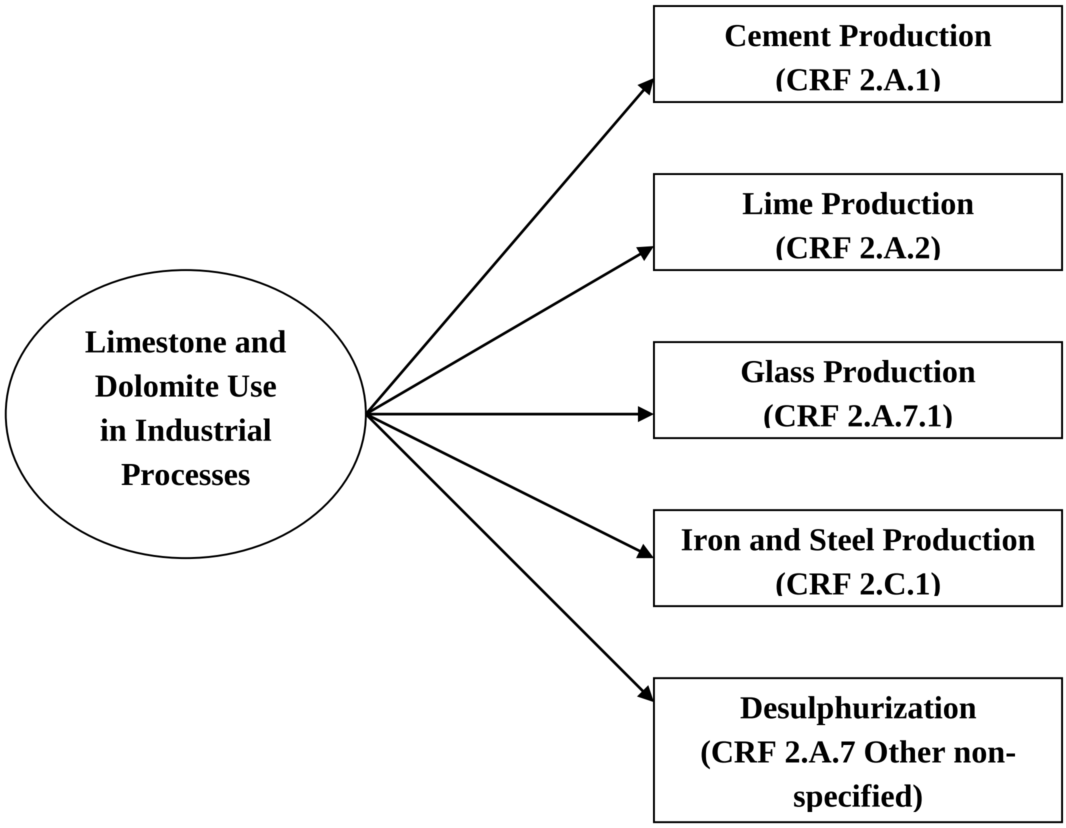
4.2.3.1 Source category description

Limestone ($CaCO_3$), dolomite ($CaMg.(CO_3)_2$) and other carbonates (e.g., $MgCO_3$ and $FeCO_3$) are basic raw materials having commercial applications in a number of industries. In addition to those industries already discussed individually (cement production, lime production and glass production), carbonates also are consumed in metallurgy (e.g. iron and steel), agriculture, construction and environmental pollution control (e.g. flue gas desulphurisation.). (2006 IPCC GL, p.2.32.)

Limestone or dolomite used for producing cement, lime and magnesium, agricultural activities and processes where CO_2 is not generated should be excluded from this calculation (1996 IPCC GL, p. 2.6).

CO_2 from liming of agricultural soils should be reported in the Land-use Change and Forestry Chapter. Limestone and dolomite used in cement and lime production should be reported under that industry sector. This section covers all other uses of limestone and dolomite which produce CO_2 emissions (1996 IPCC GL, p. 2.6).

The above is taken into account and the emissions from the limestone and dolomite usage are reported under the specific production industries, e.i. Cement Production, Lime Production, Glass Production, Desulphurisation, etc. The following diagram shows these categories to which emissions are attributed:



Issue of double accounting

Taking the above into account the CO_2 emissions from Cement, Glass, Lime (quicklime) production, metallurgy and desulphurization are presented in the respective chapters.

4.2.3.2 Source specific planned improvements

No source specific improvements are planned.

4.2.4 SODA ASH PRODUCTION AND USE (CRF 2.A.4)

4.2.4.1 Source category description

Soda ash production

There is one soda ash producing plant in Bulgaria. It applies Solvay process which is CO_2-neutral except for coke used for calcination of limestone. This coke used in soda ash production was considered as fuel in the energy sector (subcategory 1.A.2.C).

Soda ash use

In this category CO_2 emissions from soda ash use in non-ferrous metal processing and glass production are considered and other industries.

Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production

There is decrease of the total emission in the sector in 2012 compared to 2011.

Soda Ash Used and CO_2 emission in CRF 2 A 4 2 Soda Ash Used

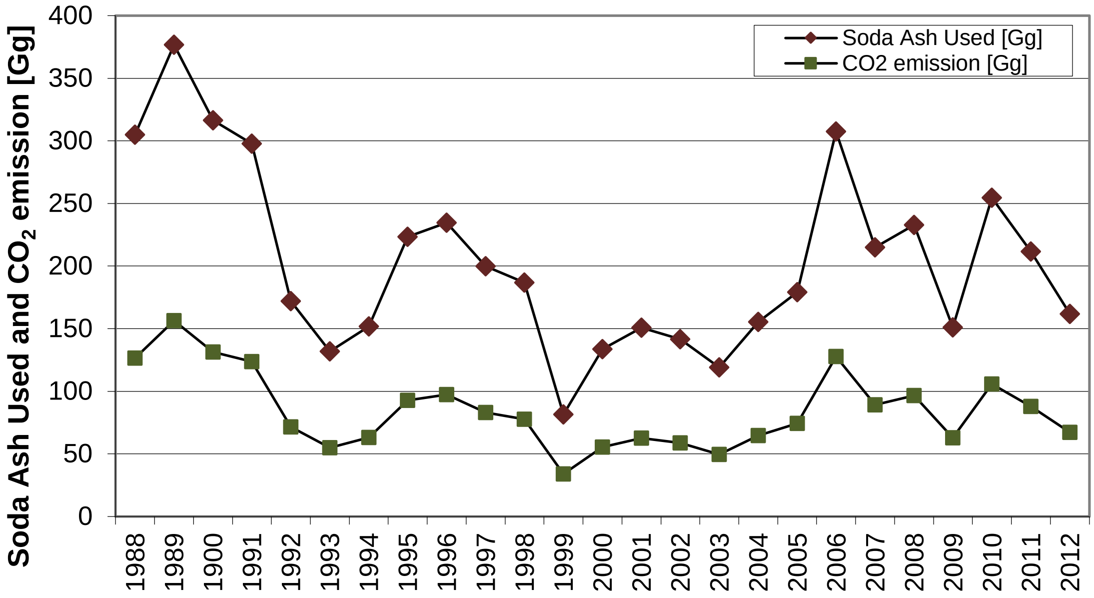


Figure 55 Soda ash used and CO_2 emission in CRF 2.A.4.2

4.2.4.2 Methodological issues

For the period 1988 - 2009 a recalculation of the emissions from soda ash use is made. The following is taken into account: Statistics on soda ash production, imports and exports are obtained from NSI. Based on that a balance is made to obtain the quantity of soda ash used. This quantity is further used as AD for the calculations of the emissions from category 2.A.4. The EF for these recalculations is estimated stoichiometrically from Na_2CO_3. The emissions are estimated following the recommendations of the Revised 1996 IPCC Guidelines.

In order to avoid double counting emissions from soda ash used in Glass productions are reported only here under 2.A.4 and are not considered under Glass production (2.A.7).

4.2.4.2.1 Method

Emissions of CO_2 from Soda ash use are estimated using the methodology described in 1996 IPCC Guidelines (and in lines with recommendations of 2006 IPCC Guidelines) and a default emission factor from the same guidelines (415 kg CO_2/t soda). Plant specific and country specific data were used to estimate CO_2 emissions from Soda ash use.

In emissions estimations the general approach described in 1996 IPCC Guidelines is applied using the following equation:

$$\textbf{TOTAL } CO_2 = AD \bullet EF$$

where:

TOTAL = the process emission (tonnes) of CO_2

AD = soda ash used (tonnes/yr)

EF = the emission factor for CO_2 (EF = 415 kg CO_2/t soda)

4.2.4.2.2 CO_2 Emission factor

Default emission factor of 415 kg CO_2/t soda ash used for the whole time series was used as described in 1996 IPCC Guidelines (p. 2.8).

4.2.4.2.3 Activity data

Soda ash production

In order to avoid double counting of the emissions the following is considered:

the coke used in soda ash production was considered as fuel in the energy sector (subcategory 1.A.2.C).

The limestone used for quicklime production is reported under Lime production (subcategory CRF 2.A.2).

Soda ash used

The activity data is calculated based on the material balance for the production, import and export of soda ash in the country, according to the recommendation of ERT during 2012.

Table 114 Soda ash used and CO_2 emission in CRF 2.A.4

Year	Soda ash used [kt/y]	CO_2 EF [t CO_2/kt soda]	CO_2 Emissions [Gg CO_2]
1988	304,86	415	126,58
1989	376,79	415	156,45
1990	316,39	415	131,37
1991	297,79	415	123,65
1992	171,96	415	71,40
1993	131,96	415	54,79
1994	151,86	415	63,06
1995	223,34	415	92,74
1996	234,48	415	97,36
1997	199,95	415	83,03
1998	186,70	415	77,53
1999	81,41	415	33,80
2000	133,50	415	55,43

Year	Soda ash used [kt/y]	CO_2 EF [t CO_2/kt soda]	CO_2 Emissions [Gg CO_2]
2001	150,73	415	62,59
2002	141,56	415	58,78
2003	119,17	415	49,48
2004	155,47	415	64,55
2005	179,07	415	74,35
2006	307,56	415	127,71
2007	214,85	415	89,21
2008	232,72	415	96,63
2009	150,95	415	62,68
2010	254,47	415	105,66
2011	211,72	415	87,91
2012	161,68	415	67,14

4.2.4.3 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	3.6 %
AD	2 %
EF	+/-3 %

Uncertainty for AD:

The two following aspects are relevant (2006 IPCC GL, Chapter 2.5.2)

Assuming that carbonate consumption is allocated to the appropriate consuming sectors/industries, the uncertainty associated with weighing or proportioning the carbonates for any given industry is 1-3 percent.
The uncertainty of the overall chemical analysis pertaining to carbonate content and identity also is 1-3 percent.
Taking the above into account as well as that for the part of the time series statistical (and not plant specific) data were used an uncertainty of 2 % for activity data is assumed.

Uncertainty for EF:

The following is taken into account:

In theory the uncertainty associated with the emission factor for this source category should be relatively low, as the emission factor is the stoichiometric ratio reflecting the amount of CO_2 released upon calcination of the carbonate. In practice, there are uncertainties due, in part, to variations in the chemical composition of the limestone and other carbonates. For example, in addition to calcium carbonate, limestone may contain smaller amounts of magnesia, silica and sulphur. Assuming that the activity data are collected correctly, and thus the correct emission factor is applied, there is negligible uncertainty associated with the emission factor. There may be some uncertainty associated with assuming a fractional purity of limestone and dolomite in cases where only carbonate rock data are available (+/- 1-5 percent) (2006 IPCC GL, Chapter 2.5.2).

On the basis of the above as well as taking into account that for the part of the time series statistical (and not plant specific) data were used the emission factor uncertainty is assumed as ± 3 %.

Quantitative uncertainty estimates are provided in Annex 7.

4.2.4.4 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

Revised the emission estimation method, by using soda ash mass balance
ISO 9001 and 14 001 standards.
EU ETS reports - emission from soda ash used in glass production (calculated by plants in the reports) and using the mass balance approach are compared.

4.2.4.5 Source specific recalculations

There are no source specific recalculations for this category

4.2.4.6 Source specific planned improvements

No source specific improvements are planned

4.2.5 GLASS PRODUCTION (CRF 2.A.7.1)

4.2.5.1 Source category description

Currently there are six glass plants in Bulgaria mainly producing flat, container and domestic glass. All of them fall under IPPC and EU ETS.

According to the information given in the Reference Document on Best Available Techniques in the Glass Manufacturing Industry, December 2001, the general description of the main types of glass produced in the country are:

Container glass

The forming process is carried out in two stages, the initial forming of the blank either by pressing with a plunger, or by blowing with compressed air, and the final moulding operation by blowing to obtain the finished hollow shape. These two processes are thus respectively termed "press and blow" and "blow and blow". Container production is almost exclusively by IS (Individual Section) machines.

Flat glass

Flat glass is produced almost exclusively with cross-fired regenerative furnaces. The basic principle of the float process is to pour the molten glass onto a bath of molten tin, and to form a ribbon with the upper and lower surfaces becoming parallel under the influence of gravity and surface tension. From the exit of the float bath the glass ribbon is passed through the annealing lehr, gradually cooling the glass to reduce residual stresses. On-line coatings can be applied to improve the performance of the product (e.g. low emissivity glazing).

Domestic glass

Domestic glass is a diverse sector involving a wide range of products and processes. Ranging from intricate handmade lead crystal, to high volume, mechanised methods used for mass produced tableware.

The forming processes are automatic processing, hand made or semi-automatic processing, and following production the basic items can be subjected to cold finishing operations (e.g. lead crystal is often cut and polished).

4.2.5.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

There is a small decrease of the total emission in the sector in 2012 compared to 2011.

One of the glass producing plants is new and has started working in the period 2005/2006. Another one had reduced capacity, operational time, during 2008 – 2009 and had stopped in 2010.

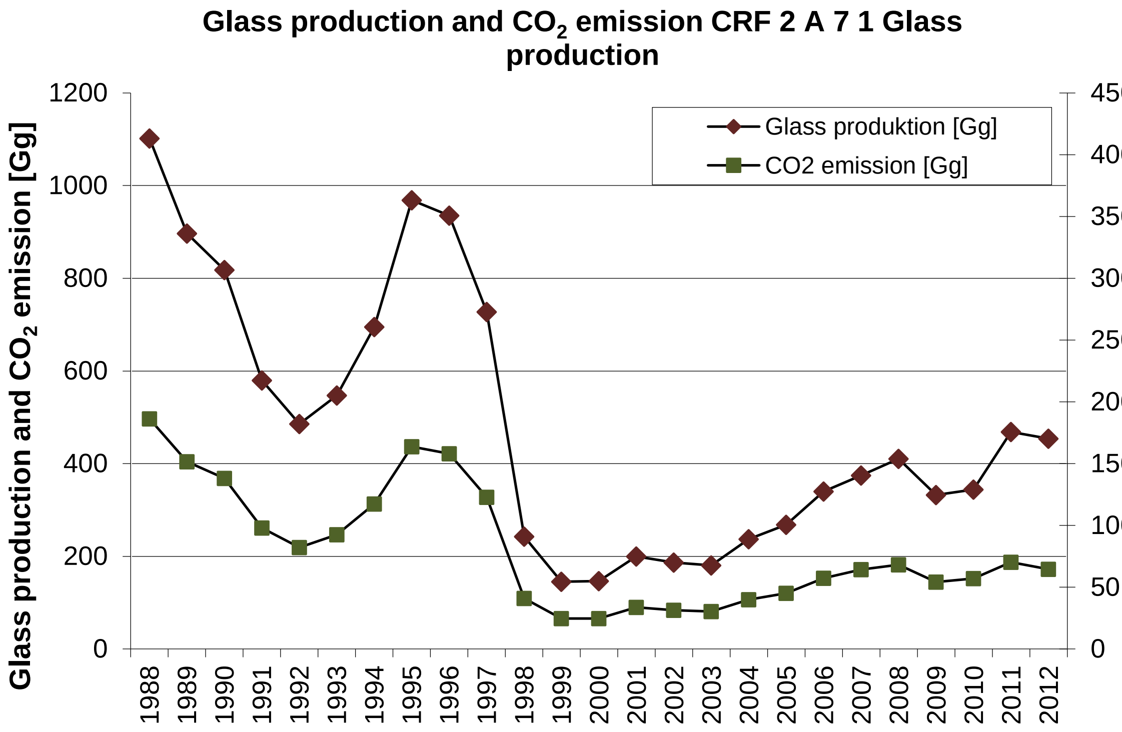


Figure 56 Glass Production and CO_2 emission in CRF 2.A.7.1. Glass production

4.2.5.3 Methodological issues

4.2.5.3.1 Method

Taking into account that no specific information about CO_2 emissions, estimation from glass production is given in 1996 Revised IPCC GL. Since a good practice guidance has not yet been developed for glass production (IPCC GPG 2000, p. 3.8) an approach in line with the general methodology described in 1996 IPCC GL is used:

The emissions were estimated using the following equation:

Emissions CO_2 = Emission factor • Glass production

For the period 2007 - 2012 plant specific emissions and production data were used based on the data reported by operators under EU ETS (except one plant) and IPPC. Thus plants specific emission factors were obtained which from an implied emission factor was delivered.

4.2.5.3.2 CO_2 Emission factor

For the period 2007 - 2012 plant specific (for five plants) emission factors were calculated on the basis of data from IPPC and ETS reports (see Table 114). These emission factors were used to calculate an implied emission factor which was further used to recalculate the emissions for the rest of the time series.

4.2.5.3.3 Activity data

Plant specific data from IPPC and ETS reports are available for the years 2007 - 2012. For the time series 1988 – 2012 statistical activity data were used. The quantity of glass produced was recalculated by NSI in tones due to differences in the measurement units reported.

Issue of double counting:

Only the emissions from the use of lime stone in the glass production process are estimated in this category. The quantities of soda ash and fuel used are reported under Soda ash use and Energy Chapter respectively.

Table 115 Glass production and CO_2 emission in CRF 2.A.3 Glass production

Year	Glass Production (GP) [kt/y]	Emission Factor (EF CO_2) [kt CO_2/kt GP]	CO_2 Emissions [kt CO_2]
1988	1102,09	0,169	186,24
1989	896,74	0,169	151,54
1990	818,04	0,169	138,24
1991	579,65	0,169	97,96
1992	485,66	0,169	82,07
1993	547,33	0,169	92,49
1994	694,82	0,169	117,42
1995	968,79	0,169	163,72
1996	935,62	0,169	158,11

Year	Glass Production (GP) [kt/y]	Emission Factor (EF CO_2) [kt CO_2/kt GP]	CO_2 Emissions [kt CO_2]
1997	727,54	0,169	122,95
1998	242,41	0,169	40,97
1999	145,54	0,169	24,60
2000	146,66	0,169	24,78
2001	199,59	0,169	33,73
2002	186,58	0,169	31,53
2003	180,62	0,169	30,52
2004	237,31	0,169	40,10
2005	267,94	0,169	45,28
2006	340,01	0,169	57,46
2007	374,65	0,171	64,21
2008	410,19	0,167	68,33
2009	332,20	0,163	54,21
2010	344,16	0,166	57,11
2011	468,41	0,150	70,35
2012	454,32	0,142	64,62

4.2.5.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	60.3 %
AD	±6 %
EF	60%

Uncertainty for AD:

"Glass production data are typically measured fairly accurately (+/-5 percent) for Tier 1 and Tier 2. As mentioned above, inventory compilers should be cautious where activity data are not originally available in mass, but rather as a unit (e.g., bottle) or area (e.g., m2). If activity data have to be converted to mass, this may result in additional uncertainty." (2006 IPCC GL, p. 2.31)

Taking the above into account the uncertainty of the emission factor was assumed as ±6 %.

Uncertainty for EF:

Uncertainty associated with use of the Tier 1 emission factor and cullet ratio is significantly higher, and may be on the order of +/- 60 percent.

Quantitative uncertainty estimates are provided in Annex 7.

4.2.5.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.
Revision of the activity data by using IPPC and EU ETS reports as well as statistical data.
Development of country specific emission factor for glass production based on IPPC and ETS data.

ISO 9001 and 14 001 standards.

4.2.5.6 Source specific recalculations

There are no source specific recalculations for this category.

4.2.5.7 Source specific planned improvements

No source specific improvements are planned

4.2.6 CERAMICS PRODUCTION (CRF 2.A.7)

4.2.6.1 Source category description

According to the Reference Document on Best Available Techniques in the Ceramic Manufacturing Industry, August 2007, the fundamental methods and steps in the production processes hardly differ in the manufacture of the various ceramic products, besides the fact that, for the manufacture of, e.g. wall and floor tiles, table- and ornamentalware (household ceramics), sanitaryware and also technical ceramics, often a multiple stage firing process is used.

The manufacture of ceramic products takes place in different types of kilns, with a wide range of raw materials and in numerous shapes, sizes and colours. The general process of manufacturing ceramic products, however, is rather uniform, besides the fact that, for the manufacture of wall and floor tiles, table- and ornamentalware (household ceramics), sanitaryware and also technical ceramics, often a multiple stage firing process is used. In general, raw materials are mixed and cast, pressed or extruded into shape. Water is regularly used for a thorough mixing and shaping. This water is evaporated in dryers and the products are either placed by hand in the kiln (especially in the case of periodically operated kilns) or placed onto carriages that are transferred through continuously operated kilns. In most cases, the kilns are heated with natural gas, but liquefied petroleum gas, fuel oil, coal, petroleum coke, biogas/biomass or electricity are also used.

The currently operating ceramic plants in Bulgaria are producing mostly bricks, roof and wall tiles and other ceramic products. Those of them which cover the capacity criteria according to the IPPC Directive have IPPC permits as well as ETS permits.

4.2.6.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

A relatively stable production amount is observed for the period after the world economic crisis. This level is stable but significantly lower than the previous years. The production in this sector is highly dependent on the construction business. As this business flourishes in 2004-2005 there is also a great increase in the production of ceramics. After

2009 the demand is considerably lower and the market is oversaturated with goods which brings the production ot a collapse in 2009.

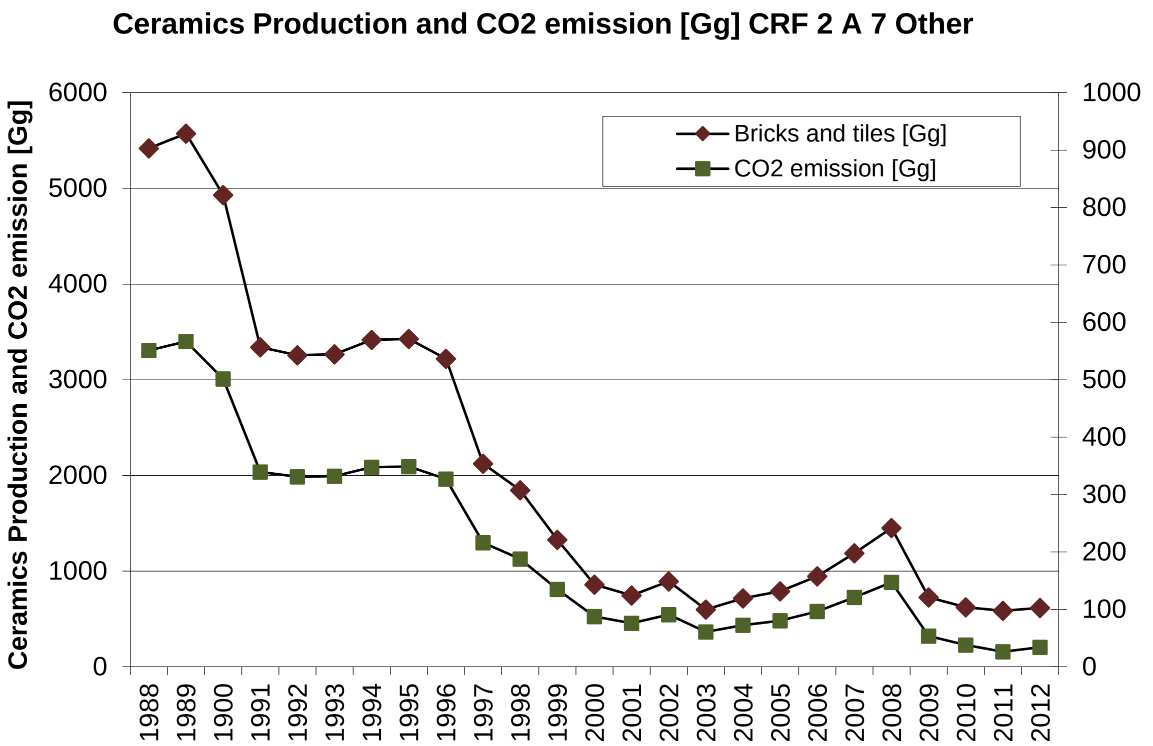


Figure 57 Ceramics Production and CO_2 emission in 2 A 7 "Other (mineral products)"

4.2.6.3 Methodological issues

4.2.6.3.1 Method

The CO_2 emissions from the verified ETS reports are used. These emissions are estimated taking into account the CaO and MgO content in the products. The CO_2 emissions in the ETS reports are calculated using the following equation:

Emissions CO_2 **= ∑ (Activity data • Emission factor MeO • Conversion coefficient)**

Where:

Activity data = Ceramics production, tones

MeO = CaO, MgO

Emission factor $_{MeO}$:

Emission factor $_{CaO}$ = 0.785,

Emission factor $_{MgO}$ = 1.092

Conversion coefficient = 1.

The emissions estimated by the above equation are used together with the respective EU ETS production data for 2008 to obtain country specific emission factor.

For the rest of the time series NSI data were used. Since these data were expressed in different measurement units (for example: m^3, units) a conversion factor was applied in order to obtain the production in tones. To convert the production from units to tones a local conversion factor was obtained.

4.2.6.3.2 CO_2 Emission factor

Country specific emission factor was calculated on the basis of data from ETS and IPPC reports of the operators (see Table 115). The ETS data used to estimate the EF take into account the $CaCO_3$, $MgCO_3$ in the used in the raw materials (clay).

4.2.6.3.3 Activity data

Statistical data on production are used for the whole time series. Conversion of the production data (from m^3 and units) was performed in order to obtain them in tones.

Issue of double counting:

In order to avoid double counting, the quantity fuel used are reported under Energy Chapter respectively.

Table 116 Ceramic production and CO_2 emission in CRF

Year	Ceramic Production (CP) [kt/y]	Emission Factor [kt CO_2/kt CP]	CO_2 Emissions [kt CO_2]
1988	5419,1	0,102	551,22
1989	5571,2	0,102	566,69
1990	4929,8	0,102	501,45
1991	3338,5	0,102	339,59
1992	3255,7	0,102	331,16
1993	3268,1	0,102	332,43
1994	3418,3	0,102	347,70
1995	3428,1	0,102	348,70
1996	3218,1	0,102	327,34
1997	2124,1	0,102	216,06
1998	1845,2	0,102	187,70
1999	1329,3	0,102	135,22
2000	859,7	0,102	87,45
2001	745,7	0,102	75,85
2002	892,5	0,102	90,79
2003	598,3	0,102	60,86
2004	716,1	0,102	72,84
2005	790,0	0,102	80,36
2006	947,8	0,102	96,40
2007	1189,0	0,102	120,94
2008	1450,2	0,102	147,52
2009	725,0	0,074	53,75
2010	621,63	0,062	38,25
2011	585,70	0,045	26,39
2012	615,71	0,055	34,04

* Ceramic Production = Bricks and Tiles

4.2.6.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	5.8 %
AD	3 %
EF	5%

Uncertainty for AD:

The following is relevant (2006 IPCC GL, p. 2.39)

Assuming that carbonate consumption is allocated to the appropriate consuming sectors/industries, the uncertainty associated with weighing or proportioning the carbonates for any given industry is 1-3 percent. The uncertainty of the overall chemical analysis pertaining to carbonate content and identity also is 1-3 percent.

Uncertainty for EF:

The following is relevant (2006 IPCC GL, p. 2.39)

Assuming that the activity data are collected correctly, and thus the correct emission factor is applied, there is negligible uncertainty associated with the emission factor. There may be some uncertainty associated with assuming a fractional purity of limestone and dolomite in cases where only carbonate rock data are available (+/- 1-5 percent).

Quantitative uncertainty estimates are provided in Annex 7.

4.2.6.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

Check with IPPC reports on the activity data used.
ETS CO_2 emissions used for the emission factor estimation and recalculations.

4.2.6.6 Source specific recalculations

There are no source specific recalculations for this category.

4.2.6.7 Source specific planned improvements

A revision of the data from ETS reports is planned and implementation of a new EF for the period before 2008.

4.2.7 DESULPHURISATION (CRF 2.A.7 OTHER NON-SPECIFIED)

4.2.7.1 Source category description

Flue gas desulphurization (FGD) is a technology used to remove sulphur dioxide (SO_2) from the exhaust flue gas if fossil fuels power plants. Fossil fuels such as coal, peat and oil contain varying amounts of sulphur. To avoid high emissions of sulphur dioxide to the atmosphere, large combustion plants (in particular plants over 100 MWth) are usually equipped with FGD.

Nowadays there are many different ways of reducing the SO_2 emissions generated by the combustion of fossil fuels. In Bulgaria two following desulphurization techniques are applied:

Use of adsorbents in fluidised bed combustion systems

This is a primary measure to reduce the sulphur oxide emissions. The use of adsorbents in fluidised bed combustion systems are integrated desulphurisation systems. This limits the combustion temperature to about 850°C. The adsorbent utilised is typically CaO, $Ca(OH)_2$ or $CaCO_3$. The reaction needs a surplus of adsorbent with a stoichiometric ratio (fuel/adsorbent) of 1.5 to 7 depending on the fuel. Due to chlorine corrosion effects, the desulphurisation rate is limited by 75%. This technique is mainly utilised in coalfired LCPs and is described in Chapter 4. (LCP BREF, p. 65).

Wet scrubbers

This is a secondary measure to reduce sulphur oxide emissions. Wet scrubbers, especially the limestone-gypsum processes, are the leading FGD technologies. They are used in large utility boilers. This is due to their high SO_2 removal efficiency and their high reliability. Limestone is used in most cases as the sorbent, as it is available in large amounts in many countries and is cheaper to process than other sorbents. By-products are either gypsum or a mixture of calcium sulphate/sulphite, depending on the oxidation mode. (LCP BREF, p. 66 - 67).

Limestone and quicklime are used for desulphurisation in the large combustion plants (LCP) in Bulgaria. CO_2 emissions in this sector are estimated only for these LCP's which use limestone for desulphurisation. Currently there are five LCP in Bulgaria applying desulphurization for the flue gas cleaning with lime stone. Four of them have desulphurization installations applying wet scrubbing process and the fifth one is using fluidized bed combustion system where the desulphurisation is incorporated into the combustion process.

4.2.7.2 Trend description

The first desulphurization installation started its operation in 2002. The next desulphurization installations started operation in 2006 - 2012.

In 2005 there was only one plant with such instillations and during that year its boilers with desulphurization installations had reduced capacity.

There is a reduced demand for electrical energy in 2012 compared to 2011, due to which the emissions are lower despite the fact that one of the installations switched from quick lime to limestone.

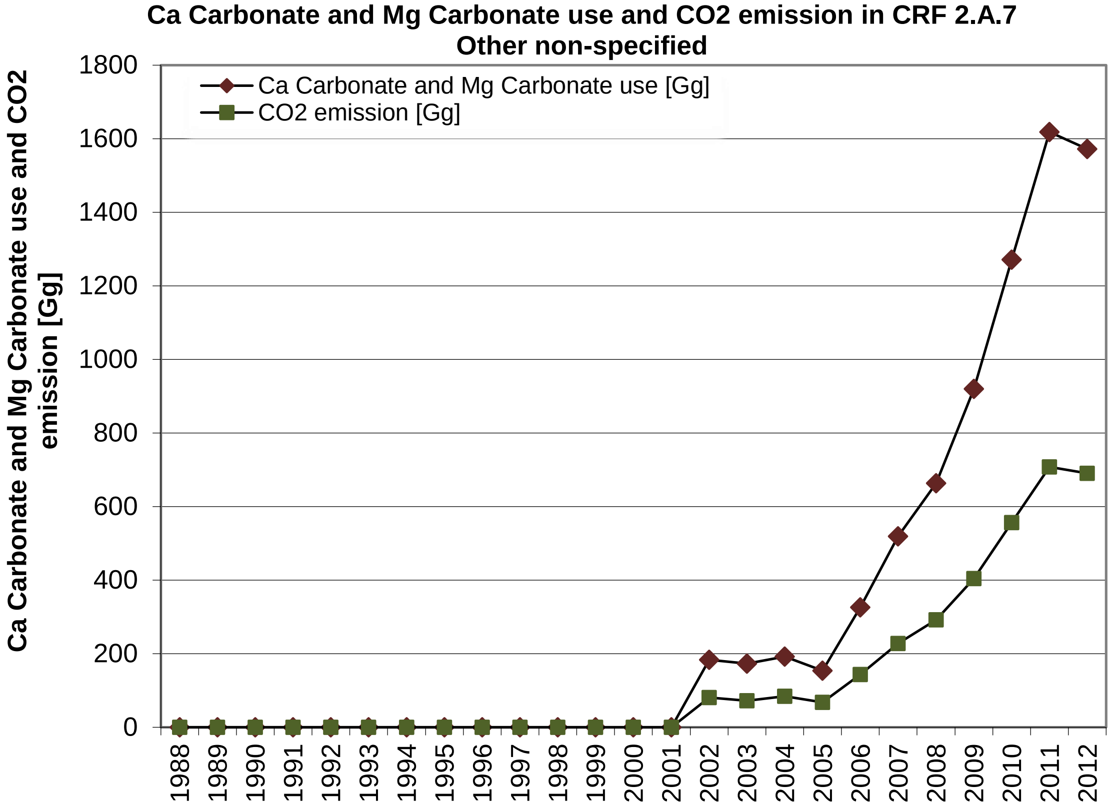


Figure 58 $CaCO_3$, $MgCO_3$ use and CO_2 emission in CRF 2.A.7 "Other non-specified"

4.2.7.3 Methodological issues

Tier 2 method for the CO_2 emissions estimation is used. The CO_2 emissions estimated using the above equation are taken from the LCP operators EU ETS reports. The quantities of calcium carbonate ($CaCO_3$) and magnesium carbonate ($MgCO_3$) used for the estimations are also taken form the EU ETS reports thus allowing to take into account the pure carbonates used in the process.

4.2.7.3.1 Method

Tier 2 method for the CO_2 emissions estimation is used. Under Tier 2, the amount of CO_2 emitted from the use of limestone and dolomite is estimated from a consideration of consumption and the stoichiometry of the chemical processes.

The equation used to estimate the emissions is as follows:

$$\mathbf{CO_2\ Emissions = (MCa \cdot EFCa) + (MMg \cdot EFMg)}$$

Where:

CO_2 Emissions = emissions of CO_2 from other process uses of carbonates - desulphurisation, tonnes

M_{Ca} or M_{Mg} = mass of Ca Carbonate and Mg Carbonate (consumption), tonnes.

EF_{Ca} or EF_{Mg} = emission factor for Ca Carbonate and Mg Carbonate calcination respectively, tonnes CO_2/tonne carbonate

The CO_2 emissions estimated using the above equation are taken from the operators EU ETS reports.

4.2.7.3.2 CO_2 Emission factor

The emission factor is based on the mass of CO_2 released per mass of carbonate consumed (2006 IPCC GL, p. 2.7).

The EFs used to estimate CO_2 emissions from desulphurization processes are the following:

EF_{CaCO3} = 0.44,

EF_{MgCO3} = 0.522.

4.2.7.3.3 Activity data

Plant specific activity data on the amount of carbonates use are obtained from EU ETS reports.

Issue of double counting:

The quantity of carbonates used in desulphurization are not considered in CRF 2.A.3 Limestone and dolomite use.

Table 117 $CaCO_3$ and $MgCO_3$ use and CO_2 emission in CRF 2.A.7 Other non-specified

Year	Ca Carbonate and Mg Carbonate use [kt/y]	CO_2 EF [kt CO_2/kt Lime]	CO_2 Emissions [Gg CO_2]
1988	0,0	-	0,0
1989	0,0	-	0,0
1990	0,0	-	0,0
1991	0,0	-	0,0
1992	0,0	-	0,0
1993	0,0	-	0,0
1994	0,0	-	0,0
1995	0,0	-	0,0
1996	0,0	-	0,0
1997	0,0	-	0,0
1998	0,0	-	0,0
1999	0,0	-	0,0
2000	0,0	-	0,0
2001	0,0	-	0,0
2002	183,58	0,440	80,77
2003	173,28	0,416	72,10
2004	192,61	0,440	84,75
2005	154,26	0,440	67,87
2006	326,62	0,440	143,71
2007	518,91	0,440	228,32
2008	663,61	0,440	292,19
2009	919,70	0,440	404,66
2010	1271,65	0,438	556,68
2011	1618,22	0,438	708,16
2012	1572,51	0,439	690,11

4.2.7.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	2.9 %
AD	±1.5 %
EF	±2.5 %

Uncertainty for AD:

Activity data uncertainties are greater than the uncertainties associated with emission factors. Assuming that carbonate consumption is allocated to the appropriate consuming sectors/industries, the uncertainty associated with weighing or proportioning the carbonates for any given industry is 1-3 percent. The uncertainty of the overall chemical analysis pertaining to carbonate content and identity also is 1-3 percent (2006 IPCC GL, p. 2.39).

Uncertainty for EF:

In theory the uncertainty associated with the emission factor for this source category should be relatively low, as the emission factor is the stoichiometric ratio reflecting the amount of CO_2 released upon calcination of the carbonate. In practice, there are uncertainties due, in part, to variations in the chemical composition of the limestone and other carbonates. For example, in addition to calcium carbonate, limestone may contain smaller amounts of magnesia, silica and sulphur. Assuming that the activity data are collected correctly, and thus the correct emission factor is applied, there is negligible uncertainty associated with the emission factor. There may be some uncertainty associated with assuming a fractional purity of limestone and dolomite in cases where only carbonate rock data are available (+/- 1-5 percent) (2006 IPCC GL, p. 2.39).

4.2.7.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

AD compared with the annual reports under IPPC.
ISO 9001 and 14 001 standards.
EU ETS reports

4.2.7.6 Source specific recalculations

There are no source specific recalculations for this category.

4.2.7.7 Source specific planned improvements

No source specific improvements are planned.

4.3 CHEMICAL INDUSTRY (CRF 2.B)

4.3.1 AMMONIA PRODUCTION (CRF 2.B.1)

4.3.1.1 Source category description

Ammonia is synthesised from nitrogen and hydrogen by the following reaction:

$$N_2 + 3H_2 = 2NH_3.$$

The technological process for Ammonia production in both of the currently operating plants is similar. Ammonia (NH_3) is produced by catalytic steam reforming of natural gas. The feedstock is reformed with steam in a heated primary reformer and subsequently with air in a second reformer in order to produce the synthesis gas.

The reaction taking place during primary reforming is:

$$CH_4 + H_2O = CO + 3H_2$$

The main objective of secondary reforming is to add the nitrogen required for the synthesis and to complete the conversion of the hydrocarbon feed.

The synthesis gas then undergoes processes of heat and CO_2 removal and reaction of methanation due to the fact that small amounts of CO and CO_2, remaining in the synthesis gas, are poisonous for the ammonia synthesis catalyst. The synthesis gas is then compressed in a compressor to the required pressure for Ammonia synthesis.

Currently ammonia is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and EU ETS. Until the year of 2002 there were four plants operating.

4.3.1.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation, which is the case in 1999/2000 and 2002 when two of the ammonia producing plants stopped working.

There is decrease by 28% of the total emission in the sector in 2012 compared to 2011. The reasons for this decrease could be of different nature, such as major maintenance activities which consume time, or fluctuations on the internal and external fertiliser markets.

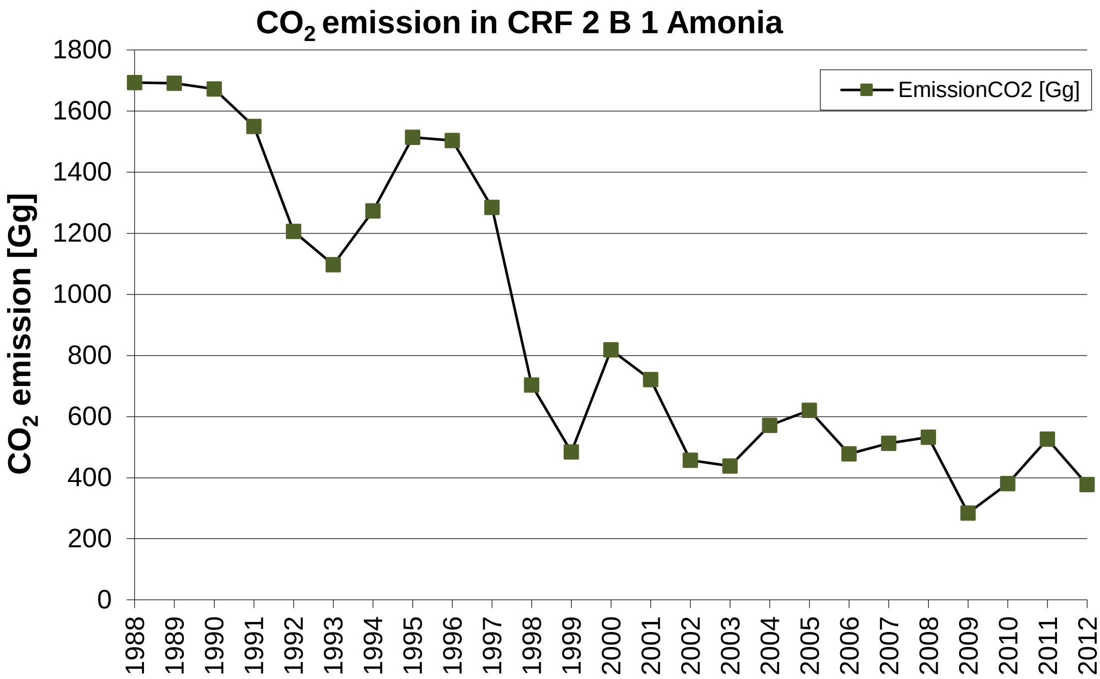


Figure 59 Ammonia Production and CO_2 emission in CRF 2 B 1 Ammonia production

4.3.1.3 Methodological issues

4.3.1.3.1 Method

As recommended in revised 1996 IPCC Guidelines plant specific data were used to estimate CO_2 emissions from ammonia production. Taking into account that good practice guidance has not yet been developed for the ammonia production (IPCC GPG 2000, p. 3.8) a higher tier method – Tier 2, is applied using the following equations from 2006 IPCC Guidelines (Chapter 3: Chemical Industry Emissions, equation 3.2).

TOTAL FUEL REQUIREMENT FOR AMMONIA PRODUCTION – TIER 2

$$TFR_i = \sum_j (AP_{ij} \times FR_{ij})$$

Where:

TFR_i = total fuel requirement for fuel type i, GJ

AP_{ij} = ammonia production using fuel type i in process type j, tonnes

FR_{ij} = fuel requirement per unit of output for fuel type i in process type j, GJ/tonne ammonia produced

CO_2 EMISSIONS FROM AMMONIA PRODUCTION – TIER 2

$$E_{CO_2} = \sum_i \left(TFR_i \times CCF_i \times COF_i \times \frac{44}{12} \right) - R_{CO_2}$$

Where:

E_{CO2} = emissions of CO_2, kg

TFR_i = total fuel requirement for fuel type i, GJ

CCF_i = carbon content factor of the fuel type i, kg C/GJ

COF_i = carbon oxidation factor of the fuel type i, fraction – "1"

R_{CO2} = CO_2 recovered for downstream use (urea production, CO_2) – "0"

Data on COF are default (1, fraction) and they are taken from Table 3.1 from 2006 IPCC Guidelines (Chapter 3, p. 3.15). All other parameter and data are plant specific.

4.3.1.3.2 CO_2 Emission factor

Based on plant specific data of the currently operating plants emission factors for the whole time series are estimated.

An implied emission factor is used to recalculate CO_2 emissions for the rest of the ammonia producing plants.

4.3.1.3.3 Activity data

For the whole time series (where available) plant specific activity data were used. An adjustment with statistical data from NSI has been made for the periods where no activity data for all the ammonia producing plants were available.

The following questionnaire is regularly sent to the plant operator:

Table 118 Questionnaire to plant operator of Ammonia production

1	Ammonia production (100%)	t
2	Amount of natural gas per t Ammonia	$Nm^3/t\ NH_3$
3	Amount of natural gas used	Nm^3
4	Natural gas input (Net caloric value)	GJ
5	Amount of natural on the base of the density of natural gas	t
6	Carbon content	t
7	Carbon content	kg/GJ
8	Carbon stored	t

Issue of double counting:

In order to avoid double counting, the quantity of gas used is subtracted from the quantity reported under energy and non-energy use in the Energy Chapter.

Table 119 Ammonia production and CO_2 emission in CRF 2.B.1 Ammonia production

Year	Ammonia Production (NH_3) [kt/y]	Ammonia Production (NH_3) [kt/y]	CO_2 IEF [kt CO_2/kt NH_3]	CO_2 Emissions [Gg CO_2]
1988	PS data / NSI	C	C	1693,34
1989	PS data / NSI	C	C	1691,25
1990	PS data / NSI	C	C	1672,38
1991	PS data / NSI	C	C	1549,98
1992	PS data / NSI	C	C	1205,85
1993	PS data / NSI	C	C	1096,76
1994	PS data / NSI	C	C	1272,67
1995	PS data / NSI	C	C	1513,78
1996	PS data / NSI	C	C	1503,19
1997	PS data / NSI	C	C	1284,18
1998	PS data / NSI	C	C	703,77
1999	PS data / NSI	C	C	484,33
2000	PS data / NSI	C	C	818,32
2001	PS data / NSI	C	C	721,07
2002	PS data / NSI	C	C	457,40
2003	PS data	C	C	438,48
2004	PS data	C	C	570,86
2005	PS data	C	C	620,74
2006	PS data	C	C	478,33
2007	PS data	C	C	512,51
2008	PS data	C	C	532,70
2009	PS data	C	C	284,79
2010	PS data	C	C	380,32
2011	PS data	C	C	526,05
2012	PS data	C	C	377,94

C - Confidential data

Confidentiality issue

In accordance with the 'Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11. As mentioned in § 27 emissions and removals should be reported at the most disaggregated level of each source/sink category, taking into account that a minimum level of aggregation may be required to protect confidential business and military information (FCCC/SBSTA/2006/9).

In CRF 2.B.1 Ammonia production the production data and the EF as well as IEF is marked as confidential "C", because these information could lead to the disclosure of confidential information provided by the plant operator.

4.3.1.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	7.8 %
AD	±3.5 %
EF	7%

Uncertainty for AD:

The two following aspects are relevant (2006 IPCC GL, Chapter 3.2.3)

Where activity data are obtained from plants, uncertainty estimates can be obtained from producers. These activity data are likely to be highly accurate (i.e., with uncertainty as low as ±2 percent).
Where uncertainty values are not available from other sources, a default value of ±5 percent can be used.
For two plants, which stopped in 1999/2000 and 2002 respectively, statistical data had to be used. Therefore an uncertainty of 3.5 % for activity data is assumed.

Uncertainty for EF:

The uncertainty for the EF is about 7%. This values is derived from European average values for specific energy consumption (Mix of modern and older plants) Average value – natural gas (2006 IPCC GL, Chapter 3, Table 3.1)

Quantitative uncertainty estimates are provided in Annex 7.

4.3.1.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Chapter 1.6.

Check if the estimated emission factors are within the range of default emission factors provided for the Tier 1 method
Check of CO_2 generation rate
ISO 9001 and 14 001 standards, EMAS.

4.3.1.6 Source specific recalculations

There are no source specific recalculations for this category.

4.3.1.7 Source specific planned improvements

No source specific improvements are planned.

4.3.2 NITRIC ACID PRODUCTION (CRF 2.B.2)

4.3.2.1 Source category description

Currently nitric acid is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and ETS. Until 1999/2000 there were three plants operating.

The nitric acid is produced by following general technological steps:

Oxidation of NH_3

NH_3 is reacted with air on a catalyst in the oxidation section. Nitric oxide and water are formed in this process according to the main equation:

$$\mathbf{4\ NH_3 + 5\ O_2 = 4\ NO + 6\ H_2O}$$

Nitrous oxide, nitrogen and water are formed simultaneously in accordance with the following equations:

$$\mathbf{4\ NH_3 + 3\ O_2 = 2\ N_2 + 6\ H_2O}$$

$$4 NH_3 + 4 O_2 = 2 N_2O + 6 H_2O$$

The reaction is carried out in the presence of a catalyst.

Oxidation of NO and absorption in H_2O

Nitric oxide is oxidised to nitrogen dioxide as the combustion gases are cooled, according to the equation:

$$2 NO + O_2 = 2 NO_2$$

For this purpose, secondary air is added to the gas mixture obtained from the ammonia oxidation. Demineralised water, steam condensate or process condensate is added at the top of the absorption column. The weak acid solution (approximately 43 %) produced in the cooler condenser is also added to the absorption column. The NO_2 in the absorption column is contacted countercurrently with flowing H_2O, reacting to give HNO_3 and NO:

$$3 NO_2 + H_2O = 2 HNO_3 + NO$$

The oxidation, absorption of the nitrogen dioxide and its reaction to nitric acid and nitric oxide take place simultaneously in the gaseous and liquid phases. Both reactions (oxidation and HNO_3 formation) depend on pressure and temperature and are favoured by higher pressure and lower temperature.

The most common treatment techniques for tail gases from nitric acid plants are:

SCR (Selective Catalytic Reduction, for NOx abatement)
NSCR (Selective Non-Catalytic Reduction, for NOx and N_2O abatement)
One of the currently operating plants conducts both reactions of oxidation and absorption at normal pressure and the other plant – at high pressure. Both of the plants are using NSCR as emissions abatement technology.

4.3.2.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation, which is the case around 1999/2000 with one of the nitric acid producing plants.

There is 44% reduction of the total emission in the sector in 2012 compared to 2011, which is due to production decrease with 28% in November 2011 as well as utilisation of new treatment facilities in one of the plants to reduce the N_2O emissions the following treatment facilities are utilised after 2005.

- Catalytic converter for N_2O reduction since September 2005 – average efficiency 75%
- Since November 2011 catalyst DN_2O(BASF) – 85% efficiency for N_2O

This is connected with the decrease of the Ammonia production which is performed by the same plants.

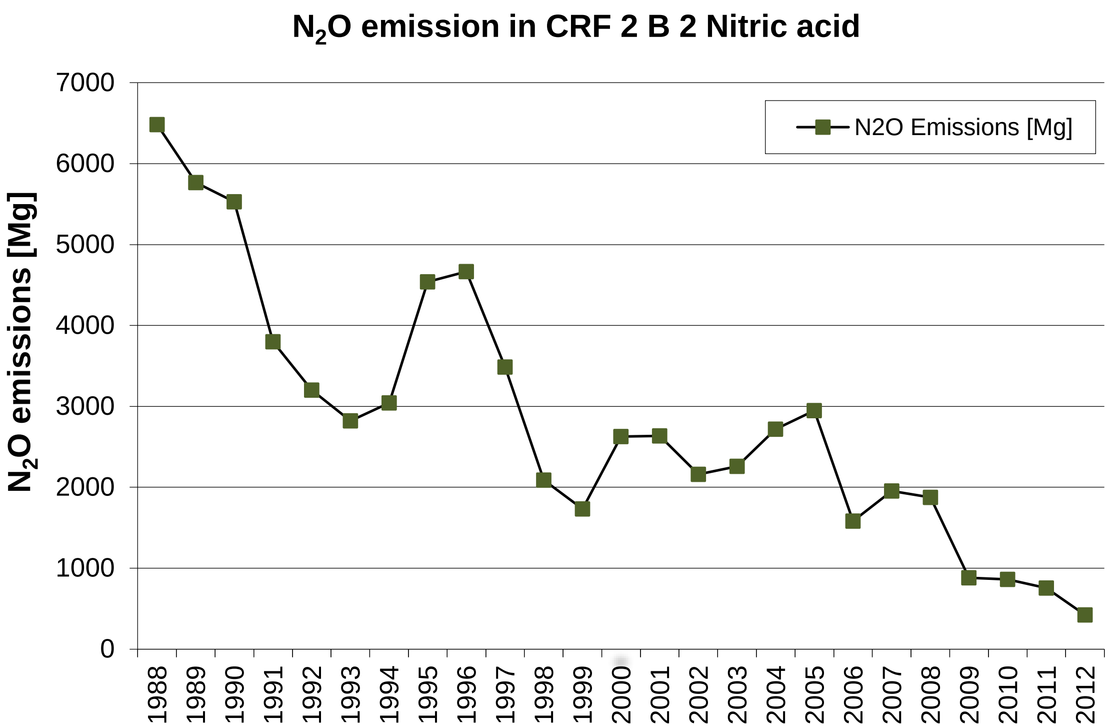


Figure 60 Nitric acid production and N_2O emission in CRF 2 B 2 Nitric acid production

4.3.2.3 Methodological issues

4.3.2.3.1 Method

Taking into account the recommendations of the ERT for N_2O emissions from the nitric production, plant specific data are used and a country specific emission factor was developed. Following the Decision tree for N_2O emissions from nitric acid production (IPCC GPG 2000, p. 3.32) plant specific data on N_2O emissions and destruction were obtained. A higher tier method (referred as Tier 3 in 2006 IPCC Guidelines, Chapter 3, p. 3.21) is applied, which means that the N_2O emissions are based on real measurement data.

For completing the time series additional data from NSI were also used. The emissions were recalculated using the following equation:

$$\textbf{Emission } N_2O = IEF * NAP$$

Where:

IEF – Implied emission factor,

NAP – Nitric acid production.

4.3.2.3.2 N_2O Implied Emission factor

For the years 2000 to 2012 a plant specific emission factor was calculated on the basis measured data from plants operators.

For the period 1988 – 2000 the IEF was applied, assuming that technology and abatement types are similar. A default emission factor was applied for the third plant where no information is available and which stopped working in period 1999/2000.

4.3.2.3.3 Activity data

For the 2000 to 2012 emission data from plant operators were available; for the entire time series the production data were available. Following the recommendations of 2006 IPCC GL as a good practice in order to reduce uncertainty all activity data obtained were for 100 % HNO_3.

For the third plant activity data from NSI were used.

The following questionnaire is regularly sent to the plant operator:

Table 120 Questionnaire to plant operator of Ammonia production

1	Nitric acid production (100%)	t
2	N_2O emissions	t/y

Table 121 Nitric acid production and N_2O emission

Year	Nitric acid Production (HNO_3) [kt/y]	Nitric acid Production (HNO_3) [kt/y]	Emission Factor [kt N_2O/kt HNO_3]	N_2O Emissions [kt N_2O]
1988	PS data / NSI	C	C	6,48
1989	PS data / NSI	C	C	5,77
1990	PS data / NSI	C	C	5,53
1991	PS data / NSI	C	C	3,80
1992	PS data / NSI	C	C	3,20
1993	PS data / NSI	C	C	2,82
1994	PS data / NSI	C	C	3,04
1995	PS data / NSI	C	C	4,54
1996	PS data / NSI	C	C	4,67
1997	PS data / NSI	C	C	3,49
1998	PS data / NSI	C	C	2,09
1999	PS data / NSI	C	C	1,73
2000	PS data	C	C	2,63
2001	PS data	C	C	2,63
2002	PS data	C	C	2,16
2003	PS data	C	C	2,26
2004	PS data	C	C	2,72
2005	PS data	C	C	2,95
2006	PS data	C	C	1,58
2007	PS data	C	C	1,95
2008	PS data	C	C	1,87
2009	PS data	C	C	0,88
2010	PS data	C	C	0,86
2011	PS data	C	C	0,76
2012	PS data	C	C	0,42

Confidential issue

In accordance with the 'Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11. As mentioned in § 27 emissions and removals should be reported at the most disaggregated level of each source/sink category, taking into account that a minimum level of aggregation may be required to protect confidential business and military information (FCCC/SBSTA/2006/9).

In CRF 2.B.2 Nitric acid production the production data and the EF as well as IEF is marked as confidential "C", because these information could lead to the disclosure of confidential information provided by the plant operator.

4.3.2.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	7.6 %
AD	±3 %
EF	7%

Uncertainty for AD:

The following aspects are relevant

Typical plant-level production data is accurate to ±2% due to the economic value of having accurate information (2000 IPCC GPG, Chapter 3.2).
A properly maintained and calibrated monitoring system can determine emissions within ±5% at the 95% confidence level (2000 IPCC GPG, Chapter 3.2).
Where uncertainty values are not available from other sources, a default value of ±2 percent can be used (2006 IPCC GL, Chapter 3.3.3.2).
Only for one plant, which stopped in 1999 - 2000, statistical data had to be used. Therefore an uncertainty of 3 % for activity data is assumed.

Uncertainty for EF:

The following aspects are relevant

Default EF uncertainty for Plants with NSCRa is ±10% (2000 IPCC GPG, Table 3.8, Chapter 3).
Default EF uncertainties for Plants with NSCRa (all processes) and Atmospheric pressure plants (low pressure) is ±10% (2006 IPCC GL, Chapter 3.3.2.2).
A properly maintained and calibrated monitoring system can determine emissions within ±5% at the 95% confidence level (2000 IPCC GPG, Chapter 3.2).
Only for one plant, which stopped in 1999 - 2000, data on the abatement technology were unavailable. Therefore an EF uncertainty of about 7 % is assumed.

Quantitative uncertainty estimates are provided in Annex 7.

4.3.2.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Chapter 1.6.

Check with the activity data provided by NSI.

Check of AD with IPPC and E-PRTR reports.

ISO 9001 and 14 001 standards, EMAS.

4.3.2.6 Source specific recalculations

There are no source specific recalculations for this category.

Source specific planned improvements

No source specific improvements are planned.

4.3.3 CARBIDE PRODUCTION AND USE (CRF 2.B.4.2)

4.3.3.1 Source category description

Carbide production

There is one carbide producing plant in Bulgaria. It reports under EU ETS and has IPPC permit. The process which is used to produce carbide in it is as follows:

Calcium carbide (CaC_2) is made by reducing calcium oxide CaO with carbon e.g., anthracite coal, in electric arc furnaces. The reaction is:

$CaO + 3C \rightarrow CaC_2 + CO$ ($+ \frac{1}{2} O_2 \rightarrow CO_2$)

The CaO used for carbide production is produced by the same plant from limestone. This limestone usage is included in CRF 2.A.2 Lime production in order to avoid double counting with the quicklime production.

4.3.3.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

There is and insignificant decrease in calcium carbide production in 2012, which leads to decrease in emissions with aproximately 16%.

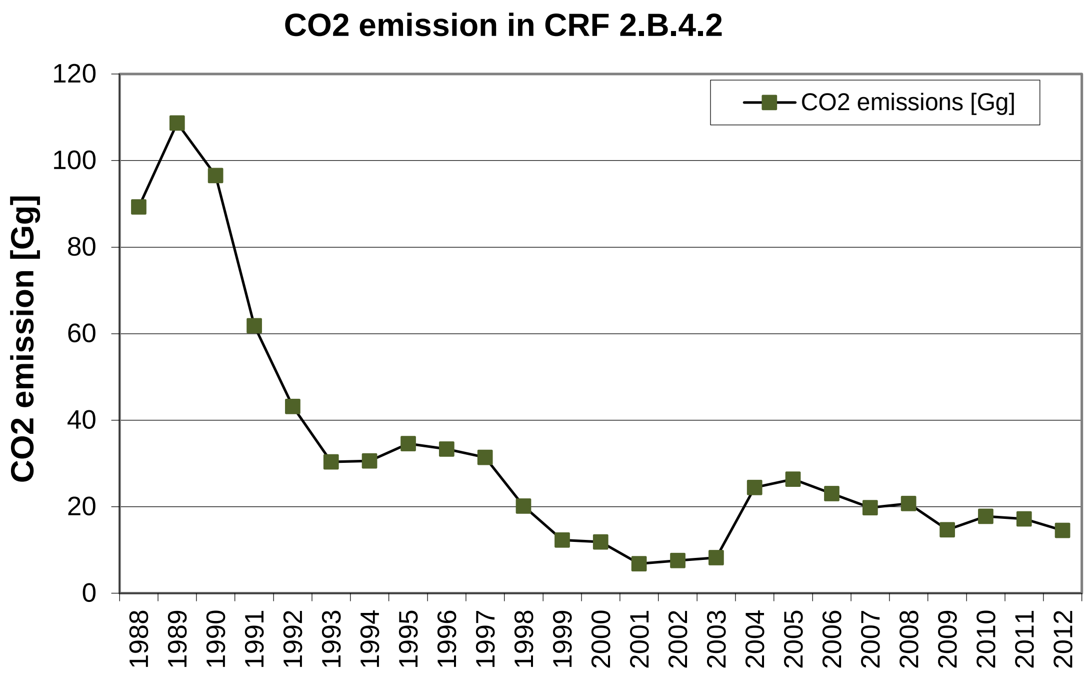


Figure 61 Carbide production and use and CO_2 emission in CRF 2.B.4.2

4.3.3.3 Methodological issues

The Tier 1 method based on default values and national statistics is used.

The carbide production is taken from NSI. This quantity is used as AD for the calculations of the emissions from category 2.B.4.

The EF for these calculations are taken as default (table 2-8, p. 2.19, 1996 IPCC GL) for the reduction process (1.09 tonnes CO_2/tonne carbide) and for the use of product (1.1 tonnes CO_2/tonne carbide).

The emissions are estimated following the recommendations of the Revised 1996 IPCC guidelines.

In order to ensure that there is no double counting with the energy sector further investigation will be made on the quantity of the anthracite used as reducing agent.

4.3.3.3.1 Method

Emissions of CO_2 from Carbide production and use are estimated using the methodology described in 1996 IPCC Guidelines and a default emission factor from the same guidelines (table 2-8, p. 2.19). Plant specific and country specific data were used to estimate CO_2 emissions from Carbide production and use.

In emissions estimations the general approach described in 1996 IPCC Guidelines is applied using the following equation:

$$\textbf{TOTAL } \mathbf{CO_2 = (AD_p \bullet EF_p) + (AD_u \bullet EF_u)}$$

where:

TOTAL CO_2 = the process emission (tonnes) of CO_2

AD_p = Carbide produced (tonnes/yr)

EF_p = the emission factor for CO_2 for Carbide produced (EF = 1.09 tonnes CO_2/tonne carbide)

AD_u = Carbide used (tonnes/yr)

EF_u = the emission factor for CO_2 for Carbide used (EF = 1.1 tonnes CO_2/tonne carbide)

4.3.3.3.2 CO_2 Emission factor

The EF for these calculations are taken as default (table 2-8, p. 2.19, 1996 IPCC GL) for the reduction process (1.09 tonnes CO_2/tonne carbide) and for the use of product (1.1 tonnes CO_2/tonne carbide).

4.3.3.3.3 Activity data

Country specific activity data on the amount of carbide produced and use are obtained from NSI for the whole time period. Plant specific data are used as quality check.

Issue of double counting:

The following is considered:

Note that the CaO (lime) might not be produced at the carbide plant. In this case, the emissions from the CaO step should be reported as emissions from lime production (Section 2.4) and only the emissions from the reduction step and use of the product should reported as emissions from calcium carbide manufacture. (P. 2.19, 1996 IPCC GL)

Table 122 Carbide production and use and CO_2 emission in CRF 2.B.4.2

Year	Carbide production [kt/y]	CO_2 EF [kt CO_2/kt CaC_2]	CO_2 Emissions [Gg CO_2]
1988	C	C	89,32
1989	C	C	108,66
1990	C	C	96,52
1991	C	C	61,80
1992	C	C	43,20
1993	C	C	30,35
1994	C	C	30,62
1995	C	C	34,61
1996	C	C	33,35
1997	C	C	31,43
1998	C	C	20,15
1999	C	C	12,28
2000	C	C	11,90
2001	C	C	6,80
2002	C	C	7,55
2003	C	C	8,28
2004	C	C	24,45
2005	C	C	26,34
2006	C	C	23,05
2007	C	C	19,81
2008	C	C	20,72

Year	Carbide production [kt/y]	CO_2 EF [kt CO_2/kt CaC_2]	CO_2 Emissions [Gg CO_2]
2009	C	C	14,69
2010	C	C	17,76
2011	C	C	17,21
2012	C	C	14,50

Confidential issue

In accordance with the 'Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11. As mentioned in § 27 emissions and removals should be reported at the most disaggregated level of each source/sink category, taking into account that a minimum level of aggregation may be required to protect confidential business and military information (FCCC/SBSTA/2006/9).

In CRF 2.B.4.2 Carbide production the production data and the EF as well as IEF is marked as confidential "C", because these information could lead to the disclosure of confidential information provided by the plant operator.

4.3.3.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	11.2 %
AD	±5 %
EF	±10 %

Uncertainty for AD:

The two following aspects are relevant (2006 IPCC GL, p. 3.45)

Where activity data are obtained directly from plants, uncertainty estimates can be obtained from producers. This will include uncertainty estimates for petroleum coke and limestone used and for carbide production data. Data that are obtained from national statistical agencies or from industrial and trade organizations usually do not include uncertainty estimates. It is good practice to consult with national statistical agencies to obtain information on any sampling errors. Where national statistic agencies collect carbide production data from production facilities, uncertainties in national statistics are not expected to differ from uncertainties estimated from plant-level consultations. Where uncertainty values are not available from other sources, a default value of ±5 percent can be used.

Uncertainty for EF:

The following is taken into account:

In general, the default CO_2 emission factors are relatively uncertain because industrial-scale carbide production processes differ from the stoichiometry of theoretical chemical reactions. The uncertainty in the emission factors for CH_4 is due to the possible variations in the hydrogen-containing volatile compounds in the raw material (petroleum coke) that are used by different manufacturers and due to the possible variations in production process parameters. Where uncertainty values are not available from other sources, a default value of ±10 percent can be used.

It is good practice to obtain uncertainty estimates at the plant level which should be lower than uncertainties associated with default values. (2006 IPCC GL, p. 3.45)

4.3.3.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Chapter 1.6.
AD compared with the annual reports under IPPC.
ISO 9001 and 14 001 standards.
EU ETS reports

4.3.3.6 Source specific recalculations

There are no source specific recalculations for this category.

4.3.3.7 Source specific planned improvements

No source specific improvements are planned.

4.4 METAL PRODUCTION (CRF 2.C)

4.4.1 IRON AND STEEL PRODUCTION (CRF 2.C.1)

4.4.1.1 Source category description

According to the information given in Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, p. 16, four routes are currently used for the production of steel: the classic blast furnace/basic-oxygen furnace route, direct melting of scrap (electric arc furnace), smelting reduction and direct reduction. At present (1998), EU (15) steel production is based on the blast furnace/ basic-oxygen route (approximately 65%) and the electric arc furnace (EAF) route (approximately 35%).[27]

The following steel making processes are present in Bulgaria:

*Open hearth furnace (*until *1993)*

A type of furnaces where excess carbon and other impurities are burnt out of pig iron to produce steel. Since steel is difficult to manufacture due its high melting point, normal fuels and furnaces are insufficient and the open hearth furnace overcomes this difficulty. Compared to Bessemer steel, which it displaced, its main advantages are that it doesn't expose the steel to excessive nitrogen (which would cause the steel to become brittle), is easier to control, and it permits the melting and refining of large amounts of scrap iron and steel.

The process is far slower than that of Bessemer converter and thus easier to control and take samples for quality control. As the process is slow, it is not necessary to burn all the

---

[27] (ftp://ftp.jrc.es/pub/eippcb/doc/isp_bref_1201.pdf)

carbon away as in Bessemer process, but the process can be terminated at given point when desired carbon contents has been achieved.

*Basic oxygen steelmaking (*until November *2008)*

The objective in oxygen steelmaking is to burn (i.e., oxidise) the undesirable impurities contained in the metallic feedstock. The main elements thus converted into oxides are carbon, silicon, manganese, phosphorus, and sulphur. The purpose of this oxidation process, therefore, is:

to reduce the carbon content to a specified level (from approximately 4% to less than 1%, but often lower)
to adjust the contents of desirable foreign elements
to remove undesirable impurities to the greatest possible extent

The production of steel by the basic oxygen furnace (BOF) process is a discontinuous process which involves the following steps:

transfer and storage of hot metal
pre-treatment of hot metal (desulphurisation)
oxidation in the BOF (decarburisation and oxidation of impurities)
secondary metallurgical treatment
casting (continuous or/and ingot)

Electric steelmaking

The direct smelting of iron-containing materials, such as scrap is usually performed in electric arc furnaces (EAF). The major feed stock for the EAF is ferrous scrap, which may comprise of scrap from inside the steelworks (e.g. offcuts), cut-offs from steel product manufacturers (e.g. vehicle builders) and capital or post-consumer scrap (e.g. end of life products).

With respect to the end-products distinction has to be made between production of ordinary, so called carbon steel as well as low alloyed steel and high alloyed steels/stainless steels. In the EU about 85% of steel production is carbon or low alloyed steel [EC Study, 1996].For the production of carbon steel and low alloyed steels, following main operations are performed:

raw material handling and storage
furnace charging with/without scrap preheating
EAF scrap melting
steel and slag tapping
ladle furnace treatments for quality adjustment
slag handling
continuous casting

For high alloyed and special steels, the operation sequence is more complex and tailor-made for the end-products. In addition to the mentioned operations for carbon steels various ladle treatments (secondary metallurgy) are carried out like

desulphurisation

degassing for the elimination of dissolved gases like nitrogen and hydrogen
decarburisation (AOD=Argon-Oxygen-Decarburisation or VOD=Vacuum-Oxygen-Decarburi-sation)

The steel making plant which produced sinter, pig iron and steel (BOF) ceased operation in November 2008.

Currently in Bulgaria steel is produced only in EAF.

4.4.1.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

There is general reduction of the total emission in the sector in 2009 compared to 2008. This is mainly due to the world economic crisis in 2009 which lead to a reduction of the production processes rates. The total reduction in the sector production is about 45%.

Another factor leading to this reduction is that the biggest plant from this sector (which share in the steel production before 2008 was more than 50%) ceased operation of its pig iron and the following steel making in BOF in November 2008.

There is general reduction of the total emission in the sector in 2012 compared to 2011. This is mainly due to the stable fluctuation on the production of the second biggest steel plant.

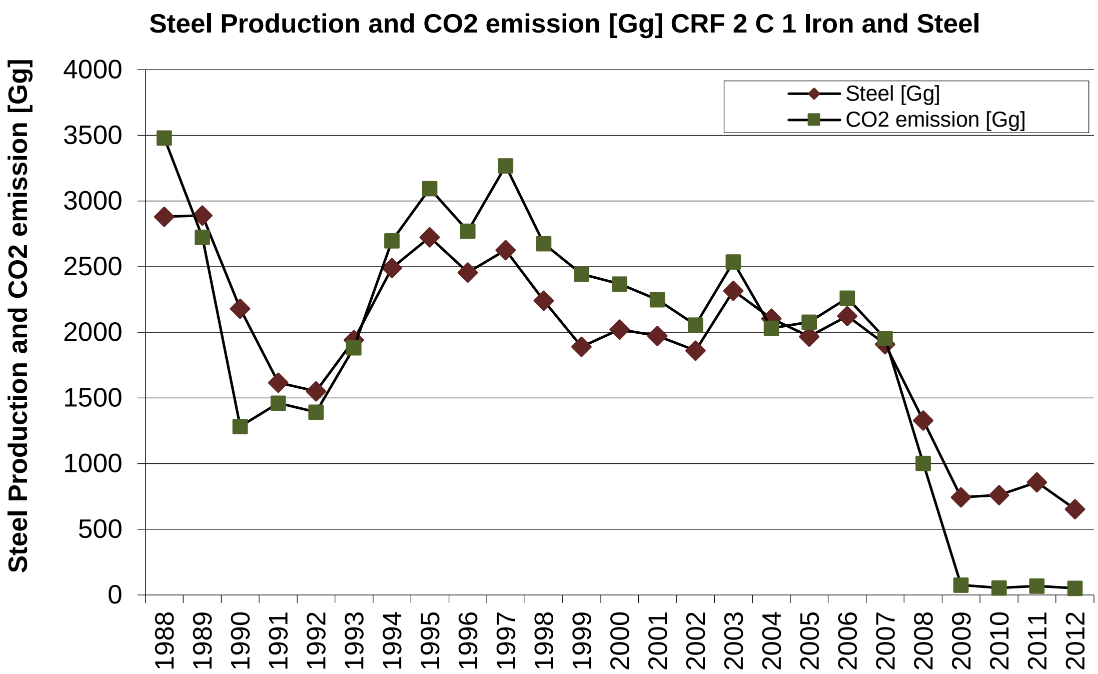


Figure 62 Iron and Steel Production and CO_2 emission in CRF 2 C 1 Iron and Steel production

4.4.1.3 Methodological issues

4.4.1.3.1 Method

Open hearth furnace

To estimate the CO_2 emissions for this category Tier 1 method is used because the production of steel with this method terminated in 1993 and no information is available to apply a higher Tier method

Basic oxygen steelmaking

To estimate the CO_2 emissions for this category a Tier 2 balance approach is used – carbon contents in the raw materials and the final product. The emissions include the entire production process for this type of steel – including the intermediate pig iron production in the BOF.This method for emissions estimation is implemented during he 2012 ESD review in cooperation the ESD revew experts.

Electric steelmaking

The CO_2 emissions from the sector are calculated using country specific data from EU ETS reports. Data for 2012 from Bulgarian association of metallurgical industry (BAMI, http://www.bcm-bg.com/) as well as data from World Steel Association (WSA, http://worldsteel.org) are used for crosscheck.

4.4.1.3.2 Emission factor

Open hearth furnace – default emission factor is used – 1.72 t CO_2/t Steel

Basic oxygen steelmaking

A production specific EF is calculated, based on the amount of carbon in the raw materials and the final products. The EF varies for the period 1989 – 2009.

Electric steelmaking

Country specific emission factor was developed for the EAF steel based on data from EU ETS reports for the period 2007 - 2011. In the calculation of ETS emissions the operators performed a mass balance of the Carbon content in the raw materials used and the produced end product. Thus CO_2 emissions are estimated by an approach similar to the following equation (IPCC GPG 2000, p. 3.25):

EQUATION 3.6B

Emissions crude steel = (Mass of Carbon in the Crude Iron used for Crude Steel Production – Mass of Carbon in the Crude Steel) • 44/12 + Emission FactorEAF • Mass of Steel produced in EAF

4.4.1.3.3 Activity data

Country specific data from EU ETS reports as well as from BAMI and WSA on total crude steel production were received.

Issue of double accounting:

In order to avoid double counting, the quantity the fuel used is subtracted from the quantity reported under energy and non-energy use in the Energy Chapter.

Table 123 Iron and Steel production and CO_2 emission

Year	Steel Production	Steel Production [kt/y]	Emission Factor [kt CO_2/kt Steel]	CO_2 Emissions [kt CO_2]
1988	BAMI / WSA	2880,00	1,209	3481,44
1989	BAMI / WSA	2890,00	0,943	2724,87
1990	BAMI / WSA	2180,00	0,589	1283,24
1991	BAMI / WSA	1616,00	0,904	1460,58
1992	BAMI / WSA	1552,00	0,897	1392,13
1993	BAMI / WSA	1942,00	0,970	1883,71
1994	BAMI / WSA	2490,00	1,083	2697,12
1995	BAMI / WSA	2724,00	1,136	3095,68
1996	BAMI / WSA	2457,00	1,128	2771,76
1997	BAMI / WSA	2628,00	1,244	3268,68
1998	BAMI / WSA	2242,00	1,194	2676,82
1999	BAMI / WSA	1889,00	1,294	2444,83
2000	BAMI / WSA	2022,00	1,171	2368,01
2001	BAMI / WSA	1972,00	1,140	2247,66
2002	BAMI / WSA	1860,00	1,105	2055,21
2003	BAMI / WSA	2316,00	1,096	2537,47
2004	BAMI / WSA	2106,00	0,965	2031,37
2005	BAMI / WSA	1969,00	1,055	2078,16
2006	BAMI / WSA	2124,00	1,065	2261,72
2007	BAMI / WSA / ETS	1909,00	1,023	1953,25
2008	BAMI / WSA / ETS	1330,00	0,754	1003,16
2009	BAMI / WSA / ETS	744,53	0,100	74,17
2010	BAMI / WSA / ETS	761,41	0,070	53,47
2011	BAMI / WSA / ETS	858,92	0,079	67,96
2012	BAMI / WSA / ETS	653,88	0,077	50,33

As can be seen in Table 122 the emission factor for 2008 is lower than the ones for the previous years. This is mainly due to the fact that in 2008 the biggest steel making plant (which is also the only one producing steel in BOF) significantly decreased and subsequently stopped BOF steel production. This leads to a decrease in the production as well as in the CO_2 emissions.

For the period 2009-2012, there is no BOF steel production in Bulgaria since the abovementioned steelmaking company stopped its BOF furnaces from operation in November 2008.

Currently the steel in Bulgaria is produced only in EAF hence the IEF takes into account only this type of steel making. In 2008 the IEF includes also BOF steel. Due to the described facts the IEF in 2009-2012 decreases significantly.

4.4.1.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	11.2 %
AD	5 %
EF	10 %

Uncertainty for AD:

The two following aspects are relevant

According to IPCC GPG 2000 (Chapter 3, p 3.28):
For both Tier 1 and 2 the most important type of activity data is the amount of reducing agent used for iron production. According to Chapter 2, Energy, energy data have a typical uncertainty of about 5% (about 10% for countries with less developed energy statistics). For calculating the carbon storage term Tier 2 requires additional activity data on amounts of pig iron and net crude steel production that have a typical uncertainty of a few percent. In addition, Tier 2 requires information on the carbon content of pig iron, crude steel, and of iron ore that may have an uncertainty of 5% when plant-specific data are available. Otherwise the uncertainty in the carbon content could be of the order of 25 to 50%. Finally, the uncertainty in the emission factors for the reducing agent (e.g. coke) are generally within 5% (see Section 2.1.1.6, CO_2 Emissions from Stationary Combustion, Uncertainty Assessment).

Taking into account that plant specific data from EU ETS reports were used to estimate emissions an uncertainty of 5% is considered.

Uncertainty for EF:

According to Table 4.4 (2006 IPCC GL, Chapter 4.2.3) applying Tier 2 material-specific carbon contents would be expected to have an uncertainty of 10 percent. This uncertainty is considered due to using EU ETS data.

Quantitative uncertainty estimates are provided in Annex 7.

4.4.1.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

CO_2 emissions were taken from ETS reports.
Aggregated national steel production data provided by BAMI and reported by World Steel Association are used for crosscheck.

4.4.1.6 Source specific recalculations

There are no source specific recalculations for this category.

4.4.1.7 Source specific planned improvements

No source specific improvements are planned.

4.4.2 PIG IRON PRODUCTION (CRF 2.C.1.2)

4.4.2.1 Source category description

There is one pig iron production plant in Bulgaria. Currently it has ceased operation (since November 2008).

4.4.2.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

In particular in pig iron production case the only plant ceased operation in November 2008 (see also "Iron and steel production" chapter).

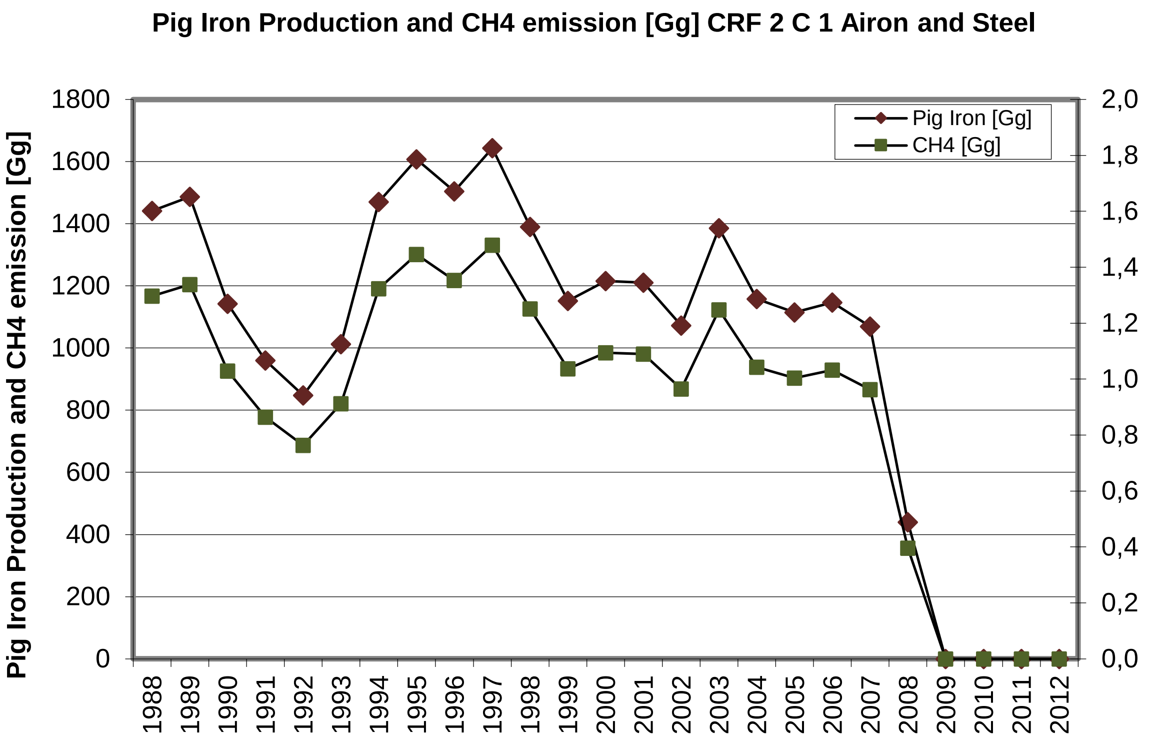


Figure 63 Pig iron Production and CH_4 emission in CRF 2.C.1.2 Pig iron production

4.4.2.3 Methodological issues

4.4.2.3.1 Method

Tier 1 methodology for CH_4 based on emission factors and national production statistics is applied (2006 IPCC GL, p. 4.24).The emissions from the sector are calculated using country specific data on the total amount of pig iron produced taken from WSA Yearbooks. Default emission factor is applied.

The emissions are estimated using the following equation (2006 IPCC GL, p. 4.24, equation 4.13).

EQUATION 4.13

CH_4 EMISSIONS FROM BLAST FURNACE PRODUCTION OF PIG IRON (TIER 1)

$$E_{CH4,non-energy} = PI \bullet EF_{PI}$$

Where

$E_{CH4,non-energy}$ – non-energy CH_4 emissions from pig iron production

PI – pig iron production (kt)

EF_{PI} – emission factor for pig iron

4.4.2.3.2 Emission factor

The following is taken into account: "The conversion factors provided in Table 4.1 of the IPPC I&S BAT Document are 940 kg pig iron per tonne liquid steel" (2006 IPCC GL, p. 4.25, BAT Reference Document on the Production of Iron and Steel, December 2001).

Thus an emission factor of 0.9 [kg CH_4/ton production] is obtained.

4.4.2.3.3 Activity data

Country specific data on the total pig iron production are taken from WSA.

The following is also taken into account (2006 IPCC Guidelines, p. 4.28):

"The Tier 1 method requires only the amount of steel produced in the country by process type, the total amount of pig iron produced that is not processed into steel, and the total amount of coke, direct reduced iron, pellets, and sinter produced; in this case the total amount of coke produced is assume to be produced in integrated coke production facilities. These data may be available from governmental agencies responsible for manufacturing statistics, business or industry trade associations, or individual iron and steel companies."

Issue of double counting:

In order to avoid double counting, the CO_2 emissions from pig iron production are reported under BOF steel production (see *Basic oxygen steelmaking*).

Table 124 Pig iron production and CH_4 emission

Year	Pig Iron Production [kt/y]	Emission Factor [t CH_4/ kt production]	CH_4 Emissions [kt CH_4]
1988	1441,00	0,900	1,30
1989	1487,00	0,900	1,34

Year	Pig Iron Production [kt/y]	Emission Factor [t CH_4/ kt production]	CH_4 Emissions [kt CH_4]
1990	1143,00	0,900	1,03
1991	960,00	0,900	0,86
1992	848,00	0,900	0,76
1993	1013,00	0,900	0,91
1994	1470,00	0,900	1,32
1995	1607,00	0,900	1,45
1996	1504,00	0,900	1,35
1997	1643,00	0,900	1,48
1998	1390,00	0,900	1,25
1999	1152,00	0,900	1,04
2000	1216,00	0,900	1,09
2001	1211,00	0,900	1,09
2002	1072,00	0,900	0,96
2003	1386,00	0,900	1,25
2004	1158,00	0,900	1,04
2005	1115,00	0,900	1,00
2006	1147,00	0,900	1,03
2007	1069,00	0,900	0,96
2008	440,00	0,900	0,40
2009	0,00	0,900	0,00
2010	0,00	0,900	0,00
2011	0,00	0,900	0,00
2012	0,00	0,900	0,00

4.4.2.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	26.9 %
AD	± 10 %
EF	± 25%

Uncertainty for AD:

For Tier 1 the most important type of activity data is the amount of steel produced using each method. National statistics should be available and likely have an uncertainty of ± 10 percent. (2006 IPCC GL, p. 4.30, see also Table 4.4).

Uncertainty for EF:

The default emission factors for coke production and iron and steel production used in Tier 1 may have an uncertainty of ± 25 percent. (2006 IPCC GL, p. 4.30, see also Table 4.4).

Quantitative uncertainty estimates are provided in Annex 7.

4.4.2.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Chapter 1.6.

Aggregated national pig iron production data and default emission factor are used.

Comparison with NSI and BAMI data on pig iron production.

4.4.2.6 Source specific recalculations

There are no source specific recalculations for this category.

4.4.2.7 Source specific planned improvements

The only pig iron production plant has ceased operation.

No source specific improvements are planned.

4.4.3 COKE PRODUCTION (CRF 2.C.1.4)

4.4.3.1 Source category description

Coal pyrolysis means the heating of coal in an oxidation free atmosphere to produce gases, liquids and a solid residue (char or coke). Coal pyrolysis at high temperature is called carbonisation. In this process the temperature of the flue gases is normally 1150 – 1350 °C indirectly heating the coal up to 1000 – 1100 °C for 14 – 24 hours. This produces blast furnace and foundry cokes. Coke is the primary reducing agent in blast furnaces and cannot be wholly replaced by other fuels such as coal. Coke functions both as a support material and as a matrix through which gas circulates in the stock column.

Only certain coals, for example coking or bituminous coals, with the right plastic properties, can be converted to coke and, as with ores, several types may be blended to improve blast furnace productivity, extend coke battery life, etc. (BREF Document on the Production of Iron and Steel, December 2001).

There is one coke production plant in Bulgaria. Currently it is non-operating since November 2008. The plant has no IPPC or and ETS permit hence no reports are available.

4.4.3.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

In particular in coke production case the only plant ceased operation in November 2008 (see also "Iron and steel production" chapter).

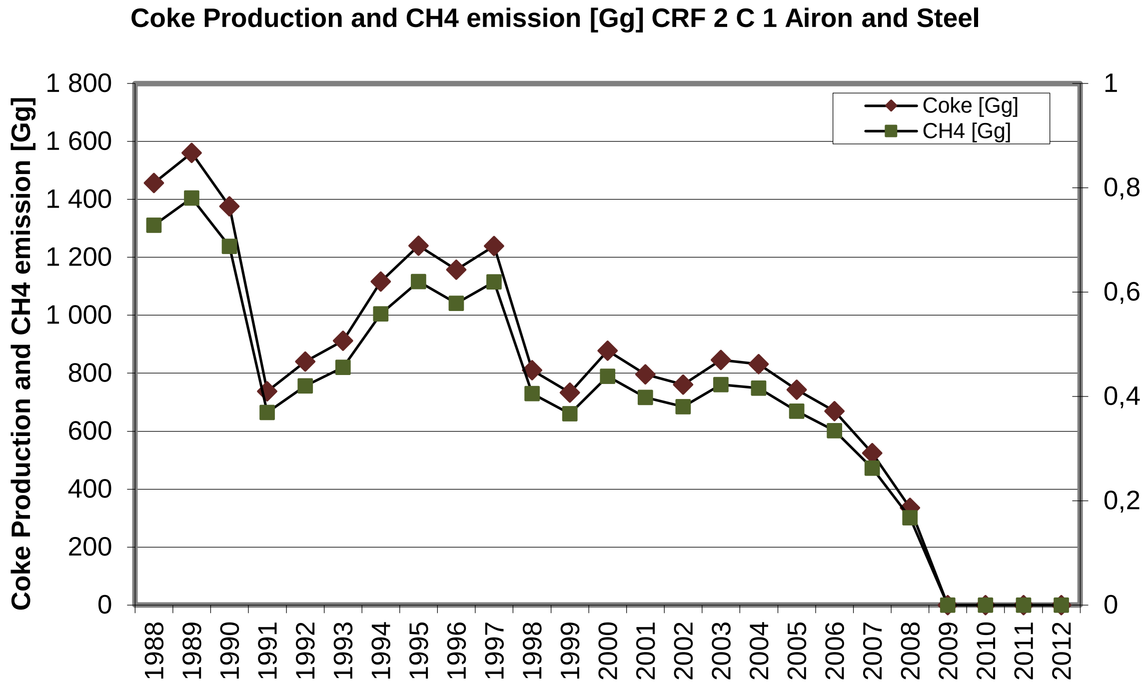


Figure 64 Coke Production and CH_4 emission in CRF 2.C.1.4 Coke production

4.4.3.3 Methodological issues

4.4.3.3.1 Method

The emissions from the sector are calculated using country specific data on the total amount of coke produced provided by NSI. Default emission factor is applied.

The emissions are estimated following the general approach recommended in 1996 IPCC Guidelines using the following equation:

Emissions CH_4 **= Emission factor • Coke production**

4.4.3.3.2 Emission factor

Default emission factor of 0.5 kg CH_4/ ton production is used (1996 IPCC GL, p. 2.21, Table 2-9).

4.4.3.3.3 Activity data

Country specific data on the total coke production are provided by NSI.

Issue of double counting:

The following is considered: Metallurgical coke production is considered to be an energy use of fossil fuel, and as a result emissions should be reported in Category 1A of the Energy Sector (2006 IPCC Guidelines, p. 4.9).

In order to avoid double counting, the CO_2 emissions from coke production are reported in the Energy Chapter.

Table 125 Coke production and CH_4 emission

Year	Coke Production [kt/y]	Emission Factor [t CH_4/ tk production]	CH_4 Emissions [kt CH_4]
1988	1457,00	0,500	0,73
1989	1561,00	0,500	0,78
1990	1376,00	0,500	0,69
1991	738,00	0,500	0,37
1992	840,00	0,500	0,42
1993	912,00	0,500	0,46
1994	1116,00	0,500	0,56
1995	1240,00	0,500	0,62
1996	1157,00	0,500	0,58
1997	1239,00	0,500	0,62
1998	810,65	0,500	0,41
1999	733,65	0,500	0,37
2000	877,47	0,500	0,44
2001	796,56	0,500	0,40
2002	761,06	0,500	0,38
2003	845,71	0,500	0,42
2004	831,71	0,500	0,42
2005	743,29	0,500	0,37
2006	668,92	0,500	0,33
2007	524,79	0,500	0,26
2008	335,25	0,500	0,17
2009	0,00	0,500	0,00
2010	0,00	0,500	0,00
2011	0,00	0,500	0,00
2012	0,00	0,500	0,00

4.4.3.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

Combined uncertainty	26.9 %
AD	± 10 %
EF	± 25%

Uncertainty for AD:

For Tier 1 the most important type of activity data is the amount of steel produced using each method. National statistics should be available and likely have an uncertainty of ± 10 percent. (2006 IPCC GL, p. 4.30, see also Table 4.4).

Uncertainty for EF:

The default emission factors for coke production and iron and steel production used in Tier 1 may have an uncertainty of ± 25 percent. (2006 IPCC GL, p. 4.30, see also Table 4.4).

Quantitative uncertainty estimates are provided in Annex 7.

4.4.3.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Chapter 1.6.

Aggregated national coke production data and default emission factor are used.

4.4.3.6 Source specific recalculations

There are no source specific recalculations for this category.

4.4.3.7 Source specific planned improvements

The only coke production plant has ceased operation.

No source specific improvements are planned.

4.4.4 FERROALLOYS PRODUCTION (CRF 2.C.2)

4.4.4.1 Source category description

Ferroalloys production is a non-key category.

Ferroalloys production involves a metallurgical reduction process that results in CO_2 emissions.

This is only a minor source of CO_2 emissions in Bulgaria: in 2012, emissions account for the 0.002% of total emissions from Industrial Processes sector.

There is one ferroalloys producer in Bulgaria. Recovered CO_2 emissions in ferroalloys production are not included.

4.4.4.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation.

There is a significant decrease of the total emission in the sector in 2012 compared to 2011. This is due to the fact that a steel making plant which produced sinter, pig iron and steel ceased operation in November 2008.

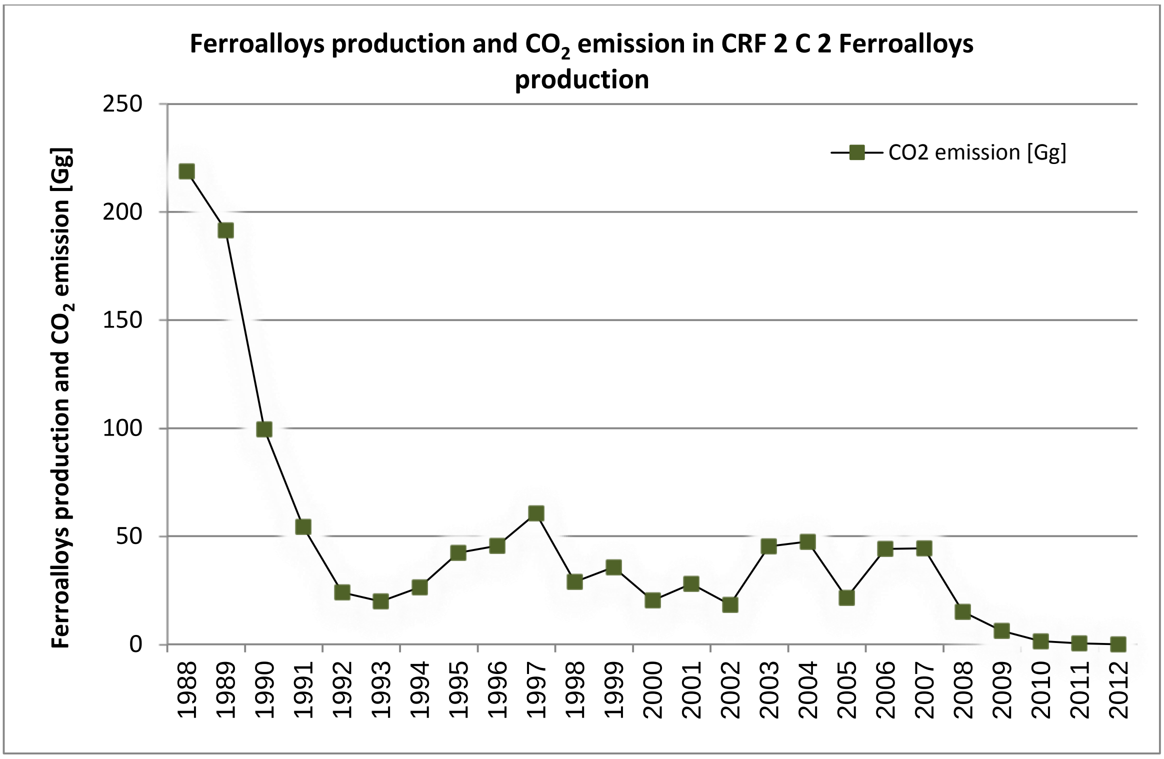


Figure 65 Ferroalloys production and CO_2 emission in CRF 2.C.2

4.4.4.3 Methodological issues

The Tier 1 method based on default values and national statistics is used.

The ferroalloys production is taken from NSI. This quantity is used as AD for the calculations of the emissions from category 2.C.2.

The EF for these calculations is taken as an average default factor 2.4 tonnes CO_2/tonne ferroalloys.

4.4.4.3.1 Method

Emissions of CO_2 from ferroalloys production is estimated using the methodology described in 1996 IPCC Guidelines and an average default emission factor from the same guidelines (table 2.15, p. 2.31).

In emissions estimations the general approach described in 1996 IPCC Guidelines is applied using the following equation:

$$\textbf{TOTAL } CO_2 = (AD_p \bullet EF_p)$$

where:

TOTAL CO_2 = the process emission (tonnes) of CO_2

AD_p = ferroalloys produced (tonnes/yr)

EF_p = the emission factor for CO_2 for ferroalloys produced (EF = 2.4 tonnes CO_2/tonne ferroalloys)

4.4.4.3.2 CO_2 Emission factor

The EF for these calculations is taken as an average default (table 2.15, p. 2.31, 1996 IPCC GL) for the reduction process (2.4 tonnes CO_2/tonne ferroalloys).

4.4.4.3.3 Activity data

Country-specific activity data on the amount of ferroalloys produced and use are obtained from NSI for the whole time period.

Table 126 Ferroalloys production and CO_2 emission in CRF 2.C.2

Year	Ferroalloys production [kt/y]	CO_2 EF [kt CO_2/kt]	CO_2 Emissions [kt CO_2]
1988	C	C	218,84
1989	C	C	191,62
1990	C	C	99,47
1991	C	C	54,55
1992	C	C	23,95
1993	C	C	19,87
1994	C	C	26,37
1995	C	C	42,37
1996	C	C	45,62
1997	C	C	60,54
1998	C	C	28,81
1999	C	C	35,68
2000	C	C	20,28
2001	C	C	27,97
2002	C	C	18,44
2003	C	C	45,37
2004	C	C	47,56
2005	C	C	21,54
2006	C	C	44,11
2007	C	C	44,38
2008	C	C	15,04
2009	C	C	6,29
2010	C	C	1,56
2011	C	C	0,45
20121	C	C	0,07

In CRF 2.C.2 Ferroalloys production the production data and the EF as well as IEF is marked as confidential "C", because these information could lead to the disclosure of confidential information provided by the plant operator.

4.4.4.4 Uncertainties and time series consistency

Combined uncertainty	25.5 %
AD	± 5 %
EF	± 25 %

4.4.4.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Chapter 1.6.

4.4.4.6 Source specific recalculations

There are no source specific recalculations for this category.

4.4.4.7 Source specific planned improvements

There are no source-specific planned improvements.

4.5 CONSUMPTION OF HALOCARBONS AND SF_6 – SECTOR OVERVIEW (CRF 2.F)

The following table and figure summarize the results for CRF Sector 2.F for 2012:

Table 127 Summary of the results for 2012

Sector	Actual emission 2012	Potential emission 2012	Actual share	Potential share
	Gg CO_2-eq.		%	
Solvents	0,00	0,00	0,00%	0,00%
Aerosols	9,15	4,34	1,95%	0,04%
Foams	26,42	304,77	5,64%	2,51%
Domestic refrigeration	7,24	76,14	1,55%	0,63%
Commercial and industrial refrigeration	58,17	615,37	12,42%	5,08%
Transport refrigeration	6,81	23,26	1,45%	0,19%
Domestic AC	205,95	9195,01	43,97%	75,84%
Stationary AC	17,02	227,30	3,63%	1,87%
Mobile AC	121,44	1032,86	25,92%	8,52%
Fire protection	4,26	85,16	0,91%	0,70%
Electrical equipment	11,96	559,67	2,55%	4,62%
Total	**468,41**	**12123,88**	**100,00%**	**100,00%**

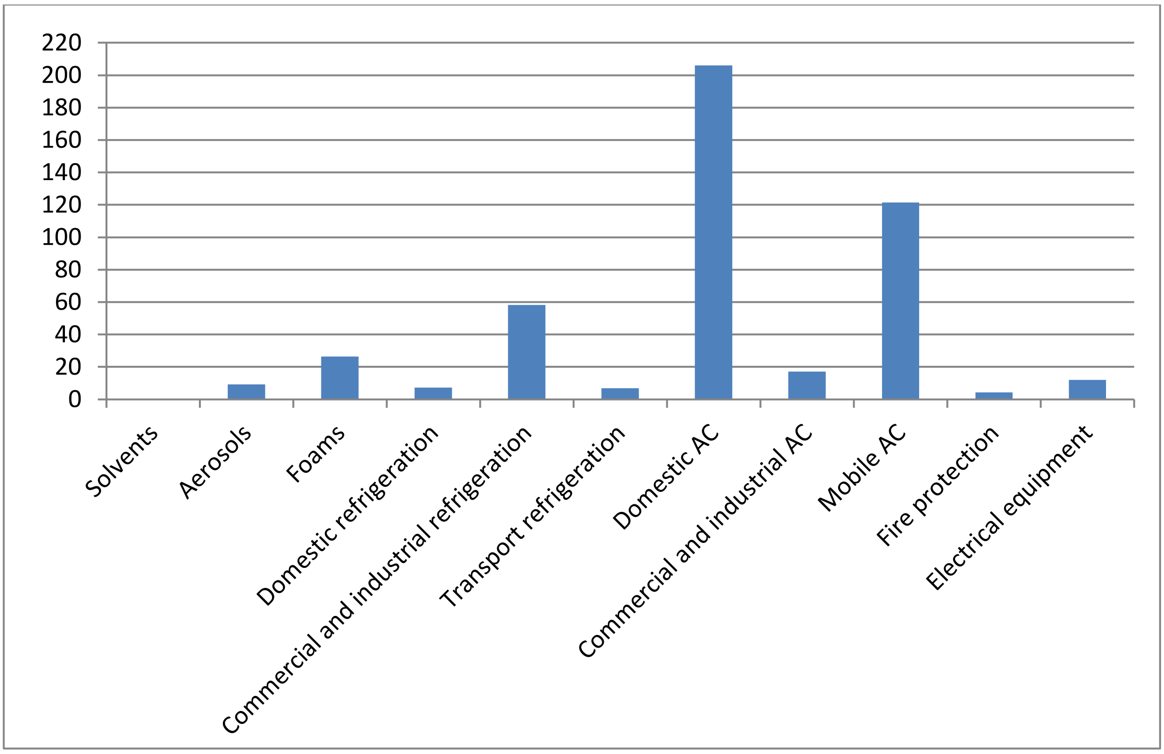


Figure 66 Actual emissions for 2012 [Gg CO_2-eq.]

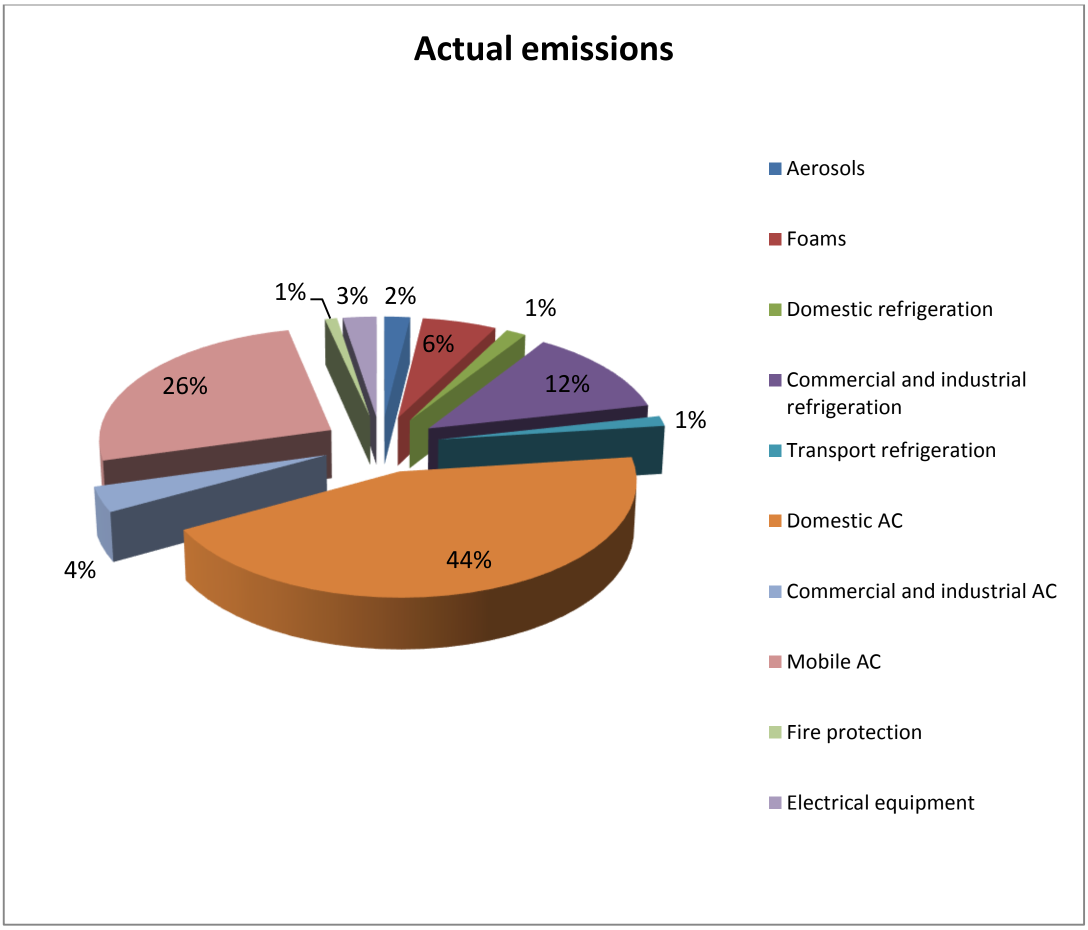


Figure 67 Actual emissions for 2012 [Gg CO_2-eq.]

The following table and figure represent the actual emissions for the whole time series:

Table 128 Actual emissions [Gg CO_2-eq.]

Year	Solvents	Aerosols	Foams	Domestic Ref	Industrial and Commercial Ref	Transport Ref	Domestic AC	Commercial and industrial AC	Mobil AC	Fire protecion	Electrical equipment
1988	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3,46
1989	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3,66
1990	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3,87
1991	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4,10
1992	NO	NO	NO	0,00	NO	NO	NO	NO	NO	NO	4,33
1993	NO	NO	NO	0,01	NO	NO	NO	NO	NO	NO	4,59
1994	NO	NO	NO	0,02	NO	NO	NO	NO	NO	NO	4,85
1995	NO	NO	NO	0,03	NO	NO	NO	NO	2,36	NO	5,13
1996	NO	NO	NO	0,04	NO	0,01	NO	NO	4,15	NO	5,43
1997	NO	NO	NO	0,06	NO	0,04	NO	NO	6,30	NO	5,75
1998	NO	1,01	NO	0,08	NO	0,09	NO	NO	9,05	NO	6,08
1999	NO	1,61	NO	0,12	NO	0,15	NO	NO	12,71	NO	6,43

Year	Solvents	Aerosols	Foams	Domestic Ref	Industrial and Commercial Ref	Transport Ref	Domestic AC	Commercial and industrial AC	Mobil AC	Fire protecion	Electrical equipment
2000	NO	0,69	NO	0,16	0,67	0,22	NO	0,12	16,58	NO	6,80
2001	NO	0,30	NO	0,18	4,46	0,37	0,78	1,29	21,32	0,47	7,20
2002	NO	0,74	NO	0,20	8,25	0,58	1,99	2,46	27,18	0,58	7,62
2003	NO	1,18	NO	0,22	12,04	0,86	3,96	3,63	37,30	0,72	8,06
2004	NO	1,71	NO	0,24	15,82	1,32	8,41	4,79	46,86	0,90	8,53
2005	NO	2,36	10,78	0,26	19,61	1,93	12,83	5,96	59,49	1,12	8,56
2006	NO	6,52	31,43	0,97	23,40	3,00	17,72	7,13	76,23	1,40	8,89
2007	NO	8,79	42,57	1,98	27,18	3,84	25,93	8,30	88,75	1,75	9,24
2008	NO	8,76	117,36	3,08	30,97	4,59	41,59	9,47	103,33	2,18	9,60
2009	NO	10,30	58,91	3,52	34,76	5,58	110,46	10,64	112,56	3,02	9,97
2010	NO	9,63	38,40	5,35	38,54	5,89	143,06	11,81	116,55	3,02	13,07
2011	NO	9,33	32,36	5,93	44,42	6,18	173,65	13,21	120,76	4,24	14,87
2012	NO	9,15	26,42	7,24	58,17	6,81	205,95	17,02	121,44	4,26	11,96

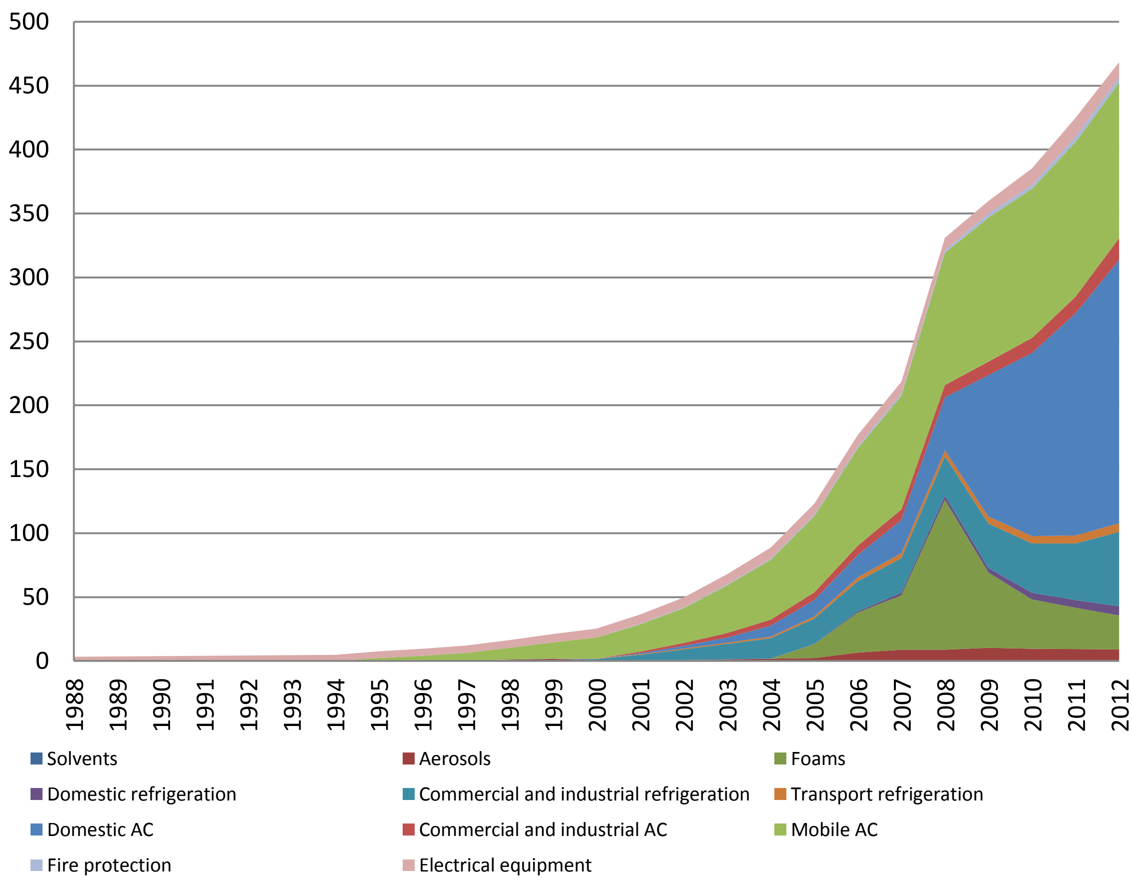


Figure 68 Actual emissions [Gg CO_2-eq.]

