REPUBLIC OF BULGARIA
MINISTRY OF ENVIRONMENT AND WATER

EXECUTIVE ENVIRONMENT AGENCY

NATIONAL INVENTORY REPORT 2012

for Greenhouse Gas Emissions

Submission under the UNFCCC and the Kyoto Protocol

April, 2012

Reporting Entity

Executive Environment Agency at the Ministry of Environment and Water

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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 International 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 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 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.

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[1] Fourth Assessment Report of the International 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 2012 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 2010. Full time series of the emissions and removals (with exception of F-gases) from 1988 to 2010 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 only partly. 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 2010. 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].

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[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 2010. 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 1988-2010 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 comparability, accuracy, transparency 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 EU's greenhouse gas monitoring mechanism (280/2004/EC)[15] combines information on annual emission inventories, the climate strategy and the evaluation of the effects of the policy measures and planning of new measures into a dynamic process. The Commission decisions on the implementing provisions and rules of the monitoring mechanism (29 October 2004 and 10 February 2005) specify in detail the content of the reports to be submitted to the Commission. The rules and modalities for reporting of greenhouse gas inventory data are based on those applied in the reporting under the UNFCCC and Kyoto Protocol, supplemented with provisions for reporting to enable the assessment of actual and projected progress of the Community and its Member States to meet their 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:2004:049:0001:0001: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 International 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 the 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 Decision 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 2012 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 2010. Full time series of the emissions and removals (with exception of F-gases) from 1988 to 2010 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 only partly. 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 2010. 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 KPLULUCF, 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 2010. 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 1988-2010 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, Landuse 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 comparability, accuracy 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.[16]

The EU’s greenhouse gas monitoring mechanism (280/2004/EC) combines information on annual emission inventories, the climate strategy and the evaluation of the effects of the policy measures and planning of new measures into a dynamic process. The Commission decisions on the implementing provisions and rules of the monitoring mechanism (29 October 2004 and 10 February 2005) specify in detail the content of the reports to be submitted to the Commission. The rules and modalities for reporting of greenhouse gas inventory data are based on those applied in the reporting under the UNFCCC and Kyoto Protocol, supplemented with provisions for reporting to enable the assessment of actual and projected progress of the Community and its Member States to meet their commitments under the UNFCCC and the Kyoto Protocol.

[16] 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 2012 update of the Action Plan is presented in Chapter 10. 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/2010/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 2008-2012)	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.

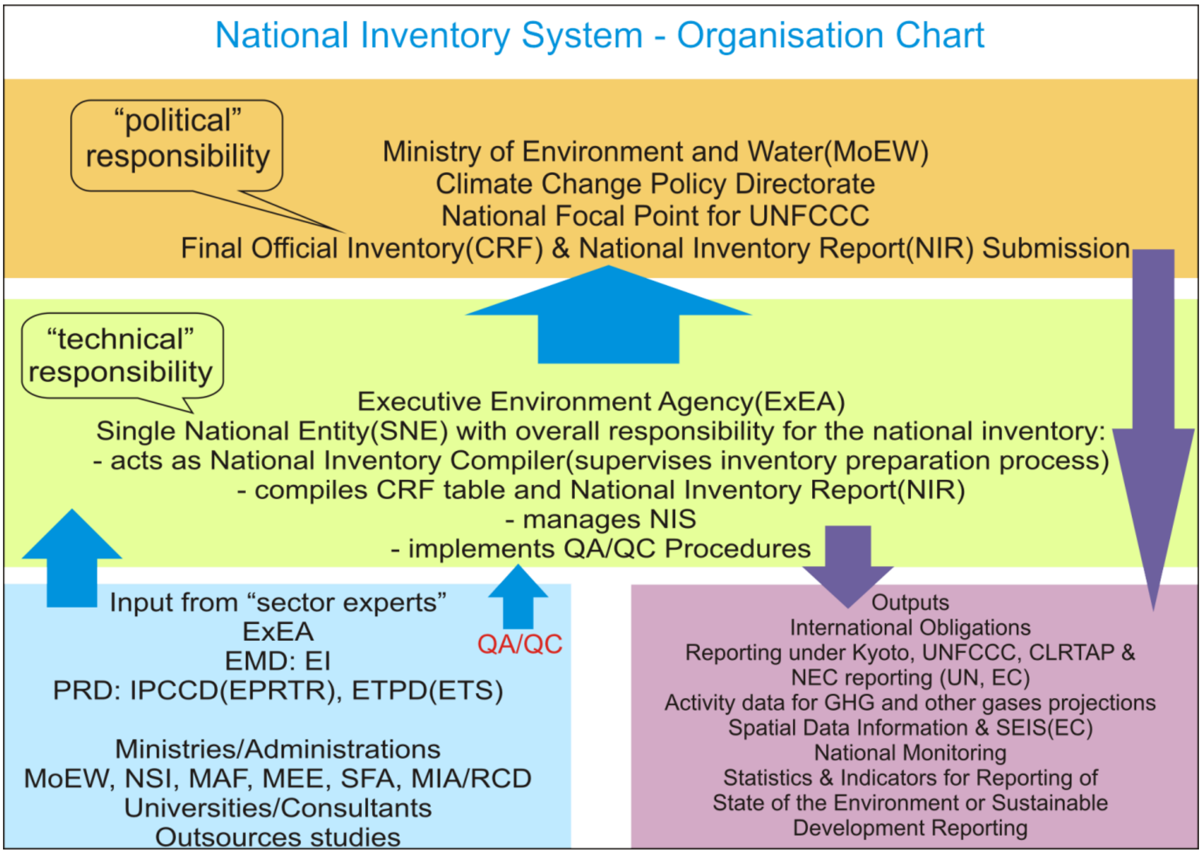

Figure 1 Organizational Chart of the Bulgarian National Inventory System

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 as well as with the business through Interministerial Working group created with an Order of the Minister. In result, the European Commission has accepted the Plan in accordance to the requirements and criteria for approval. In April 2010, 132 Bulgarian installations have received their allowances in the National Registry.

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

Amendment of the Environmental Protection Law was developed and approved by the Council of Ministers and the National Assembly in October 2010. The new legislationcreates 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

Six JI projects were approved according to the national JI Guidance and procedures. The projects are renewable energy projects – wind, hydro as well as cogeneration and gasification. The buyers of the Emission Reduction Units from those projects are Republic of Austria, The Netherlands and the Kingdom of Denmark. The implementation of those projects will generate approximately 1 962 738 tones CO_2 equivalent reduction.

Approval of JI Guidance on Track 1 approach

In April 2010, the Minister of Environment and Water approved new JI Guidance on Track 1 approach. The Guidance was developed with the assistance of the Netherlands and Denmark in order to allow the early movers to go ahead. On the base of the Guidance, MOEW performed the first transfers of emission reduction units to Bulgarian JI projects in 2010.

Development of the Third National Action Plan on Climate Change

Currently, the Ministry coordinates the development of the Third National Action Plan on Climate Change which is to be prepared to April 2012 and implemented in2013-2020. The Plan is being developed under a project for international cooperation funded by the Norwegian program for cooperation and development "Holistic approach for the reduction of Greenhouse Gasses in 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 0 and 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).

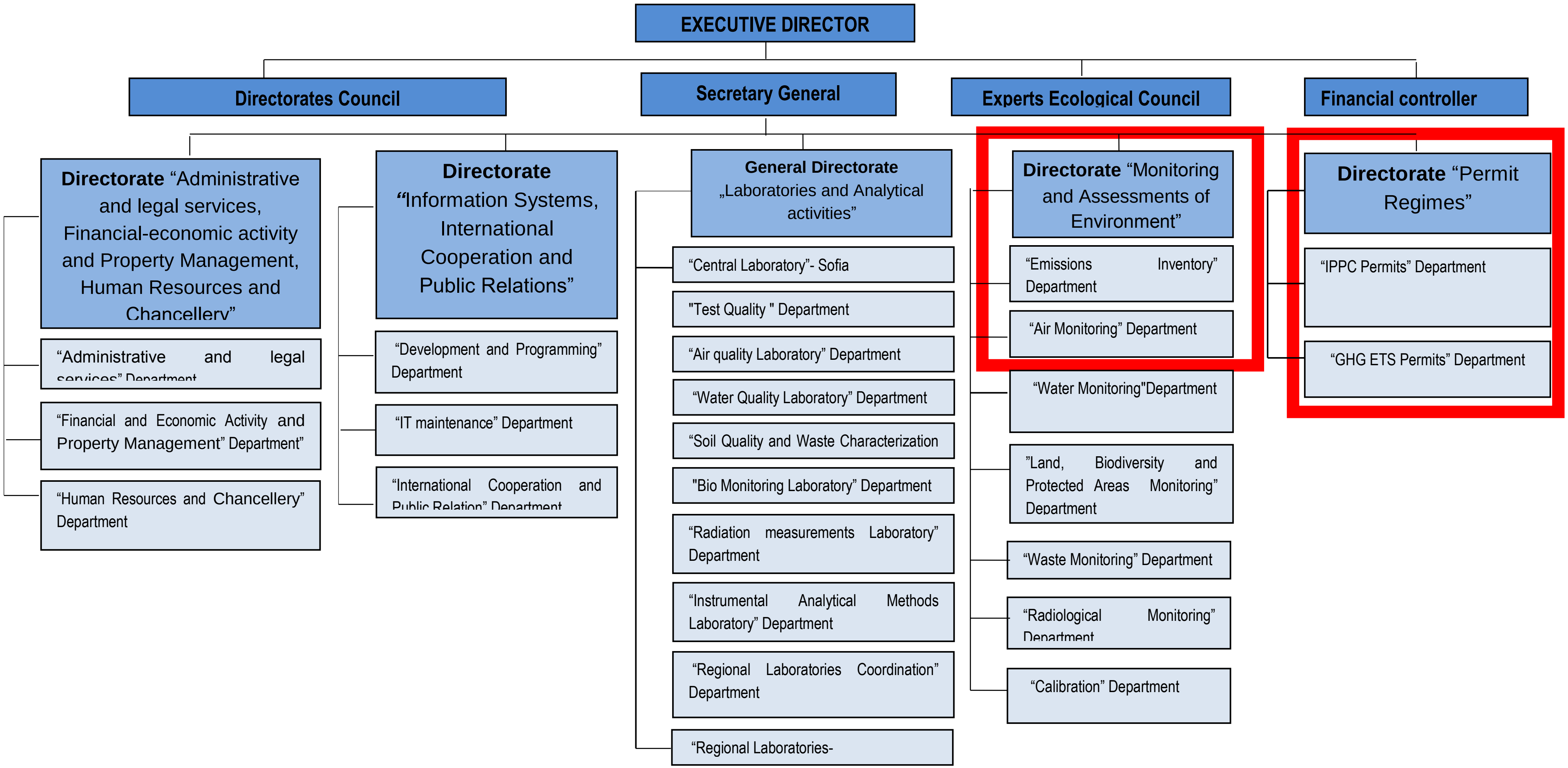

Figure 2 Organizational Chart of the Executive Environmental Agency (ExEA)

Since 01 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)

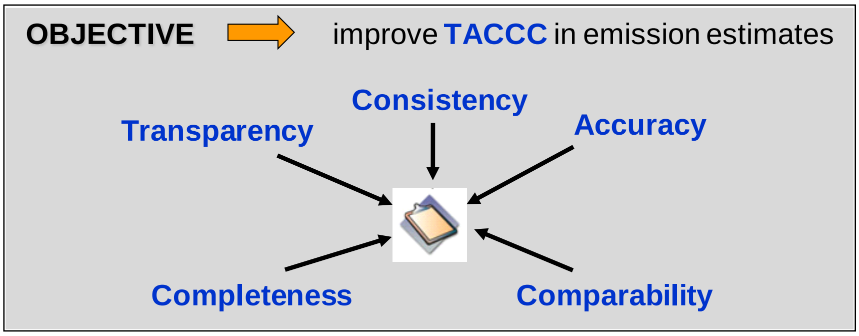

Figure 3 Objectives of the Bulgarian National Inventory System

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 it 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 and Air Protection 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 June 2010);

Statute on the organization and structure of ExEA (Decision of Council of ministers 162/03.08.2010);

Order № 202/29.09.2010 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 June 2010), 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 162/03.08.2010), 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 № 202/29.09.2010 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 Forestry Agency);
- Ministry of Economy, Energy and Tourism (MEET);
- 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

Large industrial plants;

Branch Business Associations

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	MEET	Ministry of Economy, Energy and Tourism
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 Forestry 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[17];
- Prepare estimates[18] 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[19] for each source category and for the inventory in total recalculations[20] 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[21] (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.