The following table and figure represent the potential emissions for the whole time series:

Table 129 Potential emissions [Gg CO_2-eq.]

Year	Solvents	Aerosols	Foams	Domestic Ref	Industrial and Commercial Ref	Transport Ref	Domestic AC	Commercial and industrial AC	Mobil AC	Fire protection	Electrical equipment
1988	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	142,38
1989	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	150,63
1990	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	159,37
1991	NO	NO	NO	0,72	NO	NO	NO	NO	NO	NO	168,61
1992	NO	NO	NO	2,47	NO	NO	NO	NO	NO	NO	178,39
1993	NO	NO	NO	5,33	NO	NO	NO	NO	NO	NO	188,74
1994	NO	NO	NO	8,64	NO	NO	NO	NO	NO	NO	199,69
1995	NO	NO	NO	13,83	NO	0,05	NO	NO	18,18	NO	211,27
1996	NO	NO	NO	19,61	NO	0,22	NO	NO	33,25	NO	223,52
1997	NO	NO	NO	26,73	NO	0,44	NO	NO	52,60	NO	236,49
1998	NO	1,01	NO	38,83	NO	0,73	NO	NO	77,88	NO	250,20
1999	NO	0,60	NO	53,22	NO	1,11	NO	NO	107,16	NO	264,72
2000	NO	0,09	NO	60,95	37,87	1,86	NO	11,69	136,78	NO	280,07
2001	NO	0,21	NO	67,96	75,74	2,91	79,18	23,38	178,31	9,30	296,31
2002	NO	0,53	NO	74,40	113,61	4,31	156,90	35,07	222,60	11,60	313,50
2003	NO	0,65	NO	80,83	151,48	6,35	333,06	46,76	317,84	14,46	331,68
2004	NO	1,07	NO	85,86	189,35	8,79	505,69	58,45	400,52	18,03	350,92
2005	NO	1,29	10,78	88,70	227,22	13,87	695,28	70,14	521,36	22,48	364,61
2006	NO	5,23	36,83	91,05	265,09	17,77	1014,86	81,83	651,91	28,03	378,83
2007	NO	3,57	60,98	92,61	302,96	21,06	1629,02	93,52	786,14	34,94	393,60
2008	NO	5,19	304,30	92,35	340,83	24,12	4363,70	105,22	916,07	43,57	408,95
2009	NO	5,11	336,71	90,36	378,70	24,18	5614,05	116,91	951,52	60,33	424,90
2010	NO	4,52	328,33	86,46	416,57	23,92	6768,71	128,60	984,79	60,33	484,93
2011	NO	4,81	317,19	81,96	571,56	23,81	7978,41	163,77	1025,38	84,83	558,36
2012	NO	4,34	304,77	76,14	615,37	23,26	9195,01	227,30	1032,86	85,16	559,67

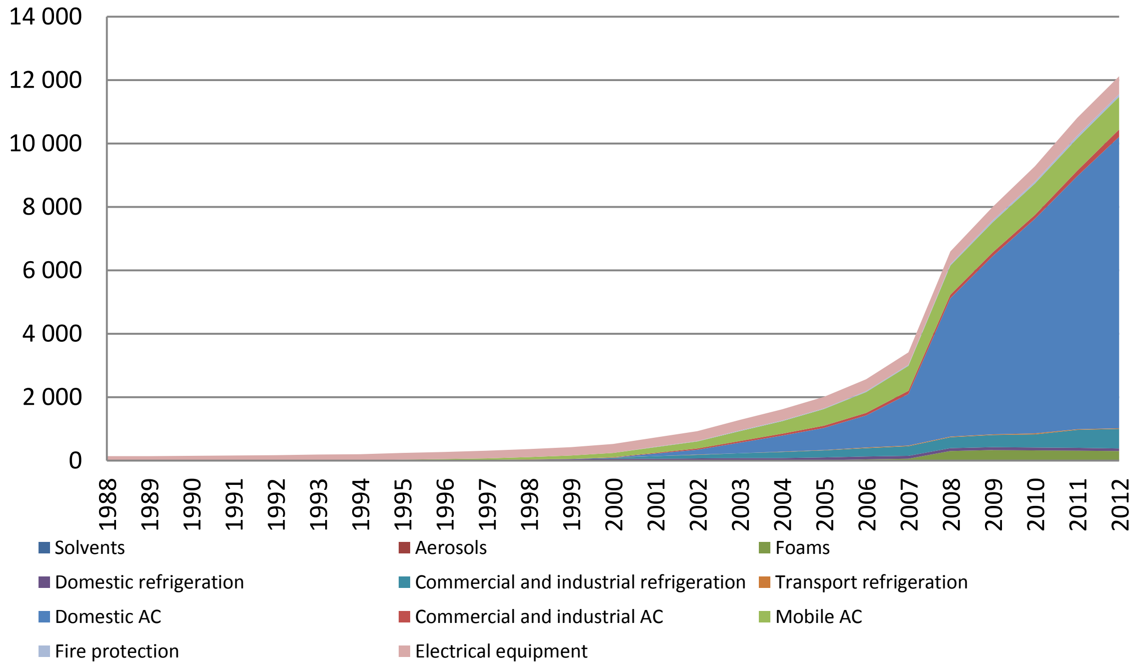


Figure 69 Potential emissions [Gg CO_2-eq.]

4.5.1 REFRIGERATION AND AIR CONDITIONING

4.5.1.1 Source Category Description

Depending on the purpose and specifics of the country, the refrigeration and air conditioning equipment can be divided into six major subcategories listed below. It should be noted that according to a recent study (Lambrev, 2010), subsector Refrigeration and Air Conditioning employs over 1000 certified technicians and over 70 licensed service companies in the country.

4.5.1.1.1 Domestic refrigeration (2.IIA.F.1.1)

There is no production of domestic refrigeration using HFCs in Bulgaria. The producers have switched from CFCs, HFCs, HCFCs and ammonia to other alternatives as i-butane, for example. Therefore, the calculations on this subsector are based on data for imports. The following table represents the activity date for the subsector:

Table 130 Activity data for Domestic refrigeration – HFC-134a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	558	558	NO	NO	NO	NO
1992	1344	1900	NO	NO	2	NO

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1993	2203	4100	NO	NO	6	NO
1994	2552	6645	NO	NO	12	NO
1995	4000	10635	NO	NO	20	NO
1996	4463	15082	NO	NO	32	NO
1997	5503	20562	NO	NO	45	NO
1998	9341	29872	NO	NO	62	NO
1999	11111	40939	NO	NO	90	NO
2000	6010	46887	NO	NO	123	NO
2001	5460	52277	NO	NO	141	NO
2002	5035	57233	NO	NO	157	NO
2003	5027	62174	NO	NO	172	NO
2004	3969	66050	NO	NO	187	NO
2005	2280	68231	NO	NO	198	NO
2006	2458	70041	NO	NO	205	545
2007	2614	71237	NO	NO	210	1314
2008	2061	71037	NO	NO	214	2154
2009	1071	69507	NO	NO	213	2495
2010	1019	66511	NO	NO	209	3911
2011	998	63045	NO	NO	200	4364
2012	1001	58572	NO	NO	189	5380

4.5.1.1.2 Commercial and industrial refrigeration (2.IIA.F.1.2 and 2.IIA.F.1.4)

In this subsector emissions from the production of refrigerators, emissions from refrigeration of goods in a supermarket for example, as in other retail outlets are included. The task to determine emissions from this sector is complex because it is more heterogeneous in terms of equipment characteristics: design, size, type of refrigerant, the amount of losses and more. In addition to supermarkets, there is also a wide range of equipment for other types of applications - slaughterhouses, gastronomy, agriculture and others. In contrast to household refrigeration equipment or automotive air conditioning systems, systems that are manufactured in batch production are in smaller quantities than those produced on demand.

Today the most commonly used blend of HFC is R-404A, which becomes even more important than HFC-134a. R-407C also plays an important role. Currently, there are still banked amounts of HCFC-22.

Since the available data does not permit a separate calculation of the banked quantities used in commercial and industrial refrigeration equipment and since the emission factors as recommended by the IPCC Guidelines, are in similar margins, it was decided the two subcategories - commercial and industrial refrigeration - to be grouped and evaluated together.

Even before the entry into force of the Montreal Protocol bans for the use of CFCs and HCFCs (which were subsequently implemented in the European and national legislation), industrial refrigeration equipment was the only sector using alternative cooling agents in significant quantities (mainly ammonia). However, after the ban on the CFC-12 use, imposed by the Montreal Protocol, the main substitute on the market became different types of HFCs. It is also difficult to determine the annual inflow of new refrigerant for this sector due to the its heterogeneity. The following tables represent the activity date for the subsector:

Table 131 Activity data for Commercial refrigeration – HFC-134a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	2181	2143	NO	38	NO	NO
2001	2181	4286	NO	38	214	NO
2002	2181	6428	NO	38	429	NO
2003	2181	8571	NO	38	643	NO
2004	2181	10714	NO	38	857	NO
2005	2181	12857	NO	38	1071	NO
2006	2181	14999	NO	38	1286	NO
2007	2181	17142	NO	38	1500	NO
2008	2181	19285	NO	38	1714	NO
2009	2181	21428	NO	38	1929	NO
2010	2181	23571	NO	38	2143	NO
2011	7057	30504	NO	124	2357	NO
2012	7953	38319	NO	139	3050	NO

Table 132 Activity data for Commercial refrigeration – HFC-32 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	446	438	NO	8	NO	NO
2001	446	876	NO	8	44	NO
2002	446	1315	NO	8	88	NO
2003	446	1753	NO	8	131	NO
2004	446	2191	NO	8	175	NO
2005	446	2629	NO	8	219	NO
2006	446	3067	NO	8	263	NO
2007	446	3505	NO	8	307	NO
2008	446	3944	NO	8	351	NO
2009	446	4382	NO	8	394	NO
2010	446	4820	NO	8	438	NO
2011	956	5759	NO	17	482	NO
2012	381	6134	NO	7	576	NO

Table 133 Activity data for Commercial refrigeration – HFC-125 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	5395	5301	NO	94	NO	NO
2001	5395	10601	NO	94	530	NO
2002	5395	15902	NO	94	1060	NO
2003	5395	21203	NO	94	1590	NO

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2004	5395	26503	NO	94	2120	NO
2005	5395	31804	NO	94	2650	NO
2006	5395	37104	NO	94	3180	NO
2007	5395	42405	NO	94	3710	NO
2008	5395	47706	NO	94	4241	NO
2009	5395	53006	NO	94	4771	NO
2010	5395	58307	NO	94	5301	NO
2011	23249	81149	NO	407	5831	NO
2012	5792	86840	NO	101	8115	NO

Table 134 Activity data for Commercial refrigeration – HFC-143a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	5346	5252	NO	94	NO	NO
2001	5346	10504	NO	94	525	NO
2002	5346	15756	NO	94	1050	NO
2003	5346	21008	NO	94	1576	NO
2004	5346	26260	NO	94	2101	NO
2005	5346	31512	NO	94	2626	NO
2006	5346	36764	NO	94	3151	NO
2007	5346	42016	NO	94	3676	NO
2008	5346	47268	NO	94	4202	NO
2009	5346	52520	NO	94	4727	NO
2010	5346	57772	NO	94	5252	NO
2011	21804	79194	NO	382	5777	NO
2012	4681	83794	NO	82	7919	NO

Table 135 Activity data for Commercial refrigeration – HFC-152a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2009	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO
2011	2,1	2,1	NO	0,04	NO	NO
2012	31,3	32,9	NO	0,55	0,21	NO

Table 136 Activity data for Commercial refrigeration – HFC-23 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2009	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO
2011	0,028	0,028	NO	0,0005	NO	NO
2012	NO	0,008	NO	NO	0,003	0,017

4.5.1.1.3 Transport refrigeration (2.IIA.F.1.3)

Since the reporting of refrigeration vehicles is not obligated by the legislation, as it is for stationary equipment above 3 kg, there are not many companies, which have submited any data in their annual reports to the RIEW. It is observed that the reports are missing data for years before 2007, and the available for 2007-2012 is scarce, probably inaccurate and it is registered only on the territories of the inspectorates in Sofia, Plovdiv and Burgas.

Therefore, it was attempted to contact and obtain information directly from some large transport companies, including ones operating outside Bulgaria. Attempt was unsuccessful. As it was not possible to compel the operators to report the data, but apparently, there is data lack in the annual reports of RIEW, estimates are made using one of the largest websites for vehicle resales in Bulgaria. According to statistic extract from the website database, the average number of refrigerated vehicles is taken and after they are classified based on expert judgement and foreign studies' verification and experience (F-gases, Germany, 2005). The following tables represent the activity date for the subsector:

Table 137 Activity data for Transport refrigeration – HFC-134a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	27	27	NO	NO	NO	NO
1996	73	101	NO	NO	5	NO
1997	95	196	NO	NO	20	NO
1998	121	317	NO	NO	39	NO
1999	162	479	NO	NO	63	NO
2000	330	810	NO	NO	96	NO
2001	467	1276	NO	NO	162	NO
2002	621	1897	NO	NO	255	NO
2003	918	2815	NO	NO	379	NO
2004	1056	3844	NO	NO	563	27
2005	2739	6509	NO	NO	769	73
2006	1542	7940	NO	NO	1302	95
2007	1419	9225	NO	NO	1588	121
2008	1484	10537	NO	NO	1845	162
2009	398	10574	NO	NO	2107	330
2010	372	10454	NO	NO	2115	467
2011	550	10363	NO	NO	2091	621
2012	606	10035	NO	NO	2073	918

Table 138 Activity data for Transport refrigeration – HFC-152a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO
2001	NO	NO	NO	NO	NO	NO
2002	14	14	NO	NO	NO	NO
2003	9	20	NO	NO	3	NO
2004	14	30	NO	NO	4	NO
2005	5	29	NO	NO	6	NO
2006	NO	24	NO	NO	6	NO

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2007	NO	19	NO	NO	5	NO
2008	NO	15	NO	NO	4	NO
2009	NO	12	NO	NO	3	NO
2010	NO	10	NO	NO	2	NO
2011	NO	8	NO	NO	2	NO
2012	NO	6	NO	NO	2	NO

Table 139 Activity data for Transport refrigeration – PFC-218 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO
2001	NO	NO	NO	NO	NO	NO
2002	NO	NO	NO	NO	NO	NO
2003	NO	NO	NO	NO	NO	NO
2004	NO	NO	NO	NO	NO	NO
2005	NO	NO	NO	NO	NO	NO
2006	NO	NO	NO	NO	NO	NO
2007	NO	NO	NO	NO	NO	NO
2008	11,7	11,7	NO	NO	NO	NO
2009	NO	9,4	NO	NO	2,3	NO
2010	NO	7,5	NO	NO	1,9	NO
2011	NO	6,0	NO	NO	1,5	NO

Table 140 Activity data for Transport refrigeration – HFC-125 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	1	1	NO	NO	NO	NO
1996	10	12	NO	NO	0	NO
1997	15	26	NO	NO	2	NO
1998	18	45	NO	NO	5	NO
1999	24	69	NO	NO	9	NO
2000	47	116	NO	NO	14	NO
2001	66	181	NO	NO	23	NO
2002	87	269	NO	NO	36	NO
2003	124	393	NO	NO	54	NO
2004	163	555	NO	NO	79	1
2005	250	795	NO	NO	111	10
2006	318	1098	NO	NO	159	15
2007	255	1335	NO	NO	220	18
2008	212	1523	NO	NO	267	24
2009	51	1527	NO	NO	305	47
2010	51	1512	NO	NO	305	66
2011	89	1514	NO	NO	302	87
2012	107	1496	NO	NO	303	124

Table 141 Activity data for Transport refrigeration – HFC-32 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	2,5	2,5	NO	NO	NO	NO
1999	2,5	5	NO	NO	0,5	NO
2000	5	10	NO	NO	1	NO
2001	9,5	19,5	NO	NO	2	NO
2002	12	31,5	NO	NO	3,9	NO
2003	14,5	46	NO	NO	6,3	NO
2004	21,5	67,5	NO	NO	9,2	NO
2005	35,5	103	NO	NO	13,5	NO
2006	42,5	145,5	NO	NO	20,6	NO
2007	31,5	174,5	NO	NO	29,1	2,5
2008	26,5	198,5	NO	NO	34,9	2,5
2009	5	198,5	NO	NO	39,7	5

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2010	5	194	NO	NO	39,7	9,5
2011	10	192	NO	NO	38,8	12
2012	12,5	190	NO	NO	38,4	14,5

Table 142 Activity data for Transport refrigeration – HFC-143a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	2	2	NO	NO	NO	NO
1996	12	14	NO	NO	0,3	NO
1997	17	31	NO	NO	3	NO
1998	19	50	NO	NO	6	NO
1999	26	75	NO	NO	10	NO
2000	50	125	NO	NO	15	NO
2001	66	191	NO	NO	25	NO
2002	89	280	NO	NO	38	NO
2003	130	410	NO	NO	56	NO
2004	168	576	NO	NO	82	2
2005	254	818	NO	NO	115	12
2006	325	1126	NO	NO	164	17
2007	265	1372	NO	NO	225	19
2008	219	1565	NO	NO	274	26
2009	54	1570	NO	NO	313	50
2010	54	1557	NO	NO	314	66
2011	93	1562	NO	NO	311	89
2012	112	1544	NO	NO	312	130

4.5.1.1.4 Stationary air conditioning (2.IIA.F.1.5)

Stationary air conditioning is divided on domestic and commercial air conditioning systems, respectively divided into more than 20 kW and 20 kW of power. Commercial systems have capacity that is able to provide a comfortable temperature in the whole buildings (central air conditioning systems) or large rooms. In both types of systems, a wide range of HFC is used. Emissions may occur during installation, charging and disposal. Emissions from domestic and commercial air conditioning systems are calculated separately. The following four tables represent the activity date for the subsector, divided by HFC types:

Table 143 Activity data for Stationary air conditioning – HFC-32 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	8595	8583	NO	11,9	NO	NO
2001	12842	21228	NO	11,9	303	NO
2002	20183	40927	NO	11,9	710	NO
2003	44100	84080	NO	11,9	1297	NO
2004	44309	126393	NO	11,9	2476	NO
2005	49378	172748	NO	11,9	3647	NO
2006	81481	250075	NO	11,9	4931	NO
2007	153571	397589	NO	11,9	7004	NO
2008	662485	1050359	NO	11,9	10854	NO
2009	325106	1349459	NO	11,9	27381	NO
2010	309754	1625760	NO	11,9	35268	NO
2011	337325	1922679	NO	87,7	42674	NO
2012	343966	2219054	NO	65,6	51239	NO

Table 144 Activity data for Stationary air conditioning – HFC-125 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	9697	9676	NO	21,4	NO	NO
2001	14032	23497	NO	21,4	401	NO
2002	21523	44517	NO	21,4	908	NO
2003	45927	89469	NO	21,4	1599	NO
2004	46141	133564	NO	21,4	2894	NO

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2005	51314	181783	NO	21,4	4180	NO
2006	84071	261606	NO	21,4	5583	NO
2007	157633	413049	NO	21,4	7790	NO
2008	676933	1080059	NO	21,4	11810	NO
2009	332668	1386182	NO	21,4	28766	NO
2010	317003	1669040	NO	21,4	36906	NO
2011	342216	1970045	NO	69,6	44555	NO
2012	353404	2274862	NO	91,1	53097	NO

Table 145 Activity data for Stationary air conditioning – HFC-143a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	556	550	NO	5,6	NO	NO
2001	556	1101	NO	5,6	55	NO
2002	556	1651	NO	5,6	110	NO
2003	556	2202	NO	5,6	165	NO
2004	556	2752	NO	5,6	220	NO
2005	556	3303	NO	5,6	275	NO
2006	556	3853	NO	5,6	330	NO
2007	556	4403	NO	5,6	385	NO
2008	556	4954	NO	5,6	440	NO
2009	556	5504	NO	5,6	495	NO
2010	556	6055	NO	5,6	550	NO
2011	556	6605	NO	5,6	605	NO
2012	2766	9343	NO	27,7	661	NO

Table 146 Activity data for Stationary air conditioning – HFC-134a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	6171	6149	NO	22	NO	NO
2001	8649	14453	NO	25	320	NO
2002	12769	26500	NO	27	694	NO
2003	25684	50992	NO	29	1162	NO
2004	26019	75039	NO	31	1941	NO
2005	28933	101229	NO	34	2709	NO
2006	46191	143854	NO	36	3530	NO
2007	84668	223721	NO	38	4762	NO
2008	354928	571683	NO	40	6926	NO
2009	176135	731984	NO	43	15791	NO
2010	168213	880187	NO	45	19965	NO
2011	182771	1039036	NO	84	23837	NO
2012	182771	1039036	NO	84	23837	NO

4.5.1.1.5 Mobile air conditioning (2.IIA.F.1.6)

Emissions from mobile air conditioners are summarized in the IPCC manual under the chapter "3.7.5. Mobile air-conditioning sub-source category". There are no special comments, guidelines and methodologies for the separation of air conditioners into different subcategories. However, in this report, mobile air conditioners are divided into three subcategories - for cars, trucks, buses and railway carriages - as each of them has its own specifics that need to be addressed. Production of air conditioners for railway carriages started in 2011. The following table represents the activity date for the subsector:

Table 147 Activity data for Mobile air conditioning – HFC-134a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	15800	13983	NO	NO	1817	NO
1996	14677	25577	NO	NO	3191	NO
1997	19400	40464	NO	NO	4845	NO
1998	25672	59911	NO	NO	6964	NO
1999	30907	82429	NO	NO	9774	NO
2000	33462	105212	NO	NO	12754	NO
2001	45549	137161	NO	NO	16398	NO
2002	51195	171229	NO	NO	20906	NO
2003	97285	244493	NO	NO	28694	NO
2004	93832	308095	NO	NO	36048	NO
2005	131543	401043	NO	NO	45763	NO
2006	149886	501469	NO	NO	58640	NO
2007	161172	604722	NO	NO	68266	NO
2008	166842	704672	NO	NO	79483	NO
2009	99097	731780	NO	NO	86585	NO
2010	100748	757323	NO	NO	89182	449
2011	128497	788570	NO	64,7	91829	960
2012	100631	794354	NO	52,7	91534	1788

Table 148 Activity data for Mobile air conditioning – HFC-125 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2009	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO
2011	C	NO	NO	3,3	NO	NO
2012	C	NO	NO	3,8	NO	NO

Table 149 Activity data for Mobile air conditioning – HFC-32 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2009	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO
2011	C	NO	NO	3,0	NO	NO
2012	C	NO	NO	3,5	NO	NO

Table 150 Activity data for Mobile air conditioning – PFC-218 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2007	NO	NO	NO	NO	NO	NO
2008	NO	NO	NO	NO	NO	NO
2009	29,7	29,7	NO	NO	NO	NO
2010	12,897	38,1	NO	NO	4,5	NO
2011	1,35	33,8	NO	NO	5,7	NO
2012	NO	28,7	NO	NO	5,1	NO

4.5.1.2 Methodological Issues

4.5.1.2.1 Domestic refrigeration (2.IIA.F.1.1)

A default emission factor of 0.3% per year and average amount of refrigerant in a number of equipment - 0,1 kg was used (IPCC, 2006). The results, obtained according Tier 2a show an annual emission of 7,24 Gg CO_2-eq. for 2012 and potential emissions of 76.14 Gg CO_2-eq. for the observed period (1988-2012). In this subsector, emissions from disposal are estimated with lifetime of the equipment set to 15 years (which falls within the boundaries set by IPCC Guidelines, 1996 and 2006).

4.5.1.2.2 Commercial and industrial refrigeration (2.IIA.F.1.2 and 2.IIA.F.1.4)

Emission factor of 1.75% was used for the first year and 10% emission factor for emissions from operation (IPCC, 2006). Emissions from disposal of equipment are accounted only if this is explicitly written in the reports of any of the 16 RIEWs, from which the data is taken. The calculations are based on Tier 2a method.

4.5.1.2.3 Transport refrigeration (2.IIA.F.1.3)

The only data that was obtained is used for the amount of refrigerant in the railways from 1998 to 2012. Therefore, their emissions are calculated, even the small amounts of HFC used. Railway carriages were filled with R-12 which is being gradually replaced by HFC-134a, R-401A and R-413A. Tier 2a method, default emission factor for emissions from operation of 20% were used, which fully coincide with the given limits of the Guidelines (IPCC, 2006). This equipment has not been used since 2008 and is kept on storage, but not decommissioned i.e. the equipment is not removed and the cooling agent is not drawn and therefore is being reported.

Concerning the use of refrigeration equipment and cooling agents respectively within the motoring transport, the data concerning the import of heavy and light trucks for the period observed is extracted from statistical databases (NSI, 2012), as well as online database of the one of the biggest websites for vehicle resells in Bulgaria. The statistical processing of the data lets to the calculation of the share of heavy and light trucks imported related to the number of those, equipped with refrigeration system. This share after related to the number of the vehicles imported in the country based on data from NSI, gives us the number of vehicles with refrigeration equipment, divided by categories.

A default EF of 20% (average for Europe) for operation emissions is used, which falls within the boundaries set by the Guidelines (IPCC, 2006). There is no production of mobile refrigeration equipment in the country.It is assumed that 5% in 1995 of the refrigerated trucks used HFCs, reaching 75% in 2010 (IPCC, Working group III). Here, as well as in other categories because of lack of enough stable data for the country, the data concerning the average quantity and type of agent within the different categories of equipment is taken from different European studies (F-gases Germany, 2005). The emissions from disposal are calculated based on lifetime of 9 years.

4.5.1.2.4 Stationary air conditioning (2.IIA.F.1.5)

Data about domestic AC was received from NSI. The most commonly used refrigerants are R-407C and R-410A (in ratio of approximately 2:3). The calculation of emissions from domestic systems was made after the following assumptions: default EF of 2,5% (IPCC, 2006) was used and the average quantity of agent is 2,92 kg per unit equipment (F-gases Germany, 2005). Emission lifetime is set to 15 years. The results are calculated based on Tier 2a.

Data on F-gas quantities used in the commercial air conditioning equipment were obtained from RIEW reports that importers, operators and service companies are required to report each year. Emission factor of 1.0% was used for the first year and 10% emission factor for emissions from operation (IPCC, 2006). Emissions from disposal of equipment are accounted only if this is explicitly written in the reports of any of the 16 RIEWs, from which the data is taken. The results are based on Tier 2a.

4.5.1.2.5 Mobile air conditioning (2.IIA.F.1.6)

The Guidelines does not take into account the quantities of refrigerant over 1.5 kg and therefore offers no default emission factors for such systems. Only quantities over 1.5 kg for bus air-conditioners are used for the calculations.

Due to the specifics of the Bulgarian car market, a detailed model for the emissions calculation from Car AC subsector had to be created. As regards the fact that in Bulgaria there is no production of cars, trucks or buses, data about import from NSI was used (data from the Association of Automobile manufacturers and their authorized representatives in Bulgaria, which have data from 1991 to today is used for verification),. For the proper assessment of the Bulgarian fleet, a detailed statistics of the largest website in the country for trade of new and used cars, including the year of manufacture of the vehicle, the presence of air-conditioning system and year of import in Bulgaria was obtained. The results obtained are based on Tier 2a method.

For the selection of appropriate EF, a number of foreign researches have been reviewed. The most detailed information was found in a British study (AEAT, 2003), in which values are set for an average amount of agent 1,2 kg in 1993, declining to 0,8 kg in 2000. Expectations of this study is the amount to decrease up to 0,6 kg in 2010 on the annual level of losses (which include losses from normal use and losses in accidents), the data show that losses in 1995 is amounted to 15%, reducing to 10% in 2000 and projections are for about 6% in 2010. Disposal emissions are not calculated as average lifetime for the country is very high (over 20 years). Overall emissions are overestimated due to the fact that it is assumed that after the refrigerant has been leaked, it has been recharged in 100% of the cases.

According to various international studies (F-gases Germany, 2005; AEAT, 2003), the average quantity of refrigerant in air conditioning systems in the cabins of trucks varies around 1,00-1,20 kg. Similar studies are an appropriate source of information for this report, since Bulgaria does not produce trucks, as well as studies in this field.

According to the classification of NSI (NSI, 2011) whose data were used, mainly trucks are divided by weight - less than 5 t, 5-20 t and over 20 t. In the lowest grade trend over the years is the amount of refrigerant to decrease from 1 to 0,85 kg, while in the other two classes, it remains constant - 1,20 kg. However, for the purposes of this project, a constant quantity of 1 kg for the lower class was chosen, because of lack of accurate data on truck fleet in Bulgaria and the assumption that the car park is older than the average age for Western Europe. The amount of coolant in the three classes vary in small range, since it considers that the magnitude of the cabin and the corresponding volume to be cooled remain almost identical regardless of the increasing weight of the vehicle.

The refrigerant used is mainly HFC-134a. It enters mass market after 1993-1995, as a substitute of CFC-12. At the end of 1993 in Germany, half of all new trucks used cooling agent based on HFCs. Admittedly, in Bulgaria this share was lower. Studies show that from 1994 to 2002, the percentage of trucks with air conditioners has increased from 5 to 32% and this share continues to grow today, especially for heavy trucks (Schwarz, 2007a).

Operating losses of coolant here are much higher than in vehicle AC for number of reasons such as long time driving, larger loads, the greater length of piping and more. No evidence of studies on the loss of agent in trucks over 1,5 t was observed. Additional 5% on 10% emissions during operation are considered acceptable because of the possibility of higher losses in trucks compared to cars and light trucks. The results obtained are based on Tier 2a.

It is assumed that all coaches manufactured after 1999 are equipped with air-conditioning system, and since 1995 their percentage is growing slowly from 20% (AEAT, 2003). As with other mobile air conditioning systems, here the most used cooling agent is HFC-134a. Its average quantity contained in one air conditioner is assumed to be 12 kg. The length of piping may exceed 30 m in order to reach the cooled air to all passengers. Due to this great length, emissions from leakage are increased. Emissions of refrigerant in use are accepted as 15% annually. Here, as in trucks, to 10% emission factor adopted for passenger cars a further 5% were added due to longer pipelines and more frequent bus exploitation. Equipment lifetime is assumed to be 15 years. Emissions from disposal are also included. Calculations were conducted according to Tier 2a methodology.

Since this year the data from the railways is divided to refirgaration and air conditioning(before that all were reported as refrigeration). The quantities of imported carriages for passenger transport are included in this category. To calculate the emissions from this sub-category an EF of 15% is used. Production of air conditioners for railway carriages started in 2011 and all of it is exported. The data is acquired from the manufacturer's report, where it is said also that the used cooling agents are HFC-134a and R-407C. An EF of 0.35% is used for emission estimation.

4.5.1.3 Uncertainties and time-series consistency

4.5.1.3.1 Domestic refrigeration (2.IIA.F.1.1)

The share of domestic refrigeration equipment using HFCs in Bulgaria has been allocated approximately from 0% in 1990 to a maximum of 90% in 1998. A drop follows to 40% in 2002 and 5% in 2005. These numbers show the change of Bulgarian producers and importers to use a hydrocarbon refrigerant, replacing HFCs. It is believed that the level of equipment containing HFCs after 2005 remains within 5%. According to a relevant British study (AEAT, 2003) the only agent to be used in this sector is HFC-134a, which has GWP of 1300. Data about the calculation of emission was extracted from the import of refrigeration and air conditioning of the NSI from 2000 to 2010. Data for the years 1988-1999 was extrapolated as a function of data about the total amount of imports of goods and services in Bulgaria (NSI, 2011). An uncertainty in the rage of 20-100% is applied.

4.5.1.3.2 Commercial and industrial refrigeration (2.IIA.F.1.2 and 2.IIA.F.1.4)

Since the beginning of 2009 in Bulgaria a new legal instrument (Ordinance establishing measures for the implementation of Regulation (EC) № 842/2006 on certain fluorinated greenhouse gases, called The Ordinance for short) is in effect, that fulfils the Regulation (EC) № 842/2006 requirements. According to the Ordinance, operators of equipment containing more than 3 kg refrigerant must report annually their relevant quantities to RIEWs, which then send a summary report of all reported to MOEW. Prior to 2008, the reports have been prepared under the legislation for the control and management of ODS. In order to assess emissions from this sector, reports from all 16 RIEW in Bulgaria for the period 1996-2012 were analysed. After summarizing the information it was concluded that in the years before 2009 a significant number of companies were not aware of the new reporting obligations. Therefore, to make an accurate assessment of this sector data from 2010 was used and then linearly extrapolated back in time. Uncertainty is assumed to be around 50%.

4.5.1.3.3 Transport refrigeration (2.IIA.F.1.3)

It is a high uncertainty (80%) that emissions from this subsector are calculated based on many assumptions extracted from foreign studies and do not reflect in the best way the Bulgarian case.

4.5.1.3.4 Stationary air conditioning (2.IIA.F.1.5)

Data for actual numbers of AC units is available for the period 2000-2005. For the period after 2006 the NSI provides data only for the total money spent on AC equipment. To estimate the number of units after 2006, first the average price of an AC unit calculated for 2005 and the the total numbers for the next period were divided into in. The average price for 2005 was taken insted of average price for 2000-2005 because throught the period the price of a single AC unit drops with a stready trend. Admission was made that before 1999 the majority of equipment was using CFCs and therefore, the calculations do not include the years before 2000. After 2007, legislative modifications have forced the import of equipment with HFCs. Despite that 35% of the refrigerant used in this sector is assumed still to be a CFC (AEAT, 2003).

It is believed that the data concerning commercial AC and reported for the years before 2009 from RIEW reports are not reliable enough. Therefore, to calculate the emissions, data for 2012 were used by 1% emission factor for the first year and 10% in operating emission factor (IPCC, 2006) and then linearly extrapolated back to 1999. Uncertainty is assumed to be around 15%.

4.5.1.3.5 Mobile air conditioning (2.IIA.F.1.6)

Data on annual imports of new and second hand cars from NSI was received for the period 2000-2012. The data for the years between 1990 and 1999 were extrapolated from the data as a function of the total imports of goods and services in Bulgaria.

NSI data for imports of trucks provides information only on the years 2000-2012 and therefore it was necessary here on the basis of imports of goods and services (World Bank, 2011) to extrapolate the input data back to 1988.

Data on the number of buses imported into the country were taken from NSI, but only for the years 2000 to 2012. For the years before 2000, data were based on extrapolation of the imports of goods and services for the period 1988-1999 (World Bank, 2011).

The subsector is assumed to have approx. 80% uncertainty.

4.5.1.4 Source-Specific QA/QA and Verification

In general, the whole Refrigeration and air conditioning subsector (CRF 2.F.1) is verified by an external expert from the MOEW. The expert was introduced with all activity data collection and assumptions, methodological issues and calculation approaches. After a discussion, some measures and improvements, concerning assumptions of the overall subsector were decided to be implemented.

4.5.1.5 Source-Specific recalculations

4.5.1.5.1 Domestic refrigeration (2.IIA.F.1.1)

The calculations methodology has been improved i.e. the losses from diffuse emissions during equipment disposal are also reported.

4.5.1.5.2 Commercial and industrial refrigeration (2.IIA.F.1.2 and 2.IIA.F.1.4)

A technical error was found in the 2011 data and the methodology for the calculation of the AD for the time series has been improved.

4.5.1.5.3 Transport refrigeration (2.IIA.F.1.3)

The methodology for emissions estimations has been improved i.e. the amount of transport refrigeration equipment, the emissions from manufacturing are no longer calculated since there is no production of such equipment in the country etc. The data from the railways is divided in two sub-categories according the reports – Transport refrigeration and Mobile air conditioning

4.5.1.5.4 Stationary air conditioning (2.IIA.F.1.5)

The calculations methodology has been improved similar to the on used for transport refrigeration – no it is divided into Domestic refrigeration and Commercial and industrial refrigeration.

4.5.1.5.5 Mobile air conditioning (2.IIA.F.1.6)

The methodology has been improved similar to the on for Transport refrigeration and the data from the railways and from the manufacturing of air conditioning equipment for railways are added up

4.5.1.6 Source-Specific planned improvements

If new information is available for changes and trends in the category, improvements will be made in the relevant field including AD, EF etc.

4.5.2 FOAM BLOWING(CRF 2.F.2)

4.5.2.1 Source category description

Only two types of HFCs are used in the manufacture of extruded polystyrene insulation foams (XPS), solid polyurethane foams and one component foams (OCF). In Bulgaria, there are several larger companies in the production of foams. The largest of them, using as a blowing agent HFCs, imports raw materials from abroad. Others are using CO_2 and/or water as a substitute for HCFCs.

A large manufacturers of XPS, using HFCs is on the Bulgarian market since 2005. Quantity of imported and used HFCs is reported annually. These quantities (reported to RIEW/MoEW) are used to calculate emissions in this category, by assuming the entire quantity of produced foams stays in the country (although more than 50% is exported). There is no data available for the quantities of foams containing HFCs that were imported in the country.

4.5.2.2 Methodological issues

The data about quantities of HFCs were obtained from questionnaires and annual reports of RIEWs. Market research in Bulgaria showed that only HFC-134a and HFC-152a are used, where foam blowing is carried out with HFCs. For the purposes of the calculations, default emission factors were used as follows - for HFC-134a 25% loss in the first year and 0.75% annual loss, for HFC-152a - 50% EF for the first year and 25% per annum thereafter (IPCC, 2006). Global warming potential of the two gases are respectively 1300 and 140 for HFC-134a and HFC-152a. The results, calculated based on Tier 2a, represent 26,42 Gg CO_2-eq. actual emissions in 2012 and 304,77 Gg CO_2-eq. potential emissions.

Activity data for Foam blowing – HFC-152a, HFC-134a could not be reported, because there is only one producer and data is confidential.

4.5.2.3 Uncertainties and time-series consistency

It is assumed that import and export balance each other, but could also be 40/60 or 60/40 (20% uncertainty).

4.5.2.4 Source-Specific QA/QA and Verification

No source-specific QA/QC and verification is obtained.

4.5.2.5 Source-Specific recalculations

There are no source specific recalculations for this category.

4.5.2.6 Source-Specific planned improvements

There are no planned improvements in this category.

4.5.3 FIRE EXTINGIUSHERS(CRF 2.F.3)

4.5.3.1 Source category description

According to experts from the industry, who have been asked, fire protections activities with the use of HFC in Bulgaria are implemented in very rare cases - mainly in fire protection systems installed in the server and computer rooms. At the same time in Bulgaria filling of fire fighting equipment is not practiced. It is all imported, as there are no Bulgarian manufacturers of fire protection equipment, using HFC. The following two tables represent the activity date for the subsector:

Table 151 Activity data for Fire extinguishers – HFC-125 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO
2001	148,4	148,4	NO	NO	7,4	NO
2002	36,6	185,0	NO	NO	9,3	NO
2003	45,7	230,7	NO	NO	11,5	NO
2004	56,9	287,6	NO	NO	14,4	NO
2005	71,0	358,6	NO	NO	17,9	NO
2006	88,5	447,1	NO	NO	22,4	NO
2007	110,3	557,4	NO	NO	27,9	NO
2008	137,6	695,0	NO	NO	34,8	NO
2009	2712,0	3407,0	NO	NO	170,4	NO
2010	NO	3407,0	NO	NO	170,4	NO
2011	NO	3407,0	NO	NO	170,4	NO
2012	NO	3407,0	NO	NO	170,4	NO

Table 152 Activity data for Fire extinguishers – HFC-227a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO
2001	3065	3065	NO	NO	153	NO
2002	756	3821	NO	NO	191	NO
2003	943	4764	NO	NO	238	NO
2004	1176	5940	NO	NO	297	NO

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
2005	1466	7406	NO	NO	370	NO
2006	1827	9233	NO	NO	462	NO
2007	2278	11511	NO	NO	576	NO
2008	2841	14352	NO	NO	718	NO
2009	3162	17514	NO	NO	876	NO
2010	NO	17514	NO	NO	876	NO
2011	8448	25962	NO	NO	1298	NO
2012	114	26076	NO	NO	1304	NO

4.5.3.2 Methodological Issues

Data about banked HFC quantities in firefighting equipment were used(mainly FM-200 and NAFS-125 type), according to which the mainly used HFC is HFC-227ea (80%) and to a lesser extent - HFC-125. This data is provided by "National Fire Safety and Protection of Population Service" in Ministry of Interior. Using default EF of 5% of the IPCC Guidelines, 1996, the results obtained based on Tier 2a show actual emissions of 4,26 Gg CO_2-eq. and 85,16 Gg CO_2-eq. potential emission for both gases in 2012.

4.5.3.3 Uncertainties and time-series consistency

Analysis of data obtained by the questionnaires from operators and importers determined that there is no use of F-gases in fire protection equipment before 2005, while reports of RIEW have reported small amounts of HFC-227ea imports since 2001. Therefore, it is assumed that the starting year of HFC usage in fire protection equipment is 2001. To calculate emissions for the years before 2008, an assumption for linear growth of about 25% in fire fighting equipment was made. Uncertainty is considered to be in range of 60-100% of the original value.

4.5.3.4 Source-Specific QA/QA and Verification

No source-specific QA/QC and verification is obtained.

4.5.3.5 Source-Specific recalculations

Revision of data as companies, included in a list from National Fire Safety and Protection of Population Service" which have fire extinguishing installations were reviewed.

4.5.3.6 Source-Specific planned improvements

No source-specific planned improvements are to be performed.

4.5.4 AEROSOLS (CRF 2.F.4)

4.5.4.1 Source category description

The used HFCs as propellants currently are HFC-134a, HFC-227ea and HFC-152a. Data on their use as medical and technical aerosols were obtained directly from industry by telephone calls and questionnaires. After direct contact with experts from the industry, the researched showed that in Bulgaria there is only one producer, which uses HFC-134a in the production of aerosols. There are several companies working in this field, but they do not use any F-gases.

Concerning the import and usage of meter dose inhalers (MDIs) in the medicine, according to an official letter of the Executive Drug Agency in Bulgaria HFC-134a is the only F-gas used in MDIs. The Agency provided a full list of operators and importers of MDIs, containing HFC-134a. A profound research on those companies and contacting them helped in collecting data for the use of such equipment since 2005. Therefore, the results are based on real numbers, reported by the companies. The following table represents the activity date for the subsector:

Table 153 Activity data for Aerosols/Meter dose inhalers – HFC-134a [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	NO	NO	NO	NO	NO	NO
1989	NO	NO	NO	NO	NO	NO
1990	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	NO	NO	NO	NO	NO	NO
1998	1559	779	NO	779	NO	NO
1999	925	462	NO	462	779	NO
2000	134	67	NO	67	462	NO
2001	323	162	NO	162	67	NO
2002	816	408	NO	408	162	NO
2003	996	498	NO	498	408	NO
2004	1640	820	NO	820	498	NO
2005	1990	995	NO	995	820	NO
2006	8039	4020	NO	4020	995	NO
2007	5485	2743	NO	2743	4020	NO
2008	7984	3992	NO	3992	2743	NO
2009	7855	3928	NO	3928	3992	NO
2010	6953	3477	NO	3477	3928	NO
2011	7400	3700	NO	3700	3477	NO
2012	6674	3337	NO	3337	3700	NO

4.5.4.2 Methodological Issues

According to the 2006 IPCC Guidelines, aerosol emissions are considered to be immediate, occurring during the first year of production. Using data on quantities of HFC-134a consumed by the company for the period 1988-2011, the default EF of 50% for the first year and 100% for the next year (IPCC, 2006), emissions were calculated as 4,81

Gg CO_2-eq. potential emissions in 2011 and 9.33 Gg CO_2-eq. real emissions in 2011. The EFs selected are default because of the absence of specific empirical data on the territory of Bulgaria. Results are obtained according to Tier 2a method.

4.5.4.3 Uncertainties and time-series consistency

Uncertainty is assumed to be around 30% for the whole subsector.

4.5.4.4 Source-Specific QA/QA and Verification

Data is verified by MOEW expert.

4.5.4.5 Source-Specific recalculations

There are no source specific recalculations for this category.

4.5.4.6 Source-Specific planned improvements

No source-specific planned improvements are to be performed.

4.5.5 SOLVENTS (2.F.5)

Research showed that this activity is not applicable for Bulgaria and emissions are not ocurring.

4.5.6 OTHER APPLICATION USING ODS SUBSTITUTES (CRF SOURCE CATEGORY NUMBER)

Research showed that this activity is not applicable for Bulgaria and emissions are not ocurring.

4.5.7 SEMICONDUCTOR MANUFACTURING (CRF SOURCE CATEGORY NUMBER)

Research showed that this activity is not applicable for Bulgaria and emissions are not ocurring.

4.5.8 ELECTRICAL EQUIPMENT (CRF 2.F.6)

4.5.8.1 Source category description

In 2009, the ExEA has conducted a study concerning the determination of banked quantities of SF_6 in the country. This study was extended in the years after - detailed questionnaires to 30 companies were sent, including importers and operators of equipment. The purpose of the survey was to gather additional historical data, with the desire to apply a higher tier to calculate the emissions and in view of the fact that reported data for imports of SF_6 and equipment containing SF_6 is incomplete. The following table represents the activity date for the subsector:

Table 154 Activity data for Eclectrical Equipment – SF_6 [kg]

Activity Data	Filled in new manufactured products	In operating systems	Remained in products at decommissioning	Actual emissions from manufacturing	Actual emissions from stocks	Actual emissions from disposal
1988	471	5957	NO	33	112	NO
1989	499	6303	NO	35	118	NO
1990	528	6668	NO	37	125	NO
1991	558	7055	NO	39	133	NO
1992	591	7464	NO	41	140	NO
1993	625	7897	NO	43	148	NO
1994	661	8355	NO	46	157	NO
1995	699	8840	NO	49	166	NO
1996	740	9352	NO	51	176	NO
1997	783	9895	NO	54	186	NO
1998	828	10469	NO	58	197	NO
1999	876	11076	NO	61	208	NO
2000	927	11718	NO	64	220	NO
2001	981	12398	NO	68	233	NO
2002	1038	13117	NO	72	247	NO
2003	1098	13878	NO	76	261	NO
2004	1162	14683	NO	81	276	NO
2005	931	15255	NO	66	292	NO
2006	967	15850	NO	69	303	NO
2007	1005	16469	NO	71	315	NO
2008	1044	17111	NO	74	328	NO
2009	1085	17778	NO	77	340	NO
2010	3059	20290	NO	193	354	NO
2011	3695	23362	NO	222	400	NO
2012	555	23417	NO	46	454	NO

4.5.8.2 Methodological Issues

The data obtained were used to assess emission using Tier 2a and default EF, according to the IPCC Guidelines, 2006.

Due to the long life of equipment and lack of sufficient data from the questionnaires, it is not possible to calculate country-specific EF. Default EF given by the IPCC Guidelines for the equipment containing SF_6, are 0.002 (0.2%) (for Sealed-for-life Equipment) and 0.026 (2.6%) (for Closed Pressure Systems) (IPCC, 2006).

In the temporal scope of this study in Bulgaria there was no manufacturing of equipment containing SF_6, but just imported. Extremely small amounts were reported as installation emissions. No amounts of SF_6 were reported as used in servicing of equipment or quantities contained in retiring equipment.

Most of the companies who were sent questionnaires are power plants that use equipment containing from 1 to 30 kg of SF_6. Three electricity distribution companies operate on the Bulgarian market, holding a total of less than 4,000 kg SF_6 in their facilities. The most important company for the purposes of this study was "Electricity System Operator" PLC, having equipment with a total of around 12,000 kg SF_6. The total amount of banked quantities is about 17,000 kg. Companies have reported SF_6 in very small quantities used in new equipment during the entire period 1988-2009 (less than 500 kg), the reason for which is probably the longer life of equipment and lack of data on the early years of the study. Significant amount (about 2,500 kg, 20% of the total amount of banks) was reported as a quantity that is contained not in equipment, but in containers (bottles).

According to the IPCC Guidelines 2006, equipment is divided into two main types - with and without the possibility of topping up. Systems without the possibility of additional charging (Sealed-for-life Equipment) usually have a capacity of less than 5 kg per functional unit and they are used at a voltage below 52 kV. They do not require any maintenance during the period of operation; their respective emission factor is much lower. Systems capable of charge (Closed Pressure Systems) are used in more than 52 kV tension and may contain amounts of 5 to several hundred kg.

Since it is not possible to do a proper allocation between the equipment with or without possibility of charge, it was assumed that the equipment of the high-voltage grid owned by "Electricity System Operator" PLC is closed pressured (about 97% of equipment is with a capacity of over 5 kg and is part of 110, 220 or 400 kV grid). It was assumed that 25% of the quantities of equipment could be initially charged, according to data from the questionnaires about the newly installed equipment, and the quantities used for initial charging,

The data collected made it possible to calculate the SF_6 emissions for period observed. Actual emissions amount of 11,96 Gg CO_2-eq. and potential emissions of 559,76 Gg CO_2-eq. were calculated.

4.5.8.3 Uncertainties and time-series consistency

Although the study was designed to cover the years from 1988 to 2010, almost no company that can report on data from the years before 2003, but most of them reported only data from the last 2-3 years. Therefore, the calculations for previous years were made by extrapolation of the reported amounts for 2009 under the assumption for annual growth rate of newly installed equipment by 5.8% for the period 1995-2003 and 3.9% for the period 2004-2010 (Ecofys, 2005).

Activity data in last years is assumed to be uncertain by +/-10%, in 1988 much less information is available (+/-50%). Furthermore, based on the default EF used, also default uncertainty of the EF (+/-30%) is applied.

4.5.8.4 Source-Specific QA/QA and Verification

No source-specific QA/QC and verification is performed.

4.5.8.5 Source-Specific recalculations

Methodology is not changed for this sector, however due to revised activity data, results increase compared to the previous year.

4.5.8.6 Source-Specific planned improvements

No source-specific planned improvements are to be performed.

4.5.9 REFERENCES

AEAT, 2003. Emissions and Projections of HFCs, PFCs and SF_6 for the UK and Constituent Countries, Haydock H., Adams M., Bates J., Passant N., Pye S., Salway G., Smith A. Publisher: AEA Technology

Eurostat, 2011. online database, available at: http://epp.eurostat.ec.europa.eu/

F-gases, Germany, 2005. Emissions, Activity Data, and Emission Factors of Fluorinated Greenhouse Gases (F-Gases) in Germany 1995-2002, Schwarz W., Publisher: Federal Environmental Agency (Umweltbundesamt), Berlin

ICF, 2008. Analysis on the Recovery of Fluorinated Greenhouse Gases in EU-27 in the Period 2004-2007 and Determination of Options for Further Progress. Prepared by ICF International, 2008.

ICF, 2010. Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment. Prepared by ICF International, 2010

IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

IPCC Third Assessment Report - Climate Change 2001 - online versions, available at: http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/248.htm

J.P. van der Sluijs et al., 2004. RIVM/MNP Guidance for Uncertainty Assessment and Communication: Tool Catalogue for Uncertainty Assessment, Copernicus Institute & RIVM, 2004

Kyoto Protocol to the United Nations Framework Convention on Climate Change, United Nations, 1998. Online version, available at: http://unfccc.int/resource/docs/convkp/kpeng.pdf

NIR, Austria, 2010. Austria's National Inventory Report 2010, Pazdernik K. et al., Publisher : Umweltbundesamp GmbH, Vienna

National Survey and Development of a National Strategy Outline of HCFC Phase-out for Consumption Sectors in Republic of Bulgaria. Lambrev Y., Fikiin K., Sofia, 2010.

Reductions of SF_6 Emissions from High and Medium Voltage Electrical Equipment in Europe, Ecofys, 2005

Schwarz W., 2007a. Establishment of Leakage Rates of Mobile Air Conditioners in Heavy Duty Vehicles, Part 1: Trucks, prepared for the European Commission

Schwarz W., 2007b. Establishment of Leakage Rates of Mobile Air Conditioners in Heavy Duty Vehicles, Part 2: Buses and Coaches, prepared for the European Commission

Bulgarian inventory of the additional greenhouse gases (HFC, PFC and SF_6), included in the Kyoto Protocol for 1995

Regulation establishing measures for the implementation of Regulation (EC) № 842/2006 on certain fluorinated greenhouse gases

NSI, 2011. National Statistical Institute, Bulgaria, online database: http://www.nsi.bg/index.php; http://ftrade.nsi.bg/portal/page?_pageid=34, 34826 & _dad = portal & _schema = PORTAL

World Bank, 2011. Online database of the World Bank: http://databank.worldbank.org/ddp/home.do

Regulation (EC) № 842/2006 of the European Parliament and the Council of 17 May 2006 on certain fluorinated greenhouse gases

Strategy for phase-out of hydrochlorofluorocarbons in Bulgaria, MEW, Danish Agency for Environmental Protection, 2003

5 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

5.1 OVERVIEW OF SECTOR

This chapter describes the methodology used for calculating greenhouse gas emissions from solvent use in Bulgaria. Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber and plastic. They are used also in production of chemicals, in printing industry or for cleaning purposes (degreasing of metals and dry cleaning). Most of the solvents are released into air after application of these substances or other processing. Solvents consist mainly of NMVOC, it is the cause their use is a major source for anthropogenic NMVOC emissions. Once released into the atmosphere NMVOCs react with air molecules (mainly HO-radicals) or high energetic light and generated emission of CO_2.

N_2O emissions are caused by medical uses of N_2O (for anaesthesia) and other possible sources emissions (aerosol cans).

CO_2 emissions from CRF sector 3D5.1, 3D5.2 and 3D5.3 are estimated, based on conversion factor, provided by 2006 IPCC Guidelines.
Calculation of N_2O emission from CRF sector 3 D.1 are based on emission factor in accordance with 2006 IPCC Guidelines.

5.1.1 EMISSION TRENDS

Greenhouse gas emissions in this sector decrease by 95.44 % between 1988 and 2012. The decrease of solvent emissions is due to the positive impact of the enforced regulations in Bulgaria:

Regulation №7/2003 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations, which replaced a Council Directive 1999/13/EC into national legislation.
Regulation on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products from 23/02/2007, which replace the Council Directive 2004/42/CE of the European Parliament and of the Council of 21 April 2004.

5.1.1.1 Trend for NMVOC and CO_2 emissions from solvent and other product use (CRF SECTOR 3A, 3B, 3C AND 3D5)

Emissions in CRF Sector 3 have been calculated for the period 1988 - 2012. The emission factors are in accordance with the EMEP/EEA air pollutant emission inventory guidebook –2009[28]. The activity data are provided mainly by the National Statistics Institute – NSI.

[28] In the following referred as EMEP/EEA Guidebook (2009)

The trend of NMVOC and CO_2 emissions is presented in Figure 70 and Table 155 and also in Table 156.

The drop from 1993 to 1995 is mainly due to economic crisis. The production of many plants in Bulgaria is decreased in the same period; thus the metal degreasing activities decreased.

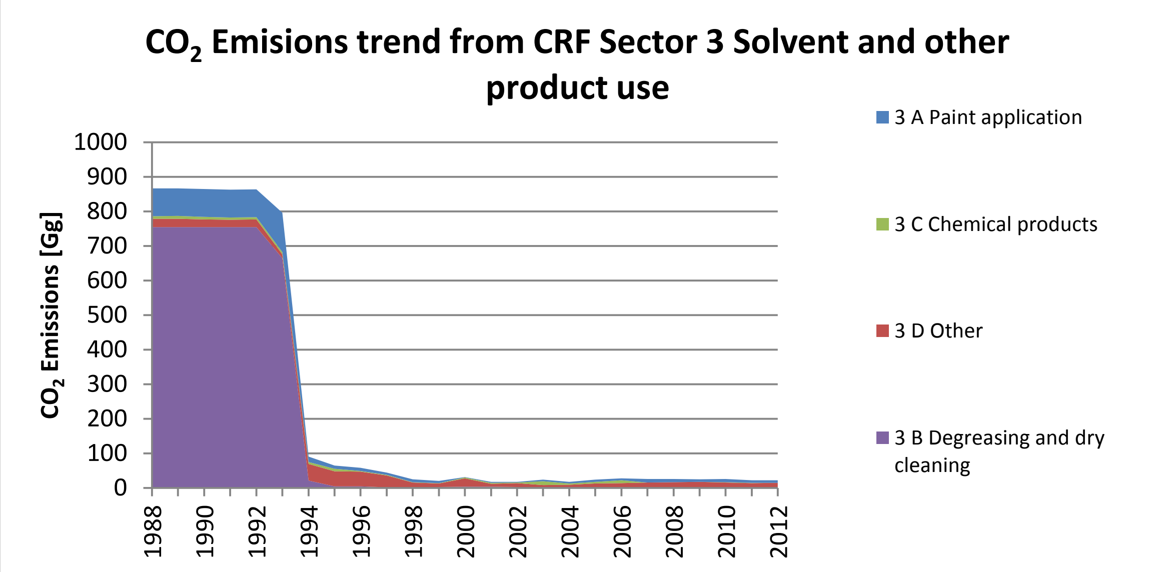


Figure 70 Trend of CO_2 emissions from CRF sector 3 Solvent and other product use

Table 155 Trend of NMVOC emissions from Solvent and other product use, Gg

	3 A	3 B	3 C	3 D			
Sub-categories	Paint Application	Degreasing and Dry Cleaning	Chemical Products, Manufacturing and Processing	Pharmacy	Use of lacquers and solvents	Vegetable Oil Production	Total
1988	36.517	342.76	3.652	0.126	7.716	3.115	393.88
1989	36.517	342.76	3.673	0.123	7.716	3.198	393.98
1990	36.517	342.76	3.33	0.121	7.716	2.512	392.95
1991	36.517	342.76	3	0.12	7.716	1.917	392.03
1992	36.517	342.76	3.004	0.119	7.716	2.323	392.43
1993	51.914	301.96	2.861	0.118	2.337	2.721	361.91
1994	7.203	9.38	2.732	0.118	19.295	2.543	41.27
1995	3.998	1.92	3.608	0.117	16.155	3.428	29.22
1996	4.289	1.84	0.799	0.117	16.389	2.878	26.31
1997	2.971	0.58	0.754	0.116	12.886	2.798	20.11
1998	3.964	1.03	0.606	0.115	3.838	1.876	11.43
1999	2.73	1.14	0.493	0.115	2.643	1.83	8.95
2000	0.667	1.38	1.23	0.114	9.032	1.845	14.27
2001	0.975	1.42	1.328	0.11	2.273	1.607	7.71
2002	0.81	0.99	0.867	0.11	3.817	1.222	7.82
2003	1.893	0.59	5.008	0.109	1.751	1.393	10.74
2004	2.116	0.62	1.378	0.109	2.249	1.236	7.7
2005	2.911	0.45	2.372	0.108	3.548	1.487	10.88
2006	2.853	0.45	3.601	0.108	4.159	1.491	12.66

2007	4.33	0.34	0.284	0.107	4.945	1.48	11.49
2008	4.183	0.1	0.294	0.106	5.63	1.442	11.76
2009	3.183	0.12	0.232	0.106	4.703	2.84	11.19
2010	4.647	0.16	0.276	0.105	5.144	1.77	12.10
2011	3.507	0.18	0.262	0.103	4.451	1.62	10.12
2012	3.36	0.24	0.162	0.102	4.567	1.74	10.17

Table 156 Trend of CO_2 emissions from Solvent and other product use, Gg

	3 A	3 B	3 C	3 D			
Sub-categories	**Paint Application**	**Degreasing and Dry Cleaning**	**Chemical Products, Manufacturing and Processing**	**Pharmacy**	**Use of lacquers and solvents**	**Vegetable Oil Production**	**Total**
1988	80.411	754.06	8.035	0.277	16.974	6.852	866.61
1989	80.411	754.06	8.08	0.27	16.974	7.035	866.83
1990	80.411	754.06	7.326	0.267	16.974	5.527	864.57
1991	80.411	754.06	6.6	0.265	16.974	4.218	862.53
1992	80.411	754.06	6.609	0.261	16.974	5.11	863.43
1993	114.32	664.31	6.294	0.261	5.141	5.986	796.31
1994	15.86	20.626	6.01	0.26	42.449	5.596	90.8
1995	8.804	4.215	7.938	0.258	35.54	7.541	64.3
1996	9.444	4.05	1.759	0.257	36.056	6.332	57.9
1997	6.541	1.28	1.66	0.255	28.349	6.156	44.24
1998	8.728	2.263	1.332	0.253	8.443	4.128	25.15
1999	6.011	2.513	1.085	0.252	5.815	4.027	19.7
2000	1.468	3.033	2.707	0.251	19.87	4.059	31.39
2001	2.147	3.126	2.921	0.243	5	3.535	16.97
2002	1.784	2.188	1.907	0.242	8.398	2.688	17.21
2003	4.168	1.29	11.018	0.24	3.853	3.064	23.63
2004	4.659	1.353	3.032	0.239	4.948	2.719	16.95
2005	6.411	0.999	5.218	0.238	7.806	3.271	23.94
2006	6.281	0.986	7.923	0.237	9.15	3.28	27.86
2007	9.534	0.752	0.625	0.235	10.879	3.255	25.28
2008	9.21	0.223	0.648	0.234	12.386	3.172	25.87
2009	7.01	0.269	0.51	0.233	10.347	6.247	24.62
2010	9.20	0.367	0.61	0.231	11.326	3.898	25.632
2011	7.724	0.405	0.58	0.226	9.792	3.550	22.277
2012	7.407	0.535	0.36	0.224	10.05	3.82	22.396

Trend of N_2O emissions from solvent and other product use (CRF SECTOR 3D1 AND 3D3)

The N_2O emissions from CRF sector 3 D.1 Use of N_2O for Anaesthesia are calculated for the entire time series 1988 – 2012. The activity data are provided by the only Bulgarian Plant operator – NEOHIM AD.
The trend of N_2O emissions is presented in Table 157.

Table 157 Trend of N_2O emissions from Solvent and other product use, Mg

Sub-categories	3D1.Use of N_2O for Anaesthesia	3D3.N_2O from Aerosol Cans	Population, 1000 number
1988	106.95	0.09	8986.6
1989	106.95	0.088	8767.3
1990	106.95	0.087	8669.27
1991	106.95	0.086	8595.47
1992	106.95	0.085	8484.86
1993	107.38	0.085	8459.76
1994	115.87	0.084	8427.42
1995	100.95	0.084	8384.72
1996	108.32	0.083	8340.94
1997	113.44	0.083	8283.2
1998	125.73	0.082	8230.37
1999	118.84	0.082	8190.88
2000	119.3	0.081	8149.47
2001	121.82	0.079	7891.1
2002	129.62	0.078	7845.84
2003	118.53	0.078	7801.27
2004	103.01	0.078	7761.05
2005	86.17	0.077	7718.75
2006	83.39	0.077	7679.29
2007	80.08	0.076	7640.24
2008	81.31	0.076	7606.55
2009	74.83	0.076	7563.71
2010	65,00	0,075	7679.29
2011	61.26	0.073	7327.224
2012	59.93	0.073	7284.552

5.2 SOURCE CATEGORY DESCRIPTION

NMVOC emissions from Paint application, Degreasing and Dry cleaning, Chemical products and other product use are calculated, based on the emission factors, set in the EMEP/EEA Guidebooks (2006 and 2009) and activity data, provided by the NSI. For some categories as 060307 Paints manufacturing, the activity data are taken from the National Register under the European Solvents Directive 1999/13/EC.

The Solvent Inventory is based on the SNAP[29] systematic and has current reporting format under the LRTAP Convention – the NFR[30] format.

[29] **SNAP** (Selected Nomenclature for sources of Air Pollution) 90 or 97 respectively means the stage of development.

[30] **NFR** (Nomenclature For Reporting) – is a classification system developed by the UN/ECE TFEIP for the Reporting Guidelines described in eb.air.ge.1.2001.6.e.doc

3. A Paint application

This sector deals with the use of paints within the industrial and domestic sectors.

Decorative coating application (3.A.1), which includes:

- Paint application: construction and buildings (SNAP 060103)
- Paint application: domestic use (SNAP 060104)

Industrial coating application (3.A.2), which includes:

- Paint application: manufacture of automobiles (SNAP 060101)
- Paint application: car repairing (SNAP 060102)
- Paint application: coil coating (SNAP 060105)
- Paint application: boat building (SNAP 060106)
- Paint application: wood (SNAP 060107)
- Other industrial paint application (SNAP 060108)

Other coating application (3.A.3), which includes:

- Other non-industrial paint application (SNAP 060109)

3. B. Degreasing and Dry cleaning

This category deals with the following activities:

3. B.1 Degreasing - process for cleaning products from water-insoluble substances such as grease, fats, oils, waxes, carbon deposits, fluxes and tars. In most cases the process is applied to metal products, but also plastic, fibreglass, printed circuit boards and other products are treated by the same process.

3. B.2 Dry cleaning - refers to any process to remove contamination from furs, leather, down leathers, textiles or other objects made of fibres using organic solvents.

3. C Chemical products

This sector covers the emissions from the use of chemical products, manufacture and processing.

3. D 5 Other product use

- Use of lacquers and solvents
- Printing industry (SNAP 060403)
- Fat, edible and non-edible oil extraction (SNAP 060404)
- Application of glues and adhesives (SNAP 060405)
- Preservation of wood (SNAP 060406)
- Vegetable Oil Production
- Pharmacy

5.3 METHODOLOGICAL ISSUES

5.3.1 METHODS

The Tier 2 default approach has been implemented for the inventory of most of the SNAP activities' in 3.A, 3.B, 3.C and 3D. Tier 1 has been implemented for SNAP activity 060302 and Tier 3 been implemented for SNAP activity 060201.

The emissions of NMVOC are estimated based on EMEP/EEA Guidebook (2009). The general equation is:

$$Emission_{NMVOC} = AR_{Production} \times EF_{Pollutant}$$

Where:

$Emission_{NMVOC}$ = the emission of NMVOC

$AR_{production}$ = the activity rate (consumption of paint, chemical production data)

EF_{NMVOC} = the emission factor for NMVOC.

This equation is applied at national level, using annual national total figures for the activity data.

5.3.1.1 CO_2 and N_2O emissions from solvent and other product use

Converting of NMVOC into CO_2 with conversion factor is provided in 2006 IPCC Guidelines, Volume 1, Chapter 7.2.1.5 Carbon Emitted in Gases Other than CO_2.

From NMVOC:

$$Inputs_{CO_2} = Emissions_{NMVOC} \times C \times \frac{44}{12}$$

Where C is the fraction carbon in NMVOC by mass (default = 0.6)

Due to lack of data and the fact it is not a key category the default value is used.

Reference for default: conversion factor NMVOC – CO_2, 2006 IPCC Guidelines , Volume 3, Chapter 5: Industrial Processes and Product Use, page 5.17, 2006 IPCC Guidelines s, Volume 1, Chapter 7: Precursors and Indirect Emissions, page 7.6

The N_2O emissions from CRF sector 3 D.1 Use of N_2O for Anaesthesia are estimated based on methodological issues set in the 2006 IPCC Guideline (Volume 3: Industrial Processes and Product Use, Chapter 8). Equation 8.24 for estimation of N_2O emissions from other product use is implemented. It is assumed that none of the administered N_2O is chemically changed by the body, and all is returned to the atmosphere. It is reasonable to assume an emission factor of 1.0. The activity data are provided by the only Bulgarian Plant operator – NEOHIM AD.

The estimation of emissions in CRF sector 3 D 3 N_2O from Aerosol Cans is based on an assumption, that the intensity of using aerosols is the same as in Switzerland (10 grams per person per year of N_2O emissions). There is no activity data available by manufacturers and distributors of N_2O products for total quantity of N_2O supplied by application type. Thus the N_2O emissions from aerosol cans sub-category are estimated based on the assumption.

5.3.1.2 Emission Factors

The default emission factors for NMVOC are taken from the EMEP/EEA Guidebook – 2006 and EMEP/EEA Guidebook (2009).

The default emission factors used for assessment of emissions of NMVOC from 3.A, 3.B, 3.C and 3D are presented in Table 158.

Table 158 Emission factors used for estimation of NMVOC emissions from Solvent and Other product use

SNAP activity	Name of activity	Emission factor	Unit	Reference
3.A Paint application				
060101	Manufacture of automobiles	500	g/kg of paint	EMEP/EEA guidebook – 2006
060102	Car repairing	720	g/kg of paint	EMEP/EEA guidebook – 2009
060103	Construction and buildings (except 060107)	230	g/kg of paint	EMEP/EEA guidebook – 2009
060104	Domestic use (except 060107)	230	g/kg of paint	EMEP/EEA guidebook – 2009
060105	Coil coating	480	g/kg of paint	EMEP/EEA guidebook – 2009
060106	Boat building	750	g/kg of paint	EMEP/EEA guidebook – 2006
060107	Wood	800	g/kg of paint	EMEP/EEA guidebook – 2009
060108	Other industrial paint application	750	g/kg of paint	EMEP/EEA guidebook – 2006
060109	Other non-industrial paint application	740	g/kg of paint	EMEP/EEA guidebook – 2009
3.B. Degreasing and Dry cleaning				
060201	Metal degreasing	1000	kg/Mg solvent use	EMEP/EEA guidebook – 2009
060203	Electronic components manufacturing	740	kg/Mg wafer	
060202	Dry cleaning	1000	kg/Mg solvent use	
060202	Dry cleaning - Open-circuit machine	177	g/kg textiles cleaned	
060202	Dry cleaning - closed - circuit machine (abatement n=89%)	19.47	g/kg textiles cleaned	
3.C Chemical products				
060301	Polyester processing	50	g/kg monomer used	EMEP/EEA guidebook – 2009

SNAP activity	Name of activity	Emission factor	Unit	Reference
060302	Polyvinylchloride processing	10	g/kg product	
060303	Polyurethane foam processing	120	g/kg foam processed	
060304	Polystyrene foam processing	60	g/kg foam processed	
060305	Rubber processing	8	g/kg rubber produced	
060306	Pharmaceutical products manufacturing	300	g/kg solvents used	
060307	Paints manufacturing	11	g/kg product	
060308	Inks manufacturing	11	g/kg product	
060309	Glues manufacturing	11	g/kg product	
060310	Asphalt blowing	1710	g/Mg asphalt	
3.D Other product use				
060403	Printing industry	730	g/kg ink	EMEP/EEA guidebook – 2009
060404	Fat, edible and non-edible oil extraction	3	g/kg seed	EMEP/EEA guidebook – 2009
060405	Application of glues and adhesives	780	g/kg adhesives	EMEP/EEA guidebook – 2009
060406	Preservation of wood	900	g/kg preservative	EMEP/EEA guidebook – 2009
3D5.3	Vegetable Oil Production	18	kg/t	CORINAIR
3D5.2	Pharmacy	14	kg/t	CORINAIR

5.3.1.3 Activity Data

The activity data for estimation of emissions in sector 3A.Paint application, 3B.Degreasing and Dry cleaning, 3C.Chemical products and 3D.Other product use are provided by the NSI. For the most SNAP activities under 3A, 3B, 3C and 3D the NSI has provided activity data just for the period 1992 – 2012.

For some categories as Paints manufacturing (SNAP 060307), the activity data for the last five years are taken from the National Register. Due to lack of data, the activity data for the period 1988 – 1991 are taken the same as first available year.

5.3.2 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of the GHG emissions is presented in Table 159.

Table 159 Uncertainty of sector Solvents and Other product use, %

CRF categories	Key Category	GHG	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
3	No	CO_2	10	30	31.62
3	No	N_2O	10	100	100,5

5.3.3 SOURCE-SPECIFIC QA/QC AND VERIFICATION, IF APPLICABLE

All activities regarding QC as described in QA/QC System have been undertaken.

The following sector specific QA/QC procedures have been carried out:

- Check of methodology, emissions, emission factors and IEF (time series);
- Time series consistency;
- Plausibility checks of the results (due to the national statistic and national VOC register);
- Documentation and archiving of all information required in NIR, background documentation and archive;
- QA procedures have been performed by the Sector expert in the MOEW (Order № RD-218/05.03.2010 by the Minister of Environment and Water).

5.3.4 SOURCE-SPECIFIC RECALCULATIONS

There are recalculations of CRF category 3.A.2 - pain application: wood,(SNAP 060107). The EF is revised according to EMEP/EEA guidebook 2009 (800g/kg paint)

5.3.5 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Obtaining additional data and comparing data for some sources using the National VOC Register.

Check if it is possible to provide the necessary activity data for N_2O of aerosol cans from Bulgarian customs or other institution. At this moment there are no activity data for manufacturers and distributors or import and export of these N_2O products.

6 AGRICULTURE (CRF SECTOR 4)

6.1 OVERVIEW OF SECTOR

This chapter gives information about the estimation of greenhouse gas emissions from Sector Agriculture in correspondence to the data reported under the Sector 4 in the Common Reporting Format. The following sources exist in Bulgaria:

- domestic livestock activities with enteric fermentation and manure management,
- rice cultivation,
- agricultural soils, and
- agricultural residue burning.

The agricultural holdings surveyed during the census in 2010 were 371 100, which is a decrease of 44% compared to the number of holdings surveyed during the census in 2003. A trend of decrease has been maintained over the recent years. Conducted sample surveys of the structure of agricultural holdings in 2005 and 2007 show that the number of holdings decreased by 19.7% in 2005 compared to 2003, by 7.8% in 2007 compared to 2005 and by 24.7% in 2010 compared to 2007.

The holdings owned by individuals are 363 700 or 98% of all agricultural holdings; followed by those owned by commercial companies – 1%, sole traders – 0.6%, cooperatives – about 0.3% and other holdings – about 0.1%.

357 900 agricultural holdings use agricultural area to the amount of 3 620 900 ha. An agricultural holding manages the average of 10.1 ha of utilized agricultural area (UAA), this indicator being the highest in the Northeast region (17.6 ha) and lowest in the Southwest region (3.6 ha).

Natural persons manage 33.8% of the UAA. The commercial companies manage 31.6% of the UAA of the country, the cooperatives – 17.7%, sole traders – 14.9%, and the remaining holdings – 2%.

In the UAA of 3 620 900 ha of the agricultural holdings, the share of arable land of 86.5% is the highest, followed by permanent grassland – 10.4% of the UAA. Permanent crops occupy 2.8% of the UAA.

The arable land is 3 133 000 hectares and is divided into 250 900 agricultural holdings. Cereals are grown on 47.8% of the holdings, representing 58.1% of the arable land. Industrial crops occupy 33.9% of the arable land and are grown on 23.1% of the holdings possessing arable land. Most industrial plants are grown in the Northwest region – 250 300 ha or 23.6%. Vegetables occupy 1.2% of the arable land and are grown mainly in the South Central region - 44.6% of the land under vegetables. Fodder crops are grown in 30% of the holdings on an area of 106,300 ha. This area is only 3.4% of the arable land.

The agricultural holdings with UAA from 0.00 to 1.99 ha in 2010 were 83.2% of all holdings. Over 78.2% of the UAA is located in holdings with an area of 100.00 ha or more, the average UAA of these holdings was 534 ha.

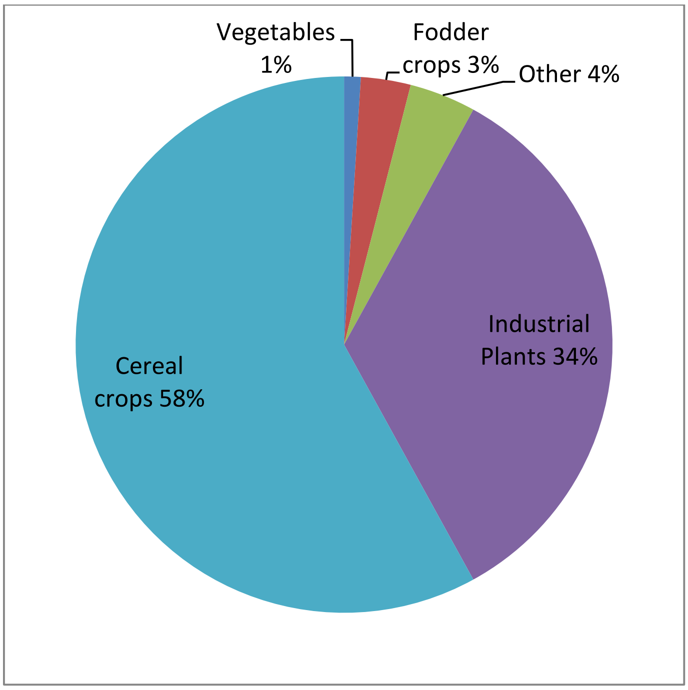
Around 280 300 were the holdings that kept livestock, poultry and bees as of 31 August 2010. Of these 91.5% used agricultural area from 0.01 ha to 10 ha (the analysis of the UAA of the holdings does not include collectively used common land for grazing animals). In the holdings with UAA from 0.01 ha to 10 ha 86.6% of equidae species, 82.5% of goats and 65.8% of sheep were raised. Cattle were raised in 34.1% of the holdings. Of these 4.4% did not have UAA and raised 7.7% of cattle, and the holdings with UAA from 0.01 ha to 10 ha were 89.1% and they raised 51.0% of the cattle. In the holdings without UAA 45.1% of the pigs and 47.6% of the birds were raised. 66.2% of the livestock holdings raised poultry. Over 10 ha of UAA were owned by 3.8% of the livestock breeding holdings. 5% of the holdings that raised pigs farmed more than 10 ha of the UAA and they raised 23.9% of the pigs.

About 100 of the surveyed agricultural holdings were engaged in activities for the production of mushrooms, growing of silkworms, hatcheries and others.

Labour force in agriculture

371 100 agricultural holdings employed 751 700 persons in 2010, the proportion of family labour force was 92.8% or 697 400 employed persons. 54 300 persons were employed in agriculture as paid workers. The total reduction of the persons employed in agriculture compared to those in 2007 was 20.8%. The annual work units (AWU) of all employed were 394 100, of these 343 100 were family labour force and 51 000 were paid labour force.

The proportion of men employed in agricultural holdings in 2010 was 55.7%. Employed men were by 22.1% less compared to 2007. Total of 61.0% of employed persons were aged 35 to 64 years. In the agricultural holdings 9.8% of the persons employed were aged between 15 and 34 years, and 29.2% were persons over 65 years of age.



Source: Ministry of Agriculture and Food, Agrostatistics Department

Figure 71 Arable land, used agricultural area and area of agricultural designation in the period in 2008 (ha)

6.2 EMISSION TRENDS

In the year 2012 the sector agriculture contributed 10 % to the total of Bulgaria's greenhouse gas emissions (without LULUCF). The trend of GHG emissions from 1988 to 2012 shows a decrease of 69,53% for this sector due to decrease in activity data. (**Figure 72**)

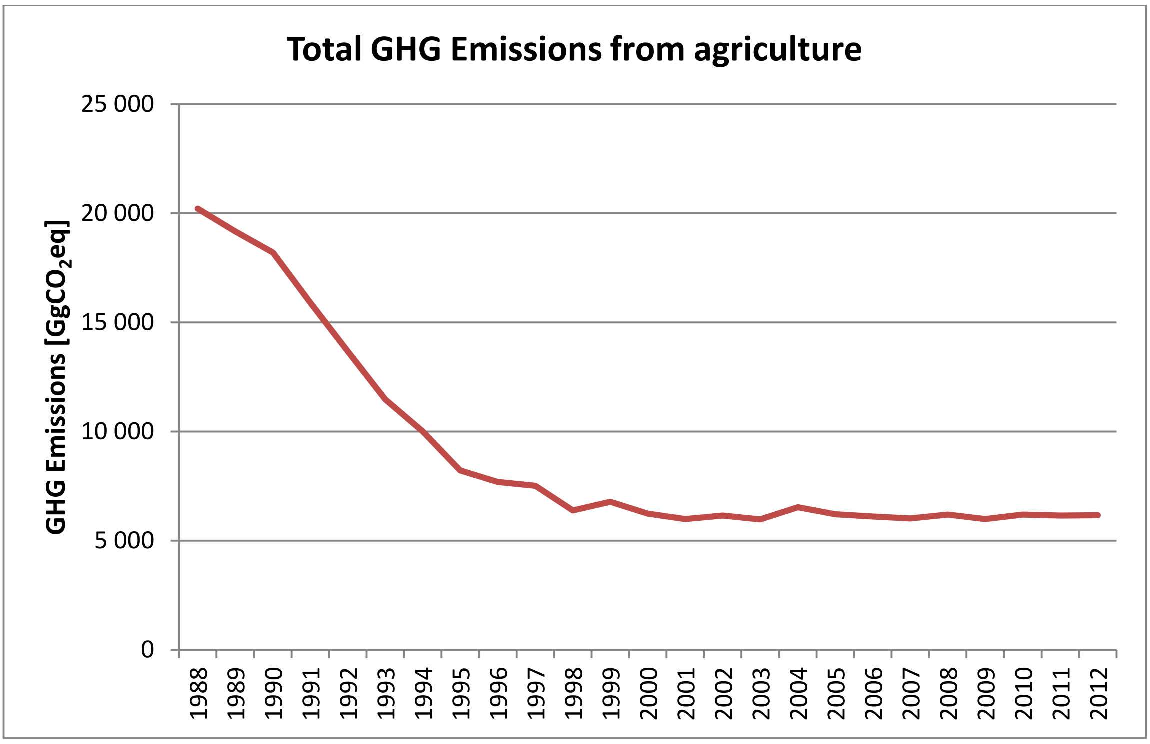


Figure 72 Trend of GHG Emissions from agriculture

6.3 EMISSION TRENDS PER GAS

CH_4 emissions form 31,6% of the total emissions in the sector in CO_2-eq in 2012. A steady trend of emissions decrease is observed after 2004 due to reduction in animal numbers.

N_2O emissions from the sector are also significant. The biggest share belongs to the agricultural soils emissions. The share of N_2O emissions is 68,4% for the year 2012. The biggest share in these emissions have the Agricultural soils category with 87,21%. N_2O emissions from manure management and field burning of agricultural residues are of an order of magnitude smaller and in total are about 13,1% from the aggregated N_2O emissions of the sector.

Since 1988 CH_4 emissions from agriculture decreased by 76,4% and N_2O emissions by 64,8%. The trend is presented in Table 160.

Table 160 Emissions of greenhouse gases from agriculture 1988 – 2012.

Year	GHG emissions [Gg]	
	CH_4	N_2O
1988	372,82	38,61
1989	369,82	35,46
1990	369,47	32,30
1991	362,51	25,33
1992	323,08	21,03
1993	254,31	18,90
1994	196,22	18,32
1995	160,14	15,14
1996	148,84	14,27
1997	133,81	14,83
1998	118,42	12,35
1999	116,77	13,75
2000	105,38	12,85
2001	89,81	13,14
2002	96,20	13,18
2003	103,54	12,08
2004	104,32	13,82
2005	102,67	12,89
2006	103,99	12,42
2007	101,24	12,33
2008	98,49	13,08
2009	95,59	12,64
2010	95,05	13,32
2011	95,34	13,19
2012	90,20	13,58

6.3.1 EMISSION TRENDS PER SUB CATEGORY

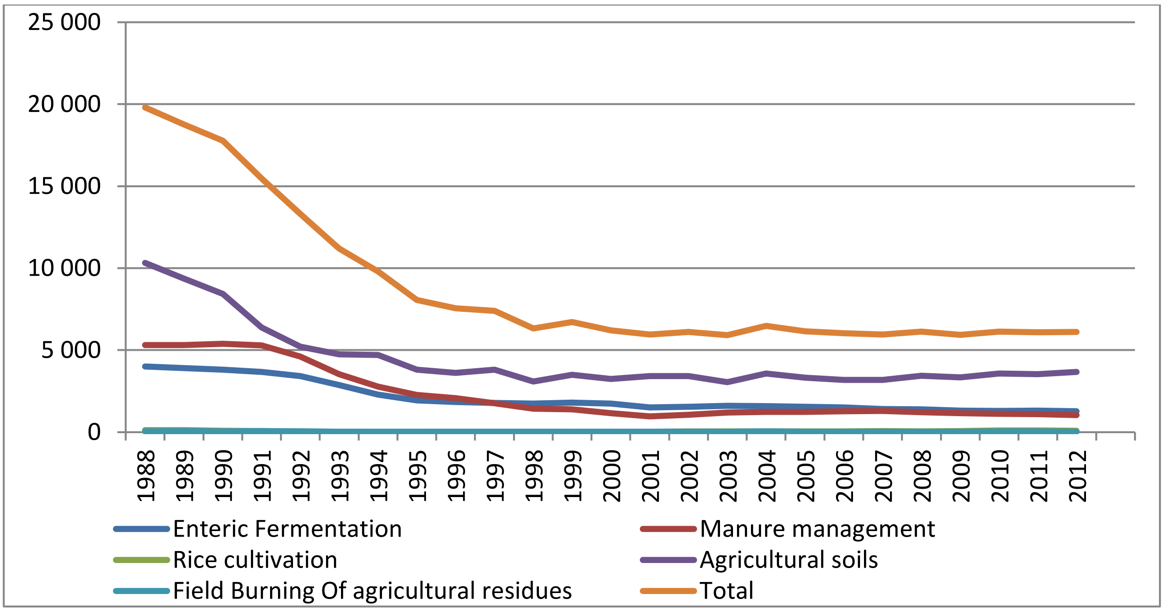


Figure 73 GHG emission trends 1988–2012 of agriculture by categories (Gg CO_2-eq)

Table 161 and Figure 73 present total GHG emissions and trend 1988–2012 from agriculture by sub-categories as well as the contribution to the overall inventory emissions. Important categories are 4.D Agricultural soils (60,2%) and 4.A Enteric Fermentation (20,8%) followed by 4.B Manure management (17%).

Table 161 GHG emissions 1988–2012 of agriculture by categories.

Year	GHG emissions [Gg CO_2 equivalent] by categories					
	4	4.A	4.B	4.C	4.D	4.F
1988	19799,34	4008,12	5310,15	114,24	10318,14	48,69
1989	18759,06	3906,62	5314,71	114,60	9361,85	61,29
1990	17772,9	3810,57	5382,62	88,96	8439,95	50,80
1991	15463,87	3665,20	5291,57	68,91	6380,25	57,95
1992	13303,15	3412,97	4608,49	38,01	5204,02	39,66
1993	11200,24	2874,99	3527,67	26,20	4742,71	28,67
1994	9799,72	2288,75	2768,52	6,95	4705,78	29,72
1995	8057,831	1930,46	2264,25	11,59	3817,90	33,63
1996	7550,396	1835,34	2065,98	21,89	3607,29	19,89
1997	7406,508	1780,55	1758,05	31,87	3807,00	29,04
1998	6315,065	1736,75	1438,14	33,63	3080,58	25,96
1999	6714,49	1798,20	1384,64	11,90	3492,84	26,91
2000	6198,022	1747,92	1147,22	30,00	3251,47	21,42
2001	5960,844	1505,52	970,15	32,73	3427,29	25,15
2002	6104,964	1554,30	1050,54	43,95	3425,02	31,16
2003	5919,17	1612,24	1198,07	47,41	3039,23	22,23
2004	6475,255	1586,45	1231,83	45,33	3575,40	36,24
2005	6151,32	1540,62	1229,64	39,34	3313,06	28,66
2006	6034,78	1499,00	1279,25	42,69	3185,24	28,61
2007	5948,537	1413,23	1287,54	54,21	3177,98	15,58
2008	6124,003	1386,92	1220,02	42,35	3441,07	33,64
2009	5925,292	1318,70	1165,27	69,82	3339,65	31,85
2010	6125,673	1286,40	1125,83	100,61	3576,21	36,62
2011	6091,264	1309,57	1105,06	99,38	3540,94	36,31
2012	6104,841	1272,65	1042,04	83,53	3672,35	34,27
Share in Total 2012	-	20,8%	17,1%	1,4%	60,2%	0,6%

As can be seen in Figure 73 and Table 161 the overall trend concerning emissions from all categories is decreasing. The reasons for the decrease are structural changes in agricultural holdings which lead to reduction in farm animal populations and decrease in arable land area.

6.3.2 KEY CATEGORIES

Table 162 Key sources of agriculture.

IPCC Category	Source Categories	Key Sources	
		GHG	KS-Assessment*
4D1	Direct N_2O emissions from Agricultural soils	N_2O	Yes
4A1	Enteric Fermentation - cattle	CH_4	Yes
4A3	Enteric Fermentation - sheep	CH_4	Yes
4B1	Manure Management - cattle	CH_4	Yes
4B8	Manure Management - swine	CH_4	Yes
4D3	Indirect N2O from Nitrogen used in Agriculture	N_2O	Yes
4B9	Manure Management - swine	CH_4	Yes
4D2	Pasture, Range and Paddock Manure	N_2O	Yes

6.3.3 COMPLETENESS

Table 163 gives an overview of the IPCC categories included in this chapter and provides information on the status of emission estimates of all subcategories. A "✓" indicates that emissions from this sub-category have been estimated.

Table 163 Overview of sub-categories of agriculture.

IPCC Category		CH_4		N_2O
4.A	**ENTERIC FERMENTATION**	**ENTERIC FERMENTATION**	✓	**NA**
4.A.1	Cattle	–	✓	NA
4.A.1.a	Dairy Cattle	Dairy cows	✓	NA
4.A.1.b	Non-Dairy Cattle	Other cattle	✓	NA
4.A.1.C	Young cattle	Calves and heifers	✓	NA
4.A.2	Buffalo	Buffalos	✓	NO
4.A.3	Sheep	Sheep	✓	NA
4.A.4	Goats	Goats	✓	NA
4.A.5	Camels and Lamas	Camels	NO	NO
4.A.6	Horses	Horses	✓	NA
4.A.7	Mules and Asses	Mules and asses	✓	NA
4.A.8	Swine	Swine	✓	NA
4.A.9	Poultry	Laying hens, broilers, other poultry	NA	NA
4.A.10	Other	-	NO	NO
4.B.	**MANURE MANAGEMENT**	**MANURE MANAGEMENT REGARDING ORGANIC COMPOUNDS MANURE MANAGEMENT**	✓	**NO**

IPCC Category		CH_4		N_2O
		REGARDING NITROGEN COMPOUNDS	**NO**	**✓**
4.B.1	Cattle	–	✓	✓
4.B.1.a	Dairy Cattle	Dairy cows	✓	✓
4.B.1.b	Non-Dairy Cattle	Other cattle	✓	✓
4.A.1.C	Young cattle	Calves and heifers	✓	✓
4.B.2	Buffalo	Buffalos	✓	✓
4.B.3	Sheep	Sheep	✓	✓
4.B.4	Goats	Goats	✓	✓
4.B.5	Camels and Llamas	Camels	NO	NO
4.B.6	Horses	Horses	✓	✓
4.B.7	Mules and Asses	Mules and asses	✓	✓
4.B.8	Swine	Swine	✓	✓
4.B.9	Poultry	Laying hens, broilers, Other poultry (ducks, gooses,…)	✓	✓
4.A.10	Other	-	NO	NO
4.B.11	Anaerobic	Anaerobic	-	✓
4.B.12	Liquid Systems	Liquid Systems	-	✓
4.B.13	Solid Storage	Solid Storage and Dry Lot	-	✓
4.B.14	Other	Other management/ manure without bedding Pit storage of swine manure included here	-	✓
4.C	**RICE CULTIVATION**	**Rice Field (with fertilizers) Rice Field (without fertilizers)**	✓	**NO**
4.D	**AGRICULTURAL SOILS**	**CULTURES WITH FERTILIZERS CULTURES WITHOUT FERTILIZERS**	**NO**	**✓**
4.D.1	Direct Soil Emissions	Cultures with and without fertilizers	NO	✓
4.D.2	Pasture, Range and Paddock Manure	Cultures without fertilizers	NO	✓
4.D.3	Indirect Emissions	Cultures with and without fertilizers	NO	✓
4.E	**PRESCRIBED BURNING OF SAVANNAS**	**–**	**NO**	**NO**
4.F	**FIELD BURNING OF AGRICULTURAL RESIDUES**	**ON-FIELD BURNING OF STUBBLE, STRAW, …**	**✓**	**✓**
4.F.1	Cereals	Cereals	✓	✓
4.F.2	Pulses	Pulse	✓	✓
4.F.3	Tubers and Roots	Tuber and Root	✓	✓
4.F.4	Sugar Cane	Sugar Cane	✓	✓

QA/QC activities

- Sector specific QA/QC procedures are to be intensified;
- Comparison of emissions using alternative approaches;
- Food and Agriculture Organization of the United Nations (FAO);
- Documentation and archiving of all information required in NIR, background documentation and archive.

Recalculations and time-series consistency

- Emissions from young cattle have been recalculated for the entire time series due to finding by the ESD Technical review in 2012 for the way animal weight is calculated.

- Emissions from poultry manure have been recalculated for the entire time series due to acquisition of country specific data for the amount of nitrogen excreted and AWMS distribution.

6.4 ENTERIC FERMENTATION (CRF SECTOR 4A)

Emissions from this key source result from fermentation in ruminant animals' digestive system. All domestic animals indicated in IPCC except for llamas and camels are bred in Bulgaria.

6.4.1 SOURCE CATEGORY DESCRIPTION

CH_4 emissions in CO_2-eq. were 1272,6 Gg in the year 2012. The decrease for the year 2012 is 2,82% compared to 2011. Compared to base year a decrease of 68,25% is observed.

CH_4 emissions from the enteric fermentation of domestic livestock are given in Table 164.

Table 164 Greenhouse gas emissions from enteric fermentation 1988–2012.

Year	CH_4 emissions [Gg] per Livestock Category								
	4.A	4.A.1 a	4.A.1.b	4.A.1.c	4.A.2	4.A.3	4.A.4	4.A.6& A7	4.A.8
	Total	Mature Dairy	Mature Non-Dairy	Young	Buffalo	Sheep	Goats	Horses, Mules & asses	Swine
1988	190,86	68,94	9,79	33,12	1,39	63,63	2,17	5,75	6,06
1989	186,03	68,95	9,48	32,07	1,31	60,21	2,16	5,72	6,11
1990	181,46	67,89	9,23	31,21	1,28	57,68	2,17	5,66	6,34
1991	174,53	65,93	8,66	29,28	1,34	55,03	2,33	5,58	6,39
1992	162,52	64,18	7,56	25,55	1,39	50,29	2,63	5,42	5,50
1993	136,90	58,16	5,79	19,58	1,30	39,53	2,91	5,27	4,37
1994	108,99	49,65	3,87	13,10	1,08	29,40	3,22	5,10	3,56
1995	91,93	42,12	2,94	9,93	0,85	24,21	3,68	5,16	3,04
1996	87,40	39,42	2,61	8,82	0,75	23,07	4,07	5,56	3,09
1997	84,79	39,83	2,31	7,80	0,69	21,61	4,21	5,62	2,73
1998	82,70	40,78	2,13	7,20	0,60	20,15	4,54	5,06	2,24
1999	85,63	44,33	2,25	7,60	0,58	19,22	5,03	4,23	2,40
2000	83,23	44,20	2,32	10,17	0,53	15,75	4,47	3,88	1,91

2001	71,69	38,54	2,12	10,31	0,43	11,56	3,54	3,99	1,21
2002	74,01	39,43	2,55	11,27	0,39	11,38	3,57	4,09	1,34
2003	76,77	39,46	3,12	13,18	0,42	11,53	3,70	3,84	1,52
2004	75,55	40,18	2,85	12,13	0,44	11,31	3,61	3,54	1,47
2005	73,36	39,55	2,61	11,14	0,44	11,36	3,32	3,53	1,41
2006	71,38	38,64	2,64	10,71	0,45	11,09	2,89	3,49	1,47
2007	67,30	36,64	2,74	9,35	0,47	10,59	2,61	3,46	1,43
2008	66,04	35,72	2,84	9,35	0,50	10,18	2,31	3,90	1,25
2009	62,74	33,56	2,86	8,62	0,48	9,62	1,98	4,49	1,14
2010	61,26	33,28	2,84	8,68	0,48	9,22	1,79	3,91	1,05
2011	62,36	33,88	3,10	8,79	0,53	9,39	1,74	3,97	0,95
2012	60,60	32,44	3,41	8,43	0,53	9,35	1,59	4,01	0,85
Share 2012		53,52%	5,63%	13,90%	0,87%	15,43%	2,62%	6,62%	1,41%
Trend 1988–2012	31,75%	47,05%	34,84%	25,44%	37,73%	14,69%	73,03%	69,74%	14,09%

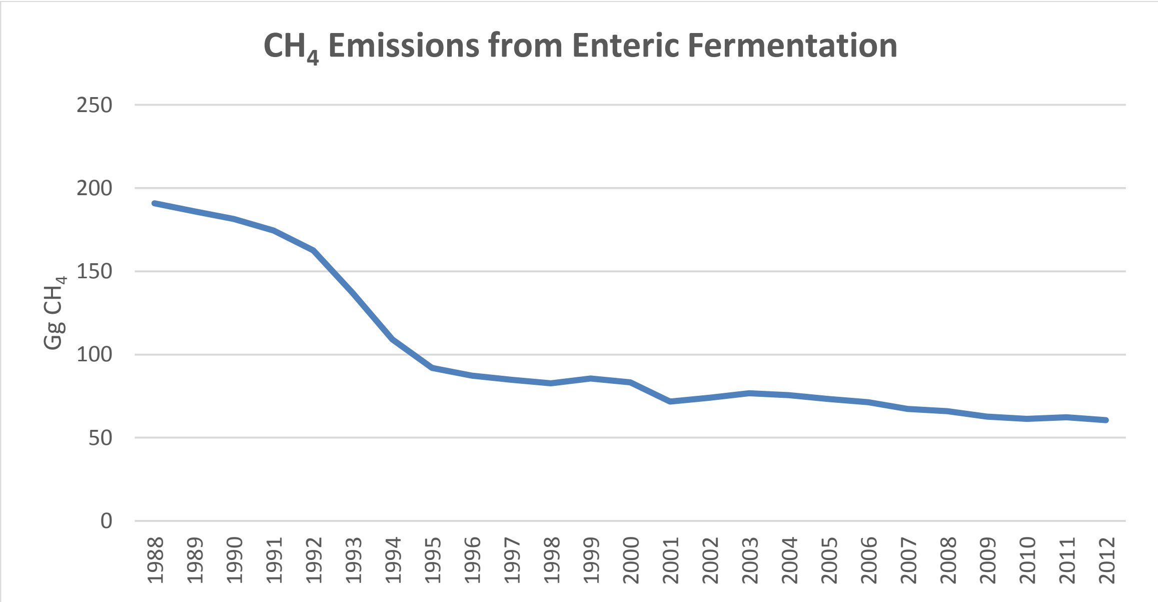


Figure 74 CH_4 emission from enteric fermentation

Figure 74 shows steady decrease in CH_4 emissions after 2002. The rapid decrease in the period 1991-1995 is consequence of a reform in agricultural holdings during this period. The overall reduction is caused by a decrease in total numbers of animals.

6.4.2 METHODOLOGICAL ISSUES

6.4.2.1 Methods

The IPCC Tier 1 method has been used to estimate the emissions from all farm animal categories with the exception of cattle (IPCC Sub-category 4A1) and sheep (IPCC Sub-category 4A3) for which Tier 2 method is used and option B for cattle.

6.4.2.2 Emission factors

Country specific emission factors are used. They are calculated from the specific gross energy intake and the methane conversion rate.

$EF_i = [GE_i \bullet Ym_i \bullet 365] / 55.65$

With *i = each livestock category*

EF_i expressed in kg CH_4/head/year

Y_m Methane conversion rate
Ge =Gross energy intake

The factor 55.65 expressed in MJ/kg of CH_4

➔ See equation 4.14 in the IPCC-GPG 2000.

For the Tier 1 method, default GE is usually provided in the IPCC Guidelines. For the Tier 2 method, GE is the combination of various feed intake – or net energy – estimates relating to maintenance, activity, growth, etc. of the animals.

The methane conversion rate (Y_m) is taken from the IPCC guidelines.

Tier 2 method – cattle

For dairy cattle, the EF has been calculated by combining activity data, coefficients and parameters sown in Table 165. Bulgarian specific values for dairy cows were derived from feed intake data and energy content of food in dependency of annual milk yields.

Table 165 Activity data and parameters used for IPCC Sub-category 4A1 – Cattle – Mature Dairy Cattle

Parameter	Unit	Source
Livestock (# of animals)		Ministry of Agriculture and Food (see Table 140- Table 142)
Live Weight	kg	Executive Agency for Selection and Reproduction in Animal Breeding (see Table 144)
Calf Birth weight	kg	Eq. 7 - IPCC Ref Man_1996
Daily Weight Gain	kg/day	NA
Annual Milk Yield	kg/cow/year	Ministry of Agriculture and Food (see Table 143)
Daily Milk Yield	kg/cow/day	Calculated using division by 365 days/yr
Fat Content of Milk	%	Ministry of Agriculture and Food (see Table 143)
Digestible Energy	%	based on Table 10.2 - IPCC Ref Man_2006
Net Energy for Maintenance	MJ/day	Eq. 4.1 & Table 4.4 - GPG_2000
Net Energy for Activity	MJ/day	Eq. 4.2a & Table 4.5 - GPG_2000
Net Energy for Growth	MJ/day	Eq. 4.3a - GPG_2000

Parameter	Unit	Source
Net Energy due to Weight Loss	MJ/day	Eq. 4.4a - GPG 2000
Net Energy for Lactation	MJ/day	Eq. 4.5a - GPG 2000
Net Energy for Work	MJ/day	Eq. 4.6 - GPG_2000
Net Energy for Pregnancy	MJ/day	Eq. 4.8 & Table 4.7 - GPG_2000
Ratio of Net Energy in a Diet for Maintenance to Digestible Energy Consumed		Eq. 4.9 - GPG_2000
Ratio of Net Energy Available for Growth in a Diet to Digestible Energy Consumed		Eq. 4.10 - GPG_2000
Gross Energy Intake (average)	MJ/day	Eq. 4.11 - GPG_2000
CH4 conversion rate (average)	%	Table 4.8 - GPG_2000
Implied Emission Factor - CH4	kg CH_4/head/ year	Eq. 4.14 - GPG_2000

For the other cattle categories, IEF's are obtained by combining slightly different parameters which are listed in Table 166.

Table 166 Activity data and parameters used for IPCC Sub-category 4A1 – Cattle – Non-Dairy Cattle

Parameter	Unit	Source
Livestock	#	Ministry of Agriculture and Food (see Table 140-Table 142)
Live weight	kg	Executive Agency for Selection and Reproduction in Animal Breeding (see Table 144)
Live body weight	kg	Agrostatitisc bulletins
Daily weight gain	kg/day	- mature non-dairy cattle: NA - young cattle: Default
Digestible energy	%	- mature non-dairy cattle: 60% - young cattle: Table A2 IPCC Reference manual
Net energy for maintenance	MJ/day	equation 4.1 & table 4.4 – 2000 IPCC-GPG
Net energy for activity	MJ/day	equation 4.2a & table 4.5 – 2000 IPCC-GPG
Net energy for growth	MJ/day	equation 4.3a – 2000 IPCC-GPG
Net energy due to weight loss	MJ/day	equation 4.4b – 2000 IPCC-GPG
Net energy for lactation	MJ/day	equation 4.5a – 2000 IPCC-GPG
Net energy for work	MJ/day	equation 4.6 – 2000 IPCC-GPG
Net energy for pregnancy	MJ/day	equation 4.8 & table 4.7 – 2000 IPCC-GPG
Ratio of Net Energy in a Diet for Maintenance to Digestible Energy Consumed	#	equation 4.9 – 2000 IPCC-GPG
Ratio of Net Energy Available for Growth in a Diet to Digestible Energy Consumed	#	equation 4.10 – 2000 IPCC-GPG
Gross Energy Intake (average)	MJ/day	equation 4.11 – 2000 IPCC-GPG
CH4 Conversion Rate (average)	%	table 4.8 – 2000 IPCC-GPG

Tier 1 method – all farm animal categories except cattle and sheep

For farm animals, other than cattle and sheep, the IEFs are the default enteric fermentation EFs for developed countries presented in Table 4-3 of the Revised 1996 IPCC Guidelines. More details are provided in Table 167.

Table 167 Activity data, coefficients and parameters used for IPCC Sub-categories

Parameter name	Unit	Parameter source
Livestock	#	Ministry of Agriculture and Food – Agrostatistics department (see Table 140- Table 142)
Live Weight	kg	- Ministry of Agriculture and Food – Agrostatistics department (see Table 144) - Executive Agency for Selection and Reproduction in Animal Breeding
Gross Energy Intake (average)	MJ/day	Equation 4.11 – GPG 2000
CH_4 Conversion Rate (average)	%	Revised 1996 IPCC Guidelines

6.4.2.3 Activity data

The average number of animals per year is shown in Table 168.

The time series for the different types of domestic animals has been consistent despite the change of the survey methodology in the year 2000. Data is collected from the Agricultural Statistics Department of the Ministry of Agriculture and Food, FAO Database and National Statistics Institutes' yearbooks 1990-2012.

Table 168 Domestic livestock populations 1988–2012 (I).

	Dairy cattle	Non-dairy cattle-females	Non-dairy cattle - bulls	Young cattle - <1yr	Young cattle 1-2yrs	Goats	Buffalo
1988	628,64	134,37	18,97	688,06	193,45	434,78	25,31
1989	628,78	130,11	18,37	666,28	187,32	431,98	23,89
1990	619,14	126,59	17,87	648,25	182,25	434,28	23,27
1991	601,25	118,77	16,77	608,21	171,00	465,51	24,28
1992	585,30	103,66	14,64	530,84	149,24	525,41	25,34
1993	530,33	79,43	11,21	406,75	114,36	581,98	23,64
1994	452,79	53,14	7,50	272,12	76,51	643,83	19,68
1995	384,11	40,28	5,69	206,25	57,99	735,93	15,46
1996	359,52	35,77	5,05	183,15	51,49	814,38	13,69
1997	363,21	31,64	4,47	162,03	45,55	841,03	12,57
1998	371,85	29,22	4,13	149,63	42,07	907,43	11,00
1999	404,24	30,81	4,35	157,78	44,36	1006,86	10,46
2000	392,02	32,40	3,97	183,50	45,42	893,82	9,67
2001	360,63	30,01	3,27	206,41	38,52	707,66	7,76
2002	358,41	35,22	4,68	219,26	45,26	714,88	7,01

2003	360,01	42,72	6,11	237,08	63,86	739,89	7,68
2004	365,28	38,76	5,83	224,58	65,50	721,71	7,92
2005	358,24	35,15	5,66	190,67	56,97	663,27	8,09
2006	348,95	35,81	5,44	180,61	54,23	578,75	8,22
2007	343,02	38,12	4,91	174,20	54,91	522,28	8,61
2008	325,28	39,32	5,18	160,90	52,80	462,66	9,10
2009	305,71	38,56	6,07	148,90	52,99	395,33	8,77
2010	302,46	39,58	5,02	141,36	53,22	358,58	8,78
2011	307,50	44,42	4,49	139,75	54,88	348,85	9,56
2012	297,80	48,96	4,82	129,78	60,52	317,50	9,55

The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data. In the case of Bulgaria, this data comes from the national statistical system. FAOSTAT data are seemingly based on the official data but there is an annual attribution error. The rapid decline in cattle numbers in the period 1992-1994 is due to reforms in agricultural holdings in this period.

Table 169 Domestic livestock populations 1988–2012 (II).

	Mature sheep			Young sheep	Horses	Swine	Mules & Asses	Poultry	
	For meat or wool production or both	commercial milk production	Other (males)	Intact males, castrates & Females				Chicken (1)	ducks, geese, etc.(2)
1988	590,22	6.838,09	217,21	1.579,05	122,13	4042,2	355,27	35856,16	4723,47
1989	559,69	6484,38	205,97	1497,37	122,41	4076,47	351,51	36770,38	4843,90
1990	535,52	6204,34	197,08	1432,71	120,45	4225,23	349,19	34523,50	4547,91
1991	514,06	5955,66	189,18	1375,28	117,16	4259,10	347,42	28423,85	3744,38
1992	468,41	5426,78	172,38	1253,15	114,85	3663,99	335,32	21959,95	2892,87
1993	368,47	4268,97	135,60	985,79	113,99	2910,56	322,03	18369,90	2419,94
1994	274,41	3179,21	100,99	734,14	113,41	2375,53	305,86	21149,37	2786,09
1995	229,09	2654,12	84,31	612,89	123,08	2028,76	294,69	20819,73	2742,66
1996	216,93	2513,21	79,83	580,35	141,78	2063,10	301,10	16671,62	2196,22
1997	204,83	2373,11	75,38	548,00	160,50	1820,23	273,06	15390,86	2027,50
1998	187,70	2174,62	69,08	502,16	148,34	1490,09	239,41	13692,69	1803,79
1999	179,04	2074,24	65,89	478,98	129,79	1600,62	189,01	13453,35	1772,26
2000	142,63	1652,50	52,49	381,60	137,20	1276,43	140,67	15528,73	2045,66
2001	106,45	1233,33	36,37	264,40	140,67	809,90	145,50	15221,82	2005,23
2002	106,54	1234,38	37,36	271,60	145,50	892,46	147,17	14636,46	1928,12
2003	105,59	1223,32	42,21	292,34	138,51	1014,39	134,99	17673,16	1849,54
2004	104,48	1210,50	39,47	291,08	125,66	981,85	128,28	18239,40	1970,25
2005	99,63	1233,17	36,14	278,44	124,00	937,20	130,23	17182,20	2331,35
2006	97,55	1207,74	36,87	276,68	121,50	977,82	130,23	17582,00	2254,00
2007	106,91	1157,90	36,48	279,61	120,00	950,63	130,23	17192,50	2235,00
2008	102,40	1113,38	35,54	249,31	144,14	836,13	130,23	16095,50	2028,00
2009	79,07	1087,72	33,64	237,11	171,68	756,72	139,80	15883,50	1591,00
2010	72,49	1041,76	27,20	242,67	142,15	696,90	135,60	14063,00	1871,00
2011	78,62	1054,48	27,19	251,01	143,95	636,13	137,70	13606,50	1688,50
2012	80,94	1048,25	30,61	248,28	145,78	569,61	138,65	13493,50	1464,50

(1) broiler and layer chickens, roosters, chicks
(2) ducks, geese, turkeys, guinea-fowls, wild poultry

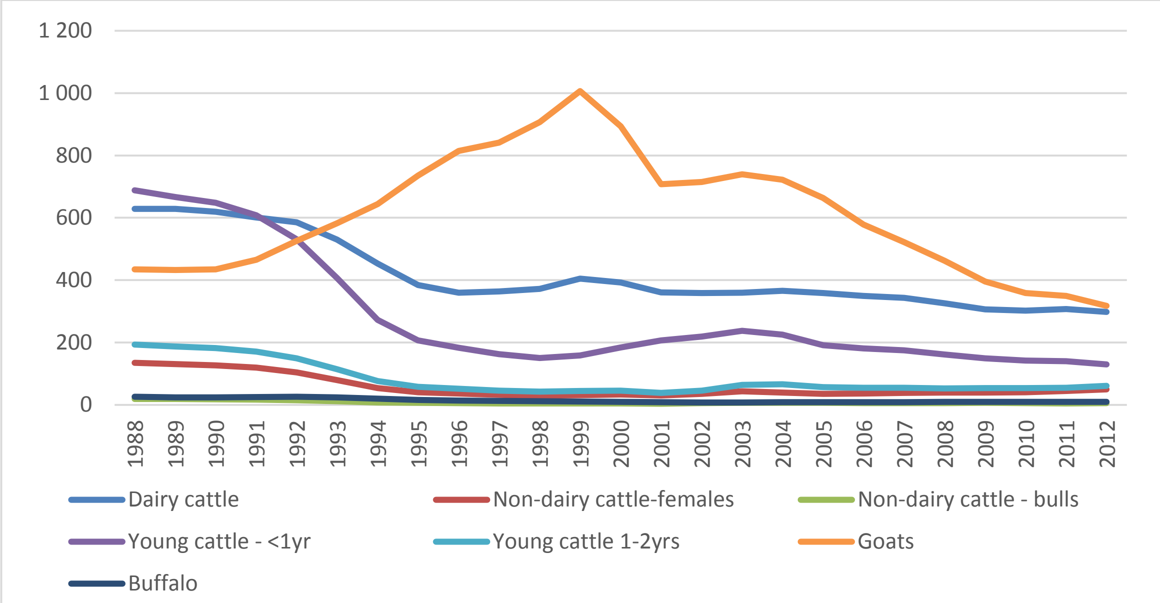


Figure 75 Domestic livestock populations (I)

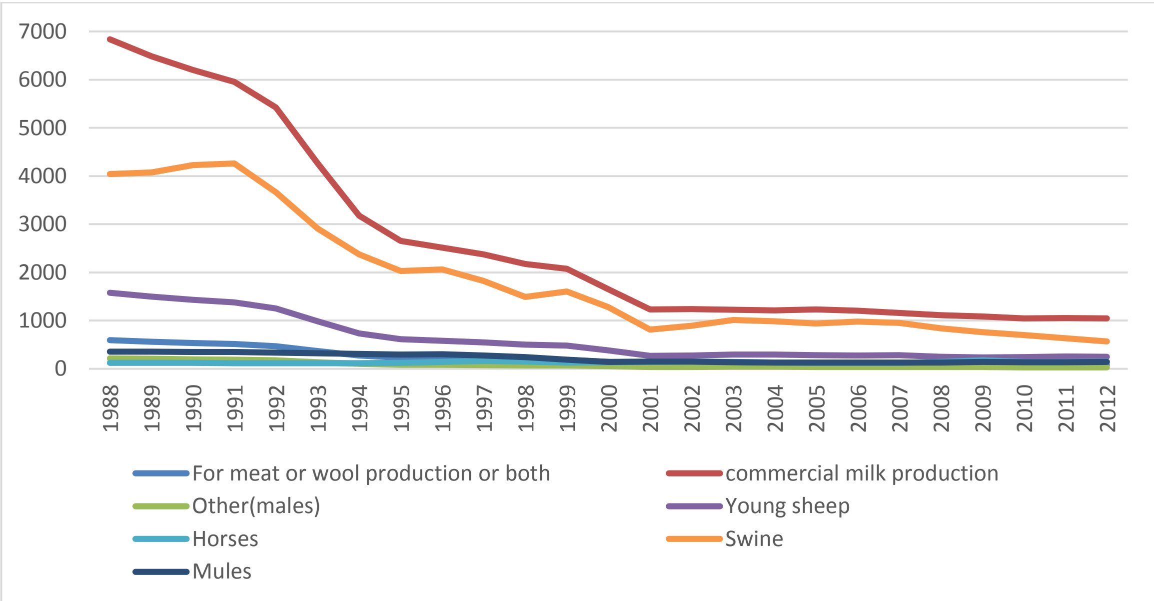


Figure 76 Domestic livestock populations (II)

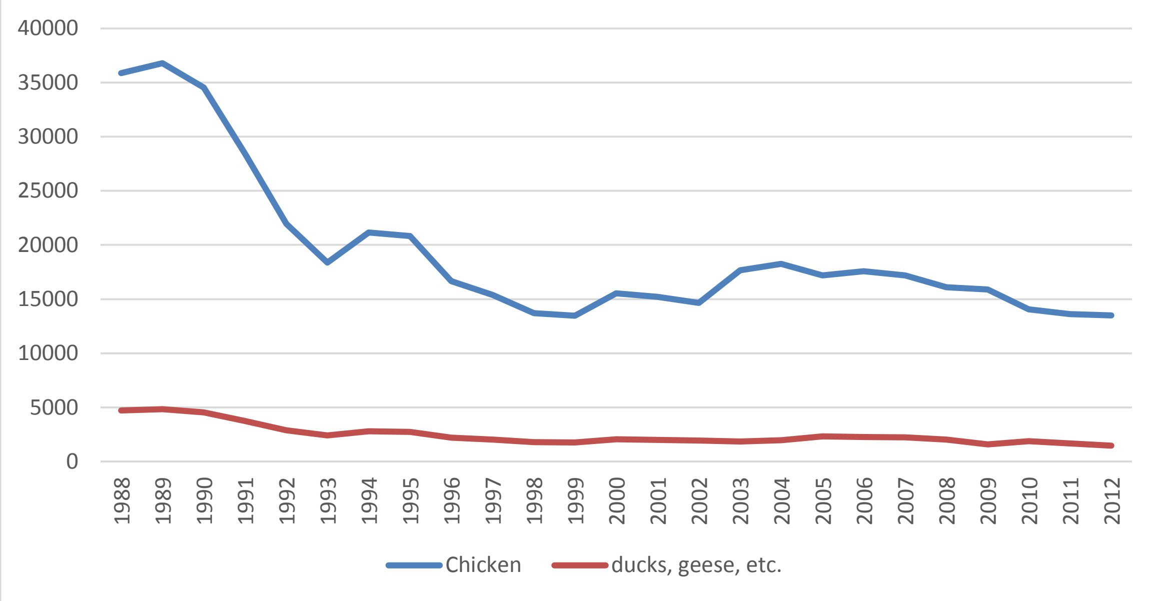


Figure 77 Domestic livestock populations (III)

6.4.2.3.1 Milk yield and fat content

The milk yield is obtained by dividing the milk production by the number of dairy cows. It is measured in kg per head. The Agrostatistics department at the Ministry of Agriculture and Food calculates the milk production by adding up the amount of milk collected by the dairy industry directly from the farmers;

Over the period 2000-2012, the milk yield has increased by 0,7%. At the same time the dairy cattle population declined by 51%. As these two parameters are the main drivers for the calculation of the EF under the Tier 2 method, it is no surprise to have slight fluctuations in the EF expressed in CH_4/head/year.

The average fat content of milk for 2012 is 3.76%

Table 170 Milk yield, gross energy intake and EFs for dairy cattle: 2000 – 2012

Year	Milk Yield [kg/cow*yr]	Gross Energy Intake [MJ/head*day]	Emission Factor [kg CH_4/head*yr]
2000	4639	286,53	112,76
2001	4091	271,55	106,86
2002	4383	279,54	110,01
2003	4346	278,54	109,61
2004	4383	279,54	110,01
2005	4420	280,54	110,4
2006	4456	281,37	110,73
2007	4091	271,4	106,8
2008	4346	279,02	109,8
2009	4344	278,94	109,77
2010	4366	279,57	110,02
2011	4381	279,98	110,18
2012	4265	276,77	108,92

Source: *Ministry of Agriculture and Food, Agrostatistics Department*

6.4.2.3.2 Live weight

Live-weight for most animal categories has been provided by the Agrostatistics department of Ministry of Agriculture and Food. The live weight of mature dairy cattle, mature non-diary These data are not published as such and, therefore, might be considered as expert judgments. However, they rely on measurements and are not purely speculative. These weights are constant over time and are provided in Table 171.

Table 171 Live-weight for farm animals reported in the inventory

<table>
<tr><th>Livestock category</th><th colspan="2">Live-weight in kg used for estimating enteric fermentation emissions</th></tr>
<tr><td>4A1 – Cattle – Mature Dairy Cattle</td><td colspan="2">588</td></tr>
<tr><td>4A1 – Cattle – Mature Non-Dairy Cattle – Females</td><td colspan="2">613</td></tr>
<tr><td>4A1 – Cattle – Mature Non-Dairy Cattle – Males</td><td colspan="2">880</td></tr>
<tr><td>4A1 – Cattle – Young Cattle – Calves</td><td colspan="2">195</td></tr>
<tr><td>4A1 – Cattle – Young Cattle – Growing Heifers</td><td colspan="2">375,5</td></tr>
<tr><td>4A3 - Sheep-Mature ewes where either meat or wool production or both is the primary purpose</td><td colspan="2">61</td></tr>
<tr><td>4A3 - Sheep-Mature ewes where commercial milk production is the primary purpose</td><td colspan="2">45.2</td></tr>
<tr><td>4A3 - Mature Sheep-Other(males)</td><td colspan="2">65</td></tr>
<tr><td rowspan="2">4A3 - Young sheep - Intact males, castrates & Females</td><td>Slaughter body weight</td><td>15</td></tr>
<tr><td>Weight at weaning</td><td>12.9</td></tr>
<tr><td>4A8 – Swine</td><td colspan="2">104</td></tr>
<tr><td>4A9 – Poultry – Chickens</td><td colspan="2">2.1</td></tr>
<tr><td>4A10 – Other – Other Poultry</td><td colspan="2">4,7</td></tr>
</table>

Source: Ministry of agriculture and Food, Agrostatistiscs department

6.4.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty from methane emissions from this source is 50%.

Table 172 Uncertainty of sub-sector Enteric Fermentation for 2012, %

CRF categories	Key Category	GHG	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
4.A.1	Cattle	CH_4	2	20	20
4.A.2	Buffalo	CH_4	2	20	20
4.A.3	Sheep	CH_4	2	20	20
4.A.4	Goats	CH_4	2	20	20
4.A.6	Horses	CH_4	2	20	20
4.A.7	Mules and Asses	CH_4	2	20	20
4.A.8	Swine	CH_4	2	20	20
4.A.9	Poultry	CH_4	2	20	20

Uncertainty values are the default ones from the IPCC Guidelines

6.4.4 SOURCE-SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken.

Data were checked for transcription errors between input data and calculation sheets. Calculations were examined focusing on units/scale and formulas. Quality Control following the GPG is described in the chapters of the sub-categories.

Activity data check

The inventory compiler reviews livestock data collection methods, in particular checking that livestock subspecies data were collected and aggregated correctly. The data is cross-checked with previous years to ensure the data are reasonable and consistent with the expected trend. Inventory compilers documents data collection methods, identifies potential areas of bias, and evaluate the representativeness of the data.

Review of emission factors

- Cross-check country-specific factors against the IPCC defaults;
- Sector specific QA/QC procedures are intensified according to QMS;
- Comparison of emissions using alternative approaches (Tier 1 method);
- Compared national statistics activity data with data from Food and Agriculture Organization of the United Nations (FAO);
- Documentation and archiving of all information required in NIR, national statistic of agriculture and food provided by MAF, background documentation and archive.

Revision of activity data and emission factors:

- Animal population and animal categories;
- Correction of notation key and cross-check with CRF tables (especially CRF table 8);

In general the TACCC is improved.

6.4.5 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

There are no planned improvements for this category.

6.5 MANURE MANAGEMENT

6.5.1 SOURCE CATEGORY DESCRIPTION

CH_4 and N_2O emissions from manure management are given in Table 173 and Table 174.

Table 173 CH_4 emissions from Manure management 1988 –2012, Gg

CH_4 emissions from manure management [Gg]										
Livestock categories										
	4.B Total	4.B.1.a Dairy	4.B.1.b Non Dairy	4.B.1.c Young	4.B.2 Buffalo	4.B.3 Sheep	4.B.4 Goats	4.B.6 Horses	4.B.8 Swine	4.B.9 Poultry
1988	174,49	2,05	0,21	0,70	0,23	1,14	0,08	0,26	166,65	3,18
1989	175,88	2,05	0,20	0,68	0,22	1,08	0,08	0,26	168,07	3,26
1990	181,70	2,02	0,19	0,66	0,21	1,03	0,08	0,25	174,20	3,06
1991	182,41	1,96	0,18	0,62	0,22	0,99	0,08	0,25	175,60	2,52
1992	157,08	1,91	0,16	0,54	0,23	0,90	0,09	0,24	151,06	1,94
1993	114,85	1,73	0,12	0,41	0,21	0,71	0,10	0,24	109,69	1,63
1994	85,56	1,48	0,08	0,28	0,18	0,53	0,12	0,24	80,80	1,87
1995	66,24	1,25	0,06	0,21	0,14	0,43	0,13	0,26	61,91	1,84
1996	59,43	1,17	0,05	0,19	0,12	0,41	0,15	0,30	55,56	1,48
1997	46,24	1,18	0,05	0,16	0,11	0,39	0,15	0,34	42,49	1,36
1998	33,00	1,21	0,04	0,15	0,10	0,36	0,16	0,31	29,44	1,21
1999	29,49	1,32	0,05	0,16	0,09	0,34	0,18	0,27	25,88	1,19
2000	19,86	1,31	0,05	0,21	0,09	0,28	0,16	0,29	16,09	1,38
2001	15,55	1,15	0,04	0,22	0,07	0,21	0,13	0,30	12,09	1,35
2002	18,88	1,17	0,05	0,24	0,06	0,20	0,13	0,31	15,42	1,30
2003	23,65	1,17	0,07	0,28	0,07	0,21	0,13	0,29	19,91	1,53
2004	25,29	1,20	0,06	0,26	0,07	0,20	0,13	0,26	21,53	1,58
2005	26,36	1,18	0,06	0,23	0,07	0,20	0,12	0,26	22,71	1,53
2006	29,51	1,15	0,06	0,23	0,07	0,20	0,10	0,26	25,90	1,55
2007	30,72	1,09	0,06	0,20	0,08	0,19	0,09	0,25	27,24	1,52
2008	29,20	1,06	0,06	0,20	0,08	0,18	0,08	0,30	25,81	1,42
2009	28,29	1,00	0,06	0,18	0,08	0,17	0,07	0,36	25,00	1,37
2010	27,68	0,99	0,06	0,18	0,08	0,16	0,06	0,30	24,60	1,25
2011	26,93	1,01	0,07	0,19	0,09	0,17	0,06	0,30	23,85	1,20
2012	24,36	0,96	0,07	0,18	0,09	0,17	0,06	0,31	21,36	1,17
Share 2012		3,96%	0,30%	0,73%	0,35%	0,69%	0,23%	1,26%	87,68%	4,81%
Trend 1988–2012	-86,04%	-52,95%	-65,16%	-74,56%	-62,27%	-85,36%	-26,97%	19,37%	-87,18%	-63,14%

Table 174 N_2O emissions from Manure management 1988 –2012, Gg

Year	N_2O emissions from manure management [Gg] Livestock categories									
	4.B Total	4.B.1.a Dairy	4.B.1.b Non Dairy	4.B.1.c Young	4.B.2 Buffalo	4.B.3 Sheep	4.B.4 Goats	4.B.6 & 7 Horses, Mules & Asses	4.B.8 Swine	4.B.9 Poultry
1988	5,28	1,14	0,21	0,80	0,0014	1,48	0,09	0,23	0,14	1,19
1989	5,20	1,14	0,20	0,77	0,0013	1,41	0,09	0,23	0,14	1,22
1990	5,03	1,12	0,20	0,75	0,0013	1,35	0,09	0,22	0,15	1,15
1991	4,69	1,09	0,18	0,70	0,0014	1,29	0,10	0,22	0,15	0,94
1992	4,20	1,06	0,16	0,61	0,0014	1,18	0,11	0,22	0,13	0,73
1993	3,57	0,95	0,12	0,47	0,0013	0,93	0,12	0,21	0,16	0,61
1994	3,11	0,80	0,08	0,31	0,0011	0,69	0,14	0,20	0,19	0,70
1995	2,79	0,68	0,06	0,23	0,0009	0,58	0,16	0,20	0,20	0,69
1996	2,62	0,63	0,05	0,20	0,0008	0,55	0,17	0,21	0,25	0,55
1997	2,52	0,63	0,05	0,18	0,0007	0,52	0,18	0,20	0,26	0,51
1998	2,39	0,64	0,04	0,16	0,0006	0,47	0,19	0,17	0,24	0,45
1999	2,45	0,69	0,04	0,17	0,0006	0,45	0,22	0,14	0,30	0,45
2000	2,34	0,66	0,05	0,19	0,0005	0,36	0,19	0,12	0,26	0,52
2001	2,07	0,62	0,04	0,20	0,0004	0,27	0,15	0,12	0,16	0,50
2002	2,10	0,63	0,05	0,23	0,0004	0,27	0,15	0,12	0,16	0,49
2003	2,25	0,65	0,07	0,27	0,0004	0,27	0,16	0,12	0,17	0,57
2004	2,25	0,67	0,06	0,26	0,0004	0,26	0,15	0,11	0,15	0,58
2005	2,17	0,67	0,06	0,23	0,0005	0,27	0,14	0,11	0,13	0,57
2006	2,12	0,65	0,06	0,22	0,0005	0,26	0,12	0,11	0,12	0,58
2007	2,06	0,64	0,06	0,22	0,0005	0,25	0,11	0,11	0,11	0,57
2008	1,95	0,61	0,06	0,20	0,0005	0,24	0,10	0,11	0,08	0,53
2009	1,83	0,57	0,06	0,19	0,0005	0,23	0,08	0,13	0,06	0,50
2010	1,75	0,56	0,06	0,19	0,0005	0,22	0,08	0,12	0,05	0,47
2011	1,73	0,57	0,07	0,19	0,0005	0,23	0,07	0,12	0,04	0,45
2012	1,70	0,55	0,07	0,19	0,0005	0,23	0,07	0,12	0,03	0,44
Share 2012	-	32,6%	4,4%	10,9%	0,0%	13,3%	4,0%	7,1%	1,7%	26,0%
Trend 1988–2012	-67,8%	-51,3%	-64,4%	-76,6%	-62,3%	-84,8%	-27,0%	-47,5%	-79,3%	-62,8%

The analysis of Table 173 shows a decrease of 2,74% in CH_4 emission for the present inventory, compared to the emissions from the preceding year and maintaining the low level compared to the base 1988 year – i.e. 84,6%% reduction. N_2O emissions have decreased by 1,1% compared to the previous year and 67,2% compared to the base year

6.5.2 METHODOLOGICAL ISSUES

6.5.2.1 Methods

The IPCC Tier 2 methodology has been applied to estimate CH_4 emissions from manure management of cattle and swine as these are key sources. This method requires detailed information on animal characteristics and the manner in which manure is managed.

The following formula has been used (IPCC GPG 2000, Equation 4.17):

$$EF_i = VS_i * 365 \text{ [days yr}^{-1}] * B_{0i} * 0.67 \text{ [kg m}^{-3}] * \Sigma_{jK} MCF_{jK} * MS\%_{ijK}$$

EF_i = *annual emission factor (kg) for animal type i (e.g. dairy cows)*

VS_i = *Average daily volatile solids excreted (kg) for animal type i*

B_{0i} = *maximum methane producing capacity (m³ per kg of VS) for manure produced by animal type I*

MCF_{jK} = *methane conversion factors for each manure management system j by climate region K*

$MS\%_{ijK}$ = *fraction of animal type i`s manure handled using manure systems j in climate region K*

Sheep, goats, horses, mules, asses, and other animals are of minor importance in Bulgaria, therefore the CH_4 emissions of these livestock categories are estimated with the Tier 1 approach with default EFs from the IPCC guidelines.

Table 175 Methane conversion factors

AWMS	Allocation by climate	MCF
Anaerobic lagoon	Temperate	90%
Liquid system	Cool	39%
Daily spread	Cool	0.1%
Solid storage	Cool	1
Pasture range and paddock	Cool	1%
Pit storage <30days<	Cool	22.5%
Other	Cool	1%

A survey conducted with the Agricultural University of Plovdiv, provided data about the distribution of AWMS. The survey provided data for 4 pillar years – 1995, 2000, 2005 and 2010. This data as well as interpolated data is provided in Table 176.

Table 176 AWMS distribution for cattle, swine, and poultry

	Cattle			Swine			Poultry	
	Solid storage	Dry lot	Pasture range paddock	Anaerobic lagoon	Solid storage	Dry lot	Solid storage	Dry lot
1988	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%	50%	50%
1989	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%	50%	50%
1990	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%	50%	50%
1991	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%	50%	50%
1992	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%	50%	50%
1993	35,2%	44,6%	20,2%	84,0%	12,5%	3,5%	50%	50%
1994	36,7%	42,3%	21,0%	75,7%	17,3%	7,0%	50%	50%
1995	38,4%	40,0%	21,6%	67,8%	22,0%	10,2%	50%	50%
1996	40,0%	37,7%	22,3%	59,7%	26,6%	13,7%	50%	50%
1997	41,6%	35,4%	23,0%	51,6%	31,3%	17,1%	50%	50%
1998	43,2%	33,1%	23,7%	43,5%	36,0%	20,5%	50%	50%
1999	44,8%	30,7%	24,5%	35,4%	40,6%	24,0%	50%	50%
2000	46,4%	28,4%	25,2%	27,4%	45,3%	27,4%	50%	50%
2001	45,0%	31,5%	23,5%	32,6%	42,8%	24,6%	50%	50%
2002	43,6%	34,3%	22,1%	37,9%	40,3%	21,8%	50%	50%
2003	42,2%	37,5%	20,3%	43,2%	37,8%	19,0%	50%	50%
2004	40,7%	40,6%	18,7%	48,4%	35,3%	16,3%	50%	50%
2005	39,3%	43,6%	17,1%	53,6%	32,9%	13,5%	50%	50%
2006	36,8%	46,1%	17,1%	58,7%	29,3%	12,0%	50%	50%
2007	34,3%	48,7%	17,0%	63,6%	25,7%	10,7%	50%	50%
2008	32,8%	51,1%	16,1%	68,6%	22,1%	9,3%	50%	50%
2009	29,2%	53,7%	17,1%	73,5%	18,6%	7,9%	50%	50%
2010	26,7%	56,1%	17,2%	78,6%	15,0%	6,4%	50%	50%
2011	26,5%	56,3%	17,3%	83,6%	11,5%	5,0%	50%	50%

6.5.2.2 Estimating N_2O emissions from manure management

Following the guidelines, all emissions of N_2O taking place before the manure is applied to soils are reported under manure management.

For the estimation of N_2O emissions from manure management systems only a Tier 1 approach is available. The IPCC Guidelines method for estimating N_2O emissions from manure management entails multiplying the total amount of N excretion (from all animal species/categories) in each type of manure management system by an emission factor for that type of manure management system. Emissions are then summed over all manure management systems (see formulas below).

<u>N excretion per animal waste management system:</u>

$$Nex_{(AWMS)} = \sum_{(T)}[N_{(T)} \times Nex_{(T)} \times AWMS_{(T)}]$$

$Nex_{(AWMS)}$ = *N excretion per animal waste management system [kg yr^{-1}]*

$N_{(T)}$ = *number of animals of type T in the country*

$Nex_{(T)}$ = *N excretion of animals of type T in the country [kg N animal^{-1} yr^{-1}]*

$AWMS_{(T)}$ = *fraction of $Nex_{(T)}$ that is managed in one of the different distinguished animal waste management systems for animals of type T in the country*

T = *type of animal category*

<u>N_2O emission per animal waste management system:</u>

$$N_2O_{(AWMS)} = \sum[Nex_{(AWMS)} \times EF_{3(AWMS)}]$$

$N_2O_{(AWMS)}$ = *N_2O emissions from all animal waste management systems in the country [kg N yr^{-1}]*

$Nex_{(AWMS)}$ = *N excretion per animal waste management system [kg yr^{-1}]*

$EF_{3(AWMS)}$ = *N_2O emissions factor for an AWMS [kg N_2O-N per kg of Nex in AWMS]*

AWMS

The animal waste management systems distribution data applied to estimate N_2O emissions from *Manure Management* is the same as used for the estimation of CH_4 emissions from *Manure Management* (see **Table 176**).

6.5.2.3 Nitrogen excretion

Table 177 Nitrogen excretion rates of animal livestock categories.

Livestock category	Nitrogen excretion [kg/animal*yr.]
Mature Dairy Cattle	71,54
Mature Non Dairy Cattle Females	53,66
Mature Non Dairy Cattle Males	53,66
Young Cattle - Calves	30,7
Young Cattle - Growing Heifers	53,66
Buffalo	50
Mature Sheep	16
Young Sheep	8
Goats	17
Horses	25
Mules & Asses	42,5
Swine(average) - Pigs <20kg - Pigs20-50 kg - Pigs 50-80kg - Pigs 80-110kg - Breeding pigs - boars	8,53 2,46 5,09 8,71 12,65 13,47 13,47 13,47
Poultry avergage Poultry Chickens Other Poultry	0,93 0,82 1,87

6.5.2.4 Emission factors

N_2O emission factors of the IPCC GPG 2000 have been used for all AWMS.

Emission factors applied in the Bulgarian inventory are listed in the following table:

Table 178 Emission factors for N_2O from manure management

Animal Waste Management System	Emission factor [kg N_2O-N per kg N excreted]	Reference
Anaerobic lagoon	0.001	IPCC GPG 2000, Table 4.12
Liquid system	0.001	IPCC GPG 2000, Table 4.12
Daily spread	0.00	IPCC GPG 2000, Table 4.12
Solid storage	0.020	IPCC GPG 2000, Table 4.12
Pasture range, paddock	0.020	IPCC GPG 2000, Table 4.12
Pit storage <30days<	0.001	IPCC GPG 2000, Table 4.12
Other	0.001	IPCC GPG 2000, Table 4.12

6.5.2.5 Activity data

The time series for the different types of domestic animals has been consistent despite the change of the survey methodology in the year 2000. Data is collected from the Agricultural Statistics Department of the MAF, FAO Database and National Statistics Institutes' yearbooks 1990-2012.

Animal numbers are the same as the ones used for calculating emissions from enteric fermentation and are presented in Table 168 and Table 169, except pigs are divided into sub-categories in order to estimate more accurately the nitrogen excretion. Division of pigs is presented in Table 179. Data for estimating nitrogen excretion from cattle is shown in Table 180.

Table 179 Activity data for estimating nitrogen excretion from swine

		2008	2009	2010	2011	2012
Pigs < 20 kg	Population size	146496	135654	127246	129926	119 371
	Kg Manure/day	1,5	1,5	1,5	1,5	1,5
Pigs 20-50 kg	Population size	163994	162787	141764	131418	147 203
	Kg Manure/day	3,1	3,1	3,1	3,1	3,1
Pigs 50 - 80 kg	Population size	126151	117215	107584	106988	103 933
	Kg Manure/day	5,3	5,3	5,3	5,3	5,3
Pigs 80 - 110 kg	Population size	198574	161380	142807	124380	93 856
	Kg Manure/day	7,7	7,7	7,7	7,7	7,7
Pigs > 110 kg,	Population size	200915	179689	177499	143422	105 243

		2008	2009	2010	2011	2012
breeding pigs and boars	Kg Manure/day	8,2	8,2	8,2	8,2	8,2
Kg N in 1000 Kg manure		4,5	4,5	4,5	4,5	4,5
Weighted Nex		8,98	8,78	8,85	8,53	7,99

Table 180 Activity data for estimating nitrogen excretion from cattle

		2008	2009	2010	2011	2012
Mature dairy cattle	Population size	325277	305713	302461	307504	297796
	Kg Manure/day	40,0	40,0	40,0	40,0	40,0
Mature non-dairy cattle	Population size	44506	44635	44607	48911	53782
	Kg Manure/day	30,0	30,0	30,0	30,0	30,0
Fattering claves under 1 year	Population size	67799	62464	58238	61842	57717
	Kg Manure/day	15,0	15,0	15,0	15,0	15,0
Other calves under 1 year	Population size	93101	86432	83124	77913	72061
	Kg Manure/day	15,0	15,0	15,0	15,0	15,0
Bovine 1-2 years	Population size	13826	13463	13210	12316	12376
	Kg Manure/day	30,0	30,0	30,0	30,0	30,0
Heifers	Population size	38972	39525	40005	42564	48146
	Kg Manure/day	30,0	30,0	30,0	30.0	30.0
Kg N in 1000 Kg manure		4,9	4,9	4,9	4,9	4,9

6.5.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of CH_4 emissions from this source is 50% and of N_2O emissions - 300%.

Table 181 Uncertainty of sub-sector Manure Management for 2012, %

CRF categories	Key Category	GHG	Activity data uncertainty, %	Emission factor uncertainty, %	Combined uncertainty, %
4B	N_2O emission from Manure	N_2O	2	300	300.0

CRF categories	Key Category	GHG	Activity data uncertainty, %	Emission factor uncertainty, %	Combined uncertainty, %
	Management				
4B1	Cattle	CH_4	2	20	20
4B.2	Buffalo	CH_4	2	50	50
4B.3	Sheep	CH_4	2	50	50
4B.4	Goats	CH_4	2	50	50
4B.6	Horses	CH_4	2	50	50
4B.7	Mules and Asses	CH_4	2	50	50
4B.8	Swine	CH_4	2	20	20
4B.9	Poultry	CH_4	2	50	50

Default values from the IPCC guidelines

6.5.4 SOURCE-SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken.

Activity data check

The inventory compiler reviews livestock data collection methods, in particular checking that livestock subspecies data were collected and aggregated correctly. The data is cross-checked with previous years to ensure it is reasonable and consistent with the expected trend. Inventory compilers document data collection methods, identify potential areas of bias, and evaluate the representativeness of the data. Population modelling can be used to support this approach.

Review of emission factors

If cross-check country-specific factors against the IPCC defaults finds significant differences between country-specific factors and default factors are explained and documented.

6.5.5 SOURCE-SPECIFIC RECALCULATIONS

The full time series is recalculated due to the newly determined emission factors.

Animal type	Reason for recalculation	Recalculated period
4A1c & 4B1c – Young Cattle	Change in animal weights due to recommendations from the ESD review	1988-2010
4B9 - Poultry	Change in awms distribution and nitrogen excretion	1988-2010

6.5.6 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Collection of data for implementation higher ensure TACCC (see above)

Collection of data for dividing swine into sub-categories and data regarding each sub-category AWMS distribution in order to imply Tier 2 method since the N_2O emissions from swine manures are a key category.

Analyse if its time/resources effective to develop specific parameter values for 4A9-Poultry since agrostatistics department provide breakdown of Poultry in various sub-categories.

6.6 RICE CULTIVATION (CRF SECTOR 4C)

6.6.1 SOURCE CATEGORY DESCRIPTION

Rice cultivation is a traditional Bulgarian agricultural activity. During the structural reforms, rice crop areas decreased from 13 600 ha in 1988 to 1 417 ha in 1999. There has been a restoration of rice crop areas after 1999, reaching 9 944 ha in 2012.

83,53 Gg CH_4 CO_2-eq. has been emitted in 2012. Emission decrease by 16% compared to the year 2011 which is due to the decrease of the areas with rice crops.

In Bulgaria rice is produced under the continuously flooded water regime with season length of 103 days and one harvest per year[31].

6.6.2 METHODOLOGICAL ISSUES

6.6.2.1 Methods

CH_4 emission calculation is carried out according to the default method from the IPCC Guidelines using default emission factor for continuously flooded water regime.

6.6.2.2 Emission factors

Emission factors are the default ones from IPCC Guidelines.

Standard Emission Factor	20	Table 4.22 IPCC GPG 2000
Scaling factor water management	1	Table 4.20 IPCC GPG 2000
Scaling factor organic amendments	2	Table 4.22 IPCC GPG 2000
Emission factor	40	IPCC Reference manual

6.6.2.3 Activity data

Data comes from the Agricultural Statistics Department of the Ministry of Agriculture and Food based on surveys on yields of main crops, and for the years before National Statistics Institutes'' yearbooks and FAO's database.

[31] as proposed in table 4-11 in IPPC Reference Manual 1996

6.6.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of methane emissions from this source is 20%

6.6.4 SOURCE-SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken.

6.6.5 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

There are no planned improvements for this category.

6.7 AGRICULTURAL SOILS (CRF SECTOR 4D)

6.7.1 SOURCE CATEGORY DESCRIPTION

The emissions from this subsector include the following main categories N_2O emissions:

- Direct emissions;
- Emissions from pasture animals;
- Indirect emissions.

These three categories above are key sources in the year 2012.

Direct emissions result from:

- Soil fertilization with synthetic nitrogenous fertilizers;
- Nitrogen input from manure applied to soils (excluding manure from pasture animals);
- Decomposition of waste from N-fixing crops;
- Decomposition of vegetable waste from other cultures;
- Cultivation of histosols.

The emissions of **pasture animals** include emissions from the excretion on pasture range and paddock.

Indirect emissions include:

- ammonia and nitrous oxides release in the ambient air after nitrogen fertilization;
- emissions from drawing of water.

Activities described above are differentiated according to the IPCC classification. One has to take into consideration that the existing emissions of methane from soil are considered natural (non-anthropogenic) and is not subject of the inventory.

Direct N_2O emissions are 2244 Gg CO_2-eq. in 2012. The emission increase by 9,01% in 2012 compared to 2011

Indirect N_2O emissions were 1377 Gg CO_2-eq. in 2012. The emissions from this increase by 14,05% compared to 2011.

The N2O emissions from pasture animals are 272,5 Gg CO_2-eq. which is an decrease by 1,27% compared to 2011.

6.7.2 METHODOLOGICAL ISSUES

6.7.2.1 Methods

The IPCC Tier 1a and – where applicable – Tier 1b method was applied and IPCC default emission factors were used.

Table 182 N_2O emissions factors for agricultural soils.

Category	Emission Factor [t N2O-N/t N]	Source
4.D.1 Direct Soil Emissions		
Synthetic fertilizers (mineral fert.)	0.0125	IPCC GPG 2000 (Table 4.17)
Animal waste applied to soils		
N-fixing crops		
Crop residue		
Sewage sludge spreading		
4.D.2 Pasture, range and paddock manure		
Grazing animals	0.02/ t N_{exGRAZ}	1996 IPCC GL (Table 4.22)
4.D.3 Indirect soil emissions		
Atmospheric deposition	0.01/ t of volatized nitrogen	IPCC GPG 2000 (Table 4.18)
Nitrogen leaching (and run-off)	0.025/ t N-loss by leaching	IPCC GPG 2000 (Table 4.18)

6.7.2.2 Emission factors

Emission factors are the default ones from the 1996 IPCC Guidelines. So far, there are no assessments of these emission factors, which result from measurements in the country.

6.7.2.3 Activity data

The manure quantity is calculated using the prototype parameters for different types of animals in the Eastern Europe region, given in the IPCC Guidelines.

The synthetic fertilizers quantities are provided by the National Service for Plant Protection at the Ministry of Agriculture and Food.

Annual crop production data is provided by the Agrostatistics department at the Ministry of Agriculture and Food and is cross-checked with FAO database and National Statistics Institute's yearbooks.

Category	Data Sources
4.D.1 Direct soil emissions	
Synthetic fertilizers (mineral fert.)	National service for Plant Protection

Animal waste applied to soils	Calculations within source category 4.B
N-fixing crops	Agrostatistics department
Crop residue	Harvested amount of agricultural crops - MAF
Sewage sludge spreading	Data from wastewater treatment plants
4.D.2 Pasture, range and paddock manure	
Grazing Animals	Calculations within source category 4.B
4.D.3 Indirect soil emissions	
Atmospheric deposition	The amount of manure left for spreading was calculated within source category 4.B. Mineral fertiliser data
Nitrogen leaching (and Run-off)	see above (synthetic fertilizers, animal waste, sewage sludge)

6.7.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty from the direct N_2O emissions from this source is 250% and from the indirect emissions - 500%.

Table 183 Uncertainty of sub-sector Manure Management for 2012, %

CRF categories	Key Category	GHG	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
4D1	Direct soil emissions	N_2O	3	250	250
4D2	Pasture, Range and Paddock Manure	N_2O	3	250	250
4D3	Indirect Emissions	N_2O	3	500	500

Default values

6.7.4 SOURCE-SPECIFIC QA/QC

All activities regarding QC as described in QA/QC System have been undertaken.

6.7.5 SOURCE-SPECIFIC RECALCULATIONS

The parameters of manure processing were slightly modified in compliance with the IPCC Guidelines.

6.7.6 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Collection of data for implementation higher TIER and ensure TACCC (see above).

6.8 FIELD BURNING OF AGRICULTURAL RESIDUES (CRF SECTOR 4F)

6.8.1 SOURCE CATEGORY DESCRIPTION

This sector covers the emissions of non-CO_2 greenhouse gases from the burning (in the field) of crop residue and other agricultural waste on site.

Despite field burning is prohibited by the Bulgarian law, this "tradition" continues and is emission source not only of main GHGs but also of GHGs-precursors.

34,27 Gg CO_2-eq. aggregated GHGs were emitted in 2012. This is a decrease of 5,73%, compared to 2011. The estimations are based on the expert judgement that 3% of the vegetal residues, left on the fields after yielding the crops, are burned.

6.8.2 METHODOLOGICAL ISSUES

According to the provisions in IPCC GPG 2000, the calculation methodology took into account 1996 IPCC GL default emissions ratios (Table 4-16 of Reference Manual). Emission ratios are presented in Table 149.

Table 184 Default emission factors for burning of agricultural residues

Gas	Default IPCC 1996 emission ratios
Methane	0.005
Carbon monoxide	0.06
Nitrous oxide	0.007
Nitrous oxides	0.121

Activity data is provided by the Statistical Department of the MAF.

Table 185 Specific parameters used for calculation of Total carbon released

GREENHOUSE GAS SOURCE AND SINK CATEGORIES						
	Residue/ Crop ratio	Dry matter fraction of residue	Fraction burned in fields	Fraction oxidized	C fraction of residue	N - C radio in biomass residues
1.Cereals						
Wheat	1,3	0,55	0,03	0,9	0,4853	0,01
Barley	1,2	0,55	0,03	0,9	0,4567	0,01
Maize	1	0,78	0,03	0,9	0,4709	0,02
Oats	1,3	0,92	0,03	0,9	0,4466	0,016
Rye	1,6	0,9	0,03	0,9	0,4238	0,01
Rice	1,4	0,85	0,03	0,9	0,4144	0,016
Maize for silage	1	0,78	0,03	0,9	0,4709	0,017
2.Pulses						
Dry beans	2,1	0,85	0,03	0,9	0,4812	0,05
Peas	1,5	0,87	0,03	0,9	0,4466	0,031
Soybeans	2,1	0,86	0,03	0,9	0,4129	0,056
Lentils	0,3	0,18	0,03	0,9	0,4642	0,036
Chick peas	2,1	0,18	0,03	0,9	0,4642	0,036
3.Tubers and Roots						
Potatoes	0,4	0,45	0,03	0,9	0,42	0,026
Sugar beet	0,2	0,15	0,03	0,9	0,41	0,02
4.Other						
Cotton	2,4	0,65	0,03	0,9	0,45	0,02
Sunflower	1,2	0,4	0,03	0,9	0,47	0,02
Peanuts	1	0,86	0,03	0,9	0,4612	0,023

Tobacco	1,2	0,4	0,03	0,9	0,47	0,02
Feetbeet	0,3	0,2	0,03	0,9	0,41	0,06

6.8.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of methane emissions from this source is 50% and of N_2O emissions – 200%, with very high uncertainty of the activity data.

6.8.4 SOURCE-SPECIFIC QA/QC

All activities regarding QC as described in QA/QC System have been undertaken.

Activity data has been cross-checked with FAO's statistical database.

6.8.5 SOURCE-SPECIFIC RECALCULATIONS

There are no recalculations for this category

7 LAND-USE, LAND-USE CHANGES AND FORESTRY (CRF SECTOR 5)

7.1 GENERAL OVERVIEW LULUCF

Land Use, Land-Use Change and Forestry (LULUCF) sector includes emissions and greenhouse gas removals from different land-use types, changes in the land-use and forestry. The greenhouse gas inventory of LULUCF sector comprises emissions and removals of CO_2 due to overall carbon gains or losses in the relevant carbon pools of the predefined six land-use categories. These pools are above-ground biomass, below-ground biomass, dead organic matter (litter and dead wood) and soils. The methodology used to calculate emissions and removals in LULUCF follows that of the IPCC Good Practice Guidance for LULUCF 2003 (IPCC GPG 2003). The predefined land-use types under IPCC GPG are Forest land (FL), Cropland (CL), Grassland (GL), Wetland (WL), Settlements (S), Other land (OL). In accordance with the IPCC GPG 2003 emissions and removals should be reported into two sub-categories – land remaining in the same category and land converted to another land-use category. All the land-use changes were traced down and reported for a transition period of 20 years (as require in IPCC GPG 2003) after which they are reported in the respective categories.

7.1.1 SECTOR COVERAGE

In the 2014 Inventory submission Bulgaria reports carbon stock changes, as well as greenhouse gas emissions and removals from Forest Land (CRF 5.A), Cropland (CRF 5.B) and Grassland (CRF 5.C), Wetlands (CRF 5.D) and Settlements (CRF 5.C). The quantity of of CH_4 and N_2O emissions is estimated for these sub-categories, where they occur. The completeness of the estimated emissions from sources and removals by sinks is shown in the table below.

Table 186 Overview of subcategories of CRF Sector 5 – LULUCF: status of emission estimates for CO_2, CH_4 and N_2O

Land-Use Categories	Net CO_2 emissions/removals	CH_4	N_2O
A. Forest Land	**x**	**x**	**x**
1. Forest Land remaining Forest Land	x	x	x
2. Land converted to Forest Land	x	x	x
B. Cropland	**x**	**NO**	**x**
1. Cropland remaining Cropland	x	NO	NO
2. Land converted to Cropland	x	NO	x
C. Grassland	**x**	**NO**	**NO**
1. Grassland remaining Grassland	NO	NO	NO
2. Land converted to Grassland	x	NO	NO
D. Wetlands	**x**	**NO**	**NO**
1. Wetlands remaining Wetlands	NE,NO	NO	NO
2. Land converted to Wetlands	x	NO	NO
E. Settlements	**x**	**NO**	**NO**
1. Settlements remaining Settlements	NE	NO	NO

Land-Use Categories	Net CO_2 emissions/removals	CH_4	N_2O
2. Land converted to Settlements	x	NO	NO
F. Other Land	**NO**	**NO**	**NO**
1. Other Land remaining Other Land			
2. Land converted to Other Land	NO	NO	NO

7.1.2 EMISSION TRENDS

The emissions and removals in the different categories are presented in Table 187.

Table 187 Net emissions and removals of greenhouse gases from land use, land use changes and forestry by categories in CO_2 eq.

Year	Total CO_2 removals	5 A Total Forestland	5 B Total Cropland	5 C Total Grassland	5 D Total Wetlands	5 E Total Settlements	5 F Total Other land
1988	-13787.68	-14775.49	937.77	-632.69	0.00	682.72	NO
1989	-13650.93	-14800.45	1099.46	-632.69	0.00	682.74	NO
1990	-13507.82	-14807.29	1255.93	-632.69	0.00	676.22	NO
1991	-13377.56	-14840.77	1409.74	-632.69	0.00	686.15	NO
1992	-13036.68	-14685.15	1585.01	-632.69	0.00	696.14	NO
1993	-12320.16	-14229.62	1866.13	-632.69	0.00	676.01	NO
1994	-12099.23	-14238.68	2092.69	-632.69	0.00	679.44	NO
1995	-12569.69	-14840.25	2205.25	-632.69	12.64	685.36	NO
1996	-10114.87	-12496.38	2308.57	-632.69	20.25	685.39	NO
1997	-10106.33	-12491.41	2291.18	-632.69	41.18	685.41	NO
1998	-10043.12	-12239.64	2086.95	-632.69	56.83	685.43	NO
1999	-10031.18	-12187.51	2031.04	-632.69	72.52	685.46	NO
2000	-8337.17	-10495.76	2015.54	-632.69	88.24	687.50	NO
2001	-8232.87	-10329.86	1996.63	-632.69	103.71	629.34	NO
2002	-8682.92	-10800.82	1993.61	-632.69	119.04	637.94	NO
2003	-8714.73	-10897.56	2061.20	-632.69	134.23	620.09	NO
2004	-8892.75	-11019.86	2006.43	-632.69	149.27	604.09	NO
2005	-8784.05	-11020.66	1995.62	-632.69	164.18	709.50	NO
2006	-8304.19	-10495.54	1906.29	-632.69	178.94	738.81	NO
2007	-6950.59	-9170.39	1831.09	-632.69	193.57	827.83	NO
2008	-8127.26	-10495.71	1786.71	-632.69	208.04	1006.39	NO
2009	-8460.69	-10652.91	1750.33	-632.69	222.37	852.21	NO
2010	-8268.87	-10534.11	1638.64	-632.69	236.56	1022.72	NO
2011	-8394.15	-10537.19	1571.60	-632.69	250.87	953.26	NO
2012	-8207.49	-10352.49	1572.96	-632.69	265.31	939.42	NO

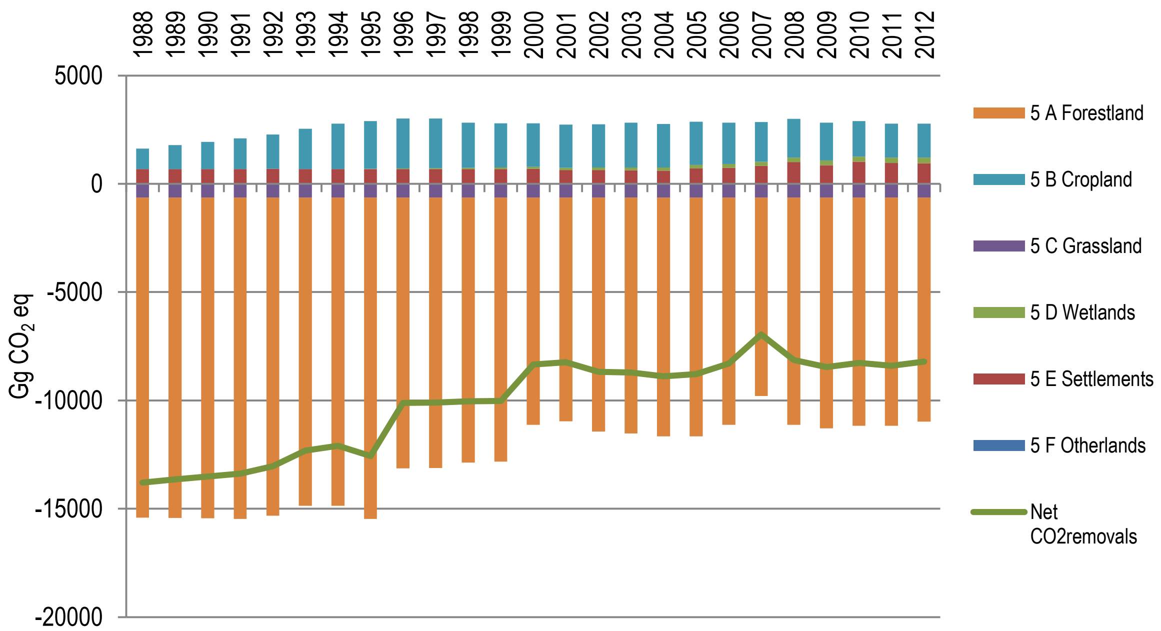


Figure 78 LULUCF emissions and removals 1988 – 2012 CO_2 eq.

The figure shows that the LULUCF sector is serving as a sink of greenhouse gases for Bulgaria. The two categories – "Forest land" and "Grassland" are removals of CO_2. All other categories are sources of CO_2 emissions. The trend of net CO_2 removals (CO_2 eq) from LULUCF decreases by 40.47% compared to the base year. The main reason for the overall decrease of the uptakes of CO_2 emissions from LULUCF is due to the fall in removals from category Forest land and the slight increase in emissions from CL, WL and SM categories. The key driver for the fall in removals from FL is the observed decline in the rate of forest growth as the average age of the forest stands increases steadily over the reporting period. In spite of the decrease observed, the share of the removals from the total GHG emissions (in CO_2eq) is still remarkable. The reason for this is that the emissions in the other sectors have dropped dramatically. The share of the removals in the base year has the figure of -11,3% from the total GHG emissions in CO_2eq, while in the inventoried year the share is -13.5%.

Comparing with the base year an increase in the emissions in croplands, settlements and wetlands is observed. The total emissions from croplands fluctuate during the whole time series. The emissions from Settlements increase last couple of years due to changes from other land uses to Settlements according to the risen infrastructural activities since Bulgaria's joined the EU.

7.1.3 KEY CATEGORIES

The key source categories within this sector are presented in the table below.

Table 188 Key sources of LULUCF sector

Source categories	GHG	Key category assesment - level and trend assesment
5A1 Forest land remaining Forest land	CO2	LA1988; LA2012, TA
5A2 Land use change to Forest land	CO2	LA 2012
5B1 Cropland remaining Cropland	CO2	LA 2012, TA
5B2 Land use change to Cropland	CO2	LA1988; LA2012, TA
5C2 Land use change to Grassland	CO2	LA 2012, TA
5E2 Land use change to Settlements	CO2	LA 2012, TA

7.1.4 METHODOLOGY

The inventory is based on the principles envisaged in the 2003 IPCC GPG. All land-use changes were traced down and reported for a transition period of 20 years after which they are reported in the respective categories.

7.1.5 LAND AREA REPRESENTATION AND LAND USE TRANSITION MATRIX

7.1.5.1 Information on approaches and database used for representing land areas. Land-use definitions and the classification systems used and their correspondence to the LULUCF categories.

As it was mentioned above, the LULUCF sector consists of the following categories: Forest land, Cropland, Grassland, Wetlands, Settlements and Other land. According to the IPCC Good Practice Guidance for LULUCF, all land areas within a country should be assigned to one of these categories. Bulgarian definitions for the land use categories are given in the individual category sections in this chapter.

The land area representation is assembled based on data from different statistical sources (Table 189). Therefore, when compiling the data available for land area representation, the following hierarchical treatment of the data sources has been performed, from top to bottom:

- Top priority is given to the most reliable data which comes from systematically measured statistics and ortho photoimages. This data is used to present the total area of each particular land use cateogry for the whole time series
- Concerning estimation of LUCs between categories, priority is given to estimates based on specific information on land-use changes rather than to estimates of LUCs based on expert judgement
- Estimates of LUCs between categories based on expert judgement are with higher priority than estimates of LUCs based on data gaps
- Data gaps

Hence, the area of forestland is obtained from the National Forest Inventory and Forest Management Plans (data provider Executive Forest Agency). Information on CL and GL areas is gathered from National Statistical Yearbooks and orthophotoimages. The National Statistical Yearbooks provide information on CL and GL areas over the period 1988-2000. The balance of the territory of Bulgaria based on orthophotoimages has been available since

2010. To ensure a full time-series interpolation between the years 2000 and 2010 has been applied. Concerning the data on WL and SM, information on its area for single years (1994, 1996) has been obtain from the cadastral maps of the agricultural fund of Bulgaria (Balance by Type of Territories as per their Designation, Cadastre Agency) as well as data from the balance of the territory of Bulgaria based on orthophotoimages for the year 2012. In order to cover the time series – interpolation and extrapolation have been applied. Information on rocks and landslides from the forestry fund reporting forms (NFI, FMP, Executive Forest Agency) is referred to category "Other land". The total national area of 11100.19 kha remains constant over time. Thus, in accordance with IPCC GPG 2003, the difference of the area of all land-use category and the whole area of the country is referred to "Other land" category in order to avoid double accounting or omission of an area.

Table 189 Information on data sources and providers

<table>
<tr><th rowspan="2">Land use category</th><th colspan="2">Main data source</th><th colspan="2">Data provider</th></tr>
<tr><th>1988-1999</th><th>2000-2012</th><th>1988-2000</th><th>2000-2008</th></tr>
<tr><td>5A Forest land</td><td colspan="2" rowspan="4">National Forest Inventory, Forestry Management Plans and its Forestry fund reports</td><td colspan="2" rowspan="4">Executive Forest Agency (ExFA)</td></tr>
<tr><td>coniferous</td></tr>
<tr><td>deciduous</td></tr>
<tr><td>forests out of yield</td></tr>
<tr><td>5B Cropland</td><td rowspan="3">National Statistical Yearbooks</td><td rowspan="3">balance of the territory of Bulgaria based on orthophotoimages for the years 2010-2012; inbetween interpolation</td><td rowspan="3">National Statistic Institute (NSI)</td><td rowspan="3">Ministry of agriculture and food (MAF)</td></tr>
<tr><td>annual cropland</td></tr>
<tr><td>perennial cropland</td></tr>
<tr><td>5C Grassland</td><td>National Statistical Yearbooks</td><td>balance of the territory of Bulgaria based on orthophotoimages for the years 2010-2012; inbetween interpolation</td><td>National Statistic Institute (NSI)</td><td>Ministry of agriculture and food (MAF)</td></tr>
<tr><td>5D Wetlands</td><td colspan="2" rowspan="2">Cadastral maps of the agricultural fund for single years 1994 and 1996; balance of the territory of Bulgaria based on orthophotoimages for 2012 - inbetween interpolation</td><td colspan="2" rowspan="2">Cadastre Agency and MAF</td></tr>
<tr><td>5E Settlement</td></tr>
<tr><td>5D Other land</td><td colspan="2">National Forest Inventory, Forestry Management Plans and its Forestry fund reports</td><td colspan="2">Executive Forest Agency (ExFA)</td></tr>
</table>

Major problem in presenting the land use pattern is the limited information on the land-use changes between particular categories. The activity data providers identify the total area for each individual land-use category, but they do not provide detailed information on changes of area between each category. Thus, the approach 1 according to the IPCC GPG 2003 has been used for representing the area. When data for completing the information is missing, information from available statistics as well as probability assumptions of known pattern on land-use changes have been used. Thereby, the remaining LUC areas to forests have been assumed to stem from cropland, grassland and other lands. The assessment of the former land use on the identified new forest areas is based on expert judgment on basis of likelihoods. The assessment of the former land use has been done by forestry experts from the Executive Forest Agency (ExFA).The time series in the area statistics shows different trends in the years before and after 2000. Therefore, the time series was divided into these two periods and the land-use changes from cropland, grassland and other lands to forest land were fitted to the different trends in these two periods.

As regards reporting of LUCs to cropland and grassland, information from agricultural statistics (BANSIK) has been used. The agrostatics provides information on LUCs between cropland and grassland as well as between annual and perennial crops and in reverse for a period of 12 years (2000-2012). Therefore, the remain annual LUCs between these categories and subcategories over the period 2000-2012 according to the statistics have been extrapolated back to 1988 in order to ensure the time series consistency. Any conversions and re-conversions from wetlands and settlements are considered as unlikely. Other lands are not suitable for cropland and grassland, therefore such transition between these categories is not reported.

For Submission 2014, the LUCs to wetlands have been assumed to stem from cropland and other land. The determination of these land use categories as the possible land-use changes where the increase in wetlands may stem from is based on the last step from the hierarchical treatment of the data sources – that is data gaps. It has been considered that the shares of these individual land use categories to the observed increase in wetlands behave like the ratios of the total areas of these land use categories in Bulgaria. In its previous submission Bulgaria reported LUCs from forestland to wetlands due to probability reasons. It was assumed that the observed increase in wetlands suggests also deforestation for wetlands. This forest loss to wetlands was estimated as a share of forest land in the totals of forest land, cropland plus grassland (it was supposed that the increase in wetlands comes from such lands). Actually the reported LUC from forestland to wetlands in the previous submissions of Bulgaria represented an overestimation of deforestation activity since all the information for forest loss due to changes in designation of forest was reported under LUCs to settlements (SM). Since the last improvements in area representation made for the Submission 2014 LUCs from forestland to wetlands were not calculated. According to experts from the ExFA, the changes of designation of forest in the years 1988-2012 have been associated with conversion only to SM. There is only one new dam lake (Tsankov kamak) which was built up in recent years but the forest loss associated with its construction works has been already reported in the 70's. Therefore, Bulgaria reports all information provided by the ExFA for forest loss across the time series as LUC associated with conversion to SM. The reported estimates of land-use changes from grassland to other land use categories (forestland and cropland), which are based on specific data and expert judgment, fit very well to the observed decrease in the total grassland area since the base year. Therefore, no land-use changes from grassland to wetlands have been assumed and reported.

Concerning the LUCs to settlements there is information for LUC from forest land to settlements, which is available for the period 1990-1994 and for the years 2001 to 2012. The annual forest loss to settlements for the years 1988, 1989 and 1995-2000 is estimated as an average value of forest loss in the period 1990-1994. Information for LUC from arable land (e.g cropland and grassland) to settlements is available for the years 2001 to 2012. The share of annual cropland, perennial cropland and grassland within the available figure for the total area, which is changed to settlement between 2001 and 2011, was assumed to be the same as the share of the totals of these land-use categories. LUCs from arable lands to settlements for the years before 2001 are estimated using the data gaps approach. The reported land-use changes to settlement fit very well to the increases in settlement area.

Additional information in details on the methodologies and assumptions used in the estimation of land use over the reporting period is presented in the chapters for the different types of land-use.

In accordance with the IPCC GPG 2003, Bulgaria reports the LUC areas within the LUC categories for a transition period of 20 years. Therefore, activity data back to 1968 is needed to report the LUC areas adequately. Due to the lack of data it is assumed that the trends of LUCs in the first years after 1988 were the same as in the years before. Consequently, the trends of the first years of the reporting period were extrapolated back to 1968.

Table 190 presents the total area of the respective land uses and land-use changes between categories for the base and the inventoried year as well as the net changes for the period.

Table 190 Area by type of land use and land-use changes for the base year and the last year of inventory

area in kha	1988	2012	2012-1988
5.A Forest Land - Total	3620	3850	229
5A1. Forest land remaining forest land	3479	3645	165
5A1a. Forest land remaining forest land – coniferous	1199	1073	-126
5A1b. Forest land remaining forest land – deciduous	2259	2549	290
5A1c. Forest land remaining forest land - out of yield	22	23	1
5A2. LUC in forest land	141	205	64
5A2.1.a Annual Cropland in forest land	19	36	18
5A2.1.b Perennial Cropland in forest land	1	2	1
5A2.2 Grassland in forest land	120	165	46
5A2.3 Wetland in forest land	0	0	0
5A2.4 Settlement in forest land	0	0	0
5A2.5 Other land in forest land	2	1	0
5.B Cropland - Total	4087	3818	-269
Cropland annual	3791	3608	-183
Cropland perennial	295	210	-85
5B1. Cropland remaining cropland	3820	3551	-269
5B1a annual cropland remaining annual cropland	3481	3297	-183
5B1b perennial cropland remaining perennial cropland	217	132	-85
5B1c LUC perennial cropland in annual cropland	57	57	0
5B1d LUC annual cropland in perennial cropland	65	65	0
5B2. LUC in cropland	266	266	0
5B2.1a Forest land in annual cropland	0	0	0
5B2.1b Forest land in perennial cropland	0	0	0
5B2.2a Grassland in annual cropland	253	253	0
5B2.2b Grassland in perennial cropland	13	13	0
5B2.3a Wetlands in annual cropland	0	0	0
5B2.3b Wetlands in perennial cropland	0	0	0
5B2.4a Settlements in annual cropland	0	0	0
5B2.4b Settlements in perennial cropland	0	0	0
5B2.5a Other land in annual cropland	0	0	0
5B2.5b Other land in perennial cropland	0	0	0
5.C. Grassland	2025	1812	-213
5C1. Grassland remaining grassland	1758	1545	-213
5C2. LUC in grassland	267	267	0
5C2.1 Forest land in grassland	0	0	0
5C2.2.a Annual cropland in grassland	243	243	0

area in kha	1988	2012	2012-1988
5C2.2.b Perennial cropland in grassland	24	24	0
5C2.3 Wetlands in grassland	0	0	0
5C2.4 Settlements in grassland	0	0	0
5C2.5 Other land in grassland	0	0	0
5 D Wetlands	214	231	17
5D1. Wetlands remaining wetlands	214	214	0
5D2. LUC in wetlands	0	17	17
5D2.1 Forest land in wetlands	0	0	0
5D2.2.a Annual Cropland in wetlands	0	16	16
5D2.2.b Perennial Cropland in wetlands	0	0	0
5D2.3 Grassland in wetlands	0	0	0
5D2.4 Settlement in wetlands	0	0	0
5D2.5 Other land in wetlands	0	2	2
5 E Settlements	794	856	62
5E1. Settlements remaining settlements	756	804	48
5E2. LUC in settlements	38	52	14
5E2.1 Forest land in settlements	2	3	1
5E2.2.a Annual Cropland in settlements	23	31	8
5E2.2.b Perennial Cropland in settlements	1	2	0
5E2.3 Grassland in settlements	12	16	4
5E2.4 Wetlands in settlements	0	0	0
5E2.5 Other land in settlements	0	0	0
5 F Other land	361	534	174
5F1. Other land remaining other land	361	534	174
5F2. LUC in other land	0	0	0
5F2.1 Forest land in other land	0	0	0
5F2.2.a Annual Cropland in other land	0	0	0
5F2.2.b Perennial Cropland in other land	0	0	0
5F2.3 Grassland in other land	0	0	0
5F2.4 Wetlands in other land	0	0	0
5F2.5 Settlements in other land	0	0	0
Total area of Bulgaria	11 100	11 100	11 100

The data shows that over the period 1988-2012 the areas in the categories "Forest land", "Wetlands" and "Settlements" and "Other land" have increased by 229.19 kha, 17.02 kha, 61.63 kha and 173.71 kha and they have decreased in the categories "Cropland" and "Grassland" by 268.92 kha and 212.62 kha respectively.

7.1.5.2 Development of land use transition matrix

The land use transition matrices (Table 191) describe the initial and final areas of particular land-use categories and the identified annual land-use conversions among these categories over the reporting period. It should be noticed that the annual totals for the individual years in the matrices do not correspond to the annual totals from CRF tables, where the changes are reported for a transition period of 20 years. Annual figures for area in transition have been derived by national area statistic when it is available and by basic assumption when data on land-use changes is not available (chapter 1.1.5.1).

Explanation on missing fit of the land-use changes and area changes of some subcategories are explained in the specific chapters.

Table 191 Annual land use and land-use change matrices

kha	FL	CL	GL	WL	SL	OL	1987
FL	3613.34				0.12		3613.45
CL	0.99	4073.25	13.35		1.19		4088.78
GL	5.99	13.31	2011.28		0.60		2031.18
WL				213.50			213.50
SL					792.29		792.29
OL	0.08					360.92	361.00
1988	3620.39	4086.55	2024.63	213.50	794.19	360.92	11100.19

kha	FL	CL	GL	WL	SL	OL	1988
FL	3620.27				0.12		3620.39
CL	0.99	4079.05	13.35	0.00	1.20		4094.58
GL	5.99	13.31	2011.48		0.60		2031.38
WL				213.50			213.50
SL					794.19		794.19
OL	0.08			0.00		346.07	346.15
1989	3627.33	4092.35	2024.83	213.50	796.10	346.07	11100.19

kha	FL	CL	GL	WL	SL	OL	1989
FL	3627.28				0.05		3627.33
CL	0.98	4089.45	13.35	0.00	1.24		4105.01
GL	5.94	13.31	1991.98		0.62		2011.85
WL				213.50			213.50
SL					796.10		796.10
OL	0.08			0.00		346.33	346.41
1990	3634.26	4102.75	2005.33	213.50	798.01	346.33	11100.19

kha	FL	CL	GL	WL	SL	OL	1990
FL	3634.12				0.15		3634.26
CL	0.99	4094.45	13.35	0.00	1.17		4109.96
GL	6.02	13.31	1986.98		0.59		2006.90
WL				213.50			213.50
SL					798.01		798.01
OL	0.08			0.00		337.49	337.56
1991	3641.20	4107.75	2000.33	213.50	799.91	337.49	11100.19

kha	FL	CL	GL	WL	SL	OL	1991
FL	3640.95				0.25		3641.20
CL	1.00	4092.45	13.35	0.00	1.11		4107.91
GL	6.10	13.31	1988.98		0.55		2008.95
WL				213.50			213.50
SL					799.91		799.91
OL	0.08			0.00		328.64	328.72
1992	3648.14	4105.75	2002.33	213.50	801.82	328.64	11100.19

kha	FL	CL	GL	WL	SL	OL	1992
FL	3648.09				0.05		3648.14
CL	0.98	4105.45	13.35	0.00	1.24		4121.01
GL	5.94	13.31	1975.98		0.62		1995.85
WL				213.50			213.50
SL					801.82		801.82
OL	0.08			0.00		319.80	319.87
1993	3655.08	4118.75	1989.33	213.50	803.73	319.80	11100.19

kha	FL	CL	GL	WL	SL	OL	1993
FL	3654.99				0.08		3655.08
CL	0.98	4113.45	13.35	0.00	1.22		4128.99
GL	5.96	13.31	1967.98		0.61		1987.86
WL				213.50			213.50
SL					803.73		803.73
OL	0.08			0.00		310.95	311.03
1994	3662.01	4126.75	1981.33	213.50	805.63	310.95	11100.19

kha	FL	CL	GL	WL	SL	OL	1994
FL	3661.90				0.12		3662.01
CL	0.99	4139.45	13.35	0.46	1.20		4155.44
GL	5.99	13.31	1946.98		0.60		1966.88
WL				213.50			213.50
SL					805.63		805.63
OL	0.08			0.03		296.62	296.73
1995	3668.95	4152.75	1960.33	214.00	807.54	296.62	11100.19

kha	FL	CL	GL	WL	SL	OL	1995
FL	3668.84				0.12		3668.95
CL	0.99	4138.45	13.35	0.46	1.19		4154.44
GL	5.99	13.31	1947.98		0.60		1967.88
WL				214.00			214.00
SL					807.54		807.54
OL	0.08			0.03		287.28	287.39
1996	3675.89	4151.75	1961.33	214.49	809.45	287.28	11100.19

kha	FL	CL	GL	WL	SL	OL	1996
FL	3675.77				0.12		3675.89
CL	0.99	4233.45	13.35	0.95	1.19		4249.92
GL	5.99	13.31	1891.98		0.60		1911.88
WL				214.49			214.49
SL					809.45		809.45
OL	0.08			0.06		238.43	238.56
1997	3682.83	4246.75	1905.33	215.49	811.35	238.43	11100.19

kha	FL	CL	GL	WL	SL	OL	1997
FL	3682.71				0.12		3682.83
CL	0.99	4233.45	13.35	0.95	1.19		4249.93
GL	5.99	13.31	1891.98		0.60		1911.88
WL				215.49			215.49
SL					811.35		811.35
OL	0.08			0.05		228.59	228.72
1998	3689.76	4246.75	1905.33	216.49	813.26	228.59	11100.19

kha	FL	CL	GL	WL	SL	OL	1998
FL	3689.65				0.12		3689.76
CL	0.99	4233.45	13.35	0.95	1.19		4249.93
GL	5.99	13.31	1891.98		0.60		1911.88
WL				216.49			216.49
SL					813.26		813.26
OL	0.08			0.05		218.74	218.87
1999	3696.70	4246.75	1905.33	217.50	815.17	218.74	11100.19

kha	FL	CL	GL	WL	SL	OL	1999
FL	3696.59				0.12		3696.70
CL	0.99	4233.45	13.35	0.95	1.19		4249.93
GL	5.99	13.31	1891.98		0.60		1911.88
WL				217.50			217.50
SL					815.17		815.17
OL	0.08			0.05		208.89	209.02
2000	3703.64	4246.75	1905.33	218.50	817.07	208.89	11100.19

kha	FL	CL	GL	WL	SL	OL	2000
FL	3703.62				0.01		3703.64
CL	2.48	4184.20	13.35	0.94	0.51		4201.48
GL	9.64	13.31	1890.32		0.25		1913.52
WL				218.50			218.50
SL					818.21		818.21
OL	0.06			0.06		244.74	244.85
2001	3715.80	4197.51	1903.67	219.50	818.98	244.74	11100.19

kha	FL	CL	GL	WL	SL	OL	2001
FL	3715.68				0.12		3715.80
CL	2.50	4134.96	13.35	0.94	0.65		4152.40
GL	9.72	13.31	1888.65		0.33		1912.01
WL				219.50			219.50
SL					821.23		821.23
OL	0.06			0.07		279.14	279.26
2002	3727.96	4148.26	1902.00	220.50	822.33	279.14	11100.19

kha	FL	CL	GL	WL	SL	OL	2002
FL	3727.89				0.07		3727.96
CL	2.49	4085.71	13.35	0.93	0.71		4103.19
GL	9.69	13.31	1886.98		0.36		1910.33
WL				220.50			220.50
SL					824.54		824.54
OL	0.06			0.07		313.54	313.67
2003	3740.12	4099.02	1900.33	221.50	825.68	313.54	11100.19

kha	FL	CL	GL	WL	SL	OL	2003
FL	3740.04				0.08		3740.12
CL	2.49	4036.47	13.35	0.92	0.63		4053.86
GL	9.69	13.31	1885.31		0.32		1908.63
WL				221.50			221.50
SL					828.00		828.00
OL	0.06			0.08		347.94	348.08
2004	3752.28	4049.77	1898.66	222.50	829.03	347.94	11100.19

kha	FL	CL	GL	WL	SL	OL	2004
FL	3752.10				0.19		3752.28
CL	2.52	3987.22	13.35	0.91	2.32		4006.31
GL	9.78	13.31	1883.65		1.16		1907.89
WL				222.50			222.50
SL					828.71		828.71
OL	0.06			0.09		382.34	382.48
2005	3764.45	4000.53	1897.00	223.51	832.38	382.34	11100.19

kha	FL	CL	GL	WL	SL	OL	2005
FL	3764.29				0.15		3764.45
CL	2.51	3937.98	13.35	0.90	2.44		3957.17
GL	9.75	13.31	1881.98		1.22		1906.26
WL				223.51			223.51
SL					831.92		831.92
OL	0.06			0.10		416.74	416.89
2006	3776.61	3951.28	1895.33	224.51	835.73	416.74	11100.19

kha	FL	CL	GL	WL	SL	OL	2006
FL	3776.31				0.29		3776.61
CL	2.54	3888.73	13.35	0.89	2.96		3908.47
GL	9.86	13.31	1880.31		1.48		1904.96
WL				224.51			224.51
SL					834.34		834.34
OL	0.06			0.11		451.14	451.30
2007	3788.77	3902.04	1893.66	225.51	839.07	451.14	11100.19

kha	FL	CL	GL	WL	SL	OL	2007
FL	3787.94				0.83		3788.77
CL	2.65	3839.49	13.35	0.88	3.46		3859.82
GL	10.28	13.31	1878.65		1.73		1903.97
WL				225.51			225.51
SL					836.41		836.41
OL	0.06			0.12		485.54	485.71
2008	3800.93	3852.79	1892.00	226.51	842.42	485.54	11100.19

kha	FL	CL	GL	WL	SL	OL	2008
FL	3800.83				0.10		3800.93
CL	2.50	3790.24	13.35	0.88	2.08		3809.04
GL	9.71	13.31	1876.98		1.04		1901.03
WL				226.51			226.51
SL					842.56		842.56
OL	0.06			0.13		519.94	520.12
2009	3813.09	3803.55	1890.33	227.51	845.77	519.94	11100.19

kha	FL	CL	GL	WL	SL	OL	2009
FL	3812.79				0.31		3813.09
CL	2.54	3741.00	13.35	0.87	3.88		3761.63
GL	9.87	13.31	1875.31		1.94		1900.43
WL				227.51			227.51
SL					843.00		843.00
OL	0.06			0.14		554.34	554.53
2010	3825.25	3754.30	1888.66	228.52	849.12	554.34	11100.19

kha	FL	CL	GL	WL	SL	OL	2010
FL	3825.14				0.11		3825.25
CL	2.50	3754.29	13.35	0.87	2.17		3773.17
GL	9.72	13.31	1849.61		1.08		1873.72
WL				228.52			228.52
SL					849.11		849.11
OL	0.06			0.13		550.23	550.42
2011	3837.41	3767.60	1862.96	229.52	852.47	550.23	11100.19

kha	FL	CL	GL	WL	SL	OL	2011
FL	3837.19				0.23		3837.41
CL	2.52	3804.33	13.35	0.87	1.10		3822.17
GL	9.81	13.31	1798.66		0.55		1822.33
WL				229.52			229.52
SL					853.95		853.95
OL	0.06			0.13		535.63	535.82
2012	3849.58	3817.63	1812.01	230.52	855.82	535.63	11101.19

7.1.6 EMISSION FACTORS

The calculation of the emission factors follows to a great extent the methods, described in the IPCC. In those cases where possible, the emission factors are determined considering the specific conditions of the country. To calculate them data from national statistical sources and studies are used - the official reports of the forestry fund, the national system for environmental monitoring, the scientific research database in Bulgaria and other European countries.

7.1.7 RECALCULATIONS

The recalculations within LULUCF category are as a result of the following improvements which have been implemented in Submission 2014:

- Complete recalculation of the land area representation due to the availability of new data (e.g the balance of the territory of Bulgaria from orthophotoimages for the years 2010-2012, information on LUCs between cropland and grassland and in reverse over the period 2000-2012, new data on the increase in forest area)
- Recalculation of the reference stocks of organic carbon in soils under different land-use practices
- Change in the way of estimating the biomass loss associated with conversion from forest land to other land-use following the ERT's recommendations from the last review (FCCC/ARR/2013/BGR)
- Change in the way of estimating the emissons from dead wood associated with conversion from forest land to other land-use

According to Submission 2014 the overall removals from LULUCF category are by 4% lower for the base year (1988) and by 5% higher for the last inventoried year (2011).

7.2 FOREST LAND (5.A.)

7.2.1 DESCRIPTION OF THE CATEGORY

Forests in Bulgaria cover an area of 3 849 576 ha which represents 34.7% of the country's territory. Over the reporting period a steady increase in forest territory is observed. In 2012 the forests cover is by 6.3% more compared to the base year.

In accordance with the IPCC GPG the evaluation of the emissions/removals from Forest land category includes an assessment of the changes in the carbon stock in 3 pools – living biomass (above- and below-ground biomass), dead organic matter (dead wood and litter) and soil. The available database in Bulgaria allows to estimate the changes in the carbon stocks in the living biomass (above- and belowground biomass, including all leaves and needles), in the litter (fumic and humic layers) and in the soil pool (0-40 cm depth). Considering the calculations of changes in carbon stock of dead organic matter and soil from the subcategory Forest land remaining forest land tier 1 (IPCC GPG 2003) approach has been applied assuming there is no change in the stock of these carbon pools.

CO_2 and non-CO_2 emissions from wildfires (Table 193) are allocated between the subcategory 5.A.1 and 5.A.2 according to their area share in total forestland.

There is no fertilization on forest land in Bulgaria, therefore, direct N_2O emissions from fertilization are reported as NO (not occurring). Non-CO_2 emissions associated with drainage of organic soils are reported as NO, since such activity is not occurring in Bulgarian forests.

7.2.1.1 Trends in the emissions/removals from Forest category

The Forest category is serving as a sink of CO2 emissions over the entire time series. The amount of CO2 removals from the category ranges between 14 775.49 Gg CO2 eq. for 1988 and 10 352.49 Gg CO2 eq for 2012. Despite the observed increase in forest area (Figure 2), there is a drop in the amount of the removals from the category. This is due to a fall (by 30%) in removals from living biomass pool since 2000 in subcategory Forest land remaining forest land. This is caused by a decrease in the rate of forest growth as the average age of the forest stands increases steadily over the reporting period. At the same time the changes in soil carbon pools when converting other land to forests are associated with emissions – 825 Gg CO2. This is caused by the higher level of the organic carbon stock in soils of grassland and cropland compared to those of forest land.

Over the reporting period 1988-2012 the data for the total annual net emissions and removals of CO2 (biomass, litter and soils) are presented in Table 192.

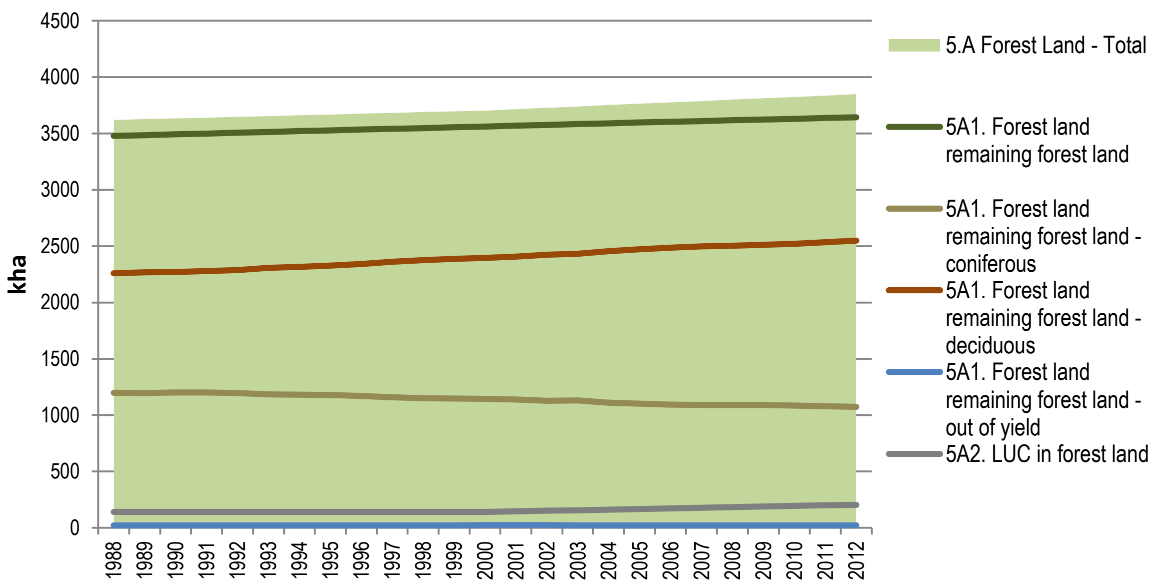


Figure 79 Trends of the changes in area within Forest land category

Table 192 Emissions/removals from Forest land category

year	5.A Total Forest land	5.A.1 FL remaining FL	5.A.2 Land converted to FL	CL to FL	GL to FL	WL to FL	SM to FL	OL to FL
1988	-14791.17	-14228.75	-562.42	-116.48	-410.08	0.00	0.00	-35.86
1989	-14808.02	-14245.44	-562.57	-116.64	-410.08	0.00	0.00	-35.86
1990	-14842.62	-14278.89	-563.74	-116.77	-411.13	0.00	0.00	-35.84
1991	-14858.11	-14296.30	-561.81	-116.65	-409.31	0.00	0.00	-35.85
1992	-14863.10	-14302.22	-560.88	-117.17	-407.83	0.00	0.00	-35.88
1993	-14846.13	-14279.08	-567.04	-119.67	-411.51	0.00	0.00	-35.87
1994	-14853.01	-14285.43	-567.58	-120.98	-410.74	0.00	0.00	-35.86
1995	-14858.88	-14291.40	-567.48	-121.54	-410.08	0.00	0.00	-35.86
1996	-12569.36	-12001.70	-567.66	-121.72	-410.08	0.00	0.00	-35.86
1997	-12517.79	-11949.88	-567.91	-121.97	-410.08	0.00	0.00	-35.86
1998	-12476.11	-11909.18	-566.93	-121.00	-410.08	0.00	0.00	-35.86
1999	-12468.91	-11901.80	-567.11	-121.18	-410.08	0.00	0.00	-35.86
2000	-12461.48	-11894.49	-566.99	-121.05	-410.08	0.00	0.00	-35.86
2001	-11014.56	-10539.34	-475.22	-98.60	-341.22	0.00	0.00	-35.39
2002	-11021.88	-10521.73	-500.15	-108.78	-356.43	0.00	0.00	-34.94
2003	-11070.84	-10542.56	-528.28	-119.56	-374.24	0.00	0.00	-34.49
2004	-11058.55	-10503.29	-555.26	-130.11	-391.12	0.00	0.00	-34.03
2005	-11069.75	-10489.27	-580.48	-140.36	-406.54	0.00	0.00	-33.58
2006	-10621.35	-10012.53	-608.82	-151.21	-424.48	0.00	0.00	-33.14
2007	-10644.61	-10010.79	-633.81	-161.44	-439.67	0.00	0.00	-32.70
2008	-10680.32	-10027.96	-652.36	-170.56	-449.46	0.00	0.00	-32.33
2009	-10729.99	-10033.51	-696.47	-184.53	-480.06	0.00	0.00	-31.88
2010	-10755.72	-10035.45	-720.27	-194.48	-494.33	0.00	0.00	-31.46
2011	-10780.36	-10028.28	-752.08	-206.18	-514.90	0.00	0.00	-31.00
2012	-10795.27	-10019.23	-776.04	-215.72	-529.79	0.00	0.00	-30.53

Table 193 Total emissions from forest wildfires 1988-2012 in CO_2 eq

year	area burnt (ha)	CO2 emission Gg CO2 equivalent	CH4 emission Gg CO2 equivalent	N2O emission Gg CO2 equivalent
1988	462,00	14,00	1,36	0,31
1989	223,00	6,76	0,66	0,15
1990	1041,00	31,56	3,07	0,70
1991	511,00	15,49	1,51	0,35
1992	5243,00	158,94	15,48	3,54
1993	18164,00	550,62	53,62	12,26
1994	18100,00	548,68	53,43	12,22
1995	549,00	16,64	1,62	0,37
1996	2150,00	65,17	6,35	1,45
1997	777,00	23,55	2,29	0,52
1998	6967,00	211,20	20,57	4,70
1999	8291,00	251,33	24,48	5,60
2000	57915,40	1755,64	170,98	39,10
2001	20173,04	611,52	59,55	13,62
2002	6513,00	197,43	19,23	4,40
2003	5105,55	154,77	15,07	3,45
2004	1139,90	34,55	3,37	0,77
2005	1446,20	43,84	4,27	0,98

year	area burnt (ha)	CO2 emission Gg CO2 equivalent	CH4 emission Gg CO2 equivalent	N2O emission Gg CO2 equivalent
2006	3706,54	112,36	10,94	2,50
2007	43434,60	1316,67	128,23	29,33
2008	5439,10	164,88	16,06	3,67
2009	2270,80	68,84	6,70	1,53
2010	6529,35	197,93	19,28	4,41
2011	7164,30	217,18	21,15	4,84
2012	13045.7	395.46	38.513	8.81

7.2.2 INFORMATION FOR THE APPROACHES USED TO PRESENT THE DATA ON THE AREAS AND THE DATABASE FOR LAND-USE, USED FOR THE INVENTORY

The National Forest Inventory (NFI) and the information from the Forest Management Plans (FMP) are the main sources of information for the area of forest land and its land-use changes. The NFI in Bulgaria covers assessments for the entire country territory in 10 years' cycles. Therefore, all forest stands are surveyed once in every 10 years. The stand-wise inventory in Bulgaria measures the main data as tree composition, origin, age, management purpose, tree height and diameter; annual increment, bonitat, density of stand, tree growing stock etc. Forest inventory presents collection of qualitative and quantitative data about the investigated area. On the other side, the management planning gives recommendations about the silvicultural operations and activities for the next 10 years period. The plans contain data for forests' territorial division and management, basic characteristics of the forest stands; complex of activities for protection, regeneration and optimal utilization of the forest resources; economic justification, considering ecological and social effects from the implementation of the planned activities. These plans are prepared in accordance with *Regulation № 6 on the structure of the forests and land included in the forest fund and the hunting reserves of Republic of Bulgaria.* The plans contain reporting forms for the forestry fund (FF) including information on: forest area (1FF), afforestated area (2FF), tree biomass stock (3TR), stock by groups of forests and forest cover (4FF), wood harvest (5FF), age and density (6FF) and types of forest stands (7FF). The reporting forms 1FF and 5FF are updated annually and the remaining forms every other 5th year and are submitted to the Regional Forestry Offices and in the Executive Forest Agency (ExFA). The process of forest inventory and planning is stable and consistent over time.

When compiling the data on forest areas, data from the forestry fund reports has been used. Although the high reliability of the gathered data, some adjustments of the original data have been made. In the Submission 2011 it was identified that the net increase in forest land was not only due to afforestation/reforestation (AR) activities but also due to inclusion of area, which were forested before 1990. In order to distinguish those new forest areas which were forested before 1.1.1990 from the total increase in forest area, Bulgaria submitted a plan for improvement of the estimation of AR units of land. In its submission 2014 Bulgaria continues to follow this plan as accepted by the ERT team as answer to the related Saturday paper issue of the 2011 review. The plan has been implemented in stages starting in Submission

2012 and completed for the Submission 2014. According to this plan the following improvement steps have been implemented:

Bulgaria examined the Forest Management Plans (FMPs – see below) for all State Forest Enterprises (SFE), which were inventoried for the period 1991-2012. Like this all changes since 1992 in forest area for each and every SFE has been traced and identified. For those SFE, where there is an increase in the forest area since 1990, the increase is derived into:

a. New forest areas which are included in the forest total, but which were forested before 1990, so new forests with stands of older age classes.
b. And the new forested areas with stands of the youngest age class, which are due to afforestation and reforestation activities (planting and seeding) on arable lands and barren areas or afforestation and reforestation activities (planting, manual and natural seeding) on grassland or on croplands.

These improvement steps have been performed by the experts from Executive Forest Agency, by using the following sources of information:

- Forest Inventory and FMPs[32];
- Forestry Fund Reporting Form 1FF[33] (forest area) for the 1990;
- Forest maps

The results from the revision of the FMPs are given in Chapter 11. The observed increase in forest area due to AR activities for every single SFEs is given for two periods - 1992-2000 and since 2000. The amount of the "new" forest areas since 1.1.1990 which were forested before 1990 (point a) was added to the total forest area in 1991 and the years after according to Forestry Fund Reporting Form 1FF (forest area). Like that the total forest area (particularly those of forest land remaining forest land) in 1991 and in the years after has been adjusted by using interpolation. The new forest areas between 2012 and 1992 according to point b represent the **net increase** in forest due to planting or seeding (manually or naturally) activities. Changes in forest area for the years 1988 – 1991 are based on extrapolation using the same forest change as in the year 1992.

In order to get information for the former land uses that became forests, an expert judgement has been used. Land use (cropland, grassland, other land) typically follows ecological site condition. The experts going through the FMPs know the dominating land uses in the SFE

[32] Forest Inventory and FMPs are carried out for each State Forest Enterprise. The inventory aims measurement and processing of the following main data:

1) Forest area and its changes
2) Tree composition, origin, age, management purpose
3) Tree height and diameter,
4) Annual increment, bonitat, density of the stands
5) Tree growing stock
6) Data about main rock, soil type and soil bonitat and other important habitat characteristics.

The measurements of the Forest Inventory are carried out for each and every SFE once in every 10 years.

[33] The reporting forms 1FF to 7 FF represent the forest fund reporting forms. The data gathered during the forest inventories is used as data base for preparation of the reporting forms of the forest fund

region, so they made an expert judgement of former land use on basis of likelihoods. For example, there are regions where grassland (GL) dominates, because growth/site conditions are not good enough for cropland (CL) plants or CL management or, site conditions are so good that CL dominates. Similarly, other land (OL) can be found in extreme site conditions where FL, CL, GL cannot grow.

7.2.3 DEFINITIONS AND CLASSIFICATION SYSTEMS USED IN COMPLIANCE WITH LULUCF CATEGORIES LAND-USE DEFINITIONS AND THE CLASSIFICATION SYSTEMS USED AND THEIR CORRESPONDENCE TO THE LULUCF CATEGORIES (E.G. LAND USE AND LAND-USE CHANGE MATRIX)

For defining forest, Bulgaria uses the definition in the Bulgarian Forest Act (last amendment 07.08.2012, SG №60):

"***Area over 0.1 ha, covered with forest tree species higher than 5 meters and tree crown cover over 10% or with trees which can reach these parameters in natural environment***".

Areas of natural forest regeneration outside urban areas with a size of more than 0.1 ha also represent "forest". City parks with trees, forest shelter belts, and single row trees do not fall under the category "forests.

According to their functions, forests are divided in: forests for timber production, protective and recreation forests and forests in protected areas.

Forests are also:

- areas which are in a process of recovering and are still under the parameters, but it is expected to reach forest crown cover over 10% and tree height 5 meters;
- areas, which as the result of anthropogenic factors or natural reasons are temporarily deforested, but will be reforested;
- protective forest belts, as well as tree lines with an area over 0.1 ha and width over 10 meters;
- cork oak stands."

All forests in Bulgaria are managed.

7.2.4 METHODOLOGY

7.2.4.1 Forest Land remaining Forest Land (5.A.1.)

7.2.4.1.1 Changes in the carbon stock in the living biomass

Bulgaria follows IPCC GPG 2003 and applies the stock change method when defining carbon stock changes in living biomass. Conversion coefficients used are specific for Bulgaria and the ones given in the IPCC GPG 2003 tables. The main database includes: forest area by type (coniferous and deciduous), and the volume stock (stem wood and branches) by forest type obtained from the forestry fund reports (1 FF and 4 FF). To calculate the changes in the carbon stock of the living biomass Method 2 of IPCC GPG 2003 is used.

$$\Delta C_{FFLB} = (C_{t2} - C_{t1})/(t2 - t1)$$

The carbon stock in the biomass is calculated using the equation:

$$C = [V \cdot D \cdot BEF_2] \cdot (1 + R) \cdot CF$$

where:

V – tree stock (stemwood and branches) m3 .ha-1

D –basic wood density, tonnes m -3

BEF_2 – expansion factor for conversion of the stem wood plus branches into a total aboveground tree biomass (stem, branches, leaves),

R – root to shoot ratio

CF – carbon fraction in the dry matter in tonnes C (tonnes d.m.)$^{-1}$

To determine the total quantity of carbon in tree biomass, data for the stemwood plus branches volume (V) is used. The Bulgarian national forest inventory assesses not only the stemwood volume but also the volume of the branches of the trees. Such data have been published on a regular basis in the reports of the forestry fund over a five year period since 1965. For this inventory, data on the wood volume are used separately for coniferous and deciduous forests for the years 1985, 1990, 1995, 2000, 2005 and 2010. The stock changes of the wood volumes were obtained by estimating the difference between the periods divided by 5.

Concerning basic wood density (D) national data is used. The calculations are based on values determined for Bulgaria for shrinkage and the density of the absolutely dry wood (Bluskova, G., 1994; Enchev, E., 1984). Density and shrinkage of the main Bulgarian tree species are available (Norway spruce, Scots pine, Silver fir, Oaks, Common beech, Ash, Willow, White birch, Common hornbeam, Elm).

The values for basic wood density are determined as weighed mean depending on the relative share of the stocks of the coniferous and the deciduous species in the Bulgarian forests. The calculations are made for the periods of which data on the wood stock is available for and an average out of these values is estimated. The variation of the values for the separate periods is from 0.7% for the coniferous to 1.1% for the deciduous.

Table 194 Wood density (D)

D- weighed mean wood density –tonnes m-3	1995	2000	2005	2010
Coniferous	0.427	0.430	0.431	0.430
Weighed mean value	0.430			
Deciduous	0.605	0.605	0.606	0.597
Weighed mean value	0.603			
Weighed mean value for all forests	0.528			

There are no specific values for the biomass expansion factor (BEF_2) for converting the stemwood+branches stock into a total aboveground biomass. Since the Bulgarian NFI assesses also the stock of branches the biomass expansion factor used does not need to account for this tree compartment, so BEF_2 has only to add the leaf biomass. To estimate this specific BEF_2 data from literary sources on results from ecosystem studies for Spruce, Scots pine, Beech and Oaks were used (compiled in Korner, C., Schilcher B. und Pelaez-Riedl S. 1993: Vegetation und Treibhausproblematik: Eine Beurteilung der Situation in Österreich unter besonderer Berücksichtigung der Kohlenstoff- Bilanz. In: ÖAW (Hrsg.): Anthropogene Klimaänderungen: Mögliche Auswirkungen auf Österreich – mögliche Maßnahmen in Österreich. Dokumentation, Österreichische Akademie der Wissenschaften, Wien, 6.1-6.46). The coefficients were recalculated as weighed mean according to the relative share of the forests of Spruce, Scots pine, Beech and Oak in the Bulgarian forests

Table 195 Biomass expansion factor for converting stemwood+branches into total aboveground biomass (BEF2)

Types of forests	Coniferous	Deciduous
BEF2	1.08	1.03
Mean	1.05	

Due to the lack of specific data for the ratio root to shoot (R) for Bulgaria coefficients presented in the IPCC Good Practice Guidance for LULUCF adapted to the conditions in the country (Table 196) are used. A weighed mean value according to the wood stock is determined for the deciduous forests based on the values for R in IPCC GPG (0.35 for oak forests and 0.26 for other deciduous). Concerning the coniferous the value of IPCC GPG is used.

Table 196 Root-to-shoot ratio (R)

Types of forests	Coniferous	Deciduous
R	0.32	0.28

The carbon fraction in the dry matter (CF) is adopted by default form the IPCC Good Practice Guidance for LULUCF. It is 0.5 tonnes C.

A permanent trend in increasing the volume stock in Bulgarian forest is observed. However, the carbon stock change of living biomass has decreased significally since 2000 (approx. with 20%). The key driver for the observed decline is the decrease in the rate of forest growth beacuse the average age of the forest stands increases over the reporting period.

Changes in the carbon stock in the dead organic matter

7.2.4.1.1.1 Changes in carbon stock in dead wood

For the changes in dead wood, the IPCC GPG Tier 1 approach was used, assuming that there are no changes in dead wood stocks in all managed forests remaining forests.

7.2.4.1.1.2 Changes in carbon stock in litter

Bulgaria reports CSC in litter under Tier 1 (IPCC GPG 2003), where litter inputs and outputs are assumed to balance and the pools therefore taken to be stable.

7.2.4.1.2 Changes in carbon stock in soils

No evaluation of the impact of the different systems of forest management and silviculture practices on the carbon contents of the Bulgarian soils have been carried out. There is no official information on the changes that took place over the last 20 years. Due to this reason it is assumed that the average stock of organic carbon in the soils is stable in terms of the types of forests, the manner of their management and the implemented silviculture practices. Therefore the tier 1 approach (IPCC GPG 2003) has been applied, which assume that the carbon stock change in mineral soils for sub-category Forest land remaining Forest land is zero.

Histosols cover 0,06% of the total area of Bulgaria and are in protected areas, where all anthropogenic impacts are forbidden. Therefore, there is no peat extraction, draining of soils or other anthropogenic activities that affect the water regime, the temperature on soil's surface and the species. Due to this reasons Histosols are not subject to evaluation.

7.2.4.1.3 Forest fires

There is no biomass burning as in Bulgarian forests the controlled fires are forbidden by law. Therefore, in the current report only emissions of CO_2, CH_4 and N_2O from wildfires have been calculated. For the estimates Tier 1 has been applied, equation 3.2.20 of IPCC GPG:

$$L_{fire\,(tGHG)} = A \cdot B \cdot C \cdot D \cdot 10^{-6}$$

where:

A – Area destroyed by fire, ha;

B – Quantity of wood burnt down, kg d.m. ha^{-1};

C – Burning efficiency;

D – Emission factor.

For the product of the quantity of the wood burnt down (B) and the burning efficiency (C) an average value of 19,8 tonnes/ha has been used (IPCC Good Practice Guidance for LULUCF). The values of the emission factors (D) have been taken from Table 3.A.1.16 from the IPCC GPG (for CO_2- 1531, for CH4 - 7.1 and for N_2O - 0.11).

Annual data for the areas affected by fires (A) has been obtained from the Executive Forest Agency and the National Parks in Bulgaria – Rila, Pirin and Central Balkan. Thus, all forest areas were covered by these data. Since the reporting system for wildfires in forests cannot define whether the wildfire happens in AR units of land or not, Bulgaria has shared these emissions between sub-category Forest lands remaining forest land and LUCs to forest land (Afforestation/reforestation areas). Therefore, the emissions from wildfires between these two sub-categories have been estimated according to their area share in total forestland

The total emissions from wildfires (e.g. 5.A.1 and 5.A.2) are presented in Table 193.

7.2.4.2 Lands converted to forests (5.A.2.)

This subcategory includes activities related to the conversion of lands from other type of land-use to forests. The changes in the carbon stocks and emissions and removals of greenhouse gases of lands converted to forests over the last 20 years have been estimated.

7.2.4.2.1 Changes in the carbon stock in the living biomass

To determine the changes in the carbon stock in the living biomass data for the stemwood and branch stock for the first age class (1-20 years) has been used. An average annual increment of the stock (stemwood and branches) of the first age class was determined to 6.5 m3/ha/y, obtained by dividing the stock of the stands of I^{st} age class by average age of 10 years. This value has been used for all land use changes to forests.

In Inventory 2012, the value for wood density (D) of forest stands of first age class has been recalculated due to new NFI data (2010). The weighed mean value for D was determined for the total first age class of the Bulgarian forests according to the wood stock of the single species – 0,505 tonnes m^{-3}. This value has been used for all land use changes to forests.

There are no specific values for the biomass expansion factor (BEF_2) for converting the stemwood+branches stock into total aboveground biomass of the I^{st} age class. Since the Bulgarian NFI assesses also the stock of branches the biomass expansion factor used does not need to account for this tree compartment, so BEF_2 has only to add the leaf biomass. To estimate this specific BEF_2 data from literary sources on results from ecosystem studies for Spruce, Scots pine, Beech and Oaks for the I^{st} age class stands were used (compiled in Korner et al.1993). The coefficients were recalculated as weighed mean according to the relative share of Spruce, Scots pine, Beech and Oak in the first age class of the Bulgarian forests. Table 197 presents the values for BEF_2 .

Table 197 Biomass expansion factor for converting stemwood+branches into total aboveground biomass (BEF_2) for the first age class

Types of forests	Coniferous	Deciduous
BEF_2	1.10	1.08
Mean	1.09	

For the ratio root-to-shoot of the young trees one coefficient is used (R=0,29). It is being calculated as weighed mean value of the coefficients used in the chapter Forest land Remaining Forest land according to the wood stock of coniferous and deciduous forests of the first age class taking into account also the NFI data from 2010.

The calculated average annual increment of carbon stock in the living biomass in lands converted to forests is 2,25 tonnes C/ha.y for the I^{st} age class. For estimating the biomass changes equation 3.2.22 from IPCC GPG ha been used. The biomass of the previous land use that is lost due to the land-use change to forest is estimated as described in the related land-use chapters.

7.2.4.2.2 Changes in dead organic matter

7.2.4.2.2.1 Changes in the carbon stock in dead wood

Due to the young age of the forests in the area converted to forests it is assumed that there is no dead wood and there is no change in this carbon stock.

7.2.4.2.2.2 Changes in the carbon stock in litter in lands converted to forests

According to IPCC definition litter pool includes all non-living biomass in a various state of decomposition, so this means – litter layer (fresh dead plant material), fumic and humic layers. As it was explained in chapter Forest remaining forest, changes in carbon stock in soil the source of information in order to estimate a country specific value for the carbon stock in litter is EEA-MOEW. The database resulted from the implementation of the ICP "Assessment and Monitoring of Air Pollution Effects on Forests"-UN/ECE Convention on Long Range Transboundary Air Pollution.

When analysing carbon content in litter Bulgaria follows ICP Forests Manual methodological approach http://www.icp-forests.org/pdf/FINAL_soil.pdf (see Annex 7 Soil horizon designation p.195) where litter definition is :

OL-horizon (Litter, Förna): this organic horizon is characterised by an accumulation of mainly leaves/needles, twigs and woody materials (including bark), fruits etc. This sublayer is generally indicated as litter. It must be recognized that, while the litter is essentially unaltered, it is in some stage of decomposition from the moment it hits the floor and therefore it should be considered as part of the humus layer. There may be some fragmentation, but the plant species can still be identified. So most of the original biomass structures are easily iscernible. Leaves and/or needles may be discoloured and slightly fragmented. Organic fine substance (in which the original organs are not recognisable with a naked eye) amounts to less than 10 % by volume.

According to IPCC-GPG definition this represents the "litter layer" (a horizon consisting of relatively fresh dead plant material). For Bulgaria there are no data gathered for the carbon content in this layer during the soil surveys. However, since the changes in biomass fully account for all leaves and needles (the tree biomass estimates accounts for these pools) that represent the material of the litter layer within one year any further accounting of this material would end in double accounting.

In Submission 2010 Bulgaria reported carbon stock changes in litter in the figure of the carbon model stock for soils. The estimation of the model carbon stock in soils for Bulgaria was based on the data for the carbon stock in the 30 cm layer and OFH horizons (OH+OF, the fumic and humic layers which are the further parts of the "litter pool" in sense of IPCC GPG definition).

OF-horizon (fragmented and/or altered) is a zone immediately below the litter layer. This organic horizon is characterised by an accumulation of partly decomposed (i.e. fragmented, bleached, spotted) organic matter derived mainly from leaves/needles, twigs and woody materials. The material is sufficiently well preserved to permit identification as being of plant origin (no identification of plant species).The proportion of organic fine substance is 10 % to 70 % by volume. Depending on humus form, decomposition is mainly accomplished by soil fauna (mull, moder) or cellulose-decomposing fungi. Slow decomposition is characterised by a partly decomposed matted layer, permeated by hyphae.

OH-horizon (humus, humification): characterised by an accumulation of well-decomposed, amorphous organic matter. It is partially coprogenic, whereas the F horizon has not yet passed through the bodies of soil fauna. The humified H horizon is often not recognized as such because it can have friable crumb structure and may contain considerable amounts of mineral materials. It is therefore often misinterpreted and designated as the Ah horizon of the mineral soil and not as part of the forest floor as such. To qualify as organic horizon, it should fulfil the FAO requirement, as described above. The original structures and materials are not discernible. Organic fine substance amounts to more than 70 % by volume. The OH is either sharply delineated from the mineral soil where humification is dependent on fungal activity (mor) or partly incorporated into the mineral soil (moder).

According to the ICP Forests Manual samples are taken separately for the different depth. OH and OF layers should be sampled together (see Table 5, p. 15 ICP Forests Manual). The data is available for each depth. The estimation for the model carbon stock in litter pool is based on data base for carbon content in OFH layers available for the years 2000 – 2002. According to the data available it was estimated that the carbon stock in litter is 5.38 tC/ha.

7.2.4.2.3 Changes in the carbon stock in soils

The changes in soil organic carbon pool followed the land-use conversion from other land-use to forests have been estimated based on reference stock of the soil organic carbon from the soil under different land-use type using the equation:

$$\Delta C_{mineral\ soil} = \left[(SOC_{ref} - SOC_{non\ forest\ land}) \cdot A_{Aff}\right] / T_{Aff}$$

where:

$\Delta C_{mineral\ soil}$ - annual change in the carbon stock in mineral soils in the year of assessment, tonnes C/ yr

SOC_{ref} – reference carbon stock in forest's, tonnes C/ ha

$SOC_{non\ forest\ land}$ - stable carbon stock in the soil in a previous type of land-use (croplands, grasslands and other lands), tonnes C/ ha

A_{Aff} - total afforestated area after the conversion, ha

T_{Aff} - duration of the transition from non-forest land to forest , yr

The used transition period is 20 years according to IPCC GPG.

For Submission 2014 a recalculation of the reference stocks of organic carbon in soils under different land-use practices has been performed. Source of information for the contents of organic carbon in forest soil is the database of the ICP "Assessment and Monitoring of Air Pollution Effects on Forests"-UN/ECE Convention on Long Range Trans-boundary Air Pollution (CLRTAP)". The data provider is the Executive Environment Agency, which is the responsible authority for the reporting under CLRTAP. Regular assessments on soils have been carried out since 1986. Taking into account the representativeness of the data and the purpose of the estimate, the reference soil organic carbon stock in forest's soil has been evaluated based on dataset since 1998. The dataset on soil contains information on the soil chemistry and physical parameters. The measurements of the soil’s parameters are made for layers (0-5cm, 5-10cm, 0-10cm, 10-20cm, 20-40cm.). The content of organic matter is presented in percentage. In order to estimate the organic carbon stock (tC/ha), data on bulk density is needed. However, the data on bulk density is not available for all layers. Therefore, the bulk density of the soil from different layers has been estimated using the Alexander B (1980) PTF function[34]:

$$\rho_{\mathrm{b}} = 1.72 - (0.294 - org.C,\%)^{0.5}$$

Thus, the organic carbon stock has been calculated for all samples from the dataset. Then, the samples have been grouped by soil type and an average value for carbon stock in the different soil types has been derived. Data on the area of the particular soil types under forest land-use is available according to Soil map of Bulgaria (1:400 000) and Corine land cover data (1:100 000). Therefore, the reference soil organic carbon stock in forest’s soil has been derived as a weighted mean from the averages SOCs of every particular soil types which are presented in Bulgarian forests. The procedure to derive the reference carbon stock in forest soils, which has the value of 78.26 tC/ha (0-40 cm) is presented in the figure below. The statistics and the uncertainty associated with the evaluation of the reference stock are presented in the table below. They are derived by using Monte Carlo analysis.