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

[18] 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

[19] following the IPCC good practice guidance

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

[21] in accordance with the IPCC good practice guidance

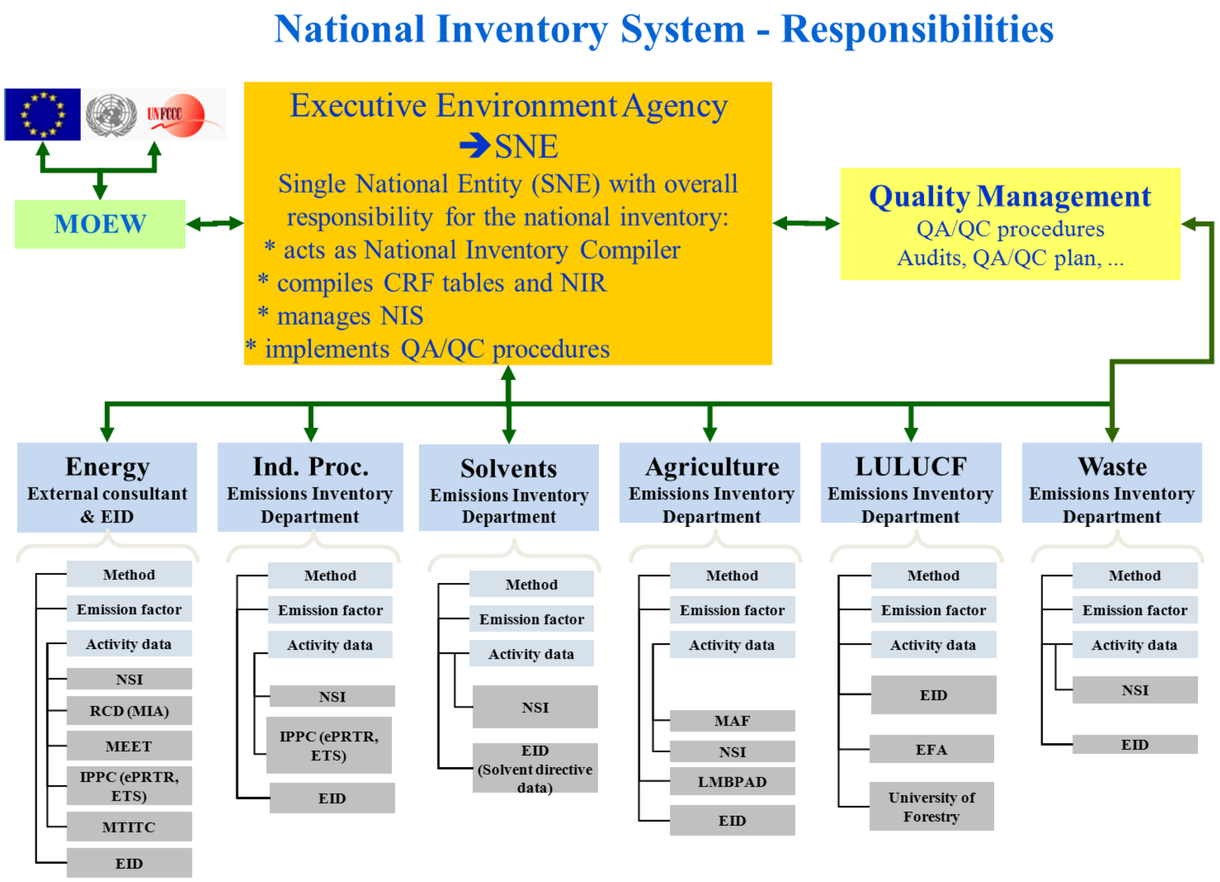

Figure 4 Bulgarian National Inventory System – Responsibilities

The following table presents the responsibilities of all engaged institutions for preparation of GHGs emission inventory for 2012 submission.

Table 2 Preparation of GHGs emission inventory for 2012 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 MEET	ExEA, NSI, MEET	External consultants
Industry processes CRF2	NSI ExEA MOEW	ExEA, NSI, Branch chambers, Installations operators	Sector expert ExEA external consultants for F-gases
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 and University of Chemical technology and metallurgy

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 sectors 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.

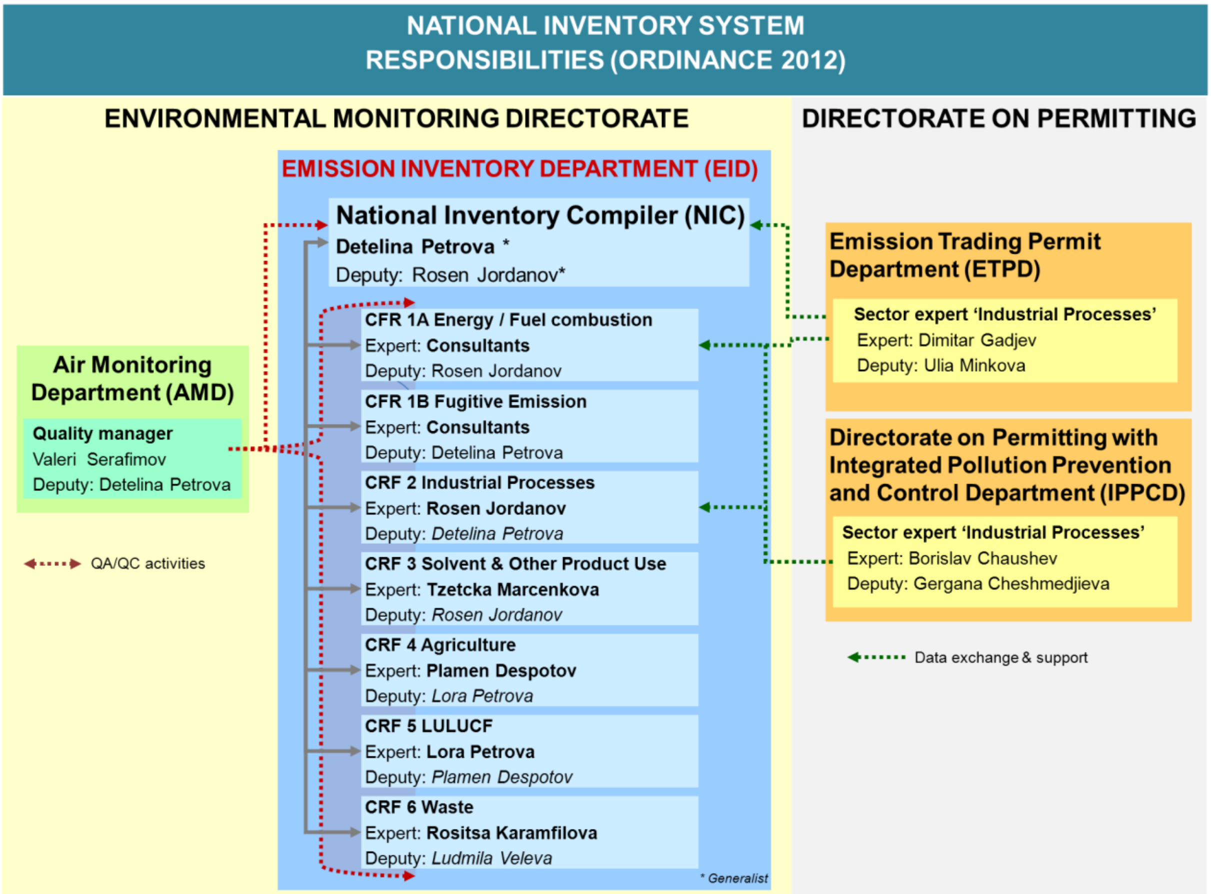

Figure 5 ExEA capacity for ensuring the function of BGNIS

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 № 202/29.09.2010 by the Executive Director of ExEA.

Collaboration with external Consultants for 2012 submission

In order to support ExEA staff in preparation of 2012 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 2012 submission

Consultant	Cooperation agreements	Responsibilities and outputs
Denkstatt	Preparation of 2012 GHG inventory in Sector Energy (including Transport). The contract № 2095 was signed on 10.10.2011, duration - 2 years.	Prepared CRF tables and respective chapters in NIR Training of ExEA's staff
Denkstatt	Preparation of 2012 F-gases inventory. The contract № 2094 was signed on 10.10.2011, duration - 6 months.	Prepared CRF tables and respective chapters in NIR Training of ExEA's staff
Denkstatt in collabouration with expert from the Austrian institute of technology	Preparation of 2012 uncertainty analysis of Bulgaria's GHG Inventory on 24.10.2011. The contract № 2101 was signed on 24.10.2011, duration - 6 months.	Prepared CRF tables and respective chapters in NIR Training of ExEA's staff
University of Chemical technology and metallurgy	Preparation of 2012 GHG inventory in Sector Waste, category Waste water handling. The contract № 2100 was signed on 21.10.2011, duration - 4 months.	Support of ExEA staff in preparation of 2012 submission (6C CRF tables and NIR). Training of ExEA's staff
External consultant In collabouration with Executive Forest Agency	Revision of KP-LULUCF activity data. The contract № 2103 was signed on 26.10.2011, duration - 3 months.	Support of ExEA staff in preparation of 2012 submission (KP-LULUCF tables)
External consultant	Preparation of 2012 uncertainty analysis of LULUCF sector. The contract № 2092 was signed on 06.10.2011, duration - 5 months.	Support of ExEA staff in preparation of uncertainty analysis of LULUCF sector

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[22]. The program covered all inventory sectors in a series of workshops realised in the period December 2009 to September 2010.