Table 198 Statistics of the evaluation of the reference carbon stock in forest's soil and its uncertainty assessment

statistics	value		probability	value
Trials	10000		0.025	58.976
Min	48.231		0.05	61.311
Median	76.429		0.1	64.219
Mean	**78.257**		0.25	69.592
Max	204.950		0.5	76.429
Std. Dev.	**12.751**		0.75	84.898
Variance	162.576		0.9	93.890
Skewness	1.372		0.95	100.808
Kurtosis	5.257		0.975	107.922

uncertainty	**-24.6**	**37.9**

[34]G.TAULYA et al., 2005 Validation of pedotrasfer functions for soil bulk density estimation on a Lake Victoria Basin soilscape

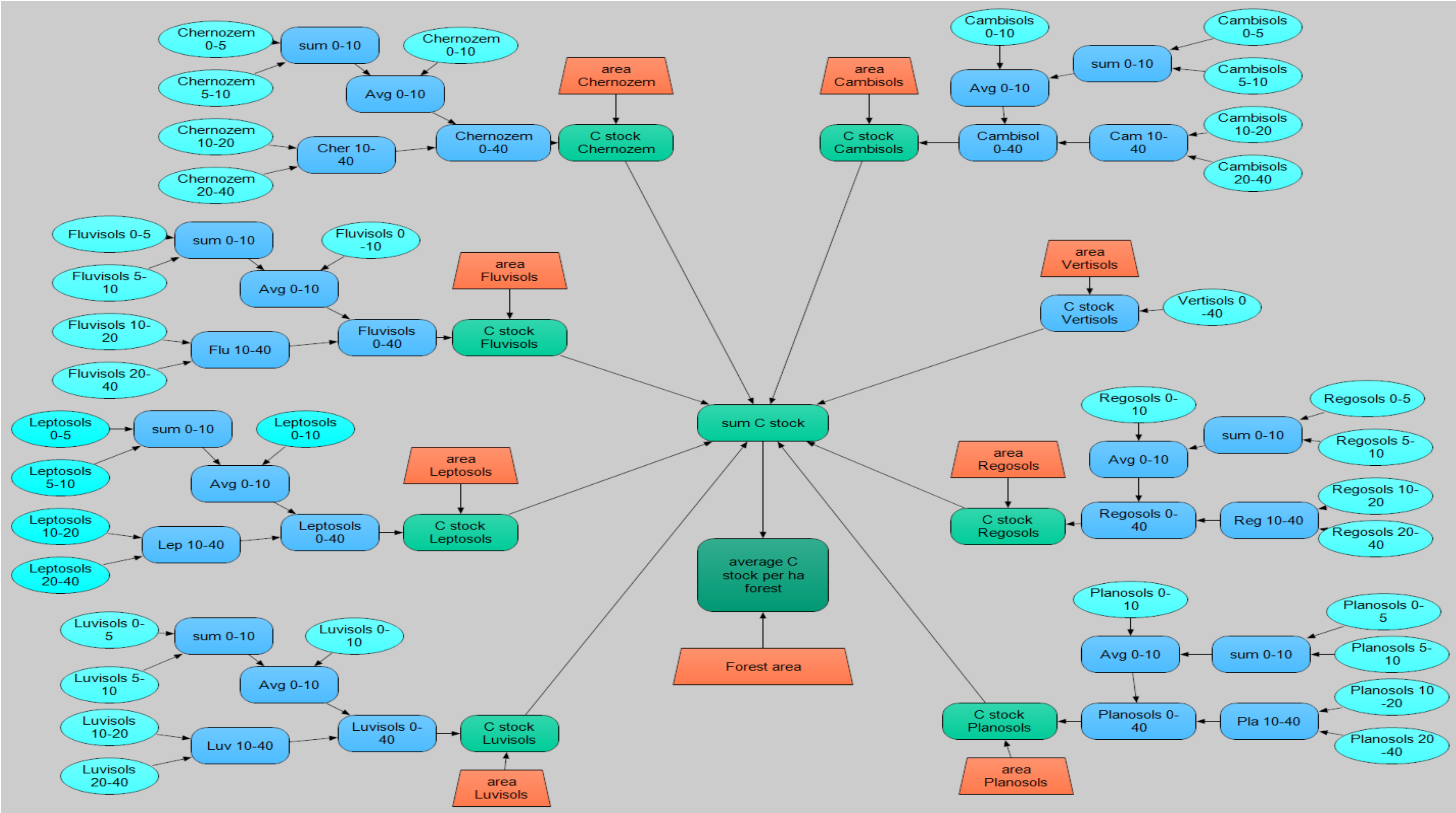


Figure 80 Procedure to derive the organic carbon reference stock in forest's soils

For the stable stock of organic carbon in soils (0-40 cm) of previous types of land-use the following country specific values for annual and perennial cropland, grassland and other land have been used:

- annual crops: 89.9 t C/ha
- perennial crops: 76.5 t C/ha
- grasslands: 103.57 t C/ha
- other land: 0 t C/ha

A description of the methods of deriving these soil C stocks can be found in the respective chapters.

7.2.5 UNCERTAINTY ASSESSMENT

The uncertainties associated with the estimates of CO_2 emissions and removals have been calculated using both Tier 1 and Tier 2 method. Tier 1 method combines the uncertainties by means of the error propagation equations (IPCC Good Practice Guidance, IPCC, 2003). The input uncertainties, associated with the different emission factors and the activity data as well as the sources of information (default values, empirical data or expert judgment) are presented in Table 199 and Table 200. The total uncertainty for Forestland remaining forestland is ± 146.8% while for Land converted to Forestland is ± 191.8%. The total uncertainty for CO_2, CH_4 and N_2O emissions form forest fires is ±102.1% estimated by using Tier 1 method.

Tier 2 method, based on Monte Carlo simulation technique, has been implemented to assess uncertainty for the Forestland category. The applied algorithm follows the instructions, described in IPCC Good Practice Guidance (IPCC, 2003). Models for computation the emissions and their uncertainties at different levels of aggregation have been created. Normal distribution has been assumed for the most of the inputs. After appropriate statistical analysis, the lognormal probability distribution function (PDF) has been used for some data sets. The number of the applied iterations is 10000. The uncertainty values derived from the resulting PDF for Forestland remaining forestland are equal to -159.0% and 145.5%, taking into account all the carbon pools estimated. As for Land converted to Forestland the uncertainty is estimated to be equal to -198.0% and 178.7% respectively. A more detailed description on the Monte Carlo analysis' results is included in ANNEX 7.

Comparison between the uncertainties calculated by categories and carbon pools by means of the two approaches is presented in Table 275 in ANNEX 7.

Table 199 Uncertainties of emission factors and activity data (Tier 1)

Inputs	Uncertainty (in %)	Source of information
V - Volume stock	10	Executive Forest Agency
D - wood density	30	Default, IPCC GPG 2003
BEF2 - Biomass expansion factor	30	Default, IPCC GPG 2003
R - root to shoot ratio (forestland)	30	Default, IPCC GPG 2003
R - root to shoot ratio (grassland)	95	Default, IPCC GPG 2003
CF - carbon factor	2	Default, IPCC GPG 2003

Inputs	Uncertainty (in %)	Source of information
B cut - yield biomass	10	National Statistical Institute
B peak - biomass of the growth	75	Default, IPCC GPG 2003
Aboveground biomass for perennial	75	Default, IPCC GPG 2003
Annual average growth in annual crops	75	Default, IPCC GPG 2003
Annual accumulation of C in the aboveground biomass of perennials	75	Default, IPCC GPG 2003
Annual Growth in annual cropland	75	Default, IPCC GPG 2003
Losses of carbon in the aboveground biomass of perennials	75	Default, IPCC GPG 2003
C stock in litter pool	141.5	empirical data
Soil C stock in forestland	32.6	empirical data
Soil C stock in annual cropland	25.0	empirical data
Soil C stock in perennial cropland	55.0	empirical data
Soil C stock in grassland	32.9	empirical data
Area	3	for industrial countries, IPCC 2006
Area – LUC	10	expert judgment

Table 200 Uncertainties of emission factors for forest fire (Tier 1)

Inputs	Uncertainty (in %)	Source of information
A - Area destroyed by fire	25%	Average value (20% - 30%), IPCC GPG 2003
B*C - Quantity of wood burnt down*Burning efficiency	75%	Default, IPCC GPG 2003
D - Emission factor for CO_2	75%	Default, IPCC GPG 2003
D - Emission factor for CH_4	75%	Default, IPCC GPG 2003
D- Emission factor for N_2O	75%	Default, IPCC GPG 2003

Table 201 Tier 1 uncertainties and reporting

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
A		B	C	D	E	F	G
			[Gg CO2 equivalent]	[Gg CO2 equivalent]	%	%	%
5A	Forest land	CO_2	-14775.5	-10352.5	3	143	142.9
5A1	Forestland remaining forestland	CO_2	-14228.7	-10019.2	3	147	146.8
5A2	Land converted to Forestland	CO_2	-562.4	-776.0	10	192	191.8
5A1	Forest fires	CO_2	14.0	395.5	25	99	102.1
5A2	Forest fires	CH_4	1.4	38.5	25	99	102.1
5A3	Forest fires	N_2O	0.3	8.8	25	99	102.1

7.2.6 DATA VERIFICATION CATEGORY-SPECIFIC QA/QC AND VERIFICATION, IF APPLICABLE

See Chapter 7.8

7.2.7 CATEGORY-SPECIFIC RECALCULATIONS

The following recalculations have been made for Submission 2014:

- Changes in area of forest land
- Changes in the way of estimating the biomass loss associated with conversion from forest land to other land-use.
- New estimate of the reference carbon stock in forest's soils
- CO_2 and non-CO_2 emissions from wildfires have been shared between sub-categories Forest land remaining forest land and LUCs to forest land.

The areas of Forest land (e.g Forest land remaining Forest land and LUCs to forest land) have been recalculated for the whole time series taking into account the results of the project implemented in the terms of an on-going Bulgarian improvement process of reporting the supplementary information under article 3.3 of the KP (details for the project and its implementation are given in Chapter 11). In the previous Submissions (2012, 2013) it was necessary to aggregate one more subcategory – "other vegetation" in order to adjust properly the area of forest land category. This had to be done because some areas which fall under forest land category according to IPCC, but were not taken into account when the revision of the FMPs was performed. This lapse has been corrected for this Submission and the area which were reported under "other vegetation" (2013) is now allocate respectively under coniferous and deciduous forests.

Following the ERT's recommendations from the last review (FCCC/ARR/2013/BGR) change in the way of estimating the biomass loss associated with conversion from forest land to other land-use has been done. This change affects the emissions/removals from deforestation activity. More details on the changes are described in 5.E.2 Land-use change to Settlements.

For Submission 2014 a recalculation of the reference stocks of organic carbon in soils under different land-use practices has been performed. The procedure to derive the reference stock of organic carbon in forest's soils is described in 7.2.4.2.3.

7.2.8 CATEGORY-SPECIFIC PLANNED IMPROVEMENTS INCLUDING THOSE IN RESPONSE TO THE REVIEW PROCESS

See Chapter 7.9

7.3 CROPLAND (5.B)

7.3.1 DESCRIPTION OF THE CATEGORY

Croplands in Bulgaria cover an area of 3 817 634 ha which represents 34.4% of the country's territory. Annual crops have a share of 94.5% from the total cropland's territory and the rest 5% are referred to perennial crops. Over the reporting period a steady decrease in cropland areas is observed. In 2012 the area of cropland is by 7.7% lower compared to those from the base year.

In accordance with the IPCC GPG the evaluation of the emissions/removals from Cropland category is based on estimates of the changes in the carbon stocks in living biomass and soil. The changes in biomass stock are estimated only for perennial crops. For annual crops, increase in biomass stocks in a single year is assumed equal to biomass losses from harvest and mortality in that same year - thus there is no net accumulation of biomass carbon stocks.

Non-CO_2 emissions associated with the management of permanent agricultural lands are estimated as part of Agriculture Chapter from this report. In this category N_2O emissions from land-use conversions to cropland as a result of soil oxidation are reported.

There is no agricultural lime application in Bulgaria during the reporting period so CO_2 emissions from liming are reported as NO (not occurring).

Table 202 Categories assessed for emissions/removals

Categories
5.B. Cropland- total
5.B.1 Cropland remaining cropland
- carbon stock change in living biomass of perennial cropland and LUC between annual and perennial cropland
- carbon stock change due to changes in organic matter input (harvest residues) to cropland soils
5.B.2 Land converted to cropland
5.B.2.1 Forest land converted to cropland
5.B.2.2 Grassland converted to cropland
- carbon stock change in living biomass of annual/perennial cropland
- carbon stock change due to changes in organic matter input to cropland soils

The trend in the areas of cropland category is presented in the figure below. The annual cropland's emissions over the reporting period range from 937 Gg CO_2 eq. to 2308 Gg CO_2 eq. The overall cropland's emissions in the inventoried year (2012) are 1573 Gg CO_2 eq. As it can be seen from the table below, emissions from subcategory Cropland remaining cropland show a high level of inter-annual variability (ranging from 51 Gg CO_2 eq to 1422 Gg CO_2 eq). The reason for the variation in the emissions is that Bulgaria reports changes in carbon stock within cropland category (e.g. change from perennial to annual, annual crops to perennial and perennials remaining perennials). Major source of the emissions within subcategory Lands converted to croplands is the carbon stock change in the soil pool when converting grassland to cropland.

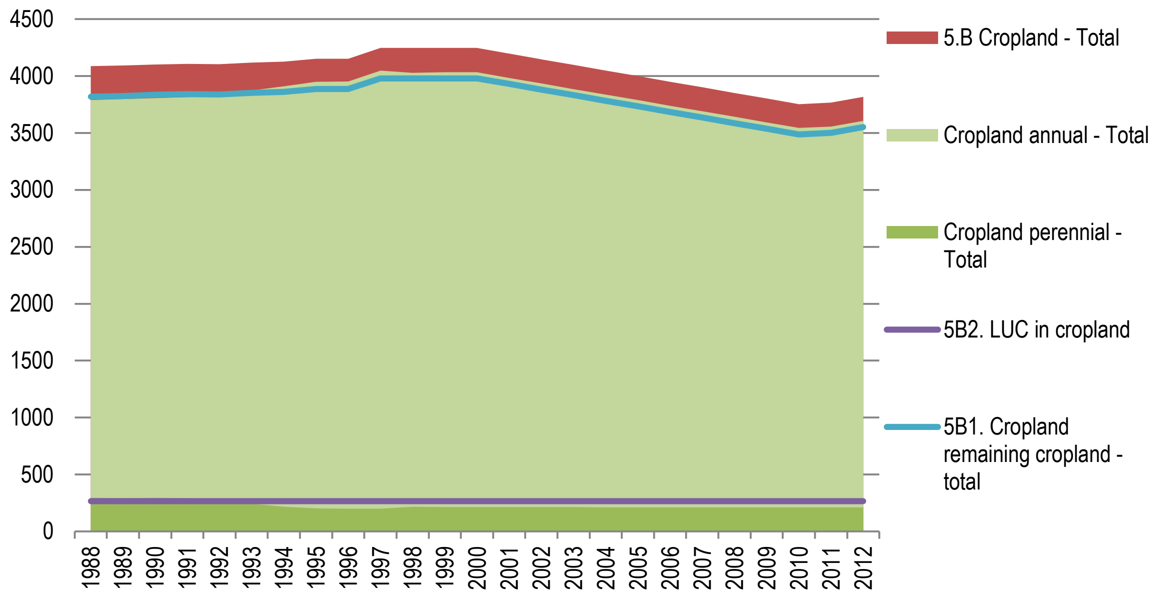


Figure 81 Trend in the areas whitin Cropland category

Table 203 Net emissions /removalsof CO_2 whitin Cropland category (Gg CO_2 equivalent)

year	5B Cropland total	5B1 Cropland remaining Cropland	5B2 Land converted to Cropland	Grassland converted to Cropland	N_2O emissions (CO_2 eq) from convertion of GL to CL
1988	937.77	51.36	886.41	770.44	115.97
1989	1099.46	213.05	886.41	770.44	115.97
1990	1255.93	369.52	886.41	770.44	115.97
1991	1409.74	523.33	886.41	770.44	115.97
1992	1585.01	698.60	886.41	770.44	115.97
1993	1866.13	979.72	886.41	770.44	115.97
1994	2092.69	1206.28	886.41	770.44	115.97
1995	2205.25	1318.84	886.41	770.44	115.97
1996	2308.57	1422.16	886.41	770.44	115.97
1997	2291.18	1404.77	886.41	770.44	115.97
1998	2086.95	1200.54	886.41	770.44	115.97
1999	2031.04	1144.63	886.41	770.44	115.97
2000	2015.54	1129.13	886.41	770.44	115.97
2001	1996.63	1110.22	886.41	770.44	115.97
2002	1993.61	1107.20	886.41	770.44	115.97
2003	2061.20	1174.79	886.41	770.44	115.97
2004	2006.43	1120.02	886.41	770.44	115.97
2005	1995.62	1109.21	886.41	770.44	115.97
2006	1906.29	1019.88	886.41	770.44	115.97
2007	1831.09	944.68	886.41	770.44	115.97
2008	1786.71	900.31	886.41	770.44	115.97
2009	1750.33	863.93	886.41	770.44	115.97
2010	1638.64	752.24	886.41	770.44	115.97
2011	1571.60	685.19	886.41	770.44	115.97
2012	1572.96	686.55	886.41	770.44	115.97

7.3.2 INFORMATION ON THE APPROACHES USED FOR PRESENTING THE DATA FOR THE AREAS AND THE DATABASE FROM THE LAND-USE USED OF THE INVENTORY.

Information on total Cropland (CL) and Grassland (GL) areas over the reporting period is gathered from National Statistical Yearbooks and orthophotoimages. The National Statistical Yearbooks provide information on CL and GL areas over the period 1988-2000. The balance of the territory of Bulgaria based on orthophotoimages has been available since 2010. To ensure a full time-series interpolation between the years 1999 and 2010 has been applied. The trend in the cropland areas between 1996 and 1999 shows a sharp increase which results in a dramatic decrease in cropland area in 2000. To level out this break the cropland area of 1999 has been assumed to be the same as in 2000. For the years before 1999 the annual changes of the cropland areas of the time series 1988 to 1999 have been taken exactly and have been adjusted to the new area figure for 1999 to give a new time series of annual cropland areas.

As regards reporting of LUCs to cropland and grassland, information from agricultural statistics (BANSIK) has been used. The agrostatics provides information on LUCs between cropland and grassland as well as between annual and perennial crops and in reverse for a period of 12 years (2000-2012). The remain annual LUCs between these categories and subcategories over the period 2000-2012 according to the statistics have been extrapolated back to 1968 in order to ensure the time series consistency. Any conversions and re-conversions from wetlands and settlements to cropland and grassland are considered as unlikely. Other lands are not suitable for cropland and grassland, therefore such transition between these categories is not reported. Thus, the only possible change from other land use to cropland and grassland is between these two categories. So as to be check whether the extrapolation method applied is suitable the following was taken into consideration. As it was explained the activity data on the area of the particular land-use type gives the total of net-change in the area. Therefore, the total sum of net-gains in the area of single land-use type needs to be equal to the net losses of area. However, as it can be noticed from the annual land-use matrices there is a missing match between the gains and losses in most of the assessed categories. The reason for the discrepancies is that Bulgaria is trying to keep the original activity data as much as possible when compiling the land area representation for the entire time series. Though, in order to check the reliability of the land area representation over the reporting period, a comparison between the averages gains and losses in area of particular land-use type has been made. But the areas of both categories have decreased compared to their areas in the base year.

The amount of total change in GL area since the base year and the sum of the known losses of grassland area to Forest land and Settlements over the reporting period are almost equal (-214.29 kha vs -214.61 kha). Hence, the sum of LUC from grassland to cropland for the entire time series should be almost equal to those from CL to GL. However, the average annual change in the total of CL area is almost as twice as bigger than the known losses of CL area to other land use (considering also LUC from CL to GL). Therefore it was decided to extrapolate back to 1969 (20 years transition period) the available statistics (2000-2012) for

LUCs between CL and GL and in reverse but with a slight adjustment of the losses from CL to GL in order to keep at least the fit in the overall grassland area pattern.

At the moment an improvement of the cropland area representation is not possible. All other land use categories and their area patterns across the time series show rather good fit. In order to avoid any double accounting of an area the inconsistency in the cropland area pattern is covered by Other land category. Before any other adaptations of the available area data further assessment of the cropland area statistics especially for the years before 2000 has to be done.

7.3.3 DEFINITIONS AND CLASSIFICATION SYSTEMS USED AND THEIR COMPLIANCE WITH THE LULUCF CATEGORIES

According to the area data available the category "Cropland" consists of annual crops (cornfields and kitchen gardens) and perennials (vineyards, fruit and berry plantation and nurseries).

Arable land is the land worked regularly, generally under a system of crop rotation - area with annual crops, set - aside area as well as area with seeds and seedlings.

Perennial crops include fruit and berry plantation, vineyards and other permanent crops, nurseries for wine, fruits, ornamental plants, forest trees etc. The orchard is a uniformly kept plantation (by annual pruning and regular treatment for protection from diseases and insects) of fruit trees (pip- trees, stone-trees and nut-trees). The orchard production may be used for direct consumption or processing. The density of plantation is a least 10 trees per decar and therefore the maximum distance between the trees a 10x10m.

7.3.4 METHODOLOGY

7.3.4.1 Cropland remaining Cropland (5.B.1.)

7.3.4.1.1 Changes in the carbon stocks in the living biomass

The change in biomass is only estimated for perennial woody crops. For annual crops, increase in biomass stocks in a single year is assumed equal to biomass losses from harvest and mortality in that same year - thus there is no net accumulation of biomass carbon stocks. The estimates of the change in carbon in perennial biomass follow the approach for estimating the annual rates of growth and loss which is recognised as Tier 1 method according to IPCC GPG 2003. There is no national data on the dynamics of the biomass in the perennials influenced by the changes in the land use. According to the IPCC Guidance the perennials accumulate biomass through the first 30 years. Emissions from perennials occur in the year of their clearing, assuming that annually 3,33% of the area of perennials are being replanted.

The area of the perennials over the time series ranges from 293 kha to 199 kha. In general there is a trend of decrease in their area. The changes are as a result of the reorganization that took place in the Bulgarian agriculture and especially in land ownership. To determine the annual change in the biomass carbon stock of the perennials the following equation has been used:

$$Annual\ change\ in\ the\ biomass\ carbon\ stock = (area\ of\ the\ perennials\ remaining\ perennials \cdot coefficient\ of\ accumulation\ of\ carbon) - (area\ of\ the\ perennials\ 30\ year\ earlier^{1} \cdot 0.033 \cdot coefficient\ of\ accumulation\ of\ biomass);$$

$$^{1}\ excluding\ area\ lost\ through\ land - use\ change$$

For the aboveground biomass stock at maturity the value 63 tonnes C.ha-1 has been adopted, and for the annual accumulation - 2,1 tonnes $C.ha^{-1}.y^{-1}$ (IPCC Guidance).

Table 204 Accumulation and loss of carbon in the aboveground biomass and period of clearing of perennials using the IPCC GPG default method

Climatic zone	Aboveground biomass C stock at maturity (tonnes C/ ha)	Period of clearing (years)	Annual accumulation of C in the aboveground biomass (tonnes C/ha/yr	Loss of carbon in the aboveground biomass (tonnes C/ha/yr)	Uncertainty
Temperate (all humidity regimes)	63	30	2,1	63	±75

7.3.4.1.2 Changes in the carbon stock in the biomass of perennials converted to annual crops

The annual change in biomass C stock is equal to the area of the converted lands (AConversion), multiplied by the carbon stock in the biomass of the perennials (L Conversion) plus the changes in the carbon stock in the biomass during the first year after the conversion (ΔCGrowth).

$$The\ annual\ change\ of\ carbon\ stock\ in\ biomass = A_{conversion}(L_{conversion} + \Delta C_{growth})$$

where,

$L_{conversion} = C_{after} - C_{before}$

$A_{conversion}$ – area of the lands converted to annual crops, ha yr^{-1}

$L_{conversion}$– carbon stock in the biomass of lands which were converted to annual crops, tonnes C ha-1

ΔC_{growth} – change of the carbon stock in the biomass in the first year after the conversion, tonnes C ha-1

For Bulgaria ΔC_{Growth} has been calculated on the basis of the NSI's yield data for annual crops (cereals, industrial crops, vegetables, fodder crops) for 1995, 2000 and 2005. The absolutely dry weight of these crops was corrected with national coefficients (Krachunov, I, Al. Alexandrov, 2007). To obtain the total biomass of the plants for the expansion from the yield biomass to the total biomass the following coefficients[35] have been used (Table 205). The expansion factors for the rest of the aboveground biomass stem from Austria and the root–to-shoot ratios - from US. Since both countries belong like Bulgaria to the temperate region, they are considered as appropriate for Bulgarian conditions.

Table 205 Coefficients used for calculating the total biomass of the annual crops

Crop	Rest of aboveground biomass (in % of yield biomass)	Aboveground/belowground ratio	Root-to–shoot ratio
wheat	100	-	0,21
rye	140	-	NE
barley	110	-	1,02
oats	150	-	0,4
maize	140	-	0,18
fied peas	100	-	NE
rape	210	-	NE
sunflower	250	-	0,06
sugar beet	80	-	0,43
fodder beet	30	-	NE
potato	30	-	0,07
soya	150	-	0,15
corn silage	20	-	0,18
lucerne	10	-	NE
red clover	10	-	NE
cotton	-	0.4	0,17
rice	-	0.4	0,46
peanuts	-	0.4	0,07
tabacco	-	0.6	0,8

To estimate the total, the yield biomass is expanded with a coefficient for the rest of the aboveground biomass. After that the aboveground biomass is expanded to the total biomass with the root-to-shoot ratios. An average weighed mean of the cropland biomass was calculated then on basis of the yields of the individual crops in Bulgaria for single years - ΔC_{Growth} = 3 tonnes C ha-1.

The changes in the carbon stock immediately after the conversion is assumed to be 0 as the biomass is taken away (C_{After}=0).

The value of 63 tonnes C/ha (C_{Before}) (IPCC GPG 2003) is used for the carbon stock immediately before the conversion.

[35] The expansion factors according to Bodenfruchtbarkeitsbeirat 2001 (pers. comm.)
Root-to-shoot ratios are published by West, T.O., 2008

7.3.4.1.3 Changes in the carbon stock in the biomass of annual crops converted to perennials

To calculate the annual change of carbon in living biomass in annual crops converted to perennial equation 3.3.8. is being used (IPCC GPG). For the annual increase of the carbon stock in the biomass of the perennials the value 2.1 tonnes C $ha^{-1}y^{-1}$ is used (for each year of the transition period) given in the IPCC GPG. The value 3 tonnes C ha^{-1} (item 7.3.4.1.2.) is used for the loss of carbon from the biomass of annual crops.

The annual change in the carbon stock of the biomass is equal to the area of the converted lands for a transition period of 20 years ($A_{Conversion}$) multiplied by the annual carbon stock growth of the perennial biomass (ΔC_{Growth} = 2.1 tonnes C ha^{-1}). For the biomass losses the actual annual land use change area annual to perennial is multiplied by the biomass carbon stock of annual crops.

$$Annual\ change\ in\ carbon\ stock\ in\ biomass = \big(area\ of\ the\ converted\ lands\ for\ 20\ yeats \cdot \Delta C_{growth}\big) + (actual\ annual\ area\ of\ conversion \cdot L_{conversion})$$

where,

$$L_{conversion} = C_{after} - C_{before}$$

$L_{conversion}$– carbon stock in the biomass of lands which were converted to annual crops, tonnes C ha^{-1}

ΔC_{growth} – change of the carbon stock in the biomass in the first year after the conversion, tonnes C ha^{-1}

Change of the carbon stock immediately after the conversion is considered to be 0 as the biomass is taken away (C_{After} =0).

For the carbon stock immediately before the conversion the value calculated for Bulgaria is used: 3 tonnes C $ha^{-1}y$ (item 7.3.4.1.2).

7.3.4.1.4 Changes in the carbon stocks in the soils of croplands remaining croplands

The assessment of the carbon stock in soil is performed at 0-40 cm. The carbon stock of the plant residues on the surface (dead organic matter) and the changes in the non-organic carbon (in the carbonate minerals) are not estimated. The estimates of carbon stock changes in soils are carried out only for mineral soils. The emissions of organic soils are not assessed, because there is no peat extraction or other type of impact on Histosols under annual crops and perennials.

In the period after 1990 Bulgaria is witnessing substantial changes in the land ownership and worsening of the agricultural practices. We could assume that this has affected the emissions/removals of carbon in the soils. There are no representative, official data concerning the impact of the changes that happened in the management of the lands on the stock of organic carbon in the soils. There is no information also for the exact size of the areas which have been affected by the changes in the soils. Due to that an assessment of emissions/removals of carbon by mineral soils in croplands which remain croplands is not carried out.

For Submission 2014 a recalculation of the reference stocks of organic carbon in soils under different land-use practices has been performed. Source of information for the contents of organic carbon in cropland and grassland soils is the National System for Environment Monitoring (EAEW-MOEW). Taking into account the representativeness of the data and the purpose of the estimate, the reference soil organic carbon stock in cropland and grassland soils has been evaluated based on dataset from a full soil inventory carried out in 2012. The dataset on soil contains information on the soil chemistry and physical parameters from soils under different land use (e.g cropland and grassland). The measurements of the soil's parameters are made for layers (0-20cm, 20-40cm.). The content of organic matter is presented in percentage. In order to estimate the organic carbon stock (tC/ha), data on bulk density is needed. However, the data on bulk density is available only for the upper layer. Therefore, the bulk density of the soil from the layer 20-40 cm has been estimated using the Alexander B (1980) PTF function[36]:

$$\rho_{\mathrm{b}} = 1.72 - (0.294 - org.C,\%)^{0.5}$$

Thus, the organic carbon stock has been calculated for all samples from the dataset. Then, the samples have been grouped by land use and soil type and an average value for carbon stock in the different soil types has been derived. Data on the area of the particular soil types under cropland or grassland management is available according to Soil map of Bulgaria (1:400 000) and Corine land cover data (1:100 000). Therefore, the reference soil organic carbon stock in soils of cropland and grassland has been derived as a weighted mean from the averages SOCs of every particular soil types under cropland and grassland categories. The reference soil organic carbon stocks in cropland (0-40 cm) are 89.92 tC/ha for annual crops and 76.52 tC/ha (STD – 21.05; CV – 27.51) for perennial crops. The statistics and the uncertainty associated with the evaluation of the reference stock in soils of annual crops are presented in the tables below. They are derived by using Monte Carlo analysis.

Table 206 Statistics of the evaluation of the reference carbon stock in soils of annual crops and its uncertainty assessment

statistics	value
Trials	10000
Min	46.890
Median	89.731
Mean	**89.920**
Max	136.662
Std. Dev.	**11.221**
Variance	125.906
Skewness	0.197
Kurtosis	0.114

probability	value
0.025	68.954
0.05	72.043
0.1	75.904
0.25	82.111
0.5	89.731
0.75	97.121
0.9	104.325
0.95	109.061
0.975	113.291

[36]G.TAULYA et al., 2005 Validation of pedotrasfer functions for soil bulk density estimation on a Lake Victoria Basin soilscape

uncertainty	-23.3	26.0

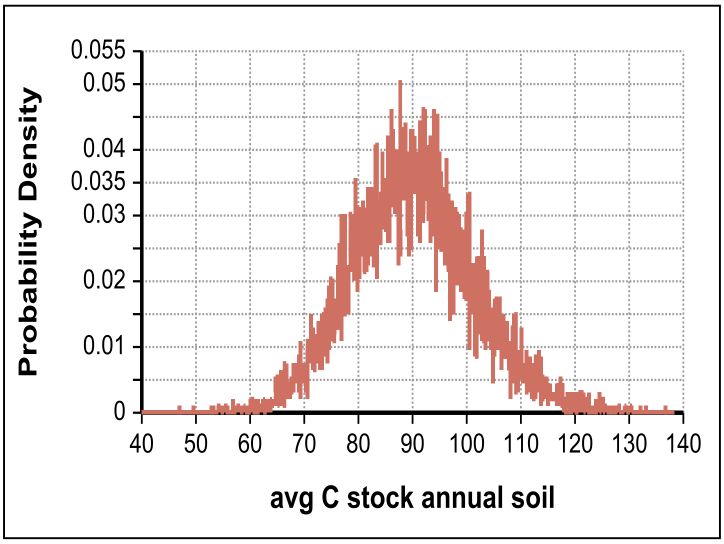


Figure 82 Probability density function resulting from Monte Carlo analysis

7.3.4.1.4.1 Changes in the carbon stock in the soils of lands with perennials converted to annual crops

The average annual change in the carbon stock in mineral soils of perennials, converted to annual crops (ΔSOC20) has been calculated using the equation:

$$\Delta SOC_{20} = \frac{[(SOC_0 - SOC_{0-T})]}{20} = 0.67\ tC/ha$$

where,

SOC_0 – carbon stocks in the soils after 20 years of transition = 89.92 t C/ha,

SOC_{0-T} – carbon stock in the soils before the conversion = 76.52 t C/ha.

To find the net change in the carbon stock in the soil, the annual change (ΔSOC_{20}) has been multiplied by the converted area.

7.3.4.1.4.2 Changes in the carbon stock in the soils of lands under annual croplands converted to perennials

The average change in the carbon stock in mineral soils of lands under annual crops converted to perennials (ΔSOC20) has been calculated using the equation:

$$\Delta SOC_{20} = \frac{[(SOC_0 - SOC_{0-T})]}{20} = -0.67\ tC/ha$$

where,

SOC_0 – carbon stocks in the soils after 20 years of transition = 76.52 t C/ha,

SOC_{0-T} – carbon stock in the soils before the conversion = 89.92 t C/ha.

To find the net change in the carbon stock in the soil, the annual change (ΔSOC_{20}) has been multiplied by the converted area.

7.3.4.1.5 Liming

There is no liming after 1987.

7.3.4.2 Lands converted to croplands (5.B.2.)

7.3.4.2.1 Forests converted to croplands (5.B.2.1)

Forest are not converted to croplands in Bulgaria.

7.3.4.2.2 Grassland converted to croplands (5.B.2.2.)

7.3.4.2.2.1 Changes in the carbon stock in the living biomass in grassland converted to annual crops

The calculation of the annual changes of the carbon stock in the living biomass in grassland converted to annual crops is calculated using the following equations:

$$The\ annual\ change\ \ of\ carbon\ stock\ in\ biomass = A_{conversion}(L_{conversion} + \Delta C_{growth})$$

where,

$L_{conversion} = C_{after} - C_{before}$

$A_{conversion}$ – area of the lands converted to annual crops, ha yr-1

$L_{conversion}$– carbon stock in the biomass of lands which were converted to annual crops, tonnes C ha-1

ΔC_{growth} – change of the carbon stock in the biomass in the first year after the conversion, tonnes C ha-1

The stock of the carbon in the living biomass after the conversion (C_{After}) is equal to 0. To calculate the carbon stock in the living biomass of grassland before the conversion (C_{Before}) the calculated value (6.4 t C ha^{-1}) for Bulgaria has been used. The calculations have been done on the basis of statistical data (National Statistical Yearbook) for the average yield of hay from grasslands for a period of 10 years (1995-2005). The values were recalculated to the absolutely dry matter (Krachunov, I., Alexandrov, A, 2007) and expanded with the remaining aboveground stubble biomass (1.6 t ha-1) (according to IPCC GPG) and with a coefficient for the root-to-shoot ratio (2.8) (according to IPCC GPG).

The annual accumulation of carbon in the annual cropland biomass in the first year after the conversion (ΔC_{Growth}) is = 3,0 tonnes C ha-1. The approach for determining the ΔC_{Growth} is described in section 7.3.4.1.2.

The quantity of carbon in the biomass is adopted by default -0,5 t C/t absolute dry matter (IPCC GPG).

7.3.4.2.2.2 Changes of the carbon stock in the living biomass in grassland converted to perennials.

For perennials a value for the average annual growth of the biomass has been used according to IPCC GPG (2,1 tC/ha y), for the whole period of conversion – 20 years.

$$Annual\ change\ in\ carbon\ stock\ in\ biomass = \left(area\ of\ the\ converted\ lands\ for\ 20\ yeats \cdot \Delta C_{growth}\right) + (actual\ annual\ area\ of\ conversion \cdot L_{conversion})$$

where,

$$L_{conversion} = C_{after} - C_{before}$$

$L_{cnversion}$– carbon stock in the biomass of lands which were converted to annual crops, tonnes C ha-1

ΔC_{growth} – change of the carbon stock in the biomass in the first year after the conversion, tonnes C ha-1

To calculate the changes in the carbon stocks in the biomass the following values were used:

ΔC_{growth} = 2,1 tC/ha y (IPCC GPG)

C_{after}= 0

C_{before} = 6.4 t C/ha, calculated for Bulgaria.

7.3.4.2.2.3 Changes in the carbon stock in soils of grassland converted to annual crops

To assess the emissions/removals of carbon specific data for the country has been used. The reference carbon stock in grassland soils (103.57) has been calculated as described in 7.3.4.1.4. The statistics and the uncertainty associated with the evaluation of the reference stock are presented in the table below. They are derived using Monte Carlo analysis.

Table 207 Statistics of the evaluation of the reference carbon stock in grassland's soil and its uncertainty assessment

statistics	value
Trials	10000
Min	37.778
Median	103.366
Mean	**103.566**
Max	172.060
Std. Dev.	**17.058**
Variance	290.976
Skewness	-0.015
Kurtosis	-0.063

probability	value
0.025	70.234
0.05	75.803
0.1	81.742
0.25	92.022
0.5	103.366
0.75	115.104
0.9	125.669
0.95	131.326
0.975	136.872

uncertainty	**-32.2**	**32.2**

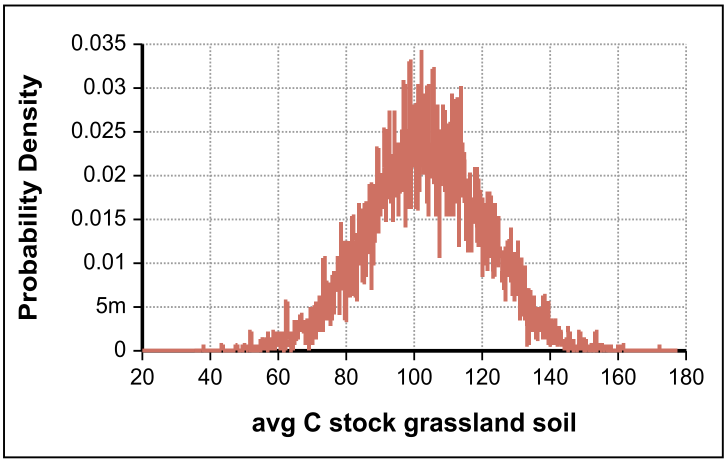


Figure 83 Probability density function resulting from Monte Carlo analysis

The average annual change in the carbon stock in the soils of grassland converted to annual crops (ΔCLG_{Soils}), is calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{[(SOC_0 - SOC_{0-T})]}{20} = -0.68\ tC/ha$$

where,

ΔC_{LGsoil} - annual change in carbon stock in soils in land converted to CL

SOC_0 – carbon stocks in the soils after 20 years of transition = 89.92 t C/ha,

SOC_{0-T} – carbon stock in the soils before the conversion = 103.57 t C/ha.

T – period assessed, years (equal to 20 years),

The change in the carbon stock in soils of lands under grassland converted to annual crops was calculated by multiplying the emission factor (-0.68 t C ha-1 y-1) by the area of the converted territory.

7.3.4.2.2.4 Changes in the carbon stock in soils of grassland converted to perennials

To assess the emissions/removals of carbon specific data for the country has been used.

The average annual change in the carbon stock in the soils of grassland (ΔCLG_{Soils}), converted to perennials is calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{[(SOC_0 - SOC_{0-T})]}{20} = -1.35\ tC/ha$$

where,

ΔC_{LGsoil} - annual change in carbon stock in soils in land converted to CL

SOC_0 – carbon stocks in the soils after 20 years of transition = 53 t C/ha,

SOC_{0-T} – carbon stock in the soils before the conversion = 80,99 t C/ha.

T – period assessed, years (equal to 20 years),

The change in the carbon stock in soils of grassland converted to perennials was calculated by multiplying the emission factor (1.40 t C ha-1 y-1) by the area of the converted territory.

7.3.4.2.2.5 N_2O emissions in grasslands converted to croplands

N_2O emissions from land-use conversions to cropland as a result of soil oxidation has been estimated based on tier 1 approach and equations 3.3.14 and 3.3.15. (IPCC GPG 2003).

The ratio C/N in the mineral soils is determined on the basis of data from the National network for environmental monitoring (EAEW-MOEW), 2012, which has been recalculated for Submission 2014.

For annual crops C/N = 10,00
For perennials C/N = 9.90

7.3.5 UNCERTAINTY ASSESSMENT

The uncertainties associated with the estimates of CO_2 emissions and removals have been calculated using both Tier 1 and Tier 2 method. Tier 1 method combines the uncertainties by means of the error propagation equations (IPCC Good Practice Guidance, IPCC, 2003). The input uncertainties, associated with the different emission factors and the activity data as well as the sources of information (default values, empirical data or expert judgment) are presented in Table 200. The total uncertainty for Cropland remaining cropland is ±245.5% while for Land converted to Cropland is ±249.1%. The total uncertainty for N_2O emissions in soils of Land converted to Cropland is ±357.8% estimated by using Tier 1 method.

Tier 2 method, based on Monte Carlo simulation technique, has been implemented to assess uncertainty for the Cropland category. The applied algorithm follows the instructions, described in IPCC Good Practice Guidance (IPCC, 2003). Models for computation the emissions and their uncertainties at different levels of aggregation have been created. Normal distribution has been assumed for the most of the inputs. After appropriate statistical analysis, the lognormal probability distribution function (PDF) has been used for some data sets. The number of the applied iterations is 10000. For the Cropland remaining cropland the uncertainties are equal to -269.0% and 263.9%, taking into account all the carbon pools estimated. The uncertainty values derived from the resulting PDF for Land converted to Cropland are estimated to be -255.1% and 246.3% respectively. A more detailed description on the Monte Carlo analysis' results is included in ANNEX 7.

Comparison between the uncertainties calculated by categories and carbon pools by means of the two approaches is presented in Table 275 in the ANNEX 7.

7.3.6 DATA VERIFICATION CATEGORY-SPECIFIC QA/QC AND VERIFICATION, IF APPLICABLE

See Chapter 7.8

7.3.7 CATEGORY-SPECIFIC RECALCULATIONS

The following recalculations have been made for Submission 2014:

- Changes in the total area of croplands over the reporting period

- Recalculation of the LUCs to cropland
- New estimate of the reference carbon stock in cropland's soils
- Recalculation of N_2O emissions from land-use conversions to cropland as a result of soil oxidation

After the calculations CO_2 emissions form Cropland category increased by 51% in the base year (1988) and decreased by 31% in 2011.

7.3.8 CATEGORY-SPECIFIC PLANNED IMPROVEMENTS INCLUDING THOSE IN RESPONSE TO THE REVIEW PROCESS

See Chapter 7.9

7.4 GRASSLAND (5.C.)

7.4.1 DESCRIPTION OF THE CATEGORY

Grassland in Bulgaria cover an area of 1 812 011 ha which represents 16.3 % of the country's territory. Over the reporting period there is a trend of gradual decrease in grassland areas. In the 2012 the area of grassland is by 10.6 % lower compared to the base year.

In accordance with the IPCC GPG the evaluation of the emissions/removals from Grassland category is based on estimates of the changes in the carbon stocks in living biomass and soil.

Some management practices, like burning of stubble-fields are forbidden in Bulgaria. There is no peat extraction, draining of peat soils or other anthropogenic activity which affects their water regime, the temperature on their surface and the species. Due to these reasons the carbon stock change in Histosols is not subject to evaluation.

The area of Grassland category (e.g Grassland remaining grassland 5.C.1 and Lands converted to grassland 5.C.2) and its associated emissions/removals are presented in the tables below.

Table 208 Categories assessed for emissions/removals

Categories
5.C. Grassland-total
5.C.1. Grassland remaining grassland
5.C.2. Land converted to grassland
5.C.2.1. Forest land converted to grassland
5.C.2.2. carbon stock change in living biomass of grassland
5.C.2.3. carbon stock change due to changes in organic matter input (harvest residues) to grassland soils
5.C.2.4. Settlements converted to grassland
5.C.2.5. Other land converted to grassland

Table 209 Land use and land-use changes in the category Grassland (kha) (other land- use changes are not occurring)

year	5.C Grassland Total	5.C.1 Grassland remaining Grassland	5.C.2 LUC in Grassland	5.C.2.2.a Annual cropland in Grassland	5.C.2.2.b Perennial cropland in Grassland
1988	2008,47	1759,05	249,43	229,53	19,90
1989	2019,99	1770,56	249,43	229,53	19,90
1990	2024.63	1757.63	267.00	243.37	23.63
1991	2024.83	1757.83	267.00	243.37	23.63
1992	2005.33	1738.33	267.00	243.37	23.63
1993	2000.33	1733.33	267.00	243.37	23.63
1994	2002.33	1735.33	267.00	243.37	23.63
1995	1989.33	1722.33	267.00	243.37	23.63
1996	1981.33	1714.33	267.00	243.37	23.63
1997	1960.33	1693.33	267.00	243.37	23.63
1998	1961.33	1694.33	267.00	243.37	23.63
1999	1905.33	1638.33	267.00	243.37	23.63
2000	1905.33	1638.33	267.00	243.37	23.63
2001	1905.33	1638.33	267.00	243.37	23.63
2002	1905.33	1638.33	267.00	243.37	23.63
2003	1903.67	1636.67	267.00	243.37	23.63
2004	1902.00	1635.00	267.00	243.37	23.63
2005	1900.33	1633.33	267.00	243.37	23.63
2006	1898.66	1631.66	267.00	243.37	23.63
2007	1897.00	1630.00	267.00	243.37	23.63
2008	1895.33	1628.33	267.00	243.37	23.63
2009	1893.66	1626.66	267.00	243.37	23.63
2010	1892.00	1625.00	267.00	243.37	23.63
2011	1890.33	1623.33	267.00	243.37	23.63
2012	1888.66	1621.66	267.00	243.37	23.63

Table 210 Emissions (+)/removals of CO_2 in Grassland Remaining Grassland and Lands Converted to Grassland (Gg CO_2 equivalent) (other land use changes are not occurring)

year	5 C Grassland Total	5.C.1 Grassland remaining grassland	5.C.2 Land converted to grassland	5.C.2.2 Cropland converted to grassland
1988	-632.69	0,00	632.69	632.69
1989	632.69	0,00	632.69	632.69
1990	632.69	0,00	632.69	632.69
1991	632.69	0,00	632.69	632.69
1992	632.69	0,00	632.69	632.69
1993	632.69	0,00	632.69	632.69
1994	632.69	0,00	632.69	632.69
1995	632.69	0,00	632.69	632.69
1996	632.69	0,00	632.69	632.69
1997	632.69	0,00	632.69	632.69
1998	632.69	0,00	632.69	632.69
1999	632.69	0,00	632.69	632.69
2000	632.69	0,00	632.69	632.69

year	5 C Grassland Total	5.C.1 Grassland remaining grassland	5.C.2 Land converted to grassland	5.C.2.2 Cropland converted to grassland
2001	632.69	0,00	632.69	632.69
2002	632.69	0,00	632.69	632.69
2003	632.69	0,00	632.69	632.69
2004	632.69	0,00	632.69	632.69
2005	632.69	0,00	632.69	632.69
2006	632.69	0,00	632.69	632.69
2007	632.69	0,00	632.69	632.69
2008	632.69	0,00	632.69	632.69
2009	632.69	0,00	632.69	632.69
2010	632.69	0,00	632.69	632.69
2011	632.69	0,00	632.69	632.69
2012	632.69	0,00	632.69	632.69

7.4.2 INFORMATION ON THE APPROACHES USED TO PRESENT THE DATA ON THE AREAS AND THE DATABASE ON THE LAND-USE USED FOR THE INVENTORY

The approach used for deriving the area information for sub-categories 5.C.1 and 5.C.2 is described in 7.3.2

7.4.3 DEFINITIONS FOR LAND-USE AND CLASSIFICATION SYSTEMS USED IN COMPLIANCE WITH THE LULUCF CATEGORIES.

Part of this category is the permanent grasslands – natural meadows, low productive grasslands, permanent lawns and grassland which are not used for production purposes.

All grasslands are managed.

7.4.4 METHODOLOGY

7.4.4.1 Grassland Remaining Grassland (5.C.1.)

7.4.4.1.1 Changes of the carbon stock in the living biomass

In line with IPCC GPG (Tier 1) the biomass in the grassland remaining grassland is not a source of emissions.

7.4.4.1.2 Changes of the carbon stock in soils

In accordance with the data available in the country it is assumed that there are no changes in the organic carbon stock in the soils of grassland remaining grassland. there is no liming of grassland in Bulgaria.

7.4.4.2 Lands converted to grasslands (5.C.2)

7.4.4.2.1 Forests converted to grassland

This category is not assessed as during the reporting period forests were not converted to grassland.

7.4.4.2.2 Lands under annual crops converted to grassland

7.4.4.2.2.1 Changes in the carbon stock in the living biomass of the annual crops converted to grassland

The estimates of the changes in biomass carbon stock are based on country-specific data. The average value of the aboveground and belowground biomass of the annual crops is 3 t C ha (Section 7.3.4.2).

The carbon stock in the living biomass of grassland has been estimated. Source of information for the aboveground biomass in grassland is the National Statistical Yearbook, Agroststistics, where the information for the hay yield is published. To recalculate the absolute dry matter a coefficient of 0.8 was used (Krachunov, I, Al. Alexandrov, 2007). The total biomass was calculated after a correction and adding of the rest of the aboveground stubble biomass and the root-to-shoot ratio (IPCC-GPG).

The equation below has been used to aggregate the annual growth of the total stock of the biomass in grasslands (aboveground and belowground)

$$B_{total} = \left[(B_{cut} \cdot 0.5) + (B_{peak\ aboveground} \cdot 0.5)\right] \cdot (1 + R)$$

where:

B_{total} – total biomass (aboveground and belowground), tonnes d.m.

B_{cut}- yield biomass, tonnes d.m =1.8

$B_{peak\ aboveground}$ – biomass of the growth, tonnes d.m =1.6 (according to IPCC GPG)

R - root-to-shoot ratio = 2.8 (according to IPCC GPG)

To calculate the annual carbon stock changes in the living biomass of annual crops converted to grassland the following equation has been used:

$$The\ annual\ change\ \ of\ carbon\ stock\ in\ biomass = A_{conversion}(L_{conversion} + \Delta C_{growth})$$

where,

$L_{conversion} = C_{after} - C_{before}$

$A_{conversion}$ – annual area of the lands converted to grassland, ha yr-1

$L_{conversion}$– carbon stock in the biomass of lands which were converted to grassland, tonnes C ha-1

ΔC_{growth} – change of the carbon stock in the biomass in the first year after the conversion, tonnes C ha-1

ΔC_{growth} = 6.4 tC/ha y (IPCC GPG)

C_{after}= 0

C_{before} = 3 t C/ha, calculated for Bulgaria.

7.4.4.2.2.2 Changes in the carbon stock in the living biomass of perennials converted to grassland

To calculate the stock of carbon in the living biomass of perennials the same equation was used as for annual crops converted to grasslands. Due to lack of national data for C_{before} the default value from the IPCC GPG has been used - 63 t C ha y^{-1}.

7.4.4.2.2.3 Changes in the carbon stock in soils of lands under annual crops converted to grassland

The reference carbon stock in soils of grassland and cropland has been calculated as described in 7.3.4.1.4. and 7.3.4.2.2.3. The annual change in the carbon stock in soils of lands under annual crops (ΔCLG_{Soils}), converted to grassland is calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{[(SOC_0 - SOC_{0-T})]}{20} = 0.68\ tC/ha$$

where,

ΔC_{LGsoil} - annual change in carbon stock in soils in land converted to GL

SOC_0 – carbon stocks in the soils after 20 years of transition = 103.57 t C/ha,

SOC_{0-T} – carbon stock in the soils before the conversion = 89.92 t C/ha.

T – period assessed, years (equal to 20 years),

The change in the carbon stock in soils of lands under annual crops converted to grassland has been calculated by multiplying the emission factor (0.68 t C ha^{-1} y^{-1}) by the area of the converted territory.

7.4.4.2.2.4 Changes in the carbon stock in soils of lands under perennials converted to grassland

The reference carbon stock in soils of grassland and cropland has been calculated as described in 7.3.4.1.4. and 7.3.4.2.2.3. The average annual change in the carbon stock in the soils of lands under perennials ($\Delta C_{LGSoils}$), converted to grassland has been calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{[(SOC_0 - SOC_{0-T})]}{20} = 1.35\ tC/ha$$

where,

ΔC_{LGsoil} - annual change in carbon stock in soils in land converted to GL

SOC_0 – carbon stocks in the soils after 20 years of transition = 103.57 t C/ha,

SOC_{0-T} – carbon stock in the soils before the conversion = 76.52 C/ha.

T – period assessed, years (equal to 20 years),

The change in the carbon stock in soils of lands under perennials converted to grassland has been calculated by multiplying the emission factor (1.35 tC ha^{-1} y^{-1}) by the area of the converted territory.

7.4.5 UNCERTAINTY ASSESSMENT

The uncertainties associated with the estimates of CO_2 emissions and removals have been calculated using both Tier 1 and Tier 2 method. Tier 1 method combines the uncertainties by means of the error propagation equations (IPCC Good Practice Guidance, IPCC, 2003). The input uncertainties, associated with the different emission factors and the activity data as well as the sources of information (default values, empirical data or expert judgment) are presented in Table 200. The total uncertainty for Land converted to Grassland is ±295.0%.

Tier 2 method, based on Monte Carlo simulation technique, has been implemented to assess uncertainty for the Grassland category. The applied algorithm follows the instructions, described in IPCC Good Practice Guidance (IPCC, 2003). Models for computation the emissions and their uncertainties at different levels of aggregation have been created. Normal distribution has been assumed for the most of the inputs. After appropriate statistical analysis, the lognormal probability distribution function (PDF) has been used for some data sets. The number of the applied iterations is 10000. The uncertainty values derived from the resulting PDF for Land converted to Grassland is estimated to -310.9% and 324.1% respectively. A more detailed description on the Monte Carlo analysis' results is included in ANNEX 7.

Comparison between the uncertainties calculated by categories and carbon pools by means of the two approaches is presented in Table 275 in the ANNEX 7.

7.4.6 DATA VERIFICATION CATEGORY-SPECIFIC QA/QC AND VERIFICATION, IF APPLICABLE

See Chapter 7.8

7.4.7 CATEGORY-SPECIFIC RECALCULATIONS

The following recalculations have been made for Submission 2014:

- Changes in the total area of grasslands over the reporting period
- Recalculation of the LUCs to grasslands
- New estimate of the reference carbon stock in grassland's soils

After the calculations the CO_2 removals from Grassland category have decreased by 20% over the reporting period

7.4.8 CATEGORY-SPECIFIC PLANNED IMPROVEMENTS INCLUDING THOSE IN RESPONSE TO THE REVIEW PROCESS

See Chapter 7.9

7.5 WETLANDS (5.D)

Due to the lack of information it is assumed that the carbon stocks in the biomass, the dead organic matter and the soils of the surface waters is equal to 0.

The areas of the wetlands range between 213 to 230 kha over the reporting period. Table 211 presents data on the area of wetlands.

Table 211 Land- use and land- use changes in the category Wetlands (kha) (other land use changes are not occurring)

year	5.D Wetlands - Total	5.D.1 Wetlands remaining wetlands	5.D.2 LUC in wetlands	5.D.2.2.a Annual Cropland in wetlands	5.D.2.5 Other land in wetlands
1988	213.50	213.50	0.00	0.00	0.00
1989	213.50	213.50	0.00	0.00	0.00
1990	213.50	213.50	0.00	0.00	0.00
1991	213.50	213.50	0.00	0.00	0.00
1992	213.50	213.50	0.00	0.00	0.00
1993	213.50	213.50	0.00	0.00	0.00
1994	213.50	213.50	0.00	0.00	0.00
1995	214.00	213.50	0.49	0.46	0.03
1996	214.49	213.50	0.99	0.92	0.07
1997	215.49	213.50	1.99	1.87	0.12
1998	216.49	213.50	2.99	2.81	0.18
1999	217.50	213.50	3.99	3.76	0.23
2000	218.50	213.50	5.00	4.72	0.28
2001	219.50	213.50	6.00	5.66	0.34
2002	220.50	213.50	7.00	6.60	0.40
2003	221.50	213.50	8.00	7.52	0.48
2004	222.50	213.50	9.00	8.44	0.56
2005	223.51	213.50	10.00	9.35	0.65
2006	224.51	213.50	11.01	10.25	0.75
2007	225.51	213.50	12.01	11.15	0.86
2008	226.51	213.50	13.01	12.03	0.98
2009	227.51	213.50	14.01	12.91	1.11
2010	228.52	213.50	15.01	13.77	1.24
2011	229.52	213.50	16.02	14.64	1.38
2012	230.52	213.50	17.02	15.51	1.51

It was assumed that during the period of inventory the conversion to wetlands comes out from annual crops and other lands. The emissions of carbon dioxide from the wetlands are presented in Table 212.

Table 212 Emissions (+)/removals of CO_2 in Wetlands Remaining Wetlands and Lands Converted to Wetlands (Gg CO_2 equivalent)

year	5.D Wetlands Total	5.D.1 Wetlands remaining Wetlands	5.D.2 Land converted to Wetlands	5.D.2.2 Cropland converted to Wetlands	5.D.2.5 Other land converted to Wetlands
1988	0.00	NE	0.00	0.00	0,00
1989	0.00	NE	0.00	0.00	0,00
1990	0.00	NE	0.00	0.00	0,00
1991	0.00	NE	0.00	0.00	0,00
1992	0.00	NE	0.00	0.00	0,00
1993	0.00	NE	0.00	0.00	0,00
1994	0.00	NE	0.00	0.00	0,00
1995	12.64	NE	12.64	12.64	0,00
1996	20.25	NE	20.25	20.25	0,00
1997	41.18	NE	41.18	41.18	0,00
1998	56.83	NE	56.83	56.83	0,00
1999	72.52	NE	72.52	72.52	0,00
2000	88.24	NE	88.24	88.24	0,00
2001	103.71	NE	103.71	103.71	0,00
2002	119.04	NE	119.04	119.04	0,00
2003	134.23	NE	134.23	134.23	0,00
2004	149.27	NE	149.27	149.27	0,00
2005	164.18	NE	164.18	164.18	0,00
2006	178.94	NE	178.94	178.94	0,00
2007	193.57	NE	193.57	193.57	0,00
2008	208.04	NE	208.04	208.04	0,00
2009	222.37	NE	222.37	222.37	0,00
2010	236.56	NE	236.56	236.56	0,00
2011	250.87	NE	250.87	250.87	0,00
2012	265.31	NE	265.31	265.31	0,00

Note: The reporting of the subcategory "wetland remaining wetland" is voluntary.

7.5.1 INFORMATION ON THE APPROACHES USED TO PRESENT THAT DATA FOR THE AREAS AND THE DATABASE FOR THE LAND-USE USED FOR THE INVENTORY

The data on total of Wetlands areas for single years (1994, 1996) has been obtain from the cadastral maps of the agricultural fund of Bulgaria (Balance by Type of Territories as per their Designation, Cadastre Agency) as well as data from the balance of the territory of Bulgaria based on orthophotoimages for the year 2012. In order to cover the time series – interpolation has been applied. The wetlands area for 1996 according to the cadastral map is much lower than the wetlands area according to the balance of the territory based on orthophotoimages. The difference is about 30 kha. Such a dramatic increase in wetlands area has been considered as unlikely. Probably the observed increase is due to the different data sources used in the aggregation of the area data. However, the data from orthophotoimages has been considered as more reliable. Then in order to level out the big increase in wetlands area a correction of the 1996 data on wetlands was needed. The correction coefficient of 12.38 kha is the net increase in wetlands from 1996 to 2012 according to Corine Land Cover data (1996-2006 CLC data and extrapolated to 2012) as it was reported in the previous submissions. The value of 12.38 kha has been added to the total wetlands area in 1996 and 1994 according to the cadastral map. Then the interpolation between 2012 and 1996 has been applied. The areas of wetlands for the years before 1994 have been considered to be the same as in 1994.

For Submission 2014, the LUCs to wetlands have been assumed to stem from cropland and other land. The determination of these land use categories as the possible land-use changes where the increase in wetlands may stem from is based on the last step from the hierarchical treatment of the data sources – that is data gaps. It has been considered that the shares of these individual land use categories to the observed increase in wetlands behave like the ratios of the total areas of these land use categories in Bulgaria. In its previous submission Bulgaria reported LUCs from forestland to wetlands due to probability reasons. It was assumed that the observed increase in wetlands suggests also deforestation for wetlands. This forest loss to wetlands was estimated as a share of forest land in the totals of forest land, cropland plus grassland (it was supposed that the wetlands increase comes from such lands). Actually the reported LUC from forestland to wetlands in the previous submissions of Bulgaria represented an overestimation of deforestation activity since all the information for forest loss due to changes in designation of forest was reported under LUCs to settlements (SM). Since the last improvements in area representation made for the Submission 2014 LUCs from forestland to wetlands were not calculated. According to experts from the ExFA, the changes of designation of forest in the years 1988-2012 have been associated with conversion only to SM. There is only one new dam lake (Tsankov kamak) which was built up in recent years but the forest loss associated with its construction works has been already reported in the 70's. Therefore, Bulgaria reports all information provided by the ExFA for forest loss across the time series as LUC associated with conversion to SM. The reported estimates of land-use changes from grassland to other land use categories (forestland and cropland), which are based on specific data and expert judgment, fit very well to the observed decrease in the total grassland area since the base year. Therefore, no land-use changes from grassland to wetlands have been assumed and reported.

7.5.2 DEFINITIONS

It is assumed that in the Wetlands category - wetlands surface water areas are included (wetlands) – covered with water or water saturated lands (throughout the year or partially in the year) which does not fall in the other categories. These are natural or artificial water-courses serving as water drainage channels, natural or artificial stretches of water, coastal lagoons, wetlands areas and peatbogs.

7.5.3 METHODOLOGY

7.5.3.1 Lands converted to wetlands (5.D.2)

7.5.3.1.1 Croplands converted to wetlands (5D.2.2)

7.5.3.1.1.1 Changes in the carbon stock in living biomass of croplands converted to wetlands

The annual change in the carbon stock in the living biomass of croplands converted to wetlands is calculated using equation 3.5.6. of IPCC GPG.

$$The\ annual\ change\ in\ the\ carbon\ stock = anual\ area\ of\ cropland\ converted\ to\ wetlands \cdot (B_{after} - B_{before}) \cdot CF$$

where,

B_{before}– living biomass of the cropland areas immediately before the conversion to wetlands, t d.m../ha.

B_{after} – living biomass immediately after the conversion, t d.m./ha (for Tierl 1 = 0),

CF –carbon fraction in the dry matter (d.m.) (under Tier 1 = 0.5 t C/t d.m.).

The average annual stock of the annual crops is 3.0 t C/ha.

During the inventory period no conversion of perennials to wetlands was assumed.

7.5.3.1.1.2 Changes in the carbon stock in soil in croplands converted to wetlands

Changes in the carbon stock in the soils when converting annual crops to wetland areas are calculated using the equation:

$$\Delta C_{wl} = \sum A \cdot \frac{SOC_{\ after} - SOC_{before}}{20}$$

where:

A – area of the converted lands for a transition period of 20 years, ha.

SOC_{before} – carbon stock in the soil immediately before the conversion, tC/ha; for soils of annual crops = 89.92 t C/ha $SOC_{\ after}$ – carbon stock in the soil 20 years after the conversion, t C/ha. The conversion of carbon in the soils 20 years after the conversion is assumed to be 0 (by default IPCC GPG).

7.5.3.1.2 Other land converted to wetlands (5D.2.3)

No emissions/removals are reported. As it was explain above the carbon stocks in biomass and soil of wetlands are assumed to be 0. Considering the land areas which are reported under category "Other land" and the lack of available data on biomass or soil stocks on such lands, it was considered that the stocks of biomass and soils in other land category are 0.

7.5.4 UNCERTAINTY ASSESSMENT

The uncertainties associated with the estimates of CO_2 emissions and removals have been calculated using both Tier 1 and Tier 2 method. Tier 1 method combines the uncertainties by means of the error propagation equations (IPCC Good Practice Guidance, IPCC, 2003). The input uncertainties, associated with the different emission factors and the activity data as well as the sources of information (default values, empirical data or expert judgment) are presented in Table 200. The total uncertainty for Land converted to Wetlands is ±26.1%.

Tier 2 method, based on Monte Carlo simulation technique, has been implemented to assess uncertainty for the Wetlands category. The applied algorithm follows the instructions, described in IPCC Good Practice Guidance (IPCC, 2003). Models for computation the emissions and their uncertainties at different levels of aggregation have been created. Normal distribution has been assumed for the most of the inputs. After appropriate statistical analysis, the lognormal probability distribution function (PDF) has been used for some data sets. The number of the applied iterations is 10000. The uncertainty values derived from the resulting PDF for Land converted to Wetlands is estimated to -23.7% and 27.8% respectively. A more detailed description on the Monte Carlo analysis' results is included in ANNEX 7.

7.5.5 DATA VERIFICATION CATEGORY-SPECIFIC QA/QC AND VERIFICATION, IF APPLICABLE

See Chapter 7.8

7.5.6 CATEGORY-SPECIFIC RECALCULATIONS

The following recalculations have been made for Submission 2014:

- Changes in the total area of wetlands over the reporting period
- Calculation of the LUCs to wetlands for the whole time series
- New estimate of the reference carbon stock in soils of lands converted to wetlands

After the calculations the CO_2 emissions from Wetlands category increased by 25% for the last inventoried year (2011)

7.5.7 CATEGORY-SPECIFIC PLANNED IMPROVEMENTS INCLUDING THOSE IN RESPONSE TO THE REVIEW PROCESS

See Chapter 7.9

7.6 SETTLEMENTS (5.E.)

Settlements cover an area of 856 kha in 2012, which represent 7.7% of the total territory of the country. The area of settlements has increased gradually over the period. The settlements area in 2012 is by 7.8% higher compared to the base year. In this category only the emissions and the removals from the subcategories "Lands Converted to Settlements" have been calculated since the reporting of emissions/removals from Settlements remaining Settlements is not obligatory It is assumed that dead wood and litter do not exist in the settlements, therefore only emissions/removals from changes in living biomass and in soil have been calculated. The land-use changes to settlements origin from the categories Forests (data provided by the Executive Forest Agency), Cropland and Grassland (data provided by the Ministry of Agriculture and Food).

Table 213 Land-use and land-use changes in the category Settlements (kha) (other land use changes are not occurring)

year	5.E Settlements Total	5.E.1 Settlements remaining Settlements	5.E.2 LUC in Settlements	5.E.2.1 Forest land in Settlements	5.E.2.2.a Annual Cropland in Settlements	5.E.2.2.b Perennial Cropland in Settlements	5E2.3 Grassland in Settlements
1988	794.19	756.06	38.13	2.46	22.59	1.19	11.89
1989	796.10	757.97	38.13	2.46	22.60	1.19	11.89
1990	798.01	759.87	38.13	2.38	22.64	1.19	11.92
1991	799.91	761.78	38.13	2.40	22.63	1.19	11.91
1992	801.82	763.69	38.13	2.53	22.55	1.19	11.87
1993	803.73	765.59	38.13	2.46	22.60	1.19	11.89
1994	805.63	767.50	38.13	2.41	22.62	1.19	11.91
1995	807.54	769.41	38.13	2.41	22.63	1.19	11.91
1996	809.45	771.31	38.13	2.40	22.63	1.19	11.91
1997	811.35	773.22	38.13	2.39	22.64	1.19	11.92
1998	813.26	775.13	38.13	2.38	22.64	1.19	11.92
1999	815.17	777.03	38.13	2.37	22.65	1.19	11.92
2000	817.07	778.94	38.13	2.36	22.65	1.19	11.92
2001	818.98	781.98	37.00	2.25	22.01	1.16	11.58
2002	822.33	786.14	36.19	2.25	21.50	1.13	11.31
2003	825.68	790.25	35.43	2.20	21.04	1.11	11.08
2004	829.03	794.48	34.55	2.16	20.51	1.08	10.80
2005	832.38	796.07	36.30	2.22	21.59	1.14	11.36
2006	835.73	797.52	38.21	2.25	22.77	1.20	11.99
2007	839.07	798.04	41.03	2.42	24.46	1.29	12.87
2008	842.42	797.28	45.14	3.13	26.61	1.40	14.00
2009	845.77	799.32	46.45	3.12	27.44	1.44	14.44
2010	849.12	798.46	50.66	3.37	29.95	1.58	15.76
2011	852.47	800.35	52.12	3.34	30.90	1.63	16.26
2012	855.82	803.73	52.09	3.32	30.89	1.63	16.26

Table 214 Emissions (+)/removals of CO_2 in Settlements remaining settlements and Lands converted to settlements (Gg CO_2 equivalent)

Year	5.E Settlements	5.E.1 Settlements remaining Settlements	5.E.2 Land converted to Settlements	5.E.2.1 Forests converted to Settlements	5.E.2.2 Cropland converted to Settlements	5.E.2.3 Grassland converted to Settlements
1988	682.72	NE	682.72	48.37	401.50	232.84
1989	682.74	NE	682.74	48.25	401.59	232.89
1990	676.22	NE	676.22	39.06	403.31	233.85
1991	686.15	NE	686.15	51.53	401.66	232.96
1992	696.14	NE	696.14	65.82	398.90	231.42
1993	676.01	NE	676.01	40.08	402.54	233.40
1994	679.44	NE	679.44	43.52	402.51	233.41
1995	685.36	NE	685.36	50.04	402.12	233.20
1996	685.39	NE	685.39	49.93	402.21	233.25
1997	685.41	NE	685.41	49.81	402.29	233.30
1998	685.43	NE	685.43	49.70	402.38	233.36
1999	685.46	NE	685.46	49.58	402.47	233.41
2000	687.50	NE	687.50	51.48	402.56	233.46
2001	629.34	NE	629.34	33.32	376.83	219.19

Year	5.E Settlements	5.E.1 Settlements remaining Settlements	5.E.2 Land converted to Settlements	5.E.2.1 Forests converted to Settlements	5.E.2.2 Cropland converted to Settlements	5.E.2.3 Grassland converted to Settlements
2002	637.94	NE	637.94	50.39	371.57	215.97
2003	620.09	NE	620.09	42.47	365.34	212.27
2004	604.09	NE	604.09	43.14	354.76	206.19
2005	709.50	NE	709.50	64.32	409.10	236.08
2006	738.81	NE	738.81	58.37	431.46	248.98
2007	827.83	NE	827.83	85.64	470.82	271.37
2008	1006.39	NE	1006.39	191.10	517.33	297.96
2009	852.21	NE	852.21	60.75	501.34	290.12
2010	1022.72	NE	1022.72	105.40	582.06	335.26
2011	953.26	NE	953.26	67.91	560.71	324.64
2012	939.42	NE	939.42	89.93	537.34	312.15

7.6.1 INFORMATION FOR THE APPROACHES USED TO PRESENT THE DATA FOR THE AREAS AND THE DATABASE FOR THE LAND-USE USED FOR THE INVENTORY

Information on the total Settlements area is aggregated using the data on settlements area from the cadastral maps of the agricultural fund of Bulgaria for the years 1994,1996 (Balance by Type of Territories as per their Designation, Cadastre Agency) and data from the balance of the territory of Bulgaria based on orthophotoimages for the year 2012. In order to ensure the time series consistency interpolation and extrapolation have been applied. The total settlements area according to the balance from the orthophotoimages is lower than the area from the cadastral map. Since a decrease in settlements area is considered as unlikely, it was assumed that the discrepancy in the extent of the settlements territory is as a result of using different methodology by the data providers. Thus, the total settlements area for 2012 has been adjusted with a correction factor in order to meet the total settlements area according to the cadastral map from 1996. To ensure the time series consistency the following steps have been performed:

- Interpolation between the 2012 and 1996 data on total settlements area
- Adjustment of the total settlements area for 2001 to match with the known increase in settlements for the period 2001-2012
- Interpolation between the adjusted settlements area for 2001 and 2012
- Interpolation between the adjusted settlements area for 2001 and the area data for 1996 from the cadastral map
- Extrapolation of settlements area for the period 1988-1996 considering the available data on LUC to settlements

Concerning the LUCs to settlements there is information for LUC from forest land to settlements, which is available for the period 1990-1994 and for the years 2001 to 2012. The annual forest loss to settlements for the years 1988, 1989 and 1995-2000 is estimated as an average value of forest loss in the period 1990-1994. Information for LUC from arable land (e.g cropland and grassland) to settlements is available for the years 2001 to 2012. The share of annual cropland, perennial cropland and grassland within the available figure for the total area, which is changed to settlement between 2001 and 2011, was assumed to be the same as the share of the totals of these land-use categories. LUCs from arable lands to settlements for the years before 2001 are estimated using the data gaps approach. The reported land-use changes to settlement fit very well to the observed increase in settlements area. Definition of the types of land-use, systems used for classification and their correspondence to the LULUCF categories

In compliance with the national classification system constructed areas, industrial zones, queries, depots, roads, railways, city parks above 0,1 ha are referred to this category. All settlements are managed lands.

7.6.2 METHODOLOGY

7.6.2.1 Land use change to settlements (5.E.2.)

7.6.2.1.1 Forests converted to settlements

The methodology and the data for the forests are presented in Chapter 7.2.

The estimates include the losses of forest biomass as well as the annual increase of the settlement biomass over the transition period (20 years) and also the changes in the litter (humic and fumic layers) and soil C stock (including the losses in litter). The converted forest area to settlements ranges between 1-2 kha.

7.6.2.1.1.1 Changes in the carbon stock in living biomass of forests converted to settlements

For estimating biomass loss associated with deforestation, data from NFI on volume stock over bark has been used. The data on volume stocks over the five years period since 1990 has been expanded and converted with the related country specific (or default) expansion/conversion factors: wood density (0.43 t/m3 for coniferous, 0.60 t/m3 for deciduous), stemwood plus branches expanded to the whole aboveground tree biomass (1.08 for coniferous, 1.03 for deciduous), root-to-shoot ratios (0.32 for coniferous, 0.28 for deciduous) and C-content (0.50 t C/t d.m.). Then it has been estimated the share of the coniferous and deciduous stocks in the total biomass stock for the respective years. Like this the weighted means for tree biomass stock have been calculated. The means have been used for estimating biomass loss from deforestation for the years across the time series.

Table 215 Living biomass stocks which are used to calculate the emissions associated with forest loss to settlements

		1990	1995	2000	2005	2010
Weighted mean tree biomass stocks	tC/ha	37.71	43.29	47.82	51.66	55.34

For the biomass growth on settlements after deforestation the following values have been taken: 0.09 $tCha^{-1}y^{-1}$ and 0.03 $tCha^{-1}y^{-1}$ for annual and perennial plants respectively. Growth of annual plants is accounted only in the year of conversion, while the growth of the perennial plants at the deforested areas continues. The annual biomass growth for annual and perennial plants has been calculated on the basis of the share of the green areas in the settlements in Bulgaria (2.63% according to study for Sofia (Kovachev, A, 2005)) and the following growth rates: for perennials (trees, bushes) it is 1.2 t C/ha.y, and for the annual plants – 3.3 t C/ha.y. These growth rates have been derived from a detailed biomass study for Vienna (and is also used for the related estimates in Austria).

7.6.2.1.1.2 Changes in carbon stock in dead organic matter of forests converted to settlements

The calculation of the emissions from litter pool (humic and fumic layer) as a result of the conversion of forests to settlements was made by using national data for the carbon stocks in litter (humic and fumic) in forests (5.4 t C/ha). The estimation of changes in litter pool are done based on annual change from FL to WL, cause it is assumed that the litter is oxidised in the year of conversion. Litter does not occur in Settlements, so the carbon stock here is considered as 0 t C/ha.

For estimating changes in DW stock due to deforestation activity it was assumed that the dead wood stocks is equal to 5% of the standing biomass stock of the Bulgarian forests. This is a percentage magnitude for dead wood that is frequently reported for managed forests in Europe. The resulting values are given in the table below.

Table 216 Dead wood stocks used for estimating the changes in DW pool after deforestation

		1990	1995	2000	2005	2010
DW stock	tC/ha	1.89	2.16	2.39	2.58	2.77

7.6.2.1.1.3 Changes in the carbon stock in soils of forests converted to settlements

The calculation of the emissions from soils as a result of the conversion of forests to settlements has been made by using national data for the carbon stocks in the soils in forests (78.26 t C/ha) and the carbon stocks in the soils of the settlements (2.47 t C/ha). The carbon stock in the soils of settlements is determined on the basis of data for the carbon stock in the soils of the green areas in Sofia for 40 cm depth (94 t C/ha), corrected as per the relative share of the green areas in Sofia (2.63%).

7.6.2.1.2 Croplands converted to settlements

7.6.2.1.2.1 Changes in the carbon stock in living biomass of the croplands converted to settlements

When calculating the changes in the carbon stock in the biomass during the conversion of cropland to settlements the used values are the average annual stock of carbon in the biomass of annual crops (3.0 t C/ha) and perennials (63 t C/ha) and the growth rates of the carbon stock in the biomass of the settlements (Section 7.3.4.1)

The annual emissions of carbon dioxide are presented in Table 214.

7.6.2.1.2.2 Changes in the carbon stock in soils for croplands converted to settlements

When calculating the changes in the carbon stock of soils during conversion of croplands to settlements the used values are those of the carbon stock in the soils of annual crops (89.92 t C/ha) and perennials (76.52 t C/ha), and values of the carbon stock in the soil of the settlements – 2.47 t C/ha.

7.6.2.1.3 Grassland converted to settlements (5.E.2.3.)

7.6.2.1.3.1 Changes in the carbon stock in living biomass of the grasslands converted settlements

When calculating the changes in the carbon stock of the biomass during the conversion of grassland to settlements the used values are the average annual carbon stock in the biomass of grassland determined for Bulgaria (6.4 t C/ha) and the annual growth rates of the carbon stock in the biomass of the settlements.

7.6.2.1.3.2 Changes in the carbon stock in soils from grassland converted to settlements

When calculating the changes in the carbon stocks in the soil during conversion of grassland to settlements the values use are those of the carbon stock in the soil of grassland (103.57 t C/ha).

7.6.3 UNCERTAINTY ASSESSMENT

The total uncertainty for Land converted to Settlements is ±75 % based on expert judgment.

7.6.4 DATA VERIFICATION CATEGORY-SPECIFIC QA/QC AND VERIFICATION, IF APPLICABLE

See Chapter 7.8

7.6.5 CATEGORY-SPECIFIC RECALCULATIONS

The following recalculations have been made for Submission 2014:

- Changes in the total area of settlements over the reporting period
- Change in the way of estimating the biomass loss associated with conversion from forest land to other land-use.
- New estimate of the reference carbon stock in soils of lands converted to settlements

After the recalculations the CO_2 emissions increased by 700% in the base year and increased by 80% in the last inventoried year 2011.

7.6.6 CATEGORY-SPECIFIC PLANNED IMPROVEMENTS INCLUDING THOSE IN RESPONSE TO THE REVIEW PROCESS

See Chapter 7.9

7.7 OTHER LAND(5.F)

Information on rocks and landslides from the forestry fund reporting forms (NFI, FMP, Executive Forest Agency) is referred to category "Other land". The total national area of 11100.19 kha remains constant over time. Thus in accordance with IPCC GPG 2003, the difference of the area of all land-use category and the whole area of the country is referred to "Other land" category in order to avoid double accounting or omission of an area. Like this the difference between the area of all land use categories and the total area of Bulgaria ranges between 0.01-3.19%.

LUC from any other land-use to other land is considered as unlikely. Therefore, no emission/removals have been estimated.

7.8 QA/QC VERIFICATION

The input data, estimates and results are checked as follows.

- Bottom-up check
- Input data
- Check for the plausibility of the activity data and their trend
- Check for plausibility of the emission factors as well as the related input data and their trends
- Check of input data for completeness
- Estimations
- Check of the correctness of all equations in the estimate files
- Check of the correctness of all interim results
- Check of the plausibility of the results and their trends
- Check of the correctness of all data and results transfer
- Top-down check
- Check of the consistence of the total area for Bulgaria.

Comparison of the activity data used with those from other statistics. Comparison of the used emission factors and underlying input data with those of other data sources (e.g. from literature, results in NIRs of other comparable regions, IPCC default values).

The correctness of the data on the areas and the tree stock is controlled during the preparation, the adoption and the execution of the Forest Management Plans (FMP). The quality control is exercised by the Executive Forest Agency and its subdivisions. Quality control could be exercised by other institutions, e.g. the Ministry of Environment and Waters, municipal authorities as well as by forest landowners. Quality control is exercised at every phase of the preparation of the FMP and the results of the check are documented and the mistakes are corrected.

Concerning the agrostatistical data, from the Agrostatistics and Strategies Directorate of MAF together with the Regional Directorates "Agriculture and forestry" and Municipal Services on agriculture and forestry at MAF organized and conducted the agricultural census in Bulgaria. Around 4000 surveyors participated in the data collection process. Around 400 controllers supervised the work of the surveyors and provided methodological assistance. The controllers delivered the checked questionnaires to the agrostatistics experts from the

Regional Directorates "Agriculture and Forestry" according to a previously adopted schedule. The operators did the data entry in the census software spread in the regional offices. The regional data bases are aggregated on national level by Agrostatistics and Strategies Directorate of MAF. The data entry from the filled in questionnaires into computer software was followed by crosschecks and coherence control in order to ensure the data quality.

7.9 PLANNED IMPROVEMENTS

For Submission 2015 it is planned to implement the following improvements:

- To continue the process of improvements in land use classification and representation
- To continuously check the coherence of reported data, ensuring consistency and accuracy in the estimation process and in the reporting phase;

8 WASTE (CRF SECTOR 6)

8.1 OVERVIEW OF SECTOR

This Chapter includes information on the GHG emissions from the Waste sector. The categories and activities for estimation of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions are described in detail.

According to the IPCC nomenclature, the following categories are included in this sector:

- Solid Waste Disposal on Land (6.A);
- Wastewater handling (6.B);
- Waste incineration (6.C);
- Other (6.D).

The report includes information on methods for estimating greenhouse emissions as well as references of activity data and emissions factors concerning waste management and treatment activities reported under CRF Category 6 Waste.

The most important gas produced in this category is methane.

Emissions from waste handling and their reporting categories in the National Greenhouse Gas Inventory are presented in Figure 84.

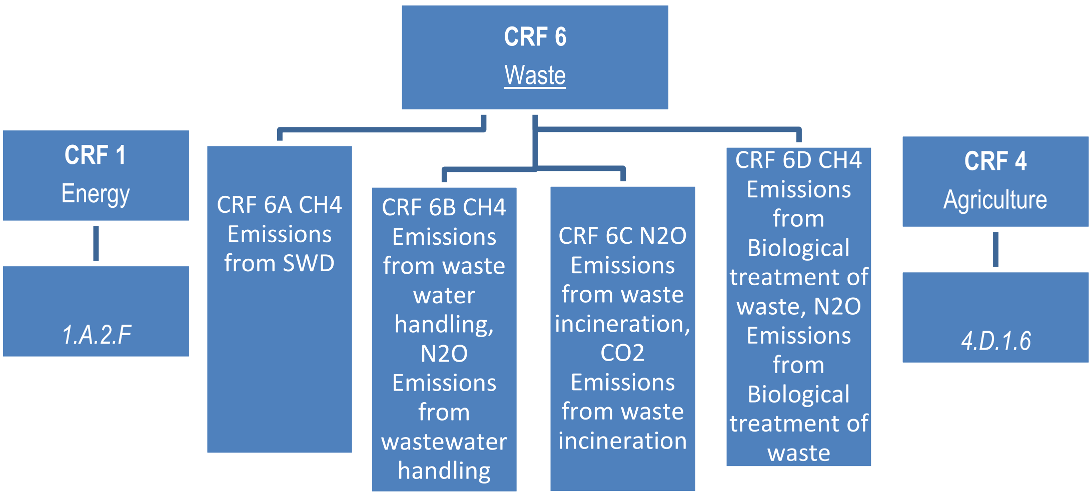


Figure 84 Allocation of Emission from waste handling and their reporting categories

8.1.1 EMISSION TREND

The major greenhouse gas emissions from Waste sector are CH_4, CO_2 and N_2O. The GHG emissions trends in this sector are presented in Table 214 and following figures.

Table 217 Trend in GHG emissions from Waste by sub-sectors for 1988-2012

GHG gases	CH_4			N_2O			CO_2
Category	6 A	6 B	6 D	6 B	6 C	6 D	6 C
1988	155.67	121.42	NO	0.92	0.02	NO	19.04
1989	157.11	114.14	NO	0.91	0.02	NO	19.54
1990	158.38	118.58	NO	0.76	0.03	NO	20.35
1991	159.51	89.65	NO	0.72	0.03	NO	20.71
1992	160.48	71.16	NO	0.68	0.02	NO	19.39
1993	161.37	65.21	NO	0.68	0.03	NO	20.86
1994	162.18	62.36	NO	0.66	0.03	NO	21.20
1995	162.91	68.16	NO	0.67	0.03	NO	21.49
1996	163.56	66.67	NO	0.64	0.03	NO	21.20
1997	165.60	60.35	NO	0.63	0.03	NO	21.38
1998	164.85	53.59	NO	0.68	0.05	NO	35.42
1999	163.43	46.32	NO	0.67	0.04	NO	28.89
2000	163.03	42.97	NO	0.64	0.08	NO	62.99
2001	162.39	37.43	NO	0.61	0.05	NO	40.24
2002	159.94	38.78	NO	0.59	0.05	NO	39.32
2003	157.55	65.40	NO	0.56	0.06	NO	44.52
2004	155.22	63.99	NO	0.57	0.09	NO	70.40
2005	153.04	36.63	NO	0.56	0.07	NO	56.06
2006	150.30	36.95	NO	0.56	0.07	NO	52.77
2007	148.29	37.43	NO	0.53	0.04	NO	35.44
2008	146.01	36.26	NO	0.55	0.06	NO	43.19
2009	147.01	31.75	NO	0.54	0.04	NO	33.89
2010	140.02	33.34	NO	0.54	0.02	NO	14.17
2011	138.08	29.31	0.33	0.53	0.01	0.03	10.47
2012	134.70	27.66	0.32	0.52	0.03	0.02	20.61

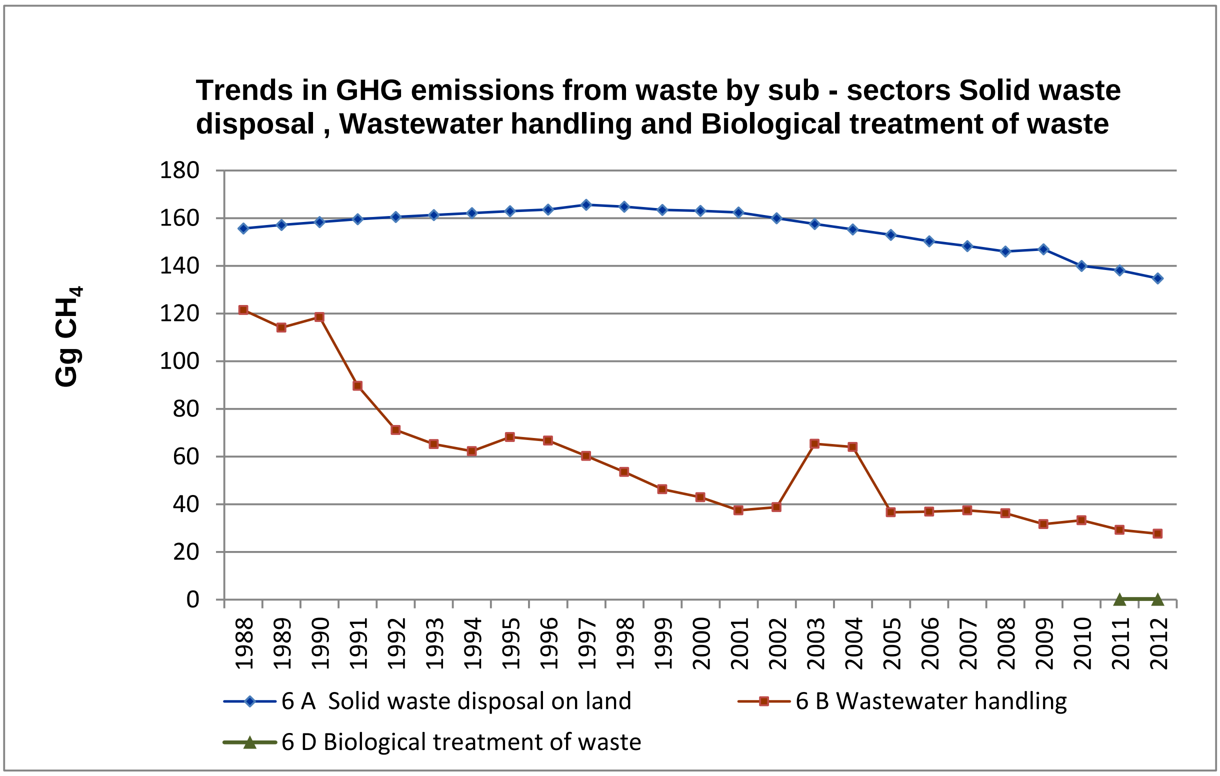


Figure 85 Trend in CH_4 emissions

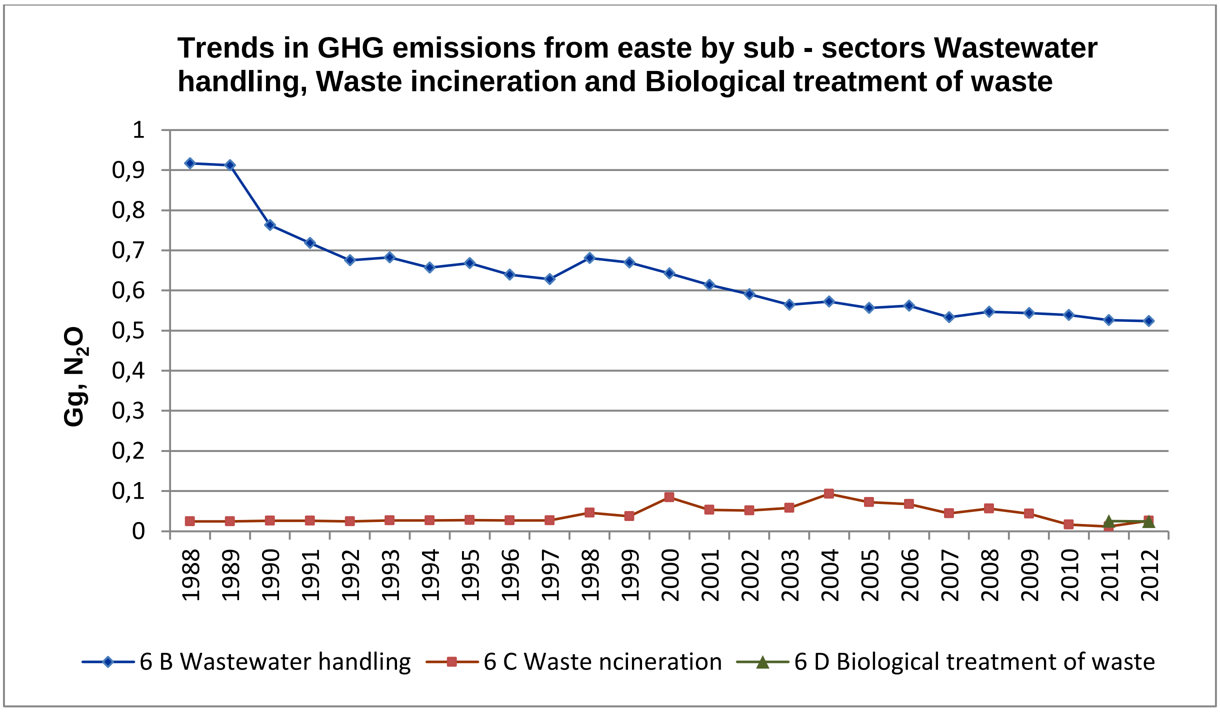


Figure 86 Trend in N_2O emissions

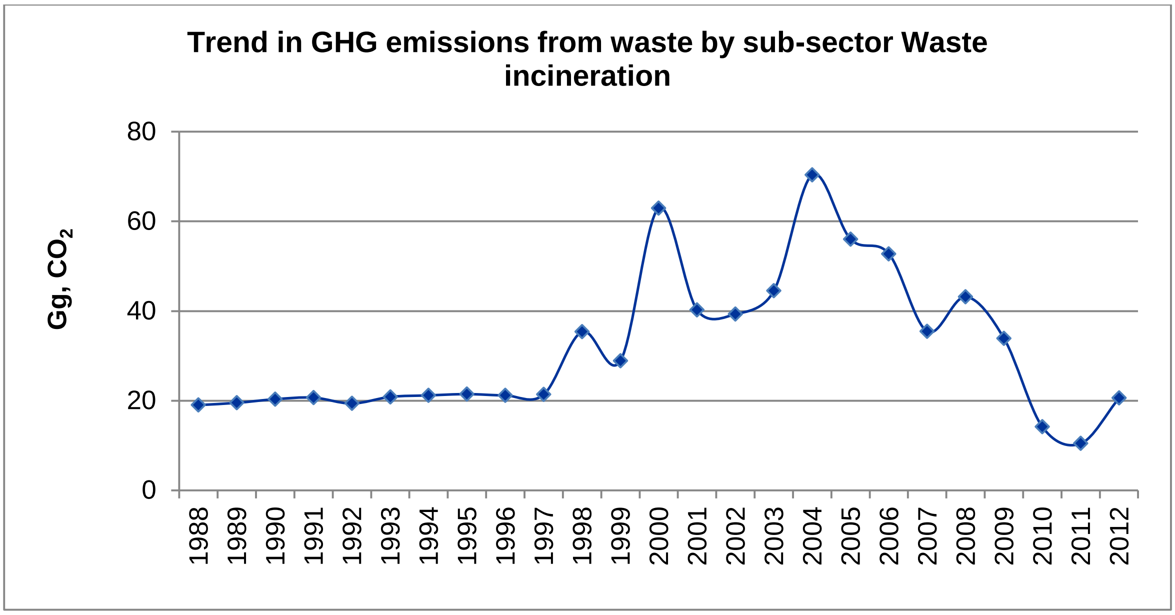


Figure 87 Trend in CO_2 emissions

The total annual GHG emission in CO_2 equivalent per year emitted from Waste sector and the trend of emissions of CO_2 for the period 1988-2012 is presented in the following figure.

The Figure below presents the share of CO_2 eqivalents from whole waste sector.

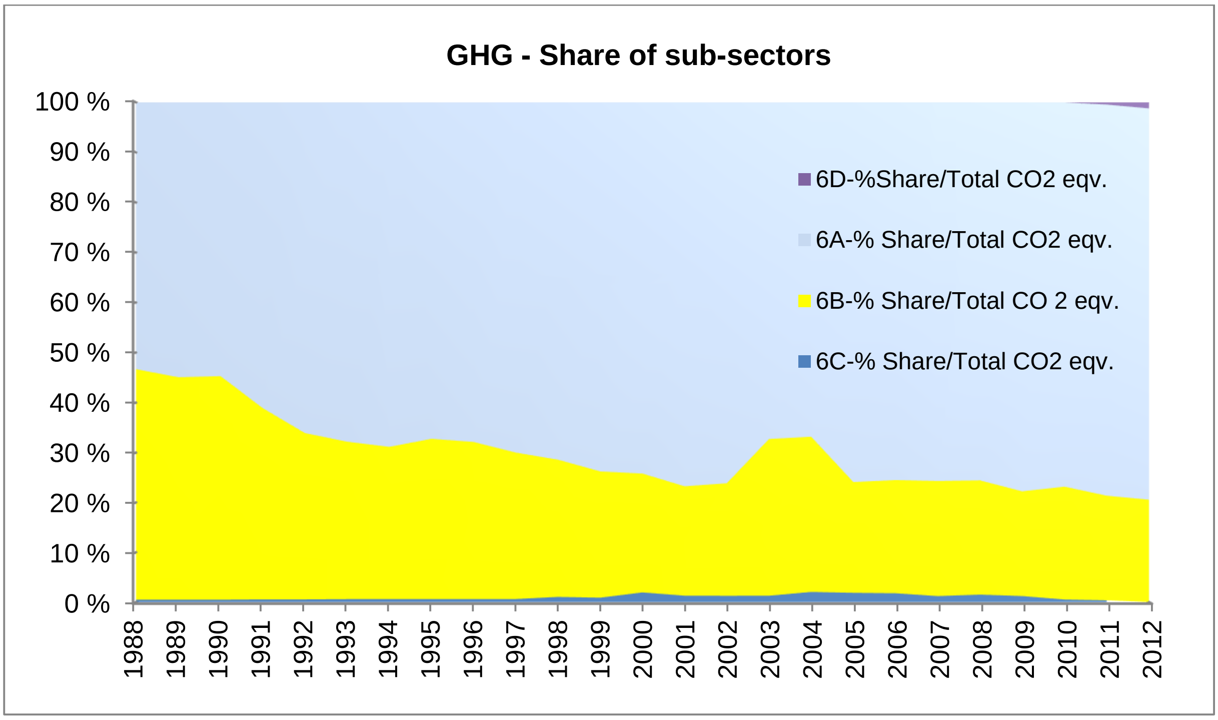


Figure 88 Share of GHG emissions in Waste sector

Emissions from the waste sector in the year 2012 are about 3 615 Gg CO_2 equivalents, and they are around 7 % including LULUCF and around 6 % excluding LULUCF of national total GHGs emissions from Bulgaria.

Solid Waste Disposal on Land contributes over 78.25%, Wastewater Handling about 20.56%, Waste Incineration about 0.79% and compost production about 0.40% sector's total emissions.

Emissions from the waste sector in 2012 decreased by 41 % (3 614.65 Gg CO_2-eq in 2012 compared to 6 129.73 Gg CO_2-eq in 1988) compared to the base year.

Figure below presents the total CO_2 eqv. emissions from the whole waste sector.

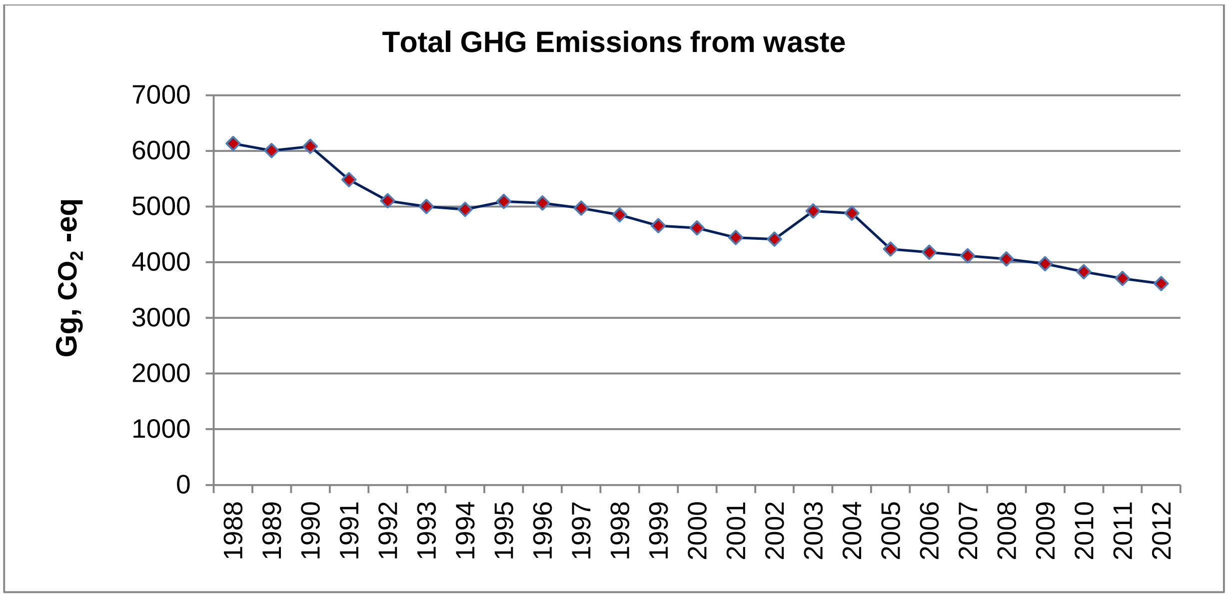


Figure 89 GHG emissions from Waste sector

8.1.2 KEY CATEGORIES

Table 215 described the key categories of the waste sector and type of emitted greenhouse emissions.

Table 218 Key categories, Waste sector (Tier 1)

CRF categories	Category	Key category Y/N	GHG	Assessment of Key Source excluding LULUCF	Assessment of Key Source including LULUCF
6.A	Solid Waste Disposal on Land	Yes	CH_4	L,T	L,T
6.B	Wastewater handling	Yes	CH_4	L,T	L,T

8.1.3 METHODOLOGY

A more detailed description on the methodology for calculating emissions can be found, described in each subcategory of waste sector.

8.1.4 QUALITY ASSURANCE AND QUALITY CONTROL

Generally described checks and improvements have been taken and are described in sub chapters.

8.1.5 UNCERTAINTY ASSESSMENT

Uncertainty assessments are provided in respective subchapter.

8.1.6 COMPLETENESS

Table 219 Description of the completeness

Waste IPCC Category	Waste IPCC Category	CO_2	CH_4	N_2O
6A Solid waste Disposal on land	6A1 Managed waste disposal	NA	▲	NA
6A Solid waste Disposal on land	6A2 Unmanaged waste disposal	NA	▲	NA
6B Wastewater handling	6B1 Industrial wastewater	NA	▲	NA
6B Wastewater handling	6B2 Domestic wastewater	NA	▲	▲
6C Waste Incineration	Incineration of municipal waste	NA	NA	NA
6C Waste Incineration	Incineration of hospital waste	▲	NO	NO
6C Waste Incineration	Incineration of sewage sludge	NO	NO	NO
6C Waste Incineration	Incineration of different type of hazardous waste	▲	NO	▲
6D Other waste	Different type of waste(compost production and etc.	NA	▲	▲

8.2 SOLID WASTE DISPOSAL ON LAND (CRF SECTOR 6A)

8.2.1 SOURCE CATEGORY DESCRIPTION

Treatment and disposal of municipal, industrial and other solid waste produces significant amounts of methane (CH_4). CH_4 produced at SWDS contributes approximately 3 to 4 percent to the annual global anthropogenic greenhouse gas emissions (IPCC 2001). In this report CH_4 is addressed.

The methodology used to estimate emissions from waste management activities requires country-specific knowledge on waste generation, composition and management practice. The improvements of quality and quantity of data are visible in last couple of years. Effort was done in order to evaluate and compile data coming from different sources and adjust them to recommended IPCC methodology which is used for GHGs emissions estimation. At present in our country are used country specific data, where they are available. Default values are used when such data are not available.

Approximately 79% of municipal solid waste generated in the country has been deposited in 2012. The landfills are classified as managed and unmanaged (see below: Activity data).

8.2.2 EMISSION TREND

Methane emissions are shown in the Table 217 and Table 86, respectively from managed and unmanaged sites. There is a reduction in CH_4 emissions from solid waste disposal on land. This is a result from decreasing population, reduced share of landfilled waste and increased recycling.

The total amount of municipal waste generated in Bulgaria in 2012 was 3 248 665 million tonnes, which is in average 1.22 kg per capita. The amounts of separately collected fractions from municipal waste are gradually increasing. Since 2009, collection schemes have been improved for management of six special waste categories - packaging waste, waste oils, end-of-life vehicles, waste electrical and electronic equipment, waste tires, batteries and accumulators. This resulted in increased quantities of collection and recovery of those waste streams and decrease in per capita waste generation.

In the country exist regional systems for waste management where before landfilling the waste are subjected to pre-treatment (separation) as recyclable fractions such as paper and cardboard, metals, glass, plastics and wood are sent to recycling facilities. This practice reduces the amount of waste which going to landfills, additionaly development of composting activities concerning the decreased landfilled degradable fraction of MSW.

The emissions from SWDS are emitted from MSW (including and similar waste as industrial - paper and cardboard, wood waste and vegetable waste), which are landfilled.

Table 220 CH_4 emissions from SWDS

Year	CH_4 emissions		Share of populations land filled on	
	managed	unmanaged	managed	unmanaged
	Gg		%	
1988	0.00	155.674	0	100
1989	0.00	157.113	0	100
1990	0.00	158.381	0	100
1991	0.00	159.512	0	100
1992	0.00	160.476	0	100
1993	0.00	161.367	0	100
1994	0.00	162.181	0	100
1995	0.00	162.911	0	100
1996	0.00	163.561	0	100
1997	0.00	165.597	0	100
1998	0.00	164.852	0	100
1999	0.00	163.432	0	100
2000	2.74	160.287	31.25%	68.75%
2001	4.86	157.536	26.19%	73.81%

Year	CH_4 emissions		Share of populations land filled on	
	managed	unmanaged	managed	unmanaged
	Gg		%	
2002	6.27	153.668	26.47%	73.53%
2003	7.88	149.661	30.57%	69.43%
2004	9.48	145.742	32.42%	67.58%
2005	11.05	141.987	32.62%	67.38%
2006	12.45	137.851	35.35%	64.65%
2007	14.54	133.745	45.34%	54.66%
2008	17.07	128.933	48.34%	51.66%
2009	19.86	127.144	53.03%	46.97%
2010	17.70	122.319	55.38%	44.62%
2011	19.22	118.864	56.80%	43.20%
2012	20.19	114.497	57.64%	42.36%

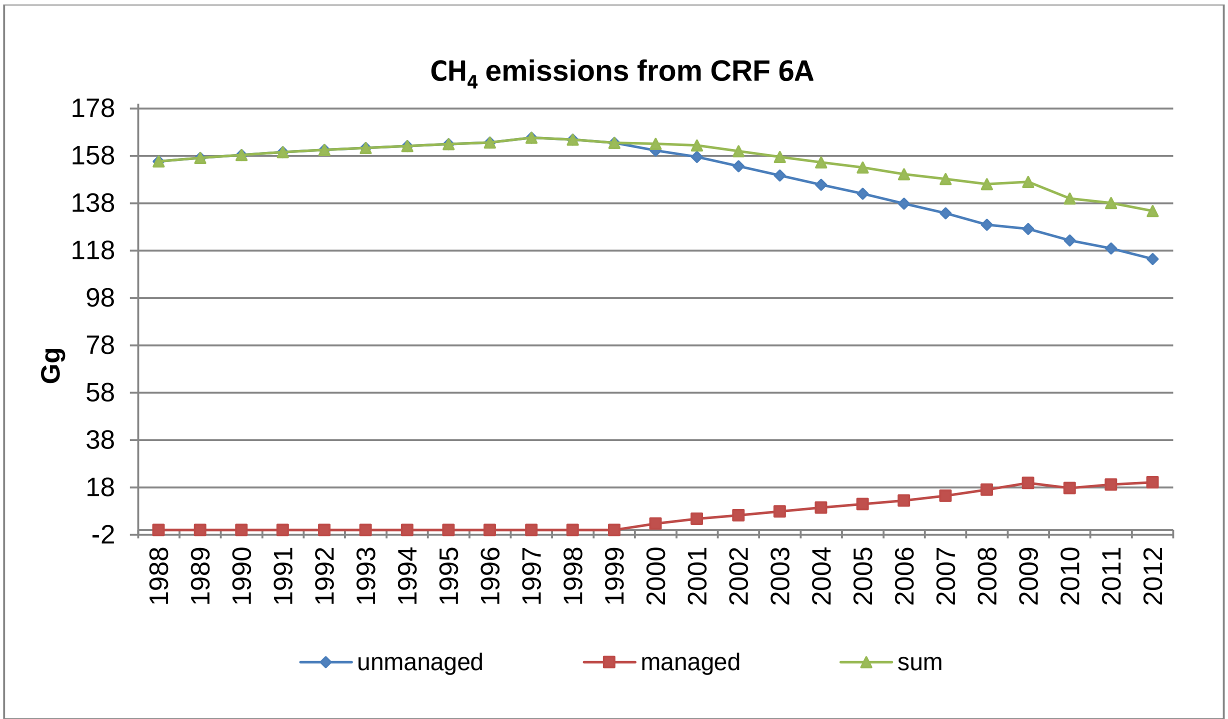


Figure 90 CH_4 Emissions from SWDS

8.2.3 METHODOLOGICAL ISSUES

8.2.3.1 Methodology

A. Choice of method:

Emissions from solid waste disposal on land have been calculated using the First Order Decay (FOD) method, which is the IPCC Tier 2 method given in the IPCC Good Practice Guidance (GPG 2000).