[22] 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

Table 4 Timetable for Activity 3.1 from Twinning project BG/07/IB/EN/07 with the Federal Environment Agency of Austria, Section Training on GHG emission inventory reporting

Sector	Missions	Duration	Date	Suggested Participants
General Workshop	1 mission	2 days	25 – 26.01.2010	All relevant "sector experts" directly involved in the inventory and interested stakeholders (e.g. data provider)
	1 mission	2 days	25 – 26 May 2010	
Energy	1st mission	2 -3 days	16 – 19 March 2010	ExEA Energy Expert Energy Expert NSI (Energy) Experts MoEW Experts from Ministry of Economy and Energy and Tourism Geophysical Institute in the Bulgarian Academy of Scientific Denkstatt
	2nd mission	2 -3 days	9 – 12 June 2010	
	3rd mission	4 days	September 2010	
Transport	1st mission	1 day	1 March 2010	ExEA Transport Expert Experts (vehicle fleet) from MIA/RCD Energy Expert NSI (Energy/Transport) Experts MoEW
	2nd mission	2 -3 days	1 – 4 June 2010	
	3rd mission	2 days	September 2010	
Agriculture	1st mission	4 days	September 2010	ExEA Agriculture experts Experts from Statistics Department within Ministry of Agriculture and Food Supply Experts MoEW Soil Resource Executive Agency within MAFS National Service for Plant Protection, Quarantine and Agro chemistry
Industrial Processes and Solvents	1st mission	2 -3 days	27 – 28 May 2010	ExEA Industrial Processes Experts Industrial Processes Experts (MoEW)
	2nd mission	4 days	02 – 05 August 2010	
	3rd mission	2 days	September 2010	
Waste	1 mission	2 -3 days	8 – 9 June 2010	ExEA Waste Experts (Waste) Experts MoEW (Waste) Experts NSI
	2nd mission	2 days	September 2010	
QA/QC audit	1st mission	2 days	June 2010	ExEA Experts Experts MoEW
	2nd mission	2 days	July 2010	
	3rd mission	2 days	September 2010	
LULUCF	4 missions	2 -3 days	3 – 16.11.2009 12 – 15.01.2010 14 – 17.02.2010	ExEA LULUCF Experts Experts from the Forestry University Experts from the Soil Institute

experts and that the improvements are mainly the result of research activities and intensive cooperation with the Austrian Federal Environment Agency."

Sector	Missions	Duration	Date	Suggested Participants
			21 – 24.03.2010 7 – 9.04.2010	"Pushkarov" MoEW experts
	5th mission	4 days	6 – 10.09. 2010	

Further collaboration with Austrian Environment Agency for training of Bulgarian experts

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)[23.]

Basic Course[24]

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.

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

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[23] http://ghginstitute.org/2010/03/03/the-unfccc-expert-reviewer-training-programme-is-ongoing
[24] 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

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@ eaa.government.bg

http://eea.government.bg/eng

National Focal Point (NFP): Milya Dimitrova

Head of Climate Change Policy Directorate
Organization: Ministry of Environment and Water

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

E-mail: madimitrova@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@eaa.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.

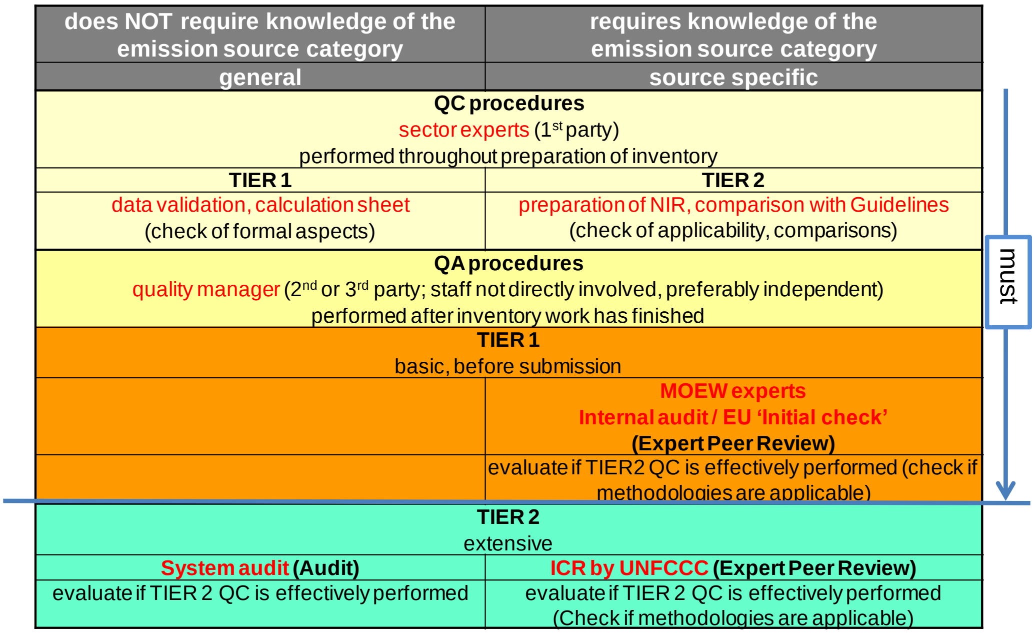

Figure 6 National quality assurance and quality control program

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 № 202/29.09.2010 by the Executive Director of ExEA) and/or external consultants.

Table 5 QC experts within the BGNIS

Responsibility	QC experts
Activity data	MAF, MI, MTITC, MEET, NSI, EAF, ExEA, MOEW
Methodology and selection of emission factors	ExEA, MAF, MI, MTITC, MEET, 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 2012 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 6 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.

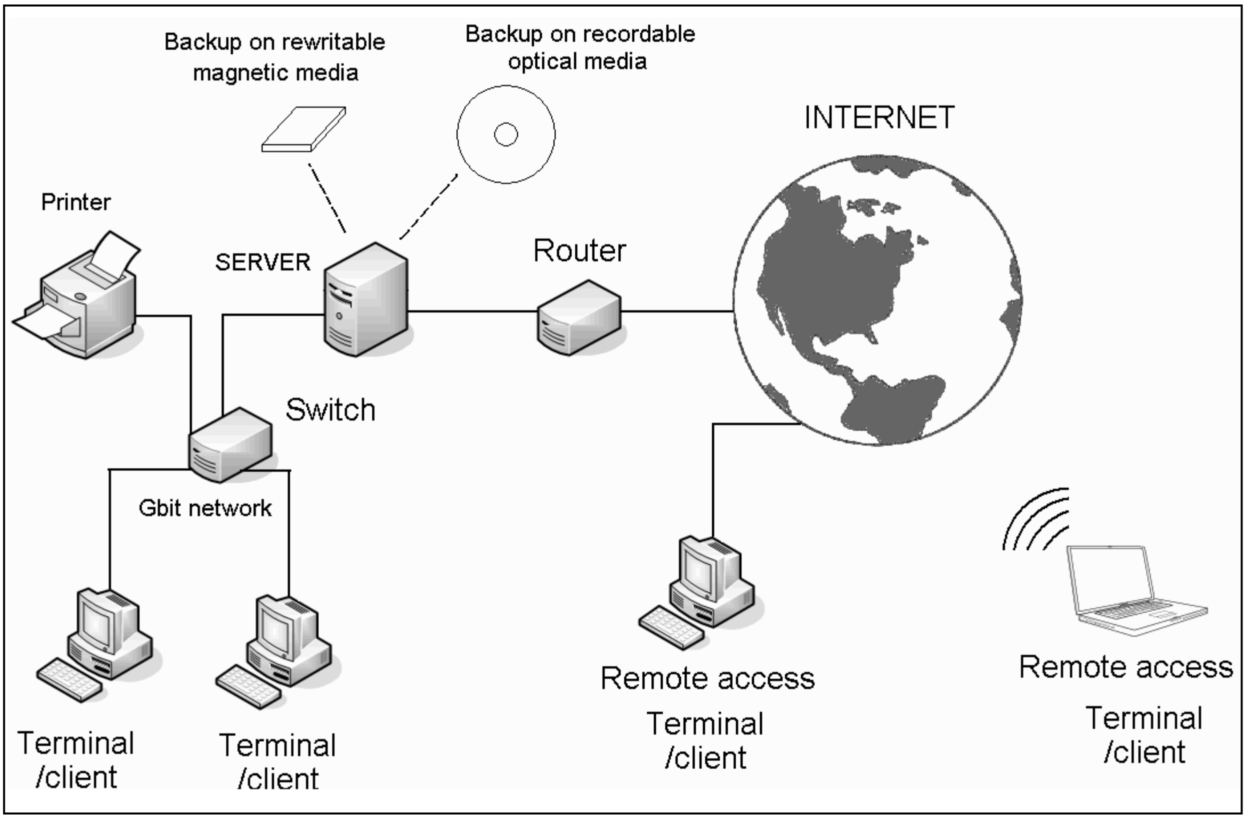

Figure 7 Documentation and data archiving in ExEA

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 7 Responsibilities in the exchange of check lists between QC experts for 2012 submission

Sector CRF	Activity data		Methodology/ emission factors		Emission calculations	
	Check	Correction	Check	Correction	Check	Correction
Energy CRF1	ExEA NSI MEET external consultant	NSI MEET	ExEA NSI MEET	external consultant	ExEA NSI MEET	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 and external consultant
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 2012 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 8 Responsibilities in exchange of the check lists between QA experts and sector experts for 2012 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 and external consultant	MOEW	Sector expert ExEA and external consultant
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[25] 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

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[25] 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 duration is app. 6 months.

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 11).

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 2009 (NIR 2011) 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)[26]
- 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 – 2009.
- Country-specific

The following tables summarise the 'Applied method' and 'Emission factor' of the inventory 2010, submission 2012 v1.3.

Table 9 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	CS,D	T1,T2	D	T1,T2	D
A. Fuel Combustion	T1,T2	CS,D	T1,T2	D	T1,T2	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	CS,D	T1,T2	D	T1,T2	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	D	D	T3	PS
A. Mineral Products	T1,T2	CS,D,PS	NA	NA	NA	NA
B. Chemical Industry	D,T2	D,PS	D	D	T3	PS
C. Metal Production	D,T2	CS,D,PS	NA	NA	NA	NA

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

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
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. Land Use, Land-Use Change and Forestry	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	T2	D	D,T2,T3	CS,D	D,T1	D
A. Solid Waste Disposal on Land	NA	NA	T2,T3	CS,D		
B. Waste-water Handling			D	CS,D	D	D
C. Waste Incineration	T2	D	NA	NA	T1	D
D. Other	NA	NA	NA	NA	NA	NA
7. Other (as specified in Summary 1.A)	NA	NA	NA	NA	NA	NA

Table 10 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 2013

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 2013 submission.

Table 11 Preparation of GHGs emission inventory for 2013 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 MEET	ExEA, NSI, MEET	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
Waste CRF6	NSI ExEA	ExEA, NSI	Sector expert ExEA

The Work plan for preparation and submission of National GHGs inventory in 2013 is presented in the next table.

Table 12 Work plan for GHGs inventory preparation and submission 2013

Action	Responsible organization	Initial Deadline	Final Deadline	Comment
Sending of statistic questionnaire to all enterprises in the country	NSI with its regional inspectorates	31.03.12	15.06.12	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	31.03.12	15.06.12	
QA/QC Procedures - Implementation of the requirements of National QA/QC Plan.	NSI MAF, MEE, MEW, SFA, RCD	15.06.12	30.09.12	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	30.09.12	30.10.12	
QA/QC Procedures - Implementation of the requirements of National QA/QC Plan	ExEA	30.10.12	15.11.12	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		30.11.12	
Preliminary estimation of emissions	ExEA, external consultants		15.12.12	
Provision of corrected activity data as a result of QA/QC procedures to ExEA	NSI MAF, MEE, MEW, EFA, MIA		20.12.12	
Recalculation of emissions, based on the corrected activity data	ExEA		31.12.12	
of inventory in the required format for reporting	ExEAand external consultant		31.12.12	
Preparation of Preliminary national inventory report (NIR) to the UNFCCC and EU decisions.	ExEA		10.01.13	

Action	Responsible organization	Initial Deadline	Final Deadline	Comment
Submission of national GHG inventory under the MM with the draft NIR.	ExEA		15.01.13	Delivered to Eionet Central Data Repository
Submission of final national GHG inventory and NIR.	ExEA		15.03.13	Delivered to Eionet Central Data Repository
Submission of the final GHG inventory and NIR after the European Commission comments	MEW ExEA		15.04.13 15.04.13	Official submission to UNFCCC Delivered to Eionet Central Data Repository
Documentation and archiving of inventory. Preparation of inventory management report	ExEA		15.05.13	
Preparation of QA/QC plan for the next inventory.	ExEA		15.06.13	

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'.