The choice of a good practice method will depend on national circumstances.

B. Basics:

- IPCC FOD Tier 2
- Multi –phase model (based on waste composition);
- Starting year 1950;
- Managed and unmanaged type of site;
- Source AD: NSI, MOEW, ExEA.

C. Equation:

The FOD methods can be represented by the next described Equation,CH_4 generated (IPCC GPG 2000, Chapter 5, eq. 5.1)

$$CH_4 \ generated \ in \ year \ t(Gg/yr) = \sum x\left[\left(A \bullet k \bullet MSW_T(x) \bullet MSW_F(x) \bullet L0(x)\right) \bullet e^{-k(t-x)}\right]$$

Equation 1

Where:

A= $(1-e^{-k})/k$ - normalization factor which corrects the summation;

k = methane generation rate constant (1/year);

MSW_T (x) = Total municipal solid waste (MSW) generated in year x (Gg / year);

MSW_F (x) = Fraction of MSW disposed at SWDS in year x;

L0(x) = Methane generation potential (MCF (x) *DOC (x) * DOC_f *F *16/12 (Gg CH_4/Gg waste);

MCF = methane correction factor (fraction);

DOC = degradable organic carbon (fraction) (Gg C/Gg waste);

DOCF = fraction DOC dissimilated;

F = fraction by volume of CH_4 in landfill gas;

16/12 = conversion from C to CH_4.

The estimation of CH_4 emitted each year, results from Equation 8.2.3.2 (IPCC GPG 2000, Chapter 5, eq. 5.2):

$$CH_4 \ emitted \ in \ year \ t(Gg/yr) = \left[CH_4 \ generated \ in \ year \ t - R(t)\right] \bullet (1 - OX)$$

Equation 2

Where:

R = CH_4 recovered (Gg/yr)

OX = oxidation factor (fraction)

D. Influencing factors/ data required:

- Waste amounts deposited / waste generated
- Waste treatment (deposition, composting, incineration, recycling)
- Management practices at landfill sites (MCF)
- Conditions at landfill sites + Composition of waste deposited
- Organic carbon in landfill sites (DOC)
- Methane generation rate constant (k)
- Landfill gas recovery, Oxidation
- National waste management policy

8.2.3.2 Activity data and emission factors

The main source of activity data is NSI. Data on Municipal Solid Waste generation rate and on the quantity of MSW disposed to SWDSs and etc. are country specific data.

The table below presents the summarized sources of initial activity data.

Table 221 Source of Activity data by year

Year	Parameters										
	generated waste	Source of information	waste generation rate	Source of information	land filling waste	Source of information	waste composition	Source of information	type of landfill		Source of information
									managed	unmanaged	
1950-1998	CS	NSI (proportional to the population)	CS	NSI	CS	NSI	D	IPCC GPG 2000	not defined as such	all unmanaged	IPCC GPG 2000
1998-2000	CS	NSI	CS	NSI	CS	NSI	D	IPCC GPG 2000	not defined as such	all unmanaged	IPCC GPG 2000
2000-2002	CS	NSI	CS	NSI	CS	NSI	D	IPCC GPG 2000	CS	CS	MOEW
2002-2012	CS	NSI	CS	NSI	CS	NSI	CS	MOEW	CS	CS	MOEW

Legislation and development planning processes in the field of waste management in Bulgaria:

In the period around from 1950 to 1995 in our country lacks statutory requirements and policies on waste management. After the global economic and political change and regime change of government in our country start to lay the groundwork for approval of plans and strategies outlining guidelines on sustainable management.

LEGAL FRAMEWORK ON WASTE MANAGEMENT IN BULGARIA
WASTE MANAGEMENT LAW AND RELATED REGULATIONS
NATIONAL STRATEGIC PLANS AND PROGRAMMES
New waste management law 2012 - separate biowaste collection (yards, park and garden wastes,green wastes must be treated via composting or anaerobic digestion); reducing the amount of biodegradable waste, sent to landfills).
National strategic plan for diversion of biodegradable waste going to landfills (2010-2020);
National strategic plan on sewage sludge management (2012-2020)
Details about activity data for the whole period (1950-2012), are given - Figure 87.

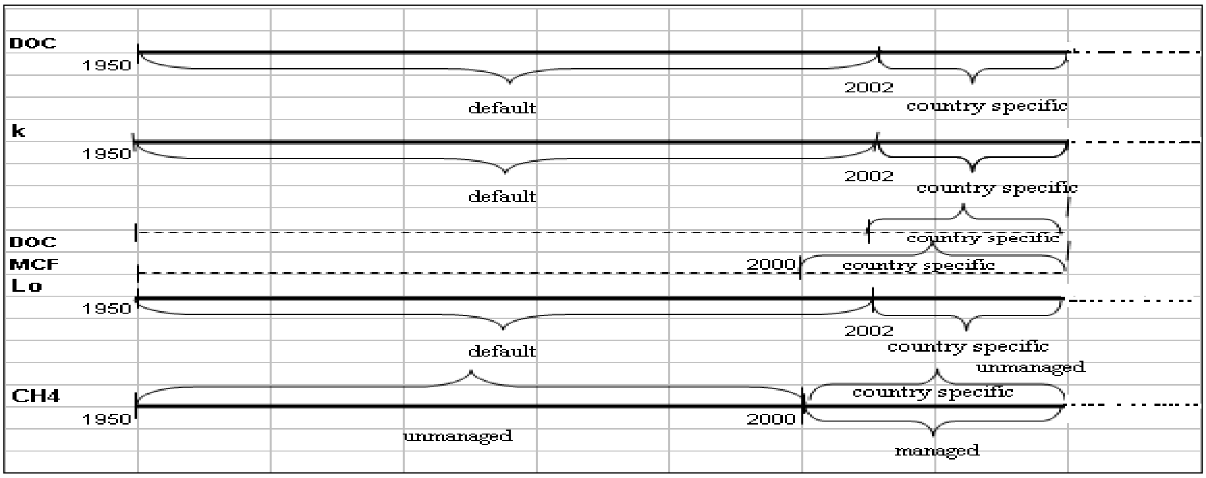


Figure 91 Regarding activity data

During the technical review, based on change of activity data concerning waste generation for period (1950-1998), Bulgaria provided the revised estimates for CH_4 emissions.

NSI is the source of information about generated waste in the country from 1999. From this year NSI applies new methodology for waste collecting data and thus improve the quality of collected and analyzed information about generated waste. On the basis of generated waste from 1999-2010 and total population of the country are calculated generated waste for the period 1950-1998.

The emissions of methane on basis of the activity data are calculated for the entire period 1950-2012, and the plan for calculation depending on the time of reallocated activity data. The quantity of CH_4 emitted during decomposition process is directly proportional to the fraction of degradable organic carbon (DOC), which is defined as the carbon content of different types of organic biodegradable wastes such as paper and textiles, garden and park waste, food waste, wood and straw waste. The main reason for the choice of the period for composition of waste calculation is the fact that in 2002 is done a study at the national level for determine the morphology of the waste. This waste composition is set later in the

Implementation Program for Directive 1999/31/EC. A major feature of the studies is to determine the rate of accumulation of different types of waste based on distribution and population in different settlements. (Program for the implementation of Directive 1999/31/EC on the landfill of waste, p.21) Table 219 shows the morphological composition of the waste % allocated according to distribution of population.

Table 222 Waste composition

Population	until 3 000	from 3 000 to 25 000	from 25 000 to 50 000	over 50 000
A	Organic waste, %			
Food	4.86	12.56	20.85	28.80
Paper	3.87	6.55	10.45	11.10
Paperboard	1.30	0.70	1.63	9.70
Plastics	5.21	8.98	9.43	12.00
Textiles	3.48	4.70	3.40	3.20
Rubber	1.15	0.45	1.10	0.60
Leather	1.36	1.35	2.10	0.70
Garden waste	14.12	14.00	5.53	6.80
Wood waste	2.14	2.28	1.58	1.30
B	Non-organic waste, %			
Glass	8.85	3.40	8.75	9.90
Metals	2.88	1.30	2.83	1.70
C	Other waste, %			
Inert waste	50.78	43.73	32.35	14.20

For country specific biodegradable organic fraction of waste calculations is implemented a model, based on human settlements and distribution of population in them, with the percentage composition of different types of waste and total waste generated for a specific year. Using this model, respectively, the composition of waste is calculated, mainly in four groups (Revised 1996 Guidelines).

A - paper , paperboard and textile waste;
B - garden waste;
C - food (kitchen) waste;
D - Wood waste.
DOC is calculated according Equation 8.2.3.3 (Eq: 5.4, p.5.9, IPCC GPG 2000):

$$DOC = (0.4 \bullet A) + (0.17 \bullet B) + (0.15 \bullet C) + (0.3 \bullet D)$$

Equation 3

With the above equation are calculated the value of the decomposed organic structure of the waste for the country at 2012 as a whole:

DOC = 10.96%

DOC was estimated by using country-specific data on waste composition and quantities based on compiled data from 2002 to 2012. From 1950 to 2001 year the default data for

DOC (15 %) was used in calculation. (Table 6-1, p.6.6, Revised 1996 Guidelines, Reference Manual)

Table 220 below shows the four components (A, B, C, and D).

Table 223 Components of waste composition

Year	waste composition, %		degradable waste, %	DOC
2002	A	16.52%	46.54%	0.1158
	B	10.22%		
	C	18.05%		
	D	1.76%		
2003	A	16.53%	46.55%	0.1158
	B	10.22%		
	C	18.05%		
	D	1.75%		
2004	A	16.55%	46.60%	0.1160
	B	10.23%		
	C	18.07%		
	D	1.76%		
2005	A	16.58%	46.65%	0.1161
	B	10.21%		
	C	18.11%		
	D	1.75%		
2006	A	16.62%	46.74%	0.1163
	B	10.19%		
	C	18.18%		
	D	1.75%		
2007	A	16.63%	46.76%	0.1164
	B	10.21%		
	C	18.17%		
	D	1.75%		
2008	A	16.63%	46.76%	0.1164
	B	10.17%		
	C	18.21%		
	D	1.75%		
2009	A	16.62%	46.74%	0.1163
	B	10.15%		
	C	18.23%		
	D	1.75%		
2010	A	16.66%	46.81%	0.1165
	B	10.13%		
	C	18.28%		
	D	1.75%		
2011	A	16.84%	47.16%	0.1174
	B	10.04%		

Year	waste composition, %		degradable waste, %	DOC
	C	18.55%		
	D	1.74		
2012	A	16.87%	41.88%	0.1096
	B	10.02%		
	C	13.25%		
	D	1.73%		

The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH_4 generation.
MCF accounts for the fact that unmanaged SWDS produce less CH_4 from a given amount of waste than anaerobic managed SWDS.

The methodology requires countries to provide data or estimates of the quantity of waste that is disposed of to each of categories of solid waste disposal sites.The IPCC Guidelines present default value for MCF (Table 6-2, p.6.8, Revised 1996 IPCC Guidelines, Reference Manual), which are presented in Table 221 below:

Table 224 Methane Correction Factor (MCF)

SWDS CLASSIFICATION AND METHANE CORRECTION FACTORS(MCF)	
Type of site	**Methane correction factor (MCF)**
Managed	1
Unmanaged 3 – deep (>5m waste)	0,8
Unmanaged 3 – shallow (<5m waste)	0,4
Uncategorised SWDS 5	0,6

To determine the quantity of managed and unmanaged landfills at the national level is applied the method of expert judgment, assessment by leading experts in the field of waste from the structure of MOEW (2006 IPCC Guidelines, Vol.1 General Guidance and Reporting). As the main criteria for whether landfills are managed and unmanaged, is considered the fact if the landfills meet the requirements laid down in EU Directive 1999/31/EC on the landfill of waste.

The methane generation potential (Lo), ($GgCH_4$/Gg waste) depends upon the composition of waste, on waste disposal practices and on the physical characteristics of the SWDS (IPCC Guidance). For 2012 inventory year the values are:

$$\mathbf{Lo}_{\text{managed landfills}} = 0.040\ GgCH_4/Gg\ \text{waste}$$

$$\mathbf{Lo}_{\text{unmanaged landfills}} = 0.032\ GgCH_4/Gg\ \text{waste}$$

The methane generation rate constant k is released to the time taken for the DOC in waste and depends on large number of factors associated with the composition of waste and the conditions at the site. Since we have available data on the composition of waste in 2002, then in this case we calculate country-specific value of the constant k for the period from 2002 to 2012.

Country doesn't have the data about specific half-life values and therefore default values are used to calculate country specific constant k. Corresponding half-lives (2006 IPCC Guidelines) are provided below in Table 222.

Table 225 Default Half-life value

TABLE 3.4
RECOMMENDED DEFAULT HALF-LIFE ($t_{1/2}$) VALUES (YR) UNDER TIER 1
(Derived from *k* values obtained in experimental measurements, calculated by models, or used in greenhouse gas inventories and other studies)

Type of Waste		Climate Zone*							
		Boreal and Temperate (MAT ≤ 20°C)				Tropical[1] (MAT > 20°C)			
		Dry (MAP/PET < 1)		Wet (MAP/PET > 1)		Dry (MAP < 1000 mm)		Moist and Wet (MAP ≥ 1000 mm)	
		Default	Range[2]	Default	Range[2]	Default	Range[2]	Default	Range[2]
Slowly degrading waste	Paper/textiles waste	17	14[3,5] – 23[3,4]	12	10 – 14[3,5]	15	12 – 17	10	8 – 12
	Wood/ straw waste	35	23[3,4] – 69[6,7]	23	17 – 35	28	17 – 35	20	14 – 23
Moderately degrading waste	Other (non – food) organic putrescible/ Garden and park waste	14	12 – 17	7	6 – 9[8]	11	9 – 14	4	3 – 5
Rapidly degrading waste	Food waste/Sewage sludge	12	9 – 14	4[4]	3[3,4] – 6[9]	8	6 – 10	2	1[10] – 4
Bulk Waste		14	12 – 17	7	6 – 9[8]	11	9 – 14	4	3 – 5[11]

The average value for constant k for 2012 inventory year is:

k=0.0399 (1/yr)

Before 2002 the period from 1950 to 2001, accept the default value of k=0.05 (IPCC Good Practice Guidance, p.5.7)

Besides the following parameters are chosen:

Fraction of DOC dissimilated (DOCF) is an estimate of the fraction of carbon that is ultimately degraded and released from SWDS, and reflects the fact that some organic carbon does not degrade, or degrades very slowly, when deposited in SWDS. It is also good practice to use a value of 0.5-0.6 (including lignin C) as the default (IPCC Good Practice Guidance). For calculations of DOC_F Bulgaria uses a default value of 0.5.

Fraction of CH_4 in landfill gas (F). Landfill gas consists mainly of CH_4 and carbon dioxide (CO_2). The CH_4 fraction F is usually taken to be 0.5 by default according to IPCC Good Practice Guidance.

Methane recovery (R). The country reports methane recovery from 2010 when the installation was brought to exploitation. Before that is zero (IPCC Good Practice Guidance).

The calculation of CH_4 from landfills is based on the questionnaires, sent to the landfill operators, which contain data about methane, stored in reservoirs, burned in a flare and utilized methane. The amount of gas collected and utilized, measured at SWDS is reported to RIEW (Regional Inspectorate of Environment and Water). Reporting is based on the metering of gas recovered for energy utilization and flaring. These data are country specific.

Sofia landfill is equipped with gas collection system, system for CH_4 utilization and flaring system. The system for methane utilization is co-generation system (CHP-combined heat and power) for heat and electricity production. The system is operating since 2010. Landfill near Silistra does not collect the landfill gas. It has a flaring system (SIMENS installation).

Oxidation factor (OX). The default oxidation factor in the IPCC Guidelines is zero (IPCC Good Practice Guidance).

Table 168 summarizes the parameters used to calculate emissions of methane from Solid waste Disposal Sites by IPCC Tier 2 method.

Table 226 Parameters in TIER 2 for Solid waste Disposal Sites

Year	Total population	Waste generation rate	Fraction of MSW disposed	Fraction DOC in MSW	CH_4 oxidation factor	CH_4 fraction in landfill gas	CH_4 generation rate constant	Time lag	CH_4 emissions
	1000s	kg/person/ day						yr	Gg/yr
1988	8986.64	1.38	0,950	0,1500	NO	0,5	0,050	38	155.674
1989	8767.31	1.38	0,950	0,1500	NO	0,5	0,050	39	157.113
1990	8669.27	1.38	0,950	0,1500	NO	0,5	0,050	40	158.381
1991	8595.47	1.38	0,950	0,1500	NO	0,5	0,050	41	159.512
1992	8484.86	1.38	0,950	0,1500	NO	0,5	0,050	42	160.476
1993	8459.76	1.38	0,950	0,1500	NO	0,5	0,050	43	161.367
1994	8427.42	1.38	0,950	0,1500	NO	0,5	0,050	44	162.181
1995	8384.72	1.38	0,950	0,1500	NO	0,5	0,050	45	162.911
1996	8340.94	1.38	0,950	0,1500	NO	0,5	0,050	46	163.561
1997	8283.20	1.38	0,950	0,1500	NO	0,5	0,050	47	165.597
1998	8230.37	1.38	0,950	0,1500	NO	0,5	0,050	48	164.852
1999	8190.88	1.64	0.651	0,1500	NO	0,5	0,050	49	163.432
2000	8149.47	1.68	0.654	0,1500	NO	0,5	0,050	50	163.029
2001	7891.10	1.66	0.670	0,1500	NO	0,5	0,050	51	162.391
2002	7845.84	1.65	0.676	0,1158	NO	0,5	0,047	52	159.940
2003	7801.27	1.65	0.681	0,1158	NO	0,5	0,047	53	157.545
2004	7761.05	1.63	0.669	0,1160	NO	0,5	0,047	54	155.221
2005	7718.75	1.59	0.698	0,1161	NO	0,5	0,047	55	153.037
2006	7679.29	1.56	0.627	0,1163	NO	0,5	0,047	56	150.304
2007	7640.24	1.49	0.714	0,1164	NO	0,5	0,047	57	148.286
2008	7606.55	1.62	0.749	0,1164	NO	0,5	0,047	58	146.008
2009	7563.71	1.61	0.770	0,1163	NO	0,5	0,047	59	147.002
2010	7504.87	1.49	0.748	0,1165	NO	0,5	0,049	60	140.014
2011	7327.22	1.34	0.719	0,1174	NO	0,5	0,048	61	138.080
2012	7284.55	1.22	0.797	0.1096	NO	0.5	0.039	62	134.696

8.2.4 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

To ensure consistency over time, it is good practice (IPCC GPG 2000) a time series should be developed using the same methods. For entire time series we apply the same FOD methods for emission calculation.

Table 227 Activity data and emission factors Uncertainty Range

Total Municipal Solid Waste (MSWT)		30%
Fraction of MSWT sent to SWDS (MSWF)		±30%
Emission factor uncertainty		80%
Total uncertainty of Waste composition		±30%
Degradable Organic Carbon (DOC) (default)		20%
Degradable Organic Carbon (DOC) (country-specific values)		±10%
Fraction of Degradable Organic Carbon Decomposed (DOCf) (IPCC default value (0.5))		± 20%
Methane Correction Factor (MCF) (IPCC default value	= 1.0	–10%, +0%
	= 0.8	±20%
Fraction of CH_4 in generated Landfill Gas (F) = 0.5 (default)		±5%
Methane Recovery (R)		-
Oxidation Factor (OX)		-
half-life (t1/2) (default)	12	20% /-14%
	23	35% /-34%
	7	17% / -22%
	4	33% / -33%
	7	17% /-22%
Combined uncertainty		85%

8.2.5 SOURCE-SPECIFIC QA/QC AND VERIFICATION

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation according to QA/QC (Improvement) plan.

Regarding to Tier 2 activities, emission factors and activity data were checked for key source categories. Solid waste disposal on land represent key source category in Waste sector. CH_4 emissions from solid waste disposal on land were estimated using Tier 2 method which is a good practice.

The next basic QA/QC activities were implemented and national circumstances was taken into account:

- Check activity data, emission factors and other parameters (value, record and archive);
- Check for errors in data input and references;
- Check that emissions and parameters are calculated correctly;
- Check completeness;
- Trends checks and etc.

8.2.6 SOURCE-SPECIFIC RECALCULATION

Change in AD for generated waste have been done on the basis of NSI project for revision of the data for recycled household wastes since 1999.

The aim of this project was to evaluate the recycled household waste and to determine their origin. It has been established that approximately 80 % of the recycled waste are of household origin and these quantities were added to the generated municipal solid waste. The change in AD affects only the generated waste, it does not affect the landfilled waste. The change of AD leads to the change in per capita waste generation and fraction of MSW disposed.The report has been sent to Eurostat.

8.2.7 SOURCE-SPECIFIC IMPROVEMENT PLAN

Since 2013 we have regulatory basis for obtaining information about waste - Ordinance No 2 on the Procedures and forms for providing information about waste management activities and the procedure for keeping public records (published in State Gazette, No 10 from 05.02.2013, modified with State Gazette, No 86 from 01.10.2013).The operators of installations are obliged to report on annual basis. In the reporting formats under te Ordinance the emissions are included.

The reported emission will be used in the inventory for the 2015 submission.

8.3 WASTEWATER HANDLING (CRF SECTOR 6B)

8.3.1 SOURCE CATEGORY DESCRIPTION

This sector includes CH_4 emissions from wastewater when treated or disposed anaerobically and indirect N_2O emissions for the period 1988-2012. CO_2 emissions from wastewater are not considered in the IPCC Guidelines.

This category includes the calculation of CH_4 emissions in the atmosphere during the wastewater handling and indirect N_2O emissions for the period 1988-2012. The calculation of the emissions is separated in two subcategories:

6B1 – Industrial wastewater treatment;

6B2 – Domestic/commercial wastewater treatment

For estimation of CH_4 recovery from waste water handling, a questionnaires have been sent to operators of WSS (Water Supply and Service) utilities. They include information about the type of plant treatment system for CH_4 utilization (e.g. gas holder system, methane tanks and gas burning system); quantity of total catched CH_4, CH_4 stored in reservoirs, utilized and flared methane) and year of commissioning of the installation for CH_4 utilization.

8.3.2 EMISSION TREND

Total CO_2 eqivalents from waste water handling for 2012 are 743 Gg CO_2 eq. The peak in emissions in 2003 compared to the preceding year is the decision of the Ministry of Environment and Water for the discharge of several big tailing ponds of mining companies in the country. The high level of the emissions of the industrial wastewater kept in 2004 due to the same reason.

Emissions decrease for 2011 and 2012 is due to CH_4 recovery from Domestic wastewater handling. For the last couple of years in modern wastewater treatment plants methane recovery increase due to installed co-generation systems (CHP system-combined heat and power production). This reduces the emissions of CH_4 and CO_2 in the atmosphere.

The higher CH_4 IEF for industrial wastewater in 2010 is due to higher generated wastewater quantities from pulp and paper industry (55.5 per cent higher than that generated in 2009) and higher DOC (9.00 kg COD/m^3 related to the other wastewater streams from other reported industries-2.00-3.00 COD/m^3).

Methane emissions from wastewater treatment and CH_4 recovery are shown on the following figures. We divide the emission by domestic and industrial origin.

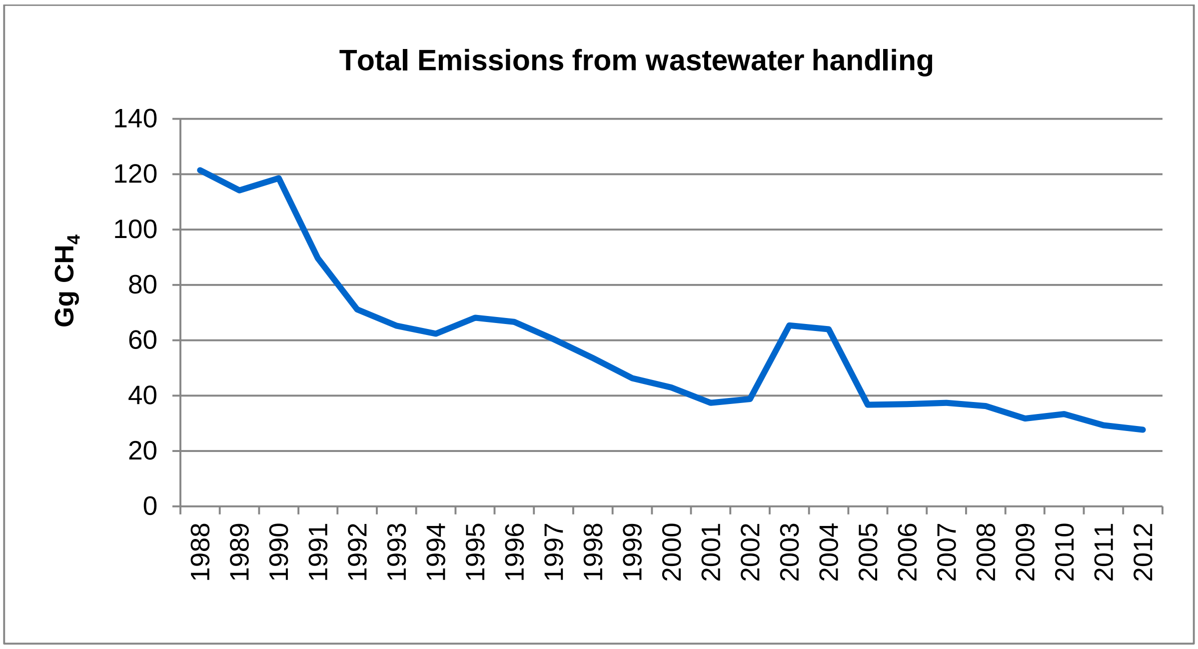


Figure 92 CH_4 emissions from wastewater handling

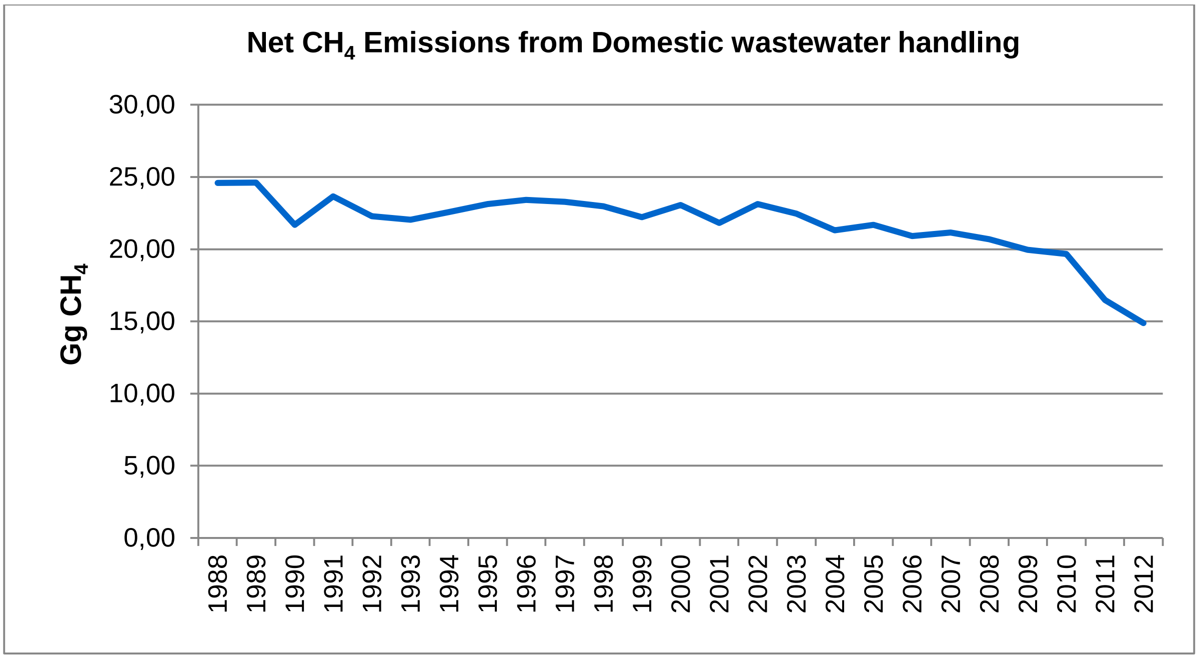


Figure 93 CH_4 emissions from Domestic Wastewater

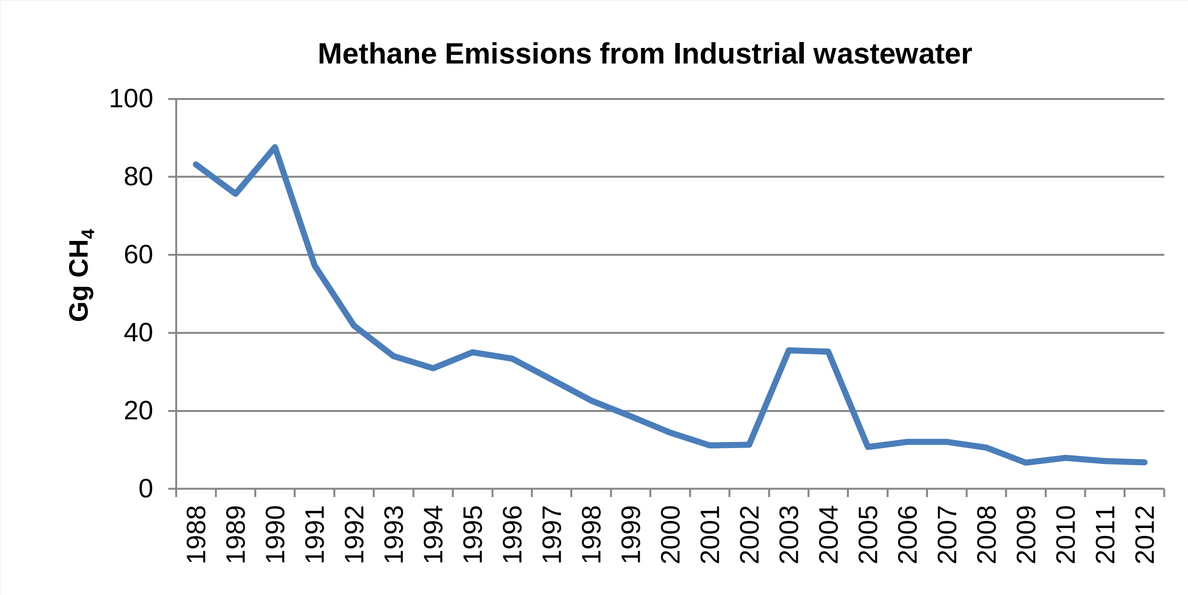
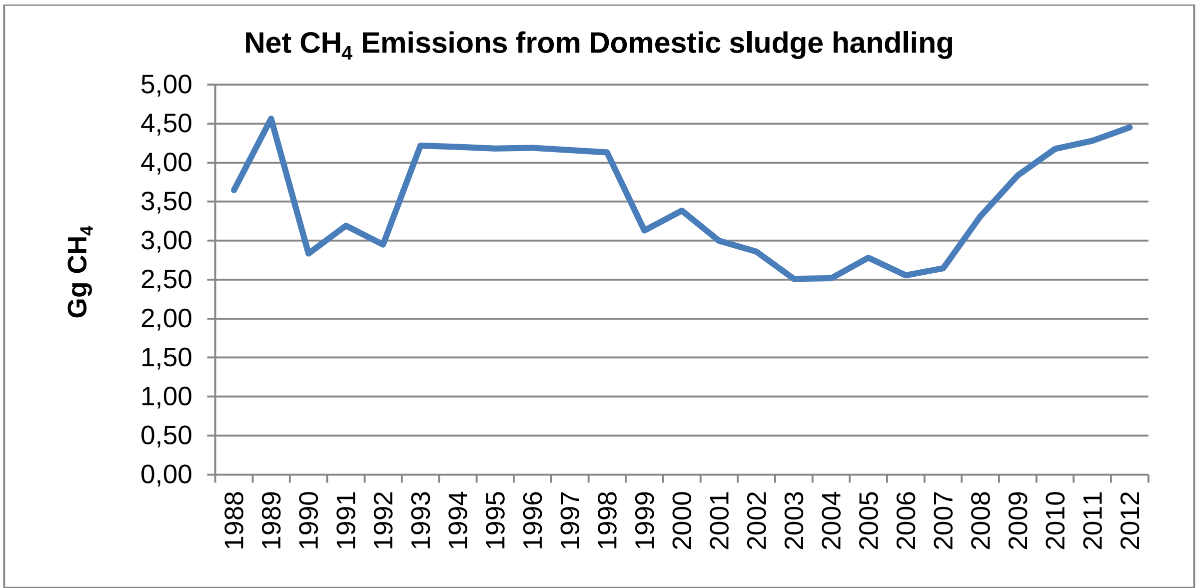


Figure 94 CH_4 emissions from Industrial wastewater



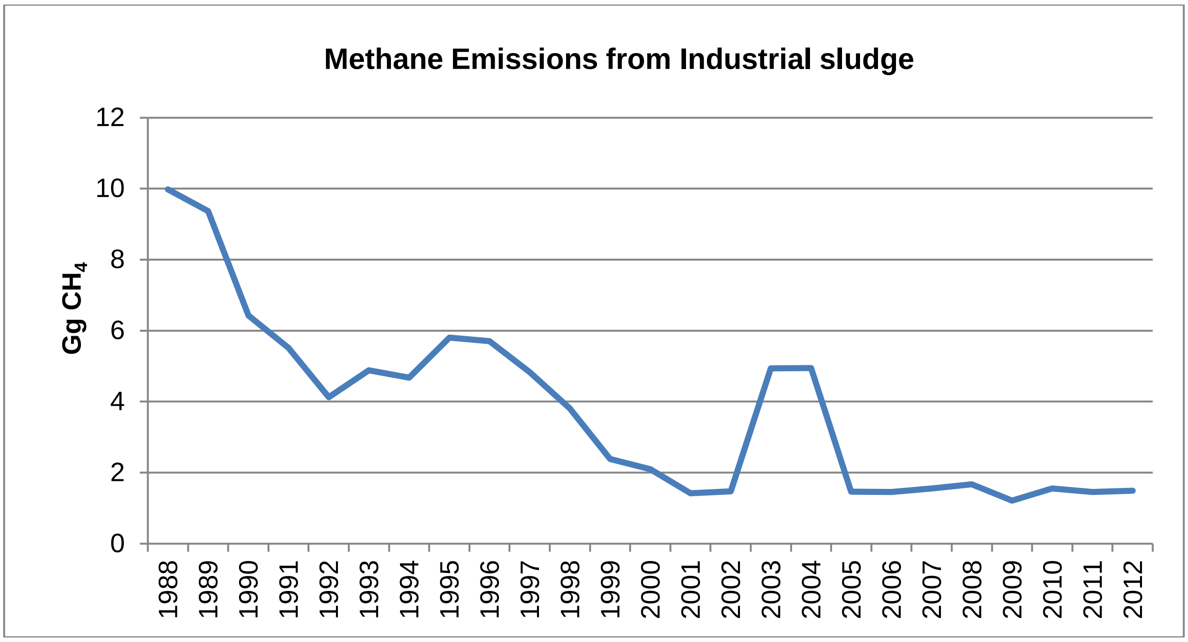


Figure 95 CH_4 emissions from Domestic Sludge

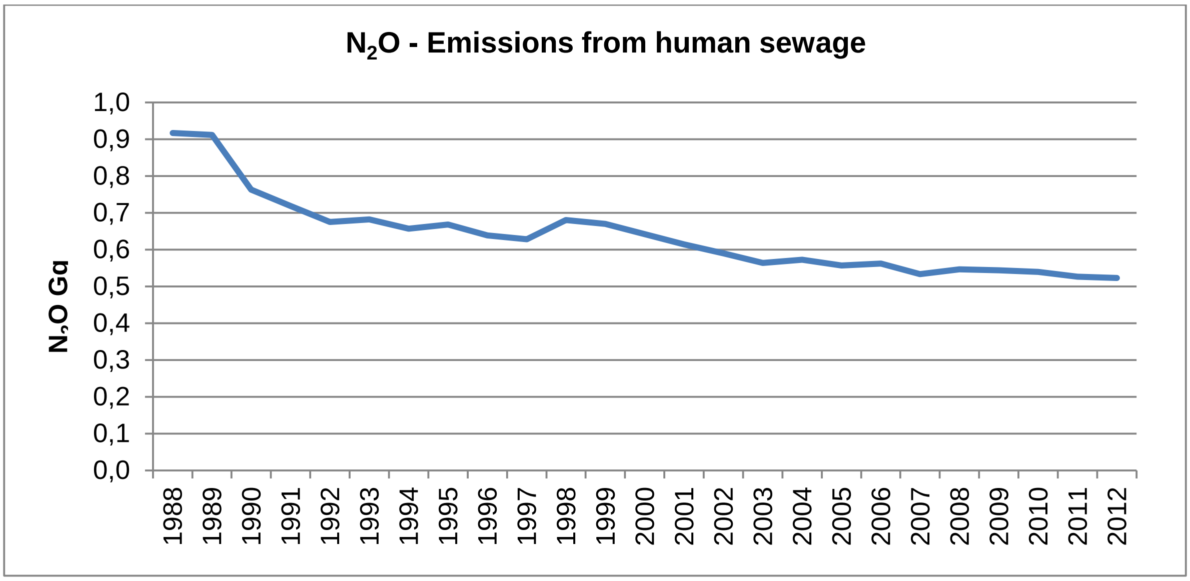


Figure 96 CH_4 emissions from Industrial Sludge

Figure 97 N_2O emissions from Human sewage

8.3.3 METHODOLOGICAL ISSUES

8.3.3.1 Methodology for calculation of the methane emissions of domestic / commercial wastewater handling.

IPCC Guidelines describe a single methodology for the calculation of the methane emissions in the atmosphere during the the processes of domestic wastewater treatment. The decision tree, which describes the steps and the algorithm for calculating methane emissions, is shown on Figure 5.2, page.5.15 / IPCC GPG 2000.

The methodology for the calculation of the methane emissions from domestic wastewater handling and sludge consists of three components: definition of the total organically degradable material in domestic wastewater, emission factor and emission estimation.

The first step in the calculation is to define the total organically degradable material in domestic wastewater (TOW), expressed in the term of biochemical oxygen demand (kg BOD/year). Based on the demographic data acquired by the National Statistical Institute for the respective inventory years, we calculate TOW with the following equation:

$$TOW = P * DOC$$

Equation 4

Where:

TOW – total organics in the wastewater in inventory year, kg BOD/yr

P – country population in inventory year, (1000 person)

DOC - Degradable organic component, kg BOD/1000 person/yr..

Degradable organic component is specified in 1996 IPCC Guidelines, Table.6-5 page 6.23, as a default value equal to 18,250 kg BOD/1000 person/yr.

The next step of the calculation is to define the Emission factor. The emission factor is function of the maximum CH_4 producing potential (Bo) and methane correction factor (MCF).

$$EF_j = B_o * MCFj$$

Equation 5

Where:

EFj – emission factor, kg CH_4/kg BOD

Bo – maximum CH_4 producing capacity, kg CH_4/kg BOD

MCF – methane correction factor

IPCC provides the default value for domestic wastewater:

Bo = 0,60 kg CH_4 /kg BOD

The first step for the definition of MCF is to characterize the systems for wastewater treatment in the country. The big picture for the flow of domestic and industrial wastewater and the different possibilities of treatment is shown on Figure 75. In bolded outline are shown the potential methane sources.

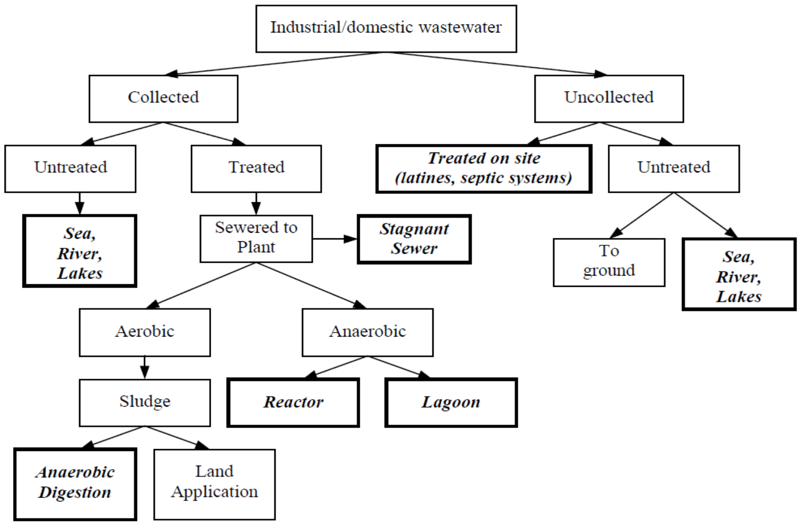


Figure 98 Potential CH_4 sources

Following the 2006 IPCC Guidelines, table 6.3, page.6.13, the type of wastewater treatment system and the discharge pathways are defined for the whole country. Based on the data by the National Statistical Institute, we point out three categories of methane emissions sources.

Category 1 - waters without treatment discharged in the water sources (sea, rivers and lakes).

Category 2 - waters discharged trough sewer systems into centralized anaerobic wastewater treatment plant. In the general case they are amortized

Category 3 - water discharged trough stagnant sewers.

Table 228 Default MCF for Domestic wastewater

TABLE 6.3 DEFAULT MCF VALUES FOR DOMESTIC WASTEWATER			
Type of treatment and discharge pathway or system	**Comments**	**MCF [1]**	**Range**
Untreated system			
Sea, river and lake discharge	Rivers with high organics loadings can turn anaerobic.	0.1	0 – 0.2
Stagnant sewer	Open and warm	0.5	0.4 – 0.8
Flowing sewer (open or closed)	Fast moving, clean. (Insignificant amounts of CH_4 from pump stations, etc)	0	0
Treated system			
Centralized, aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets.	0	0 – 0.1
Centralized, aerobic treatment plant	Not well managed. Overloaded.	0.3	0.2 – 0.4
Anaerobic digester for sludge	CH_4 recovery is not considered here.	0.8	0.8 – 1.0
Anaerobic reactor	CH_4 recovery is not considered here.	0.8	0.8 – 1.0
Anaerobic shallow lagoon	Depth less than 2 metres, use expert judgment.	0.2	0 – 0.3
Anaerobic deep lagoon	Depth more than 2 metres	0.8	0.8 – 1.0
Septic system	Half of BOD settles in anaerobic tank.	0.5	0.5
Latrine	Dry climate, ground water table lower than latrine, small family (3-5 persons)	0.1	0.05 – 0.15
Latrine	Dry climate, ground water table lower than latrine, communal (many users)	0.5	0.4 – 0.6
Latrine	Wet climate/flush water use, ground water table higher than latrine	0.7	0.7 – 1.0
Latrine	Regular sediment removal for fertilizer	0.1	0.1

[1] Based on expert judgment by lead authors of this section.

We use the *methane correction factor* as follows:

Category 1 - waters without treatment discharged in the water sources (sea, rivers and lakes) MCF = 0,1

Category 2 - waters discharged trough sewer system into centralized anaerobic wastewater treatment plant – MCF = 0,3

Category 3 - waters discharged trough stagnant sewer – MCF = 0,5

The same data from National Statistical Institute are used for wastewater distribution among different treatment systems. The data are country specific.

Table 229 Domestic wastewater distribution among different treatment systems

Year	Discharged into sea, river, lake	Centralized, aerobic, not well managed treatment plant	Stagnant sewer
1988	43.07%	32.30%	24.63%
1989	43.07%	32.30%	24.63%
1990	56.14%	17.54%	26.32%
1991	49.36%	18.95%	31.69%
1992	51.23%	21.28%	27.48%
1993	51.02%	22.79%	26.19%
1994	48.08%	25.07%	26.85%
1995	44.25%	28.99%	26.77%
1996	43.30%	28.51%	28.19%
1997	42.54%	29.82%	27.64%
1998	41.54%	32.69%	25.76%
1999	43.72%	32.19%	24.09%
2000	40.61%	32.75%	26.64%
2001	42.28%	33.14%	24.58%
2002	35.52%	37.27%	27.21%
2003	37.23%	37.10%	25.67%
2004	40.16%	37.66%	22.17%
2005	37.38%	40.18%	22.44%
2006	40.27%	38.60%	21.12%
2007	38.36%	40.52%	21.12%
2008	38.96%	41.33%	19.70%
2009	41.41%	40.28%	18.31%
2010	41.20%	41.55%	17.25%
2011	39.26%	42.55%	18.20%
2012	38.08%	45.35%	16.57%

The share of domestic wastewater, treated in treatment plant increased with 2.8 percent in comparison with preceiding year.

The calculation of CH_4 recovery from wastewater handlingis based on the questionnaires, sent to the operators of water supply and service utilities. They include information about the type of plant treatment system for CH_4 utilization (e.g. gas holder system, methane tanks and gas burning system); quantity of total catched CH_4, CH_4 stored in reservoirs, utilized and flared methane) and year of commissioning of the installation for CH_4 utilization. Reporting is based on the metering of gas recovered for energy utilization and flaring. These data are country specific. Bulgaria correctly calculated the the recovered methane for 2011 - it 3 177 691 kg CH_4 (3.177Gg) and for 2012 – 4 588 604 kg CH_4 (4.588 Gg) respectively. The correct values are reported in CRF tables.

8.3.3.2 Methodology for calculation of the methane emissions of domestic sludge handling.

Sludge can be treated aerobically or anaerobic. For the last couple of years there is an improvement in the sludge management practices – as sludge is stabilized in methane tanks.To define the MCF of sludge we analyze the type of sludge treatment - aerobically or anaerobic. Based on the letters received form all WSS utility companies in the country, we define the separation by percentage of aerobic and anaerobic treatment of sludge. Following the IPCC GPG 2000 we use methane correction factor for anaerobic treatment MCF=0,8; and for aerobic treatment MCF=0.

8.3.3.3 Methodology for calculation of the methane emissions of industrial wastewater handling.

Industrial wastewater can be treated on site or discharged into centralized sewer. Emissions from industrial wastewater discharged into centralized sewer, are included in emissions from domestic wastewater. For this reason in this sub-category we calculate the methane emissions from industrial wastewater treated on site.

Based on the data acquired by the National Statistical Institute we determine the percentage on industrial wastewater treated on site

Table 230 Industrial wastewater treated on site

Year	Total industrial	Treated on site		Non treated on site	
	thou.m^3	thou.m^3	%	thou.m^3	%
1988	1 075 286	610 746	56,80%	464 540	43,20%
1989	1 008 789	572 976	56,80%	435 812	43,20%
1990	1 127 165	610 252	54,14%	516 913	45,86%
1991	900 404	460 803	51,18%	439 601	48,82%
1992	766 131	368 586	48,11%	397 545	51,89%
1993	608 420	304 300	50,01%	304 120	49,99%
1994	526 760	291 347	55,31%	235 413	44,69%
1995	587 085	361 591	61,59%	225 494	38,41%
1996	577 742	352 879	61,08%	224 863	38,92%
1997	489 706	298 698	61,00%	191 008	39,00%
1998	418 679	250 707	59,88%	167 972	40,12%
1999	377 265	206 549	54,75%	170 716	45,25%
2000	328 497	158 273	48,18%	170 224	51,82%
2001	274 475	121 677	44,33%	152 797	55,67%
2002	225 023	136 029	60,45%	88 994	39,55%
2003	666 142	558 201	83,80%	107 941	16,20%
2004	657 812	555 546	84,45%	102 267	15,55%

Year	Total industrial	Treated on site		Non treated on site	
	thou.m³	thou.m³	%	thou.m³	%
2005	180 648	102 945	56,99%	77 703	43,01%
2006	227 422	121 008	53,21%	106 414	46,79%
2007	219 057	119 621	54,61%	99 436	45,39%
2008	204 462	109 484	53,55%	94 978	46,45%
2009	172 156	80 950	47,02%	91 206	52,98%
2010	171 890	84 462	49,14%	87 428	50,86%
2011	153 581	69 733	45,40%	83 848	54,60%
2012	146 536	69 526	47.45 %	77 011	52.55%

IPCC Guidelines describe a method for calculating methane emissions from industrial wastewater in the atmosphere.

The quantity of methane from industrial wastewater streams depends on the concentration of the biodegradable organic component in wastewater, the wastewater volume and type of treatment (aerobic or anaerobic).

Using these criteria, we determine the industries with the greatest potential for release of methane emissions, namely:

- Production of food and beverage
- Production of Paper and pulp
- Production of Organic chemicals
- Production of textiles and textile products

These four sectors are generating a large amount of wastewater with high content of degradable organic component.

In the IPCC Good Practice Guidance are set default values for the degradable organic component of COD g / l for the different types of industries (table. 5.4, page 5.22).

Table 231   COD for Industrial Type

Industry Type	Wastewater Generation (m^3/Mg)	Wastewater Generation Range (m^3/Mg)	BOD (g/l)	BOD Range (g/l)	COD (g/l)	COD Range (g/l)
Animal Feed	NA		NA		NA	
Alcohol Refining	24	16-32	NA	3-11	11	5-22
Beer & Malt	6.3	5.0-9.0	1.5	1-4	2.9	2-7
Coffee	NA		5.4	2-9	9	3-15
Coke	1.5	1.3-1.7	NA	0.1	0.1	
Dairy Products	7	3-10	2.4	1-4	2.7	1.5-5.2
Drugs & Medicines	NA		0.9		5.1	1-10
Explosives	NA		NA		NA	
Fish Processing	NA	8-18	1.5		2.5	
Meat & Poultry	13	8-18	2.5	2-3	4.1	2-7
Organic Chemicals	67	0-400	1.1	1-2	3	0.8-5
Paints	NA	1-10	NA		NA	1-10
Petroleum Refineries	0.6	0.3-1.2	0.4	1-8	1.0	0.4-1.6
Plastics & Resins	0.6	0.3-1.2	1.4	1-2	3.7	0.8-5
Pulp & Paper (combined)	162	85-240	0.4	0.3-8	9	1-15
Soap & Detergents	NA	1.0-5.0	NA	0.3-0.8	NA	0.5-1.2
Soft Drinks	NA	2.0	NA	1.0	NA	2.0
Starch Production	9	4-18	2.0	1-25	10	1.5-42
Sugar Refining	NA	4-18	NA	2-8	3.2	1-6
Textiles (natural)	172	100-185	0.4	0.3-0.8	0.9	0.8-1.6
Vegetable Oils	3.1	1.0-5.0	0.5	0.3-0.8	NA	0.5-1.2
Vegetables, Fruits & Juices	20	7-35	1.0	0.5-2	5.0	2-10
Wine & Vinegar	23	11-46	0.7	0.2-1.4	1.5	0.7-3.0

Based on these data and data provided by the National Statistical Institute about the quantity of wastewater, we define degradable organic components for the different types of industry.

After determination of degradable organic component compared with the calculation of percentage of water treated on site we determinate of total organic load in industrial water in kg COD / yr.

The next step of the calculation is to define the Emission factor. The emission factor is function of the maximum CH_4 producing potential (Bo) and methane correction factor (MCF).

$$EF_j = B_o * MCFj$$

Equation 6

Where:

EF_j – emission factor, kg CH_4/kg BOD

Bo – maximum CH_4 producing capacity, kg CH_4/kg BOD

MCF – methane correction factor

It is good practice for the maximum CH_4 producing capacity Bo to use country specific data from measurements made of various wastewaters. If there is no such specific data, IPCC provides for Bo to take a default value for industrial waste Bo = 0,25 кг CH_4 / kg COD.

To determine the methane correction factor, again, the type of wastewater treatment system and the discharge pathways are defined for the whole country.

The data are country specific. Table below shows the wastewater distribution among different treatment systems:

Table 232 Industrial wastewater distribution among different treatment systems

Year	Discharged into sea, river, lake	Centralized, aerobic, not well managed treatment plant	Stagnant sewer
1988	70.26%	11.88%	17.85%
1989	72.11%	11.26%	16.63%
1990	68.16%	10.78%	21.06%
1991	75.60%	9.74%	14.66%
1992	79.41%	9.95%	10.65%
1993	80.15%	9.48%	10.37%
1994	82.85%	8.31%	8.83%
1995	87.04%	6.47%	6.49%
1996	88.46%	5.34%	6.20%
1997	88.05%	6.55%	5.40%
1998	87.39%	6.31%	6.30%
1999	87.75%	5.73%	6.52%
2000	89.90%	4.30%	5.80%
2001	87.73%	5.80%	6.47%
2002	90.50%	4.44%	5.05%
2003	97.80%	1.03%	1.18%
2004	97.69%	1.33%	0.99%
2005	91.61%	5.94%	2.45%
2006	90.46%	5.72%	3.81%
2007	91.36%	5.48%	3.16%
2008	90.61%	5.02%	4.37%
2009	89.50%	5.76%	4.74%
2010	88.33%	7.75%	3.92%
2011	87.75%	8.88%	3.37%
2012	88.16%	9.07%	2.77%

The share of industrial wastewater, treated in treatment plant increased with 0.19 percent in comparison with preceiding year.

8.3.3.4 Methodology for calculation of the methane emissions of industrial sludge handling.

For the calculation of quantity of emissions from sludge treatment, we apply the similar steps such as in the calculation of these from domestic sludge.

8.3.3.5 Methodology for calculation of the N_2O from Humane sewage

The IPCC default methodology is used for calculating 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 Revised 1996 IPCC Guidelines was used. The data for the daily protein intake per person are taken from FAO statistics. The number of inhabitants is provided by NSI. The emission factor (0.01) and the fraction of nitrogen in protein (0.16) are IPCC default values.

.

8.3.4 TREND ANALYSIS

The next table shows in a systematic way quantities of methane emissions released in the treatment of domestic wastewater according to natural values of the parameters in the different years.

Table 233 CH_4 emissions from domestic wastewater - Country specific EF and TOW

Year	Total organic product	Aggregate Emission factor (CS)	Net methane Emissions
	kg BOD/yr	kg CH_4/kg BOD	GgCH_4
1988	155805178	0,158	24,60
1989	155904001	0,158	24,61
1990	150303451	0,144	21,68
1991	149024481	0,159	23,67
1992	147106954	0,151	22,29
1993	146671783	0,150	22,03
1994	146110048	0,155	22,58
1995	145369996	0,159	23,12
1996	144610978	0,162	23,41
1997	143609980	0,162	23,28
1998	142694057	0,161	22,98
1999	142009313	0,156	22,22
2000	141291402	0,163	23,06
2001	137477412	0,159	21,83
2002	136021339	0,170	23,13
2003	135254571	0,166	22,47
2004	134557187	0,158	21,32
2005	133822961	0,162	21,69
2006	133139690	0,157	20,91
2007	132801158	0,159	21,16
2008	131878578	0,157	20,69
2009	131135822	0,152	19,97
2010	130115649	0,151	19,68
2011	127035746	0,155	16.47
2012	126295920	0.154	14.88

The table below shows in a systematic way quantities of methane emissions released in the treatment domestic sludge according to natural values of the parameters in the different years.

Table 234 CH_4 emissions from domestic sludge - Country specific EF and TOW

Year	Total organic product	Aggregate Emission factor (CS)	Net methane Emissions
	kg BOD/yr	kg CH_4/kg BOD	GgCH_4
1988	8200273	0,445	3,65
1989	8205474	0,556	4,56
1990	7910708	0,358	2,83
1991	7843394	0,407	3,19
1992	7742471	0,381	2,95
1993	7719568	0,546	4,22
1994	7690003	0,546	4,20
1995	7651052	0,546	4,18
1996	7611104	0,550	4,19
1997	7558420	0,550	4,16
1998	7510214	0,550	4,13
1999	7474174	0,419	3,13
2000	7436389	0,455	3,39
2001	7235653	0,414	2,99
2002	7159018	0,399	2,86
2003	7118662	0,353	2,51
2004	7081957	0,356	2,52
2005	7043314	0,395	2,78
2006	7007352	0,365	2,56
2007	6989535	0.379	2.65
2008	6940978	0,477	3,31
2009	6901885	0,556	3,84
2010	6848192	0,610	4,18
2011	6686092	0,640	4,28
2012	6647154	0.670	4.45

The table below shows in a systematic way quantities of methane emissions released in the treatment of industrial wastewater according to natural values of the parameters in the different years.

Table 235 CH_4 emissions from Industrial wastewater - Country specific EF and TOW

Year	Total organic product	Aggregate Emission factor (CS)	Net methane Emissions
	kg COD/yr	kg CH_4/kg COD	GgCH_4
1988	1704936963	0,049	83.19
1989	1599501122	0,047	75.60
1990	1703558681	0,051	87,64
1991	1286361947	0,045	57,28
1992	1028932113	0,041	41,79
1994	8133143534	0,038	30,90
1995	1009405110	0,035	35,06
1996	985084988	0,034	33,37
1997	8338351545	0,034	28,08
1998	657635604	0,034	22,66
1999	540731179	0,034	18,59
2000	437684455	0,033	14,42
2001	325430864	0,034	11,18
2002	350779401	0,032	11,32
2003	1329364791	0,027	35,48
2004	1321187434	0,027	35,21

2005	351709779	0,030	10,70
2006	379811403	0,032	12,03
2007	390684758	0,031	12,07
2008	332144592	0,032	10,59
2009	206649733	0,033	6,74
2010	241833457	0,033	7,93
2011	216365573	0,033	7,10
2012	211318931	0.032	6.83

The following table shows in a systematic way quantities of methane emissions released in the treatment of industrial sludge according to natural values of the parameters in the different years.

Table 236 CH_4 emissions from Industrial sludge - Country specific EF and TOW

Year	Total organic product	Aggregate Emission factor (CS)	Net methane Emissions
	kg COD/yr	kg CH_4/kg COD	GgCH_4
1988	89733524	0,111	9.98
1989	84184269	0,111	9.36
1990	89660983	0,072	6,42
1991	67703260	0,081	5,51
1992	54154322	0,076	4,13
1993	44709132	0,109	4,89
1994	42806019	0,109	4,68
1995	53126585	0,109	5,81
1996	51846578	0,110	5,71
1997	43886061	0,110	4,83
1998	34612400	0,110	3,81
1999	28459536	0,084	2,38
2000	23036024	0,091	2,10
2001	17127940	0,083	1,42
2002	18462074	0,080	1,47
2003	69966568	0,071	4,94
2004	69536181	0,071	4,95
2005	18511041	0,079	1,46
2006	19990074	0,073	1,46
2007	20562356	0,076	1,56
2008	17481294	0,095	1,67
2009	10876302	0,111	1,21
2010	12728077	0,122	1,55
2011	11387662	0,128	1,46
2012	11122049	0.134	1.49

8.3.5 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

Table 237 Uncertainty of sub-sector Waste water handling

CRF categories	Key Category	GHG	AD uncertainty	EF uncertainty	Combined uncertainty
6B	Wastewater Handling	CH_4	30	30	42
6B	Wastewater Handling	N_2O	30	100	104

8.3.6 SOURCE-SPECIFIC QA/QC AND VERIFICATION

It is recommended to carry out the following basic procedures for checking the quality of data and calculations:

Review and detailed analysis of natural indicators;
Analysis of trends in emissions of greenhouse gases emitted in the treatment of wastewater and sludge;
Evaluation of the emission factors;

Overview of all archived documents and data necessary for the inventory;

8.3.7 SOURCE-SPECIFIC RECALCULATION

For 2012 recalculations have been done for N_2O emissions from protein consumption. Emissions from protein consumption published by FAOSTAT (http://faostat3.fao.org/home/index.html) are slightly higher than reported by Bulgaria in CRF tables for some years . The slight difference is the use of old data from the FAO table, which are average values for the relevant periods. Bulgaria recalculated emissions from protein consumption using a present data at FAO web site for the whole time series.

8.3.8 SOURCE-SPECIFIC IMPROVEMENT PLAN

Since 2013 we have regulatory basis for obtaining information about waste - Ordinance No 2 on the Procedures and forms for providing information about waste management activities and the procedure for keeping public records (published in State Gazette, No 10 from 05.02.2013, modified with State Gazette, No 86 from 01.10.2013). The operators of installations are obliged to report on annual basis. In the reporting formats under te Ordinance the emissions are included.

The reported emission will be used in the inventory for the 2015 submission.

8.4 WASTE INCINERATION (CRF CATEGORY 6.C)

8.4.1 SOURCE CATEGORY DESCRIPTION

Emissions from waste incineration without energy recovery have to be reported in the Waste sector, while emissions from incineration with energy recovery should be reported in the Energy Sector. According to IPCC GPG incineration of waste produces emissions of CO_2, CH_4 and N_2O. Normally, emissions of CO_2 from waste incineration are significantly greater than CH_4 and N_2O emissions. Except this type of emissions in the atmosphere are released and "non-greenhouse gases" like NOx, NH_3, NMVOCs and est. Emissions of CH_4 are not likely to be significant and these emissions are much dependent on the continuity of the incineration process, the incineration technology and management practices. For the purpose of this inventory are calculated emissions of CO_2 from waste incineration (which are significantly greater than N_2O emissions.) and N_2O emissions.

A. Emissions of CO_2

Generally CO_2 emissions are calculated indirectly from the total carbon content in different types of incinerated waste. For this purpose it is necessary to have country specific waste composition data, based on analyses and measurements.

B. Emissions of N_2O

Emissions from N_2O differ with facility type and conditions of incineration process. As a result, emissions can vary from site to site.

According to Revised 1996 Guidelines only CO_2 emissions resulting from incineration of carbon fractions in waste of fossil origin (e.g. plastics, textiles, rubber, liquid solvents and waste oil) without energy recovery should be included in emissions estimates from Waste sector. CO_2 emissions results from incineration of biomass materials (e.g. paper, food waste, wood waste) are called biogenic emissions and should not be included in national total emissions estimates.

Currently waste incineration is a practice to incinerate clinical waste. Additionally in emission inventory in waste sector are included emissions from hazardous waste and sewage sludge.

At this stage of moment the source of activity data are operators of incineration plants, about quantity and type of incinerated waste and type of technology.

This report includes CO_2 and N_2O emissions from: Clinical waste and Hazardous waste that practically are incinerated in country.

8.4.2 EMISSION TREND

Table 235 shows in a systematic way the quantity of incinerated type of waste and respectively emissions of CO_2 and N_2O, according to activity data and type of waste for different years.

Table 238 Quantity of incinerated type of waste CO_2 and N_2O emissions

Year	CO_2 emissions					N_2O emissions	
	Hazardous waste Gg/yr	HW emissions	Clinical waste Gg/yr	CW emissions	CO_2 -Total	Hazardous waste Gg/yr	HW emissions
1988	11.51	18.90	0.165	0.14	19.04	10.70	0.024
1989	11.82	19.40	0.165	0.14	19.54	11.00	0.025
1990	12.31	20.21	0.165	0.14	20.35	11.50	0.026
1991	12.53	20.57	0.165	0.14	20.71	11.70	0.026
1992	11.73	19.25	0.165	0.14	19.39	10.90	0.025
1993	12.63	20.73	0.165	0.14	20.86	11.80	0.027
1994	12.83	21.06	0.166	0.14	21.2	12.00	0.027
1995	13.00	21.35	0.168	0.14	21.49	12.10	0.027
1996	12.83	21.06	0.168	0.14	21.2	11.90	0.027
1997	12.93	21.24	0.167	0.14	21.38	12.00	0.027
1998	21.49	35.28	0.167	0.14	35.42	20.56	0.046
1999	17.51	28.75	0.172	0.14	28.89	16.58	0.037
2000	38.28	62.84	0.174	0.15	62.99	37.33	0.084
2001	24.42	40.10	0.171	0.14	40.24	23.46	0.053
2002	23.86	39.17	0.171	0.14	39.32	22.86	0.051

Year	CO_2 emissions					N_2O emissions	
	Hazardous waste Gg/yr	HW emissions	Clinical waste Gg/yr	CW emissions	CO_2 -Total	Hazardous waste Gg/yr	HW emissions
2003	26.98	44.29	0.271	0.23	44.52	25.73	0.058
2004	42.72	70.13	0.322	0.27	70.4	41.28	0.093
2005	33.96	55.76	0.365	0.31	56.06	31.97	0.072
2006	31.81	52.22	0.649	0.54	52.77	29.88	0.067
2007	21.48	35.26	0.214	0.18	35.44	19.66	0.044
2008	26.25	43.09	0.117	0.10	43.19	24.93	0.056
2009	20.51	33.67	0.266	0.22	33.89	19.48	0.044
2010	8.50	13.96	0.250	0.21	14.17	7.47	0.017
2011	6.29	10.32	0.179	0.15	10.47	5.22	0.012
2012	12.61	20.44	0.202	0.17	20.61	11.45	0.026

The emissions trends are presented in the next figures.

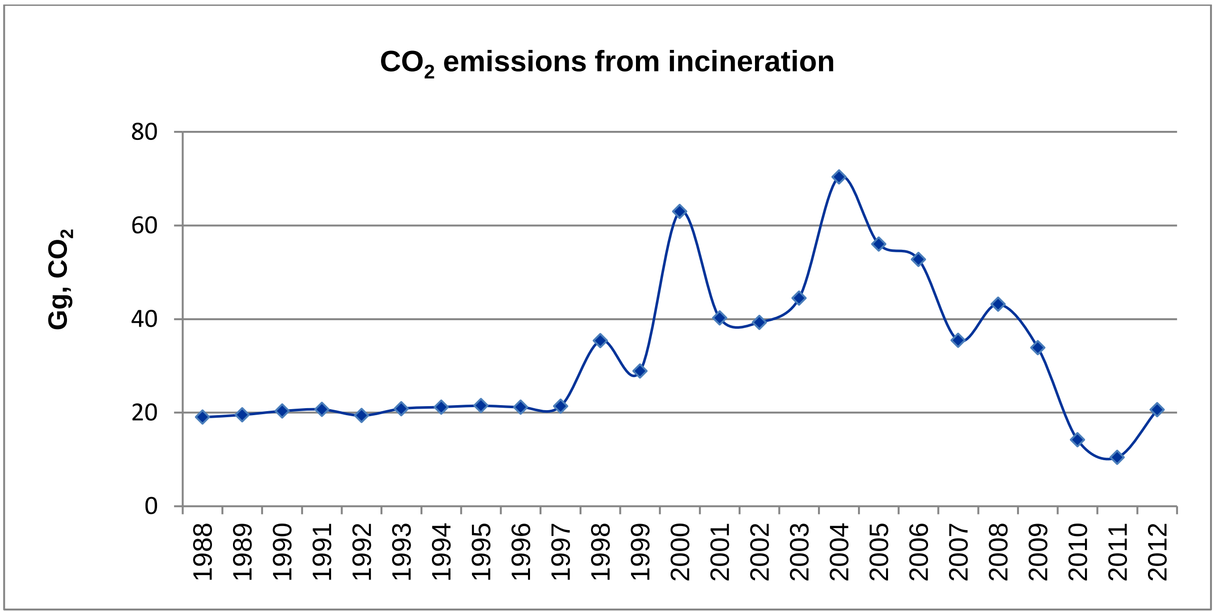


Figure 99 CO_2 Emissions trends for Waste Incineration

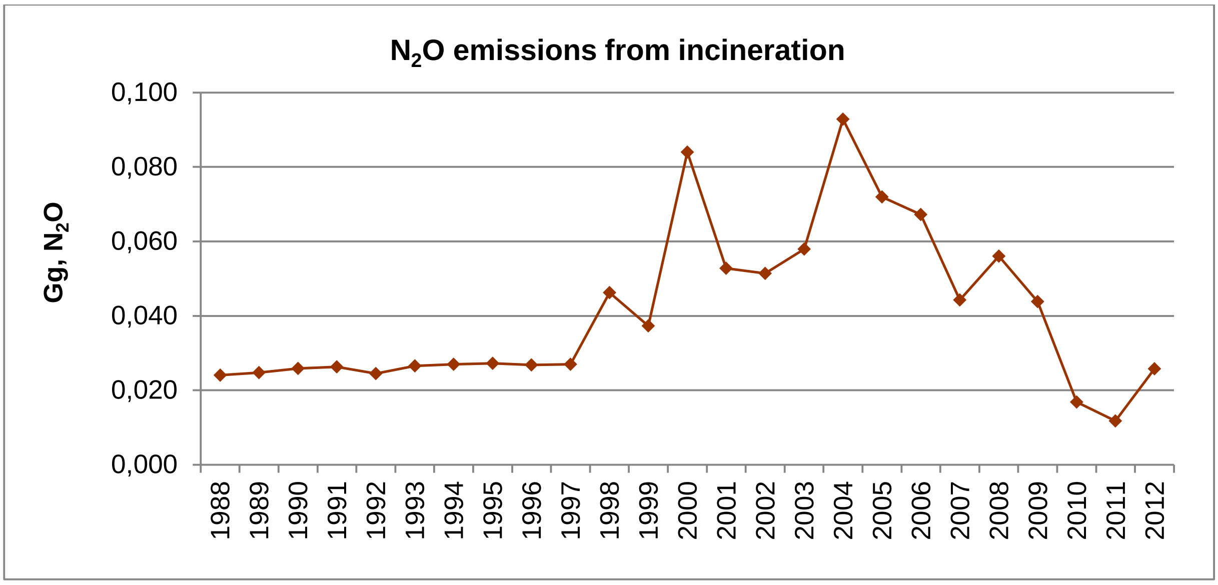


Figure 100 N_2O Emissions trends for Waste Incineration

CO_2 emissions trend is more stable and cover the whole time series. In this way are followed the main inventory principles for Completeness and Comparability.

Reduced incineration for 2010 in the installation of Lukoil Neftochim is due to reduced quantity of processed sludge which is connected with decrease of the quantity of waste waters in wastewater treatment plant. For 2011except reduced quantity of processed sludge, a repair of the three-phase centrifuge for oil midding slime processing took place for a long time.

For 2012 the quantity of incinerated hazardous waste in the installation of Lukoil Neftochim increase in comparison with preceiding years (doubled quantity of the incinerated waste in comparison with 2011) and that lead to emissions increase respectively.

Bulgaria calculated biogenic CO_2 emissions from waste incineration, according to ERT recommendations (FCCC/ARR/2013/BGR - § 90), but they are not included in net emissions in this sub-sector. In CRF tables are specified the quantities of incinerated waste and relevant emissions.

8.4.3 METHODOLOGICAL ISSUES

8.4.3.1 Methodology

A. Choice of method:

The choice of good method for emission calculations depend on national circumstances, including whether incineration of waste is a key category in the country and to what extent country and plant-specific information is available.

Concerning waste incineration, most adequate and correct results are going to complete if the information about type of waste and incineration technology are available.

The most adequate results will be obtained if the emissions are going to be estimated on the level of the incineration plant or divided by type of incinerated waste.

The methods for estimating CO_2 and N_2O from incineration differ because of the different factors that influence emission levels. For this reason, they are described separately.

A1. Choice of method for estimating CO_2 emissions

CO_2 emissions from incineration of waste have been calculated using the methodology proposed by IPCC Guidelines, by multiplying the total incinerated waste with default values for fraction of carbon content, fraction of fossil carbon and burn out efficiency of combustion.

The choice of proper method depend on national circumstances. (IPCC Good Practice Guidance, Figure 5.5, page 5.26).

A2. Choice of method for estimating N_2O emissions

Revised 1996 IPCC Guidelines and IPCC GPG 2000 describe one method (Tier 1) for estimating N_2O emissions.

B. Choice of equations

B1. Equations for estimation CO_2 emissions

For carbon dioxide emissions calculating from waste incineration, the following equation is used (eq. 5.11 from page 5.25 of IPCC GPG 2000).

$$CO2emissions(Gg/yr) = \sum_i \left(IW_i \bullet CCW_i \bullet FCF_i \bullet EF_i \bullet {}^{44}\!/_{12} \right)$$

Equation 7

Where:

i= MSW

HW-hazardous waste

CW-clinical waste

SS- sewage sludge

IWi= Amount of incinerated waste of type i (Gg/yr);

CCWi=Fraction of carbon content

Where:

i= MSW

HW-hazardous waste

CW-clinical waste

SS- sewage sludge

IWi= Amount of incinerated waste of type i (Gg/yr);

CCWi=Fraction of carbon content in waste of type i

FCFi = Fraction of fossil carbon in waste of type i

EFi= Burn out efficiency of combustion of incinerators for waste of type I (fraction)

44/12= Conversion from C to CO_2

B2. Equations for estimation N_2O emissions

For N_2O emissions calculations the next equations are is used (eq.5.12, IPCC GPG 2000)

$$N2O\, emissions(Gg/yr) = \sum i\left(IW_i \bullet EF_i\right) \bullet 10^{-6}$$

Equation 8

Where:

IWi = Amount of incinerated waste of type I (Gg/yr);

EFi= Aggregate N_2O emission factor for waste type I (kg N_2O/Gg)

Or (Equation 5.13 IPCC GPG)

$$N_2O\ emissions(Gg/yr) = \sum i\left(IWi \bullet ECi \bullet FGVi\right) \bullet 10^{-9}$$

Equation 9

Where:

IWi = Amount of incinerated waste of type I (Gg/yr);

ECi= N_2O emission concentration in flue gas from waste of type i (mg N_2O/m3)

For calculation Bulgaria applies first of above equations.

The best calculations results will be obtained if greenhouse emissions estimations are on the plant level, based on the plant-specific monitored data and then all this data are summed on the national level.

C. Influencing factors

The main emission factors and parameters which are influencing on the emissions from waste incineration are:

- Amount of incinerated waste;
- Type of incinerated waste;
- Carbon content of waste;
- Fossil carbon as % of Total carbon in waste;
- Efficiency of combustions;
- Incineration plant type.

8.4.3.2 Activity data and emissions factors

For inventory 2012 the main source of activity data are operators of incineration plants, process without energy recovery .

Currently in country are operating only tree big installations, for waste incineration, without energy recovery. There are two incinerators for incineration of hospital waste at the EMEPA and Medicom located in Sofia. In the installation of Lukoil Neftochim are incinerated hazardous waste, mainly sludge and other waste contaminated with oil. The country does not have incinerator for MSW.

Before 2006 in country were working considerable number of furnace for hospital waste incineration, located on the territory of the hospitals throughout the country.

Following the adoptions of more stringent requirements of Directive 2000/76 / EC transposed into Regulation № 6 / 28.04.2004 that has led to the closure of the operation of all this type of furnaces.

For activity data completeness the letters are sent to 3 incineration plants, to present the data about quantity of incinerated waste for 2012, inserting the data about:

- Type of incineration plant
- Capacity of installation
- Year of commissioning the installation
- Reconstructions of the installation (change, year and etc.)
- Quantity of incinerated waste
- Characteristics of incinerated waste

A. Choice of emission factors for CO_2 estimations

In an analysis of completed questionnaires by the operators of incinerators for waste incineration shows lack of completed data for specifying characteristics of waste as, carbon content in the waste, fractions of "fossil" carbon and coefficient of efficiency of waste incineration. There are no country-specific emission factors.

Following the decision tree path for CO_2 emission estimations, we used emission factors by default, according to IPCC GPG 2000.

The next table shows the emission factors and default value (table 5.6, p.5.29, IPCC GPG 2000), used for CO_2 calculations. Bold frame, illustrated used emission factors, useful for type of waste incinerated in country, with default value.

Based on installation level the information is worked out in detail and summarized on the national level.

Table 239 Default data for CO_2 emissions calculation

TABLE 5.6 DEFAULT DATA FOR ESTIMATION OF CO_2 EMISSIONS FROM WASTE INCINERATION				
	MSW	Sewage Sludge	Clinical Waste	Hazardous Waste
C Content of Waste	33-50% of waste (wet) default: 40%	10-40% of sludge (dry matter) default: 30%	50-70% of waste (dry matter) [a] default: 60%;	1-95% of waste (wet) default: 50%
Fossil Carbon as % of Total Carbon	30-50% default: 40%	0%	30-50% default: 40% more information is needed	90-100% [b] default: 90%
Efficiency of Combustion [c]	95-99% default: 95%	95%	50-99.5% default: 95%	95–99.5% default: 99.5%

[a] Clinical waste contains mainly paper and plastics. The carbon content can be estimated from the following factors: C-content of paper: 50% and C-content of plastics: 75-85%.
[b] The fossil carbon may be reduced if it includes carbon from packaging material and similar materials.
[c] Depends on plant design, maintenance and age.
Source: Judgement by Expert Group (see Co-chairs, Editors and Experts; Emissions from Waste Incineration).

B. Choice of emission factors for N_2O estimations

If site-specific N_2O emissions factors are not available, default factors can be used (table 5.7, p.5.30, IPCC GPG 2000)

In country almost all incinerator plants are type heart or grate. For this type of installation, according to table for emission factors from IPCC GPG it is NA for calculation of N_2O emissions with default emission factors. Only N_2O emission calculation is possible, in incineration plant rotating type, using default emission factors (on national level have one such type of installation)

Table 240 Default EF for N_2O emissions calculation.

TABLE 5.7 EMISSION FACTORS FOR N_2O FROM WASTE INCINERATION				
Incineration Plant Type	MSW kg N_2O/Gg waste (dry)	Sewage Sludge kg N_2O/Gg sewage sludge (dry matter)	Clinical Waste kg N_2O/Gg waste (dry)	Hazardous Waste (from industry) kg N_2O/Gg waste (dry)
Hearth or grate	5.5-66 (Germany) average 5.5-11 highest value 30 (UK) 40-150 (Japan: wet)	400 (Japan: wet)	NA	NA
Rotating	NA	NA	NA	210-240 (Germany)
Fluidised bed	240-660 (Japan: wet)	800 (Germany) 100-1500 (UK) 300-1530 (Japan: wet)	NA	NA

Note: NA = Not Available.
Source:
Germany: Johnke (1999),
United Kingdom: Environment Agency (1999),
Japan: Yasuda (1993).

8.4.4 SOURCE-SPECIFIC QA/QC AND VERIFICATION

It is recommended to perform the following main QA/QC procedures:

Review and detailed analysis of the activity data;

Trend analysis of the greenhouse gas emission in the waste sector;
Assessment of the used emission factors;
Review of documents and archive about all required information.
Verification with Ordinance No 9 about the Procedures and forms which provide information about waste management activities and the procedure for keeping public register of permits issued, registration documents and closed facilities and activities (published in State Gazette No 95 from 26.10.2004, modified in State Gazette No 113 from 28.12.2004)

8.4.5 SOURCE-SPECIFIC RECALCULATION

Recalculations for 2011 have been done due to the technical reason. The data about incinerated waste from Medicom came after the submission period.

8.4.6 SOURCE-SPECIFIC PLANNED IMPROVEMENT

Since 2013 we have regulatory basis for obtaining information about waste - Ordinance No 2 on the Procedures and forms for providing information about waste management activities and the procedure for keeping public records (published in State Gazette, No 10 from 05.02.2013, modified with State Gazette, No 86 from 01.10.2013).The operators of installations are obliged to report on annual basis. In the reporting formats under te Ordinance the emissions are included.

The reported emission will be used in the inventory for the 2015 submission.

8.5 OTHER WASTE (CRF CATEGORY 6D)

8.5.1 SOURCE CATEGORY DESCRIPTION

The category includes calculation of CH_4 and N_2O emissions in the atmosphere from biological treatment of solid waste (composting). The calculation of the emissions depend on the quality of collected data, amount and type of solid waste, treated biologically and the choice of emission factors respectively. For the first time country reports the emissions from biological treatment of waste.

8.5.2 METHODOLOGICAL ISSUES

Methodology for calculation of CH_4 and N_2O emissions from composting.

As the methodological guidance for estimating and reporting of emissions from biological treatment was not included in the previous IPCC Guidelines, it is recommended to follow the methodology of estimation and calculations of the emissions in 2006 IPCC Guidelines. The 2006 IPCC GL suggests three methods for emission calculation.

For the emissions estimation from biological treatment of solid waste country uses TIER 1 with default emission factors.

Default emission factors for CH_4 and N_2O emissons from biological treatment of waste

Type of biological treatment	CH_4 Emission Factors (g CH_4/kg waste treated)		N_2O Emission Factors (g N_2O/kg waste treated)	
	on a dry weight basis	on a wet weight basis	on a dry weight basis	on a wet weight basis
Composting	10 (0.08-20)	4 (0.03-8)	0.6 (0.2-1.6)	0.3 (0.06-0.6)

The CH_4 and N_2O emissions from composting can be estimated using default method given in Equations 4.1 and 4.2 shown below:

Equation 4.1

$$CH_4 \ \textit{Emissions} = \sum_i (Mi * EFi) * 10^{-3} - R$$

Where:

CH_4 emissions = total CH_4 emissions in inventory year, Gg CH_4

M_i = mass of organic waste treated by biological treatment type *i*, Gg

EF = emission factor for treatment *i*, g CH_4/kg waste treated

i = composting or anaerobic digestion

R = total amount of CH_4 recovered in inventory year, Gg CH_4

Equation 4.2

$$N_2O \ \textit{Emissions} = \sum_i (Mi * EFi) * 10^{-3}$$

Where:

N_2O Emissions = total N_2O emissions in inventory years, Gg N_2O

M*i* = mass of organic waste treated by biological treatment type *i*, Gg

EF = emission factor for treatment *i*, g N_2O/kg waste treated

i = composting or anaerobic digestion

8.5.2.1 Activity data

The source of activity data is NSI.

The emissions from composting are given in the table No 23 below:

Table 241 CH_4 and N_2O emissions from composting

Year	Total Annual amount treated by biological treatment facilities (Gg)	CH_4 emissions	N_2O emissions
2011	83.686	0.33	0.03
2012	81.233	0.32	0.02

8.5.2.2 Emission factors

Default emission factors (on wet weight basis) are used for emission estimation of CH_4 and N_2O from composting. Country specific emission factors or plant specific emission factors are not available at the moment.

8.5.3 UNCERTAINTY AND TIME – SERIES CONSISTENCY

The uncertainty in CH_4 emissions from compost production is estimated to be about 100% in annual emissions, 10% concerning activity data and 100% for emission factors used.

8.5.4 SOURCE-SPECIFIC QA/QC AND VERIFICATION

The category is covered by the general QA/QC procedures.

8.5.5 SOURCE-SPECIFIC RECALCULATIONS

Source specific recalculations are not planned.

8.5.6 SOURCE-SPECIFIC PLANNED IMPROVEMENT

Since 2013 we have regulatory basis for obtaining information about waste - Ordinance No 2 on the Procedures and forms for providing information about waste management activities and the procedure for keeping public records (published in State Gazette, No 10 from 05.02.2013, modified with State Gazette, No 86 from 01.10.2013).The operators of installations are obliged to report on annual basis. In the reporting formats under te Ordinance the emissions are included.

The reported emission will be used in the inventory for the 2015 submission.

9 OTHER (CRF SECTOR 7)

This sector from the IPCC classification is designated to submit all GHGs emission sources, which for one or another reason have not been categorized at one of the six preceding sectors.

The Bulgaria inventory has no such specific sources to be reported in this sector.

10 RECALCULATIONS AND IMPROVEMENTS

10.1 EXPLANATIONS AND JUSTIFICATIONS FOR RECALCULATIONS INCLUDING FOR KP-LULUCF INVENTORY

Recalculations of previously submitted inventory data are performed following the IPCC Good Good Practice Guidance, Chapter 7 with the purpose to improve the GHG inventory.

10.1.1 GHG INVENTORY

The GHG emission recalculations for the period 1988-2011 (emission data 1988-2011) were made because of update and revision of activity data, EF and other parameters used for all sectors.

The main reason for recalculations is implementation of recommendations of the Expert Review Team as set out in the annual review report.

Table 242 Summary of GHG emission recalculations in submission 2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
Total (Net Emissions)			
A. Fuel Combustion (Sectoral Approach)			.
1. Energy Industries	Revised activity data	Revised activity data from the National Energy Balance regarding Gaseous Fuels consumption in subcategory 1A1a Public Electricity and Heat Production.	For more information please see Chapter 3.3.10
2. Manufacturing Industries and Construction	Revised activity data	Revised activity data in the energy balance regarding non-energy use of fuels	For more information please see Chapter 3.3.11.1.1
	Revised CH_4 and N_2O emissions	During the 2014 submission was identified a calculation error for the CH_4 and N_2O emissions resulting from the use of alternative fuels, which was leading to double counting of the emissions (they were reported both under 'Biomass' and 'Other fuels'). Since the alternative fuels contain both a biomass and a fossil fraction, the resulting emissions from the biomass fraction are currently reported under biomass, while the emissions from the fossil fraction are reported under 'Other fuels'.	For more information please see Chapter 3.3.11.5.1
3. Transport	.		
1A3a Civil Aviation	Revised activity data	The emissions for the whole period from 1996 to 2012 are calculated using Tier 2 approach based on National energy balance and LTOs information provided by Eurocontrol for the period 1996-2012	For more information please see Chapter 3.3.12.2.8

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
1A3b Road Transportation	Revised method	Emissions from biodiesel are now calculated with the COPERT model.	For more information please see Chapter 3.3.12.3.8
1A3c Railway	Revised activity data	Following a recommendation made by FCCC/ARR/2013/BGR emissions from residual fuel oil in the railways subcategory are reallocated to the category commercial/institutional for the entire time series.	For more information please see Chapter 3.3.12.4.7
4. Other Sectors	Revised activity data	Revised activity data from the National Energy Balance regarding Gaseous Fuels.	For more information please see Chapter 3.3.13
5. Other			
B. Fugitive Emissions from Fuels			
1. Solid Fuels	New source of emissions	Added calculation of the emissions from charcoal production	For more information please see Chapter 3.4
2. Oil and Natural Gas	Revised activity data	Revised activity data from the National Energy Balance	For more information please see Chapter 3.4.6
2. Industrial Processes			
A. Mineral Products			
B. Chemical Industry			
C. Metal Production			
D. Other Production			
E. Production of Halocarbons and SF6			
F. Consumption of Halocarbons and SF6	Revised activity data and methodology	Improve the methodology and check the activity activity data	For more information please see Chapter 4.5
G. Other			
3. Solvent and Other Product Use	Revised EF	New EF for CRF 3A Paint application((SNAP 060107	For more information please see Chapter 5.3.4
4. Agriculture			
A. Enteric Fermentation			
B. Manure Management	Revised EF	4A1c & 4B1c – Young Cattle - 1988-2010 - Change in animal weights due to recommendations from the ESD review	For more information please see Chapter 6.5.5
	Revised EF	4B9 – Poultry - 1988-2010 - Change in awms distribution and nitrogen excretion	For more information please see Chapter 6.5.5
C. Rice Cultivation			
D. Agricultural Soils			
E. Prescribed Burning of Savannas			
F. Field Burning of Agricultural Residues			
G. Other			
5. Land Use, Land-Use Change and Forestry			
A. Forest Land	Revised activity data	Changes in area representation, update of coefficient for SOC.	For more information please see Chapter 7.2.7
B. Cropland	Revised activity data	Changes in area representation, update of coefficient for SOC.	For more information please see Chapter 7.3.7
C. Grassland	Revised activity data	Changes in area representation, update of coefficient for SOC.	For more information please see Chapter 7.4.7
D. Wetlands	Revised activity data	Changes in area representation.	For more information please see Chapter 7.5.6

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
E. Settlements	Revised activity data	Changes in area representation, update of coefficient for SOC.	For more information please see Chapter 7.6.6
F. Other Land	Revised activity data	There is change in the area of OL due to area adjustment in other categories	There is change in the area of OL due to area adjustment in other categories
G. Other			
6. Waste			
A. Solid Waste Disposal on Land	Revised activity data	Change in AD for generated waste have been done on the basis of NSI project for revision of the data for recycled household wastes since 1999. The change in AD affects only the generated waste, it does not affect the landfilled waste.	For more information please see Chapter 8.2.6
B. Waste-water Handling	Revised activity data	For 2012 recalculations have been done for N2O emissions from protein consumption. Emissions from protein consumption published by FAOSTAT (http://faostat3.fao.org/home/index.html) are slightly higher than reported by Bulgaria in CRF tables for some years. The slight difference is the use of old data from the FAO table, which are average values for the relevant periods. Bulgaria recalculated emissions from protein consumption using a present data at FAO web site for the whole time series.	For more information please see Chapter 8.3.7
C. Waste Incineration	Revised activity data for 2011	Recalculations for 2011 have been done due to the technical reason. The data about incinerated waste from Medicom came after the submission period	For more information please see Chapter 8.4.5
D. Other			

10.1.2 KP-LULUCF INVENTORY

The reported AR areas in Submission 2014 has been updated and corrected since the last 2013 Submission. This has been done in the terms of an ongoing Bulgarian improvement process of reporting the supplementary information under the article 3.3 of the KP (details are given in Chapter 11.2.1).

Referring to the issue, raised during the review process in 2011, Bulgaria began to stepwise improve the reported AR units of land starting with its Submission 2012 and completing this process until the submission 2014 at the latest.

10.2 IMPLICATIONS FOR EMISSION LEVELS, INCLUDING ON KP-LULUCF EMISSION LEVELS

10.2.1 GHG INVENTORY

As a result of the continuous improvement of Bulgaria's GHG inventory, emissions of some sources have been recalculated on the basis of updated data or revised methodologies, thus emission data for 1988 to 2011 which are submitted this year differ slightly from data reported previously.

The following table presents the recalculation difference with respect to last year's submission for each gas (positive values indicate that this year's estimate is higher).

Table 243 Recalculation difference of Bulgaria's greenhouse gas emissions compared to the previous submission.

	1988 (Base year)	2011
	Recalculation Difference [%]	
Total	-0,05	-0,21
CO_2	0,49	-0,63
CH_4	-0,09	-0,16
N_2O	0,00	-0,07
HFC	0.0	0,02
PFC	0.0	0,00
SF_6	0.0	0.0

Emissions without LULUCF

Table 241 presents the recalculation differences of national total GHG emissions for all years.

Table 244 Recalculation Difference of National Total GHG Emissions.

Year	National Total GHG emissions without LULUCF		
	Submission 2013 [Gg CO_2e]	Submission 2014 [Gg CO_2e]	Recalculation Difference [%]
1988*	121936,4	121880,3	-0,05
1989	119384,4	119223,1	-0,14
1990	109540,9	109138,6	-0,37
1991	86743,21	86325,85	-0,48
1992	80492,73	80125,69	-0,46
1993	78715,21	78452,09	-0,33
1994	75074,24	74873,38	-0,27
1995	75838,74	75705,13	-0,18
1996	75702,43	75576,8	-0,17
1997	72074,36	71979,04	-0,13
1998	67127,18	67071,52	-0,08
1999	60314,73	60264,02	-0,08
2000	59500,75	59470,85	-0,05
2001	62659,28	62642,81	-0,03
2002	59676,48	59648,93	-0,05
2003	64434,81	64389,58	-0,07
2004	63638,25	63592,22	-0,07
2005	63749,17	63711,73	-0,06
2006	64566,42	64504,69	-0,10
2007	68488,01	68422,73	-0,10
2008	66942,68	66842,7	-0,15
2009	57805,17	57725,27	-0,14
2010	60352,4	60272,04	-0,13
2011	66133,29	65995,75	-0,21

**Base year is 1988 for all gases*

10.2.2 KP-LULUCF INVENTORY

In Submission 2013 the net CO_2 emissions/removals for 2011 from the activities under Article 3.3 of the Kyoto Protocol have a figure of – 962.27 $GgCO_2$ eq. while in Submission 2014 after the recalculation that took place the figure of the net removals is – 973.02 $GgCO_2$ eq, which are by 1,1% more than the last submission.

10.3 IMPLICATIONS FOR EMISSION TRENDS, INCLUDING TIME SERIES CONSISTENCY, AND ALSO FOR KP-LULUCF TRENDS AND TIME SERIES CONSISTENCY

10.3.1 GHG INVENTORY

As can be seen in Table 241 and Figure 101 Bulgaria's greenhouse gas emissions as reported in the UNFCCC submission 2013 are different compared to the values reported last year due to recalculations. For the base year recalculated national total emissions excluding LULUCF are 3.15% higher than those reported last year, and 1% lower for the year 2009.

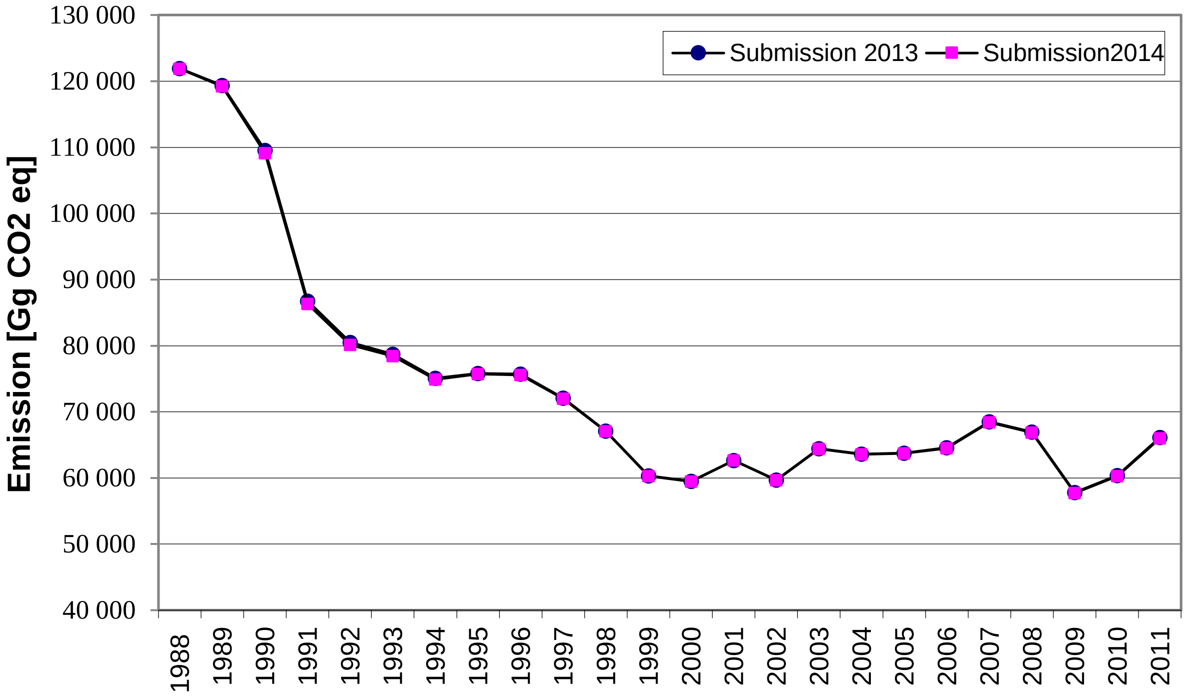


Figure 101 Emission estimates of the submission 2014 and recalculated value

10.3.2 KP-LULUCF INVENTORY

See chapter 11.2

10.4 RECALCULATIONS, INCLUDING IN RESPONSE TO THE REVIEW PROCESS, AND PLANNED IMPROVEMENTS TO THE INVENTORY

10.4.1 GHG INVENTORY

Many recalculation have baeen carried out in resopone to recommendations proposed in review reports. All relevant recalculations are presented in Chpt. 10.1.1. Further information on improvements due to the ERT recommendation are found Table 239.

The following general improvements are planned for the next submissions

- Update and revision of activity data, emission factors and related parameters;
- Conduct further studies for verification of emission factos and assumptions;
- Improvement of uncertainty assessment;
- Improvement of the relation with Branch Business Associations;
- Executive Environment Agency (ExEA) Communication & Information Centre (Data management);
- Further collaboration with external organizations;
- QA/QC activities and audit;
- Documentation and archiving.

All improvements will be conducted to increase TACCC.

10.4.2 IMPROVEMENT PLAN

The **Compliance Action Plan** (improvement plan) was prepared in 2010 according to the requirements as set out in paragraph 20 (b) of the preliminary finding (CC-2010-1-6/Bulgaria/EB), confirmed by the final decision of the Enforcement Branch concerning Bulgaria (CC-2010-1-8/Bulgaria/EB).

The activities have been planned for the period 2010-2011 in order to remedy the non-compliance and to fulfill the recommendations of Expert Review Team (ERT) as set out in the annual review report FCCC/ARR/2009/BGR.

The enclosed progress report presents the updated status of implementation of the **Compliance Action Plan** and the implementation of activities and planned improvements for the next annual submission following the recommendations of the Expert Review Team as set out in the annual review report FCCC/ARR/2010/BGR.
Specific information about improvements are mentioned in the relevant chapters 'source-specific improvements' of each subsector.

Table 245 Improvement plan for GHG Inventory

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
General Improvements				
Institutional arrangements	To continue the intensive cooperation with the main data providers in the frame of the signed agreements	High priority 2014	All recommendations (from FCCC/ARR/2009/BGR FCCC/ARR/2010/BGR and FCCC/ARR/2011/BGR, FCCC/ARR/2012/BGR, FCCC/ARR/2014/BGR) were already implemented in Submission 2010, 2011, 2012, 2013 and 2014	
Legal basis	Update of legal basis of BGNIS	High priority 30/09/2010	New Regulation of the Council of Ministers 215/21.09.2010 SG 76/2010: Establish and maintain the institutional, legal and procedural arrangements necessary to perform the functions of BGNIS, as defined in Decision 19/CMP.1. reinforce the institutional agreements by specifying the roles of all data providers QA/QC activities.	Adequately planned and implemented in 2010 (FCCC/ARR/2010/BGR § 203)
Expert capacity	**FCCC/ARR/2009/BGR** Strengthening the staff, engaged in planning, preparation	High priority 30/09/2010	Extension of the staff, engaged in planning, preparation and	Adequately planned and implemented in 2010

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	and management of the emissions inventory. Training of the staff within the project with the Federal Environment Agency of Austria (workshops in the period December 2009 to June 2010)		management of inventory Order № 110/30.04.2010 by the Executive Director of ExEA Training of the staff within the project with the Federal Environment Agency of Austria Incorporated results from completed Projects with external consultants "Energy", "LULUCF", "F-gases" (CRF tables and NIR)	(FCCC/ARR/2010/BGR § 203)
	FCCC/ARR/2010/BGR Further extension of the staff involved in planning, preparation and management of the emissions inventory (§ 39). Further training of the staff Participation of the Bulgarian experts in the meetings, organized by UNFCCC and EC Further collaboration with Austrian Environment Agency On-line UNFCCC training	High priority 2011 submission	New Order N 202/29.09.2010 by the Executive Director of ExEA (see Figure 1) Training of the staff in the frame of contracts with external consultants	Adequately planned and implemented in 2011
	FCCC/ARR/2011/BGR Continue the extension of the staff involved in planning, preparation and management of the emissions inventory. Continue training of the staff. Continue participation of the Bulgarian experts in the meetings, organized by UNFCCC and EC. Continue the collaboration with Austrian Environment Agency. Continue the on-line UNFCCC training.	High priority 2012 and 2013 submission	Training of the staff in the frame of contracts with external consultants	Adequately planned and implemented in 2012 and 2013
	Continue training of the staff. Continue participation of the Bulgarian experts in the meetings, organized by UNFCCC and EC.	High priority 2014 submission	Training of the staff in the frame of contracts with external consultants	Adequately planned and implemented in 2014
Collaboration with consultants and external auditors	**FCCC/ARR/2009/BGR** Strengthening the contacts with Branch Business Associations. Further intensive cooperation for studies (verification of EFs)	High priority 13/08/2010	Signed Contracts with external consultants for supporting the preparation of 2010 GHGs inventory and NIR.	Adequately planned and implemented in 2010 (FCCC/ARR/2010/BGR § 203)

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	with other non-governmental institutions, universities and private consultants Support of external auditors for improvement of QA procedures			
	FCCC/ARR/2010/BGR Sustainable development of inventory planning, preparation and management (§ 37)	High priority 2011 submission 15/04/2011	Signed new contracts with the same consultants for the 2011 submission	Adequately planned and implemented in 2011
	FCCC/ARR/2011/BGR Continue the intensive cooperation for studies (verification of EFs) with other non-governmental institutions, universities and private consultants. Continue support of external auditors for improvement of QA procedures.	High priority 2012 and 2013	Signed contracts with external consultants for supporting the preparation of 2012 GHGs inventory and NIR 2012	Adequately planned and implemented in 2012 and 2013
	Continue the intensive cooperation for studies (verification of EFs) with other non-governmental institutions, universities and private consultants. Continue support of external auditors for improvement of QA procedures.	High priority 2014		Adequately planned and implemented in 2014
Quality Management System	**FCCC/ARR/2009/BGR** Improvement of the activity in QMS Ensuring that other institutions are engaged in the checking and review of the annual submission as set out in its QA/QC plan Improvement of Sector specific QA/QC procedures Starting the documentation and archiving process ARR § 55 The ERT recommends that Bulgaria provide sufficient information in the NIR on the use of EU ETS data for verification of its emissions data, including which tier approach from the EU ETS guidelines was used for the QA and/or verification of the EU ETS data used.	High priority 13/08/2010	Update of the National QA/QC Plan due to the newly implemented institutional, legal and procedural arrangements within the BGNIS A new System for sector experts workflow organization, documentation and archiving has been implemented in the ExEA Intensive cross-check with ETS, EPRTR, IPPC permits was undertaken. The relevant data was incorporated into the GHG inventory	Adequately planned and implemented in 2010 (FCCC/ARR/2010/BGR § 52) Need of better implementation in the next submission (FCCC/ARR/2010/BGR §52)
	FCCC/ARR/2010/BGR Improvement of implementation of QA/QC in the next submission (§ 52) Including of provisions of QA/QC activities for a final check of the consistency between the NIR and CRF.	High priority 2011 submission	Revision of QA/QC check lists following the recommendations of ERT Preparation of Manual for using of documentation and archiving system	Adequately planned and implemented in 2011

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	Provide sufficient information in the NIR on the use of EU ETS data for verification of its emissions data, including which tier approach from the EU ETS guidelines was used for the QA and/or verification of the EU ETS data used Support of external auditors for improvement of QA procedures			
	FCCC/ARR/2011/BGR Continue to improve implementation of QA/QC. Support of external auditors for improvement of QA procedures.	High priority 2012 and 2013 submission	Project for "Improvement of National Quality Management System for GHG Inventories" has been started in collaboration with the Austrian Environment Agency, started since 2011 and it will be finalized 2013.	Adequately planned and implemented in 2014
Source categories improvements				
Energy sector	**FCCC/ARR/2009/BGR** Revising of the AD (entire time series) due to differences in IEA/EUROSTAT questionnaire (international reporting obligation) and national energy balance (national reporting obligation with different allocation/definition fuel) due to different reporting obligation on national and international level. Outcome: consolidated "Energy Balance" for national and UNFCCC/ UNECE reporting obligation Revision of the EF. Investigation whether it would be possible to update country specific emission factors A cross-check with ETS, EPRTR, IPPC permits data Comparison of emissions using alternative approaches. Documentation and archiving of all information required in NIR, background documentation and archive. Improvements in transparency by updating and revising EF and AD. Recalculations and time-series consistency To ensure TACCC internal energy experts and external consultants were involved in the submission 2010. Further collaboration is foreseen for the future submission. Implementation of Sector specific QA/QC procedures Support of consultants and external auditors for 2010 and	High priority 13/08/2010	Contract with external consultants for supporting preparation of GHGs inventory and NIR for Sector Energy (excluding sub-sector Transport) Recalculated emissions in Energy Sector based on revised AD for entire time series (IEA/EUROSTAT questionnaire). A cross-check with ETS, EPRTR, IPPC permits was realized; Improved documentation and archiving of the inventory, including work sheets QA procedures have been performed by the Sector expert in the MoEW.	Adequately planned and implemented in 2010 (FCCC/ARR/2010/BGR §63-80)

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	next submissions			
	FCCC/ARR/2010/BGR (§62 - §82) Sustainable development of inventory planning, preparation and management (§ 37) Implementation of higher tier method for Road Transport (COPERT 4) Develop and use country-specific EFs. A cross-check with ETS, EPRTR, IPPC permits data Estimation of fugitive emissions from solid fuels and oil and natural gas activities. Estimation of emissions from combusting waste fuels at industrial facilities. Estimation of emissions from the combustion of biofuels in transport. Report emissions related to the combustion of gaseous fuels from utility combined heat and power plants under public electricity and heat production instead of other manufacturing industries and construction. Determine a better allocation of emissions for residual fuel oil in road transport Improved QA/QC activities Revising of AD in domestic aviation and navigation	High priority 2011 submission	Signed Contract with consultant for preparation of 2011GHG inventory in Sector Energy and implementation of model COPERT in sub sector "Road transport". Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory	Adequately planned and implemented in 2011
	➢ Develop a fully automated check between the data in the calculation models and the CRF tables for all subcategories in energy sector. ➢ Investigation whether it would be possible to update country specific emission factor (CS EF) for liquid fuels. ➢ Implement a higher tier method for subcategory 1A3a based on LTOs and aircraft types. ➢ Improve vehicles distribution and technology split matrix used by COPERT model by obtaining better country-specific data.	High priority 2012 submission	➢ For the submission 2012 were used automated checks for subcategories 1A3 and 1B. For the other subcategories were manually checked the totals. ➢ Data on LTOs was collected. Detailed data on aircraft types will be collected for domestic and international aviation.	Adequately planned and implemented in 2012

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	➢ Prepare a simplified vehicle distribution matrix based on the available national data. Analyse the effect of the vehicle distribution matrix over the emission estimates prepared by the COPERT model. Continue with the efforts to obtain more detailed data regarding the vehicle fleet from the responsible authorities. ➢ Improve the emission factors used for the precursors emission estimates to match closely with the emissions reported under the LRTAP convention. ➢ Analyse if there is any available activity data from underground mines in order to implement higher-tier method for coal mining and handling emissions. Estimate the required resources for obtaining the activity data and take decision whether this is justified in order the activity to be planned for a future submission.	Low priority 2015 submission		
Industrial processes (CRF sector 2)	**FCCC/ARR/2009/BGR** Revising of the AD with ETS, EPRTR, IPPC permits data. Revising of the EF. Investigation to update country specific emission factors Sector specific QA/QC procedures were implemented in 2010 submission. Support of external auditors are envisaged for 2010 and next submissions Comparison of emissions using alternative approaches. Documentation and archiving of all information required in NIR, background documentation and archive.	High priority 13/08/2010	Recalculated emissions based on revised AD in accordance with plant specific data submitted under EPRTR and ETS for productions of CRF 2.B.1 Ammonia, CRF 2.B.2, Nitric acid, CRF 2.A.1Cement, CRF 2.C.1 Iron and steel, 2.A.7 Glass and Bricks. Sector specific QA/QC procedures were implemented in 2010 submission. QA procedures have been performed by the Sector expert in the MoEW. Improved documentation and archiving of the inventory, including work sheets	Adequately planned and implemented in 2010 (FCCC/ARR/2010/BGR §84, 92) Need of improvements in the next submission
	FCCC/ARR/2010/BGR Continue to develop expertise and level of engagement with industry Provide additional information in relation to recalculations made as a response of 2010 Saturday Paper (§93) Assessment of underestimates in the industrial processes	High priority 2011 submission		Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	sector, namely missing activities under limestone and dolomite use and under soda ash use Improved QA/QC activities (§ 94) Strength the routine CRF checking to ensure that the CRF is correct and that it is consistent with the data in the individual calculation sheets and in the NIR (§ 94).			
	FCCC/ARR/2011/BGR Improve the information on calcium and magnesium oxide contents and particularly for the split between high-calcium lime and dolomitic lime. Verify that the plant-specific data for glass production include only emissions from limestone and dolomite use in order to ensure that double counting is avoided. Make a detail discussion of the method and EFs used to estimate emissions from BOF and OHF steel production	High priority 2012 and 2013 submission	Emissions form BOF steel production were recalculated due to doubts for double counting of the emissions from coke used in blast furnaces whish are reported in the energy sector.	Adequately planned and implemented in 2012 and 2013
	Continue comparison of emissions using alternative approaches. Continue to develop expertise and level of engagement with industry.	Medium priority 2014 submission		Adequately planned and implemented in 2014
Consumption of Halocarbons and SF_6 (CRF 2.F)	**FCCC/ARR/2009/BGR** Support of consultants and external auditors for 2010 and next submissions A study on F-gases "National study for determine the quantity of actual fluorinated gases (F-gases) (HFCs, PFCs and SF_6) in Bulgaria and methods for their calculations". Incorporation of final results of the study in the August resubmission of the inventory.	High priority 13/08/2010	Contract with external consultants. For the NIR 2010 a complete new and changed estimation was carried out for CRF 2.F (F-gases) (complete time series). Incorporated results from completed Project 4 "F-gases" (CRF tables and NIR) Improved documentation and archiving of the inventory, including work sheets	Adequately planned and implemented in 2010
	FCCC/ARR/2010/BGR Sustainable development of inventory planning, preparation and management Report a complete time series for the F-gases between 1988 and 1994	High priority 2011 submission	Signed Contract with external consultants for preparation of 2011 F-gases inventory. Most of the ERT recommendations are implemented in the preliminary 2011	Adequately planned and implemented in 2011

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	Using of appropriate notation keys Improved QA/QC activities		GHGs inventory	
	FCCC/ARR/2011/BGR Continue the research on the F-gases Refrigeration and air-conditioning subsector in order to improve the current assumptions.	High priority 2012 submission		Adequately planned and implemented in 2012
	A recalculation was made in some sub-categories of the Consumption of Halocarbons and SF_6 category due to that in the previous submission base of the ERT recommendations.	High priority 2013 submission		Adequately planned and implemented in 2012
	It s planned to make a step by step revision of data and models about each category in order to increase the transparency.	Medium priority 2014 submission		
	FCCC/ARR/2013/BGR Correct the calculation method of HFC emissions from refrigeration and air-conditioning system disposal by deducting the gas losses during the lifetime of the systems	Medium priority 2014 submission		Adequately planned and implemented in 2014
Solvent and other product use (CRF sector 3)	**FCCC/ARR/2009/BGR** **FCCC/ARR/2010/BGR** Recalculation of all the estimates based on the updated EMEP/CORINAIR Emission Inventory Guidebook Implementation of Sector specific QA/QC procedures QA procedures by the Sector expert in the MoEW (Order № RD-218/05.03.2010 by the Minister of Environment and Water). Documentation and archiving of all information required in NIR, Background documentation and archive.	Medium priority 2011 submission 15/04/2011	Recalculations of Sub-sectors 3A, 3B and 3C are already incorporated into preliminary inventory. In the final GHG inventory also Sub-sector 3D will be incorporated	Adequately planned in 2010 and implemented in 2011
	FCCC/ARR/2011/BGR Obtaining additional data and comparing data for some sources using the National VOC Register. Check if it is possible to provide the necessary activity data for N_2O of aerosol cans from Bulgarian customs or other institution. At this moment there are no activity data for manufacturers and distributors or import and export of these N_2O products.	Medium priority 2013 submission 15/04/2013	There is no information in imported product if they contain the N2O or not.	Adequately planned and implemented in 2013

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	Continue the research on activity data for N_2O of aerosol cans from Bulgarian customs or other institution.	Medium priority 2014 submission 15/04/2014		
Agriculture (CRF sector 4)	**FCCC/ARR/2009/BGR** Collection of data for implementation higher TIER method. Revision of activity data and emission factor. Sector specific QA/QC procedures have to be intensified. Comparison of emissions using alternative approaches. Documentation for national statistics of agriculture and food provided by MAF and FAO. Support of external auditors are envisaged for 2010 and next submissions. Documentation and archiving of all information required in NIR, background documentation and archive.	High priority 13/08/2010	Recalculated emissions in Agriculture Sector based on revised AD for entire time series in accordance with data provided by national agro statistic (MAF) Implementation of higher tier method for key categories like cattle Improving QA/QC, documentation and archiving of the inventory, including work sheets	Adequately planned and implemented in 2010 Need of improvements in the next submission

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	FCCC/ARR/2010/BGR Improvement the consistency of the time series by using national statistics in the first instance, and, if this is not possible, use of international statistical data from the FAO for the years before 2001 which are well harmonized with recent national statistics. Improvement of the transparency of information on emission trends by explaining any fluctuations in the trends. Improvement of documentation on the milk yield of dairy cattle or the live weight of animals (cattle, sheep and swine) in the NIR. Obtaining more precise data on animal populations by climate zone within the country. Obtaining information on the amount of sewage sludge that is applied to agricultural soil and to estimate emissions from this activity. Estimation of N_2O emissions from other (sewage sludge applied to soil – 4.D.1.6) in the agriculture sector Use higher-tier methods to estimate emissions from agricultural soils; Improved QA/QC, documentation and archiving of all information required in NIR, background documentation and archive.	High priority 2011 submission	Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory	Adequately planned and implemented in 2011
	FCCC/ARR/2011/BGR Obtaining more precise data on animal populations by climate zone within the country. Use higher-tier methods to estimate emissions from agricultural soils.	High priority 2012 and 2013 submission		Adequately planned and implemented in 2012 and 2013
	Continue to increase expertise and comparison of emissions using alternative approaches.	Medium priority 2014 submission		
LAND-USE, LAND-USE	**FCCC/ARR/2009/BGR** Incorporation of the results from successfully completed	High priority 13/08/2010	For the NIR2010 a complete new and changed estimate was carried out for	Adequately planned and implemented in 2010

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
CHANGES AND FORESTRY (CRF sector 5) **KP-LULUCF (see Chapter 10.4.3)**	Project "Development of methodology for calculation of emissions and removals for LULUCF sector according to requirements of UNFCCC and Kyoto Protocol". For 2011 an improvement of the inventory of the areas of the cropland as well as estimations of the organic carbon stock in cropland and grassland by soil groups is planned. In 2011 estimations of the organic carbon stock in forest soil, by soil groups (WRB, 2006) is planed. Support of consultants and external auditors are envisaged for 2010 and next submissions. Bulgaria will carry out an assessment of the most important factors contributing to the results of the LULUCF sectors together with their uncertainties and needs to improve them as well as the available resources for improvements. On basis of this assessment a prioritization and a plan of improvement will be made.	High priority 2011 submission	the whole LULUCF-sector of Bulgaria (complete time series). Incorporated results from completed Projects 1 "LULUCF" (CRF tables and NIR) Improved documentation and archiving of the inventory, including work sheets Internal Review of the national system by EEA/EC (JRC) in July 2010	Need of improvements in the next submission (FCCC/ARR/2010/BGR §139)
	FCCC/ARR/2010/BGR Strengthen arrangements to ensure the sustainability of existing capacities and competence of technical staff for LULUCF reporting in accordance with the IPCC good practice guidance; Improve the transparency of the LULUCF inventory by reporting information in the NIR on methodologies, parameters and AD used; Ensure consistency in land classification by using the LUC matrices; Check the coherence of reported data and apply QC checks, ensuring consistency and accuracy in the estimation process and in the reporting phase; Include the LULUCF sector in its uncertainty analysis, assessing the uncertainties for each LULUCF category. Improved QA/QC activities Documentation and archiving of all information required in NIR, Background documentation and archive.	High priority 2011 submission	See Chapter 7.9 BG NIR 2011	
	FCCC/ARR/2011/BGR To continue the process of improvements in land use	High priority 2012 and 2013	All recommendations (from FCCC/ARR/2009/BGR and	Adequately planned and implemented in 2013

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	classification and representation An improvement of the country specific factors on soil reference stock will be made according to the results of revision of the measured data, used for calculation. It is expecting to revised the reference carbon stock in soil by estimating the soil carbon content by regions and by soil type and then to aggregate the figure of the reference stock. To continuously check the coherence of reported data, ensuring consistency and accuracy in the estimation process and in the reporting phase.	submission	FCCC/ARR/2010/BGR) were already implemented in Submission 2010 and 2011. In Submission 2012, improvements in area representation were made according to recommendations from the review 2011.	
	➢ To continue the process of improvements in land use classification and representation ➢ An improvement of the country specific factors on soil reference stock will be made according to the results of revision of the measured data, used for calculation. It is expecting to revised the reference carbon stock in soil by estimating the soil carbon content by regions and by soil type and then to aggregate the figure of the reference stock ➢ To continuously check the coherence of reported data, ensuring consistency and accuracy in the estimation process and in the reporting phase; ➢ To continue assessing the uncertainties for each LULUCF and KP-LULUCF category Tier 2.	High priority 2014 submission	All planned improvements for Submission 2014 were implemented. All recommendations with high priority listed in FCCC/ARR/2013 have been taken into account and implemented in Submission 2014	Adequately planned and implemented in Sbmission 2014
	➢ To continue the process of improvements in land use classification and representation ➢ To continuously check the coherence of reported data, ensuring consistency and accuracy in the estimation process and in the reporting phase; ➢ Revision of LULUCF chapter in the NIR in order to	High priority 2015 Submission		

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	increase the transparency ➢ Implementation of the new reporting requirements for KP-LULUCF			
Waste (CRF sector 6)	**FCCC/ARR/2009/BGR** Incorporation of the FOD model provided by the 2006 IPCC Guidelines Revision of activity data and emission factor - Waste statistics and DOC value and other related parameters Sector specific QA/QC procedures were implemented in 2010 submission. QA procedures have been performed by the Sector expert in the ExEA and MoEW. Collaboration with external auditors are envisaged for 2010 and next submissions Documentation and archiving of all information required in NIR, background documentation and archive. Recalculations and time-series consistency To account for the methane capture and separation of waste during and after collection, and to use specific degradable organic carbon (DOC) for every year after year 2000 as these data are available.	High priority 13/08/2010	The complete new and changed estimation was carried out for the sub-sector CRF 6 A Solid waste Disposal on Land (complete time series). The complete new estimation was carried out for the sub-sector CRF 6 C Waste Incineration 2004 – 2008 Recalculation of the emissions in sub-sector CRF 6C Waste Incineration, based on revised AD for entire time series (IPA questionnaire)	Adequately planned and implemented in 2010 Need of improvements in the next submission (FCCC/ARR/2010/BGR §)

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	FCCC/ARR/2010/BGR Improve consistency between CRF and NIR To provide information and detailed descriptions of background data and references, AD and EFs and methodologies and assumptions used. To provide more information on waste management policies and existing practices and technologies of waste recovery and waste disposal facilities To provide an explanation for the trend in the waste generation rate in the next annual submission Revision of the landfill parameters for the entire time series Estimate of CH_4 recovery from landfill Provision of information on the wastewater streams and treatment technologies used at wastewater treatment plants N_2O emissions from human sewage in the waste sector; and CO_2 emissions from waste incineration (without energy recovery) in the waste sector	High priority 2011 submission	Signed contract with University of Chemical technology and metallurgy for Preparation of 2011 GHG inventory in Sector Waste – 6C. The contractor has to Support of ExEA staff in preparation of 2011 submission (6C CRF tables and NIR). Training of ExEA's staff. Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory	

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	➢ Revision of activity data and emission factor - Waste statistics and DOC value and other related parameters ➢ Documentation and archiving of all information required in NIR, Background documentation and archive.		The complete new and changed estimation was carried out for the sub-sector CRF 6 B Wastewater treatment.	Adequately planned and implemented in 2012 Need of improvements in the next submission

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
		High priority 2012 submission	Signed contract with Astra Consult for Preparation of 2012 GHG inventory in Sector Waste – 6B. The contractor has to Support of ExEA staff in preparation of 2012 submission (6W CRF tables and NIR). Training of ExEA's staff. Most of the ERT recommendations for 2009 and 2010 are implemented in the 2012 GHGs inventory.	
	FCCC/ARR/2011/BGR ➢ Improve consistency between CRF and NIR ➢ Estimate of CH_4 emissions from waste composting activities; ➢ Estimate a CH_4 recovery from wastewater treatment facilities; ➢ Send the questionnaire about methane to operators of treatment facilities	High priority 2013 submission		Adequately planned and implemented in 2013

Issue	Planned improvement for 2010 and next submissions	Priority high - medium - low	Status of implementation	Comments
	FCCC/ARR/2013/BGR ➢ Improve transparency in the NIR about industrial waste disposal ➢ Improve transparency in the NIR about AD from composting ➢ Improve consistency between CRF tables and NIR and consistency and accuracy within the NIR ➢ Improve accuracy and consistency of inventory with reporting of biogenic CO2 emissions from waste incineration as memo item	High priority 2014 submission	Most of ERT recommendations for 2012 are implemented in 2014 GHGs inventory.	