Separate uncertainty calculation were performed using a spreadsheet prepared specifically according to the Tier 1 approach (IPCC, GPG, 2000), and with a Monte Carlo approach fully considering statistical dependence of detailed input data as described in Annex 7 (Tier 2 approach).). It should be noted that the Monte Carlo approach, averaging a large number of randomly varied input data, may exhibit slightly different results in total and source category emissions than a direct calculation. This difference is similar to a rounding error and may be ignored.

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 14, 'Table 6.1 TIER 1 Uncertainty calculation and reporting'.

Combined uncertainty as a part of overall emissions for 2010 for every source has been calculated as following equation:

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

where MCUi – measured combined uncertainty,

Emi - source emissions for 2010,

EMtotal – total country emissions for 2010,

CNi – combined uncertainty of the i-th source.

Uncertainty of the overall emissions trend for 2010 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 2010 (row 7, column H in Table 6.1 of the GPG), and the overall emission trend related to the base inventory year until 2010 (row 7, column M in Table 6.1.) are given in Table 14. The relevant data for the previous inventory for 2009 are given for comparison (NIR 2011 and NIR 2012).

Table 13 Uncertainty in total GHG emissions, %

Uncertainty	Uncertainty NIR 2011	Uncertainty NIR 2012
Uncertainty in total GHG emissions	15.18 %	14.60 %
Overall uncertainty into the trend in total GHG emissions	3.88 %	3.05 %

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.

Table 14 Tier 1 Uncertainty Calculation and Reporting (level assessment), Gg CO_2-eq.

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	uncertainty as % of total national emissions in year	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.		%	%	%	%	%	%	%	%	%
1A1		CH_4	15,8	7,5	3	50	50,09	0,006	0,000	0,000	0,000	0,000	0,000
1A1		N_2O	134,1	120,0	3	200	200,02	0,391	0,000	0,001	0,087	0,004	0,087
1A1	Gaseous fuel	CO_2	6476,1	2208,4	1	2	2,24	0,080	-0,007	0,017	-0,014	0,024	0,028
1A1	Liquid fuel	CO_2	9993,9	1717,4	3	7	7,62	0,213	-0,024	0,013	-0,167	0,057	0,176
1A1	Solid fuel	CO_2	25497,3	27410,4	1	2	2,24	0,999	0,118	0,214	0,237	0,302	0,384
1A2	Gaseous fuel	CO_2	0,0	1484,9	1	2	2,24	0,054	0,012	0,012	0,023	0,016	0,028
1A2	Liquid fuel	CO_2	7243,4	1159,8	3	7	7,62	0,144	-0,018	0,009	-0,126	0,038	0,131
1A2	Solid fuel	CO_2	13034,6	1096,4	1	2	2,24	0,040	-0,040	0,009	-0,080	0,012	0,081
1A2		CH_4	31,0	10,5	3	50	50,09	0,009	0,000	0,000	-0,002	0,000	0,002
1A2		N_2O	71,8	17,3	3	200	200,02	0,056	0,000	0,000	-0,027	0,001	0,027
1A3a	Liquid fuel	CO_2	98,0	46,1	5	5	7,07	0,005	0,000	0,000	0,000	0,003	0,003
1A3a	Liquid fuel	CH_4	0,0	0,0	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3a	Liquid fuel	N_2O	0,9	0,4	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3b	Diesel Oil	CO_2	2631,3	4430,1	3	5	5,83	0,421	0,025	0,035	0,124	0,146	0,192
1A3b	Gasoline	CO_2	4364,4	1805,3	3	5	5,83	0,172	-0,002	0,014	-0,011	0,060	0,061
1A3b		CH_4	84,5	16,7	3	40	40,11	0,011	0,000	0,000	-0,007	0,001	0,007
1A3b		N_2O	89,3	73,2	3	40	40,11	0,048	0,000	0,001	0,009	0,002	0,010
1A3b	LPG	CO_2	0,0	1028,0	3	5	5,83	0,098	0,008	0,008	0,040	0,034	0,053

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	uncertainty as % of total national emissions in year	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.		%	%	%	%	%	%	%	%	%
1A3b	Gaseous fuel	CO_2	0,0	154,9	3	5	5,83	0,015	0,001	0,001	0,006	0,005	0,008
1A3c	Liquid fuel	CO_2	0,0	61,758	5	5	7,07	0,007	0,000	0,000	0,002	0,003	0,004
1A3c	Liquid fuel	CH_4	0,0	0,0	5	60	60,21	0,000	0,000	0,000	0,000	0,000	0,000
1A3c	Liquid fuel	N_2O	0,0	0,0	5	60	60,21	0,000	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	CO_2	0,0	324,1	1	5	5,10	0,027	0,003	0,003	0,013	0,004	0,013
1A3e	Gaseous fuel	CH_4	0,0	0,0	1	50	50,01	0,000	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	N_2O	0,0	0,0	1	150	150,00	0,000	0,000	0,000	0,000	0,000	0,000
1A4		CH_4	283,7	244,7	5	50	50,25	0,200	0,001	0,002	0,042	0,013	0,045
1A4		N_2O	31,6	42,7	5	200	200,06	0,139	0,000	0,000	0,043	0,002	0,043
1A4	Gaseous fuel	CO_2	0,0	354,3	5	2	5,39	0,031	0,003	0,003	0,006	0,020	0,020
1A4	Liquid fuel	CO_2	2795,5	579,8	5	7	8,60	0,081	-0,006	0,005	-0,041	0,032	0,052
1A4	Solid fuel	CO_2	3403,0	791,4	2	5	5,39	0,069	-0,007	0,006	-0,033	0,017	0,037
1A5	Stationary	CO_2	8181,5	0,0	5	7	8,60	0,000	-0,030	0,000	-0,213	0,000	0,213
1B1	Solid Fuels	CH_4	1733,0	742,1	10	200	200,25	2,421	-0,001	0,006	-0,135	0,082	0,158
1B2	Oil and Natural Gas	CH_4	1095,0	466,7	5	50	50,25	0,382	0,000	0,004	-0,022	0,026	0,034
2A1	Cement Production	CO_2	2406,4	805,2	2	2	2,83	0,037	-0,003	0,006	-0,005	0,018	0,019
2A2	Lime Production	CO_2	1103,3	919,6	2	2	2,83	0,042	0,003	0,007	0,006	0,020	0,021
2A3	Limestone and Dolomite Use	CO_2	0,0	0,0	5	15	15,81	0,000	0,000	0,000	0,000	0,000	0,000
2A4	Soda Ash	CO_2	126,6	105,7	2	3	3,61	0,006	0,000	0,001	0,001	0,002	0,003

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	uncertainty as % of total national emissions in year	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.		%	%	%	%	%	%	%	%	%
2A7	Other - Glass	CO_2	186,2	57,1	6	60	60,30	0,056	0,000	0,000	-0,015	0,004	0,015
2A7	Other Bricks	CO_2	551,2	38,3	3	5	5,83	0,004	-0,002	0,000	-0,009	0,001	0,009
2A7	Other - DeSOx	CO_2	0,0	556,7	1,5	2,5	2,92	0,026	0,004	0,004	0,011	0,009	0,014
2B1	Ammonia Production	CO_2	3137,9	735,3	3,5	7	7,83	0,094	-0,006	0,006	-0,042	0,028	0,050
2B2	Nitric Acid Production	N_2O	1790,5	267,5	3	7	7,62	0,033	-0,005	0,002	-0,032	0,009	0,033
2B4.2	Calcium Carbide	CO_2	89,3	17,8	5	10	11,18	0,003	0,000	0,000	-0,002	0,001	0,002
2B5	Other (please specify)	CH_4	9,1	1,1	5	50	50,25	0,001	0,000	0,000	-0,001	0,000	0,001
2C	Metal Production	CH_4	73,3	0,0	10	25	26,93	0,000	0,000	0,000	-0,007	0,000	0,007
2C1	Iron and Steel Production	CO_2	2700,4	52,2	5	10	11,18	0,010	-0,010	0,000	-0,097	0,003	0,097
2C2	Ferroalloys Production	CO_2	218,8	1,6	5	25	25,50	0,001	-0,001	0,000	-0,020	0,000	0,020
2F	ODS substitutes	HFCs	0,0	280,9	10	50	50,99	0,233	0,002	0,002	0,109	0,031	0,114
2F8	Electrical Equipment	SF_6	3,5	13,1	10	50	50,99	0,011	0,000	0,000	0,004	0,001	0,005
2G	Other	CH_4	7,6	0,0	10	50	50,99	0,000	0,000	0,000	-0,001	0,000	0,001
3	Solvent and other product use	CO_2	866,61	25,74	10	30	31,62	0,013	-0,003	0,000	-0,091	0,003	0,091
3	Solvent and other product use	N_2O	33,2	20,2	10	100	100,50	0,033	0,000	0,000	0,003	0,002	0,004
4A1	Cattle	CH_4	2441,8	962,3	2	20	20,10	0,315	-0,002	0,007	-0,032	0,021	0,038
4A.2	Buffalo	CH_4	29,2	10,1	2	50	50,04	0,008	0,000	0,000	-0,001	0,000	0,002
4A.3	Sheep	CH_4	1336,2	193,7	2	20	20,10	0,063	-0,003	0,002	-0,069	0,004	0,070
4A.4	Goats	CH_4	45,7	37,7	2	50	50,04	0,031	0,000	0,000	0,006	0,001	0,006
4A.6	Horses	CH_4	46,2	53,7	2	50	50,04	0,044	0,000	0,000	0,012	0,001	0,012
4A.7	Mules and Asses	CH_4	74,6	28,5	2	50	50,04	0,023	0,000	0,000	-0,003	0,001	0,003