11 KP-LULUCF

11.1 GENERAL INFORMATION

11.1.1 DEFINITION OF FOREST AND ANY OTHER CRITERIA

For defining forest, Bulgaria uses the definition in the Bulgarian Forest Act (last amendment 07.08.2012, SG №60):

"Area over 0.1 ha, covered with forest tree species higher than 5 meters and tree crown cover over 10% or with trees which can reach these parameters in natural environment".

Areas of natural forest regeneration outside urban areas with a size of more than 0.1 ha also represent "forest". City parks with trees, forest shelter belts, and single row trees do not fall under the category "forests.

According to their functions, forests are divided in: forests for timber production, protective and recreation forests and forests in protected areas.

All forests in Bulgaria are managed.

Forests are also:

- areas which are in a process of recovering and are still under the parameters, but it is expected to reach forest crown cover over 10% and tree height 5 meters;
- areas, which as the result of anthropogenic factors or natural reasons are temporarily deforested, but will be reforested;
- protective forest belts, as well as tree lines with an area over 0.1 ha and width over 10 meters;
- cork oak stands."

For reaching the targets of KP the minimal figures of the defined range of parameters for tree height, tree crown cover and minimum area have been chosen by Bulgaria:

Minimum forest area – 0.1 ha;

Tree crown cover -10%;

Tree height - 5 meters

In accordance with Article 7 of the Kyoto Protocol the country will report in the National Inventories the following activities, following the definitions of the forest related activities, as given in **Decision 16/CMP.1 Land use, land-use change and forestry:**

"Afforestation" as a direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources

"Reforestation" as a direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

"Deforestation" as a direct human-induced conversion of forested land to non-forested land

Forest Fund according to the Forest Act is a territory, with a main purpose to be forest. It covers forested area, area covered by mountain pine and non-timber production lands. Urbanized areas, separated settlements and agricultural lands are not included in the Forest Fund. The National Forest Inventory (NFI) contains the following reporting forms: forest areas (1FF), afforestated area (2FF), tree biomass stock (3FF), stock by groups of forests and forest cover (4FF), wood harvest (5FF), age and density (6FF) and types of forest stands (7FF). The reporting forms 1FF and 5FF are updated annually. The remaining reporting forms are updated every 5th year (e.g. 1985, 1990, 1995, 2000, 2005) and are submitted to the Regional Forestry Offices and in the Executive Forest Agency.

Forests and lands from the Forestry Fund are managed and utilized based on the Forest Management Projects, Plans and Programmes. The Forest Management Projects, Plans and Programmes are elaborated on ownership base according the order and period pointed in the Regulation for planning the management of forests and lands in the Forest Fund of the Republic of Bulgaria, issued by the Minister of Agriculture and Food on a proposal of the Head of the National Forestry Board.

The Forest Management Projects are approved by the Head of the Executive Forest Agency after coordination with other stakeholder ministries and organizations.

11.1.2 ELECTED ACTIVITIES UNDER ARTICLE 3, PARAGRAPH 4, OF THE KYOTO PROTOCOL

Bulgaria has decided not to elect any of the activities under Article 3, paragraph 4, in the first commitment period.

11.1.3 DESCRIPTION OF HOW THE DEFINITIONS OF EACH ACTIVITY UNDER ARTICLE 3.3 AND EACH ELECTED ACTIVITY UNDER ARTICLE 3.4 HAVE BEEN IMPLEMENTED AND APPLIED CONSISTENTLY OVER TIME

Bulgaria has chosen to account for each activity under Article 3, paragraph 3 at the end of the commitment period.

The base year for reporting ARD activities is 1990. The area units reported as Afforestation/Reforestation (AR) and Deforestation (D) have the same basis as the area of land-use change to and from forest under the UNFCCC GHG inventory reporting taking into account the different time frame. All LUC from and to forests are considered to be direct human induced. Afforestation/Reforestation (AR) activities are reported together.

The National Forest Inventory (NFI) and the information from the Forest Management Plans (FMP) are the main sources of information for the ARD units of land (see chapter 11.2.1).

11.2 LAND-RELATED INFORMATION

11.2.1 SPATIAL ASSESSMENT UNIT USED FOR DETERMINING THE AREA OF THE UNITS OF LAND UNDER ARTICLE 3.3

The National Forest Inventory (NFI) and the information from the Forest Management Plans (FMP) are the main sources of information for the ARD units of land. The NFI in Bulgaria covers assessments for the entire country territory in 10 years' cycles. In other words all forest stands are surveyed once in every 10 years. Forest inventory presents collection of qualitative and quantitative data about the investigated area. The management planning gives recommendations about the silvicultural operations and activities for the next 10 years period. The process of forest inventory and planning is stable and consistent over time. The measurements of the forest inventory are carried out for all sub-compartments in each and every State Forest Enterprises (SFE). The area of one sub-compartment or forest management unit is from 1-25 ha, when forested. The area of the non-forested unit is 0,1 ha. The territory of one SFE may include the territory of one or several municipalities.

11.2.2 METHODOLOGY USED TO DEVELOP THE LAND TRANSITION MATRIX

Reprting of AR units of land:

Bulgaria continues to follow the plan for improvement of the estimation of AR units of land as accepted by the ERT team as answer to the related Saturday paper issue of the 2011 review. The plan has been implemented in stages starting in Submission 2012 and completed for the Submission 2014. According to this plan the following improvement steps have been implemented in order to fulfil the reporting requirement set out in paragraph 8 (a) of the annex to decision 15/CMP.1.

Bulgaria examined the Forest Management Plans (FMPs – see below) for all State Forest Enterprises (SFE), which were inventoried for the period 1991-2012. Like this all changes since 1992 in forest area for each and every SFE has been traced and identified. For those SFE, where there is an increase in the forest area since 1990, the increase is derived into:

c. New forest areas which are included in the forest total, but which were forested before 1990, so new forests with stands of older age classes.
d. And the new forested areas with stands of the youngest age class, which are due to afforestation and reforestation activities (planting and seeding) on barren areas or afforestation and reforestation activities (planting, manual and natural seeding) on grassland or on croplands.

These improvement steps have been performed by the experts from Executive Forest Agency, by using the following sources of information:

- Forest Inventory and FMPs[37];

[37] Forest Inventory and FMPs are carried out for each State Forest Enterprise. The inventory aims measurement and processing of the following main data:

- Forestry Fund Reporting Form 1FF[38] (forest area) for the 1990;
- Forest maps

The results from the revision of the FMPs are given in the table below. The observed increase in forest area due to AR activities for every single SFEs is given for two periods - 1992-2000 and since 2000. The amount of the "new" forest areas since 1.1.1990 which were forested before 1990 (point a) was added to the total forest area in 1991 and the years after according to Forestry Fund Reporting Form 1FF (forest area). The new forest areas between 2012 and 1992 according to point b represent the **net increase** in forest due to planting or seeding (manually or naturally) activities. Changes in forest area for the years 1990, 1991 are based on extrapolation using the same forest change as in the year 1992.

Table 246 Results from the revision of the FMPs for all SFEs for the period 2001-2012, representing the net AR activities since 1992 till 2012

State Forest Enterprises	Forest area in ha for 1991	Forest area in ha for 2012.	Planted or manually seeded in ha 1992-2000	Planted or manually seeded in 2001-2012	AR due to natural seeding in ha. 1992-2000	AR due to natural seeding in ha 2001-2012	Forest area forested before 1990
I. DISTRICT VIDIN							
1. Vidin	27 483	32 070	-	21	1 438	3 884	-
2. Belogradjik	27 730	27 826	620	6	-	2 128	906
3. Midjur	16 510	23 943	-	-	70	2 548	495
Total	**71 723**	**83 839**	**620**	**27**	**1 508**	**8 560**	**1 401**
II. DISTRICT MONTANA							
1. Montana	28 136	14 950	-	27	242	20	184
2. Chiprovtsi	-	16 506	1	2	19	316	818
3. Berkovitsa	24 346	26 344	59	-	196	1 392	20
4. Lom	4 868	6 237	-	50	110	573	608
5. Govejda	15 862	16 456	-	2 264	-	-	22
6. Burziya	6 919	6 644	-	-	-	-	83
Total	**80 131**	**87 137**	**60**	**2 343**	**567**	**2 301**	**1 735**
III. DISTRICT OF VRATSA							
1. Vratsa	20 591	24 588	-	-	288	627	1 068
2. Mezdra	26 816	30 140	757	670	2 109	1 260	300
3. Oryahovi	4 628	4 433	-	-	-	47	-

7) Forest area and its changes
8) Tree composition, origin, age, management purpose
9) Tree height and diameter,
10) Annual increment, bonitat, density of the stands
11) Tree growing stock
12) Data about main rock, soil type and soil bonitat and other important habitat characteristics.

The measurements of the Forest Inventory are carried out for each and every SFE once in every 10 years.

[38] The reporting forms 1FF to 7 FF represent the forest fund reporting forms. The data gathered during the forest inventories is used as data base for preparation of the reporting forms of the forest fund

State Forest Enterprises	Forest area in ha for 1991	Forest area in ha for 2012.	Planted or manually seeded in ha 1992-2000	Planted or manually seeded in 2001-2012	AR due to natural seeding in ha. 1992-2000	AR due to natural seeding in ha 2001-2012	Forest area forested before 1990
Total	**52 035**	**59 161**	**757**	**670**	**2 397**	**1 934**	**1 368**
IV. DISTRICT OF PLEVEN							
1. Pleven	23 002	31 441	973	-	4 767	3 001	1 320
2. Nikopol	9 645	13 559	-	40	-	198	2 054
Total	**32 647**	**45 000**	**973**	**40**	**4 767**	**3 199**	**3 374**
V. DISTRICT OF LOVECH							
1. Lovech	21 902	26 393	35	3 658	-	4 061	408
2. Teteven	19 589	19 728	119	54	11	589	992
3. Ribaritsa	15 491	20 096	-	18	-	76	2
4. Cherni Vit	9 113	13 735	-	4	314	352	863
5. Troyan	31 280	25 262	35	8	-	1 407	368
6. Rusalka, Apriltsi	11 501	12 863	-	-	334	356	84
7. Cherni Osam	12 900	13 437	-	2	1	312	68
8. Borima	-	7 779	-	3	-	-	-
9. Lesidren	19 729	32 583	159	118	-	1 186	-
10. Lukovit	14 374	-	-	-	-	-	-
Total	**155 879**	**171 876**	**348**	**3 865**	**660**	**8 339**	**2 785**
VI. DISTRICT OF GABROVO							
1. Gabrovo	25 447	28 568	35	11	-	3 228	10
2. Sevlievo	20 059	22 538	-	-	1 525	297	11
3. Rositsa	14 341	14 757	-	7	-	350	90
4. Plachkovtsi	20 969	27 291	-	-	1 327	5 370	77
Total	**80 816**	**93 154**	**35**	**18**	**2 852**	**9 245**	**188**
VII. DISTRICT OF VELIKO TARNOVO							
1. Bolyarka, V.Tarnovo	36 091	42 925	504	841	-	9 440	-
2. Svishtov	3 646	4 874	-	746	13	-	404
3. Gorna Oryahovitsa	17 123	20 587	211	12	4	738	94
4. Elena	30 461	33 418	-	7	-	2 736	284
5. Buinovtsi	14 366	16 507	-	33	-	123	434
Total	**101 687**	**118 311**	**715**	**1 639**	17	**13 037**	**1 216**
VIII. DISTRICT OF ROUSSE							
1. Dunav, Rousse	16 257	20 774	-	192	-	1 784	2 019
2. Byala	15 874	20 176	-	3 381	-	859	584
Total	**32 131**	**40 950**	**-**	**3 573**	**-**	**2 643**	**2 603**
IX. DISTRICT OF TARGOVISHTE							
1. Tyrgovishte	15 437	17 272	-	-	16	127	1 005

State Forest Enterprises	Forest area in ha for 1991	Forest area in ha for 2012.	Planted or manually seeded in ha 1992-2000	Planted or manually seeded in 2001-2012	AR due to natural seeding in ha. 1992-2000	AR due to natural seeding in ha 2001-2012	Forest area forested before 1990
2. Omurtag	26 170	30 857	3	320	-	1 117	1 998
3. Cherni Lom, Popovo	24 753	28 561	900	484	1 848	654	1 858
Total	**66 360**	**76 690**	**903**	**804**	**1 864**	**1 898**	**4 861**
X. DISTRICT OF SHUMEN							
1. Shumen	16 299	17 395	479	1	760	156	866
2. Preslav	17 391	16 696	184	-	-	737	384
3. Varbitsa	15 489	18 856	221	-	-	515	212
4. Smyadovo	17 467	19 217	-	-	91	537	404
5. Palamara, Venets	30 773	34 025	588	40	-	1 779	816
Total	**97 419**	**106 189**	**1 472**	**41**	**851**	**3 724**	**2 682**
XI. DISTRICT OF RAZGRAD							
1. Razgrad	20 767	22 244	775	1 235	-	446	252
2. Seslav	28 411	30 484	-	-	-	219	623
3. Iri-Hisar	13 553	13 553	-	-	-	-	-
Total	**62 731**	**66 281**	**775**	**1 235**	**-**	**665**	**875**
XII. DISTRICT OF SILISTRA							
1. Silistra	25 550	24 433	-	665	-	914	4 066
2. Karakuz	17 221	25 395	311	59	-	615	452
3. Tutrakan	8 785	10 584	30	922	158	85	579
Total	**51 556**	**60 412**	**341**	**1 646**	**158**	**1 614**	**5 097**
XIII. DISTRICT OF DOBRICH							
1. Dobrich	24 691	16 981	1 199	286	123	246	2 466
2. Balchik	12 239	15 655	778	176	-	224	1 045
3. Tervel	11 096	14 264	586	51	-	519	2 321
4. General Toshevo	-	14 120	2 268	108	26	143	429
Total	**48 026**	**61 020**	**4 831**	**621**	**149**	**1 132**	**6 261**
XIV. DISTRICT OF VARNA							
1. Varna	30 611	31 075	-	-	456	-	768
2. Suvorovo	11 626	12 104	30	25	-	179	294
3. Provadiya	20 067	12 406	394	13	-	270	173
4. Tsonevo	12 168	22 653	644	650	417	70	120
5. Sherba	12 391	14 160	-	30	-	461	864
6. Staro Oryahovo	23 501	23 822	-	-	-	-	-
Total	**110 364**	**116 220**	**1 066**	**718**	**873**	**980**	**2 219**
XV. DISTRICT OF BOURGAS							
1. Bourgas	21 967	18 084	428	278	162	406	1 427
2. Nesebar	30 131	35 362	25	104	189	503	2 168
3. Aytos	40 749	42 187	252	128	251	932	1 242

State Forest Enterprises	Forest area in ha for 1991	Forest area in ha for 2012.	Planted or manually seeded in ha 1992-2000	Planted or manually seeded in 2001-2012	AR due to natural seeding in ha. 1992-2000	AR due to natural seeding in ha 2001-2012	Forest area forested before 1990
4. Karnobat	6 965	26 047	70	-	-	144	795
5. Sungurlare	36 297	20 413	136	50	775	80	
6. Sredets	34 613	39 885	17	39	294	1 890	3 389
7. Ropotamo	9 696	15 419	88	12	88	77	522
8. Novo Panicharevo	19 542	20 593	133	8	-	226	39
9. Tsarevo	27 844	28 228	-	1	-	609	-
10. Gramatikovo	19 445	20 654	-	-	34	128	1 234
11. Kosti	12 650	12 994	57	-	79	248	-
12. Malko Tarnovo	30 845	20 776	3	2	162	134	3 985
13. Zvezdets	-	19 752	-	18	-	1 394	3 834
Total	**290 744**	**320 394**	**1 208**	**640**	**2 034**	**6 996**	**18 772**
XVI. DISTRICT OF YAMBOL							
1. Tundja, Yambol	19 384	20 376	-	33	18	110	907
2. Elhovo	26 857	31 289	194	703	214	721	2 524
Total	**46 241**	**51 665**	**194**	**736**	**232**	**831**	**3 431**
XVII. DISTRICT OF SLIVEN							
1. Sliven	43 370	44 827	513	38	-	300	294
2. Kotel	37 776	40 771	40	2	-	565	1 079
3. Tvarditsa	27 279	27 140	-	3	-	236	60
4. Nova Zagora	9 921	10 352	83	-	-	99	436
5. Ticha	12 505	12 983	-	12	568	73	638
6. Stara reka	7 536	8 155	-	21	-	67	713
Total	**138 387**	**144 228**	**636**	**76**	**568**	**1 341**	**3 220**
XVIII. DISTRICT OF STARA ZAGORA							
1. Stara Zagora	34 935	36 986	1 008	75	120	143	89
2. Chirpan	21 877	24 646	46	20	572	375	1 174
3. Mazalat	27 878	35 082	171	99	-	147	1 207
4. Gurkovo	21 668	22 493	-	-	-	356	-
5. Maglij	25 675	24 317	19	122	54	539	131
6. Kazanlak	28 956	24 410	14	37	-	-	427
Total	**160 989**	**167 934**	**1 258**	**353**	**746**	**1 560**	**3 028**
XIX. DISTRICT OF HASKOVO							
1. Haskovo	77 076	81 839	-	1 896	567	1 644	121
2. Topolovgrad	20 955	21 574	146	172	240	369	275
3. Svilengrad	25 647	28 067	607	276	354	1 807	178
4. Ivaylovgrad	44 385	48 956	104	65	244	1 685	1 623

State Forest Enterprises	Forest area in ha for 1991	Forest area in ha for 2012.	Planted or manually seeded in ha 1992-2000	Planted or manually seeded in 2001-2012	AR due to natural seeding in ha. 1992-2000	AR due to natural seeding in ha 2001-2012	Forest area forested before 1990
Total	**168 063**	**180 436**	**857**	**2 409**	**1 405**	**5 505**	**2 197**
XX. DISTRICT OF KARDJALI							
1. Kardjali	35 637	22 310	4	5	-	-	29
2. Jenda	3 517	16 964	-	7	-	3	36
3. Momichilgrad	54 424	24 698	21	8	-	-	16
4. Kirkovo	-	29 155	-	2	-	-	-
5. Krumovgrad	42 794	43 205	18	2	-	24	34
6. Ardino	18 339	18 623	9	1	9	16	-
Total	**154 711**	**154 955**	**52**	**25**	**9**	**43**	**115**
XXI. DISTRICT OF SMOLYAN							
1. Smolyan	22 570	29 438	27	46	148	2 143	493
2. Zlatograd	33 180	32 409	-	-	80	27	-
3. Smilyan	30 858	32 028	-	-	11	1 028	-
4. Slaveyno	27 126	29 005	-	-	39	459	-
5. Pamporovo	8 796	-	-	-	-	-	-
6. Chepelare	11 075	-	-	-	-	-	-
7. Hvoyna	11 588	27 280	37	273	895	125	63
8. Shiroka Laka	8 206	9 124	-	-	1	569	347
9. Mihalkovo	13 802	15 430	-	7	356	633	981
10. Izvora	2 255	17 699	12	3	43	569	826
11. Devin	12 879	-	-	-	-	-	-
12. Trigrad	7 731	10 044	256	36	628	595	784
13. Borino	10 476	12 597	-	4	837	160	1 031
14. Dospat	19 421	20 577	5	35	138	461	457
Total	**219 963**	**235 631**	**337**	**404**	**3 176**	**6 769**	**4 982**
XXII. DISTRICT OF PLOVDIV							
1. Plovdiv	25 618	23 715	543	144	-	945	5 255
2. Hisar	23 815	26 157	1 078	50	283	456	651
3. Klisura	7 216	20 731	52	61	-	-	516
4. Rozino	12 472		-	-	-	-	-
5. Karlovo	28 649	30 590	49	55	148	1 130	668
6. Chekeritsa	12 849	31 691	28	26	609	455	901
7. Parvomai	9 796	9 706	112	23	-	177	-
8. Asenovgrad	24 633	28 076	86	285	125	1 670	988
9. Kormisosh, Laki	19 347	21 365	200	34	1 099	612	144
10. Krichim	7 978	-	-	-	-	-	-
Total	**172 373**	**192 031**	**2 148**	**678**	**2 264**	**5 445**	**9 123**

State Forest Enterprises	Forest area in ha for 1991	Forest area in ha for 2012.	Planted or manually seeded in ha 1992-2000	Planted or manually seeded in 2001-2012	AR due to natural seeding in ha. 1992-2000	AR due to natural seeding in ha 2001-2012	Forest area forested before 1990
XXIII. DISTRICT OF PAZARDJIK							
1. Pazardjik	24 922	26 158	-	27	-	149	483
2. Panagurishte	38 617	39 095	371	50	-	-	207
3. Belovo	22 307	23 375	44	52	357	199	663
4. Yundola	4 977	4 933	-	1	-	-	-
5. Alabak	26 606	26 001	107	121	-	238	457
6. Chepino	2 573	19 504	-	-	18	136	135
7. Chehlyovo	15 078	-	-	-	-	-	-
8. Selishte	15 677	16 126	80	14	-	122	211
9. Shiroka Polyana	15 539	10 942	-	-	-	86	148
10. Rodopi	2 651	19 966	-	1	-	121	181
11. Beglika	12 601	-	-	-	-	-	-
12. Borovo	14 747	15 348	-	-	-	104	478
13. Batak	9 627	10 026	-	-	-	99	238
14. Rakitovo	18 771	19 614	92	109	70	15	379
15. Peshtera	18 873	19 676	476	118	21	17	203
Total	**243 566**	**250 764**	**1 170**	**493**	**466**	**1 286**	**3 783**
XXIV. DISTRICT OF BLAGOEVGRAD							
1. Blagoevgrad	24 418	29 001	16	131	345	2 490	2 559
2. Simitli	31 387	34 172	422	235	301	1 080	388
3. Kresna	21 625	23 062	-	-	92	235	431
4. Strumyani	18 780	21 015	-	3	-	148	970
5. Parvomay	18 629	17 970	252	43	-	442	-
6. Petrich	10 899	11 451	-	-	-	260	79
7. Sandanski	22 412	22 543	242	-	57	290	107
8. Katuntsi	26 629	28 193	-	-	62	48	910
9. Gotse Delchev	28 955	29 327	46	42	129	176	-
10. Dikchan, Satovcha	18 115	18 640	60	91	-	-	-
11. Garmen	24 907	27 039	40	8	-	62	-
12. Mesta	16 925	11 567	49	82	1	6	-
13. Dobrinishte	12 116	18 984	29	80	359	639	429
14. Eleshnitsa	16 607	16 814	179	132	-	546	1 065
15. Yakoruda	20 161	21 635	1 162	688	-	-	-
16. Belitsa	10 591	11 265	100	269	-	218	907
17. Razlog	18 269	19 596	112	54	461	-	-
Total	**341 425**	**362 284**	**2 709**	**1 858**	**1 807**	**6 640**	**7 845**
XXVI. DISTRICT OF KUSTENDIL							

State Forest Enterprises	Forest area in ha for 1991	Forest area in ha for 2012.	Planted or manually seeded in ha 1992-2000	Planted or manually seeded in 2001-2012	AR due to natural seeding in ha. 1992-2000	AR due to natural seeding in ha 2001-2012	Forest area forested before 1990
1. Osogovo	46 737	58 598	-	-	868	5 990	3 175
2. Nevestino	21 703	23 166	407	525	510	497	516
3. Dupnitsa	46 798	48 973	-	-	-	450	2 561
Total	**115 238**	**130 737**	**407**	**525**	**1 378**	**6 937**	**6 252**
XXVII. DISTRICT OF PERNIK							
1. Radomir	25 248	20 589	3 834	216	-	124	135
2. Zemen	15 506	18 484	28	53	740	764	1 743
3. Breznik	8 939	10 415	153	110	-	980	176
4. Tran	30 547	33 947	956	2	797	713	421
5. Vitoshko-Studena	-	8 878	-	-	-	-	128
Total	**80 240**	**92 313**	**4 971**	**381**	**1 537**	**2 581**	**2 603**
XXVIII. DISTRICT OF SOFIA							
1. Sofia	45 229	55 423	-	2 383	-	3 223	3 175
2. Svoge	46 447	45 198	-	405	240	266	221
3. Vitinya	9 179	17 295	-	-	-	-	-
4. Botevgrad	40 797	33 957	-	111	-	1 425	307
5. Godech	10 182	11 107	-	5	14	243	626
6. Etropole	20 994	22 779	144	11	-	1 335	264
7. Pirdop	43 526	45 228	-	46	-	824	883
8. Elin Pelin	25 157	22 129	25	74	150	629	22
9. Aramliets		7 534	-	27	-	3	-
10. Ihtiman	26 682	25 622	-	56	214	625	1 275
11. Kostenets	19 409	21 228	14	208	316	409	265
12. Samokov	65 481	68 994	-	-	192	2 607	14
13. Iskar	3 297	3 470	-	-	-	-	128
Total	**356 380**	**379 964**	**183**	**3 326**	**1 126**	**11 589**	**7 360**
Total for the Country	3 531 825	3 849 576	29 026	29 144	33 411	116 794	109 376

Therefore, the net increase in forest areas plus the annual deforestation areas must represent the annual AR areas:

$$AR_x = FL_x - FL_{x-1} + D_{SMx}$$

Where,

AR – AR area

X - year

FL – forest area

D_{SM} – D area for settlements

The assessment of the former land use of the identified AR units of land was made by using an expert judgment. Land use (cropland, grassland, other land) typically follows ecological site condition. The forestry experts know the dominating land uses in the SFE region or at the region of identified AR lands, so they made an expert judgment of former land use on basis of likelihoods. For example, there are regions where grassland (GL) dominates, because growth/site conditions are not good enough for cropland (CL) plants or CL management or, site conditions are so good that CL dominates. Similarly, other land (OL) can be found in extreme site conditions where FL, CL, GL cannot grow. **It should be noticed** that considering the growing conditions on other land which consist of rocks, landslides and barren areas, regrowth of forests on such lands without planting or manual seeding cannot happen. So, any conversion from OL to FL is based on planting or manual seeding measures and reported as such.

Reporting of D units of land:

All changes of designation of forests are registered in Executive Forest Agency for every single year since 2001. The registry contains administrative information in relation with the orders issued for excluding of forests. For the years before 2001 data on forest loss is available for the period 1990-1994. The information is provided by the experts from ExFA and is gathered from specific books, where all changes of designation of forest for these years were written up. There is no activity data on forest loss for the years 1995-2000, so the forest loss for these years is estimated as an average from the forest loss for the period 1990-1994. Since Bulgaria uses the national boundary as a geographical boundary for reporting of activities under Article 3.3 of KP the total amount of changes in designation of forests and lands from forest fund was used as data source for D reporting. All changes of designation of forests are associated with conversion from forest land to settlement (SM) and are reported as such. In its previous submission Bulgaria reported forest loss also for WL due to probability reasons. It was assumed that the observed increase in WL suggested also deforestation for WL. The assumed D for WL was estimated as a share of forest land in the totals of forest land, cropland plus grassland (it was supposed that the wetlands increase comes from such lands). Actually the reported D area to WL in the previous submissions of Bulgaria represented an overestimation of D activity since all the information for forest loss due to changes in designation of forest was reported under D to SM. Since the last improvements in area representation made for the Submission 2014 LUCs from FL to WL were not calculated. According to experts from the ExFA, the changes of designation of forest in the years 1990-2012 are associated with conversion only to SM. There is only one new dam lake (Tsankov kamak) which was built up in recent years but the forest loss associated with its construction works has been already reported in the 70's. Therefore, Bulgaria reports all information provided by the ExFa for forest loss across the time series (3.76 kha) as D activity associated with conversion to SM.

Table 247 Land transition matrix. Area change between the current and the previous year for 2008 (CRF NIR-2 table)

(kha)		Article 3.3 activities		Article 3.4 activities					
		Afforestation and Reforestation	Deforestation	Forest Management (if elected)	Cropland Management (if elected)	Grazing Land Management (if elected)	Revegetation (if elected)	Other	Total area at the beginning of the current inventory year
Article 3.3 activities	Afforestation and Reforestation	163.63	NO						163.63
	Deforestation		2.19						2.19
Article 3.4 activities	Forest Management (if elected)		NA	NA					NA
	Cropland Management (if elected)	NA	NA		NA	NA	NA		NA
	Grazing Land Management (if elected)	NA	NA		NA	NA	NA		NA
	Revegetation (if elected)	NA			NA	NA	NA		NA
Other		12.99	0.83	NA	NA	NA	NA	10 920.55	10 934.37
Total area at the end of the current inventory year		176.62	3.02	NA	NA	NA	NA	10 920.55	11 100.19

Table 248 Land transition matrix. Area change between the current and the previous year for 2009 (CRF NIR-2 table)

(kha)		Article 3.3 activities		Article 3.4 activities					
		Afforestation and Reforestation	Deforestation	Forest Management (if elected)	Cropland Management (if elected)	Grazing Land Management (if elected)	Revegetation (if elected)	Other	Total area at the beginning of the current inventory year
Article 3.3 activities	Afforestation and Reforestation	176.62	NO						176.62
	Deforestation		3.02						3.02
Article 3.4 activities	Forest Management (if elected)		NA	NA					NA
	Cropland Management (if elected)	NA	NA		NA	NA	NA		NA
	Grazing Land Management (if elected)	NA	NA		NA	NA	NA		NA
	Revegetation (if elected)	NA			NA	NA	NA		NA
Other		12.26	0.10	NA	NA	NA	NA	10 908.19	10 920.55
Total area at the end of the current inventory year		188.88	3.12	NA	NA	NA	NA	10 908.19	11 100.19

Table 249 Land transition matrix. Area change between the current and the previous year for 2010 (CRF NIR-2 table)

(kha)		Article 3.3 activities		Article 3.4 activities					
		Afforestation and Reforestation	Deforestation	Forest Management (if elected)	Cropland Management (if elected)	Grazing Land Management (if elected)	Revegetation (if elected)	Other	Total area at the beginning of the current inventory year
Article 3.3 activities	Afforestation and Reforestation	188.88	NO						188.88
	Deforestation		3.12						3.12
Article 3.4 activities	Forest Management (if elected)		NA	NA					NA
	Cropland Management (if elected)	NA	NA		NA	NA	NA		NA
	Grazing Land Management (if elected)	NA	NA		NA	NA	NA		NA
	Revegetation (if elected)	NA			NA	NA	NA		NA
Other		12.47	0.31	NA	NA	NA	NA	10 895.42	10 908.19
Total area at the end of the current inventory year		201.35	3.42	NA	NA	NA	NA	10 895.42	11 100.19

Table 250 Land transition matrix. Area change between the current and the previous year for 2011 (CRF NIR-2 table)

(kha)		Article 3.3 activities		Article 3.4 activities					
		Afforestation and Reforestation	Deforestation	Forest Management (if elected)	Cropland Management (if elected)	Grazing Land Management (if elected)	Revegetation (if elected)	Other	Total area at the beginning of the current inventory year
Article 3.3 activities	Afforestation and Reforestation	201.35	NO						201.35
	Deforestation		3.42						3.42
Article 3.4 activities	Forest Management (if elected)		NA	NA					NA
	Cropland Management (if elected)	NA	NA		NA	NA	NA		NA
	Grazing Land Management (if elected)	NA	NA		NA	NA	NA		NA
	Revegetation (if elected)	NA			NA	NA	NA		NA
Other		12.27	0.11	NA	NA	NA	NA	10 883.03	10 895.42
Total area at the end of the current inventory year		213.62	3.53	NA	NA	NA	NA	10 883.03	11 100.19

Table 251 Land transition matrix. Area change between the current and the previous year for 2012 (CRF NIR-2 table)

(kha)		Article 3.3 activities		Article 3.4 activities					
		Afforestation and Reforestation	Deforestation	Forest Management (if elected)	Cropland Management (if elected)	Grazing Land Management (if elected)	Revegetation (if elected)	Other	Total area at the beginning of the current inventory year
Article 3.3 activities	Afforestation and Reforestation	213.62	NO						213.62
	Deforestation		3.53						3.53
Article 3.4 activities	Forest Management (if elected)		NA	NA					NA
	Cropland Management (if elected)	NA	NA		NA	NA	NA		NA
	Grazing Land Management (if elected)	NA	NA		NA	NA	NA		NA
	Revegetation (if elected)	NA			NA	NA	NA		NA
Other		12.39	0.23	NA	NA	NA	NA	10 870.41	10 883.03
Total area at the end of the current inventory year		226.01	3.76	NA	NA	NA	NA	10 870.41	11 100.19

11.2.3 MAPS AND/OR DATABASE TO IDENTIFY THE GEOGRAPHICAL LOCATIONS, AND THE SYSTEM OF IDENTIFICATION CODES FOR THE GEOGRAPHICAL LOCATIONS

The database used to identify the geographical locations of the ARD activities is the NFI in Bulgaria. All measurements gathered in accordance with the forest inventory and FMP are mapped. Forest Inventory and FMP are carried out for each State Forest Enterprise. The SFE is divided into compartments and sub-compartments. The forest maps in Bulgaria are carried out for each State Forest Enterprise (SFE) as a result of the Forest Inventory (therefore, the maps are updated every 10th years for each SFE). The country territory is divided into almost 180 State Forest Enterprises. The territory of one SFE may include the territory of one or several municipalities. The area of one sub-compartment or forest management unit is between 1-25 ha, when forested. The area of the non-forested unit is 0,1 ha. The sub-compartments are defined based on uniformity of stands by species, age class structure, etc. According to Ordinance N 6 on the Forestry Planning and the Lands from the Forest Fund and the Game management Regions of Republic of Bulgaria (State Gazette 27 /2004) section 2 – Types of forest maps, forest maps are elaborated by SFE. The forest maps have unified consecutive numbering in the adopted geodesic coordinating system (BG, 2000), and contain information on areas or parts of them with permanent use as forests according to the Forest act. Forest maps are maintained separately by Forestry enterprises according to their FMP.

The forest maps give detailed data on:

- state boundary and all administrative boundaries in the scope of the particular map
- the boundaries of the urbanized areas
- the boundaries of the transportation areas
- the boundaries of the agricultural lands
- the boundaries of the State forestry enterprises and State game management areas and their subdivisions (forestry compartments and subcompartments)
- main and secondary watersheds
- roads, track and underground line facilities, within the boundaries of the forestry departments

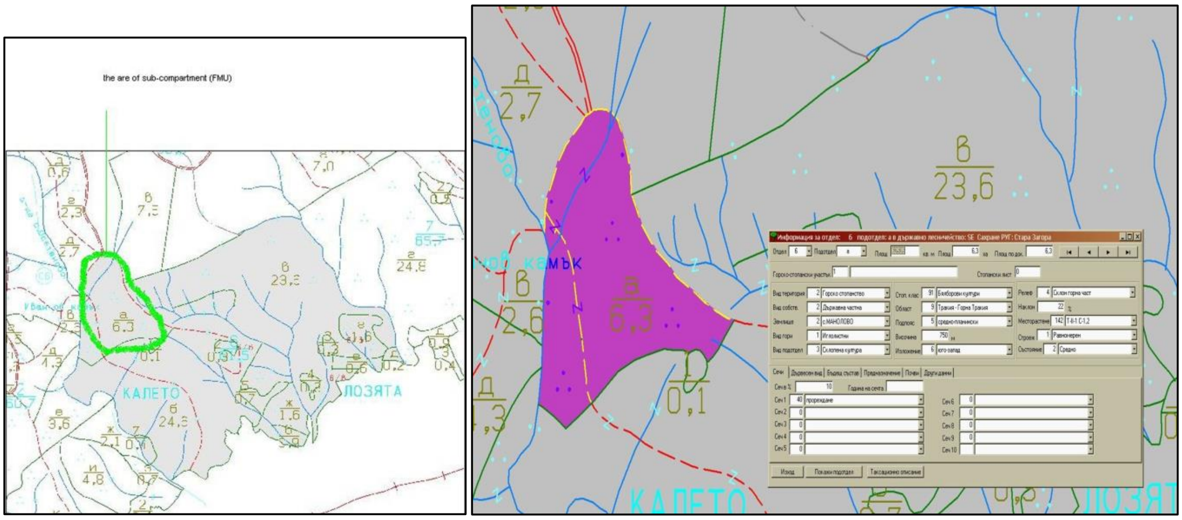


Figure 102 A map of one SFE (on left side), showing a forest land compartment (in grey colour) and a sub-compartment (green line). On the right side - the area of the sub-compartment and its details in a table

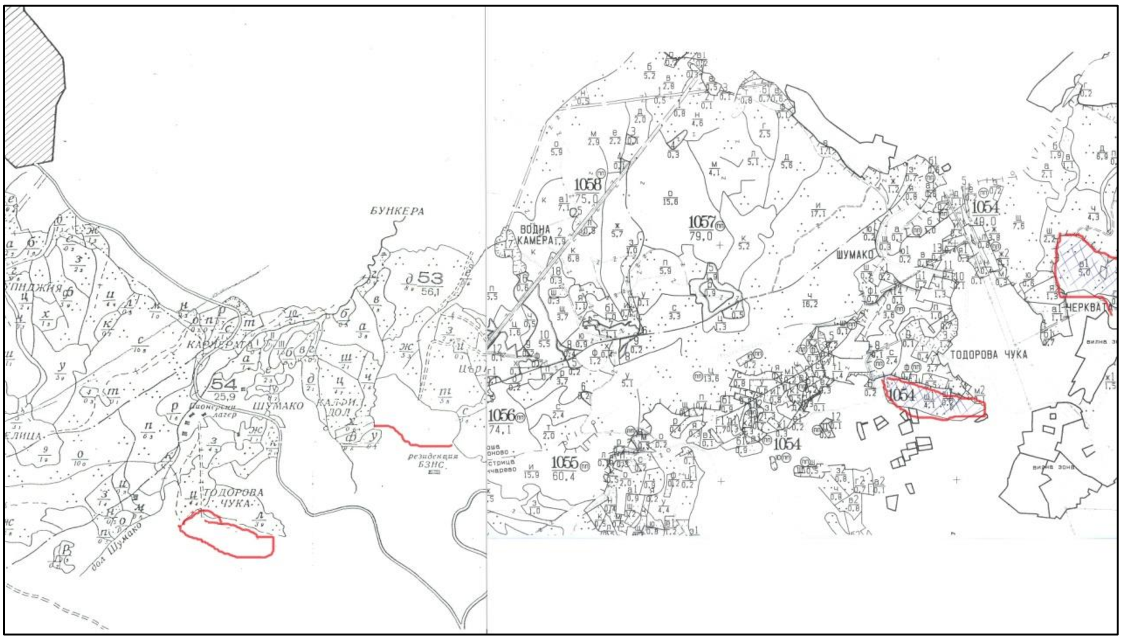


Figure 103 A map of the area of one SFE before (left) and now (right), which trace the changes in the forest land (in red).

11.3 ACTIVITY-SPECIFIC INFORMATION

11.3.1 METHODS FOR CARBON STOCK CHANGE AND GHG EMISSION AND REMOVAL ESTIMATES

11.3.1.1 Description of the methodologies and the underlying assumptions used

The methodologies and assumptions used for the reporting under the Kyoto Protocol Art. 3.3. follow completely those for the areas of LUCs from and to forests (see Chapter 7.2.4.2 Lands converted to Forest Land).

The emission factors were estimated in the following manner:

11.3.1.2 Biomass

Data for the tree volume stock for coniferous and deciduous species from different age classes is available for the years 1990, 1995, 2000, 2005 and 2010 according to FF reporting form 3 from NFI. Based on this data an average volume stock per ha for forest stands from Ist and IInd age class was estimated as weighed mean depending on the relative share of the stocks of the coniferous and the deciduous species. The average annual stock for the first age class is 6.28 m^3/ha/y obtained by dividing the average volume stock per ha for the first age class by average age of 10 years. Using the same approach the average annual stock for the IInd age class is determined of 12.16 m^3/ha/y.

There are no specific values for the biomass expansion factor (BEF_2) for converting the stemwood + branches stock into total aboveground biomass of the Ist age class. Since the Bulgarian NFI assesses also the stock of branches the biomass expansion factor does not need to account for this tree compartment, so BEF_2 has only to add the leaf biomass. To estimate this specific BEF_2 data from literary sources on results from ecosystem studies for Spruce, Scots pine, Beech and Oaks for the Ist age class stands were used (compiled in Korner et al.1993). The coefficients were recalculated as weighed mean according to the relative share of Spruce, Scots pine, Beech and Oak in the first and second age class of the Bulgarian forests Table 252 presents the values for BEF_2.

Table 252 Biomass expansion factor for converting stemwood +branches into total aboveground biomass (BEF_2) for the first and second age class

Types of forests	Coniferous	Deciduous
BEF2 first age class	1.10	1.08
Mean	1.09	
BEF2 second age class	1.09	1.05
Mean	1.07	

The weighed mean value for wood density (D) was estimated of 0.505 tonnes m^{-3} according to the wood stock of the single species.

For the ratio root-to-shoot of the young trees one coefficient is used (R=0.30). It is being calculated as weighed mean value of the coefficients used in the chapter Forest land Remaining Forest land according to the wood stock of coniferous and deciduous forests for the first age class.

The carbon fraction in the dry matter (CF) is adopted by default form the IPCC Good Practice Guidance for LULUCF and it is 0.5 tonnes C, due to the lack of national data.

Therefore, the calculated living biomass growth rates used for estimating biomass increment in AR is 2.25 t C/ha/yr for the first age class and 4.28 t C/ha/yr for the second age class. The biomass increment for the first age class (2.25 tC//ha/yr) is applied for forest cohorts up to 20 years, while the biomass increment for the second age class (4.28 tC/ha/yr) is applied for forest cohorts greater than 21 years.

For estimating biomass loss associated with deforestation, data from NFI on volume stock over bark was used. The data on volume stocks over the five years period since 1990 was expanded and converted with the related country specific (or default) expansion/conversion factors: wood density (0.43 t/m3 for coniferous, 0.60 t/m3 for deciduous), stemwood plus branches expanded to the whole aboveground tree biomass (1.08 for coniferous, 1.03 for deciduous), root-to-shoot ratios (0.32 for coniferous, 0.28 for deciduous) and C-content (0.50 t C/t d.m.). Then it was estimated the share of the coniferous and deciduous stocks in the total biomass stock for the respective years. Like this the weighted means for tree biomass stock were calculated. The means were used for estimating biomass loss from deforestation for the years across the time series.

Table 253 Living forest biomass stocks which are used to calculate emissions from deforestation

		1990	1995	2000	2005	2010
Weighted mean tree biomass stocks	tC/ha	37.71	43.29	47.82	51.66	55.34

For the biomass growth on settlements after deforestation the following values were taken: 0.09 $tCha^{-1}y^{-1}$ and 0.03 $tCha^{-1}y^{-1}$ for annual and perennial plants respectively. Growth of annual plants is accounted only in the year of D, while the growth of the perennial plants at the D areas continues. The annual biomass growth for annual and perennial plants is calculated on the basis of the share of the green areas in the settlements in Bulgaria (2.63% according to study for Sofia) and the following growth rates: for perennials (trees, bushes) it is 1.2 t C/ha.y, and for the annual plants – 3.3 t C/ha.y. These growth rates have been derived from a detailed biomass study for Vienna (and is also used for the related estimates in Austria).

11.3.1.3 Dead wood

Due to the young age of the forests at the AR areas it is assumed that there is no dead wood and there is no change in this carbon stock at AR areas. If there was any in the young forests of AR areas it would represent a C stock increase due to the lack of dead wood in the previous land uses. So, the assumption is conservative.

For estimating changes in DW stock due to deforestation activity it was assumed that the dead wood stocks is equal to 5% of the standing biomass stock of the Bulgarian forests. This is a percentage magnitude for dead wood that is frequently reported for managed forests in Europe. The resulting values are given in the table below.

Table 254 Dead wood stocks used for estimating the changes in DW pool after deforestation

		1990	1995	2000	2005	2010
DW stock	tC/ha	1.89	2.16	2.39	2.58	2.77

11.3.1.4 Litter

According to IPCC definition litter pool includes all non-living biomass in a various state of decomposition, so this means – litter layer (fresh dead plant material), fumic and humic layers. As it was explained in chapter Forest remaining forest, changes in carbon stock in soil the source of information in order to estimate a country specific value for the carbon stock in litter is EEA-MOEW. The database resulted from the implementation of the ICP "Assessment and Monitoring of Air Pollution Effects on Forests"-UN/ECE Convention on Long Range Transboundary Air Pollution.

When analysing carbon content in litter Bulgaria follows ICP Forests Manual methodological approach http://www.icp-forests.org/pdf/FINAL_soil.pdf (see Annex 7 Soil horizon designation p.195) where litter definition is:

> OL-horizon (Litter, Förna): this organic horizon is characterised by an accumulation of mainly leaves/needles, twigs and woody materials (including bark), fruits etc. This sublayer is generally indicated as litter. It must be recognized that, while the litter is essentially unaltered, it is in some stage of decomposition from the moment it hits the floor and therefore it should be considered as part of the humus layer. There may be some fragmentation, but the plant species can still be identified. So most of the original biomass structures are easily iscernible. Leaves and/or needles may be discoloured and slightly fragmented. Organic fine substance (in which the original organs are not recognisable with a naked eye) amounts to less than 10 % by volume.

According to IPCC-GPG definition this represents the "litter layer" (a horizon consisting of relatively fresh dead plant material). For Bulgaria there is no data gathered for the carbon content in this layer during the soil surveys. However, since the changes in biomass fully account for all leaves and needles (the tree biomass estimates accounts for these pools) that represent the material of the litter layer within one year. Any further accounting of this material would end in double accounting.

OF-horizon (fragmented and/or altered) is a zone immediately below the litter layer. This organic horizon is characterised by an accumulation of partly decomposed (i.e. fragmented, bleached, spotted) organic matter derived mainly from leaves/needles, twigs and woody materials. The material is sufficiently well preserved to permit identification as being of plant origin (no identification of plant species).The proportion of organic fine substance is 10% to 70% by volume. Depending on humus form, decomposition is mainly accomplished by soil fauna (mull, moder) or cellulose-decomposing fungi. Slow decomposition is characterised by a partly decomposed matted layer, permeated by hyphae.

OH-horizon (humus, humification): characterised by an accumulation of well-decomposed, amorphous organic matter. It is partially coprogenic, whereas the F horizon has not yet passed through the bodies of soil fauna. The humified H horizon is often not recognized as such because it can have friable crumb structure and may contain considerable amounts of mineral materials. It is therefore often misinterpreted and designated as the Ah horizon of the mineral soil and not as part of the forest floor as such. To qualify as organic horizon, it should fulfil the FAO requirement, as described above. The original structures and materials are not discernible. Organic fine substance amounts to more than 70% by volume. The OH is either sharply delineated from the mineral soil where humification is dependent on fungal activity (mor) or partly incorporated into the mineral soil (moder).

According to the ICP Forests Manual samples are taken separately for the different depth. OH and OF layers should be sampled together (see Table 5, p. 15 ICP Forests Manual). The data is available for each depth

The estimation for the model carbon stock in litter pool is based on data for carbon content in OFH layers available for the years 2000 – 2002. According to the data available it was estimated that the carbon stock in litter is 5.38 tC/ha.

11.3.1.5 Soil

Emissions/removals of carbon stock in the mineral soils due to AR were evaluated through the annual change in the carbon stock at the AR areas using the equation:

$$\Delta C_{LFmineral} = \frac{[(SOC_{ref} - SOC_{non-frest\ land}) \cdot A_{aff}]}{T_{aff}}$$

where:

$\Delta C_{LFmineral}$ - annual change in the carbon stock in mineral soils in the year of assessment, tonnes C/yr

SOC_{ref} – stable carbon stock in forests for a certain soil type, tonnes C/ ha

$SOC_{non-frest\ land}$ - stable carbon stock in the soil of the previous type of land-use (croplands, grasslands and other lands), tonnes C/ ha

A_{aff} - total af-/reforestated area after the conversion, ha

T_{aff} - duration of the transition from SOC Non forest Land to SOCref, yr

The used transition period was 20 years according to IPCC GPG.

For the stable stock of organic carbon in soils (0-40 cm) from forest ecosystems (SOCref) a country specific value is used = 78.3 t C/ha.

For the stable stock of organic carbon in soils (0-40 cm) of previous types of land-use the country specific values obtained for annual or perennial cropland, grassland and other land are used:

- annual crops: 89.9 t C/ha
- perennial crops: 76.5 t C/ha
- grasslands: 103.57 t C/ha
- other land: 0 t C/ha

For C stock changes in soils of D areas the same approach and values as for AR areas were used, but with an appropriate reverse equation. The soil C stock (0-40 cm) used for settlements is:

- Settlements: 2.5 t C/ha

A description of the methods of deriving all these soil C stocks can be found in the respective chapters of these subsectors.

11.3.1.6 Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4

No carbon pool is omitted.

Deadwood is assumed not to occur on AR areas. Due to the young age of the forests at AR areas (since 1990) and the assumed lack of dead wood at areas of all other land uses it is assumed that a stock change of dead wood does not occur at AR areas. If there was any in the young forests of AR areas it would represent a C stock increase due to the lack of dead wood in the previous land uses. So, the assumption is conservative.

There is no practice of biomass burning at ARD areas in Bulgaria. Furthermore, forests are not fertilised and liming does not exist in Bulgaria. So, fertilisation at AR areas and liming at ARD areas do not occur.

11.3.1.7 Information on whether or not indirect and natural GHG emissions and removals have been factored out

Due to a lack of available methods in the IPCC GPG and elsewhere, indirect and natural GHG emissions/removals have not been factored out.

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

Details on changes in data and method are given in Chapter 11.2.1

11.3.1.9 Uncertainty estimates

The uncertainties associated with the emissions/removals from art. 3.3 activities have been calculated by using Tier 2 method – Monte Carlo simulation. The results of the assessment are presented in ANNEX 7.

11.3.1.10 Information on other methodological issues

The methods used to estimate emissions/removals from ARD activities are of the same tier method as those used for the UNFCCC reporting.

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

In 2012 the following ARD activities were presumed: AR at 12 390 ha, D at 229 ha.

11.4 ARTICLE 3.3

11.4.1 INFORMATION THAT DEMONSTRATES THAT ACTIVITIES UNDER ARTICLE 3.3 BEGAN ON OR AFTER 1 JANUARY 1990 AND BEFORE 31 DECEMBER 2012 AND ARE DIRECT HUMAN-INDUCED

Changes in forest area are traced only after a forest inventory has been performed. Bulgaria reports the following AR activities that occurred on or after 1990:

- Planted or seeded on grasslands and croplands(97% from the total AR units of land due to planting and seeding on GL and around 1% on CL)
- Planted or seeded on other land for protective purposes (i.e erosive lands – around 2% from the total AR units of land due to planting and seeding)
- Abandoned lands – cropland and grassland which are naturally regrown as forest (20% from the total AR units of land due to regrowth on croplands and 80% - regrowth on GL

Table 255 Identified net AR units of land for the period 1992-2012 for each district in Bulgaria

District	Regrowth in ha. 1992-2000	Regrowth on CL	Regrowth on GL	Regrowth in ha 2001-2012.	Regrowth on CL	Regrowth on GL	Planted or manually seeded in ha 1992-2000	Planted, seeded on CL	Planted, seeded on GL	Planted, seeded on erosive areas	Planted or manually seeded in ha 2001-2012	Planted, seeded on CL	Planted, seeded on GL	Planted, seeded on erosive areas
Vidin	**1508**	257	1251	**8560**	2072	6488	**620**	-	496	124	**27**	-	27	-
Montana	**567**	186	381	**2301**	294	2007	**60**	-	56	4	**2343**	-	2313	30
Vrats	**2397**	330	2067	**1934**	121	1813	**757**	12	735	10	**670**	-	624	46
Pleven	**4767**	1656	3111	**3199**	576	2623	**973**	122	851	-	**40**	-	40	-
Lovech	**660**	85	575	**8339**	827	7512	**348**	-	321	27	**3865**	-	3841	24
Gabrovo	**2852**	973	1879	**9245**	2370	6875	**35**	-	35	-	**18**	-	18	-
Veliko Tarnovo	**17**	-	17	**13037**	1440	11597	**715**	15	689	11	**1639**	-	1597	42
Rousse	**-**	-	-	**2643**	303	2340	**-**	-	0	-	**3573**	-	3569	4
Targovishte	**1864**	566	1298	**1898**	431	1467	**903**	25	864	14	**804**	-	804	-
Shumen	**851**	33	818	**3724**	568	3156	**1472**	4	1421	47	**41**	-	41	-
Razgrad	**-**	-	-	**665**	45	620	**775**	5	770	-	**1235**	-	1213	22
Silistra	**158**	67	91	**1614**	209	1405	**341**	-	341	-	**1646**	-	1643	3
Dobrich	**149**	-	149	**1132**	138	994	**4831**	20	4767	44	**621**	-	621	-
Varna	**873**	398	475	**980**	257	723	**1066**	1	1031	34	**718**	-	714	4

District	Regrowth in ha. 1992-2000	Regrowth on CL	Regrowth on GL	Regrowth in ha 2001-2012.	Regrowth on CL	Regrowth on GL	Planted or manually seeded in ha 1992-2000	Planted, seeded on CL	Planted, seeded on GL	Planted, seeded on erosive areas	Planted or manually seeded in ha 2001-2012	Planted, seeded on CL	Planted, seeded on GL	Planted, seeded on erosive areas
Burgas	**2034**	469	1565	**6996**	1172	5824	**1208**	6	1175	27	**640**	-	636	4
Yambol	**232**	61	171	**831**	125	706	**194**	-	189	5	**736**	-	724	12
Sliven	**568**	214	354	**1341**	222	1119	**636**	-	622	14	**76**	-	76	-
Stara Zagora	**746**	174	572	**1560**	213	1347	**1258**	5	1218	35	**353**	-	344	9
Haskovo	**1405**	509	896	**5505**	480	5025	**857**	3	806	48	**2409**	-	2405	4
Kardjali	**9**	4	5	**43**	10	33	**52**	1	49	2	**25**	-	24	1
Smolyan	**3176**	644	2532	**6769**	843	5926	**337**	-	324	13	**404**	-	401	3
Plovdiv	**2264**	416	1848	**5445**	386	5059	**2148**	16	2058	74	**678**	-	670	8
Pazardjik	**466**	65	401	**1286**	88	1198	**1170**	9	1131	30	**493**	-	481	12
Blagoevgrad	**1807**	445	1362	**6640**	857	5783	**2709**	15	2669	25	**1858**		1795	63
Kustendil	**1378**	410	968	**6937**	614	6323	**407**	10	373	24	**525**	-	509	16
Pernik	**1537**	214	1323	**2581**	335	2246	**4971**	51	4859	61	**381**	-	358	23
Sofia	**1126**	234	892	**11589**	1694	9895	**183**	-	183	-	**3326**	6	3164	156
Total	**33411**	8410	25001	**116794**	16690	100104	**29026**	320	28033	673	**29144**	6	28652	486

Table 256 Total AR estimates for the period 1990-2012

Years	AR	FLx - FLx-1	Planted or manually seeded (kha)	Naturally seeded (kha)	Dx
1992-2012	211.94	208.38	58.17	150.21	3.57
1991	6.99	6.94	3.23	3.71	0.05
1990	7.08	6.94	3.23	3.71	0.15
Total	226.01	222.25			3.76

According to the Annex of Decision 16/CMP.1 art. 1 b) and c)[39] natural A/Rs occurred on abandoned arable lands have to be reported under art. 3.3. as this forest regeneration is based on a human induced promotion. Bulgaria reports these units of land consistent with the requirements. The re-growth in this case is the result of the direct human induced stop of the agricultural management at these lands, which in fact leads to a direct human induced natural seeding from the adjacent forests and (re-)growth of managed forests (all forests in Bulgaria are managed and reported as such).

According to IPCC GPG 2003 it is good practice to provide documentation that all A/R activities included in the identified units of land are direct-human induced. "Relevant documentation includes forest management records or other documentation that demonstrates that a decision had been taken to replant or to allow forest regeneration by other means." This requirement is described in the Annex of Decision 15/CMP.1 art.8 a).

As it is described in the NIR on 11.2.2, all units of land subject to AR activities are identified from the revision of all Forest Management Plans for all State Forest Enterprises (SFE) in Bulgaria. The new forest area identified and reported as AR units is included in FMPs, which by itself is evidence that the AR area is direct-human induced. FMPs are considered by Bulgaria as documentations that demonstrate human induced activity. In addition to this, there is a specific administrative procedure when as a result of the forest inventory assessment an agricultural land (e.g CL and Gl) is identified as becoming a forest. The basics of this procedure is the owner's decision (please see art. 83 and 84 from the Forest Law 2011(last amendment 07.08.2012, SG №60). In the case when the new forest is less than 10 years old the land owner is informed on the risk of conversion of the agricultural land into forest land. If the land owner decides to keep the former agricultural land under agricultural use, he has to submit a declaration to the Executive director of the Executive Forest Agency. After the submission of the declaration, in 3 years term, the land owner is

[39] *"Afforestation" is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources*
"Reforestation" is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1

obliged to cut the re-grown forest vegetation and return the land into an active status of agricultural management. As a consequence of this procedure, it can be assumed that the lack of back conversion of such new forests into agricultural lands afterwards represents clear evidence for the nature of a land owner's decision of an intended land use change into forests.

According to the Forest Act 2011 this procedure is described in the following articles:

Art. 83. (1) Where as a result of the inventory of forest territories it is established, that the farm territories have acquired characteristics of a forest in the meaning of this law, the persons, who have performed the inventory shall produce to the Executive director of the a list of the properties upon the lands of the populated areas.

(2) The list under Para. 1 shall be published in one local and one central daily newspaper and shall be announced in public on the internet site of the relevant regional administration, Regional directorate of forests and the Executive Forest Agency.

(3) On the basis of the list under Para. 1, the Executive director of the Executive Forest Agency or an official, authorized by him shall invite in writing the owners of the relevant properties to declare if they wish to use their properties as farm or forest territories.

*(4) **Within 6-month term** from receiving the invitation under Para. 3, the owner, **who wishes to use his property as a farm territory** shall submit a declaration to the Executive director of the Executive Forest Agency.*

(5) If the owner fails to submit a declaration within the term under Para. 4, the Executive director of the Executive Forest Agency shall propose to the Minister of Agriculture and Food to issue an order for change of function of the properties as forest territory. The proposal shall describe the size of the properties, the type and origin of the forest and a plan of the property shall be attached from the map of the restored ownership or from the cadastre map and taxation characteristics.

(6) The order under Para. 5 shall be sent to the owner, to the relevant Regional directorate of forests, as well as to the relevant Office of geodesy, cartography and cadastre – for reflecting the change in the cadastre map and cadastre registers, or to the Municipal office of agriculture – for reflecting the change in the map of the restored ownership.

(7) The provisions of Para. 1 – 6 shall not apply to territories, provided to sites of the national security and defence.

Art. 84. (1) Where as a result of the inventory of the forest territories it is established, that farm territories have acquired the characteristics of a forest in the meaning of this law and the owner declares in writing before the Executive director of the Executive Forest Agency that he wishes to use his property as a farm territory within the term of 3 years from submitting the declaration he shall be obliged to clean his property from the forest timber vegetation.

(2) In case that within the term of Para. 1 the owner fails to clean his property from forest-timber vegetation, the provision of Art. 83, Para. 4 – 6 shall apply.

(3) Notwithstanding of the inventory under Para. 1, unfit for farm use territories may be included on the forest territories on the basis of a written application of the owner under Art. 83, Para. 5 and 6

When the new forest is older than 10 years, then this forested area belongs to the Forest Fund at once and the land owner cannot change the designation.

The old Forest Act did not contain specific procedure as the one described in the Forest Act 2011. However, under the old Forest act (1997-2011) the following have been taken into account:

The Forest Act (1997-2011) defines the term "Forest" (*"Art. 2. (1) (amend. SG 16/03) Forest, in the context of this law is the land occupied by forest ligneous plants with area not less than 1 decare*."). The Forest Act regulates the way of use and management of forests. The purpose of the law is ensuring the protection of the forest territory and increasing the area covered by forest. The subject of the Act includes only forest land and land within the Forest Fund and their management is done in accordance with the Forest management plans, programs and projects, as prescribed in Regulation № 6 on the structure of the forests and land included in the forest fund and the hunting reserves of Republic of Bulgaria. For the purpose of the management of the forests in the Forest management plans, programs and projects and the relevant reports that are integral part of them, all Afforestation and Reforestation activities in the Forest Fund are described in the Forest Act (1997-2011) (art.42(1)

Art. 42. (amend. SG 16/03) (1) (amend. – SG 64/07; amend. – SG 80/09) The afforestation in the forest fund shall be carried out according to the forest development projects, technical projects for fighting with the erosion and landslides, plans and programs under the conditions and by the order, determined with ordinance by the Minister of Agriculture and Food.

In cases when as a result of the natural regrowth agricultural land has become forest and has met definition of "forest" given by the Forest Act, this area should be managed as forest and is subject to forest inventory and therefore included in FMPs.

(*§ 9. (new – SG 28/92) Farm lands, in which the right of ownership has been restored by the order of art. 10 of this law and which are forests in the sense of the Law of the forests, shall be subordinated to the regime of the Law of the forests and the Law of the hunting economy(**LAW OF THE OWNERSHIP AND THE USE OF THE FARM LAND**)*

As regards Deforestation activities, Forest Act clearly inscribes all cases in which forest is taken out of the Forest Fund (existing woods). This is followed by LUC and they are transformed from forested to non-forested lands. The procedure for taking out of the Forest Fund is given in the Forest Act (please see the respective articles below). **Therefore all changes in the function or designation of the forests are considered as deforestation and are reported as such.**

All forests in Bulgaria are protected by the Forest Act.

Art. 3. (1) Decreasing the existing woods shall not be allowed:

1. on the territory of the Republic of Bulgaria;

2. on the territory of Municipalities, in which the woods are under 10%.

Forest Act (2009):

*Art. 14. (amend. SG 16/03) (1) Forests and lands of the forest fund **shall be excluded at change of their designation for:***

1. plots for construction of power plants, dams and other hydro-technical and electric-technical facilities, obtaining of underground resources, graveyard parks, waste depots, re-loading stations;

2. tracks for linear sites;

a) located on the surface of the terrain – roads, railways, water canals, cable cars, draglifts and other facilities for technical infrastructure;

b) located under the surface of the terrain – oil pipelines, gas pipelines, heat conduits and water supply pipeline with cross section over 1500 mm;

3. creating of new or expansion of the construction boundaries of existing urbanized territories (settlements and settlement formations), as well as creating or expanding of the boundaries of separate regulated landed properties out of them;

4. (amend. – SG 64/07) creating of new or expanding of the construction boundaries of existing urbanized territories (settlements and settlement formations), as well as creating or expanding of the boundaries of separate regulated landed properties out of them in the cases when disposing actions with payment have been implemented with forests and lands of the state forest fund, in which till March 1, 2003 construction has been implemented in the sense of art. 12 of the Law of Spatial Planning;

5. creating of lands for agricultural use from land not producing timber in the state forest fund;

6. sites, connected with the national security, the defence of the country, the preservation and the reproduction of environment.

(2) The exclusion of forests and lands from the forest fund after fire shall be prohibited for a term of 20 years.

(3) Para 2 shall not be applied in the several cases:

1. when the change of the designation is connected with the defence or the security of the country;

2. when the change of the designation is connected with the fulfilment of investment projects, approved by the Council of Ministers.

Procedure for exclusion:

Art. 14d. (new – SG 16/03) (1) (amend. - SG 30/06, in force from 12.07.2006; amend. – SG 64/07; amend. – SG 54/08; amend. – SG 80/09) ***The Minister of Agriculture and Food upon proposal by the Executive director of the Executive Agency of Forests shall issue an order for excluding of the forests and the lands from the forest fund or propose to the Council of Ministers to take decision***

Forest Act 2011

Art. 73. (1) Change of the function of land properties in forest territories shall be admitted for:

1. grounds for construction of transport equipment (ports, airports, railway stations, bus-stations) production undertakings, extraction of ores and minerals, graveyards, waste depots, waste banks, depositories, electric power stations, damps, purifying stations for drinking or waste waters and other hydro-technical and electro-technical equipment, with the exception of the fundaments of the electric line posts;

2. permanent ways of line objects, placed on the surface of the ground – roads and railway lines, including the equipment to them, water canals;

3. creating new or expanding construction borders of existing urban territories in the cases where there are adopted general territorial plans of the Municipalities or parts of them, in which the properties are situated;

4. creating or expanding separate regulated land properties, which are not state ownership, for which there is an enforced general territorial plan;

5. national sites in the meaning of the Law on State ownership, sites, related to the national security and defence of the country, to the environment protection, for whose construction there is a Council of Ministers decision, as well as Municipal sites of first importance in the meaning of the law on the Territory Planning;

6. construction of posts for lifts and tow-lifts, as well as basic equipment of the wind-generators and photo-voltaic parks;

7. construction of ski-tracks.

Procedure for exclusion:

*Art. 74. (1) **Change of function of land properties in forest territories – public state ownership shall be done by a Council of Ministers decision upon proposal of the Minister of Agriculture and Food. The change of function of forest territories – public state ownership shall be done only for construction of sites, which are state or Municipal ownership.***

(2) The change of function of land properties in forest territories apart from the ones, indicated in Para. 1 shall be done:

1. by a commission in the Regional directorate of forests – for land properties in forest territories with area up to 50 decares falling in the territorial scope of activity of the relevant Regional directorate of forests;

2. by a commission in the Executive Forest Agency – for land properties in forest territories apart from the ones, indicated in Para. 1 and in p. 1.

*Art. 75. (1) **For a change of the function of land properties in forest territories the owner or investor shall make a request for preliminary coordination before:***

1. The Minister of Agriculture and Food – for land properties in forest territories – public state ownership;

2. the relevant commission under Art. 74, Para. 2 – for land properties in forest territories apart from the ones, indicated in p. 1.

(2) The request for preliminary coordination for change of function of land properties in forest territories shall have attached the following documents:

1. a plan of the property from the cadastre map or from the map of the restored ownership, coordinated by the Relevant regional directorate of forests upon location of the property;

2. an approved task for development of a detailed territory plan, drawn up in compliance with the provisions of the Law on the Territory Planning;

3. a Municipal council decision – for land properties in forest territories – ownership of Municipalities.

11.4.2 INFORMATION ON HOW HARVESTING OR FOREST DISTURBANCE THAT IS FOLLOWED BY THE RE-ESTABLISHMENT OF FOREST IS DISTINGUISHED FROM DEFORESTATION

According to the Forest act in Bulgaria all forests are managed.

The forests and the lands of the forest fund shall be constructed, managed and used according to forest development projects, plans and programs. To develop forest management plans (FMP), projects and programs information from NFI is used.

According to the Forest Law (last amendment SG №66/2013) all harvest activities in the forests and lands with forest are planned under the FMP.

Art. 101. (1) Felling shall be conducted for restoration, growing and improving the conditions of forests and for achieving the objectives, laid down in the forestry plans and programmes.

(3) The Minister of Agriculture and Food shall adopt an Ordinance, which shall determine:

Art. 102. Restoring felling shall be conducted at an age not smaller than:

1. 60 years in high-stem forests with the exception of birch and poplar trees, as well as the artificially created plantations out of their natural region of spreading;

2. 20 years and not bigger than 30 years in forests for sucker restoration;

3. 15 years for acacia forests.

Clear cuttings are forbidden by Law.

Art. 104. (1) It shall be prohibited:

1. conducting clear fell in all the forests with the exception of the poplar and low-stem forests;

When there is forest disturbance the owner of the forest should replant the area if it cannot be restored by naturally up to 7 years.

Art. 97. (1) Wood-cutting areas and burned out areas, which cannot be restored naturally up to 7 years after the timber cutting or burning during fire shall be planted by their owner up to 2 years after expiry the 7-year period.

(2) Where the forestry plan or programme envisages restoration in an artificial way, the forestation shall be done within the term of 3 years after cutting the plantation.

It is forbidden by the Law to convert burnt by wildfires area to other land use during the 20 years period after the damage, caused by wildfires.

The delimitation between deforestation[40] and harvesting and forest disturbance is taking into account when Bulgaria reports under the KP. As it was described above there are some obligations by the Law according to harvesting and replanting of the forest area in order to keep the forest fund stable. When there is a plan or a need to convert forest land to non-forest land – according to the Law the owner should exclude the forest area from the forest fund (see chapter 11.4.1).

11.4.3 INFORMATION ON THE SIZE AND GEOGRAPHICAL LOCATION OF FOREST AREAS THAT HAVE LOST FOREST COVER BUT WHICH ARE NOT YET CLASSIFIED AS DEFORESTED

In Bulgaria forests are managed and utilized based on forest management plans, projects or programs. According to this, all activities like felling are planned and described in detail. All

[40] (15/CMP.1 (par.8.b) "Deforestation" is the direct human-induced conversion of forested land to non-forested land.)

felling activities are carried out under the Regulation for fellings. The regulation describes the type of fellings and specifies the conditions in which fellings are carried out.

Deforestation needs administrative steps as described above, so there are only two possibilities 1) Forest areas that have lost forest plant cover (e.g. clear cut areas, damaged areas): These areas remain forests by law, and there is no transition to non-forest situation of such areas allowed (obligations for replanting etc., Art. 97. (1) Forest act SG66/2013). 2) Deforestation areas that followed all administrative steps needed to get the permission for deforestation. Only such areas are accounted as D areas in Bulgaria.

The Regulation for felling sets up the following cuttings:

1) Renewable
   - Gradual
   - Selective
   - Clear
2) Thinning
3) Other

When any harvest is conducted the requirements for the density of the stand should be obeyed where the density is different with the different types of harvests, but no less than 0.4, which is within the framework of the Forest Definition of the KP and thus reported as Forest.

As regards clear cuts they are only done in the cases described down here and obligatory followed by afforestation:

Art. 104. (1) It shall be prohibited:

1. conducting clear fell in all the forests with the exception of the poplar and low-stem forests;

Art. 97. (1) Wood-cutting areas and burned out areas, which cannot be restored naturally up to 7 years after the timber cutting or burning during fire shall be planted by their owner up to 2 years after expiry the 7-year period.

(2) Where the forestry plan or programme envisages restoration in an artificial way, the forestation shall be done within the term of 3 years after cutting the plantation.

11.5 ARTICLE 3.4

11.5.1 INFORMATION THAT DEMONSTRATES THAT ACTIVITIES UNDER ARTICLE 3.4 HAVE OCCURRED SINCE 1 JANUARY 1990 AND ARE HUMAN-INDUCED

NA for Bulgaria

11.5.2 INFORMATION RELATING TO CROPLAND MANAGEMENT, GRAZING LAND MANAGEMENT AND REVEGATATION, IF ELECTED, FOR THE BASE YEAR

NA for Bulgaria

11.5.3 INFORMATION RELATING TO FOREST MANAGEMENT

NA for Bulgaria

11.6 OTHER INFORMATION

11.6.1 KEY CATEGORY ANALYSIS FOR ARTICLE 3.3 ACTIVITIES AND ANY ELECTED ACTIVITIES UNDER ARTICLE 3.4

Table 257 Key category analysis

Category	Net CO_2	Abs	%	sum
Grassland converted to Forestland	-813,28	813,28	66,2	66,2
Annual Cropland converted to Forestland	-273,34	273,34	22,2	88,4
Other land converted to Forestland	98,91	98,91	8,0	96,4
Forestland converted to Settlement	-34,12	34,12	2,8	99,2
Perennial Cropland converted to Forestland	9,52	9,52	0,8	100,0
Total emissions/removals		1229.17758		

11.7 INFORMATION REGARDING TO ARTICLE 6

NA for Bulgaria

12 INFORMATION ON ACCOUNTING OF KYOTO UNITS

12.1 BACKGROUND INFORMATION

Annex I parties are required to report from its national registry holding of and transaction of Kyoto Protocol units and inform about related issues as specified in Decision 15/CMP.1 Section E. Information about the transactions of the Kyoto-units is attached in to this document.

12.2 SUMMARY OF INFORMATION REPORTED IN THE SEF TABLES

The Standart Electronic Format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for 2012 is submitted (April 2013).

The SEF has been generated with the SEF application version 1.2.1, provided by the secretariat at 30 January 2013.

12.3 DISCREPANCIES AND NOTIFICATION

Further information on Kyoto Protocol units referning to the respective paragraphs on decision 15/CMP 1 will be reported.

Paragraph 12: Discrepancies identified by the transaction log;

No discrepant transaction for the reporting period, pursuant of 15/CMP.1 annex I.E paragraph 12.

Paragraph13 & § 14: No CDM notifications occurred in 2013;

No CDM notifications were received by the National Registry during the reporting period, pursuant of 15/CMP.1 annex I.E paragraph 13 & 14.

Paragraph 15: No non–replacements occurred in 2013;

No non-replacements occurred during the reporting period,pursuant of 15/CMP.1 annex I.E paragraph 15.

Paragraph16: No invalid units exist as at 31 December 2013;

No invalid units exist for the reporting period, pursuant of 15/CMP.1 annex I.E paragraph 16

Paragraph 17: Actions necessary to correct any problem causing a discrepancy.

No actions were taken or changes made to address discrepancies for the period under review;

12.4 PUBLICLY ACCSSIBLE INFORMATION

Section E of the annex to decision 15/CMP.1 outlines provisions for the national registry to support, via a user-interface, non-confidential information being made available to the public. Bulgaria has made this information available on the former Registry's website which was fully operational until May 2012 year:

http://bg-server1.etr.moew.government.bg/

On 20 June 2012 year after the go-alive and the successful migration of the data from the National registry to the Bulgarian registry successfully launched it's work as part of the Union registry.

The new internet address of the Bulgarian registry in the Union registry is:

https://ets-registry.webgate.ec.europa.eu/euregistry/BG/index.xhtml

The following information has been made accessible to the public in line with the requirements That this information is non-confidential. Bulgaria considers all information to be confidential that is determined to be confidential according to article 75 of the EU Registry Regulation No 920/2010/EC. Accounts holding's publicly accessible information:

http://bg-server1.etr.moew.government.bg/iaos/contacts.php

The registry terms and conditions, operators guide, forms and guidance for opening the holding accounts are available at the website of Executive Environment Agency:

http://eea.government.bg/bg/about/rr/r-te/registry/doc.html

Joint implementation (JI) projects' publicly accessible information:

http://bg-server1.etr.moew.government.bg/iaos/projects.php

The information of approved Joint Implementation projects and their documentation is added on the website of the competent authority (Ministry of the Environment and Waters) of JI projects and can be downloaded from the following link:

http://www3.moew.government.bg/?show=top&cid=357&lang=en

Information according to paragraph 45 - 48 of the annex to decision 13/CMP.1:

(a) Account name: the holder of the account

(b) Account type: the type of account (holding, cancellation or retirement)

(c) Commitment period: the commitment period with which a cancellation or retirement account is associated

(d) Representative identifier: the representative of the account holder, using the Party identifier (the two-letter country code defined by ISO 3166) and a number unique to that representative within the Party's registry

(e) Representative names nominated by the account holder and authorized to work with the account.

The Information includes the following Article 6 project information, for each project identifier if the Party has issued ERUs for a project:

(a) Project name: a unique name for the project

(b) Project location: the Party and town or region in which the project is located

(c) Years of ERU issuance: the years in which ERUs have been issued as a result of the Article 6 project

(d) Reports: downloadable electronic versions of all publicly available documentation relating to the project, including proposals, monitoring, verification and issuance of ERUs, where relevant, subject to the confidentiality provisions in decision 9/CMP.1.

The information includes the following holding and transaction information relevant to the national registry, by serial number, for each calendar year:

(a) The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year (displayed in the year X+5, according to EU Registry Regulation No 920/2010/EC the information is confidential until the year X+5)

(b) The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3, paragraphs 7 and 8 (displayed in the year X+1)

(c) The total quantity of ERUs issued on the basis of Article 6 projects (displayed in the year X+1)

(d) The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries and the identity of the transferring accounts and registries (displayed in the year X+5, according to EU Registry Regulation No 920/2010/EC the information is confidential until the year X+5)

(e) The total quantity of RMUs issued on the basis of each activity under Article 3, paragraphs 3 and 4 (displayed in the year X+1)

(f) The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries and the identity of the acquiring accounts and registries (displayed in the year X+5, according to EU Registry Regulation No 920/2010/EC the information is confidential until the year X+5)

(g) The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3, paragraphs 3 and 4 (displayed in the year X+1)

(h) The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1 (displayed in the year X+1)

(i) The total quantity of other ERUs, CERs, AAUs and RMUs cancelled (displayed in the year X+1)

(j) The total quantity of ERUs, CERs, AAUs and RMUs retired (displayed in the year X+1)

(k) The total quantity of ERUs, CERs, and AAUs carried over from the previous commitment period (displayed in the year X+1)

(l) The Information does not include current holdings of ERUs, CERs, AAUs and RMUs in each account because this is confidential according to EU Registry Regulation No 920/2010/EC.

The information includes a list of legal entities authorized by the Party to hold ERUs, CERs, AAUs and/or RMUs under its responsibility.

12.5 CALCULATION OF THE COMMITEMENT PERIOD RESERVE CPR

According to paragraph 6 of the annex of decision 11/CMP.1 each Party included in Annex I shall maintain, in its national registry, a commitment period reserve which should not drop below of the Kyoto Protocol, or 100 per cent of five times its most recently reviewed inventory, whichever is lowest.

Bulgaria's assigned amount was fixed at 610 045 827 tonnes CO_2 equivalent in its initial review report (FCCC/IRR/2007/BGR)[41].

Bulgaria calculated the Commitment Period Reserve (CPR) 305 228 132,0 CO_2 eq in accordance with a Decision 11/CMP.1 Annex Paragraph 6:
90% of the assigned amount (AAU) or five times the of 100 percent of the most recently reviewed inventory whichever is lowest.

Assigned amount	**610 045 827**
90% of this assigned amount	**549 041 244,3** tonnes CO_2-eq
CPR = 100 % of five times Bulgaria's most recent inventory (2012)	**305 228 132,0** tonnes CO_2-eq

12.6 KP-LULUCF ACCOUNTING

In Table 258data on accounting for the KP-LULUCF activities based on the reporting for the year 2012 are given. According to this information, Bulgaria would at the end of the commitment period be able to issue RMUs corresponding to the amount of 2.9 Tg CO_2 eq., which is Bulgaria's cap value for forest management for the whole commitment period.

Table 258 Information table on accounting for activities under Articles 3.3 and 3.4 of the Kyoto Protocol. (1)(2)

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	BY(5)	Net emissions/removals(1)						Accounting Parameters(7)	Accounting Quantity (8)
		2008	2009	2010	2011	2012	Total(6)		
	($Gg\ CO_2$ equivalent)								
A. Article 3.3 activities									
A.1. Afforestation and Reforestation									-4 222,76
A.1.1. Units of land not harvested since the beginning of the commitment period(2)		-615,23	-696,23	-829,26	-972,24	-1 109,81	-4 222,76		-4 222,76

41 Report of the review of the initial report of Bulgaria: http://unfccc.int/resource/docs/2008/irr/bgr.pdf

A.1.2. Units of land harvested since the beginning of the commitment period[2]									NO
Bulgaria		NO	NO	NO	NO	NO	NO		NO
A.2. Deforestation		222,14	64,68	117,44	72,36	98,91	575,54		575,54
B. Article 3.4 activities									
B.1. Forest Management (if elected)		NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO		NA,NO
3.3 offset[3]								0,00	NA,NO
FM cap[4]								6 783,33	NA,NO
B.2. Cropland Management (if elected)	0,00	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00
B.3. Grazing Land Management (if elected)	0,00	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00
B.4. Revegetation (if elected)	0,00	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00

Notes:

(1) All estimates in this table include emissions and removals from projects under Article 6 hosted by the reporting Party.

(2) If Cropland Management, Grazing Land Management and/or Revegetation are elected, this table and all relevant CRF tables should also be reported for the base year for these activities.

(3) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to CO_2 by multiplying C by 44/12 and by changing the sign for net CO_2 removals to be negative (-) and net CO_2 emissions to be positive (+).

(4) CO_2 emissions from liming, biomass burning and drained organic soils, where applicable, are included in this column.

(5) CH_4 emissions reported here for Cropland Management, Grazing Land Management and Revegetation, if elected, include only emissions from biomass burning (with the exception of savannah burning and agricultural residue burning which are reported in the Agriculture sector). Any other CH_4 emissions from Agriculture should be reported in the Agriculture sector.

(6) N_2O emissions reported here for Cropland Management, if elected, include only emissions from biomass burning (with the exception of savannah burning and agricultural residue burning which are reported in the Agriculture sector) and N_2O emissions from mineral soils from conversion to Cropland of lands other than Forest Land (Table 5(KP-II)3). Any other N_2O emissions from Agriculture should be reported in the Agriculture sector.

(7) As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to decision 16/CMP.1, they can be reported together.

14 INFORMATION ON CHANGES IN NATIONAL REGISTRY

The following changes to the national registry of Bulgaria have therefore occurred in 2013.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	Bulgaria
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	An updated diagram of the database structure is attached as **Annex A.** Iteration 5 of the national registry released in January 2013 and Iteration 6 of the national registry released in June 2013 introduces changes in the structure of the database. Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. No change was required to the database and application backup plan or to the disaster recovery plan. No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. However, each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production (**see Annex B**). No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	No change of security measures occurred during the reporting period
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	Bulgaria No change to the list of publicly available information occurred during the reporting period.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	No change of the registry internet address occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission; the report is attached as **Annex B**.
The previous Annual Review recommendations	See below

In response to the previous Annual Review recommendations, the following document was submitted as a second addendum to Chapter 14: 'Information on changes in national registry' of the Annual Inventory Submission for the reporting year 2012.

Reference	Recommendation description	Response
2.3.3	The assessor recommends that following major changes, the party provide a data model which contains all DES required entities complete with descriptions in its annual NIR.	The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. Since the successful certification of the registry on 1 June 2012, Iteration 4 of the registry, introduced in October 2012, added a limited number of new entities, none of them relating to DES entities. A data model was attached which more clearly shows the relevant entities "RECONCILIATIONS", "NOTIFICATIONS", "RESPONSES"," INTERNAL AUDIT LOG" and "MESSAGE LOG." As specified in the DES (Section VII. Data Logging Specifications/E. Message Archive), a copy of messages sent and received is stored in standalone files in one of two managed servers in the hosting environment. For that reason, the Message Archive is not shown in the model. The "MESSAGE LOG" object holds the location of the entire message, for each Message_ID. Since the successful certification of the registry on 1 June 2012, there has been no change in the capacity of the registry or change of its infrastructure.
2.3.10	The assessor strongly recommends that the Party test each release thoroughly	The consolidated EU system of registries successfully completed a full certification procedure in June 2012. Notably, this procedure

	against the DES as part of each major release cycle and provide the results of such tests in its annual NIR.	includes connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). This included a full Annex H test. All tests were executed successfully and led to successful certification on 1 June2012 The October 2012 release (version 4.0) was only a minor iteration and changes were limited to EU ETS functionality and had no impact on Kyoto Protocol functions in the registry. The test script previously provided reflects this. However, each major release of the registry is subject to both regression testing and tests related to new functionality. These tests include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production.

13 INFORMATION ON MINIMIZATION OF ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

According to the Article 3, paragraph 14 of the Kyoto Protocol, Annex I countries shall provide information on how is striving to implement commitments in such a way as to minimize potential adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention.

Impacts on third countries are mostly indirect and frequently cannot be directly attributed to a specific policy. Therefore we cannot consider that there is an adverse social, environmental and economic impact on developing countries due to our national climate change policy. The application of the Joint Implementation mechanism in our country aims to renew the old tehnologies and improves energy efficiency, with no transboundary effects, as well as the implementation in Bulgaria of the European Union Emission Trading Scheme.

Nonetheless Bulgaria is of the view that taking the actions on mitigation, adaptation, development technology and transfer and capacity building in developing countries is very important for international climate change policy.

In this regard, in 2012 completed the project "Bulgarian contribution to the "short-term financing" 2011-2012: Sharing Bulgarian experience of monitoring, reporting and verification of greenhouse gas in the Republic of Macedonia for participation in the European Union Emission Trading Scheme of greenhouse gases". Through this project, Bulgaria has fulfilled its obligation, which made at the summit of the European Union in December 2009, to provide short-term financing of climate activities.

According to the Article 3, paragraph 14 of the Kyoto Protocol, Annex I countries shall provide information on how give priority, in implementing the commitments under Article 3, paragraph 14 , to specific actions

The majority of Bulgarian legislation measures in the climate change area, are connected mainly with transposing of the European legislation, as well as other activities on implementation of directives, connected with the politics on climate change.

The table below summarizes how the Party gives priority to selected actions, identified in paragraph 24 of the Annex to Decision 15/CMP.1.

Table 259 Selected actions, identified in Para 24 of the Annex to Decision 15/CMP.1.

Action	Implementation by the Party
The progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market	**Market imperfection** The Environmental Protection Act and Clean Air Act and related secondary legislation, including a permit system for meeting minimum standards in accordance with EU regulation on Large Combustion Plants (LPS), participation in the EU ETS and technical inspection (e.g. for cars) etc; The Energy Act, in its part on combined heat and power generation introduces the requirements of the related EU

Action	Implementation by the Party
prices and externalities.	directives and the use preferential feed-in tariffs and mandates the state regulations to the licensed activities in the power sector and purchase obligations for the Transmission and Distribution Companies to buy all electricity produced from high efficient cogeneration, and for district heating companies to buy all utilized waste thermal energy. The Renewable Energy Sources Act introduces the requirements of the related EU directives and the use of instruments such as green certificates and preferential feed in tariffs, mandates the state regulations to the licensed activities in the power sector and purchase obligations for the Transmission and Distribution Companies to by all electricity produced from renewable sources. It regulates the acceptance and realization of national indicative targets for consumption of bio fuels and other renewable fuels in the transport sector as a part of the total consumption of transport fuels; The Energy Efficiency Law and related secondary legislation, including obligation to adopt municipal energy efficiency programs, requirements for energy efficiency labelling, the use of minimum standards resulting from the EU directive on energy efficient appliances, regulations for energy efficiency labelling of various types of products (appliances, cars), obligatory audits and amendments of the Energy Performance Standards for existing buildings; The Law on Waste Management and the related secondary legislation including the obligation for collecting, management and usage (or combustion) of the omitted gases from the new waste deposits; **Fiscal policy** A number of stimulating measures for the subjects of taxation were introduced in the Act on amendment and supplement of the Act on the Corporate Income Tax and also in the Act on amendment and supplement of the Personal Income Tax Act; The on-going liberalization of energy market is in line with EU policies and directives; The main instrument addressing externalities is emission trading under the EU ETS.

PART 2: ANNEXES TO THE NATIONAL INVENTORY REPORT

ANNEX 1 KEY CATEGORIES

- Description of methodology used for identifying key categories, including for KP-LULUCF.
- Reference to the key category tables in the CRF, including in the KP-LULUCF CRF tables).
- Information on the level of disaggregation
- Tables 7.A1 - 7.A3 of the IPCC good practice guidance
- Table NIR.3, as contained in the annex to decision 6/CMP.3.

1.1 Introduction

According to the definition of Good Practice Guidance, key sources of GHG emissions are these sources, which are responsible for 95% of the sum of aggregated GHG emission expressed in CO_2-eq. in the country.

The key sources are defined according to the IPCC classification. It is advisably that the key sources in superior degree are correspondent to the structure of the fuels and the activities in the country.

By method type Tier 1 are defined key sources accounting two rules:

- Rule A – Level assessment of the GHG emissions in absolute value expressed in Gg;

- Rule B – Trend assessment of the emissions from the base year until the current year of the inventory.

By applying rule A is used information for the volume of the source emissions only for the current year of the inventory.

The application of rule B requires information for the GHG emissions for the base year in the country. That means that the trend assessment includes additional information and gives the possibility for thorough analysis of the key sources.

1.2 Tier 1 method for Assessment of Key Sources.

The method used to indentify key source categories follows the Tier 1 method – quantitative approach described in the Good Pratice Guidance (IPCC-GPG, 2000), Chapter 7 Methodological Choice and Recalculation and in the IPCC Good Pratice Guidance for Land Use, Land Use Change and Forestry (IPCC GPG-LULUCF, 2003), Chapter 5.4 Methodological Choice – Indetification of key categories.

The analysis includes all greenhouse gases reported under UNFCCC: CO_2, CH_4, N_2O, HFC, PFC and SF_6. All IPCC catetegories are included.

The identification of key categories consists of following steps:

- Identifying categories
- Level Assessment excluding LULUCF
- Level Assessment including LULUCF
- Trend Assessment excluding LULUCF
- Trend Assessment including LULUCF

The following tables present results from key source analysis:

Table 262 and Table 264 present results from the Level Assessment of the key category analysis excluding LULUCF

Table 260 presents results from the Trend Assessment of the key category analysis excluding LULUCF

Table 263 and Table 265 present the results from the Level Assessment of the key category analysis including LULUCF

Table 261 presents the results from the Trend Assessment of the key category analysis including LULUCF.

Table 260 Key category Analysis T1: Trend assessment excluding LULUCF

Source	Gas	Fuel/Cat.	1988 (BY) Gg CO_2-eq.	2012 Gg CO_2-eq.	% excl. (2012)	Trend	Contribution to Trend	cumul. %
1A1a	CO2	**Solid Fuels**	25 497,3	27 586,6	45,19%	0,484564	33,82%	33,82%
1A2f	CO2	**Solid Fuels**	9 069,4	317,6	0,52%	0,138180	9,64%	43,46%
1A3b	CO2	**Diesel Oil**	2 631,4	4 975,7	8,15%	0,119629	8,35%	51,81%
1A1a	CO2	**Liquid Fuels**	8 155,6	631,5	1,03%	0,112946	7,88%	59,70%
2C1	CO2		3 481,4	50,3	0,08%	0,055384	3,87%	63,56%
1A2e	CO2	**Liquid Fuels**	2 731,9	45,5	0,07%	0,043263	3,02%	66,58%
4B8	CH4		3 499,7	448,5	0,73%	0,042661	2,98%	69,56%
6A	CH4		3 269,2	2 828,6	4,63%	0,038959	2,72%	72,28%
1A1a	CO2	**Gaseous Fuels**	6 476,1	2 210,6	3,62%	0,033785	2,36%	74,64%
1A2f	CO2	**Liquid Fuels**	3 122,9	590,8	0,97%	0,031833	2,22%	76,86%
2B2	N2O		2 009,8	130,5	0,21%	0,028654	2,00%	78,86%
1A4b	CO2	**Solid Fuels**	3 403,0	936,5	1,53%	0,025115	1,75%	80,61%
6B	CH4		2 549,8	580,8	0,95%	0,022773	1,59%	82,20%
1A3b	CO2	**Gasoline**	4 364,4	1 597,0	2,62%	0,019261	1,34%	83,55%
1A4b	CO2	**Liquid Fuels**	1 155,6	66,3	0,11%	0,016762	1,17%	84,72%
4D3	N2O		3 723,1	1 376,6	2,25%	0,015967	1,11%	85,83%
4D1	N2O		5 426,7	2 243,5	3,68%	0,015519	1,08%	86,91%
4A3	CH4		1 336,2	196,4	0,32%	0,015467	1,08%	87,99%
2B1	CO2		1 693,3	377,9	0,62%	0,015378	1,07%	89,07%
HFCs	CO2e		2,4	456,4	0,75%	0,014888	1,04%	90,11%
2A2	CO2		1 103,3	999,7	1,64%	0,014625	1,02%	91,13%
1A2d	CO2	**Liquid Fuels**	873,2	15,3	0,03%	0,013802	0,96%	92,09%
2A7	CO2		737,5	788,8	1,29%	0,013717	0,96%	93,05%
3	CO2		866,6	22,4	0,04%	0,013464	0,94%	93,99%
1A4c	CO2	**Liquid Fuels**	1 639,9	415,2	0,68%	0,013286	0,93%	94,91%
4D2	N2O		1 168,4	272,5	0,45%	0,010227	0,71%	95,63%

Table 261 Key category Analysis T1: Trend assessment including LULUCF

Source	Gas	Fuel/Cat.	1988 (BY) Gg CO_2-eq.	2012 Gg CO_2-eq.	% incl. (2012)	Trend	Contribution to Trend	cumul. %
1A1a	CO2	**Solid Fuels**	25 497,3	27 586,6	36,83%	0,347390	28,00%	28,00%
1A2f	CO2	**Solid Fuels**	9 069,4	317,6	0,42%	0,113163	9,12%	37,13%
1A1a	CO2	**Liquid Fuels**	8 155,6	631,5	0,84%	0,093138	7,51%	44,63%
1A3b	CO2	**Diesel Oil**	2 631,4	4 975,7	6,64%	0,088924	7,17%	51,80%
5A1	CO2		14 214,8	9 625,0	12,85%	0,050198	4,05%	55,85%
2C1	CO2		3 481,4	50,3	0,07%	0,045224	3,65%	59,49%
4B8	CH4		3 499,7	448,5	0,60%	0,035541	2,87%	62,36%
1A2e	CO2	**Liquid Fuels**	2 731,9	45,5	0,06%	0,035337	2,85%	65,21%
5B1	CO2		51,4	686,6	0,92%	0,016432	1,32%	66,53%
1A1a	CO2	**Gaseous Fuels**	6 476,1	2 210,6	2,95%	0,031343	2,53%	69,06%
6A	CH4		3 269,2	2 828,6	3,78%	0,026878	2,17%	71,23%
1A2f	CO2	**Liquid Fuels**	3 122,9	590,8	0,79%	0,026962	2,17%	73,40%
1A4b	CO2	**Solid Fuels**	3 403,0	936,5	1,25%	0,022082	1,78%	75,18%
4D1	N2O		5 426,7	2 243,5	3,00%	0,016513	1,33%	76,51%
2B2	N2O		2 009,8	130,5	0,17%	0,023578	1,90%	78,41%
4D3	N2O		3 723,1	1 376,6	1,84%	0,015384	1,24%	79,65%
1A3b	CO2	**Gasoline**	4 364,4	1 597,0	2,13%	0,018449	1,49%	81,14%
1A2a	CO2	**Solid Fuels**	1 164,2	NO	0,00%	0,000000	0,00%	81,14%
5B2	CO2		770,4	770,4	1,03%	0,008923	0,72%	81,86%
1A4b	CO2	**Liquid Fuels**	1 155,6	66,3	0,09%	0,013775	1,11%	82,97%
6B	CH4		2 549,8	580,8	0,78%	0,019561	1,58%	84,55%
4A3	CH4		1 336,2	196,4	0,26%	0,012944	1,04%	85,59%
2A1	CO2		2 406,4	997,8	1,33%	0,007248	0,58%	86,17%
5E2	CO2		682,7	939,4	1,25%	0,014307	1,15%	87,33%
1A4c	CO2	**Liquid Fuels**	1 639,9	415,2	0,55%	0,011543	0,93%	88,26%
3	CO2		866,6	22,4	0,03%	0,011011	0,89%	89,14%
2A2	CO2		1 103,3	999,7	1,33%	0,010197	0,82%	89,97%
1A2d	CO2	**Liquid Fuels**	873,2	15,3	0,02%	0,011275	0,91%	90,88%
2A7	CO2		737,5	788,8	1,05%	0,009820	0,79%	91,67%
HFCs	CO2e		2,4	456,4	0,61%	0,011347	0,91%	92,58%
2B1	CO2		1 693,3	377,9	0,50%	0,013184	1,06%	93,64%
5C2	CO2		632,7	632,7	0,84%	0,007328	0,59%	94,24%
4D2	N2O		1 168,4	272,5	0,36%	0,008805	0,71%	94,94%
4B13	N2O		1 620,8	525,2	0,70%	0,008545	0,69%	95,63%

Table 262 Key category Analysis T1: Level Assessment excluding LULUCF 1988

Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% excl.	cumul. %
1A1a	CO2	**Solid Fuels**	25 497,3	20,9%	20,9%
1A2f	CO2	**Solid Fuels**	9 069,4	7,4%	28,4%
1A1a	CO2	**Liquid Fuels**	8 155,6	6,7%	35,1%
1A1a	CO2	**Gaseous Fuels**	6 476,1	5,3%	40,4%
4D1	N2O		5 426,7	4,5%	44,8%
1A3b	CO2	**Gasoline**	4 364,4	3,6%	48,4%
4D3	N2O		3 723,1	3,1%	51,5%
4B8	CH4		3 499,7	2,9%	54,3%
2C1	CO2		3 481,4	2,9%	57,2%
1A4b	CO2	**Solid Fuels**	3 403,0	2,8%	60,0%
6A	CH4		3 269,2	2,7%	62,7%
1A5a	CO2	**Gaseous Fuels**	3 253,6	2,7%	65,3%
1A2f	CO2	**Liquid Fuels**	3 122,9	2,6%	67,9%
1A5a	CO2	**Liquid Fuels**	2 781,7	2,3%	70,2%
1A2e	CO2	**Liquid Fuels**	2 731,9	2,2%	72,4%
1A3b	CO2	**Diesel Oil**	2 631,4	2,2%	74,6%
6B	CH4		2 549,8	2,1%	76,7%
2A1	CO2		2 406,4	2,0%	78,6%
4A1	CH4		2 348,9	1,9%	80,6%
2B2	N2O		2 009,8	1,6%	82,2%
1B1a	CH4	**natural gas**	1 858,4	1,5%	83,7%
1A1b	CO2	**Liquid Fuels**	1 838,2	1,5%	85,2%
2B1	CO2		1 693,3	1,4%	86,6%
1A4c	CO2	**Liquid Fuels**	1 639,9	1,3%	88,0%
4B13	N2O		1 620,8	1,3%	89,3%
4A3	CH4		1 336,2	1,1%	90,4%
4D2	N2O		1 168,4	1,0%	91,4%
1A2a	CO2	**Solid Fuels**	1 164,2	1,0%	92,3%
1A4b	CO2	**Liquid Fuels**	1 155,6	0,9%	93,3%
2A2	CO2		1 103,3	0,9%	94,2%
1B2b	CH4		1 097,0	0,9%	95,1%

Table 263 Key category Analysis T1: Level Assessment including LULUCF 1988

Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% incl.	cumul. %
1A1a	CO2	**Solid Fuels**	25 497,3	18,4%	18,4%
5A1	CO2		14 214,8	10,2%	28,6%
1A2f	CO2	**Solid Fuels**	9 069,4	6,5%	35,1%
1A1a	CO2	**Liquid Fuels**	8 155,6	5,9%	41,0%
1A1a	CO2	**Gaseous Fuels**	6 476,1	4,7%	45,6%
4D1	N2O		5 426,7	3,9%	49,6%
1A3b	CO2	**Gasoline**	4 364,4	3,1%	52,7%
4D3	N2O		3 723,1	2,7%	55,4%
4B8	CH4		3 499,7	2,5%	57,9%
2C1	CO2		3 481,4	2,5%	60,4%
1A4b	CO2	**Solid Fuels**	3 403,0	2,4%	62,9%
6A	CH4		3 269,2	2,4%	65,2%
1A5a	CO2	**Gaseous Fuels**	3 253,6	2,3%	67,5%
1A2f	CO2	**Liquid Fuels**	3 122,9	2,2%	69,8%
1A5a	CO2	**Liquid Fuels**	2 781,7	2,0%	71,8%
1A2e	CO2	**Liquid Fuels**	2 731,9	2,0%	73,8%
1A3b	CO2	**Diesel Oil**	2 631,4	1,9%	75,7%
6B	CH4		2 549,8	1,8%	77,5%
2A1	CO2		2 406,4	1,7%	79,2%
4A1	CH4		2 348,9	1,7%	80,9%
2B2	N2O		2 009,8	1,4%	82,4%
1B1a	CH4	**natural gas**	1 858,4	1,3%	83,7%
1A1b	CO2	**Liquid Fuels**	1 838,2	1,3%	85,0%
2B1	CO2		1 693,3	1,2%	86,2%
1A4c	CO2	**Liquid Fuels**	1 639,9	1,2%	87,4%
4B13	N2O		1 620,8	1,2%	88,6%
4A3	CH4		1 336,2	1,0%	89,6%
4D2	N2O		1 168,4	0,8%	90,4%
1A2a	CO2	**Solid Fuels**	1 164,2	0,8%	91,2%
1A4b	CO2	**Liquid Fuels**	1 155,6	0,8%	92,1%
2A2	CO2		1 103,3	0,8%	92,9%
1B2b	CH4		1 097,0	0,8%	93,7%
1A2d	CO2	**Liquid Fuels**	873,2	0,6%	94,3%
3	CO2		866,6	0,6%	94,9%
5B2	CO2		770,4	0,6%	95,5%

Table 264 Key category Analysis T1: Level Assessment excluding LULUCF 2012

Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% excl.	cumul. %
1A1a	CO2	**Solid Fuels**	27 586,6	45,2%	45,2%
1A3b	CO2	**Diesel Oil**	4 975,7	8,2%	53,3%
6A	CH4		2 828,6	4,6%	58,0%
4D1	N2O		2 243,5	3,7%	61,6%
1A1a	CO2	**Gaseous Fuels**	2 210,6	3,6%	65,3%
1A3b	CO2	**Gasoline**	1 597,0	2,6%	67,9%
4D3	N2O		1 376,6	2,3%	70,1%
1A3b	CO2	**Liquefied Petroleum Gases (LPG)**	1 018,9	1,7%	71,8%
2A2	CO2		999,7	1,6%	73,4%
2A1	CO2		997,8	1,6%	75,1%
1B1a	CH4	**natural gas**	937,3	1,5%	76,6%
1A4b	CO2	**Solid Fuels**	936,5	1,5%	78,2%
1A1b	CO2	**Liquid Fuels**	930,2	1,5%	79,7%
4A1	CH4		929,8	1,5%	81,2%
2A7	CO2		788,8	1,3%	82,5%
1A2f	CO2	**Gaseous Fuels**	766,8	1,3%	83,7%
1A1a	CO2	**Liquid Fuels**	631,5	1,0%	84,8%
1B2b	CH4		613,4	1,0%	85,8%
1A2f	CO2	**Liquid Fuels**	590,8	1,0%	86,8%
1A2c	CO2	**Gaseous Fuels**	590,0	1,0%	87,7%
6B	CH4		580,8	1,0%	88,7%
4B13	N2O		525,2	0,9%	89,5%
1A3e	CO2	**Gaseous Fuels**	467,9	0,8%	90,3%
HFCs	CO2e		456,4	0,7%	91,0%
4B8	CH4		448,5	0,7%	91,8%
1A4c	CO2	**Liquid Fuels**	415,2	0,7%	92,5%
2B1	CO2		377,9	0,6%	93,1%
1A2c	CO2	**Solid Fuels**	370,5	0,6%	93,7%
1A2f	CO2	**Solid Fuels**	317,6	0,5%	94,2%
4D2	N2O		272,5	0,4%	94,7%
1A2e	CO2	**Gaseous Fuels**	238,2	0,4%	95,0%

Table 265 Key category Analysis T1: Level Assessment including LULUCF 2012

Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% incl.	cumul. %
1A1a	CO2	**Solid Fuels**	27 586,6	36,8%	36,8%
5A1	CO2		9 625,0	12,8%	49,7%
1A3b	CO2	**Diesel Oil**	4 975,7	6,6%	56,3%
6A	CH4		2 828,6	3,8%	60,1%
4D1	N2O		2 243,5	3,0%	63,1%
1A1a	CO2	**Gaseous Fuels**	2 210,6	3,0%	66,0%
1A3b	CO2	**Gasoline**	1 597,0	2,1%	68,2%
4D3	N2O		1 376,6	1,8%	70,0%
1A3b	CO2	**Liquefied Petroleum Gases (LPG)**	1 018,9	1,4%	71,4%
2A2	CO2		999,7	1,3%	72,7%
2A1	CO2		997,8	1,3%	74,0%
5E2	CO2		939,4	1,3%	75,3%
1B1a	CH4	**natural gas**	937,3	1,3%	76,5%
1A4b	CO2	**Solid Fuels**	936,5	1,3%	77,8%
1A1b	CO2	**Liquid Fuels**	930,2	1,2%	79,0%
4A1	CH4		929,8	1,2%	80,3%
2A7	CO2		788,8	1,1%	81,3%
5A2	CO2		774,8	1,0%	82,4%
5B2	CO2		770,4	1,0%	83,4%
1A2f	CO2	**Gaseous Fuels**	766,8	1,0%	84,4%
5B1	CO2		686,6	0,9%	85,3%
5C2	CO2		632,7	0,8%	86,2%
1A1a	CO2	**Liquid Fuels**	631,5	0,8%	87,0%
1B2b	CH4		613,4	0,8%	87,8%
1A2f	CO2	**Liquid Fuels**	590,8	0,8%	88,6%
1A2c	CO2	**Gaseous Fuels**	590,0	0,8%	89,4%
6B	CH4		580,8	0,8%	90,2%
4B13	N2O		525,2	0,7%	90,9%
1A3e	CO2	**Gaseous Fuels**	467,9	0,6%	91,5%
HFCs	CO2e		456,4	0,6%	92,1%
4B8	CH4		448,5	0,6%	92,7%
1A4c	CO2	**Liquid Fuels**	415,2	0,6%	93,3%
2B1	CO2		377,9	0,5%	93,8%
1A2c	CO2	**Solid Fuels**	370,5	0,5%	94,3%
1A2f	CO2	**Solid Fuels**	317,6	0,4%	94,7%
4D2	N2O		272,5	0,4%	95,1%

1.2 Tier 2 method for Key Caregory Assessment

With the use of the uncertainty assessments for each key categories in the form of weight factor/coefficient is done, which is the Tier 2 method according to IPCC-GPG, 2000. It is helpful in prioritising activities to improve inventory quality and to reduce overall uncertainty.