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	uncertainty as % of total national emissions in year	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.		%	%	%	%	%	%	%	%	%
4A.8	Swine	CH_4	127,3	22,0	2	50	50,04	0,018	0,000	0,000	-0,015	0,000	0,015
4B	N_2O em. from Manure Management	N_2O	1406,0	450,0	2	300	300,01	2,200	-0,002	0,004	-0,519	0,010	0,519
4B1	Cattle	CH_4	89,8	37,2	2	20	20,10	0,012	0,000	0,000	-0,001	0,001	0,001
4B.2	Buffalo	CH_4	4,8	1,7	2	50	50,04	0,001	0,000	0,000	0,000	0,000	0,000
4B.3	Sheep	CH_4	28,1	4,1	2	50	50,04	0,003	0,000	0,000	-0,004	0,000	0,004
4B.4	Goats	CH_4	1,6	1,4	2	50	50,04	0,001	0,000	0,000	0,000	0,000	0,000
4B.6	Horses	CH_4	5,4	6,3	2	50	50,04	0,005	0,000	0,000	0,001	0,000	0,001
4B.7	Mules and Asses	CH_4	8,5	3,2	2	50	50,04	0,003	0,000	0,000	0,000	0,000	0,000
4B.8	Swine	CH_4	3908,7	577,5	2	20	20,10	0,189	-0,010	0,004	-0,201	0,013	0,202
4B.9	Poultry	CH_4	733,5	287,7	2	50	50,04	0,235	0,000	0,002	-0,025	0,006	0,025
4C	Rice Cultivation	CH_4	114,2	100,6	25	80	83,82	0,137	0,000	0,001	0,029	0,028	0,040
4D1	Direct soil emissions	N_2O	5553,9	2110,0	3	250	250,02	8,595	-0,004	0,016	-1,062	0,070	1,065
4D2	Pasture, Range and Paddock Manure	N_2O	1168,4	271,6	3	250	250,02	1,106	-0,002	0,002	-0,559	0,009	0,559
4D3	Indirect Emissions	N_2O	3660,4	1210,3	3	500	500,01	9,859	-0,004	0,009	-2,103	0,040	2,103
4F	Field Burning	CH_4	34,1	24,3	25	50	55,90	0,022	0,000	0,000	0,003	0,007	0,007
4F	Field Burning	N_2O	14,6	12,1	25	200	201,56	0,040	0,000	0,000	0,008	0,003	0,009
6A	Solid Waste Disposal on Land	CH_4	4455,0	3801,6	30	80	85,44	5,292	0,013	0,030	1,041	1,256	1,632

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	uncertainty as % of total national emissions in year	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.		%	%	%	%	%	%	%	%	%
6B	Waste Water Handling	CH_4	2229,7	700,2	30	30	42,43	0,484	-0,003	0,005	-0,086	0,231	0,247
6B	Waste Water Handling	N_2O	232,7	164,4	30	100	104,40	0,280	0,000	0,001	0,041	0,054	0,068
6C	Waste Incineration	CO_2	19,0	14,2	15	100	101,12	0,023	0,000	0,000	0,004	0,002	0,005
Total			128363,1	61379,0				14,60					3,05
%			99,97	99,92									
National Total			128399,4	61427,1									

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 Chapter 11.3.1.9.

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 2012:

Table 15 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
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.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

Sources and sinks not estimated (NE)			
GHG	Sector	Source/sink category	Explanation
Carbon	5 LULUCF	5.D.1 marshlands	Reporting is not obligatory
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 – 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

2.1 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS FOR AGGREGATED GREENHOUSE GAS EMISSIONS

In 2010 Bulgaria's greenhouse gas emissions totalled 61,4273.06 Gg CO_2. The emissions decreased by 52.16% compared with the base year and on 49.65% below the level of 122000 Gg CO_2 to which Bulgaria should limit its emissions during the Kyoto Protocol's first commitment period between 2008 and 2012. Emissions in 2010 were 4.3 % increes in comparison with the emissions of the previous year. The total greenhouse gas emissions as CO_2 equivalence and indexed emissions in relation to the base year level are presented in Figure 8.

2.2 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY GAS

The most important greenhouse gas in Bulgaria is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions has varied from 74.25% excluding LULUCF and 78.17% including LULUCF. In absolute terms CO_2 emissions have decreased 51.48% since 1988. Around 76% 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 56.12% 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 65.62%, which has been occasioned mostly by the reduced nitrogen fertilisation of agricultural fields, the biggest decline was in the beginning of time series.

The emissions of F-gases have increased over tenfold during 1995-2010. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications.

2.3 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY CATEGORY

Table 18 shows the overall emissions by sectors for the period 1988-2010, in CO_2-eq. The quantities of CO_2, sequestrated by forestry, are also included (without F-gases).

Table 19 and Table 20 shows the shares in percentage of the overall GHG emissions by sectors for the period 1988-2009. This percent is calculated on the overall emissions.

The data show that sector Energy, where GHG emissions come from fuel combustion, headed the list in 2009 with the biggest share – 76 %. Sector Agriculture ranked the second place with 10% and sector Waste ranked the third place with 8%.

The tables below shows the GHG aggregated emission trends by IPCC sectors. Obviously, sector Energy had the biggest contribution to the overall emissions, expressed in CO_2-eq. Sector Agriculture, Waste and Industrial processes followed it.

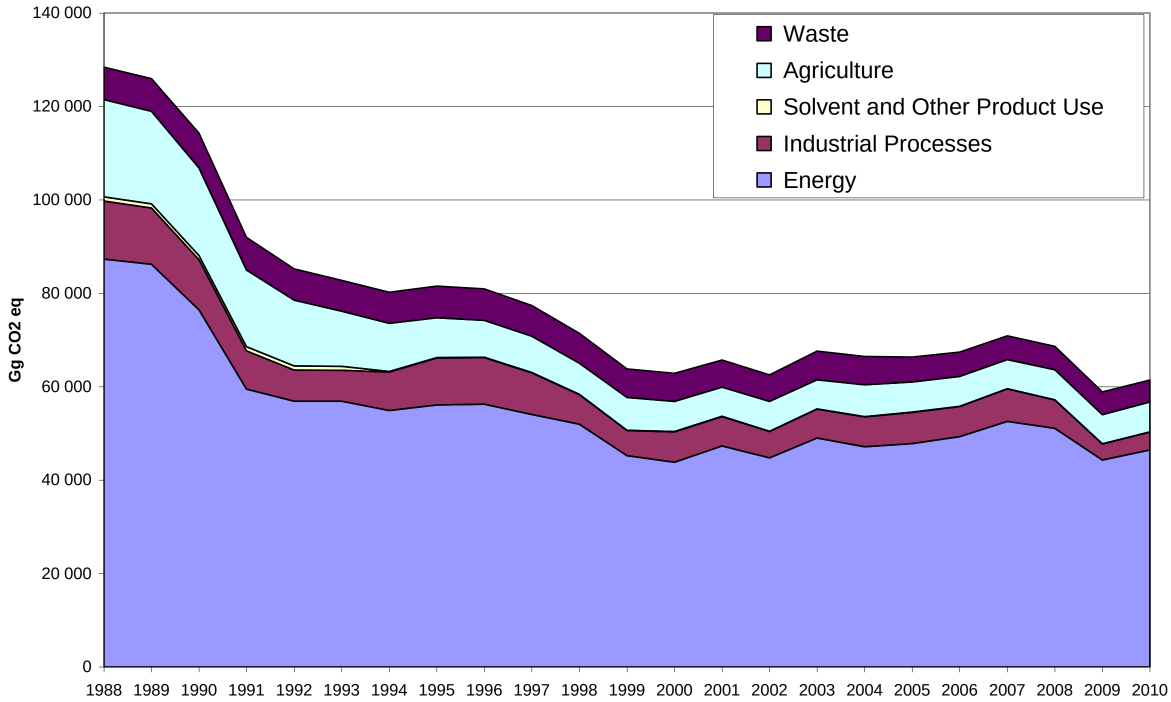


Figure 8 Total greenhouse gas emissions in CO_2-eq. per IPCC sector 1988-2010

The reduction of total GHG emissions (including LULUCF) from the base year to current inventory year is respectively 53.78% The reductions by IPCC sectors is presented in Table 16.

Table 16 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	-46,82
2. Industrial Processes	-68,95
3. Solvent and Other Product Use	-94,90
4. Agriculture	-69,25
5. Land Use, Land-Use Change and Forestry(5)	-39,12
6. Waste	-32,52
7. Other	0,00
Total (including LULUCF)	-53,78

Energy

The emissions in 2010 decreased with 46.8% compared to the base year.

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 2010 decreased with 69% compared to the base year.

The main sources of greenhouse gas emissions in the industrial processes sector are Mineral Products and Chemical Industry, which cause about 64.45 % and 26.25 %, respectively, of the emissions from this sector in 2010.

Agriculture

The overall emission reduction in the sector has amounted to 69.55% since 1988.

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

Land-Use Change and Forestry

The emissions in 2010 decreased with 39.1% compared to the base year.

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 32.5 %.

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

2.4 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 35%
- CO with 29%
- SO_x with 37%
- NMVOC with 80%

2.5 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 reported for the second time, thus trends are not available. Net removals from AR in 2010 are 1 393.25 Gg CO2 eq and net emissions from D activities are 205.53 Gg CO2 eq. More information about activities under Article 3.3 of Kyoto Protocol is described in Chapter 11.

Table 17 Summary of emission trends per gas, Gg, CO_2-eq.

Year	Total (exc. LULUCF)	CO_2	CH_4	N_2O	HFCS	PFCS	SF_6
1988	128399,39	95129,72	19059,55	14206,66	IE,NA,NO	IE,NA,NE,NO	3,46
1989	125974,26	93818,88	19144,48	13007,24	IE,NA,NO	IE,NA,NE,NO	3,66
1990	114297,70	83386,24	18970,32	11937,26	IE,NA,NO	IE,NA,NE,NO	3,87
1991	91979,16	65001,50	17716,58	9256,26	0,72	IE,NA,NE,NO	4,10
1992	85237,92	60958,04	16519,08	7756,46	0,00	IE,NA,NE,NO	4,33
1993	82787,60	60853,98	14854,56	7074,46	0,01	IE,NA,NE,NO	4,59
1994	80205,47	59697,60	13498,03	7004,98	0,02	IE,NA,NE,NO	4,85
1995	81534,82	62084,89	12946,86	6495,55	2,39	IE,NA,NE,NO	5,13
1996	80946,44	62097,49	12570,05	6269,27	4,20	IE,NA,NE,NO	5,43
1997	77402,20	59365,82	11926,91	6097,35	6,38	IE,NA,NE,NO	5,75
1998	71428,43	55394,26	11035,40	4982,55	10,14	IE,NA,NE,NO	6,08
1999	63818,64	48215,54	10309,13	5273,21	14,34	IE,NA,NE,NO	6,43
2000	62891,89	47636,36	10123,53	5107,25	17,95	IE,NA,NE,NO	6,80
2001	65695,47	51056,91	9393,01	5209,75	28,60	IE,NA,NE,NO	7,20
2002	62553,92	47907,87	9453,11	5144,15	41,17	IE,NA,NE,NO	7,62
2003	67634,77	52520,14	10250,27	4797,60	58,69	IE,NA,NE,NO	8,06
2004	66470,04	51170,63	9860,93	5351,65	78,31	IE,NA,NO	8,53
2005	66361,45	51907,75	9245,68	5098,44	101,02	IE,NA,NO	8,56
2006	67403,27	53335,92	9105,23	4789,05	164,18	IE,NA,NO	8,89
2007	70907,85	56857,74	9065,54	4775,61	199,71	IE,NA,NO	9,24
2008	68633,37	54458,66	8836,42	5027,96	300,72	0,00	9,60
2009	58895,14	45613,15	8432,80	4570,67	268,52	0,01	9,97
2010	61427,06	48016,35	8343,71	4772,94	280,94	0,04	13,07

Table 18 Aggregated GHG emissions by sector, Gg, CO_2-eq.

Year	Total (incl. LULUCF)	Energy	Industrial Processes	Solvent	Agriculture	LULUCF	Waste
1988	110 336	85 349	12 404	899,7944	18 979	-14 141	6 846
1989	107 886	84 233	12 026	900,0152	17 946	-13 989	6 770
1990	114221,94	87318,45	12404,17	899,79	20833,04	-14177,44	6943,94
1991	111932,70	86213,00	12025,64	900,02	19802,74	-14041,56	7032,87
1992	100404,75	76430,12	10740,72	897,75	18768,38	-13892,94	7460,72
1993	78203,91	59458,20	8219,71	895,71	16419,76	-13775,25	6985,78
1994	71788,55	56888,71	6677,91	896,61	14073,30	-13449,37	6701,39
1995	70078,53	56871,34	6643,31	829,62	11792,47	-12709,07	6650,86
1996	67714,13	54915,33	8200,31	126,75	10325,93	-12491,35	6637,16
1997	68571,31	56085,85	10060,95	95,61	8529,54	-12963,51	6762,87
1998	70357,03	56262,75	9940,72	91,50	7924,05	-10589,41	6727,41
1999	66791,76	54052,59	8898,65	79,43	7770,53	-10610,44	6601,00
2000	60865,64	51977,81	6330,55	64,15	6652,66	-10562,78	6403,26
2001	53345,24	45217,29	5400,62	56,57	7010,39	-10473,40	6133,78
2002	54024,05	43835,51	6475,54	68,40	6482,83	-8867,84	6029,62
2003	57018,95	47317,82	6275,53	54,76	6254,38	-8676,52	5792,99
2004	53459,28	44774,80	5604,40	57,41	6415,13	-9094,65	5702,18
2005	58579,91	49002,57	6176,75	60,40	6240,69	-9054,85	6154,35
2006	57203,15	47116,45	6408,92	48,91	6843,16	-9266,89	6052,60
2007	57283,10	47830,73	6656,68	50,68	6485,32	-9078,34	5338,03
2008	58788,03	49307,06	6437,68	53,73	6377,43	-8615,24	5227,36
2009	63518,59	52579,54	6926,06	50,13	6233,27	-7389,26	5118,85
2010	59988,47	51078,74	6074,58	51,10	6428,02	-8644,90	5000,94

Table 19 Sector contribution in aggregated emissions (excluding LULUCF), %

Year	Energy	Industrial Processes	Solvent	Agriculture	Waste
1988	68%	10%	1%	16%	5%
1989	68%	10%	1%	16%	6%
1990	67%	9%	1%	16%	7%
1991	65%	9%	1%	18%	8%
1992	67%	8%	1%	17%	8%
1993	69%	8%	1%	14%	8%
1994	68%	10%	0%	13%	8%
1995	69%	12%	0%	10%	8%
1996	70%	12%	0%	10%	8%
1997	70%	11%	0%	10%	9%
1998	73%	9%	0%	9%	9%
1999	71%	8%	0%	11%	10%
2000	70%	10%	0%	10%	10%
2001	72%	10%	0%	10%	9%

Year	Energy	Industrial Processes	Solvent	Agriculture	Waste
2002	72%	9%	0%	10%	9%
2003	72%	9%	0%	9%	9%
2004	71%	10%	0%	10%	9%
2005	72%	10%	0%	10%	8%
2006	73%	10%	0%	9%	8%
2007	74%	10%	0%	9%	7%
2008	74%	9%	0%	9%	7%
2009	75%	6%	0%	11%	8%
2010	76%	6%	0%	10%	8%

Table 20 Sector contribution in aggregated emissions (including LULUCF), %

Year	Energy	Industrial Processes	Solvent	Agriculture	LULUCF	Waste
1988	76%	11%	1%	18%	-12%	6%
1989	77%	11%	1%	18%	-13%	6%
1990	76%	11%	1%	19%	-14%	7%
1991	76%	11%	1%	21%	-18%	9%
1992	79%	9%	1%	20%	-19%	9%
1993	81%	9%	1%	17%	-18%	9%
1994	81%	12%	0%	15%	-18%	10%
1995	82%	15%	0%	12%	-19%	10%
1996	80%	14%	0%	11%	-15%	10%
1997	81%	13%	0%	12%	-16%	10%
1998	85%	10%	0%	11%	-17%	11%
1999	85%	10%	0%	13%	-20%	11%
2000	81%	12%	0%	12%	-16%	11%
2001	83%	11%	0%	11%	-15%	10%
2002	84%	10%	0%	12%	-17%	11%
2003	84%	11%	0%	11%	-15%	11%
2004	82%	11%	0%	12%	-16%	11%
2005	83%	12%	0%	11%	-16%	9%
2006	84%	11%	0%	11%	-15%	9%
2007	83%	11%	0%	10%	-12%	8%
2008	85%	10%	0%	11%	-14%	8%
2009	88%	7%	0%	12%	-18%	10%
2010	88%	7%	0%	12%	-16%	9%

3 ENERGY (CRF SECTOR 1)

3.1 OVERVIEW OF SECTOR

This chapter provides information about the GHG emission estimates from the Energy sector. According to IPCC guidelines, the following categories are included in this sector:

- 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

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 (Category 1A), as well as fugitive emissions from fuels (Category 1B) are accounted in the energy sector.

Emissions from the energy sector are the main source of GHGs in Bulgaria: in 2010 the sector is responsible for 73.5% of national total GHGs emissions (46 438 Gg CO_2e from sector 1A of the total 63 170 Gg CO_2e excl. LULUCF).

3.2 EMISSION TRENDS

Emissions from the energy sector in 2010 decreased by 46.8% compared to the base year (46 438 Gg CO_2e in 2010 compared to 87 318 Gg CO_2e in 1988), although there is a slight increase of 4.9% compared to last year. Main source of emissions in the Energy sector is Fuel combustion of solid fuels, which is responsible for 65.2% of the emissions.

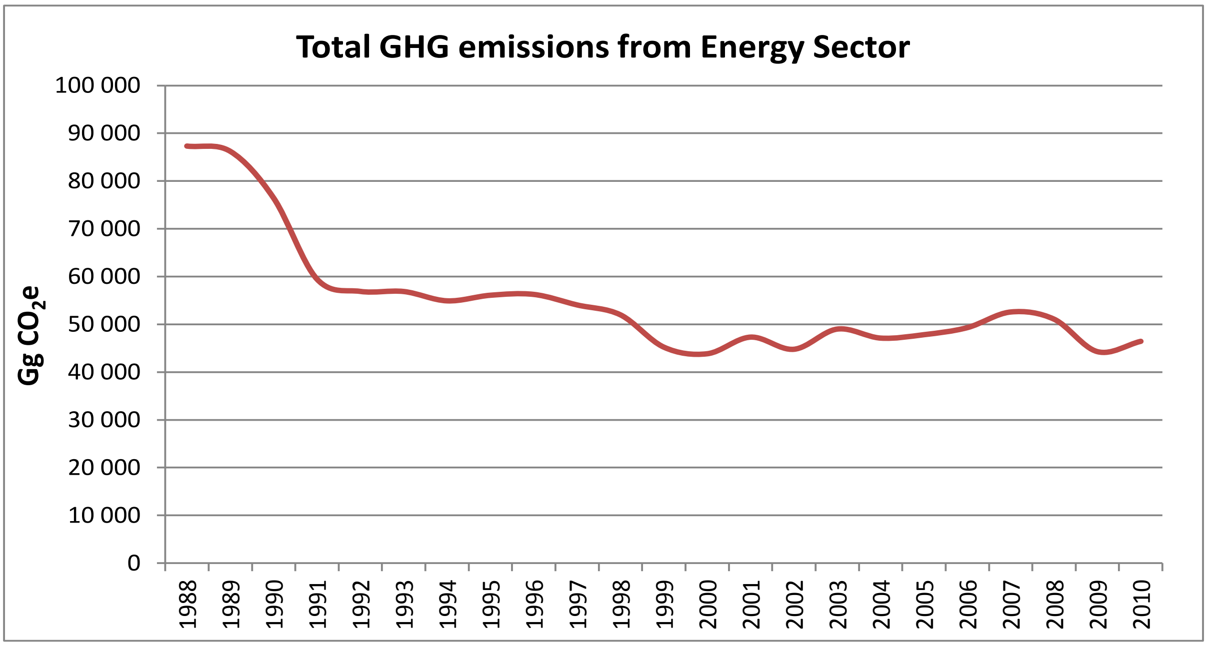


Figure 9 Total GHG emissions from Energy Sector

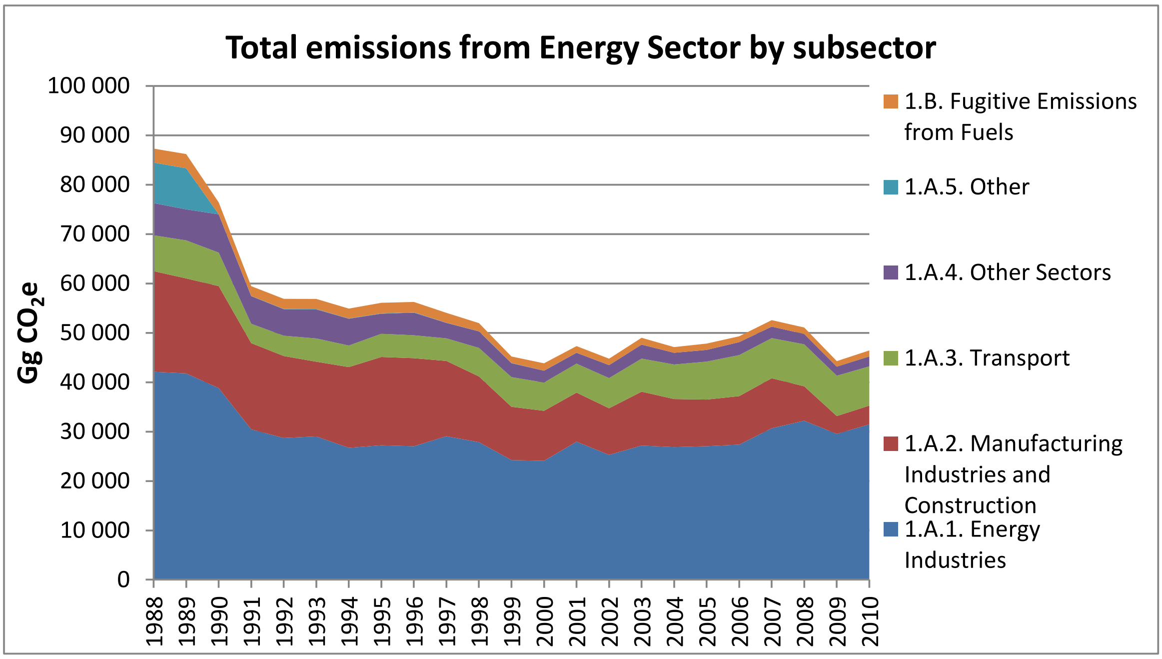


Figure 10 Total GHG emissions from Energy Sector by subsector

Total emissions from energy mainly consist of CO_2; with total amount of 44 687.12 Gg for 2010, followed by CH_4 and N_2O, which only make up about 70.90 Gg and 0.84 Gg, respectively.