Under Tier 2, the source or sink category uncertainties are incorporated by weighting the Tir 1 level and trend assessment results with the source category's relative uncertainty.

Therefore the following equation Tier 2 has been applied for the current year submission:

*Level Assessment, with Uncertainty = Tier 1 Level Assessment * Relative Category Uncertainty*

*Trend Assessment, with Uncertainty = Tier 1 Trend Assessment * Relative Category Uncertainty*

The results of the Tier 2 category analysis, without LULUCF categories, are provided in

Table 266 and Table 268 for 2012, while in Table 267 Table 269 the results, including LULUCF categories, are shown.

Table 266 Key category Analysis T2: Trend assessment excluding LULUCF

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	T*U	Relevant trend assessment excluding LULUCF	Cumulative Percentage	T2
16	4D3	Indirect Emissions	N2O	0,011	500,009	5,572	0,275	0,275	1
17	4D1	Direct soil emissions	N2O	0,011	250,018	2,708	0,134	0,408	2
8	6A	Solid Waste Disposal on Land	CH4	0,027	85,440	2,323	0,115	0,523	3
27	all others	0	0	0,044	42,626	1,864	0,092	0,615	4
26	4D2	Pasture, Range and Paddock Manure	N2O	0,007	250,018	1,785	0,088	0,703	5
1	1A1a	Solid Fuels	CO2	0,338	2,236	0,756	0,037	0,740	6
13	6B	Waste Water Handling	CH4	0,016	42,426	0,674	0,033	0,773	7
4	1A1a	Liquid Fuels	CO2	0,079	7,616	0,600	0,030	0,803	8
7	4B8	Swine	CH4	0,030	20,100	0,598	0,030	0,833	9
20	HFCs	HFCs	CO2e	0,010	50,990	0,530	0,026	0,859	10
3	1A3b	Diesel Oil	CO2	0,083	5,831	0,487	0,024	0,883	11
5	2C1	Iron and Steel Production	CO2	0,039	11,180	0,432	0,021	0,904	12
24	3	Solvent and other product use	CO2	0,009	31,623	0,297	0,015	0,919	13
6	1A2e	Liquid Fuels	CO2	0,030	7,616	0,230	0,011	0,930	14
18	4A3	Sheep	CH4	0,011	20,100	0,217	0,011	0,941	15
2	1A2f	Solid Fuels	CO2	0,096	2,236	0,216	0,011	0,951	16
10	1A2f	Liquid Fuels	CO2	0,022	7,616	0,169	0,008	0,960	17
11	2B2	Nitric Acid Production	N2O	0,020	7,616	0,152	0,008	0,967	18
15	1A4b	Liquid Fuels	CO2	0,012	8,602	0,101	0,005	0,972	19
12	1A4b	Solid Fuels	CO2	0,018	5,385	0,094	0,005	0,977	20
19	2B1	Ammonia Production	CO2	0,011	7,826	0,084	0,004	0,981	21
25	1A4c	Liquid Fuels	CO2	0,009	8,602	0,080	0,004	0,985	22
14	1A3b	Gasoline	CO2	0,013	5,831	0,078	0,004	0,989	23
23	2A7	Other-glas brick DeSOx	CO2	0,010	7,742	0,074	0,004	0,992	24
22	1A2d	Liquid Fuels	CO2	0,010	7,616	0,073	0,004	0,996	25
9	1A1a	Gaseous Fuels	CO2	0,024	2,236	0,053	0,003	0,999	26
21	2A2	Lime Production	CO2	0,010	2,828	0,029	0,001	1,000	27

Table 267 Key category Analysis T2: Trend assessment including LULUCF

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	T*U	Relevant trend assessment including LULUCF	Cumulative Percentage	T2
16	4D3	Indirect Emissions	N2O	0,012	500,009	6,201	0,165	0,165	1
5	5A1	Forest Land remaining Forest Land	CO2	0,040	149,451	6,048	0,161	0,326	2
14	4D1	Direct soil emissions	N2O	0,013	250,018	3,328	0,088	0,414	3
19	5B2	Land converted to Cropland	CO2	0,007	415,466	2,988	0,079	0,494	4
32	5C2	Land converted to Grassland	CO2	0,006	444,813	2,627	0,070	0,563	5
9	5B1	Cropland remainig Cropland	CO2	0,013	184,043	2,438	0,065	0,628	6
34	4B13	N2O em. from Manure Management	N2O	0,007	300,007	2,067	0,055	0,683	7
11	6A	Solid Waste Disposal on Land	CH4	0,022	85,440	1,851	0,049	0,732	8
35	all others	0	0	0,044	41,178	1,798	0,048	0,780	9
33	4D2	Pasture, Range and Paddock Manure	N2O	0,007	250,018	1,775	0,047	0,827	10
24	5E2	Land converted to Settlements	CO2	0,012	75,000	0,865	0,023	0,850	11
21	6B	Waste Water Handling	CH4	0,016	42,426	0,669	0,018	0,868	12
1	1A1a	Solid Fuels	CO2	0,280	2,236	0,626	0,017	0,885	13
7	4B8	Swine	CH4	0,029	20,100	0,576	0,015	0,900	14
3	1A1a	Liquid Fuels	CO2	0,075	7,616	0,572	0,015	0,915	15
30	HFCs	HFCs	CO2e	0,009	50,990	0,466	0,012	0,928	16
4	1A3b	Diesel Oil	CO2	0,072	5,831	0,418	0,011	0,939	17
6	2C1	Iron and Steel Production	CO2	0,036	11,180	0,408	0,011	0,950	18
26	3	Solvent and other product use	CO2	0,009	31,623	0,281	0,007	0,957	19
8	1A2e	Liquid Fuels	CO2	0,028	7,616	0,217	0,006	0,963	20
22	4A3	Sheep	CH4	0,010	20,100	0,210	0,006	0,969	21
2	1A2f	Solid Fuels	CO2	0,091	2,236	0,204	0,005	0,974	22
12	1A2f	Liquid Fuels	CO2	0,022	7,616	0,166	0,004	0,978	23
15	2B2	Nitric Acid Production	N2O	0,019	7,616	0,145	0,004	0,982	24
13	1A4b	Solid Fuels	CO2	0,018	5,385	0,096	0,003	0,985	25
20	1A4b	Liquid Fuels	CO2	0,011	8,602	0,096	0,003	0,987	26
17	1A3b	Gasoline	CO2	0,015	5,831	0,087	0,002	0,990	27
31	2B1	Ammonia Production	CO2	0,011	7,826	0,083	0,002	0,992	28
25	1A4c	Liquid Fuels	CO2	0,009	8,602	0,080	0,002	0,994	29
28	1A2d	Liquid Fuels	CO2	0,009	7,616	0,069	0,002	0,996	30
29	2A7	Other-glas brick DeSOx	CO2	0,008	7,742	0,061	0,002	0,997	31
10	1A1a	Gaseous Fuels	CO2	0,025	2,236	0,056	0,002	0,999	32
27	2A2	Lime Production	CO2	0,008	2,828	0,023	0,001	1,000	33
23	2A1	Cement Production	CO2	0,006	2,828	0,017	0,000	1,000	34

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	T*U	Relevant trend assessment including LULUCF	Cumulative Percentage	T2
18	1A2a	Solid Fuels	CO2	0,000	2,236	0,000	0,000	1,000	35

Table 268 Key category Analysis T2: Level Assessment excluding LULUCF 2012

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	L*U	Level assessment excluding LULUCF	Cumulative Percentage	T2
7	4D3	Indirect Emissions	N2O	0,023	500,009	11,275	0,300	0,300	1
4	4D1	Direct soil emissions	N2O	0,037	250,018	9,189	0,244	0,544	2
3	6A	Solid Waste Disposal on Land	CH4	0,046	85,440	3,959	0,105	0,649	3
11	1B1a	natural gas	CH4	0,015	200,250	3,075	0,082	0,731	4
22	4B13	N2O em. from Manure Management	N2O	0,009	300,007	2,581	0,069	0,799	5
32	all others			0,050	42,626	2,112	0,056	0,855	6
30	4D2	Pasture, Range and Paddock Manure	N2O	0,004	250,018	1,116	0,030	0,885	7
1	1A1a	Solid Fuels	CO2	0,452	2,236	1,010	0,027	0,912	8
18	1B2b	Oil and Natural Gas	CH4	0,010	50,249	0,505	0,013	0,925	9
2	1A3b	Diesel Oil	CO2	0,082	5,831	0,475	0,013	0,938	10
21	6B	Waste Water Handling	CH4	0,010	42,426	0,404	0,011	0,948	11
24	HFCs	HFCs	CO2e	0,007	50,990	0,381	0,010	0,959	12
14	4A1	Cattle	CH4	0,015	20,100	0,306	0,008	0,967	13
6	1A3b	Gasoline	CO2	0,026	5,831	0,153	0,004	0,971	14
25	4B8	Swine	CH4	0,007	20,100	0,148	0,004	0,975	15
13	1A1b	Liquid Fuels	CO2	0,015	7,616	0,116	0,003	0,978	16
15	2A7	Other-glas brick DeSOx	CO2	0,013	7,742	0,100	0,003	0,980	17
8	1A3b	Liquefied Petroleum Gases (LPG)	CO2	0,017	5,831	0,097	0,003	0,983	18
12	1A4b	Solid Fuels	CO2	0,015	5,385	0,083	0,002	0,985	19
5	1A1a	Gaseous Fuels	CO2	0,036	2,236	0,081	0,002	0,987	20
17	1A1a	Liquid Fuels	CO2	0,010	7,616	0,079	0,002	0,989	21
19	1A2f	Liquid Fuels	CO2	0,010	7,616	0,074	0,002	0,991	22
26	1A4c	Liquid Fuels	CO2	0,007	8,602	0,059	0,002	0,993	23
27	2B1	Ammonia Production	CO2	0,006	7,826	0,048	0,001	0,994	24
9	2A2	Lime Production	CO2	0,016	2,828	0,046	0,001	0,996	25
10	2A1	Cement Production	CO2	0,016	2,828	0,046	0,001	0,997	26
23	1A3e	Gaseous Fuels	CO2	0,008	5,099	0,039	0,001	0,998	27
16	1A2f	Gaseous Fuels	CO2	0,013	2,236	0,028	0,001	0,999	28
20	1A2c	Gaseous Fuels	CO2	0,010	2,236	0,022	0,001	0,999	29

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	L*U	Level assessment excluding LULUCF	Cumulative Percentage	T2
28	1A2c	Solid Fuels	CO2	0,006	2,236	0,014	0,000	0,999	30
29	1A2f	Solid Fuels	CO2	0,005	2,236	0,012	0,000	1,000	31
31	1A2e	Gaseous Fuels	CO2	0,004	2,236	0,009	0,000	1,000	32

Table 269 Key category Analysis T2: Level Assessment including LULUCF 2012

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	L*U	Level assessment including LULUCF	Cumulative Percentage	T2
2	5A1	Forest Land remaining Forest Land	CO2	0,128	149,451	19,204	0,309	0,309	1
8	4D3	Indirect Emissions	N2O	0,018	500,009	9,189	0,148	0,457	2
5	4D1	Direct soil emissions	N2O	0,030	250,018	7,489	0,121	0,578	3
19	5B2	Land converted to Cropland	CO2	0,010	415,466	4,273	0,069	0,647	4
22	5C2	Land converted to Grassland	CO2	0,008	444,813	3,757	0,060	0,707	5
4	6A	Solid Waste Disposal on Land	CH4	0,038	85,440	3,227	0,052	0,759	6
13	1B1a	natural gas	CH4	0,013	200,250	2,506	0,040	0,799	7
28	4B13	N2O em. from Manure Management	N2O	0,007	300,007	2,103	0,034	0,833	8
37	all others			0,049	41,178	2,029	0,033	0,866	9
21	5B1	Cropland remainig Cropland	CO2	0,009	184,043	1,687	0,027	0,893	10
18	5A2	Land converted to Forest Land	CO2	0,010	122,520	1,267	0,020	0,913	11
12	5E2	Land converted to Settlements	CO2	0,013	75,000	0,941	0,015	0,929	12
36	4D2	Pasture, Range and Paddock Manure	N2O	0,004	250,018	0,910	0,015	0,943	13
1	1A1a	Solid Fuels	CO2	0,368	2,236	0,824	0,013	0,957	14
24	1B2b	Oil and Natural Gas	CH4	0,008	50,249	0,412	0,007	0,963	15
3	1A3b	Diesel Oil	CO2	0,066	5,831	0,387	0,006	0,969	16
27	6B	Waste Water Handling	CH4	0,008	42,426	0,329	0,005	0,975	17
30	HFCs	HFCs	CO2e	0,006	50,990	0,311	0,005	0,980	18
16	4A1	Cattle	CH4	0,012	20,100	0,249	0,004	0,984	19
7	1A3b	Gasoline	CO2	0,021	5,831	0,124	0,002	0,986	20
31	4B8	Swine	CH4	0,006	20,100	0,120	0,002	0,988	21
15	1A1b	Liquid Fuels	CO2	0,012	7,616	0,095	0,002	0,989	22
17	2A7	Other-glas brick DeSOx	CO2	0,011	7,742	0,082	0,001	0,990	23
9	1A3b	Liquefied Petroleum Gases (LPG)	CO2	0,014	5,831	0,079	0,001	0,992	24
14	1A4b	Solid Fuels	CO2	0,013	5,385	0,067	0,001	0,993	25
6	1A1a	Gaseous Fuels	CO2	0,030	2,236	0,066	0,001	0,994	26
23	1A1a	Liquid Fuels	CO2	0,008	7,616	0,064	0,001	0,995	27

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	L*U	Level assessment including LULUCF	Cumulative Percentage	T2
25	1A2f	Liquid Fuels	CO2	0,008	7,616	0,060	0,001	0,996	28
32	1A4c	Liquid Fuels	CO2	0,006	8,602	0,048	0,001	0,997	29
33	2B1	Ammonia Production	CO2	0,005	7,826	0,039	0,001	0,997	30
10	2A2	Lime Production	CO2	0,013	2,828	0,038	0,001	0,998	31
11	2A1	Cement Production	CO2	0,013	2,828	0,038	0,001	0,999	32
29	1A3e	Gaseous Fuels	CO2	0,006	5,099	0,032	0,001	0,999	33
20	1A2f	Gaseous Fuels	CO2	0,010	2,236	0,023	0,000	0,999	34
26	1A2c	Gaseous Fuels	CO2	0,008	2,236	0,018	0,000	1,000	35
34	1A2c	Solid Fuels	CO2	0,005	2,236	0,011	0,000	1,000	36
35	1A2f	Solid Fuels	CO2	0,004	2,236	0,009	0,000	1,000	37

ANNEX 2 DETAILED DISCUSSION OF METHODOLOGY AND DATA FOR ESTIMATING CO_2 EMISSIONS FROM FOSSIL FUEL COMBUSTION

Correspondence between the Eurostat format energy balances and the CRF categories.

The following sector allocation was applied in the calculation model.

Eurostat Category	CRF Category
Indigenous Production	
Underground Production	
Surface Production	
From Other Sources	
From Other Sources - Oil	
From Other Sources - Natural Gas	
From Other Sources - Renewables	
Total Imports (Balance)	
Total Exports (Balance)	
International Marine Bunkers	
Stock Changes (National Territory)	
Inland Consumption (Calculated)	
Statistical Differences	
Transformation Sector	
Main Activity Producer Electricity Plants	1A1a
Main Activity Producer CHP Plants	1A1a
Main Activity Producer Heat Plants	1A1a
Autoproducer Electricity Plants	1A2f
Autoproducer CHP Plants	1A2f
Autoproducer Heat Plants	1A2f
Patent Fuel Plants (Transformation)	
Coke Ovens (Transformation)	
BKB Plants (Transformation)	
Gas Works (Transformation)	
Blast Furnaces (Transformation)	
Coal Liquefaction Plants (Transformation)	
For Blended Natural Gas	
Non-specified (Transformation)	
Energy Sector	
Own Use in Electricity, CHP and Heat Plants	1A1a
Coal Mines	1A1c
Patent Fuel Plants (Energy)	1A1c
Coke Ovens (Energy)	1A1c

Eurostat Category	CRF Category
BKB Plants (Energy)	1A1c
Gas Works (Energy)	
Blast Furnaces (Energy)	1A2a
Petroleum Refineries	1A1b
Coal Liquefaction Plants (Energy)	
Non-specified (Energy)	1A1c
Distribution Losses	
Total Final Consumption	
Total Non-Energy Use	
Non-Energy Use Industry/Transformation/Energy	
Of which: Non-Energy Use-Chemical/Petrochem	
Non-Energy Use in Transport	
Non-Energy Use in Other Sectors	
Final Energy Consumption	
Industry Sector	
Iron and Steel	1A2a
Chemical (including Petrochemical)	1A2c
Non-Ferrous Metals	1A2b
Non-Metallic Minerals	1A2f
Transport Equipment	1A2f
Machinery	1A2f
Mining and Quarrying	1A2f
Food, Beverages and Tobacco	1A2e
Paper, Pulp and Printing	1A2d
Wood and Wood Products	1A2f
Construction	1A2f
Textiles and Leather	1A2f
Non-specified (Industry)	1A2f
Transport Sector	
Rail	1A3c
Domestic Navigation	1A3d
Non-specified (Transport)	1A3e
Other Sectors	
Commercial and Public Services	1A4a
Residential	1A4b
Agriculture/Forestry	1A4c
Fishing	1A4c
Non-specified (Other)	1A5a

For the sectoral approach were considered all fuels for which there was reported energy consumption.

Solid fuels:	**Liquid fuels:**

Anthracite Coking Coal Other Bituminous Coal Sub-bituminous Coal Lignite/Brown Coal Coke Oven Coke Coal Tar BKB/PB Coke Oven Gas Blast Furnace Gas	Crude Oil Refinery Gas LPG Motor Gasoline Aviation Gasoline Kerosene Type Jet Fuel Gas-Diesel Oil Residual Fuel Oil Petroleum Coke Other Products
Gaseous fuels: Natural Gas	

In order to avoid double counting in the Energy sector, the following categories were not considered:

- Lignite/Brown coal used in BKB Plants (Transformation). The quantities which were considered instead are BKBs in all sectors.
- Coking coal used in Coke Ovens (Transformation). The quantities which were considered instead are:
  - Coke oven coke used in Blast Furnaces (Transformation) and Iron and Steel industry sector
  - Coke oven gas used in Autoproducer CHP Plants, Blast Furnaces (Energy) and Iron and Steel industry sector.
- Blast Furnace Gas used in Autoproducer CHP Plants, Blast Furnaces (Energy) and Iron and Steel industry sector and also the quantities of Coke oven coke used in Blast Furnaces (Transformation). These fuels are accounted under the Industrial processes sector since the emissions are calculated based on mass balance approach.

In addition, following the recommendation of the Technical review of GHG inventories under the EU Effort Sharing Decision (ESD) in 2012, we revised the methodology concerning Iron & Steel sector in order to remove the double counting with the IP sector. The following quantities were disregarded from the Energy sector:

- Coke Oven Gas reported under blast furnaces;
- Blast Furnace Gas reported under blast furnaces, Autoproducers and Iron & Steel subcategories;
- Coke oven coke in blast furnaces.

The NCVs which were provided in the energy balances were applied to the appropriate sectors, according to the following allocation:

Eurostat Category	NCVs
Indigenous Production	
Underground Production	
Surface Production	
From Other Sources	
From Other Sources - Oil	

Eurostat Category	NCVs
From Other Sources - Natural Gas	
From Other Sources - Renewables	
Total Imports (Balance)	
Total Exports (Balance)	
International Marine Bunkers	
Stock Changes (National Territory)	
Inland Consumption (Calculated)	
Statistical Differences	
Transformation Sector	
Main Activity Producer Electricity Plants	Used in Main Activity Plants (net)
Main Activity Producer CHP Plants	Used in Main Activity Plants (net)
Main Activity Producer Heat Plants	Used in Main Activity Plants (net)
Autoproducer Electricity Plants	Used in industry (net)
Autoproducer CHP Plants	Used in industry (net)
Autoproducer Heat Plants	Used in industry (net)
Patent Fuel Plants (Transformation)	
Coke Ovens (Transformation)	
BKB Plants (Transformation)	
Gas Works (Transformation)	
Blast Furnaces (Transformation)	Used in blast furnaces (net)
Coal Liquefaction Plants (Transformation)	
For Blended Natural Gas	
Non-specified (Transformation)	
Energy Sector	
Own Use in Electricity, CHP and Heat Plants	Used in Main Activity Plants (net)
Coal Mines	Production (net)
Patent Fuel Plants (Energy)	Used in industry (net)
Coke Ovens (Energy)	Used in coke ovens (net)
BKB Plants (Energy)	Used in industry (net)
Gas Works (Energy)	
Blast Furnaces (Energy)	Used in blast furnaces (net)
Petroleum Refineries	Used in industry (net)
Coal Liquefaction Plants (Energy)	
Non-specified (Energy)	For Other Uses (net)
Distribution Losses	

Eurostat Category	NCVs
Total Final Consumption	
Total Non-Energy Use	
Non-Energy Use Industry/Transformation/Energy	
Of which: Non-Energy Use-Chemical/Petrochem	
Non-Energy Use in Transport	
Non-Energy Use in Other Sectors	
Final Energy Consumption	
Industry Sector	
Iron and Steel	Used in industry (net)
Chemical (including Petrochemical)	Used in industry (net)
Non-Ferrous Metals	Used in industry (net)
Non-Metallic Minerals	Used in industry (net)
Transport Equipment	Used in industry (net)
Machinery	Used in industry (net)
Mining and Quarrying	Used in industry (net)
Food, Beverages and Tobacco	Used in industry (net)
Paper, Pulp and Printing	Used in industry (net)
Wood and Wood Products	Used in industry (net)
Construction	Used in industry (net)
Textiles and Leather	Used in industry (net)
Non-specified (Industry)	Used in industry (net)
Transport Sector	
Rail	
Domestic Navigation	
Non-specified (Transport)	
Other Sectors	
Commercial and Public Services	For Other Uses (net)
Residential	For Other Uses (net)
Agriculture/Forestry	For Other Uses (net)
Fishing	For Other Uses (net)
Non-specified (Other)	For Other Uses (net)

ANNEX 3 CO_2 REFERENCE APPROACH AND COMPARISON WITH SECTORAL APPROACH, AND RELEVANT INFORMATION ON THE NATIONAL ENERGY BALANCE

For the reference approach both fuels were considered for which there was reported energy and non-energy consumption.

Solid fuels:	**Liquid fuels:**
Anthracite Coking Coal Other Bituminous Coal Sub-bituminous Coal Lignite/Brown Coal Coke Oven Coke Coal Tar BKB/PB Coke Oven Gas Blast Furnace Gas	Crude Oil Refinery Gas LPG Motor Gasoline Aviation Gasoline Kerosene Type Jet Fuel Gas-Diesel Oil Residual Fuel Oil Petroleum Coke Other Products Naphtha White spirit Lubricants Bitumen Paraffin waxes Refinery Feedstocks
Gaseous fuels: Natural Gas	

In order to avoid double counting, the apparent consumption for different fuels was calculated according to the 1996 IPCC Reference manual, Ch. 1, p. 1.12, Table 1-1.

Previously, the fraction of carbon stored was calculated with the default values according to the 1996 IPCC Reference manual, Ch. 1, p. 1.28, Table 1-5, which lead to significant differences between the sectoral and the reference approaches. Following an ERT recommendation FCCC/ARR/2013/BGR §27, the default fractions of carbon stored were changed to 1 based on information for the use of fuels.

For the purposes of the reference approach only were calculated weighted average net calorific value for solid fuels from production, imports and exports for each fuel and each year:

Table 270 Net calorific value for solid fuels

[MJ/t]	Anthracite	Coking Coal	Other Bituminous Coal	Sub-bituminous Coal	Lignite/Brown Coal	Coke Oven Coke	Coal Tar	BKB/PB
1988	-	24.702	24.702	-	7.034	28.200	-	20.097
1989	-	24.702	24.702	-	7.034	28.200	-	20.097
1990	-	24.366	24.369	-	6.682	25.061	-	18.367
1991	-	24.366	23.488	11.669	6.268	26.380	-	18.367
1992	-	27.215	24.933	11.669	6.813	26.380	-	18.359

1993	-	32.481	26.020	11.776	6.838	31.059	-	18.569
1994	-	31.863	24.414	11.583	6.733	30.019	-	18.680
1995	-	30.148	25.207	11.537	6.584	29.832	-	18.683
1996	-	32.804	25.712	11.643	6.680	29.714	-	18.722
1997	-	32.709	25.897	-	7.014	30.061	-	18.757
1998	-	32.658	23.283	-	7.020	30.141	-	17.917
1999	-	32.659	24.911	-	7.025	30.220	-	17.077
2000	-	33.412	25.527	-	6.762	30.117	-	15.739
2001	-	30.480	24.673	-	7.036	29.969	-	16.082
2002	-	27.457	24.227	-	7.089	30.031	-	16.459
2003	-	29.326	24.365	-	7.106	29.955	-	16.490
2004	24.804	28.610	25.131	-	7.161	27.423	33 356	15.976
2005	24.465	28.638	24.645	-	7.079	27.270	32 070	15.125
2006	24.916	25.122	25.527	-	7.010	29.700	34 540	11.712
2007	23.899	27.973	25.756	-	6.973	28.500	37 700	11.504
2008	22.728	28.610	26.171	-	6.987	28.500	-	12.568
2009	25.200	-	26.712	-	7.006	28.500	-	12.212
2010	24.812	-	25.515	-	7.004	28.500	-	12.768
2011	24.349		24.369		6.973	28.500		13.064
2012	26.155		23.488		6.992	28.500		12.475

For the sectoral approach were used the NCVs per sector, as indicated in the National Energy Balance.

ANNEX 4 NATIONAL ENERGY BALANCE

ANNEX 5 ASSESSMENT OF COMPLETENESS AND (POTENTIAL) SOURCES AND SINKS OF GREENHOUSE GAS EMISSIONS AND REMOVALS EXCLUDED FOR THE ANNUAL INVENTORY SUBMISSION AND ALSO FOR THE KP-LULUCF INVENTORY

A.5.1: GHG inventory
A.5.2: KP-LULUCF inventory

Provided in Chapter 1.4

ANNEX 6 ADDITIONAL INFORMATION TO BE CONSIDERED AS PART OF THE ANNUAL INVENTORY SUBMISSION AND THE SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1, OF THE KYOTO PROTOCOL OR OTHER USEFUL REFERENCE INFORMATION

For further information see Chapter 14.

SIAR reports

R-2 List of discrepant transactions

There have been no discrepant transactions.

R-3 List of CDM notifications

There have been no CDM notifictions.

R-4 List of non-replacements

There have been no non-replacements.

R-5 List of invalid units

There have been no invalid units.

ANNEX 7 TABLES 6.1 AND 6.2 OF THE IPCC GOOD PRACTICE GUIDANCE

Introduction

A consistent assessment of uncertainties of the Bulgarian greenhouse gas inventory requires a detailed understanding of the uncertainties of the respective input parameters. In the submission 2014 was prepared the second detailed uncertainty evaluation, the Bulgarian inventory compilers have spent considerable effort to obtain uncertainties from individual contributors to the inventory. This leads to a situation where national information or at least national expert knowledge directly from the stage of inventory development may flow into the assessment of uncertainties.

For the uncertainties of the national total emissions estimated by Tier 2 analysis (the Monte Carlo approach), that have been made in Submission 2012 and 2014, Bulgaria decided to perform the Monte Carlo analysis every two-years instead of every year. The next Tier 2 analysis will be provided in submission 2016.

The respective sectoral uncertainties are documented in detail in the sectoral chapters of this report.

Theoretical background

The assessment and propagation of uncertainties in emission inventories has been described in detail by IPCC (IPCC 2000, IPCC 2006). Principally, two different pathways may be taken to arrive at a total uncertainty, and to develop an inventory uncertainty. The "Tier 1" approach is based on error propagation: assuming input information is available in form of normal distribution, and input uncertainties are statistically independent, the approach allows for reliable assessment of inventory uncertainty. More flexibility is possible in the "Tier 2" method. The Monte-Carlo approach allows any probability distribution of input parameters, and it also enables to define statistical dependencies between parameters. The most obvious dependency is a full dependency. This occurs when two values are based on the identical set of measurements. A variation or error in one value would then be fully reflected also in the other value. While "full dependency" theoretically can also be covered in error propagation, this is normally not done and only in a very limited way possible in the IPCC spreadsheets.

The general properties of error propagation allow to combine (add up) information in a way that the relative uncertainty (as percentage of the mean value) of the combination becomes lower than the relative uncertainty of any of the input parameters. This advantage of going into detail is often implicitly taken advantage of, when a problem is disassembled into sub-problems and the sub-results are being recombined. Nevertheless it is not always the most detailed level that yields results of lowest uncertainty. If measurements or assessments at the most detailed level are difficult, a more comprehensive level of information may provide the lower overall uncertainty.

As a consequence, optimizing the approach requires collecting input information at the most detailed level an inventory is prepared at. Attaching uncertainty data then may be done at a level where greatest confidence can be expected on the data. This may be the most detailed level, but more often uncertainty data will not be available, or a "balance" approach (energy balance, solvent balance) will allow more reliability at a more aggregated level.

Procedure

For the uncertainty assessment of the Bulgarian greenhouse gas inventory, the most detailed level of the inventory system was used as the base level. This "base level" of the inventory facilitates compilation of emission data for different purposes.

This approach of starting at the most detailed level the inventory offers facilitated an assessment of emission uncertainty at any level that the most reasonable uncertainty data are available. Very detailed information can be entered directly, for aggregate information the same uncertainty (as a statistically dependent entity) is applied for all input entries concerned.

Uncertainty information was taken from national studies, from international information (as e.g. in the IPCC reports) from variation presented in literature, and by contacting national experts. Structured interviews were held. The difference between a Tier 1 and a Tier 2 uncertainty approach can be explained by covariance of uncertainties between (key) source categories, which occurs when data are statistically dependent. The Tier 1 approach allows considering co-variance between years for one source category, but does not cover co-variances between source categories.

In all input and output parameters, uncertainty has been expressed as normal or lognormal probability density function. In line with the IPCC requirements, the uncertainty range is presented as the range with 95% probability of a given value being within its boundaries. Thus the boundaries were given as the 2.5 and 97.5-percentiles of the respective distribution. For a normal distribution, this is +/- 2 standard deviations from the mean.

Conclusions

The comparison of Tier 1 and Tier 2 (see Table 261, Table 262 and Table 263) results shows that, basically, both approaches yield similar results for an individual source category. Differences become visible where distributions are not symmetric. This is also seen in the difference between the "lower range" vs. "upper range" uncertainties, and those determined by standard deviations. We need to mention specifically that this difference in the results is not a necessity of the tier 2 approach, but depends just on the input assumptions taken.

Table 271 Tier 1 Uncertainty Calculation and Reporting (level assessment), Gg CO_2-eq.(excluding LULUCF)

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF uncertainty	Uncertainty in trend in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
1A1		CH4	15,8	7,4	3	50	50,09	0,006	0,000	0,000	0,000	0,000	0,000
1A1		N2O	134,1	119,5	3	200	200,02	0,391	0,000	0,001	0,086	0,004	0,086
1A1	Gaseous fuel	CO2	6476,1	2294,4	1	2	2,24	0,084	-0,008	0,019	-0,016	0,027	0,031
1A1	Liquid fuel	CO2	9993,9	1561,7	3	7	7,62	0,195	-0,028	0,013	-0,198	0,054	0,205
1A1	Solid fuel	CO2	25497,3	27589,7	1	2	2,24	1,011	0,121	0,226	0,243	0,320	0,402
1A2	Gaseous fuel	CO2	0,0	1853,7	1	2	2,24	0,068	0,015	0,015	0,030	0,022	0,037
1A2	Liquid fuel	CO2	7243,4	733,9	3	7	7,62	0,092	-0,024	0,006	-0,166	0,026	0,168
1A2	Solid fuel	CO2	10233,6	692,5	1	2	2,24	0,025	-0,036	0,006	-0,073	0,008	0,073
1A2	Other Fuels	CO3	0	40,1	5	2	5,39	0,004	0,000	0,000	0,001	0,002	0,002
1A2		CH4	25,5	11,6	3	50	50,09	0,010	0,000	0,000	0,000	0,000	0,001
1A2		N2O	60,4	17,9	3	200	200,02	0,059	0,000	0,000	-0,020	0,001	0,020
1A3a	Liquid fuel	CO2	208,9	34,1	5	5	7,07	0,004	-0,001	0,000	-0,003	0,002	0,004
1A3a	Liquid fuel	CH4	0,0	0,0	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3a	Liquid fuel	N2O	1,8	0,3	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3b	Diesel Oil	CO2	2631,4	4975,7	3	5	5,83	0,475	0,030	0,041	0,150	0,173	0,229
1A3b	Gasoline	CO2	4364,4	1597,0	3	5	5,83	0,153	-0,005	0,013	-0,024	0,056	0,061
1A3b		CH4	84,5	12,3	3	40	40,11	0,008	0,000	0,000	-0,010	0,000	0,010
1A3b		N2O	89,5	75,4	3	40	40,11	0,050	0,000	0,001	0,010	0,003	0,010
1A3b	LPG	CO2	0,0	1018,9	3	5	5,83	0,097	0,008	0,008	0,042	0,035	0,055
1A3b	Gaseous fuel	CO2	0,0	152,1	3	5	5,83	0,015	0,001	0,001	0,006	0,005	0,008

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF uncertainty	Uncertainty in trend in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
1A3c	Liquid fuel	CO2	0,0	67,9	5	5	7,07	0,008	0,001	0,001	0,003	0,004	0,005
1A3c	Liquid fuel	CH4	0,0	0,1	5	60	60,21	0,000	0,000	0,000	0,000	0,000	0,000
1A3c	Liquid fuel	N2O	0,0	8,7	5	60	60,21	0,009	0,000	0,000	0,004	0,001	0,004
1A3d	Gas/Diesel Oil	CO2	0,0	8,5	50	5	50,25	0,007	0,000	0,000	0,000	0,005	0,005
1A3d	Gas/Diesel Oil	CH4	0,0	0,0	50	50	70,71	0,000	0,000	0,000	0,000	0,000	0,000
1A3d	Gas/Diesel Oil	N2O	0,0	0,1	50	140	148,66	0,000	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	CO2	0,0	467,9	1	5	5,10	0,039	0,004	0,004	0,019	0,005	0,020
1A3e	Gaseous fuel	CH4	0,0	0,9	1	50	50,01	0,001	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	N2O	0,0	0,3	1	150	150,00	0,001	0,000	0,000	0,000	0,000	0,000
1A4		CH4	283,7	278,3	5	50	50,25	0,229	0,001	0,002	0,056	0,016	0,058
1A4		N2O	31,6	47,9	5	200	200,06	0,157	0,000	0,000	0,053	0,003	0,053
1A4	Gaseous fuel	CO2	0,0	362,4	5	2	5,39	0,032	0,003	0,003	0,006	0,021	0,022
1A4	Liquid fuel	CO2	2795,5	587,1	5	7	8,60	0,083	-0,007	0,005	-0,047	0,034	0,058
1A4	Solid fuel	CO2	3403,0	968,9	2	5	5,39	0,085	-0,006	0,008	-0,030	0,022	0,038
1A5	Stationary	CO2	6497,6	0,0	5	7	8,60	0,000	-0,027	0,000	-0,187	0,000	0,187
1A5	Stationary	CH4	8,8	0,0	5	50	50,25	0,000	0,000	0,000	-0,002	0,000	0,002
1A5	Stationary	N2O	10,9	0,0	5	200	200,06	0,000	0,000	0,000	-0,009	0,000	0,009
1B1	Solid Fuels	CH4	1869,9	939,5	10	200	200,25	3,082	0,000	0,008	0,005	0,109	0,109
1B2	Oil and Natural Gas	CH4	1125,1	624,8	5	100	100,12	1,025	0,001	0,005	0,050	0,036	0,062
1B2	Oil and Natural Gas	CO2	5,0	18,2	5	100	100,12	0,030	0,000	0,000	0,013	0,001	0,013
1B2	Oil and Natural Gas	N2O	0,0	0,0	5	1000	1000,01	0,000	0,000	0,000	0,000	0,000	0,000
2A1	Cement Production	CO2	2406,4	997,8	2	2	2,83	0,046	-0,002	0,008	-0,003	0,023	0,023

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions intro-duced by EF uncertainty	Uncertainty in trend in national emissions intro-duced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
2A2	Lime Production	CO2	1103,3	999,7	2	2	2,83	0,046	0,004	0,008	0,007	0,023	0,024
2A3	Limestone and Dolomite Use	CO2	0,0	0,0	5	15	15,81	0,000	0,000	0,000	0,000	0,000	0,000
2A4	Soda Ash	CO2	126,6	67,1	2	3	3,61	0,004	0,000	0,001	0,000	0,002	0,002
2A7	Other - Glass	CO2	186,2	64,6	6	60	60,30	0,064	0,000	0,001	-0,014	0,004	0,015
2A7	Other Bricks	CO2	551,2	34,0	3	5	5,83	0,003	-0,002	0,000	-0,010	0,001	0,010
2A7	Other - DeSOx	CO2	0,0	690,1	1,5	2,5	2,92	0,033	0,006	0,006	0,014	0,012	0,019
2B1	Ammonia Production	CO2	1693,3	377,9	3,5	7	7,83	0,048	-0,004	0,003	-0,027	0,015	0,031
2B2	Nitric Acid Production	N2O	2009,8	130,5	3	7	7,62	0,016	-0,007	0,001	-0,050	0,005	0,051
2B4.2	Calcium Carbide	CO2	89,3	14,5	5	10	11,18	0,003	0,000	0,000	-0,002	0,001	0,003
2B5	Other (please specify)	CH4	9,1	0,0	5	50	50,25	0,000	0,000	0,000	-0,002	0,000	0,002
2C	Metal Production	CH4	73,3	0,0	10	25	26,93	0,000	0,000	0,000	-0,008	0,000	0,008
2C1	Iron and Steel Production	CO2	3481,4	50,3	5	10	11,18	0,009	-0,014	0,000	-0,139	0,003	0,139
2C2	Ferroalloys Production	CO2	218,8	0,0	5	25	25,50	0,000	-0,001	0,000	-0,022	0,000	0,022
2F	ODS substitutes	HFCs	0,0	456,5	10	50	50,99	0,381	0,004	0,004	0,187	0,053	0,195
2F8	Electrical Equipment	SF6	3,5	12,0	10	50	50,99	0,010	0,000	0,000	0,004	0,001	0,004
2G	Other	CH4	7,6	0,0	10	50	50,99	0,000	0,000	0,000	-0,002	0,000	0,002
3	Solvent and other product use	CO2	866,6	22,4	10	30	31,62	0,012	-0,003	0,000	-0,101	0,003	0,101
3	Solvent and other product use	N2O	33,2	18,6	10	100	100,50	0,031	0,000	0,000	0,002	0,002	0,003
4A1	Cattle	CH4	2348,9	929,8	2	20	20,10	0,306	-0,002	0,008	-0,040	0,022	0,046
4A.2	Buffalo	CH4	29,2	11,0	2	50	50,04	0,009	0,000	0,000	-0,001	0,000	0,002
4A.3	Sheep	CH4	1336,2	196,4	2	20	20,10	0,065	-0,004	0,002	-0,078	0,005	0,078
4A.4	Goats	CH4	45,7	33,3	2	50	50,04	0,027	0,000	0,000	0,004	0,001	0,004

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF uncertainty	Uncertainty in trend in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
4A.6	Horses	CH4	46,2	55,1	2	50	50,04	0,045	0,000	0,000	0,013	0,001	0,013
4A.7	Mules and Asses	CH4	74,6	29,1	2	50	50,04	0,024	0,000	0,000	-0,003	0,001	0,003
4A.8	Swine	CH4	127,3	17,9	2	50	50,04	0,015	0,000	0,000	-0,019	0,000	0,019
4B	N2O em. from Manure Management	N2O	1637,4	527,2	2	300	300,01	2,591	-0,002	0,004	-0,721	0,012	0,721
4B1	Cattle	CH4	62,1	25,5	2	20	20,10	0,008	0,000	0,000	-0,001	0,001	0,001
4B.2	Buffalo	CH4	4,8	1,8	2	50	50,04	0,001	0,000	0,000	0,000	0,000	0,000
4B.3	Sheep	CH4	23,9	3,5	2	50	50,04	0,003	0,000	0,000	-0,003	0,000	0,003
4B.4	Goats	CH4	1,6	1,2	2	50	50,04	0,001	0,000	0,000	0,000	0,000	0,000
4B.6	Horses	CH4	5,4	6,4	2	50	50,04	0,005	0,000	0,000	0,002	0,000	0,002
4B.7	Mules and Asses	CH4	8,5	3,3	2	50	50,04	0,003	0,000	0,000	0,000	0,000	0,000
4B.8	Swine	CH4	3499,7	448,5	2	20	20,10	0,148	-0,011	0,004	-0,214	0,010	0,214
4B.9	Poultry	CH4	66,7	24,6	2	50	50,04	0,020	0,000	0,000	-0,004	0,001	0,004
4C	Rice Cultivation	CH4	114,2	83,5	25	80	83,82	0,115	0,000	0,001	0,017	0,024	0,030
4D1	Direct soil emissions	N2O	5426,7	2243,5	3	250	250,02	9,189	-0,004	0,018	-0,973	0,078	0,976
4D2	Pasture, Range and Paddock Manure	N2O	1168,4	272,5	3	250	250,02	1,116	-0,003	0,002	-0,641	0,009	0,641
4D3	Indirect Emissions	N2O	3723,1	1376,6	3	500	500,01	11,275	-0,004	0,011	-2,002	0,048	2,003
4F	Field Burning	CH4	34,1	23,1	25	50	55,90	0,021	0,000	0,000	0,002	0,007	0,007
4F	Field Burning	N2O	14,6	11,2	25	200	201,56	0,037	0,000	0,000	0,006	0,003	0,007
6A	Solid Waste Disposal on Land	CH4	3269,2	2828,6	30	80	85,44	3,959	0,010	0,023	0,782	0,985	1,257
6B	Waste Water Handling	CH4	2549,8	580,8	30	30	42,43	0,404	-0,006	0,005	-0,171	0,202	0,265
6B	Waste Water Handling	N2O	284,3	162,3	30	100	104,40	0,278	0,000	0,001	0,016	0,056	0,059
6C	Waste Incineration	CO2	19,0	20,6	15	100	101,12	0,034	0,000	0,000	0,009	0,004	0,010

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF uncertainty	Uncertainty in trend in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
6C	Waste Incineration	N2O	7,5	8,0	15	100	101,12	0,013	0,000	0,000	0,003	0,001	0,004
6D	Compost production	CH4	0,0	6,8	10	100	100,50	0,011	0,000	0,000	0,006	0,001	0,006
6D	Compost production	N2O	0,0	7,6	10	100	100,50	0,012	0,000	0,000	0,006	0,001	0,006
Total			**121880,3**	**61045,6**				**15,74**					**2,84**
%			**100,00**	**100,00**									
National Total			**121880,3**	**61045,6**									

Table 272 Tier 1 Uncertainty Calculation and Reporting (level assessment), Gg CO_2-eq.(Including LULUCF)

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF uncertainty	Uncertainty in trend in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
1A1		CH4	15,8	7,4	3	50	50,09	0,007	0,000	0,000	0,000	0,000	0,000
1A1		N2O	134,1	119,5	3	200	200,02	0,452	0,000	0,001	0,100	0,005	0,100

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF uncertainty	Uncertainty in trend in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
1A1	Gaseous fuel	CO2	6476,1	2294,4	1	2	2,24	0,097	-0,008	0,021	-0,016	0,030	0,034
1A1	Liquid fuel	CO2	9993,9	1561,7	3	7	7,62	0,225	-0,031	0,014	-0,215	0,061	0,224
1A1	Solid fuel	CO2	25497,3	27589,7	1	2	2,24	1,168	0,140	0,255	0,279	0,361	0,456
1A2	Gaseous fuel	CO2	0,0	1853,7	1	2	2,24	0,078	0,017	0,017	0,034	0,024	0,042
1A2	Liquid fuel	CO2	7243,4	733,9	3	7	7,62	0,106	-0,026	0,007	-0,182	0,029	0,184
1A2	Solid fuel	CO2	10233,6	692,5	1	2	2,24	0,029	-0,040	0,006	-0,080	0,009	0,080
1A2	Other Fuels	CO2	0,0	40,1	5	2	5,39	0,004	0,000	0,000	0,001	0,003	0,003
1A2		CH4	25,5	11,6	3	50	50,09	0,011	0,000	0,000	0,000	0,000	0,001
1A2		N2O	60,4	17,9	3	200	200,02	0,068	0,000	0,000	-0,021	0,001	0,021
1A3a	Liquid fuel	CO2	208,9	34,1	5	5	7,07	0,005	-0,001	0,000	-0,003	0,002	0,004
1A3a	Liquid fuel	CH4	0,0	0,0	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3a	Liquid fuel	N2O	1,8	0,3	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3b	Diesel Oil	CO2	2631,4	4975,7	3	5	5,83	0,549	0,034	0,046	0,171	0,195	0,259
1A3b	Gasoline	CO2	4364,4	1597,0	3	5	5,83	0,176	-0,005	0,015	-0,025	0,063	0,067
1A3b		CH4	84,5	12,3	3	40	40,11	0,009	0,000	0,000	-0,011	0,000	0,011
1A3b		N2O	89,5	75,4	3	40	40,11	0,057	0,000	0,001	0,012	0,003	0,012
1A3b	LPG	CO2	0,0	1018,9	3	5	5,83	0,112	0,009	0,009	0,047	0,040	0,062
1A3b	Gaseous fuel	CO2	0,0	152,1	3	5	5,83	0,017	0,001	0,001	0,007	0,006	0,009
1A3c	Liquid fuel	CO2	0,0	67,9	5	5	7,07	0,009	0,001	0,001	0,003	0,004	0,005
1A3c	Liquid fuel	CH4	0,0	0,1	5	60	60,21	0,000	0,000	0,000	0,000	0,000	0,000
1A3c	Liquid fuel	N2O	0,0	8,7	5	60	60,21	0,010	0,000	0,000	0,005	0,001	0,005
1A3d	Gas/Diesel Oil	CO2	0,0	8,5	50	5	50,25	0,008	0,000	0,000	0,000	0,006	0,006

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF uncertainty	Uncertainty in trend in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
1A3d	Gas/Diesel Oil	CH4	0,0	0,0	50	50	70,71	0,000	0,000	0,000	0,000	0,000	0,000
1A3d	Gas/Diesel Oil	N2O	0,0	0,1	50	140	148,66	0,000	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	CO2	0,0	467,9	1	5	5,10	0,045	0,004	0,004	0,022	0,006	0,022
1A3e	Gaseous fuel	CH4	0,0	0,9	1	50	50,01	0,001	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	N2O	0,0	0,3	1	150	150,00	0,001	0,000	0,000	0,000	0,000	0,000
1A4		CH4	283,7	278,3	5	50	50,25	0,265	0,001	0,003	0,065	0,018	0,067
1A4		N2O	31,6	47,9	5	200	200,06	0,181	0,000	0,000	0,060	0,003	0,060
1A4	Gaseous fuel	CO2	0,0	362,4	5	2	5,39	0,037	0,003	0,003	0,007	0,024	0,025
1A4	Liquid fuel	CO2	2795,5	587,1	5	7	8,60	0,096	-0,007	0,005	-0,050	0,038	0,063
1A4	Solid fuel	CO2	3403,0	968,9	2	5	5,39	0,099	-0,006	0,009	-0,032	0,025	0,041
1A5	Stationary	CO2	6497,6	0,0	5	7	8,60	0,000	-0,029	0,000	-0,206	0,000	0,206
1A5	Stationary	CH4	8,8	0,0	5	50	50,25	0,000	0,000	0,000	-0,002	0,000	0,002
1A5	Stationary	N2O	10,9	0,0	5	200	200,06	0,000	0,000	0,000	-0,010	0,000	0,010
1B1	Solid Fuels	CH4	1869,9	939,5	10	200	200,25	3,561	0,000	0,009	0,047	0,123	0,132
1B2	Oil and Natural Gas	CH4	1125,1	624,8	5	100	100,12	1,184	0,001	0,006	0,069	0,041	0,080
1B2	Oil and Natural Gas	CO2	5,0	18,2	5	100	100,12	11,242	0,054	0,064	5,403	0,453	5,422
1B2	Oil and Natural Gas	N2O	0,0	0,0	5	1000	1000,01	0,057	0,000	0,000	0,032	0,000	0,032
2A1	Cement Production	CO2	2406,4	997,8	2	2	2,83	0,053	-0,002	0,009	-0,003	0,026	0,026
2A2	Lime Production	CO2	1103,3	999,7	2	2	2,83	0,054	0,004	0,009	0,009	0,026	0,028
2A3	Limestone and Dolomite Use	CO2	0,0	0,0	5	15	15,81	0,000	0,000	0,000	0,000	0,000	0,000
2A4	Soda Ash	CO2	126,6	67,1	2	3	3,61	0,005	0,000	0,001	0,000	0,002	0,002
2A7	Other - Glass	CO2	186,2	64,6	6	60	60,30	0,074	0,000	0,001	-0,015	0,005	0,016

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions intro-duced by EF uncertainty	Uncertainty in trend in national emissions intro-duceed by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
2A7	Other Bricks	CO2	551,2	34,0	3	5	5,83	0,004	-0,002	0,000	-0,011	0,001	0,011
2A7	Other - DeSOx	CO2	0,0	690,1	1,5	2,5	2,92	0,038	0,006	0,006	0,016	0,014	0,021
2B1	Ammonia Production	CO2	1693,3	377,9	3,5	7	7,83	0,056	-0,004	0,003	-0,029	0,017	0,034
2B2	Nitric Acid Production	N2O	2009,8	130,5	3	7	7,62	0,019	-0,008	0,001	-0,055	0,005	0,055
2B4.2	Calcium Carbide	CO2	89,3	14,5	5	10	11,18	0,003	0,000	0,000	-0,003	0,001	0,003
2B5	Other (please specify)	CH4	9,1	0,0	5	50	50,25	0,000	0,000	0,000	-0,002	0,000	0,002
2C	Metal Production	CH4	73,3	0,0	10	25	26,93	0,000	0,000	0,000	-0,008	0,000	0,008
2C1	Iron and Steel Production	CO2	3481,4	50,3	5	10	11,18	0,011	-0,015	0,000	-0,153	0,003	0,153
2C2	Ferroalloys Production	CO2	218,8	0,0	5	25	25,50	0,000	-0,001	0,000	-0,025	0,000	0,025
2F	ODS substitutes	HFCs	0,0	456,5	10	50	50,99	0,440	0,004	0,004	0,211	0,060	0,219
2F8	Electrical Equipment	SF6	3,5	12,0	10	50	50,99	0,012	0,000	0,000	0,005	0,002	0,005
2G	Other	CH4	7,6	0,0	10	50	50,99	0,000	0,000	0,000	-0,002	0,000	0,002
3	Solvent and other product use	CO2	866,60	22,39	10	30	31,62	0,013	-0,004	0,000	-0,111	0,003	0,111
3	Solvent and other product use	N2O	33,2	18,6	10	100	100,50	0,035	0,000	0,000	0,002	0,002	0,003
4A1	Cattle	CH4	2348,9	929,8	2	20	20,10	0,354	-0,002	0,009	-0,040	0,024	0,047
4A.2	Buffalo	CH4	29,2	11,0	2	50	50,04	0,010	0,000	0,000	-0,002	0,000	0,002
4A.3	Sheep	CH4	1336,2	196,4	2	20	20,10	0,075	-0,004	0,002	-0,085	0,005	0,085
4A.4	Goats	CH4	45,7	33,3	2	50	50,04	0,032	0,000	0,000	0,005	0,001	0,005
4A.6	Horses	CH4	46,2	55,1	2	50	50,04	0,052	0,000	0,001	0,015	0,001	0,015
4A.7	Mules and Asses	CH4	74,6	29,1	2	50	50,04	0,028	0,000	0,000	-0,003	0,001	0,003
4A.8	Swine	CH4	127,3	17,9	2	50	50,04	0,017	0,000	0,000	-0,020	0,000	0,020
4B	N2O em. from Manure Management	N2O	1637,4	527,2	2	300	300,01	2,993	-0,003	0,005	-0,758	0,014	0,758

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF uncertainty	Uncertainty in trend in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
4B1	Cattle	CH4	62,1	25,5	2	20	20,10	0,010	0,000	0,000	-0,001	0,001	0,001
4B.2	Buffalo	CH4	4,8	1,8	2	50	50,04	0,002	0,000	0,000	0,000	0,000	0,000
4B.3	Sheep	CH4	23,9	3,5	2	50	50,04	0,003	0,000	0,000	-0,004	0,000	0,004
4B.4	Goats	CH4	1,6	1,2	2	50	50,04	0,001	0,000	0,000	0,000	0,000	0,000
4B.6	Horses	CH4	5,4	6,4	2	50	50,04	0,006	0,000	0,000	0,002	0,000	0,002
4B.7	Mules and Asses	CH4	8,5	3,3	2	50	50,04	0,003	0,000	0,000	0,000	0,000	0,000
4B.8	Swine	CH4	3499,7	448,5	2	20	20,10	0,171	-0,012	0,004	-0,233	0,012	0,234
4B.9	Poultry	CH4	66,7	24,6	2	50	50,04	0,023	0,000	0,000	-0,004	0,001	0,004
4C	Rice Cultivation	CH4	114,2	83,5	25	80	83,82	0,133	0,000	0,001	0,020	0,027	0,034
4D1	Direct soil emissions	N2O	5426,7	2243,5	3	250	250,02	10,616	-0,004	0,021	-0,946	0,088	0,950
4D2	Pasture, Range and Paddock Manure	N2O	1168,4	272,5	3	250	250,02	1,289	-0,003	0,003	-0,691	0,011	0,691
4D3	Indirect Emissions	N2O	3723,1	1376,6	3	500	500,01	13,027	-0,004	0,013	-2,050	0,054	2,051
4F	Field Burning	CH4	34,1	23,1	25	50	55,90	0,024	0,000	0,000	0,003	0,008	0,008
4F	Field Burning	N2O	14,6	11,2	25	200	201,56	0,043	0,000	0,000	0,007	0,004	0,008
5A1	Forest Land remaining Forest Land	CO2	-14213,1	-9577,9	3	149	149,45	-27,091	-0,024	-0,089	-3,641	-0,376	3,660
5A2	Land converted to Forest Land	CO2	-562,4	-774,6	10	122	122,52	-1,796	-0,005	-0,007	-0,565	-0,101	0,574
5B1	Cropland remainig Cropland	CO2	51,4	686,6	3	184	184,04	2,391	0,006	0,006	1,126	0,027	1,126
5B2	Land converted to Cropland	CO2	886,4	886,4	10	415	415,47	6,970	0,004	0,008	1,741	0,116	1,745
5C2	Land converted to Grassland	CO2	-632,7	-632,7	10	445	444,81	-5,326	-0,003	-0,006	-1,331	-0,083	1,333
5D2	Land converted to Wetlands	CO2	0,0	265,3	10	25	26,50	0,133	0,002	0,002	0,060	0,035	0,070
5E2	Land converted to Settlements	CO2	682,7	939,4	10	74	75,00	1,333	0,006	0,009	0,416	0,123	0,434
6A	Solid Waste Disposal on Land	CH4	3269,2	2828,6	30	80	85,44	4,574	0,011	0,026	0,910	1,110	1,436

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2012	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF uncertainty	Uncertainty in trend in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
A		B	C	D	E	F	G	H	I	J	K	L	M
			Gg CO_2 eq.		%	%	%	%	%	%	%	%	%
6B	Waste Water Handling	CH4	2549,8	580,8	30	30	42,43	0,466	-0,006	0,005	-0,185	0,228	0,293
6B	Waste Water Handling	N2O	284,3	162,3	30	100	104,40	0,321	0,000	0,002	0,022	0,064	0,067
6C	Waste Incineration	CO2	19,0	20,6	15	100	101,12	0,039	0,000	0,000	0,010	0,004	0,011
6C	Waste Incineration	N2O	7,5	8,0	15	100	101,12	4,978	0,013	0,028	1,311	0,596	1,440
6D	Compost production	CH4	0,0	6,8	10	100	100,50	4,226	0,024	0,024	2,400	0,339	2,424
6D	Compost production	N2O	0,0	7,6	10	100	100,50	4,679	0,027	0,027	2,657	0,376	2,684
Total			**108092,6**	**52838,1**				**36,65**					**8,57**
%			**100,00**	**100,00**									
National Total			**108092,6**	**52838,1**									

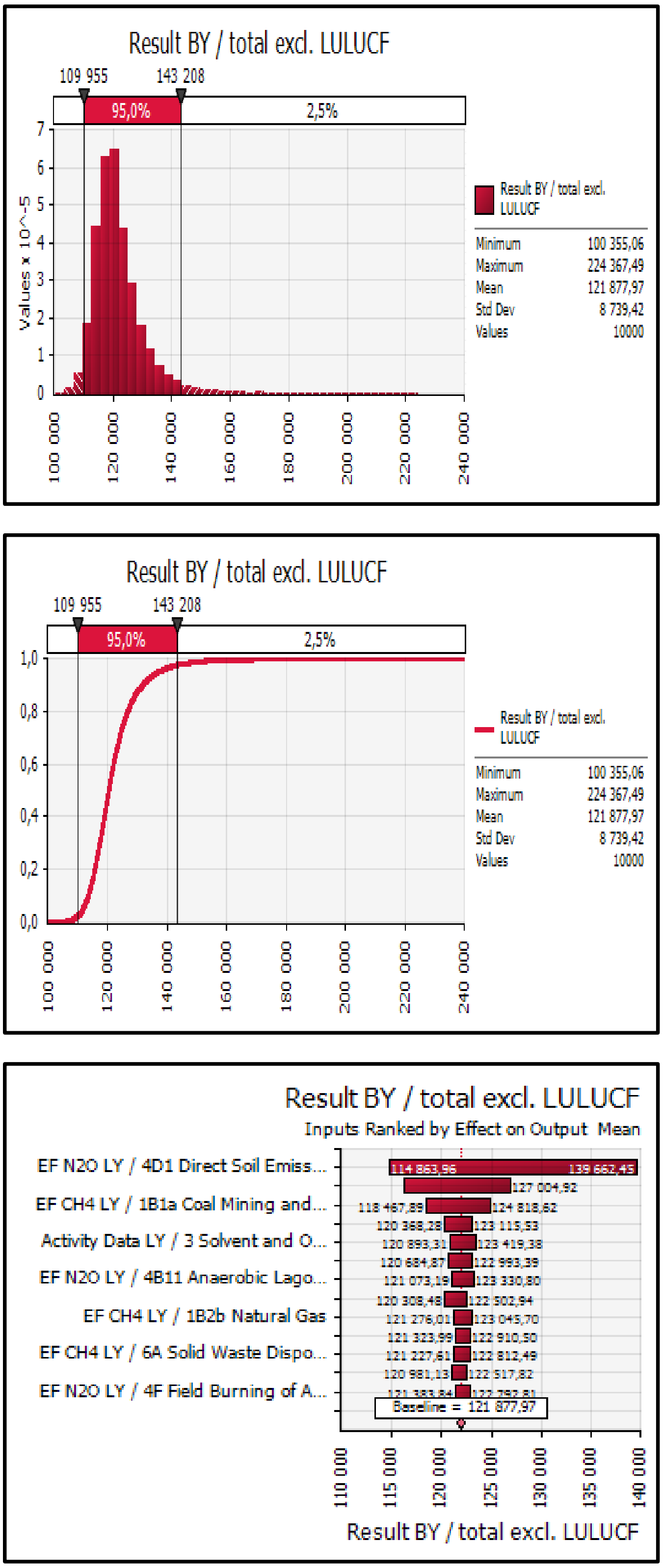
***** *Considering LULUCF sector, values for the uncertainty related to activity data and emission factor have been assigned by expert judgment, taking into account the final combined uncertainty.*

Table 273 Tier 2 Uncertainty assessment

IPCC Source category	Fuel	Gas	Uncertainty in 2012 emissions as % of emissions in the category							Range of likely % change between 2012 and 1988	
			1988 emissions (Gg CO2 equivalent)	2012 emissions (Gg CO2 equivalent)	% below (2.5 percentile)	% above (97.5 percentile)	Uncertainty introduced on national total incl. LULUCF in 2012 (%)	Uncertainty introduced on national total excl. LULUCF in 2012 (%)	% change in emissions between 2012 and 1988 (%)	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A1a	Liquid Fuels	CO2	8 155,62	631,48	3,3%	3,3%	0,04%	0,03%	-92,3%	1,5%	2,0%
1A1a	Solid Fuels	CO2	25 497,33	27 586,60	1,7%	1,8%	0,94%	0,81%	8,2%	0,0%	0,0%
1A1a	Gaseous Fuels	CO2	6 476,06	2 210,63	2,0%	2,0%	0,09%	0,07%	-65,9%	1,8%	1,9%
1A1b	Liquid Fuels	CO2	1 838,23	930,18	3,3%	3,3%	0,06%	0,05%	-49,4%	18,4%	24,5%
1A2c	Solid Fuels	CO2	0,00	370,47	1,7%	1,8%	0,01%	0,01%	-	-	-
1A2c	Gaseous Fuels	CO2	0,00	590,00	2,0%	2,0%	0,02%	0,02%	-	-	-
1A2e	Gaseous Fuels	CO2	0,00	238,16	2,0%	2,0%	0,01%	0,01%	-	-	-
1A2f	Liquid Fuels	CO2	3 122,90	590,84	3,3%	3,3%	0,04%	0,03%	-81,1%	4,1%	5,5%
1A2f	Solid Fuels	CO2	9 069,45	317,63	1,7%	1,8%	0,01%	0,01%	-96,5%	0,0%	0,0%
1A2f	Gaseous Fuels	CO2	0,00	766,81	2,0%	2,0%	0,03%	0,03%	-	-	-
1A2f	Other Fuels	CO2	0,00	40,14	20,8%	21,1%	0,02%	0,01%	-	-	-
1A3b	Gasoline	CO2	4 364,38	1 597,05	3,3%	3,3%	0,10%	0,09%	-63,4%	10,3%	13,7%
1A3b	Diesel Oil	CO2	2 631,35	4 975,67	3,3%	3,3%	0,32%	0,27%	89,1%	36,8%	49,1%
1A3b	Liquefied Petroleum Gases (LPG)	CO2	0,00	1 018,93	3,3%	3,3%	0,06%	0,06%	-	-	-
1A3b	Gaseous Fuels	CO2	0,00	152,08	2,0%	2,0%	0,01%	0,01%	-	-	-
1A3e	Gaseous Fuels	CO2	0,00	467,86	2,0%	2,0%	0,02%	0,02%	-	-	-
1A4a	Liquid Fuels	CO2	0,00	105,62	3,3%	3,3%	0,01%	0,01%	-	-	-
1A4a	Gaseous Fuels	CO2	0,00	186,90	2,0%	2,0%	0,01%	0,01%	-	-	-
1A4b	Solid Fuels	CO2	3 402,98	936,51	1,7%	1,8%	0,03%	0,03%	-72,5%	0,0%	0,0%
1A4c	Liquid Fuels	CO2	1 639,94	415,17	3,3%	3,3%	0,03%	0,02%	-74,7%	6,0%	8,0%

1B2c Venting	Venting	CO2	0,58	15,37	49,3%	49,0%	0,01%	0,01%	2529,2%	0,0%	0,0%
2A1	Cement Production	CO2	2 406,36	997,83	1,4%	1,4%	0,03%	0,02%	-58,5%	0,0%	0,0%
2A2	Lime Production	CO2	1 103,26	999,75	2,0%	2,0%	0,04%	0,03%	-9,4%	49,9%	52,6%
2A7	Glass	CO2	186,24	64,62	9,8%	9,8%	0,01%	0,01%	-65,3%	11,0%	14,0%
2A7	DeSOx installations	CO2	0,00	690,11	1,1%	1,1%	0,01%	0,01%	-	-	-
2B1	Ammonia Production	CO2	1 693,34	377,94	1,4%	1,4%	0,01%	0,01%	-77,7%	1,7%	1,8%
3	Solvent and Other Product Use	CO2	866,60	22,39	100,0%	200,4%	0,07%	0,06%	-97,4%	0,0%	0,0%
6C	Waste Incineration	CO2	19,04	20,61	20,0%	20,3%	0,01%	0,01%	8,3%	0,0%	0,0%
1A4a	Biomass	CH4	0,00	12,75	49,3%	49,0%	0,01%	0,01%	-	-	-
1A4b	Solid Fuels	CH4	226,22	60,96	48,9%	49,0%	0,06%	0,05%	-73,1%	0,0%	0,0%
1A4b	Biomass	CH4	50,03	200,13	49,3%	49,0%	0,19%	0,16%	300,0%	0,0%	0,0%
1B1a	Coal Mining and Handling	CH4	1 858,37	937,33	195,7%	195,6%	3,55%	3,07%	-49,6%	0,0%	0,0%
1B1b	Solid Fuel Transformation	CH4	11,51	2,18	196,0%	195,8%	0,01%	0,01%	-81,0%	0,0%	0,0%
1B2b	Natural Gas	CH4	1 097,03	613,40	49,1%	49,0%	0,58%	0,50%	-44,1%	0,0%	0,0%
1B2c Venting	Venting	CH4	17,07	6,57	48,8%	48,8%	0,01%	0,01%	-61,5%	0,0%	0,0%
4A1	Cattle	CH4	2 348,89	929,76	19,9%	20,1%	0,36%	0,31%	-60,4%	0,0%	0,0%
4A3	Sheep	CH4	1 336,24	196,36	19,9%	20,1%	0,08%	0,07%	-85,3%	0,0%	0,0%
4A4	Goats	CH4	45,65	33,34	19,9%	20,1%	0,01%	0,01%	-27,0%	0,0%	0,0%
4A6	Horses	CH4	46,16	55,11	19,9%	20,1%	0,02%	0,02%	19,4%	0,0%	0,0%
4A7	Mules and Asses	CH4	74,61	29,12	19,9%	20,1%	0,01%	0,01%	-61,0%	0,0%	0,0%
4A8	Swine	CH4	127,33	17,94	19,9%	20,1%	0,01%	0,01%	-85,9%	0,0%	0,0%
4B1	Cattle	CH4	62,05	25,50	30,0%	31,8%	0,02%	0,01%	-58,9%	0,0%	0,0%
4B8	Swine	CH4	3 499,75	448,51	30,0%	31,8%	0,27%	0,23%	-87,2%	0,0%	0,0%
4B9	Poultry	CH4	66,69	24,58	30,0%	31,8%	0,01%	0,01%	-63,1%	0,0%	0,0%
4C1	Irrigated	CH4	114,24	83,53	40,8%	71,0%	0,09%	0,08%	-26,9%	0,0%	0,0%
4F	Field Burning of Agricultural Residues	CH4	34,07	23,09	51,1%	55,5%	0,02%	0,02%	-32,3%	0,0%	0,0%
6A	Solid Waste Disposal on Land	CH4	3 269,16	2 828,62	30,9%	34,9%	1,80%	1,56%	-13,5%	237,8%	351,2%
6B	Waste-water Handling	CH4	2 549,78	580,78	43,9%	49,3%	0,52%	0,45%	-77,2%	0,0%	0,0%
6D	Other	CH4	0,00	6,82	97,9%	99,7%	0,01%	0,01%	-	-	-
1A1a	Solid Fuels	N2O	106,17	115,78	49,0%	48,6%	0,11%	0,09%	9,1%	0,0%	0,0%

1A2d	Biomass	N2O	0,00	7,19	49,3%	49,6%	0,01%	0,01%	-	-	-
1A3b	Gasoline	N2O	55,20	12,65	105,9%	106,2%	0,03%	0,02%	-77,1%	35,2%	51,8%
1A3b	Diesel Oil	N2O	34,28	45,71	49,4%	49,2%	0,04%	0,04%	33,4%	68,1%	90,7%
1A3b	Liquefied Petroleum Gases (LPG)	N2O	0,00	13,85	49,4%	49,2%	0,01%	0,01%	-	-	-
1A3c	Liquid Fuels	N2O	0,00	8,65	49,4%	49,2%	0,01%	0,01%	-	-	-
1A4b	Biomass	N2O	9,85	39,39	49,3%	49,6%	0,04%	0,03%	300,0%	0,0%	0,0%
3	Solvent and Other Product Use	N2O	33,18	18,60	105,9%	259,7%	0,07%	0,06%	-43,9%	0,0%	0,0%
4B13	Solid Storage and Dry Lot	N2O	1 620,83	525,17	50,5%	99,4%	0,79%	0,69%	-67,6%	0,0%	0,0%
4D1	Direct Soil Emissions	N2O	5 426,67	2 243,52	70,3%	200,3%	6,44%	5,58%	-58,7%	0,0%	0,0%
4D2	Pasture, Range and Paddock Manure	N2O	1 168,39	272,50	70,3%	200,3%	0,78%	0,68%	-76,7%	0,0%	0,0%
4D3	Indirect Emissions	N2O	3 723,07	1 376,57	70,3%	200,3%	3,95%	3,42%	-63,0%	0,0%	0,0%
4F	Field Burning of Agricultural Residues	N2O	14,62	11,19	50,6%	56,3%	0,01%	0,01%	-23,5%	0,0%	0,0%
5A1	Forest Land remaining Forest Land	N2O	0,31	8,78	97,1%	96,7%	0,02%		2720,1%	106,4%	10,5%
5B2	Land converted to Cropland	N2O	115,97	115,97	439,3%	442,2%	0,99%		0,0%	259,2%	50,0%
6B	Waste-water Handling	N2O	284,30	162,27	50,6%	56,1%	0,17%	0,14%	-42,9%	0,0%	0,0%
6C	Waste Incineration	N2O	7,46	7,99	49,0%	49,6%	0,01%	0,01%	7,0%	0,0%	0,0%
6D	Other	N2O	0,00	7,55	98,1%	98,9%	0,01%	0,01%	-	-	-
2F1	Refrigeration and Air Conditioning Equipment	F-gas	0,00	416,62	80,0%	99,9%	0,73%	0,63%	-	-	-
2F2	Foam Blowing	F-gas	0,00	26,42	49,0%	49,0%	0,03%	0,02%	-	-	-
2F3	Fire Extinguishers	F-gas	0,00	4,26	40,0%	99,9%	0,01%	0,01%	-	-	-
2F4	Aerosols & Metered Dose Inhalers	F-gas	0,00	9,15	50,0%	100,0%	0,01%	0,01%	-	-	-
2F8	Electrical Equipment	F-gas	3,46	11,96	49,1%	51,4%	0,01%	0,01%	245,8%	78,0%	136,9%



Simulation Summary Information	
Workbook Name	BG_Uncertainties_14032
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	141
Number of Outputs	20
Sampling Type	Latin Hypercube
Simulation Start Time	3.27.14 11:40:28
Simulation Duration	00:01:14
Random # Generator	Mersenne Twister
Random Seed	1559829267

Summary Statistics for Result BY / total excl. LULU

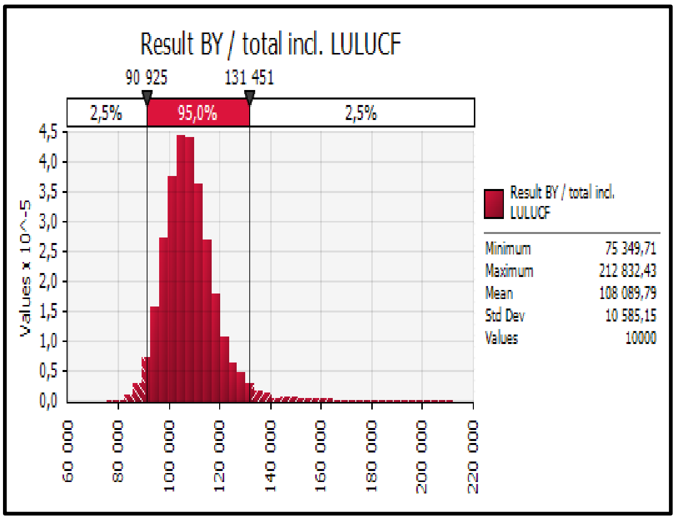
Statistics		**Percentile**	
Minimum	100 355	**5%**	111 578
Maximum	224 367	**10%**	113 412
Mean	121 878	**15%**	114 644
Std Dev	8 739	**20%**	115 590
Variance	76377508,99	**25%**	116 510
Skewness	2,296978507	**30%**	117 299
Kurtosis	15,10010296	**35%**	118 078
Median	120 327	**40%**	118 818
Mode	121 029	**45%**	119 586
Left X	109 955	**50%**	120 327
Left P	3%	**55%**	121 094
Right X	143 208	**60%**	121 882
Right P	98%	**65%**	122 893
Diff X	33 253	**70%**	123 948
Diff P	95%	**75%**	125 237
#Errors	0	**80%**	126 776
Filter Min	Off	**85%**	128 740
Filter Max	Off	**90%**	131 752
#Filtered	0	**95%**	137 295

Change in Output Statistic for Result BY / total e

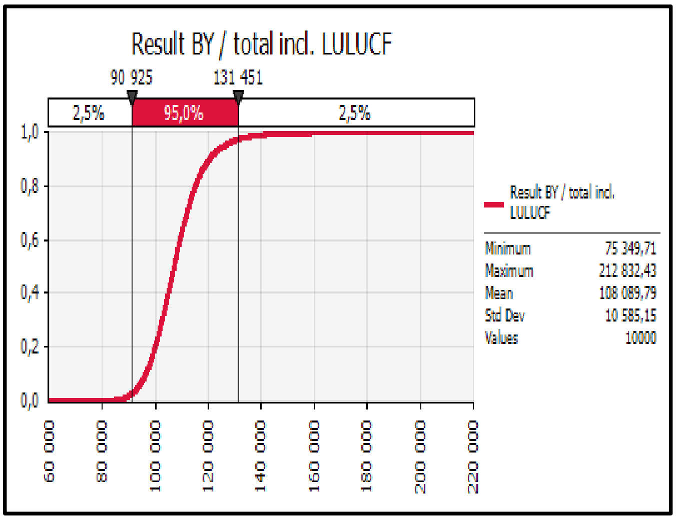
Rank	**Name**	**Lower**	**Upper**
1	EF N2O LY / 4D1 D	114 864	139 662
2	Activity Data BY /	116 279	127 005
3	EF CH4 LY / 1B1a (	118 468	124 819
4	EF CH4 LY / 6B Wa	120 368	123 116
5	Activity Data LY /	120 893	123 419
6	Activity Data BY /	120 685	122 993
7	EF N2O LY / 4B11 .	121 073	123 331
8	EF CH4 LY / 4B1 Ca	120 308	122 503
9	EF CH4 LY / 1B2b I	121 276	123 046
10	Activity Data LY /	121 324	122 911
11	EF CH4 LY / 6A Sol	121 228	122 812
12	Activity Data LY /	120 981	122 518
13	EF N2O LY / 4F Fie	121 384	122 793
14	EF CO2 LY / 1A1a S	121 066	122 405

Figure 104 Base year uncertainty, excluding lulucf

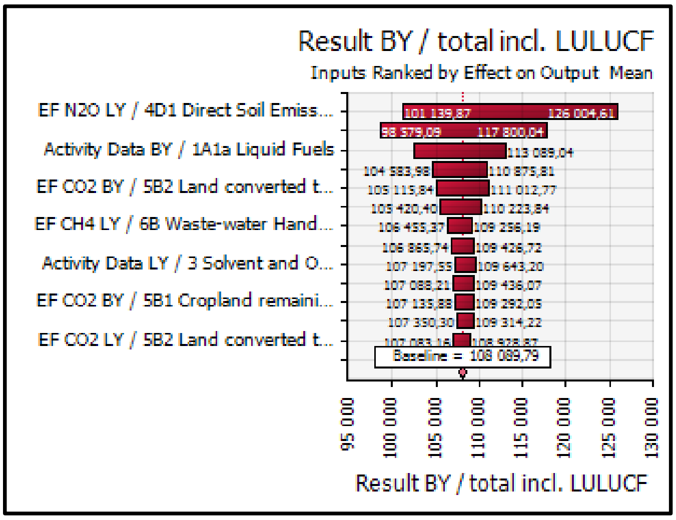
Total base year uncertainly excluding LULUCF is 14.3%



Simulation Summary Information	
Workbook Name	BG_Uncertainties_14032
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	141
Number of Outputs	20
Sampling Type	Latin Hypercube
Simulation Start Time	3.27.14 11:40:28
Simulation Duration	00:01:14
Random # Generator	Mersenne Twister
Random Seed	1559829267



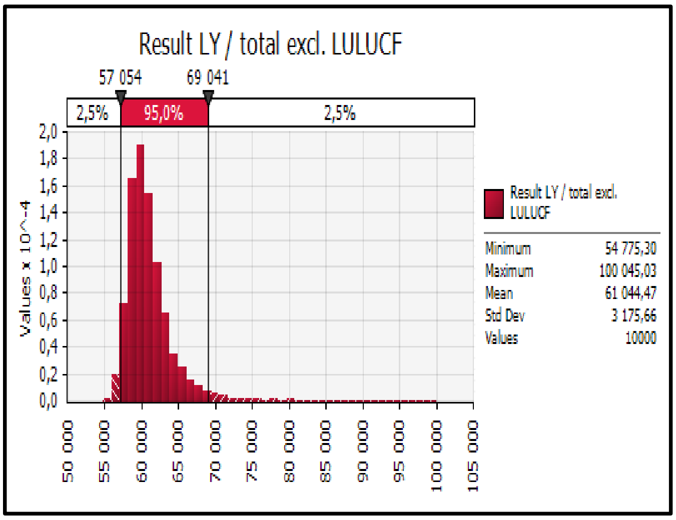
Summary Statistics for Result BY / total incl. LULU			
Statistics		**Percentile**	
Minimum	75 350	**5%**	93 593
Maximum	212 832	**10%**	96 355
Mean	108 090	**15%**	98 322
Std Dev	10 585	**20%**	99 884
Variance	112045345,7	**25%**	101 328
Skewness	1,394582462	**30%**	102 505
Kurtosis	9,244993213	**35%**	103 777
Median	107 073	**40%**	104 836
Mode	104 310	**45%**	105 896
Left X	90 925	**50%**	107 073
Left P	3%	**55%**	108 133
Right X	131 451	**60%**	109 273
Right P	98%	**65%**	110 538
Diff X	40 526	**70%**	111 933
Diff P	95%	**75%**	113 416
#Errors	0	**80%**	115 129
Filter Min	Off	**85%**	117 261
Filter Max	Off	**90%**	120 433
#Filtered	0	**95%**	126 276



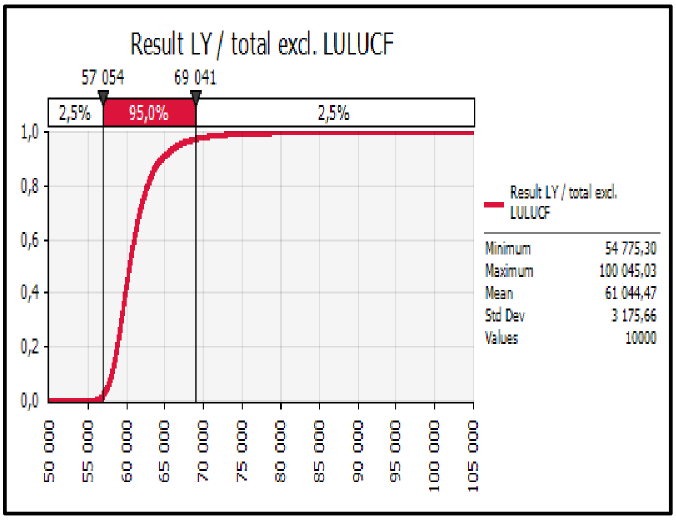
Change in Output Statistic for Result BY / total in			
Rank	**Name**	**Lower**	**Upper**
1	EF N2O LY / 4D1 D	101 140	126 005
2	EF CO2 BY / 5A1 F	98 579	117 800
3	Activity Data BY /	102 534	113 089
4	EF CH4 LY / 1B1a (	104 584	110 876
5	EF CO2 BY / 5B2 La	105 116	111 013
6	EF CO2 BY / 5C2 La	105 420	110 224
7	EF CH4 LY / 6B Wa	106 455	109 256
8	Activity Data BY /	106 866	109 427
9	Activity Data LY /	107 198	109 643
10	EF N2O LY / 4B11 /	107 088	109 436
11	EF CO2 BY / 5B1 C	107 136	109 292
12	EF CH4 LY / 6A Sol	107 350	109 314
13	EF CO2 LY / 5B2 La	107 083	108 929
14	EF CO2 BY / 5E2 La	107 040	108 852

Figure 105 Base year uncertainty, including lulucf

Total base year uncertainly including LULUCF is 19.6%

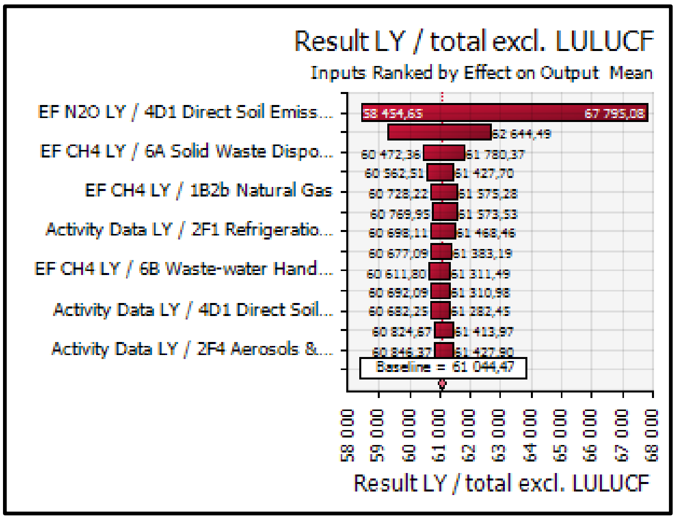


Simulation Summary Information	
Workbook Name	BG_Uncertainties_14032
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	141
Number of Outputs	20
Sampling Type	Latin Hypercube
Simulation Start Time	3.27.14 11:40:28
Simulation Duration	00:01:14
Random # Generator	Mersenne Twister
Random Seed	1559829267



Summary Statistics for Result LY / total excl. LULU

Statistics		Percentile	
Minimum	54 775	5%	57 533
Maximum	100 045	10%	58 113
Mean	61 044	15%	58 490
Std Dev	3 176	20%	58 798
Variance	10084825,02	25%	59 086
Skewness	2,567338355	30%	59 343
Kurtosis	16,84817344	35%	59 600
Median	60 383	40%	59 851
Mode	59 773	45%	60 132
Left X	57 054	50%	60 383
Left P	3%	55%	60 686
Right X	69 041	60%	61 002
Right P	98%	65%	61 330
Diff X	11 987	70%	61 714
Diff P	95%	75%	62 166
#Errors	0	80%	62 730
Filter Min	Off	85%	63 421
Filter Max	Off	90%	64 544
#Filtered	0	95%	66 709

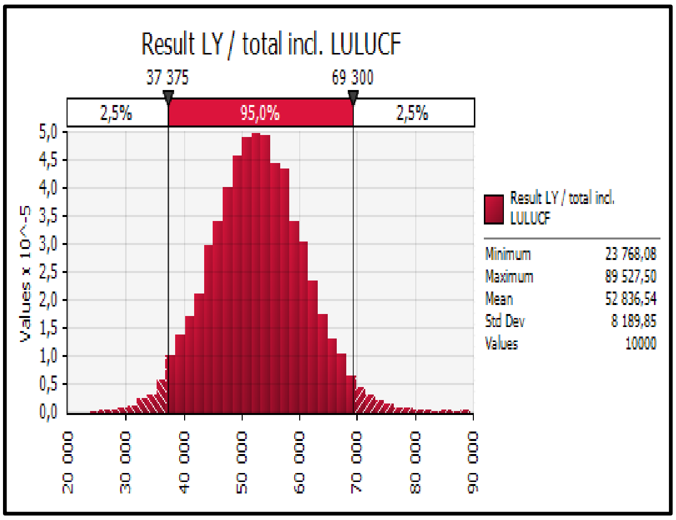


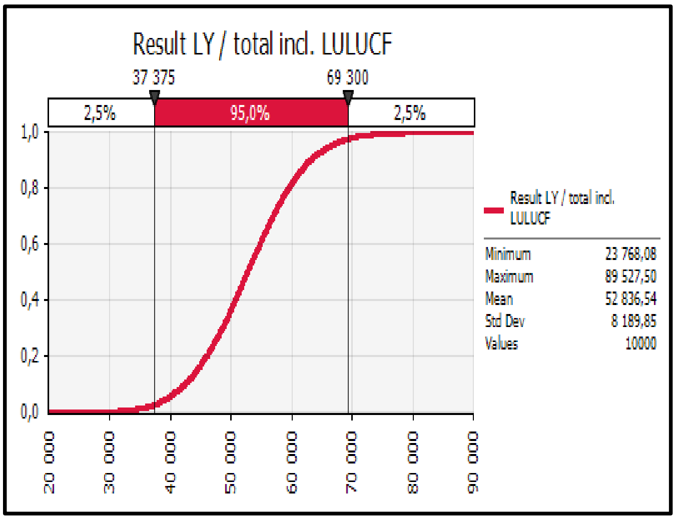
Change in Output Statistic for Result LY / total ex

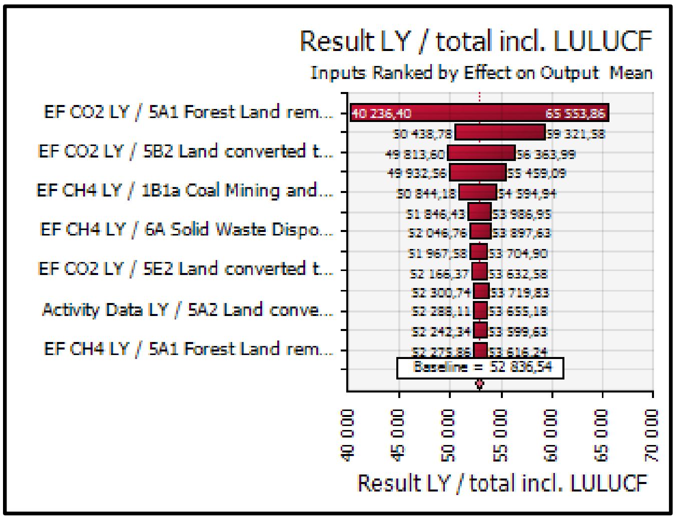
Rank	Name	Lower	Upper
1	EF N2O LY / 4D1 D	58 455	67 795
2	EF CH4 LY / 1B1a (	59 297	62 644
3	EF CH4 LY / 6A Sol	60 472	61 780
4	EF CO2 LY / 1A1a $	60 563	61 428
5	EF CH4 LY / 1B2b I	60 728	61 575
6	EF N2O LY / 4B11 /	60 770	61 574
7	Activity Data LY /	60 698	61 468
8	Activity Data LY /	60 677	61 383
9	EF CH4 LY / 6B Wa	60 612	61 311
10	Activity Data LY /	60 692	61 311
11	Activity Data LY /	60 682	61 282
12	EF N2O LY / 4F Fie	60 825	61 414
13	Activity Data LY /	60 846	61 428
14	EF CH4 LY / 4B1 Ca	60 716	61 290

Figure 106 Last year uncertainty, excluding lulucf

Total last year uncertainly excluding LULUCF is 10.4%







Simulation Summary Information	
Workbook Name	BG_Uncertainties_14032
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	141
Number of Outputs	20
Sampling Type	Latin Hypercube
Simulation Start Time	3.27.14 11:40:28
Simulation Duration	00:01:14
Random # Generator	Mersenne Twister
Random Seed	1559829267

Summary Statistics for Result LY / total incl. LULU			
Statistics		**Percentile**	
Minimum	23 768	**5%**	39 517
Maximum	89 528	**10%**	42 450
Mean	52 837	**15%**	44 405
Std Dev	8 190	**20%**	45 994
Variance	67073644,85	**25%**	47 300
Skewness	0,163149645	**30%**	48 572
Kurtosis	3,332111516	**35%**	49 671
Median	52 710	**40%**	50 731
Mode	54 867	**45%**	51 723
Left X	37 375	**50%**	52 710
Left P	3%	**55%**	53 736
Right X	69 300	**60%**	54 778
Right P	98%	**65%**	55 851
Diff X	31 924	**70%**	56 963
Diff P	95%	**75%**	58 103
#Errors	0	**80%**	59 549
Filter Min	Off	**85%**	61 115
Filter Max	Off	**90%**	63 154
#Filtered	0	**95%**	66 336

Change in Output Statistic for Result LY / total in			
Rank	**Name**	**Lower**	**Upper**
1	EF CO2 LY / 5A1 Fo	40 236	65 554
2	EF N2O LY / 4D1 D	50 439	59 322
3	EF CO2 LY / 5B2 La	49 814	56 364
4	EF CO2 LY / 5C2 La	49 933	55 459
5	EF CH4 LY / 1B1a (	50 844	54 595
6	EF CO2 LY / 5B1 Cr	51 846	53 987
7	EF CH4 LY / 6A Sol	52 047	53 898
8	EF CO2 LY / 5A2 La	51 968	53 705
9	EF CO2 LY / 5E2 La	52 166	53 633
10	EF CH4 LY / 6C Wa	52 301	53 720
11	Activity Data LY /	52 288	53 655
12	EF N2O LY / 5B2 La	52 242	53 600
13	EF CH4 LY / 5A1 Fo	52 276	53 616
14	Activity Data BY /	52 023	53 335

Figure 107 Last year uncertainty, including lulucf

Total last year uncertainly including LULUCF is 31.0%

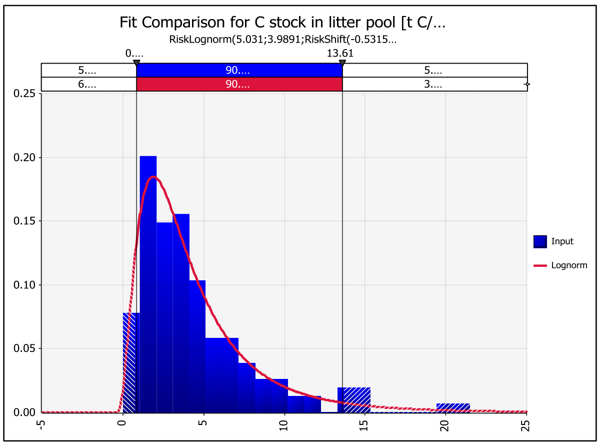
LULUCF Uncertainty assessment (Tier 2)

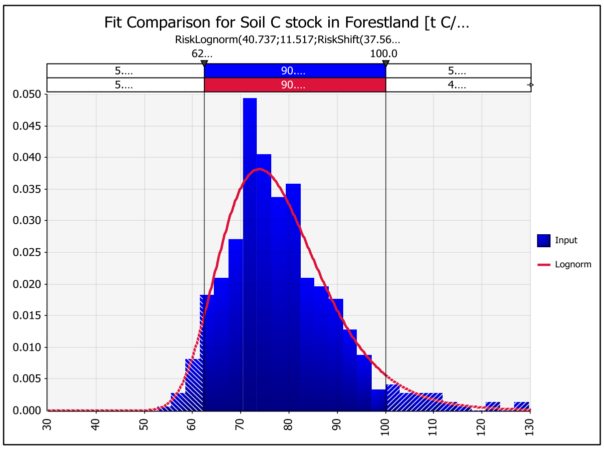
The PDF parameters - mean and standard deviation are calculated for all inputs. Normality distribution have been assumed for the most of them. In the case that empirical data were available, the choice of Probability Density Functions were made according to the *good practice* in Monte Carlo analysis (IPCC, 2003). Lognormal distribution is found to be more appropriate for C stock in litter pool, Soil C stock in forestland and Soil C stock in annual cropland. The main criteria to give preference to lognormal are large Coefficient of variation, positive skewness and normality test (Kolmogorov-Smirnov and Shapiro-Wilk) failed. Conducted Chi square test for these variables shows that the frequency distributions in the samples are more consistent with lognormal than normal distribution.

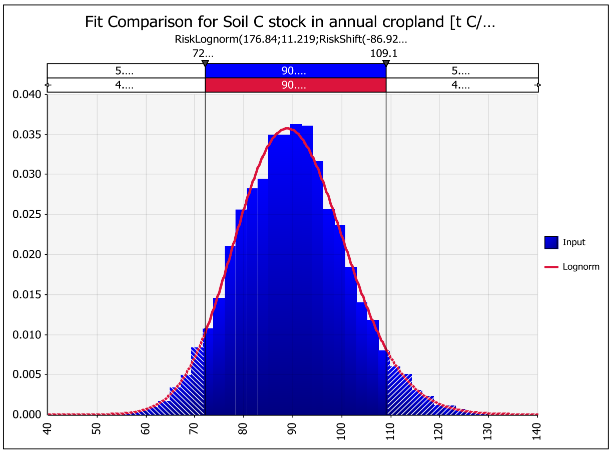
Table 274 PDF parameters of the emission factors, computed on the base of empirical data

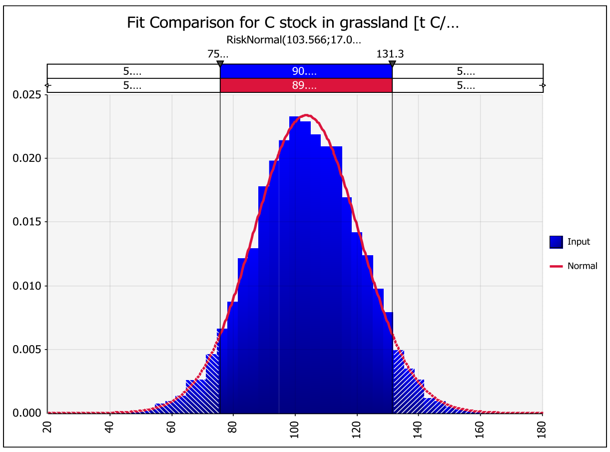
	Mean	Std. Dev.	PDF	sourse
C stock in litter pool	5.38	3.81	lognormal	pooled sample
Soil C stock in forestland	78.26	12.75	lognormal	Monte Carlo model
Soil C stock in annual cropland	89.92	11.22	lognormal	Monte Carlo model
Soil C stock in perenial cropland	76.52	21.05	normal	weighted sample formulae
Soil C stock in grassland	103.57	17.06	normal	Monte Carlo model
Soil C stock in settlement	94	42.21	normal	pooled sample

The follow graphics represent the fitting of some empirical distributions to the theoretical models.









LAND USE, LAND USE CHANGE AND FORESTRY – 2012

Table 275 Comparison between the uncertainties of the emissions, calculated by means of Tier 1 (Error propagation) and Tier 2 (Monte Carlo analysis)

IPCC		Gas	emissions	uncertainty		
Category			Gg CO_2 eq.	Tier 1	Tier 2	
5.A. Total Forestland		**CO2**	**-10795.3**	**137.0**	**-148.0**	**135.4**
5.A.1. Forestland remaining forestland		CO2	-10019.2	146.8	-159.0	145.7
pools	Living biomass	CO2	-10019.2	146.8	-159.0	145.7
5.A.2 Land converted to Forestland		CO2	-776.0	191.8	-198.0	178.7
pools	Living biomass	CO2	-1399.3	47.1	-59.4	49.9
	Litter	CO2	-202.0	117.3	-186.2	77.2
	Soil	CO2	825.2	159.1	-176.3	168.0
5.A.2.1. Cropland converted to Forestland		CO2	-215.7	125.0	-125.7	118.1
5.A.2.2. Grassland converted to Forestland		CO2	-529.8	276.3	-282.7	255.4
5.A.2.5. Other land converted to Forestland		CO2	-30.5	26.8	-29.4	25.5
5.B. Total Cropland		**CO2**	**1457.0**	**175.3**	**-184.5**	**177.9**
5.B.1. Cropland remaining cropland		CO2	686.6	245.5	-269.0	263.9
pools	Living biomass	CO2	667.4	225.5	-276.3	269.9
	Soil	CO2	19.1	3968.4	351.7	-367.3
5.B.2. Land converted to cropland		CO2	770.4	249.1	-255.1	246.3
pools	Living biomass	CO2	72.1	373.4	366.1	-416.7
	Soil	CO2	698.3	272.1	-278.2	269.8
5.B.2.2. Grassland converted to cropland		CO2	770.4	249.1	-255.1	246.3
5.C. Total Grassland		**CO2**	**-632.7**	**295.0**	**-310.9**	**324.1**
5.C.1. Grassland remaining grassland		CO2	-	-	-	-
5.C.2. Land converted to grassland		CO2	-632.7	295.0	-310.9	324.1
pools	Living biomass	CO2	93.5	346.0	-364.9	340.9
	Soil	CO2	-726.2	253.1	-264.2	276.3
5.C.2.2. Cropland converted to grassland		CO2	-632.7	295.0	-310.9	324.1
5.D. Total Wetland		**CO2**	**265.3**	**26.1**	**23.7**	**-27.8**
5.D.1. Wetland remaining wetland		CO2	-	-	-	-
5.D.2. Land converted to wetlands			265.3	26.1	23.7	-27.8
pools	Living biomass	CO2	9.6	75.7	-75.0	75.0
	Soil	CO2	255.7	26.9	-24.3	28.7
5.D.2.2. Cropland converted to wetland		CO2	265.3	26.1	23.7	-27.8
5.E. Total Settlements		**CO2**	**939.4**	**75.0**	**-**	**-**
5.F. Total Other land		**CO2**	**-**	**-**	**-**	**-**

LULUCF: CO_2 Forest Land remaining Forest Land, year 2012

Tier 2 method has been used to assess uncertainty for the CO_2 emissions and removals from Forest Land remaining Forest Land and corresponding subcategories – coniferous and deciduous forest for living biomass pool. The main statistics are presented in the following table.

Table 276 Statistics of the Monte Carlo analysis for Forest Land remaining Forest Land, 2012

	coniferous	decidious	Total
Trials	10000	10000	10000
Min	-26908	-36566	-42020
Median	-5090	-4472	-9811
Mean	-5374	-4719	-10093
Max	9423	20873	21848
Std. Dev.	3940	6589	7695
uncertainty %	-160.6; 134.8	-288.9; 268.5	**-159.0; 145.7**

The resulting Probability Density Function for whole category is shown in Figure 108.

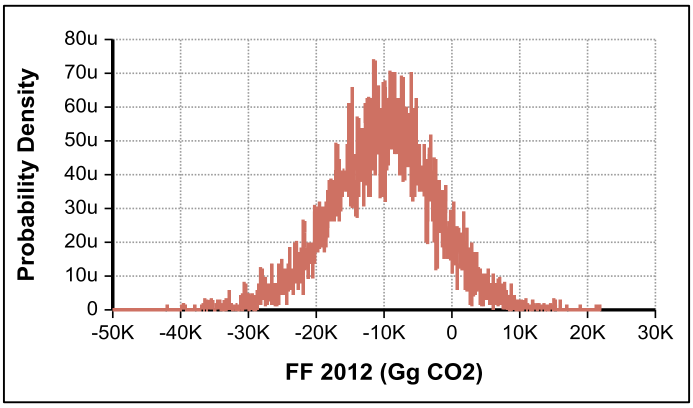


Figure 108 Probability density function resulting from Monte Carlo analysis for the CO2 emissions and removals from Forest Land remaining Forest Land, 2012

LULUCF: CO_2 Land converted to Forestland, year 2012
Tier 2 method has been used to assess uncertainty for the CO_2 emissions and removals from Land converted to Forestland and corresponding carbon pools – living biomass, litter and soil. The main statistics are presented in the following table.

Table 277 Statistics of the Monte Carlo analisys for Land converted to Forestland, 2012

	Living biomass	Litter	Soil	Total
Trials	10000	10000	10000	10000
Min	-3358	-2755	-2089	-3823
Median	-1382	-164	843	-751
Mean	-1400	-201	824	-773
Max	-149	-15	3568	2294
Std. Dev.	391	144	722	746
uncertainty %	-59.4; 49.9	-186.2; 77.2	-176.3; 168.0	**-198.0; 178.7**

The resulting Probability Density Function for whole category is shown in Figure 109.

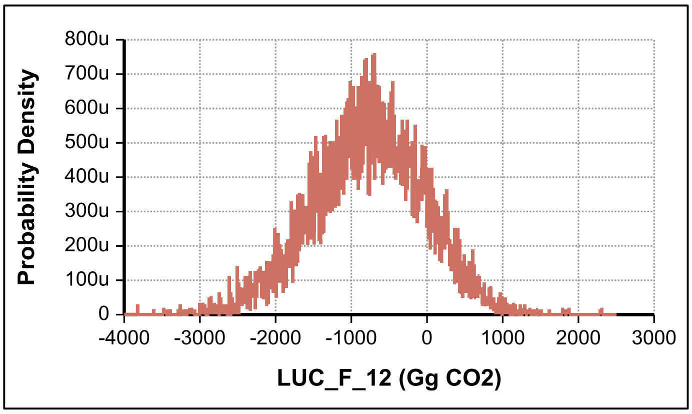


Figure 109 Probability density function resulting from Monte Carlo analysis for the CO_2 emissions and removals from Land converted to Forestland, 2012

LULUCF: CO_2 Cropland remaining cropland, year 2012
Tier 2 method has been used to assess uncertainty for the CO_2 emissions and removals from Cropland remaining cropland and corresponding carbon pools – living biomass and soil. The main statistics are presented in the following table.

Table 278 Statistics of the Monte Carlo analysis for Cropland remaining cropland, 2012

	Living biomass	Soil	Total
Trials	10000	10000	10000
Min	-2677	-115	-2649
Median	675	18	693
Mean	668	19	687
Max	4253	155	4243
Std. Dev.	925	35	925
uncertainty %	-276.3; 269.9	-351.7; 367.3	**-269.0; 263.9**

The resulting Probability Density Function for whole category is shown in Figure 110.

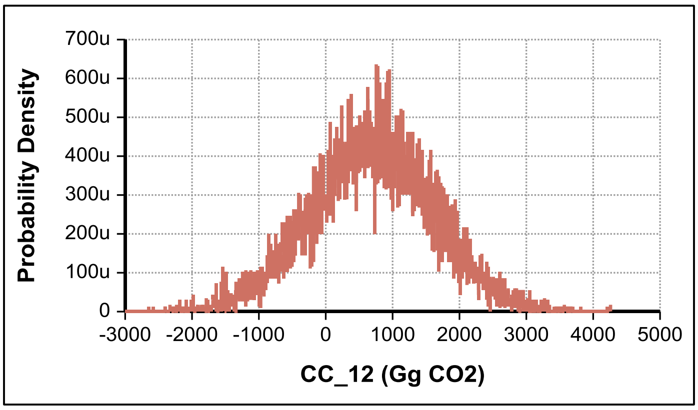


Figure 110 Probability density function resulting from Monte Carlo analysis for the CO_2 emissions and removals from Cropland remaining Cropland, 2012

LULUCF: CO_2 Land converted to cropland, year 2012
Tier 2 method has been used to assess uncertainty for the CO_2 emissions and removals from

Land converted to cropland and corresponding carbon pools – living biomass and soil. The main statistics are presented in the following table.

Table 279 Statistics of the Monte Carlo analysis for Land converted to cropland, 2012

	Living biomass	Soil	Total
Trials	10000	10000	10000
Min	-380	-3401	-3301
Median	64	714	784
Mean	71	703	774
Max	698	4210	4222
Std. Dev.	141	987	999
uncertainty %	-366.1; 416.7	-278.2; 269.8	**-255.1; 246.3**

The resulting Probability Density Function for whole category is shown in Figure 111.

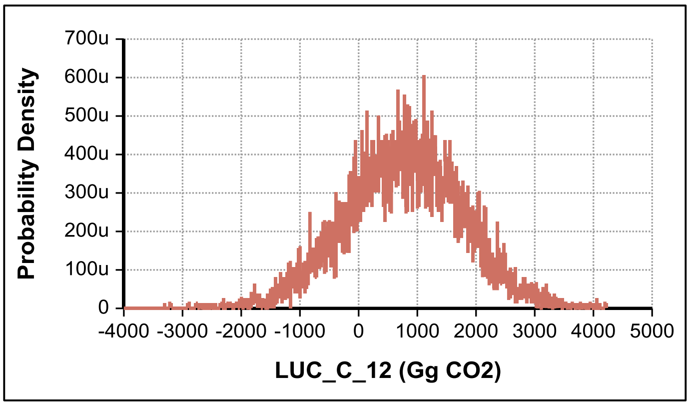


Figure 111 Probability density function resulting from Monte Carlo analysis for the CO2 emissions and removals from Land converted to cropland, 2012

LULUCF: CO_2 Land converted to grassland, year 2012
Tier 2 method has been used to assess uncertainty for the CO_2 emissions and removals from Land converted to grassland and corresponding carbon pools – living biomass and soil. The main statistics are presented in the following table.

Table 280 Statistics of the Monte Carlo analysis for Land converted to grassland, 2012

	Living biomass	Soil	Total
Trials	10000	10000	10000
Min	-973	-4056	-4037
Median	99	-723	-623
Mean	95	-711	-616
Max	713	3002	2962
Std. Dev.	171	978	994
uncertainty %	-364.9; 340.9	-264.2; 276.3	**-310.9; 324.1**

The resulting Probability Density Function for whole category is shown in Figure 112.

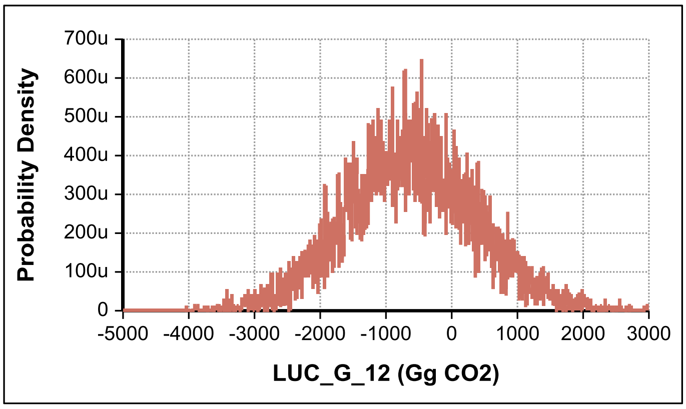


Figure 112 Probability density function resulting from Monte Carlo analysis for the CO2 emissions and removals from Land converted to grassland, 2012

LULUCF: CO_2 Land converted to wetland, year 2012
Tier 2 method has been used to assess uncertainty for the CO_2 emissions and removals from Land converted to wetland and corresponding carbon pools – living biomass, dead organic matter and soil. The main statistics are presented in the following table.

Table 281 Statistics of the Monte Carlo analysis for Land converted to Wetland 2012

	Living biomass	Soil	Total
Trials	10000	10000	10000
Min	-5	155	163
Median	10	254	263
Mean	10	256	265
Max	23	408	425
Std. Dev.	4	35	35
uncertainty %	-75.0; 75.0	-24.3; 28.7	**23.7; 27.8**

The resulting Probability Density Function for whole category is shown in Figure 113

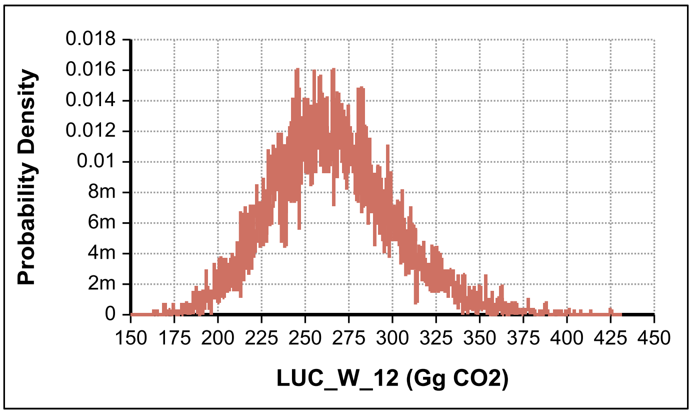


Figure 113 Probability density function resulting from Monte Carlo analysis for the CO_2 emissions and removals from Land converted to Wetland, 2012

Uncertainty analysis associated to the 2014 Bulgaria Greenhouse Gas Inventory LULUCF sector - all gases

Table 282 TIER 1 uncertainty calculation and reporting

IPCC Source category		GHG	Base year emissions (1988)	Year 2012 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
A		B	C	D	E	F	G
			[Gg CO2 equivalent]	[Gg CO2 equivalent]	%	%	%
5	LULUCF	CO2	-13787.7	-8207.5	2	185	184.58
5A	Total Forestland	CO2	-14775.5	-10352.5	3	143	142.89
5A1	Forestland remaining forestland	CO2	-14213.1	-9576.4	3	154	153.69
5A2	Land converted to Forestland	CO2	-562.4	-776.0	10	192	191.77
5B	Total cropland	CO2	937.8	1573.0	5	164	164.50
5B1	Cropland remaining cropland	CO2	51.4	686.6	3	245	245.49
5B2	Land converted to cropland	CO2	886.4	886.4	10	221	221.50
5C	Total grassland	CO2	-632.7	-632.7	10	295	294.99
5C1	Grassland remaining grassland	CO2	-	-	-	-	-
5C2	Land converted to grassland	CO2	-632.7	-632.7	10	295	294.99
5D	Total Wetland	CO2	-	265.3	10	24	26.06
5D1	Wetland remaining wetland	CO2	-	-	-	-	-
5D2	Land converted to wetlands	CO2	-	265.3	10	24	26.06
5E	Total Settlements	CO2	682.7	939.4	10	74	75.00
5F	Total Other land	CO2	-	-	-	-	-

*The uncertainties for Activity data and Emission factor of the different categories are based on the expert judgment, consistent with the calculated value of the combined uncertainties.

KP-LULUCF: CO_2 Kyoto Art.3.3, year 2008

Monte Carlo analysis has been performed for the emissions and removals.

Table 283 Statistics of the Monte Carlo analysis for Kyoto Art.3.3, 2008

	Trials	Min	Median	Mean	Max	Std. Dev.	uncertainty %
AR Biomass	10000	-2871	-1140	-1156	-25	342	-63.2; 53.2
AR Litter	10000	-2375	-141	-174	-13	124	-186.2; 77.2
AR Soil	10000	-1813	729	712	3102	626	-176.8; 168.7
D Biomass	10000	-43	156	156	393	59	-73.1; 75.0
D Dead wood	10000	4.0	7.8	7.8	13.7	1.3	-30.3; 35.8
D Litter	10000	1.0	13.4	16.3	122.4	11.4	-77.2; 182.6
D Soil	10000	23	41	42	84	7	-30.7; 39.1
Kyoto Art.3.3	10000	-3327	-378	-395	2619	723	**-372.1; 346.9**

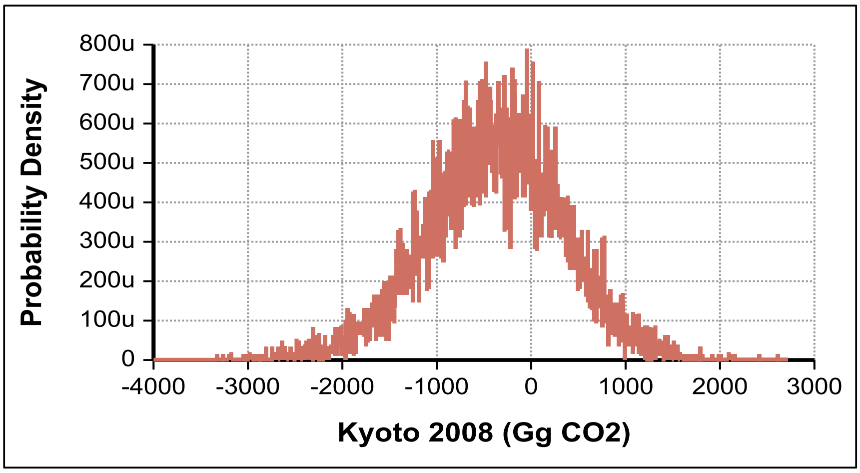


Figure 114 Probability density function resulting from Montecarlo analysis for Kyoto Art.3.3, 2008

KP-LULUCF: CO_2 Kyoto Art.3.3, year 2009

Monte Carlo analysis has been performed for the emissions and removals.

Table 284 Statistics of the Monte Carlo analysis for Kyoto Art.3.3, 2009

	Trials	Min	Median	Mean	Max	Std. Dev.	uncertainty %
AR Biomass	10000	-3090	-1257	-1273	-100	362	-60.8; 51.1
AR Litter	10000	-2541	-151	-186	-14	133	-186.2; 77.2
AR Soil	10000	-1937	779	761	3313	669	-177.0; 168.6
D Biomass	10000	-5	18	18	47	7	-73.1; 75.0
D Dead wood	10000	0	1	1	2	0	-30.3; 35.8
D Litter	10000	0	2	2	19	1	-75.9; 183.2
D Soil	10000	22	43	43	79	8	-30.5; 38.3
Kyoto Art.3.3	10000	-4540	-620	-626	2185	751	**-236.6; 228.2**

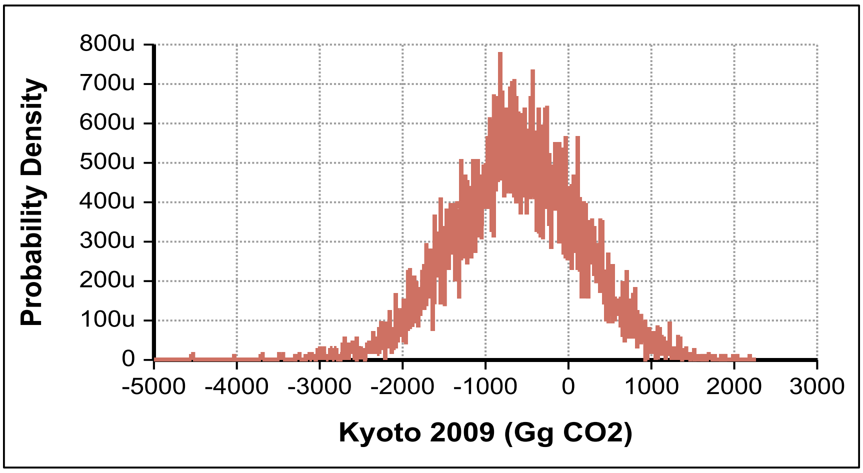


Figure 115 Probability density function resulting from Montecarlo analysis for Kyoto Art.3.3 - 2009

KP-LULUCF: CO2 Kyoto Art.3.3 – 2010

Monte Carlo analysis has been performed for the emissions and removals.

Table 285 Statistics of the Monte Carlo analysis for Kyoto Art.3.3, 2010

	Trials	Min	Median	Mean	Max	Std. Dev.	uncertainty %
AR Biomass	10000	-3271	-1398	-1421	-207	385	-58.0; 48.7
AR Litter	10000	-1684	-155	-189	-14	132	-180.1; 76.1
AR Soil	10000	-1937	807	791	3414	684	-175.5; 165.2
D Biomass	10000	-23	61	61	138	23	-74.8; 75.1
D Dead wood	10000	1.4	3.1	3.1	5.5	0.5	-30.5; 35.8
D Litter	10000	0.5	5.0	6.1	71.8	4.4	-76.9; 185.9
D Soil	10000	23	46	47	94	8	-30.3; 38.2
Kyoto Art.3.3	10000	-3711	-686	-702	1853	793	**-230.8; 213.9**

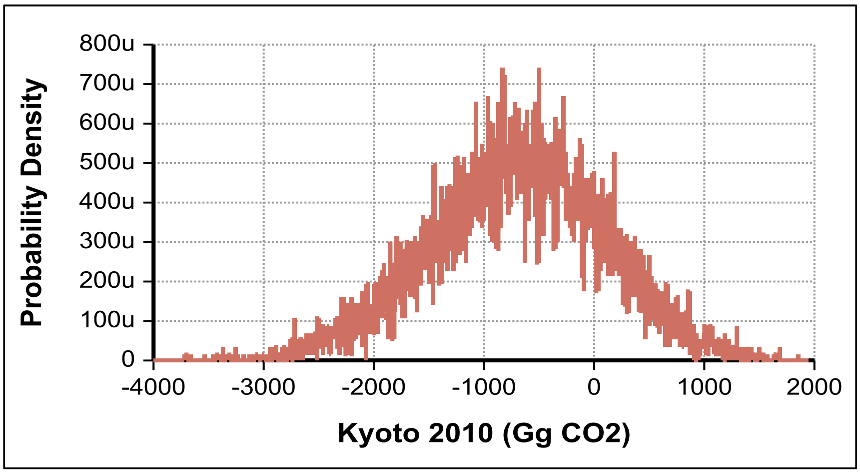


Figure 116 Probability density function resulting from Montecarlo analysisfor Kyoto Art.3.3 - 2010

KP-LULUCF: CO2 Kyoto Art.3.3 – 2011

Monte Carlo analysis has been performed for the emissions and removals.

Table 286 Statistics of the Monte Carlo analysis for Kyoto Art.3.3, 2011

	Trials	Min	Median	Mean	Max	Std. Dev.	uncertainty %
AR Biomass	10000	-3521	-1555	-1579	-330	407	-54.7; 46.1
AR Litter	10000	-1729	-160	-194	-14	135	-180.1; 76.1
AR Soil	10000	-1985	828	811	3499	702	-175.1; 165.0

D Biomass	10000	-9	23	23	51	9	-74.8; 75.1
D Dead wood	10000	0.5	1.1	1.1	2.0	0.2	-30.5; 35.8
D Litter	10000	0.2	1.8	2.3	26.7	1.6	-76.9; 185.9
D Soil	10000	22	46	46	93	8	-30.3; 38.2
Kyoto Art.3.3	10000	-3992	-873	-890	1714	818	**-187.0; 175.3**

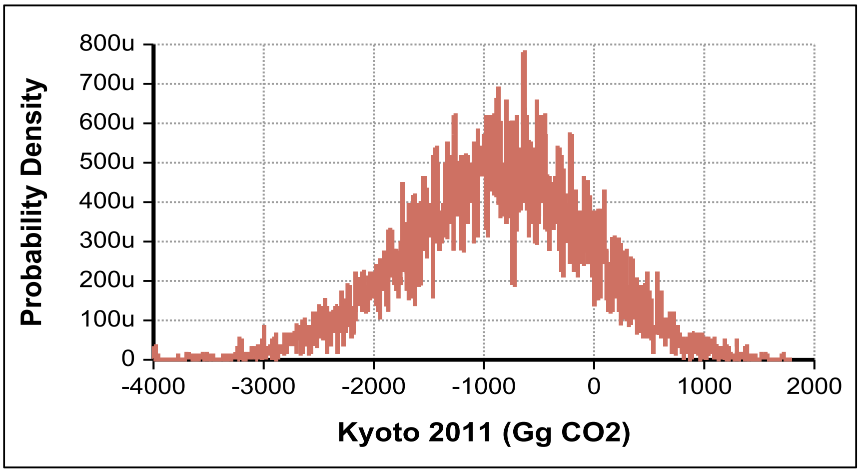


Figure 117 Probability density function resulting from Montecarlo analysis for Kyoto Art.3.3 - 2011

LULUCF: CO_2 Kyoto Art.3.3 – 2012

Monte Carlo analysis has been performed for the emissions and removals.

Table 287 Statistics of the Monte Carlo analysis for Kyoto Art.3.3, 2012

	Trials	Min	Median	Mean	Max	Std. Dev.	uncertainty %
AR Biomass	10000	-3797	-1705	-1733	-442	431	-52.5; 44.6
AR Litter	10000	-1773	-164	-199	-15	139	-180.1; 76.1
AR Soil	10000	-2033	850	832	3584	719	-174.9; 164.6
D Biomass	10000	-18	46	46	103	17	-74.8; 75.1
D Dead wood	10000	1	2	2	4	0	-30.5; 35.8
D Litter	10000	0	4	5	54	3	-76.9; 185.9
D Soil	10000	22	45	46	93	8	-30.3; 38.2
Kyoto Art.3.3	10000	-4277	-984	-1001	1678	845	**-172.7; 160.3**

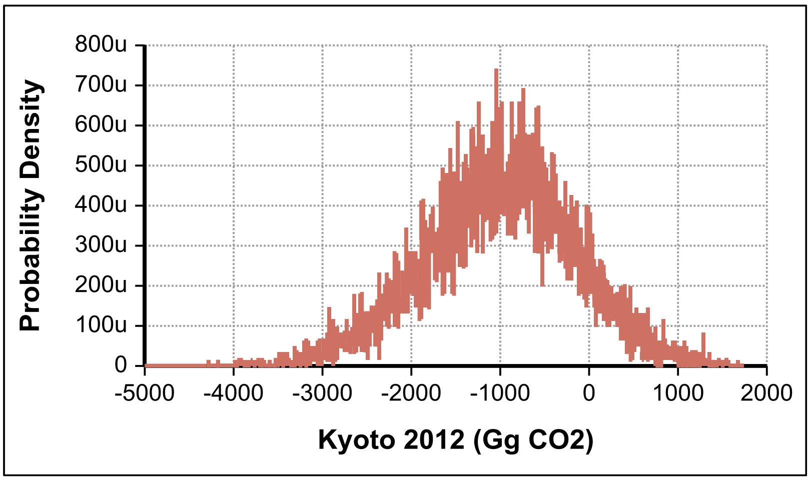


Figure 118 Probability density function resulting from Montecarlo analysis for Kyoto Art.3.3 - 2012

ANNEX 8 VEHICLE FLEET AND MILEAGE DATA FOR ROAD TRANSPORT

Table 288 Vehicle fleet data for Road transport (number of vehicles) 1988-2000

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline 0,8 - 1,4 l	PRE ECE	0	0	0	0	21342	18075	12777	10537	8303	6685	5405	4292	3597
Gasoline 0,8 - 1,4 l	ECE 15/00-01	0	0	0	0	96940	82209	62087	49854	38910	29821	22561	16235	12139
Gasoline 0,8 - 1,4 l	ECE 15/02	1023092	1053975	1085830	1104395	116231	101485	81978	65165	49795	37221	27090	18245	12643
Gasoline 0,8 - 1,4 l	ECE 15/03	0	0	0	0	215702	205685	188537	163962	136430	107210	82328	57393	39979
Gasoline 0,8 - 1,4 l	ECE 15/04	0	0	0	0	670107	667350	678010	651038	628871	584427	550850	500271	446081
Gasoline 0,8 - 1,4 l	Improved Conventional	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 0,8 - 1,4 l	Open Loop	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 0,8 - 1,4 l	PC Euro 1 - 91/441/EEC	0	0	0	0	7	89285	159612	246735	322449	321910	320137	322493	326387
Gasoline 0,8 - 1,4 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	63894	136783	230370	312064
Gasoline 0,8 - 1,4 l	PC Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 0,8 - 1,4 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 0,8 - 1,4 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 1,4 - 2,0 l	PRE ECE	0	0	0	0	5021	4422	3159	2634	2066	1768	1435	1197	1048
Gasoline 1,4 - 2,0 l	ECE 15/00-01	0	0	0	0	11805	10477	8583	7100	5725	4390	3366	2433	1780
Gasoline 1,4 - 2,0 l	ECE 15/02	107853	118617	127810	141777	15128	13903	11663	9825	7980	6304	4902	3457	2431
Gasoline 1,4 - 2,0 l	ECE 15/03	0	0	0	0	16625	16981	16823	15855	14775	13500	12164	10519	8738
Gasoline 1,4 - 2,0 l	ECE 15/04	0	0	0	0	117676	121710	135725	140647	142186	136090	134319	132515	130242
Gasoline 1,4 - 2,0 l	Improved Conventional	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 1,4 - 2,0 l	Open Loop	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	0	0	0	0	0	38866	78459	125743	180987	188908	190602	194456	198250
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	41501	104639	170749	224629
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline >2,0 l	PRE ECE	0	0	0	0	424	401	312	286	279	273	243	227	231
Gasoline >2,0 l	ECE 15/00-01	0	0	0	0	870	878	806	688	614	533	462	360	304
Gasoline >2,0 l	ECE 15/02	3739	4855	5832	7157	1598	1504	1361	1243	1124	988	822	605	495
Gasoline >2,0 l	ECE 15/03	0	0	0	0	1469	1553	1692	1646	1603	1443	1351	1170	1023

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline >2,0 l	ECE 15/04	0	0	0	0	5363	6678	9263	11392	12619	12314	12135	12117	11860
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	0	0	0	0	0	2335	4769	7160	10304	12155	13694	14390	14871
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	2205	4969	9288	12940
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel 1,4 - 2,0 l	Conventional	78624	84497	90446	97186	102894	104706	110447	109587	109134	105434	104533	102298	99524
Diesel 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	0	0	0	0	0	3989	7450	11684	17467	19350	20758	22188	23041
Diesel 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	5842	15125	28567	41099
Diesel 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel >2,0 l	Conventional	7477	8015	7518	8461	7637	8551	9858	10111	10227	9917	9699	9296	8909
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	0	0	0	0	0	461	1092	1763	2896	3604	4123	4532	4805
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	904	2381	4477	6639
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel >2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	0	0
LPG	Conventional	0	0	0	0	0	0	0	0	0	6098	11187	14957	17741
LPG	PC Euro 1 - 91/441/EEC	0	0	0	0	0	0	0	0	0	3382	6826	10442	14231
LPG	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	696	3207	8066	14498
LPG	PC Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	0	0	0	0
LPG	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
LPG	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	0	0
CNG	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CNG	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Stroke	Conventional	0	0	0	0	4441	3949	3408	2915	2278	1737	1253	785	532
Hybrid Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Hybrid Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Hybrid Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline <3,5t	Conventional	0	0	0	0	48538	52201	47293	41087	34853	29263	24002	19178	15938
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	0	0	0	0	0	0	6845	14799	23040	23369	21477	20347	19345
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	0	0	0	0	0	0	0	0	0	0	9230	20136	28040
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline <3,5t	LD Euro 5 - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel <3,5 t	Conventional	0	0	0	0	75083	85209	85103	80123	74673	70843	67092	60219	55114
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	0	0	0	0	0	0	8614	21881	34848	48892	51574	49593	47750
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	0	0	0	0	0	0	0	0	0	0	11868	27807	40460
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel <3,5 t	LD Euro 5 - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline >3,5 t	Conventional	0	0	0	0	2029	2095	2051	1925	1783	1457	1218	1100	993
Rigid <=7,5 t	Conventional	0	0	0	0	28264	29575	29527	28227	26283	24796	22611	19457	17453
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	1517	3704	6154	6517	6586	6929	6922	6803
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	1486	3418	5736	8006	10230
Rigid <=7,5 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Rigid <=7,5 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid <=7,5 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 7,5 - 12 t	Conventional	46061	48166	50372	53581	13237	12864	12072	10908	9777	8796	7624	6619	5755
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	220	488	759	801	821	839	833	813
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	208	396	632	910	1252
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 12 - 14 t	Conventional	46061	48166	50372	53581	13237	12864	12072	10908	9777	8796	7624	6619	5755
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	220	488	759	801	821	839	833	813
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	208	396	632	910	1252
Rigid 12 - 14 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 12 - 14 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 14 - 20 t	Conventional	46061	48166	50372	53581	16098	15796	14967	13746	12471	11388	10069	8859	7812
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	245	618	1068	1199	1272	1349	1375	1390
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	319	641	1117	1718	2304
Rigid 14 - 20 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Rigid 14 - 20 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 20 - 26 t	Conventional	0	0	0	0	2861	2938	2895	2843	2694	2592	2444	2240	2057
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	26	131	309	394	451	510	542	577
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	111	245	489	809	1052
Rigid 20 - 26 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 20 - 26 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 26 - 28 t	Conventional	0	0	0	0	2861	2938	2895	2843	2694	2592	2444	2240	2057
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	26	131	309	394	451	510	542	577
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	111	245	489	809	1052
Rigid 26 - 28 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 26 - 28 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 28 - 32 t	Conventional	0	0	0	0	2861	2938	2895	2843	2694	2592	2444	2240	2057
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	26	131	309	394	451	510	542	577
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	111	245	489	809	1052
Rigid 28 - 32 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid 28 - 32 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Rigid >32 t	Conventional	0	0	0	0	127	112	111	117	119	125	110	97	94
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	15	56	75	73	72	73	75
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	18	26	46	133	228
Rigid >32 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid >32 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Rigid >32 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 14 - 20 t	Conventional	46061	48166	50372	53581	16098	15796	14967	13746	12471	11388	10069	8859	7812
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	245	618	1068	1199	1272	1349	1375	1390
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	319	641	1117	1718	2304
Articulated 14 - 20 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 14 - 20 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 20 - 28 t	Conventional	0	0	0	0	2861	2938	2895	2843	2694	2592	2444	2240	2057
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	26	131	309	394	451	510	542	577
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	111	245	489	809	1052
Articulated 20 - 28 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 20 - 28 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 28 - 34 t	Conventional	0	0	0	0	2983	3050	3005	2960	2814	2721	2554	2337	2151
Articulated 28 - 34 t	HD Euro I - 91/542/EEC	0	0	0	0	0	26	146	365	469	524	582	615	652

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Stage I													
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	128	271	531	942	1280
Articulated 28 - 34 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 28 - 34 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 34 - 40 t	Conventional	0	0	0	0	127	112	111	117	119	125	110	97	94
Articulated 34 - 40 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	15	56	75	73	72	73	75
Articulated 34 - 40 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	18	26	46	133	228
Articulated 34 - 40 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 34 - 40 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 34 - 40 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 40 - 50 t	Conventional	0	0	0	0	127	112	111	117	119	125	110	97	94
Articulated 40 - 50 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	15	56	75	73	72	73	75
Articulated 40 - 50 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	18	26	46	133	228
Articulated 40 - 50 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 40 - 50 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 40 - 50 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 50 - 60 t	Conventional	0	0	0	0	127	112	111	117	119	125	110	97	94
Articulated 50 - 60 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	15	56	75	73	72	73	75
Articulated 50 - 60 t	HD Euro II - 91/542/EEC	0	0	0	0	0	0	0	0	18	26	46	133	228

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Stage II													
Articulated 50 - 60 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 50 - 60 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated 50 - 60 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Midi <=15 t	Conventional	1257	1241	1251	2341	7367	7216	6978	6737	6338	5682	5112	4559	4001
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	181	388	414	439	442	445	470	486
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	186	612	1051	1447	1926
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Standard 15 - 18 t	Conventional	1257	1241	1251	2341	7367	7216	6978	6737	6338	5682	5112	4559	4001
Urban Buses Standard 15 - 18 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	181	388	414	439	442	445	470	486
Urban Buses Standard 15 - 18 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	186	612	1051	1447	1926
Urban Buses Standard 15 - 18 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Standard 15 - 18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Standard 15 - 18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Articulated >18 t	Conventional	1257	1241	1251	2341	7367	7216	6978	6737	6338	5682	5112	4559	4001
Urban Buses Articulated >18 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	181	388	414	439	442	445	470	486
Urban Buses Articulated >18 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	186	612	1051	1447	1926
Urban Buses Articulated >18 t	HD Euro III - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Standards													
Urban Buses Articulated >18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Articulated >18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Coaches Standard <=18 t	Conventional	14137	14585	15005	14269	7492	8061	8222	8210	7961	7571	7375	6947	6506
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	483	1034	1573	1809	1905	2084	2135	2225
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	203	629	1372	2189	2804
Coaches Standard <=18 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Coaches Standard <=18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Coaches Articulated >18 t	Conventional	14137	14585	15005	14269	7492	8061	8222	8210	7961	7571	7375	6947	6506
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	483	1034	1573	1809	1905	2084	2135	2225
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	203	629	1372	2189	2804
Coaches Articulated >18 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Coaches Articulated >18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban CNG Buses	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban CNG Buses	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban CNG Buses	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban CNG Buses	EEV	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	Conventional	0	0	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Urban Biodiesel Buses	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
2-stroke <50 cm^3	Conventional	276901	279077	281270	282137	282792	283963	284571	285901	286760	288690	281749	284031	286047
2-stroke <50 cm^3	Mop - Euro I	0	0	0	0	0	0	0	0	0	0	0	0	0
2-stroke <50 cm^3	Mop - Euro II	0	0	0	0	0	0	0	0	0	0	0	0	0
2-stroke <50 cm^3	Mop - Euro III	0	0	0	0	0	0	0	0	0	0	0	0	0
2-stroke >50 cm^3	Conventional	0	0	0	0	54550	51343	46722	41942	37859	31901	26601	20953	17105
2-stroke >50 cm^3	Mot - Euro I	0	0	0	0	0	0	0	0	0	0	0	227	263
2-stroke >50 cm^3	Mot - Euro II	0	0	0	0	0	0	0	0	0	0	0	0	0
2-stroke >50 cm^3	Mot - Euro III	0	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke <250 cm^3	Conventional	0	0	0	0	116162	112243	107120	102374	97655	93737	87942	75255	64862
4-stroke <250 cm^3	Mot - Euro I	0	0	0	0	0	0	0	0	0	0	0	14289	25295
4-stroke <250 cm^3	Mot - Euro II	0	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke <250 cm^3	Mot - Euro III	0	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke 250 - 750 cm^3	Conventional	217360	221416	225533	226853	44237	52042	60696	68527	73770	79784	84026	73513	68968
4-stroke 250 - 750 cm^3	Mot - Euro I	0	0	0	0	0	0	0	0	0	0	0	13153	19652
4-stroke 250 - 750 cm^3	Mot - Euro II	0	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke 250 - 750 cm^3	Mot - Euro III	0	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke >750 cm^3	Conventional	0	0	0	0	13386	15007	17848	20521	25665	30838	35384	30597	28237
4-stroke >750 cm^3	Mot - Euro I	0	0	0	0	0	0	0	0	0	0	0	7195	11945
4-stroke >750 cm^3	Mot - Euro II	0	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke >750 cm^3	Mot - Euro III	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 289 Vehicle fleet data for Road transport (number of vehicles) 2000-2012

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Gasoline 0,8 - 1,4 l	PRE ECE	3156	2684	2566	2348	2439	1621	1927	2203	2340	2454	2549	2596
Gasoline 0,8 - 1,4 l	ECE 15/00-01	9534	7477	6307	5624	4554	2756	3101	3419	3480	3488	3544	3606
Gasoline 0,8 - 1,4 l	ECE 15/02	9152	6647	5267	4145	2718	1501	1594	1704	1652	1655	1703	1704
Gasoline 0,8 - 1,4 l	ECE 15/03	28586	20381	15046	10899	6012	2894	2635	2488	2279	2212	2196	2208
Gasoline 0,8 - 1,4 l	ECE 15/04	394716	335834	282816	221610	169965	82424	69428	56873	43162	33211	26266	21783
Gasoline 0,8 - 1,4 l	Improved Conventional	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 0,8 - 1,4 l	Open Loop	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 0,8 - 1,4 l	PC Euro 1 - 91/441/EEC	331281	335211	340298	339267	326248	200337	206996	201047	175318	146740	121932	101487
Gasoline 0,8 - 1,4 l	PC Euro 2 - 94/12/EEC	333600	340087	350985	357592	359564	241129	269452	290964	291793	283466	273170	263453
Gasoline 0,8 - 1,4 l	PC Euro 3 - 98/69/EC Stage2000	51253	108802	169727	233750	238940	158471	178634	194348	199185	202324	204105	208216
Gasoline 0,8 - 1,4 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	52671	71086	121559	181740	230600	284667	292219	303159
Gasoline 0,8 - 1,4 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	42525	79181
Gasoline 1,4 - 2,0 l	PRE ECE	935	780	761	688	805	588	731	836	861	903	936	981
Gasoline 1,4 - 2,0 l	ECE 15/00-01	1399	1094	884	801	697	456	571	589	625	646	674	701
Gasoline 1,4 - 2,0 l	ECE 15/02	1761	1284	1003	751	539	339	389	451	464	467	481	477
Gasoline 1,4 - 2,0 l	ECE 15/03	6819	5199	3902	2856	1972	993	934	920	828	813	830	834
Gasoline 1,4 - 2,0 l	ECE 15/04	126794	120273	112299	97977	82560	43298	38529	32799	25579	20028	16017	13209
Gasoline 1,4 - 2,0 l	Improved Conventional	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 1,4 - 2,0 l	Open Loop	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	200915	202840	203432	202367	194421	120227	125610	123738	110286	94242	79872	67057
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	244688	252696	262127	267592	270379	177309	198354	213059	211817	204130	195136	184496
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	26550	54932	83268	108565	112804	76274	87597	96279	99201	100253	100729	101877
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	24614	34775	64863	104056	135974	167382	172794	179010
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	23036	39362
Gasoline >2,0 l	PRE ECE	243	212	220	230	306	230	309	373	471	537	618	685
Gasoline >2,0 l	ECE 15/00-01	273	223	195	202	222	150	197	239	270	293	321	359
Gasoline >2,0 l	ECE 15/02	396	290	230	195	207	134	152	228	277	284	318	345
Gasoline >2,0 l	ECE 15/03	882	701	551	432	332	195	213	333	405	458	502	509
Gasoline >2,0 l	ECE 15/04	11566	11024	10036	8705	7410	3958	3667	3474	2889	2465	2273	2075
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	15066	15089	15088	14731	13961	8705	8860	8693	7847	6912	6067	5108
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	14495	15127	15723	16068	16180	10882	12254	13301	13085	12720	12078	11396
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	2328	4163	6035	8222	9747	6972	8526	9737	10185	10348	10270	10288
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	1333	2112	4307	6995	9381	10872	11228	11539

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	423	689
Diesel 1,4 - 2,0 l	Conventional	97670	95145	93398	87789	79063	45729	44806	41624	35269	29654	25149	22122
Diesel 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	24104	24935	25971	27085	27586	19028	21060	22047	21008	19263	17728	16554
Diesel 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	47629	57070	70788	81202	88061	65205	75126	83052	87288	87136	86101	85682
Diesel 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	15304	50243	103211	181861	206600	161431	204048	234271	247671	254578	256776	261674
Diesel 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	51816	70772	130164	204960	277959	351645	379337	415549
Diesel 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	48993	100163
Diesel >2,0 l	Conventional	8735	8484	8140	7994	7612	6814	7134	7121	6573	6076	5710	5576
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	5039	5262	5466	5726	5975	7423	8279	8646	8406	7935	7349	6894
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	8039	9560	11711	13611	15357	15473	18845	21312	22623	22871	22614	22197
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	2188	6184	12763	24106	31143	27321	36976	44507	48483	50795	51603	52446
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	6493	12862	27943	46495	62215	74015	77767	82458
Diesel >2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	5524	10847
LPG	Conventional	19788	20613	20818	18804	16337	9039	7637	6124	4823	3797	3300	2902
LPG	PC Euro 1 - 91/441/EEC	18164	22178	26315	29268	31112	21027	20965	19099	16536	13463	11583	9676
LPG	PC Euro 2 - 94/12/EEC	19674	24374	29613	33733	37601	27416	29475	29629	29116	27173	26768	25596
LPG	PC Euro 3 - 98/69/EC Stage2000	2660	6732	12198	18440	21037	15436	16870	17203	17388	16995	17558	17852
LPG	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	4575	6895	11710	16769	21185	25142	26537	27510
LPG	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	3677	6644
CNG	PC Euro 4 - 98/69/EC Stage2005	0	0	0	3007	6042	5997	9023	12364	15127	17794	15183	14792
CNG	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	651	1176
2-Stroke	Conventional	352	252	186	141	84	55	67	83	95	99	102	116
Hybrid Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0
Hybrid Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0
Hybrid Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline <3,5t	Conventional	9385	7688	6340	4955	5852	2150	1736	1510	1197	1059	888	828
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	16585	15819	15052	13882	15079	4989	4426	4039	3370	2785	2238	1878
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	27929	27988	27775	27081	28740	6257	6737	6660	6340	5869	5306	4785
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	4891	9826	13291	15322	18653	7746	7920	7841	7681	7326	7033	6785
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	1238	2828	4899	6095	7463	7274	7526
Gasoline <3,5t	LD Euro 5 - 2008 Standards	0	0	0	0	0	0	0	0	0	0	1142	1852
Diesel <3,5 t	Conventional	48668	44853	41364	37078	36252	21224	19773	18131	15855	13955	12297	11038
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	44046	42724	41869	40397	43270	25565	24590	23377	21534	19606	17462	15919
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	38727	39087	39982	40408	45523	27308	27978	28564	28286	27073	26143	25209

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	2793	8392	16821	25614	93720	58245	61460	65279	68575	69952	69329	69400
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	16689	38753	64264	82506	99754	101604	104658
Diesel <3,5 t	LD Euro 5 - 2008 Standards	0	0	0	0	0	0	0	0	0	0	16860	34025
Gasoline >3,5 t	Conventional	4494	3619	3021	2295	318	217	183	177	124	81	83	78
Rigid <=7,5 t	Conventional	14555	12444	10352	7974	6078	4507	4261	4094	3829	3494	3409	3390
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	5772	5054	4352	3544	2993	2364	2268	2248	2083	1912	1719	1691
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	9013	8283	7612	6792	6600	5016	5018	4936	4972	4717	4546	4419
Rigid <=7,5 t	HD Euro III - 2000 Standards	7617	18680	30875	45429	4629	3670	3669	3677	3685	3755	3695	3752
Rigid <=7,5 t	HD Euro IV - 2005 Standards	0	0	0	0	0	461	1063	1868	1959	2085	2159	2336
Rigid <=7,5 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	478	841	1167	1499
Rigid 7,5 - 12 t	Conventional	4057	3445	2933	2470	2062	1516	1356	1226	1112	963	874	813
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	1391	1371	1292	1200	498	404	398	395	373	354	329	316
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	2412	2501	2512	2476	1389	1245	1310	1344	1395	1383	1378	1349
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	385	695	974	1293	983	919	1018	1126	1205	1288	1311	1350
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	0	0	0	0	0	193	412	646	676	747	797	876
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	124	238	350	479
Rigid 12 - 14 t	Conventional	4057	3445	2933	2470	2062	1516	1356	1226	1112	963	874	813
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	1391	1371	1292	1200	498	404	398	395	373	354	329	316
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	2412	2501	2512	2476	1389	1245	1310	1344	1395	1383	1378	1349
Rigid 12 - 14 t	HD Euro III - 2000 Standards	385	695	974	1293	983	919	1018	1126	1205	1288	1311	1350
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	0	0	0	0	0	193	412	646	676	747	797	876
Rigid 12 - 14 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	124	238	350	479
Rigid 14 - 20 t	Conventional	6485	5563	4738	3957	3005	2181	1937	1750	1574	1345	1196	1094
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	1748	1762	1685	1577	1047	824	796	764	719	652	604	558
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	3334	3627	3760	3891	3256	2906	3021	3057	3121	3008	2922	2822
Rigid 14 - 20 t	HD Euro III - 2000 Standards	501	1086	1661	2462	3105	3388	3930	4275	4338	4290	4023	3796
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	0	0	0	0	0	861	2254	3710	3883	4328	4480	4747
Rigid 14 - 20 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	381	905	1722	2578
Rigid 20 - 26 t	Conventional	2428	2118	1804	1488	943	665	585	524	463	382	322	281
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	354	395	393	378	549	417	398	369	346	297	275	242
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	922	1126	1252	1415	1867	1662	1711	1713	1726	1626	1544	1474
Rigid 20 - 26 t	HD Euro III - 2000 Standards	119	391	688	1169	2122	2466	2912	3153	3133	3002	2712	2446
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	0	0	0	0	0	668	1842	3064	3207	3582	3683	3871
Rigid 20 - 26 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	253	667	1372	2099

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Rigid 26 - 28 t	Conventional	2428	2118	1804	1488	943	665	585	524	463	382	322	281
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	354	395	393	378	549	417	398	369	346	297	275	242
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	922	1126	1252	1415	1867	1662	1711	1713	1726	1626	1544	1474
Rigid 26 - 28 t	HD Euro III - 2000 Standards	119	391	688	1169	2122	2466	2912	3153	3133	3002	2712	2446
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	0	0	0	0	0	668	1842	3064	3207	3582	3683	3871
Rigid 26 - 28 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	253	667	1372	2099
Rigid 28 - 32 t	Conventional	2428	2118	1804	1488	943	665	585	524	463	382	322	281
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	354	395	393	378	549	417	398	369	346	297	275	242
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	922	1126	1252	1415	1867	1662	1711	1713	1726	1626	1544	1474
Rigid 28 - 32 t	HD Euro III - 2000 Standards	119	391	688	1169	2122	2466	2912	3153	3133	3002	2712	2446
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	0	0	0	0	0	668	1842	3064	3207	3582	3683	3871
Rigid 28 - 32 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	253	667	1372	2099
Rigid >32 t	Conventional	1581	1399	1236	1020	52	37	39	30	31	26	22	22
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	664	664	644	612	68	51	49	48	47	43	35	21
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	1192	1304	1427	1501	318	295	313	314	264	252	215	194
Rigid >32 t	HD Euro III - 2000 Standards	131	312	572	989	322	302	345	377	369	357	316	288
Rigid >32 t	HD Euro IV - 2005 Standards	0	0	0	0	0	153	359	524	536	524	426	411
Rigid >32 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	35	56	81	107
Articulated 14 - 20 t	Conventional	6485	5563	4738	3957	3005	2181	1937	1750	1574	1345	1196	1094
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	1748	1762	1685	1577	1047	824	796	764	719	652	604	558
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	3334	3627	3760	3891	3256	2906	3021	3057	3121	3008	2922	2822
Articulated 14 - 20 t	HD Euro III - 2000 Standards	501	1086	1661	2462	3105	3388	3930	4275	4338	4290	4023	3796
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	0	0	0	0	0	861	2254	3710	3883	4328	4480	4747
Articulated 14 - 20 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	381	905	1722	2578
Articulated 20 - 28 t	Conventional	2428	2118	1804	1488	943	665	585	524	463	382	322	281
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	354	395	393	378	549	417	398	369	346	297	275	242
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	922	1126	1252	1415	1867	1662	1711	1713	1726	1626	1544	1474
Articulated 20 - 28 t	HD Euro III - 2000 Standards	119	391	688	1169	2122	2466	2912	3153	3133	3002	2712	2446
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	0	0	0	0	0	668	1842	3064	3207	3582	3683	3871
Articulated 20 - 28 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	253	667	1372	2099
Articulated 28 - 34 t	Conventional	4005	3516	3041	2508	995	702	623	554	494	408	344	303
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	1017	1059	1037	989	613	471	447	417	393	340	309	263
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	2114	2430	2675	2916	2181	1957	2021	2027	1990	1878	1759	1668
Articulated 28 - 34 t	HD Euro III - 2000 Standards	250	703	1260	2158	2448	2771	3257	3529	3502	3358	3028	2734

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	0	0	0	0	0	821	2201	3588	3743	4106	4109	4282
Articulated 28 - 34 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	288	723	1453	2206
Articulated 34 - 40 t	Conventional	1581	1399	1236	1020	52	37	39	30	31	26	22	22
Articulated 34 - 40 t	HD Euro I - 91/542/EEC Stage I	664	664	644	612	68	51	49	48	47	43	35	21
Articulated 34 - 40 t	HD Euro II - 91/542/EEC Stage II	1192	1304	1427	1501	318	295	313	314	264	252	215	194
Articulated 34 - 40 t	HD Euro III - 2000 Standards	131	312	572	989	322	302	345	377	369	357	316	288
Articulated 34 - 40 t	HD Euro IV - 2005 Standards	0	0	0	0	0	153	359	524	536	524	426	411
Articulated 34 - 40 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	35	56	81	107
Articulated 40 - 50 t	Conventional	1581	1399	1236	1020	52	37	39	30	31	26	22	22
Articulated 40 - 50 t	HD Euro I - 91/542/EEC Stage I	664	664	644	612	68	51	49	48	47	43	35	21
Articulated 40 - 50 t	HD Euro II - 91/542/EEC Stage II	1192	1304	1427	1501	318	295	313	314	264	252	215	194
Articulated 40 - 50 t	HD Euro III - 2000 Standards	131	312	572	989	322	302	345	377	369	357	316	288
Articulated 40 - 50 t	HD Euro IV - 2005 Standards	0	0	0	0	0	153	359	524	536	524	426	411
Articulated 40 - 50 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	35	56	81	107
Articulated 50 - 60 t	Conventional	1581	1399	1236	1020	52	37	39	30	31	26	22	22
Articulated 50 - 60 t	HD Euro I - 91/542/EEC Stage I	664	664	644	612	68	51	49	48	47	43	35	21
Articulated 50 - 60 t	HD Euro II - 91/542/EEC Stage II	1192	1304	1427	1501	318	295	313	314	264	252	215	194
Articulated 50 - 60 t	HD Euro III - 2000 Standards	131	312	572	989	322	302	345	377	369	357	316	288
Articulated 50 - 60 t	HD Euro IV - 2005 Standards	0	0	0	0	0	153	359	524	536	524	426	411
Articulated 50 - 60 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	35	56	81	107
Urban Buses Midi <=15 t	Conventional	3363	3039	2525	1629	1298	675	504	359	263	141	104	0
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	503	510	517	422	427	444	435	390	324	258	186	155
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	2107	2196	2307	1998	2087	1321	1384	1416	1345	1214	1085	987
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	406	686	1153	1281	1693	1051	1137	1201	1204	1174	1119	1093
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	0	0	0	0	0	202	415	729	728	736	719	736
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	212	448	640	791
Urban Buses Standard 15 - 18 t	Conventional	3363	3039	2525	1629	1298	675	504	359	263	141	104	0
Urban Buses Standard 15 - 18 t	HD Euro I - 91/542/EEC Stage I	503	510	517	422	427	444	435	390	324	258	186	155
Urban Buses Standard 15 - 18 t	HD Euro II - 91/542/EEC Stage II	2107	2196	2307	1998	2087	1321	1384	1416	1345	1214	1085	987
Urban Buses Standard 15 - 18 t	HD Euro III - 2000 Standards	406	686	1153	1281	1693	1051	1137	1201	1204	1174	1119	1093
Urban Buses Standard 15 - 18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	202	415	729	728	736	719	736
Urban Buses Standard 15 - 18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	212	448	640	791
Urban Buses Articulated >18 t	Conventional	3363	3039	2525	1629	1298	675	504	359	263	141	104	0
Urban Buses Articulated >18 t	HD Euro I - 91/542/EEC Stage I	503	510	517	422	427	444	435	390	324	258	186	155

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Urban Buses Articulated >18 t	HD Euro II - 91/542/EEC Stage II	2107	2196	2307	1998	2087	1321	1384	1416	1345	1214	1085	987
Urban Buses Articulated >18 t	HD Euro III - 2000 Standards	406	686	1153	1281	1693	1051	1137	1201	1204	1174	1119	1093
Urban Buses Articulated >18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	202	415	729	728	736	719	736
Urban Buses Articulated >18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	212	448	640	791
Coaches Standard <=18 t	Conventional	5953	5196	4574	3084	2416	1003	761	544	384	211	151	111
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	2319	2313	2346	1835	1824	665	652	595	486	393	279	232
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	3170	3411	3619	3124	3550	1986	2075	2114	2023	1820	1627	1480
Coaches Standard <=18 t	HD Euro III - 2000 Standards	425	1020	1551	1961	2531	1572	1710	1806	1800	1766	1674	1639
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	299	623	1108	1092	1104	1078	1104
Coaches Standard <=18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	324	677	960	1187
Coaches Articulated >18 t	Conventional	5953	5196	4574	3084	2416	1003	761	544	384	211	151	111
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	2319	2313	2346	1835	1824	665	652	595	486	393	279	232
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	3170	3411	3619	3124	3550	1986	2075	2114	2023	1820	1627	1480
Coaches Articulated >18 t	HD Euro III - 2000 Standards	425	1020	1551	1961	2531	1572	1710	1806	1800	1766	1674	1639
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	299	623	1108	1092	1104	1078	1104
Coaches Articulated >18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	324	677	960	1187
Urban CNG Buses	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	0	0	0	0	0	0
Urban CNG Buses	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	0	0	0	0
Urban CNG Buses	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0
Urban CNG Buses	EEV	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	Conventional	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	0	0	0	0	0
Urban Biodiesel Buses	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	0
2-stroke <50 cm³	Conventional	288290	195658	166876	22107	23047	14081	14898	16063	16554	17053	18175	19119
2-stroke <50 cm³	Mop - Euro I	0	82018	92950	13303	12331	7325	7515	7805	7741	7684	7468	7493
2-stroke <50 cm³	Mop - Euro II	0	12955	33402	9276	13468	11969	16987	22933	26971	30246	32377	35229
2-stroke <50 cm³	Mop - Euro III	0	0	0	0	0	0	0	0	0	0	0	0
2-stroke >50 cm³	Conventional	14318	13181	10392	3668	3506	1247	970	1060	1159	1241	1286	1325
2-stroke >50 cm³	Mot - Euro I	358	578	594	216	209	151	192	265	310	301	321	363
2-stroke >50 cm³	Mot - Euro II	0	0	0	0	0	0	0	0	0	0	0	0
2-stroke >50 cm³	Mot - Euro III	0	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
4-stroke <250 cm³	Conventional	59044	55055	56326	18963	18074	5897	4142	4189	4065	3908	3755	3707
4-stroke <250 cm³	Mot - Euro I	33212	37439	45277	17982	19167	8049	7572	9465	10772	11406	11829	12334
4-stroke <250 cm³	Mot - Euro II	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke <250 cm³	Mot - Euro III	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke 250 - 750 cm³	Conventional	63894	56355	47971	16801	16314	6960	7315	7528	7496	7440	7352	7334
4-stroke 250 - 750 cm³	Mot - Euro I	25304	32138	37770	17474	21066	10900	16752	20483	23182	25032	26343	28006
4-stroke 250 - 750 cm³	Mot - Euro II	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke 250 - 750 cm³	Mot - Euro III	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke >750 cm³	Conventional	25810	23557	19617	7053	6846	3070	3438	3576	3618	3619	3591	3623
4-stroke >750 cm³	Mot - Euro I	15815	21329	24494	11112	12669	6606	10539	13545	15729	17441	19323	21280
4-stroke >750 cm³	Mot - Euro II	0	0	0	0	0	0	0	0	0	0	0	0
4-stroke >750 cm³	Mot - Euro III	0	0	0	0	0	0	0	0	0	0	0	0

Table 290 Mileage data for Road transport (average km/ year/vehicle) 1988-2000

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline 0,8 - 1,4 l	PRE ECE	15053	16132	14159	6635	5697	6088	5665	5799	4672	2959	3637	3296	2570
Gasoline 0,8 - 1,4 l	ECE 15/00-01	18131	19431	17055	7992	6861	7333	6824	6985	5627	3564	4381	3970	3095
Gasoline 0,8 - 1,4 l	ECE 15/02	18361	19676	17271	8093	6948	7425	6910	7073	5699	3609	4436	4021	3134
Gasoline 0,8 - 1,4 l	ECE 15/03	21637	23188	20353	9537	8188	8751	8143	8336	6716	4254	5228	4738	3694
Gasoline 0,8 - 1,4 l	ECE 15/04	29068	31152	27342	12812	11000	11755	10940	11198	9022	5714	7023	6365	4962
Gasoline 0,8 - 1,4 l	Improved Conventional	23877	25588	22459	10524	9036	9656	8986	9198	7411	4694	5769	5228	4076
Gasoline 0,8 - 1,4 l	Open Loop	25901	27759	24363	11416	9802	10475	9748	9978	8039	5092	6258	5672	4421
Gasoline 0,8 - 1,4 l	PC Euro 1 - 91/441/EEC	34992	37502	32914	15423	13242	14151	13169	13481	10860	6879	8455	7662	5973
Gasoline 0,8 - 1,4 l	PC Euro 2 - 94/12/EEC	40546	43453	38138	17871	15344	16397	15259	15620	12584	7971	9797	8878	6921
Gasoline 0,8 - 1,4 l	PC Euro 3 - 98/69/EC Stage2000	46783	50137	44003	20620	17704	18920	17607	18023	14520	9197	11304	10244	7986
Gasoline 0,8 - 1,4 l	PC Euro 4 - 98/69/EC Stage2005	49560	53114	46616	21845	18755	20043	18652	19093	15382	9743	11975	10852	8460
Gasoline 0,8 - 1,4 l	PC Euro 5 - EC 715/2007	55456	59431	52161	24443	20986	22427	20871	21364	17212	10902	13399	12143	9467
Gasoline 1,4 - 2,0 l	PRE ECE	16133	17289	15175	7111	6105	6524	6072	6215	5007	3171	3898	3533	2754
Gasoline 1,4 - 2,0 l	ECE 15/00-01	19315	20699	18168	8513	7309	7811	7269	7441	5995	3797	4667	4230	3297
Gasoline 1,4 - 2,0 l	ECE 15/02	20264	21716	19061	8932	7669	8195	7626	7807	6289	3984	4896	4437	3459
Gasoline 1,4 - 2,0 l	ECE 15/03	23227	24891	21847	10238	8790	9393	8741	8948	7209	4566	5612	5086	3965
Gasoline 1,4 - 2,0 l	ECE 15/04	31237	33477	29382	13768	11821	12633	11756	12034	9695	6141	7547	6840	5332
Gasoline 1,4 - 2,0 l	Improved Conventional	23877	25588	22459	10524	9036	9656	8986	9198	7411	4694	5769	5228	4076

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline 1,4 - 2,0 l	Open Loop	29401	31509	27655	12959	11126	11890	11065	11326	9125	5780	7104	6438	5019
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	38655	41427	36360	17038	14628	15633	14548	14892	11997	7599	9340	8464	6599
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	43591	46716	41003	19213	16496	17629	16405	16793	13529	8569	10532	9545	7441
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	50300	53906	47311	22170	19035	20342	18930	19378	15611	9888	12153	11014	8586
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	55826	59829	52509	24606	21126	22577	21010	21507	17327	10975	13489	12225	9530
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	61649	66068	57986	27173	23330	24932	23201	23750	19134	12119	14895	13499	10524
Gasoline >2,0 l	PRE ECE	16967	18182	15959	7478	6421	6862	6385	6536	5266	3335	4099	3715	2896
Gasoline >2,0 l	ECE 15/00-01	20297	21751	19091	8946	7681	8208	7639	7819	6299	3990	4904	4444	3465
Gasoline >2,0 l	ECE 15/02	20651	22130	19424	9102	7815	8351	7772	7956	6409	4060	4990	4522	3525
Gasoline >2,0 l	ECE 15/03	24493	26250	23039	10796	9269	9906	9218	9436	7602	4815	5918	5363	4181
Gasoline >2,0 l	ECE 15/04	32495	34826	30566	14323	12297	13142	12230	12519	10086	6388	7851	7116	5547
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	39603	42442	37251	17456	14987	16016	14904	15257	12291	7785	9569	8672	6760
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	46525	49861	43761	20507	17607	18816	17510	17924	14440	9146	11241	10188	7942
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	51798	55511	48720	22831	19602	20948	19494	19955	16076	10183	12515	11342	8842
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	58230	62405	54771	25666	22036	23549	21915	22433	18073	11447	14069	12751	9940
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	64328	68939	60506	28354	24343	26015	24210	24782	19965	12646	15543	14086	10981
Diesel 1,4 - 2,0 l	Conventional	9407	8858	5101	4046	3975	3806	2470	2458	4319	7625	8898	9138	7854
Diesel 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	10598	9979	5747	4558	4478	4288	2782	2769	4866	8590	10024	10294	8849
Diesel 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	12483	11753	6768	5369	5274	5050	3278	3261	5731	10118	11808	12124	10423
Diesel 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	14165	13337	7680	6093	5985	5730	3720	3701	6503	11481	13398	13757	11826
Diesel 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	14289	13454	7748	6146	6037	5781	3752	3733	6561	11582	13516	13879	11931
Diesel 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	16073	15133	8715	6913	6791	6501	4221	4199	7379	13027	15202	15611	13419
Diesel >2,0 l	Conventional	10389	9782	5633	4469	4390	4202	2727	2715	4770	8420	9827	10090	8674
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	11770	11082	6382	5062	4973	4762	3091	3075	5404	9540	11133	11433	9827
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	13232	12459	7174	5692	5591	5353	3475	3457	6075	10725	12515	12852	11047
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	15468	14565	8387	6653	6536	6258	4062	4042	7102	12537	14630	15024	12915
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	16005	15069	8678	6884	6762	6474	4202	4182	7348	12972	15138	15545	13363
Diesel >2,0 l	PC Euro 5 - EC 715/2007	17854	16810	9680	7679	7544	7222	4688	4664	8197	14471	16888	17342	14907
LPG	Conventional	0	0	0	0	0	0	0	0	0	110810	47245	41868	70366
LPG	PC Euro 1 - 91/441/EEC	0	0	0	0	0	0	0	0	0	125776	53625	47523	79870
LPG	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	133539	56935	50456	84799
LPG	PC Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	139981	59682	52890	88890
LPG	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	136841	58343	51704	86897
LPG	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	143944	61371	54387	91407

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CNG	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0	0	0
CNG	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Stroke	Conventional	12572	13473	11826	5541	4758	5084	4732	4843	3902	2472	3038	2753	2146
Hybrid Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	60802	65161	57190	26800	23009	24590	22883	23424	18871	11953	14691	13314	10379
Hybrid Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	61903	66340	58225	27285	23426	25034	23297	23848	19213	12169	14957	13555	10567
Hybrid Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	72149	77321	67863	31801	27303	29178	27153	27795	22393	14183	17433	15799	12316
Gasoline <3,5t	Conventional	41301	44262	38848	18204	15629	16703	15544	15911	12818	8119	9979	9044	7050
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	47536	50944	44711	20952	17989	19224	17890	18313	14754	9345	11485	10409	8115
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	53174	56986	50015	23437	20123	21505	20012	20485	16504	10453	12848	11644	9077
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	60322	64647	56738	26588	22828	24395	22702	23239	18722	11858	14575	13209	10297
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	68208	73098	64156	30064	25812	27585	25670	26277	21170	13409	16480	14936	11644
Gasoline <3,5t	LD Euro 5 - 2008 Standards	74602	79951	70170	32882	28231	30170	28076	28740	23154	14666	18025	16336	12735
Diesel <3,5 t	Conventional	9688	9122	5253	4167	4094	3919	2544	2531	4448	7853	9163	9410	8089
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	11239	10583	6094	4834	4748	4547	2951	2937	5160	9110	10631	10917	9384
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	12364	11641	6703	5318	5224	5002	3247	3230	5676	10021	11695	12009	10324
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	13490	12701	7315	5803	5700	5457	3542	3525	6193	10934	12760	13102	11263
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	15555	14645	8434	6690	6572	6292	4084	4064	7141	12608	14712	15108	12987
Diesel <3,5 t	LD Euro 5 - 2008 Standards	16680	15705	9044	7174	7047	6747	4380	4358	7658	13519	15777	16200	13926
Gasoline >3,5 t	Conventional	54337	58232	51108	23950	20563	21975	20449	20933	16864	10682	13129	11898	9276
Rigid <=7,5 t	Conventional	14026	13206	7605	6033	5926	5674	3683	3664	6439	11369	13267	13623	11711
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	16446	15484	8917	7073	6949	6652	4318	4297	7550	13330	15555	15973	13731
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	19375	18243	10506	8334	8187	7838	5087	5062	8895	15704	18326	18819	16177
Rigid <=7,5 t	HD Euro III - 2000 Standards	22672	21347	12293	9752	9579	9172	5953	5924	10410	18376	21445	22022	18930
Rigid <=7,5 t	HD Euro IV - 2005 Standards	24517	23084	13293	10545	10359	9917	6437	6406	11255	19871	23189	23812	20470
Rigid <=7,5 t	HD Euro V - 2008 Standards	7620	7175	4132	3278	3220	3082	2001	1990	3498	6176	7207	7401	6362
Rigid 7,5 - 12 t	Conventional	14428	13585	7824	6206	6096	5837	3788	3769	6624	11695	13647	14015	12047
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	18119	17061	9824	7793	7655	7330	4757	4734	8319	14686	17139	17599	15128
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	21281	20036	11538	9153	8991	8608	5587	5560	9770	17248	20128	20669	17768
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	25166	23696	13645	10824	10633	10180	6608	6575	11554	20398	23804	24444	21013
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	27474	25867	14896	11817	11607	11114	7214	7178	12614	22268	25986	26685	22939
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	7620	7175	4132	3278	3220	3082	2001	1990	3498	6176	7207	7401	6362
Rigid 12 - 14 t	Conventional	12582	11847	6823	5412	5317	5090	3304	3287	5777	10198	11901	12221	10505
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	16434	15474	8911	7069	6943	6648	4315	4293	7546	13321	15544	15962	13721
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	19647	18498	10653	8451	8301	7948	5159	5133	9020	15924	18583	19082	16404

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Rigid 12 - 14 t	HD Euro III - 2000 Standards	24512	23079	13291	10543	10357	9916	6436	6404	11253	19868	23185	23808	20467
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	25280	23802	13707	10873	10681	10226	6637	6604	11606	20490	23911	24554	21107
Rigid 12 - 14 t	HD Euro V - 2008 Standards	7620	7175	4132	3278	3220	3082	2001	1990	3498	6176	7207	7401	6362
Rigid 14 - 20 t	Conventional	15836	14910	8586	6812	6691	6406	4158	4137	7271	12835	14979	15381	13222
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	19857	18697	10766	8540	8390	8033	5214	5188	9117	16095	18783	19287	16579
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	22883	21546	12408	9843	9669	9257	6008	5978	10506	18548	21645	22226	19107
Rigid 14 - 20 t	HD Euro III - 2000 Standards	26531	24981	14386	11412	11210	10733	6966	6932	12180	21505	25096	25769	22152
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	27113	25529	14701	11662	11455	10968	7119	7083	12448	21976	25645	26334	22638
Rigid 14 - 20 t	HD Euro V - 2008 Standards	7620	7175	4132	3278	3220	3082	2001	1990	3498	6176	7207	7401	6362
Rigid 20 - 26 t	Conventional	15859	14932	8600	6822	6700	6415	4164	4143	7282	12854	15000	15404	13242
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	20122	18946	10910	8655	8502	8140	5284	5257	9239	16309	19032	19544	16800
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	23074	21725	12511	9924	9748	9333	6059	6029	10593	18702	21824	22412	19265
Rigid 20 - 26 t	HD Euro III - 2000 Standards	27404	25802	14859	11787	11578	11086	7195	7159	12582	22212	25920	26617	22881
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	24966	23508	13537	10739	10549	10099	6556	6523	11462	20236	23615	24250	20846
Rigid 20 - 26 t	HD Euro V - 2008 Standards	7620	7175	4132	3278	3220	3082	2001	1990	3498	6176	7207	7401	6362
Rigid 26 - 28 t	Conventional	15796	14873	8565	6794	6674	6390	4148	4127	7253	12803	14941	15342	13189
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	19443	18306	10542	8362	8215	7865	5105	5080	8926	15759	18391	18884	16233
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	22351	21045	12119	9614	9444	9041	5869	5840	10262	18116	21141	21709	18662
Rigid 26 - 28 t	HD Euro III - 2000 Standards	26264	24729	14240	11297	11097	10624	6896	6862	12059	21287	24843	25510	21929
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	26975	25399	14626	11602	11398	10913	7082	7048	12385	21864	25515	26200	22523
Rigid 26 - 28 t	HD Euro V - 2008 Standards	7620	7175	4132	3278	3220	3082	2001	1990	3498	6176	7207	7401	6362
Rigid 28 - 32 t	Conventional	15832	14907	8584	6810	6689	6404	4157	4136	7269	12833	14975	15377	13219
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	19697	18546	10680	8472	8323	7967	5172	5147	9043	15964	18631	19131	16445
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	22663	21339	12289	9748	9576	9168	5950	5921	10405	18369	21436	22012	18923
Rigid 28 - 32 t	HD Euro III - 2000 Standards	26911	25338	14591	11575	11370	10886	7066	7031	12355	21812	25454	26138	22469
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	25367	23884	13753	10911	10717	10261	6660	6628	11646	20560	23992	24638	21179
Rigid 28 - 32 t	HD Euro V - 2008 Standards	7620	7175	4132	3278	3220	3082	2001	1990	3498	6176	7207	7401	6362
Rigid >32 t	Conventional	19506	18366	10576	8390	8242	7891	5122	5096	8955	15811	18450	18946	16287
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	21523	20266	11671	9257	9094	8706	5652	5624	9881	17446	20358	20905	17971
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	26411	24867	14320	11360	11159	10683	6934	6900	12125	21407	24981	25652	22051
Rigid >32 t	HD Euro III - 2000 Standards	30419	28641	16494	13084	12853	12306	7988	7947	13965	24656	28772	29545	25397
Rigid >32 t	HD Euro IV - 2005 Standards	27866	26237	15109	11985	11774	11273	7317	7280	12793	22586	26357	27065	23266
Rigid >32 t	HD Euro V - 2008 Standards	7620	7175	4132	3278	3220	3082	2001	1990	3498	6176	7207	7401	6362
Articulated 14 - 20 t	Conventional	20627	19421	11184	8871	8715	8343	5416	5389	9470	16718	19510	20034	17222

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	24926	23468	13515	10720	10532	10083	6545	6512	11444	20203	23576	24210	20811
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	29823	28079	16170	12827	12600	12063	7831	7792	13692	24172	28208	28966	24900
Articulated 14 - 20 t	HD Euro III - 2000 Standards	37182	35009	20161	15993	15710	15041	9763	9714	17071	30138	35170	36115	31045
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	39469	37163	21400	16976	16677	15966	10364	10312	18121	31991	37333	38335	32954
Articulated 14 - 20 t	HD Euro V - 2008 Standards	35669	33583	19340	15342	15070	14429	9366	9319	16376	28910	33737	34644	29781
Articulated 20 - 28 t	Conventional	22870	21534	12401	9837	9663	9252	6005	5975	10500	18537	21632	22213	19095
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	27169	25581	14731	11686	11479	10990	7134	7098	12474	22022	25698	26389	22684
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	32533	30632	17640	13993	13746	13161	8542	8500	14936	26369	30772	31599	27163
Articulated 20 - 28 t	HD Euro III - 2000 Standards	39427	37122	21377	16958	16658	15949	10353	10301	18101	31957	37292	38294	32919
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	39469	37163	21400	16976	16677	15966	10364	10312	18121	31991	37333	38335	32954
Articulated 20 - 28 t	HD Euro V - 2008 Standards	35669	33583	19340	15342	15070	14429	9366	9319	16376	28910	33737	34644	29781
Articulated 28 - 34 t	Conventional	24554	23119	13313	10561	10374	9932	6447	6416	11273	19901	23224	23848	20500
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	28811	27127	15622	12392	12173	11655	7565	7528	13227	23353	27252	27985	24056
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	34459	32446	18684	14822	14560	13940	9048	9003	15821	27930	32594	33470	28771
Articulated 28 - 34 t	HD Euro III - 2000 Standards	41559	39130	22534	17875	17559	16812	10912	10858	19080	33685	39309	40366	34699
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	45248	42603	24534	19461	19118	18304	11880	11821	20773	36674	42798	43948	37778
Articulated 28 - 34 t	HD Euro V - 2008 Standards	35669	33583	19340	15342	15070	14429	9366	9319	16376	28910	33737	34644	29781
Articulated 34 - 40 t	Conventional	23415	22046	12696	10071	9893	9471	6148	6118	10750	18978	22147	22742	19549
Articulated 34 - 40 t	HD Euro I - 91/542/EEC Stage I	30102	28342	16321	12947	12718	12177	7904	7865	13820	24399	28472	29237	25133
Articulated 34 - 40 t	HD Euro II - 91/542/EEC Stage II	35703	33617	19359	15356	15086	14443	9374	9329	16392	28938	33770	34678	29810
Articulated 34 - 40 t	HD Euro III - 2000 Standards	43106	40586	23372	18541	18213	17438	11318	11262	19790	34939	40773	41868	35991
Articulated 34 - 40 t	HD Euro IV - 2005 Standards	45696	43025	24776	19655	19307	18485	11999	11938	20980	37038	43222	44383	38153
Articulated 34 - 40 t	HD Euro V - 2008 Standards	35669	33583	19340	15342	15070	14429	9366	9319	16376	28910	33737	34644	29781
Articulated 40 - 50 t	Conventional	27032	25452	14657	11627	11422	10935	7098	7063	12410	21910	25569	26256	22570
Articulated 40 - 50 t	HD Euro I - 91/542/EEC Stage I	33158	31221	17979	14262	14010	13413	8707	8663	15223	26876	31363	32206	27685
Articulated 40 - 50 t	HD Euro II - 91/542/EEC Stage II	40800	38416	22123	17549	17238	16505	10713	10660	18732	33070	38591	39628	34065
Articulated 40 - 50 t	HD Euro III - 2000 Standards	48724	45876	26419	20957	20587	19710	12793	12730	22370	39492	46086	47325	40682
Articulated 40 - 50 t	HD Euro IV - 2005 Standards	45696	43025	24776	19655	19307	18485	11999	11938	20980	37038	43222	44383	38153
Articulated 40 - 50 t	HD Euro V - 2008 Standards	35669	33583	19340	15342	15070	14429	9366	9319	16376	28910	33737	34644	29781
Articulated 50 - 60 t	Conventional	24859	23407	13479	10693	10504	10056	6528	6495	11414	20150	23513	24146	20756
Articulated 50 - 60 t	HD Euro I - 91/542/EEC Stage I	29525	27799	16009	12700	12475	11944	7752	7713	13556	23931	27927	28678	24652
Articulated 50 - 60 t	HD Euro II - 91/542/EEC Stage II	35750	33659	19383	15377	15104	14461	9386	9340	16413	28975	33814	34722	29848
Articulated 50 - 60 t	HD Euro III - 2000 Standards	43558	41013	23618	18735	18404	17621	11437	11380	19998	35306	41200	42308	36369
Articulated 50 - 60 t	HD Euro IV - 2005 Standards	45696	43025	24776	19655	19307	18485	11999	11938	20980	37038	43222	44383	38153

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Articulated 50 - 60 t	HD Euro V - 2008 Standards	35669	33583	19340	15342	15070	14429	9366	9319	16376	28910	33737	34644	29781
Urban Buses Midi <=15 t	Conventional	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	33207	31266	18005	14283	14030	13432	8719	8676	15245	26915	31409	32253	27725
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	33625	31659	18232	14463	14207	13603	8829	8785	15438	27254	31805	32659	28075
Urban Buses Standard 15 - 18 t	Conventional	26552	25000	14397	11420	11219	10740	6972	6937	12190	21521	25114	25789	22169
Urban Buses Standard 15 - 18 t	HD Euro I - 91/542/EEC Stage I	32270	30384	17497	13880	13635	13054	8474	8432	14815	26156	30522	31344	26943
Urban Buses Standard 15 - 18 t	HD Euro II - 91/542/EEC Stage II	35969	33866	19502	15471	15197	14551	9444	9397	16514	29153	34022	34936	30032
Urban Buses Standard 15 - 18 t	HD Euro III - 2000 Standards	38357	36115	20797	16498	16207	15516	10071	10021	17610	31090	36280	37256	32025
Urban Buses Standard 15 - 18 t	HD Euro IV - 2005 Standards	37138	34967	20137	15973	15692	15024	9751	9703	17051	30101	35127	36071	31008
Urban Buses Standard 15 - 18 t	HD Euro V - 2008 Standards	50438	47490	27347	21694	21311	20403	13244	13177	23157	40882	47707	48989	42112
Urban Buses Articulated >18 t	Conventional	25436	23949	13792	10940	10747	10290	6678	6646	11678	20617	24059	24705	21238
Urban Buses Articulated >18 t	HD Euro I - 91/542/EEC Stage I	32450	30554	17595	13957	13711	13128	8521	8479	14899	26302	30693	31518	27094
Urban Buses Articulated >18 t	HD Euro II - 91/542/EEC Stage II	36551	34415	19819	15722	15443	14787	9597	9549	16781	29626	34573	35502	30519
Urban Buses Articulated >18 t	HD Euro III - 2000 Standards	38794	36526	21035	16686	16390	15693	10186	10136	17811	31444	36693	37680	32390
Urban Buses Articulated >18 t	HD Euro IV - 2005 Standards	36831	34679	19970	15842	15562	14900	9671	9623	16909	29853	34837	35774	30752
Urban Buses Articulated >18 t	HD Euro V - 2008 Standards	50438	47490	27347	21694	21311	20403	13244	13177	23157	40882	47707	48989	42112
Coaches Standard <=18 t	Conventional	25585	24090	13873	11004	10810	10349	6718	6685	11746	20737	24200	24851	21361
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	29916	28167	16220	12867	12639	12101	7854	7816	13734	24247	28296	29056	24977
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	32980	31053	17882	14185	13934	13341	8660	8617	15142	26732	31195	32033	27536
Coaches Standard <=18 t	HD Euro III - 2000 Standards	35700	33614	19357	15355	15083	14442	9373	9328	16390	28936	33767	34675	29808
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	37345	35163	20249	16063	15779	15108	9806	9757	17146	30270	35324	36273	31181
Coaches Standard <=18 t	HD Euro V - 2008 Standards	50438	47490	27347	21694	21311	20403	13244	13177	23157	40882	47707	48989	42112
Coaches Articulated >18 t	Conventional	25321	23841	13729	10891	10699	10243	6648	6616	11625	20524	23950	24594	21142
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	30526	28742	16552	13130	12898	12349	8016	7976	14015	24742	28874	29649	25487
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	34870	32832	18906	14998	14732	14106	9155	9110	16009	28263	32982	33868	29113
Coaches Articulated >18 t	HD Euro III - 2000 Standards	36960	34799	20040	15897	15616	14951	9705	9657	16968	29956	34958	35899	30859
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	36922	34765	20020	15881	15600	14936	9695	9647	16951	29926	34923	35863	30828
Coaches Articulated >18 t	HD Euro V - 2008 Standards	50438	47490	27347	21694	21311	20403	13244	13177	23157	40882	47707	48989	42112
Urban CNG Buses	HD Euro I - 91/542/EEC Stage I	32270	30384	17497	13880	13635	13054	8474	8432	14815	26156	30522	31344	26943
Urban CNG Buses	HD Euro II - 91/542/EEC Stage II	35969	33866	19502	15471	15197	14551	9444	9397	16514	29153	34022	34936	30032
Urban CNG Buses	HD Euro III - 2000 Standards	38357	36115	20797	16498	16207	15516	10071	10021	17610	31090	36280	37256	32025

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Urban CNG Buses	EEV	38357	36115	20797	16498	16207	15516	10071	10021	17610	31090	36280	37256	32025
Urban Biodiesel Buses	Conventional	26552	25000	14397	11420	11219	10740	6972	6937	12190	21521	25114	25789	22169
Urban Biodiesel Buses	HD Euro I - 91/542/EEC Stage I	32270	30384	17497	13880	13635	13054	8474	8432	14815	26156	30522	31344	26943
Urban Biodiesel Buses	HD Euro II - 91/542/EEC Stage II	35969	33866	19502	15471	15197	14551	9444	9397	16514	29153	34022	34936	30032
Urban Biodiesel Buses	HD Euro III - 2000 Standards	38357	36115	20797	16498	16207	15516	10071	10021	17610	31090	36280	37256	32025
Urban Biodiesel Buses	HD Euro IV - 2005 Standards	37138	34967	20137	15973	15692	15024	9751	9703	17051	30101	35127	36071	31008
Urban Biodiesel Buses	HD Euro V - 2008 Standards	50438	47490	27347	21694	21311	20403	13244	13177	23157	40882	47707	48989	42112
2-stroke <50 cm^3	Conventional	8756	9384	8236	3859	3314	3541	3295	3373	2718	1721	2116	1917	1495
2-stroke <50 cm^3	Mop - Euro I	9230	9891	8682	4068	3493	3733	3474	3556	2865	1814	2230	2021	1576
2-stroke <50 cm^3	Mop - Euro II	6848	7339	6442	3019	2592	2770	2577	2638	2126	1346	1655	1500	1169
2-stroke <50 cm^3	Mop - Euro III	5729	6139	5388	2525	2168	2317	2156	2207	1778	1126	1384	1254	978
2-stroke >50 cm^3	Conventional	13022	13956	12249	5740	4928	5266	4901	5017	4042	2560	3146	2852	2223
2-stroke >50 cm^3	Mot - Euro I	13582	14555	12775	5986	5140	5493	5111	5232	4215	2670	3282	2974	2318
2-stroke >50 cm^3	Mot - Euro II	15385	16488	14472	6781	5822	6222	5790	5927	4775	3024	3717	3369	2626
2-stroke >50 cm^3	Mot - Euro III	15769	16899	14833	6951	5968	6377	5935	6075	4894	3100	3810	3453	2692
4-stroke <250 cm^3	Conventional	16869	18078	15867	7435	6384	6822	6349	6499	5236	3316	4076	3694	2880
4-stroke <250 cm^3	Mot - Euro I	18761	20105	17647	8269	7100	7587	7061	7228	5823	3688	4533	4108	3203
4-stroke <250 cm^3	Mot - Euro II	16616	17807	15630	7324	6288	6720	6254	6401	5157	3267	4015	3639	2837
4-stroke <250 cm^3	Mot - Euro III	17747	19019	16693	7822	6716	7177	6679	6837	5508	3489	4288	3886	3030
4-stroke 250 - 750 cm^3	Conventional	17358	18602	16327	7651	6569	7020	6533	6687	5387	3412	4194	3801	2963
4-stroke 250 - 750 cm^3	Mot - Euro I	19528	20927	18368	8607	7390	7897	7349	7523	6061	3839	4718	4276	3334
4-stroke 250 - 750 cm^3	Mot - Euro II	17499	18753	16460	7713	6622	7077	6586	6741	5431	3440	4228	3832	2987
4-stroke 250 - 750 cm^3	Mot - Euro III	17747	19019	16693	7822	6716	7177	6679	6837	5508	3489	4288	3886	3030
4-stroke >750 cm^3	Conventional	17621	18883	16575	7767	6668	7126	6632	6788	5469	3464	4258	3859	3008
4-stroke >750 cm^3	Mot - Euro I	20082	21521	18890	8852	7600	8122	7558	7737	6233	3948	4852	4398	3428
4-stroke >750 cm^3	Mot - Euro II	17956	19242	16889	7914	6795	7262	6758	6917	5573	3530	4338	3932	3065
4-stroke >750 cm^3	Mot - Euro III	17747	19019	16693	7822	6716	7177	6679	6837	5508	3489	4288	3886	3030

Table 291 Mileage data for Road transport (average km/year/vehicle) 2000-2012

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Gasoline 0,8 - 1,4 l	PRE ECE	2082	2158	1980	1903	1797	3090	2646	2351	2323	2126	1908	1784
Gasoline 0,8 - 1,4 l	ECE 15/00-01	2508	2600	2385	2292	2164	3721	3188	2831	2798	2561	2298	2148
Gasoline 0,8 - 1,4 l	ECE 15/02	2539	2633	2415	2321	2191	3769	3228	2867	2833	2593	2327	2176

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Gasoline 0,8 - 1,4 l	ECE 15/03	2993	3102	2846	2735	2582	4441	3804	3379	3339	3056	2742	2564
Gasoline 0,8 - 1,4 l	ECE 15/04	4020	4168	3823	3674	3469	5966	5110	4539	4485	4106	3684	3444
Gasoline 0,8 - 1,4 l	Improved Conventional	3302	3424	3140	3018	2850	4901	4198	3728	3684	3373	3026	2829
Gasoline 0,8 - 1,4 l	Open Loop	3582	3714	3406	3274	3091	5316	4554	4044	3997	3659	3283	3069
Gasoline 0,8 - 1,4 l	PC Euro 1 - 91/441/EEC	4840	5017	4602	4423	4176	7182	6152	5464	5400	4943	4435	4146
Gasoline 0,8 - 1,4 l	PC Euro 2 - 94/12/EEC	5608	5814	5332	5124	4839	8322	7128	6331	6257	5727	5139	4804
Gasoline 0,8 - 1,4 l	PC Euro 3 - 98/69/EC Stage2000	6471	6708	6153	5913	5584	9602	8225	7305	7219	6608	5929	5543
Gasoline 0,8 - 1,4 l	PC Euro 4 - 98/69/EC Stage2005	6855	7106	6518	6264	5915	10172	8713	7739	7648	7000	6281	5872
Gasoline 0,8 - 1,4 l	PC Euro 5 - EC 715/2007	7670	7951	7293	7009	6619	11382	9750	8659	8557	7833	7029	6571
Gasoline 1,4 - 2,0 l	PRE ECE	2231	2313	2122	2039	1925	3311	2836	2519	2489	2279	2045	1912
Gasoline 1,4 - 2,0 l	ECE 15/00-01	2671	2769	2540	2441	2305	3964	3396	3016	2980	2728	2448	2289
Gasoline 1,4 - 2,0 l	ECE 15/02	2803	2906	2665	2561	2419	4159	3563	3164	3127	2862	2568	2401
Gasoline 1,4 - 2,0 l	ECE 15/03	3212	3330	3055	2936	2772	4767	4083	3627	3584	3281	2944	2752
Gasoline 1,4 - 2,0 l	ECE 15/04	4320	4479	4108	3948	3728	6411	5492	4878	4820	4412	3959	3701
Gasoline 1,4 - 2,0 l	Improved Conventional	3302	3424	3140	3018	2850	4901	4198	3728	3684	3373	3026	2829
Gasoline 1,4 - 2,0 l	Open Loop	4066	4216	3867	3716	3509	6034	5169	4591	4537	4153	3726	3484
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	5346	5542	5084	4885	4614	7934	6796	6036	5965	5460	4899	4580
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	6029	6250	5733	5509	5203	8947	7664	6807	6726	6157	5525	5165
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	6957	7212	6615	6357	6003	10324	8843	7854	7762	7105	6375	5960
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	7721	8004	7342	7056	6663	11458	9815	8717	8614	7886	7076	6615
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	8527	8839	8108	7792	7358	12653	10838	9626	9513	8708	7814	7305
Gasoline >2,0 l	PRE ECE	2347	2433	2231	2144	2025	3482	2983	2649	2618	2397	2150	2010
Gasoline >2,0 l	ECE 15/00-01	2807	2910	2669	2565	2422	4166	3568	3169	3132	2867	2572	2405
Gasoline >2,0 l	ECE 15/02	2856	2961	2716	2610	2465	4238	3631	3225	3187	2917	2617	2447
Gasoline >2,0 l	ECE 15/03	3388	3512	3221	3096	2923	5027	4306	3825	3780	3460	3104	2902
Gasoline >2,0 l	ECE 15/04	4494	4659	4274	4107	3878	6670	5713	5074	5014	4590	4119	3850
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	5477	5678	5208	5005	4727	8128	6962	6184	6111	5594	5019	4693
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	6435	6671	6119	5880	5553	9549	8180	7265	7179	6572	5897	5513
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	7164	7427	6812	6547	6182	10631	9106	8088	7993	7316	6565	6138
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	8054	8349	7658	7359	6950	11952	10237	9093	8985	8225	7380	6900
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	8897	9223	8460	8130	7678	13203	11309	10045	9926	9086	8153	7622
Diesel 1,4 - 2,0 l	Conventional	7304	6858	8028	8115	9099	12118	9226	8930	7917	7350	7422	7844
Diesel 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	8229	7726	9044	9143	10250	13652	10392	10060	8919	8279	8363	8837
Diesel 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	9693	9101	10652	10770	12073	16080	12241	11850	10505	9752	9849	10409

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Diesel 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	10997	10326	12087	12220	13699	18246	13891	13445	11920	11066	11175	11809
Diesel 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	11095	10418	12193	12328	13820	18407	14012	13563	12025	11163	11274	11913
Diesel 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	12479	11717	13714	13866	15544	20704	15761	15256	13526	12556	12681	13400
Diesel >2,0 l	Conventional	8066	7574	8865	8962	10047	13383	10188	9861	8742	8115	8197	8661
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	9139	8581	10043	10154	11383	15161	11543	11173	9905	9195	9287	9813
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	10274	9647	11290	11416	12797	17044	12975	12560	11135	10337	10440	11032
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	12010	11277	13199	13344	14961	19926	15169	14683	13016	12084	12204	12896
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	12427	11668	13656	13808	15479	20616	15695	15192	13469	12503	12628	13344
Diesel >2,0 l	PC Euro 5 - EC 715/2007	13862	13016	15235	15403	17267	22999	17508	16947	15026	13947	14086	14886
LPG	Conventional	71190	66539	58509	47772	50136	72309	63572	58800	62047	61191	55055	57729
LPG	PC Euro 1 - 91/441/EEC	80805	75526	66411	54224	56907	82075	72158	66741	70428	69456	62491	65526
LPG	PC Euro 2 - 94/12/EEC	85792	80188	70510	57570	60419	87140	76612	70861	74774	73743	66348	69571
LPG	PC Euro 3 - 98/69/EC Stage2000	89930	84056	73911	60347	63334	91344	80307	74279	78381	77300	69548	72927
LPG	PC Euro 4 - 98/69/EC Stage2005	87914	82171	72253	58994	61913	89295	78506	72613	76624	75566	67988	71291
LPG	PC Euro 5 - EC 715/2007	92477	86436	76004	62056	65127	93930	82581	76382	80601	79488	71517	74992
CNG	PC Euro 4 - 98/69/EC Stage2005	0	0	0	30704	50366	67163	64663	44930	51117	58306	60178	63543
CNG	PC Euro 5 - EC 715/2007	0	0	0	32298	52980	70649	68019	47262	53770	61332	63302	66841
2-Stroke	Conventional	1739	1803	1653	1589	1501	2580	2210	1963	1940	1776	1593	1490
Hybrid Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	8410	8718	7997	7685	7257	12480	10690	9494	9382	8588	7706	7205
Hybrid Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	8562	8876	8141	7824	7388	12705	10883	9666	9552	8744	7846	7335
Hybrid Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	9979	10345	9489	9119	8611	14808	12684	11266	11133	10191	9144	8549
Gasoline <3,5t	Conventional	5712	5922	5432	5220	4929	8477	7261	6449	6373	5834	5235	4894
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	6575	6816	6252	6008	5673	9757	8357	7423	7335	6714	6025	5633
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	7355	7624	6993	6720	6346	10914	9348	8303	8205	7511	6739	6301
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	8343	8649	7933	7624	7200	12381	10605	9419	9308	8521	7645	7148
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	9434	9780	8971	8621	8141	14000	11992	10651	10525	9634	8645	8082
Gasoline <3,5t	LD Euro 5 - 2008 Standards	10318	10697	9811	9429	8904	15312	13116	11649	11512	10538	9455	8840
Diesel <3,5 t	Conventional	7522	7063	8267	8358	9370	12480	9501	9197	8154	7568	7645	8078
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	8726	8194	9591	9697	10870	14479	11022	10669	9458	8779	8868	9372
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	9599	9014	10550	10666	11959	15927	12124	11737	10405	9659	9756	10309
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	10474	9834	11511	11638	13047	17377	13229	12806	11353	10539	10644	11248
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	12077	11339	13272	13419	15044	20036	15254	14765	13089	12151	12272	12969
Diesel <3,5 t	LD Euro 5 - 2008 Standards	12950	12160	14232	14390	16131	21485	16357	15833	14037	13031	13160	13907
Gasoline >3,5 t	Conventional	7515	7791	7146	6867	6485	11153	9553	8485	8385	7675	6887	6438

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Rigid <=7,5 t	Conventional	10889	10225	11968	12100	13565	18067	13754	13313	11803	10957	11067	11695
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	12768	11989	14033	14187	15904	21183	16127	15610	13839	12847	12974	13711
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	15044	14125	16533	16715	18738	24958	19000	18391	16305	15136	15286	16155
Rigid <=7,5 t	HD Euro III - 2000 Standards	17603	16529	19346	19560	21927	29205	22232	21521	19080	17713	17888	18903
Rigid <=7,5 t	HD Euro IV - 2005 Standards	19035	17874	20919	21150	23712	31581	24043	23273	20632	19153	19344	20442
Rigid <=7,5 t	HD Euro V - 2008 Standards	5916	5555	6502	6574	7369	9815	7472	7234	6413	5954	6013	6353
Rigid 7,5 - 12 t	Conventional	11203	10519	12311	12448	13955	18586	14149	13696	12142	11273	11384	12030
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	14068	13209	15461	15631	17524	23341	17768	17198	15248	14155	14296	15108
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	16522	15513	18158	18359	20581	27412	20868	20200	17909	16625	16790	17743
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	19540	18347	21474	21711	24339	32418	24679	23889	21179	19660	19856	20983
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	21331	20029	23442	23701	26571	35390	26941	26079	23122	21462	21677	22907
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	5916	5555	6502	6574	7369	9815	7472	7234	6413	5954	6013	6353
Rigid 12 - 14 t	Conventional	9769	9173	10737	10856	12170	16208	12338	11943	10589	9830	9928	10491
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	12760	11981	14023	14179	15895	21169	16116	15600	13830	12839	12967	13702
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	15254	14323	16765	16950	19001	25308	19266	18649	16534	15349	15501	16380
Rigid 12 - 14 t	HD Euro III - 2000 Standards	19031	17870	20916	21146	23708	31576	24038	23268	20628	19150	19340	20438
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	19627	18429	21570	21809	24449	32563	24789	23996	21274	19748	19946	21077
Rigid 12 - 14 t	HD Euro V - 2008 Standards	5916	5555	6502	6574	7369	9815	7472	7234	6413	5954	6013	6353
Rigid 14 - 20 t	Conventional	12295	11545	13513	13662	15316	20398	15530	15031	13327	12372	12494	13203
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	15417	14476	16944	17131	19205	25580	19473	18849	16711	15513	15667	16556
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	17767	16683	19526	19742	22133	29477	22440	21722	19258	17877	18055	19080
Rigid 14 - 20 t	HD Euro III - 2000 Standards	20600	19342	22639	22889	25661	34176	26018	25186	22329	20727	20933	22121
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	21051	19766	23135	23390	26222	34925	26587	25736	22818	21181	21392	22606
Rigid 14 - 20 t	HD Euro V - 2008 Standards	5916	5555	6502	6574	7369	9815	7472	7234	6413	5954	6013	6353
Rigid 20 - 26 t	Conventional	12314	11561	13532	13682	15339	20428	15553	15053	13346	12390	12512	13223
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	15623	14669	17169	17360	19461	25921	19732	19101	16934	15720	15876	16777
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	17915	16822	19688	19907	22316	29722	22627	21903	19418	18026	18205	19239
Rigid 20 - 26 t	HD Euro III - 2000 Standards	21277	19979	23383	23642	26504	35300	26872	26014	23062	21408	21622	22849
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	19384	18202	21303	21539	24146	32159	24483	23699	21011	19504	19698	20816
Rigid 20 - 26 t	HD Euro V - 2008 Standards	5916	5555	6502	6574	7369	9815	7472	7234	6413	5954	6013	6353
Rigid 26 - 28 t	Conventional	12264	11516	13478	13627	15278	20347	15491	14995	13293	12341	12463	13170
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	15096	14174	16590	16774	18804	25045	19066	18456	16362	15189	15340	16211
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	17354	16295	19072	19283	21617	28791	21917	21217	18810	17461	17635	18635
Rigid 26 - 28 t	HD Euro III - 2000 Standards	20391	19147	22411	22659	25402	33832	25756	24931	22103	20518	20723	21898

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	20944	19666	23018	23272	26089	34748	26453	25606	22701	21073	21284	22491
Rigid 26 - 28 t	HD Euro V - 2008 Standards	5916	5555	6502	6574	7369	9815	7472	7234	6413	5954	6013	6353
Rigid 28 - 32 t	Conventional	12293	11542	13509	13659	15312	20394	15526	15028	13324	12369	12491	13201
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	15293	14359	16807	16992	19050	25372	19316	18697	16577	15388	15541	16422
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	17597	16522	19339	19552	21918	29193	22224	21513	19072	17706	17881	18895
Rigid 28 - 32 t	HD Euro III - 2000 Standards	20894	19619	22962	23216	26027	34665	26390	25544	22648	21022	21232	22437
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	19695	18493	21644	21884	24532	32675	24875	24078	21347	19816	20014	21149
Rigid 28 - 32 t	HD Euro V - 2008 Standards	5916	5555	6502	6574	7369	9815	7472	7234	6413	5954	6013	6353
Rigid >32 t	Conventional	15145	14220	16644	16829	18864	25128	19128	18516	16416	15239	15390	16263
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	16711	15691	18365	18569	20817	27725	21108	20431	18114	16814	16981	17945
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	20506	19254	22536	22784	25543	34021	25900	25070	22226	20632	20838	22020
Rigid >32 t	HD Euro III - 2000 Standards	23618	22176	25956	26243	29420	39184	29830	28875	25599	23764	24000	25361
Rigid >32 t	HD Euro IV - 2005 Standards	21636	20315	23777	24040	26950	35896	27326	26451	23450	21769	21986	23233
Rigid >32 t	HD Euro V - 2008 Standards	5916	5555	6502	6574	7369	9815	7472	7234	6413	5954	6013	6353
Articulated 14 - 20 t	Conventional	16014	15037	17600	17794	19949	26569	20226	19579	17359	16114	16274	17198
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	19353	18171	21268	21503	24106	32108	24443	23660	20977	19472	19666	20781
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	23154	21741	25447	25728	28842	38414	29244	28309	25097	23297	23529	24864
Articulated 14 - 20 t	HD Euro III - 2000 Standards	28869	27107	31727	32078	35961	47897	36462	35295	31291	29048	29337	31001
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	30644	28774	33678	34051	38173	50841	38705	37465	33216	30834	31141	32908
Articulated 14 - 20 t	HD Euro V - 2008 Standards	27693	26003	30435	30772	34497	45946	34977	33858	30017	27866	28143	29738
Articulated 20 - 28 t	Conventional	17757	16673	19515	19732	22119	29461	22427	21710	19247	17867	18045	19069
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	21095	19808	23183	23439	26277	34998	26643	25790	22865	21224	21437	22653
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	25260	23718	27760	28067	31465	41908	31903	30882	27378	25416	25669	27124
Articulated 20 - 28 t	HD Euro III - 2000 Standards	30612	28743	33643	34014	38131	50786	38663	37425	33180	30801	31107	32872
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	30644	28774	33678	34051	38173	50841	38705	37465	33216	30834	31141	32908
Articulated 20 - 28 t	HD Euro V - 2008 Standards	27693	26003	30435	30772	34497	45946	34977	33858	30017	27866	28143	29738
Articulated 28 - 34 t	Conventional	19064	17900	20952	21182	23748	31629	24078	23308	20663	19181	19372	20472
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	22370	21004	24584	24856	27865	37113	28254	27349	24247	22508	22732	24022
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	26755	25122	29404	29730	33327	44388	33791	32710	29000	26920	27189	28730
Articulated 28 - 34 t	HD Euro III - 2000 Standards	32267	30297	35462	35853	40194	53534	40754	39449	34975	32467	32790	34649
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	35130	32986	38609	39035	43761	58286	44371	42951	38079	35348	35700	37725
Articulated 28 - 34 t	HD Euro V - 2008 Standards	27693	26003	30435	30772	34497	45946	34977	33858	30017	27866	28143	29738
Articulated 34 - 40 t	Conventional	18180	17070	19979	20199	22646	30162	22961	22226	19705	18293	18475	19523
Articulated 34 - 40 t	HD Euro I - 91/542/EEC Stage I	23372	21945	25686	25970	29113	38775	29519	28574	25332	23517	23750	25097

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Articulated 34 - 40 t	HD Euro II - 91/542/EEC Stage II	27721	26028	30464	30802	34530	45991	35012	33891	30046	27893	28170	29767
Articulated 34 - 40 t	HD Euro III - 2000 Standards	33469	31425	36781	37188	41690	55526	42271	40918	36277	33675	34011	35939
Articulated 34 - 40 t	HD Euro IV - 2005 Standards	35479	33313	38991	39422	44194	58862	44811	43376	38456	35699	36053	38099
Articulated 34 - 40 t	HD Euro V - 2008 Standards	27693	26003	30435	30772	34497	45946	34977	33858	30017	27866	28143	29738
Articulated 40 - 50 t	Conventional	20988	19707	23066	23321	26144	34820	26508	25659	22749	21117	21328	22538
Articulated 40 - 50 t	HD Euro I - 91/542/EEC Stage I	25745	24174	28294	28607	32070	42714	32516	31476	27904	25904	26162	27645
Articulated 40 - 50 t	HD Euro II - 91/542/EEC Stage II	31678	29744	34815	35198	39460	52557	40010	38729	34336	31874	32192	34018
Articulated 40 - 50 t	HD Euro III - 2000 Standards	37830	35521	41576	42035	47123	62763	47779	46250	41005	38064	38443	40624
Articulated 40 - 50 t	HD Euro IV - 2005 Standards	35479	33313	38991	39422	44194	58862	44811	43376	38456	35699	36053	38099
Articulated 40 - 50 t	HD Euro V - 2008 Standards	27693	26003	30435	30772	34497	45946	34977	33858	30017	27866	28143	29738
Articulated 50 - 60 t	Conventional	19301	18123	21212	21447	24043	32022	24379	23597	20921	19421	19614	20727
Articulated 50 - 60 t	HD Euro I - 91/542/EEC Stage I	22924	21524	25194	25471	28555	38032	28954	28027	24847	23065	23296	24616
Articulated 50 - 60 t	HD Euro II - 91/542/EEC Stage II	27756	26063	30504	30842	34575	46050	35056	33935	30084	27928	28206	29805
Articulated 50 - 60 t	HD Euro III - 2000 Standards	33819	31755	37168	37579	42127	56109	42715	41347	36658	34028	34368	36318
Articulated 50 - 60 t	HD Euro IV - 2005 Standards	35479	33313	38991	39422	44194	58862	44811	43376	38456	35699	36053	38099
Articulated 50 - 60 t	HD Euro V - 2008 Standards	27693	26003	30435	30772	34497	45946	34977	33858	30017	27866	28143	29738
Urban Buses Midi <=15 t	Conventional	0	0	0	40943	67161	89559	86225	59912	68163	77748	80248	84732
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	0	0	0	50413	82690	110267	106162	73765	83923	95725	98803	104324
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	0	0	0	53808	88259	117693	113312	78733	89575	102172	105457	111350
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	0	0	0	57397	94147	125545	120871	83985	95551	108985	112492	118778
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	25782	24208	28335	28648	32116	42776	32564	31522	27945	25942	26200	27685
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	26107	24514	28691	29010	32520	43315	32974	31918	28297	26269	26531	28034
Urban Buses Standard 15 - 18 t	Conventional	20616	19357	22656	22906	25680	34202	26038	25204	22345	20742	20950	22138
Urban Buses Standard 15 - 18 t	HD Euro I - 91/542/EEC Stage I	25055	23526	27536	27840	31210	41569	31644	30632	27156	25210	25461	26905
Urban Buses Standard 15 - 18 t	HD Euro II - 91/542/EEC Stage II	27927	26222	30692	31031	34788	46333	35273	34144	30270	28100	28380	29988
Urban Buses Standard 15 - 18 t	HD Euro III - 2000 Standards	29781	27963	32730	33092	37097	49408	37613	36410	32281	29966	30263	31979
Urban Buses Standard 15 - 18 t	HD Euro IV - 2005 Standards	28835	27075	31689	32040	35917	47838	36418	35252	31254	29013	29302	30963
Urban Buses Standard 15 - 18 t	HD Euro V - 2008 Standards	39161	36770	43038	43513	48781	64971	49461	47878	42446	39403	39795	42051
Urban Buses Articulated >18 t	Conventional	19749	18544	21705	21943	24600	32765	24944	24145	21406	19870	20069	21208
Urban Buses Articulated >18 t	HD Euro I - 91/542/EEC Stage I	25195	23657	27690	27996	31386	41801	31822	30803	27309	25351	25604	27056
Urban Buses Articulated >18 t	HD Euro II - 91/542/EEC Stage II	28379	26647	31189	31534	35351	47084	35844	34697	30760	28556	28840	30474
Urban Buses Articulated >18 t	HD Euro III - 2000 Standards	30120	28281	33102	33467	37520	49972	38042	36824	32647	30306	30609	32344
Urban Buses Articulated >18 t	HD Euro IV - 2005 Standards	28596	26851	31428	31776	35622	47444	36118	34962	30995	28773	29060	30708
Urban Buses Articulated >18 t	HD Euro V - 2008 Standards	39161	36770	43038	43513	48781	64971	49461	47878	42446	39403	39795	42051

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Coaches Standard <=18 t	Conventional	19865	18652	21832	22072	24745	32956	25090	24286	21531	19987	20187	21332
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	23226	21809	25527	25809	28933	38535	29336	28397	25175	23371	23602	24941
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	25606	24043	28141	28453	31897	42483	32340	31306	27755	25765	26021	27496
Coaches Standard <=18 t	HD Euro III - 2000 Standards	27717	26026	30462	30799	34527	45986	35008	33888	30044	27890	28168	29764
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	28996	27226	31866	32219	36119	48106	36621	35450	31429	29175	29466	31136
Coaches Standard <=18 t	HD Euro V - 2008 Standards	39161	36770	43038	43513	48781	64971	49461	47878	42446	39403	39795	42051
Coaches Articulated >18 t	Conventional	19660	18459	21606	21845	24490	32617	24830	24036	21309	19780	19979	21111
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	23702	22255	26048	26336	29523	39323	29935	28977	25689	23848	24086	25451
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	27073	25421	29753	30083	33725	44916	34194	33100	29344	27241	27513	29072
Coaches Articulated >18 t	HD Euro III - 2000 Standards	28696	26944	31537	31886	35745	47610	36243	35084	31104	28874	29161	30815
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	28667	26917	31506	31854	35709	47562	36207	35049	31072	28845	29132	30784
Coaches Articulated >18 t	HD Euro V - 2008 Standards	39161	36770	43038	43513	48781	64971	49461	47878	42446	39403	39795	42051
Urban CNG Buses	HD Euro I - 91/542/EEC Stage I	25055	23526	27536	27840	31210	41569	31644	30632	27156	25210	25461	26905
Urban CNG Buses	HD Euro II - 91/542/EEC Stage II	27927	26222	30692	31031	34788	46333	35273	34144	30270	28100	28380	29988
Urban CNG Buses	HD Euro III - 2000 Standards	29781	27963	32730	33092	37097	49408	37613	36410	32281	29966	30263	31979
Urban CNG Buses	EEV	29781	27963	32730	33092	37097	49408	37613	36410	32281	29966	30263	31979
Urban Biodiesel Buses	Conventional	20616	19357	22656	22906	25680	34202	26038	25204	22345	20742	20950	22138
Urban Biodiesel Buses	HD Euro I - 91/542/EEC Stage I	25055	23526	27536	27840	31210	41569	31644	30632	27156	25210	25461	26905
Urban Biodiesel Buses	HD Euro II - 91/542/EEC Stage II	27927	26222	30692	31031	34788	46333	35273	34144	30270	28100	28380	29988
Urban Biodiesel Buses	HD Euro III - 2000 Standards	29781	27963	32730	33092	37097	49408	37613	36410	32281	29966	30263	31979
Urban Biodiesel Buses	HD Euro IV - 2005 Standards	28835	27075	31689	32040	35917	47838	36418	35252	31254	29013	29302	30963
Urban Biodiesel Buses	HD Euro V - 2008 Standards	39161	36770	43038	43513	48781	64971	49461	47878	42446	39403	39795	42051
2-stroke <50 cm³	Conventional	1211	1255	1152	1107	1045	1797	1539	1367	1351	1237	1110	1038
2-stroke <50 cm³	Mop - Euro I	1277	1323	1214	1167	1102	1894	1623	1441	1424	1304	1170	1094
2-stroke <50 cm³	Mop - Euro II	947	982	901	866	817	1406	1204	1069	1057	967	868	811
2-stroke <50 cm³	Mop - Euro III	792	821	753	724	684	1176	1007	894	884	809	726	679
2-stroke >50 cm³	Conventional	1801	1867	1713	1646	1554	2673	2289	2033	2009	1839	1651	1543
2-stroke >50 cm³	Mot - Euro I	1878	1947	1786	1717	1621	2788	2388	2121	2096	1918	1721	1609
2-stroke >50 cm³	Mot - Euro II	2128	2206	2023	1944	1836	3158	2705	2402	2374	2173	1950	1823
2-stroke >50 cm³	Mot - Euro III	2181	2261	2074	1993	1882	3237	2772	2462	2433	2227	1999	1869
4-stroke <250 cm³	Conventional	2333	2419	2219	2132	2013	3462	2966	2634	2603	2383	2138	1999
4-stroke <250 cm³	Mot - Euro I	2595	2690	2467	2371	2239	3851	3298	2929	2895	2650	2378	2223
4-stroke <250 cm³	Mot - Euro II	2298	2382	2185	2100	1983	3411	2921	2595	2564	2347	2106	1969
4-stroke <250 cm³	Mot - Euro III	2455	2545	2334	2243	2118	3643	3120	2771	2739	2507	2249	2103

Subsector	Technology	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
4-stroke 250 - 750 cm^3	Conventional	2401	2489	2283	2194	2072	3563	3052	2710	2678	2452	2200	2057
4-stroke 250 - 750 cm^3	Mot - Euro I	2701	2800	2568	2468	2331	4008	3433	3049	3013	2758	2475	2314
4-stroke 250 - 750 cm^3	Mot - Euro II	2420	2509	2301	2212	2088	3592	3076	2732	2700	2472	2218	2073
4-stroke 250 - 750 cm^3	Mot - Euro III	2455	2545	2334	2243	2118	3643	3120	2771	2739	2507	2249	2103
4-stroke >750 cm^3	Conventional	2437	2527	2317	2227	2103	3617	3098	2751	2719	2489	2233	2088
4-stroke >750 cm^3	Mot - Euro I	2778	2879	2641	2538	2397	4122	3531	3136	3099	2837	2545	2380
4-stroke >750 cm^3	Mot - Euro II	2483	2575	2361	2269	2143	3685	3157	2804	2771	2536	2276	2128
4-stroke >750 cm^3	Mot - Euro III	2455	2545	2334	2243	2118	3643	3120	2771	2739	2507	2249	2103