Table 21 Emissions of GHG and their trends for the years 1988 – 2010

Year	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Total GHG [Gg CO_2e]
1988	83 723.94	155.00	1.10	87 318.45
1989	82 575.70	157.06	1.09	86 213.00
1990	73 338.25	130.74	1.12	76 430.12
1991	56 966.45	106.99	0.79	59 458.20
1992	54 286.87	112.03	0.80	56 888.71
1993	54 169.46	112.58	1.09	56 871.34
1994	52 271.90	107.87	1.22	54 915.33
1995	53 239.89	113.57	1.49	56 085.85
1996	53 411.55	113.37	1.52	56 262.75
1997	51 432.71	106.29	1.25	54 052.59
1998	49 607.08	91.92	1.42	51 977.81
1999	43 255.78	73.75	1.33	45 217.29
2000	41 735.77	82.27	1.20	43 835.51
2001	45 413.53	73.56	1.16	47 317.82
2002	42 846.65	74.47	1.18	44 774.80
2003	46 951.92	79.84	1.21	49 002.57
2004	45 435.41	67.19	0.87	47 116.45
2005	46 033.04	72.56	0.88	47 830.73
2006	47 575.04	68.99	0.91	49 307.06
2007	50 724.50	74.54	0.93	52 579.54
2008	49 226.85	74.56	0.92	51 078.74
2009	42 668.12	64.91	0.80	44 278.23
2010	44 687.12	70.90	0.84	46 437.64

3.3 FUEL COMBUSTION (CRF 1.A)

3.3.1 COMPARISON OF THE SECTORAL APPROACH WITH THE REFERENCE APPROACH

According to the IPCC guidelines, two separate approaches have to be applied in order to estimate the emissions from fuel combustions activities:

Reference Approach;
Sectoral Approach

The Reference approach (RA) is a method for estimating CO_2 combustion emissions using a simplified methodology. RA is a 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 following quantities:

- Production;
- Import and export;
- Stock changes;
- International bunkers

The Sectoral Approach (SA) is a more detailed methodology (a bottom-up method), using the fuel consumption for each of the sub-sectors:

Electricity and heat production;
Manufacturing industries and construction;
Transport;
Commercial/institutional;
Residential;
Agriculture/forestry/fisheries

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

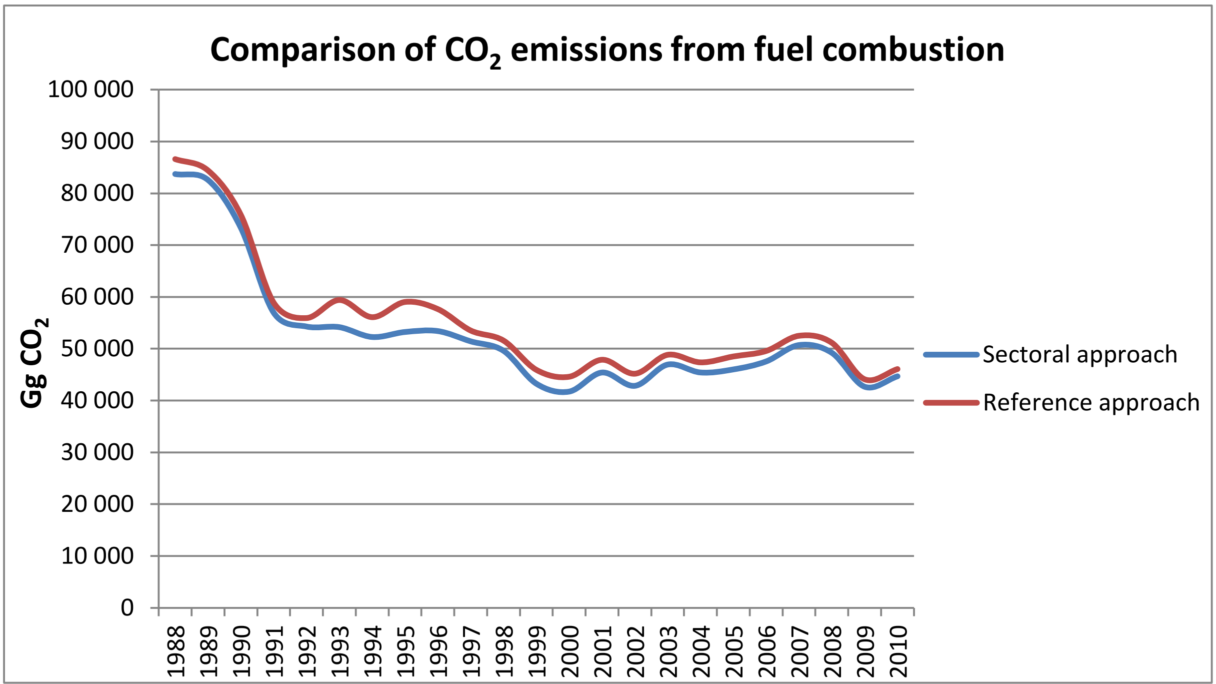


Figure 11 Comparison of the sectoral approach with the reference approach

3.3.1.3 Explanation of differences

A comparison between the Reference Approach (RA) and the Sectoral Approach (RA) indicates differences in both the energy consumption data and CO_2 emissions – 7.14% in terms of energy consumption and 3.12% in terms of CO_2 emissions for 2010.

One of the reasons for the difference in the emissions is the fact that the Reference Approach accounts part of the non-energy used fuels as oxidised. This is generally true, but 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.

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

Another explanation for the differences between the two approaches is due to the Energy Balance, since for some of the years there are significant statistical differences and losses reported.

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 (9.52% of total refinery intake in 1995 was reported as refinery losses, with an average of 3.88% for the period 1990-2010).

The following tables compare the energy consumption and the emissions according to both approaches for each fuel.

Table 22 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	1104.66	1027.56	7.50%	86601.21	83718.94	3.44%
1989	1081.75	1016.49	6.42%	84400.34	82570.78	2.22%
1990	984.42	909.79	8.20%	75816.07	73334.11	3.38%
1991	756.88	704.28	7.47%	58887.67	56962.65	3.38%
1992	706.76	663.26	6.56%	55924.19	54282.18	3.02%
1993	752.73	653.18	15.24%	59407.48	54163.95	9.68%
1994	711.74	630.06	12.96%	56093.52	52267.29	7.32%
1995	761.93	651.40	16.97%	59026.20	53235.16	10.88%
1996	745.34	653.55	14.05%	57647.96	53407.75	7.94%
1997	669.91	606.01	10.54%	53515.93	51429.48	4.06%
1998	643.60	584.01	10.20%	51574.50	49603.84	3.97%
1999	573.39	514.30	11.49%	45929.35	43252.28	6.19%
2000	563.57	494.05	14.07%	44594.76	41732.67	6.86%
2001	592.90	525.68	12.79%	47873.93	45410.52	5.42%
2002	557.09	497.55	11.97%	45177.62	42843.64	5.45%
2003	599.88	542.21	10.64%	48831.82	46949.44	4.01%
2004	582.81	528.58	10.26%	47370.48	45419.19	4.30%
2005	608.24	542.08	12.20%	48508.21	46008.22	5.43%
2006	622.60	562.50	10.68%	49568.78	47551.03	4.24%
2007	651.27	591.30	10.14%	52498.87	50710.21	3.53%
2008	630.02	569.71	10.59%	51153.63	49216.00	3.94%
2009	533.12	496.78	7.31%	44101.97	42665.88	3.37%
2010	544.86	508.54	7.14%	46076.02	44682.53	3.12%

Table 23 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	490.37	401.08	22.26%	33931.57	29908.16	13.45%
1989	475.20	389.51	22.00%	32796.01	29013.87	13.04%
1990	395.24	353.05	11.95%	27128.55	26133.80	3.81%
1991	244.48	217.53	12.39%	16444.50	16121.56	2.00%
1992	220.05	200.57	9.71%	14796.46	14912.79	-0.78%
1993	250.55	203.98	22.83%	16686.94	15087.63	10.60%
1994	232.94	195.11	19.39%	15661.84	14425.26	8.57%
1995	251.79	182.92	37.66%	16773.29	13473.37	24.49%
1996	227.35	185.17	22.78%	14798.41	13647.50	8.43%
1997	185.57	150.76	23.09%	11876.31	11136.17	6.65%
1998	198.14	162.45	21.96%	12483.24	11943.90	4.52%
1999	186.09	161.88	14.96%	11956.96	11832.58	1.05%
2000	172.92	142.33	21.49%	11023.56	10411.13	5.88%
2001	174.04	146.85	18.52%	11015.62	10707.66	2.88%
2002	180.52	145.17	24.35%	11789.15	10683.29	10.35%
2003	186.56	155.20	20.21%	11919.30	11384.49	4.70%
2004	177.58	155.84	13.95%	11280.23	11296.70	-0.15%
2005	201.32	161.65	24.54%	12926.49	11753.68	9.98%
2006	208.93	169.30	23.41%	13315.87	12340.89	7.90%
2007	199.31	164.72	20.99%	12651.69	12138.44	4.23%
2008	194.93	157.45	23.80%	12362.28	11531.12	7.21%
2009	176.09	152.64	15.36%	11778.42	11203.11	5.14%

Year	Energy consumption, PJ		Difference	CO_2 Emissions, Gg		Difference
	Reference approach	Sectoral approach		Reference approach	Sectoral approach	
2010	159.97	139.17	14.95%	11278.85	10828.24	4.16%

Table 24 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	418.67	-2.91%	41255.08	42397.13	-2.69%
1989	392.62	413.06	-4.95%	39853.85	41807.37	-4.67%
1990	363.29	360.08	0.89%	36776.27	36397.96	1.04%
1991	319.10	310.83	2.66%	32078.08	31178.02	2.89%
1992	316.44	306.18	3.35%	31962.99	30772.45	3.87%
1993	342.98	319.17	7.46%	34416.23	31934.07	7.77%
1994	318.86	305.63	4.33%	32075.99	30738.98	4.35%
1995	318.20	305.00	4.33%	32121.49	30781.88	4.35%
1996	322.21	304.99	5.65%	32575.01	30785.52	5.81%
1997	329.43	325.30	1.27%	33542.09	33155.31	1.17%
1998	314.46	307.65	2.21%	32153.76	31403.27	2.39%
1999	274.83	257.87	6.58%	28072.65	26226.40	7.04%
2000	267.89	256.96	4.25%	27289.20	26116.82	4.49%
2001	304.18	294.54	3.28%	31015.88	30072.83	3.14%
2002	275.91	273.24	0.98%	28168.06	27813.67	1.27%
2003	308.62	304.66	1.30%	31482.54	31041.75	1.42%
2004	300.87	293.15	2.63%	30733.87	29749.29	3.31%
2005	289.51	288.74	0.27%	29534.14	29216.17	1.09%
2006	292.22	293.34	-0.38%	29888.37	29722.57	0.56%
2007	325.92	326.38	-0.14%	33278.65	33065.11	0.65%
2008	313.08	315.26	-0.69%	32447.24	32353.97	0.29%
2009	266.57	265.03	0.58%	27514.16	27104.17	1.51%
2010	288.58	286.73	0.64%	29708.08	29298.15	1.40%

Table 25 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	207.81	207.81	0.00%	11414.57	11413.65	0.01%
1989	213.92	213.92	0.00%	11750.48	11749.53	0.01%
1990	225.89	196.66	14.86%	11911.25	10802.36	10.27%
1991	193.31	175.92	9.88%	10365.08	9663.07	7.26%
1992	170.27	156.51	8.79%	9164.74	8596.94	6.60%
1993	159.19	130.03	22.43%	8304.31	7142.25	16.27%
1994	159.94	129.31	23.68%	8355.68	7103.05	17.64%
1995	191.94	163.48	17.41%	10131.41	8979.92	12.82%
1996	195.78	163.39	19.82%	10274.55	8974.73	14.48%
1997	154.90	129.95	19.20%	8097.52	7138.00	13.44%
1998	131.01	113.91	15.01%	6937.50	6256.66	10.88%
1999	112.46	94.55	18.95%	5899.74	5193.30	13.60%
2000	122.76	94.75	29.56%	6282.00	5204.72	20.70%
2001	114.67	84.29	36.04%	5842.44	4630.03	26.19%
2002	100.66	79.13	27.20%	5220.41	4346.67	20.10%

Year	Energy consumption, PJ		Difference	CO_2 Emissions, Gg		Difference
	Reference approach	Sectoral approach		Reference approach	Sectoral approach	
2003	104.69	82.35	27.14%	5429.98	4523.20	20.05%
2004	104.36	79.54	31.21%	5356.38	4369.35	22.59%
2005	117.40	91.65	28.09%	6047.58	5035.25	20.10%
2006	121.44	99.85	21.62%	6364.54	5485.86	16.02%
2007	126.04	100.10	25.91%	6568.53	5498.17	19.47%
2008	122.01	96.87	25.95%	6344.11	5319.90	19.25%
2009	90.47	78.87	14.70%	4809.39	4337.19	10.89%
2010	96.31	82.30	17.03%	5089.10	4526.59	12.43%

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.

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

There are some fluctuations of the reported consumption of some of the fuels during the time series – unstable trends in the exports, imports or production. The non-energy use of fuels is on average 6.8% of the total apparent energy consumption during the period 1988-2010 and 3.4% for 2010. The apparent consumption is calculated according to Table 1-1 p. 1.12 from the 1996 IPCC Guidelines.

Table 26 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	30.96	1104.58	2.80%
1989	29.82	1081.70	2.76%
1990	59.77	984.42	6.07%
1991	38.35	756.71	5.07%
1992	36.47	706.72	5.16%
1993	54.26	752.73	7.21%
1994	48.26	711.70	6.78%
1995	51.63	761.93	6.78%
1996	59.73	745.34	8.01%
1997	53.48	669.91	7.98%
1998	48.40	643.56	7.52%

Year	Non-energy use, PJ	Apparent energy consumption incl. non-energy use, PJ	%
1999	43.45	573.39	7.58%
2000	52.79	563.57	9.37%
2001	53.32	592.90	8.99%
2002	41.42	557.09	7.44%
2003	47.95	599.88	7.99%
2004	50.43	582.81	8.65%
2005	52.62	608.21	8.65%
2006	49.47	622.60	7.95%
2007	52.41	651.27	8.05%
2008	51.11	630.02	8.11%
2009	25.71	533.12	4.82%
2010	18.55	544.86	3.40%

Table 27 Apparent consumption of non-energy fuels

TJ	Lubricants	Bitumen	Naphtha	Natural Gas as Feedstock	Other Products	Paraffin waxes	White spirit
1988	9366.00	20436.00	0.00	0.00	0.00	200.00	959.20
1989	7686.00	21060.00	0.00	0.00	0.00	160.00	915.60
1990	0.00	0.00	31064.00	27381.60	0.00	0.00	1320.00
1991	2495.70	5805.80	15796.00	13953.60	0.00	30.00	264.00
1992	2961.00	0.00	22880.00	10377.90	0.00	30.00	220.00
1993	4060.80	0.00	25696.00	24271.20	0.00	60.00	176.00
1994	3003.30	0.00	21296.00	23706.00	0.00	30.00	220.00
1995	2495.70	0.00	26180.00	22707.90	0.00	30.00	220.00
1996	2961.00	0.00	29832.00	26448.30	0.00	0.00	484.00
1997	803.70	0.00	29612.00	22670.10	0.00	0.00	396.00
1998	1565.10	3355.30	28600.00	14265.90	0.00	0.00	616.00
1999	2664.90	4637.10	19756.00	15321.60	364.02	0.00	704.00
2000	1480.50	4071.60	20900.00	25441.20	0.00	60.00	836.00
2001	1142.10	5617.30	20636.00	25178.40	0.00	90.00	660.00
2002	1438.20	3129.10	19008.00	17022.60	0.00	120.00	704.00
2003	1818.90	4335.50	23232.00	17690.40	121.34	90.00	660.00
2004	1903.50	5177.47	21734.63	20749.50	0.00	120.00	740.23
2005	1776.60	7402.17	20438.33	22127.40	242.68	150.00	478.97
2006	1945.80	9667.31	19963.02	16886.70	364.02	120.00	522.52
2007	1734.30	8218.60	21868.00	19431.90	525.81	150.00	484.00
2008	1353.60	7426.90	21956.00	19558.80	121.34	120.00	572.00
2009	1184.40	5617.30	9020.00	8968.50	121.34	90.00	704.00
2010	1861.20	4750.20	0.00	11284.20	40.45	0.00	616.00

The most significant fuels used as feedstock are naphtha and natural gas and in the latest years bitumen.

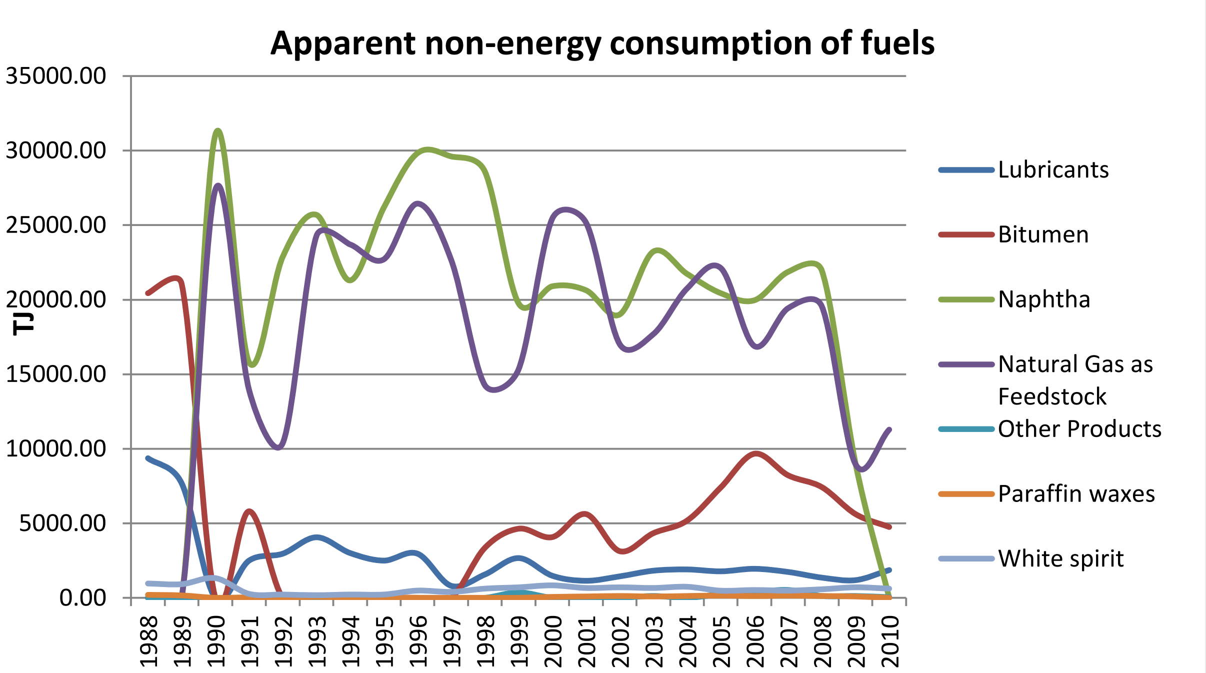


Figure 4 Apparent non-energy consumption of fuels

3.3.4 CO2 CAPTURE FROM FLUE GASES AND SUBSEQUENT CO2 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 1990-2010. 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'. For more information regarding the energy balances refer to Chapter 3.3.9.3.

3.3.6 SOURCE CATEGORY DESCRIPTION

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

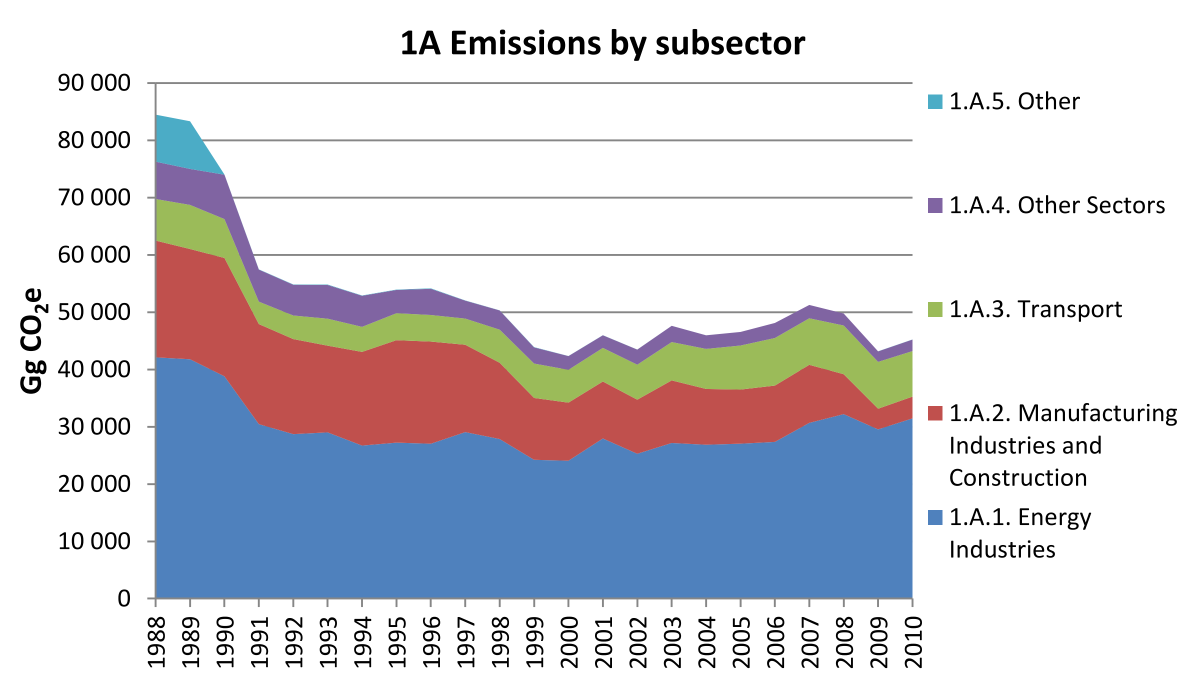


Figure 12 Total GHG emissions from Fuel combustion by subsector

Energy Industries are the main source of GHG emissions from fuel combustion with 69.6% of the sector emissions for 2010. Transport is the second most important source with 17.6% of the sector emissions, followed by Manufacturing industries and construction with 8.4%.

In general, there is 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 there is a 4.8% increase of the emissions from fuel combustion compared to previous year.

Manufacturing industry and construction is the sector, which changed drastically – compared to 1988 the emissions decreased by 81.4%. There was also a significant decrease after 2008 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 subsector in general.

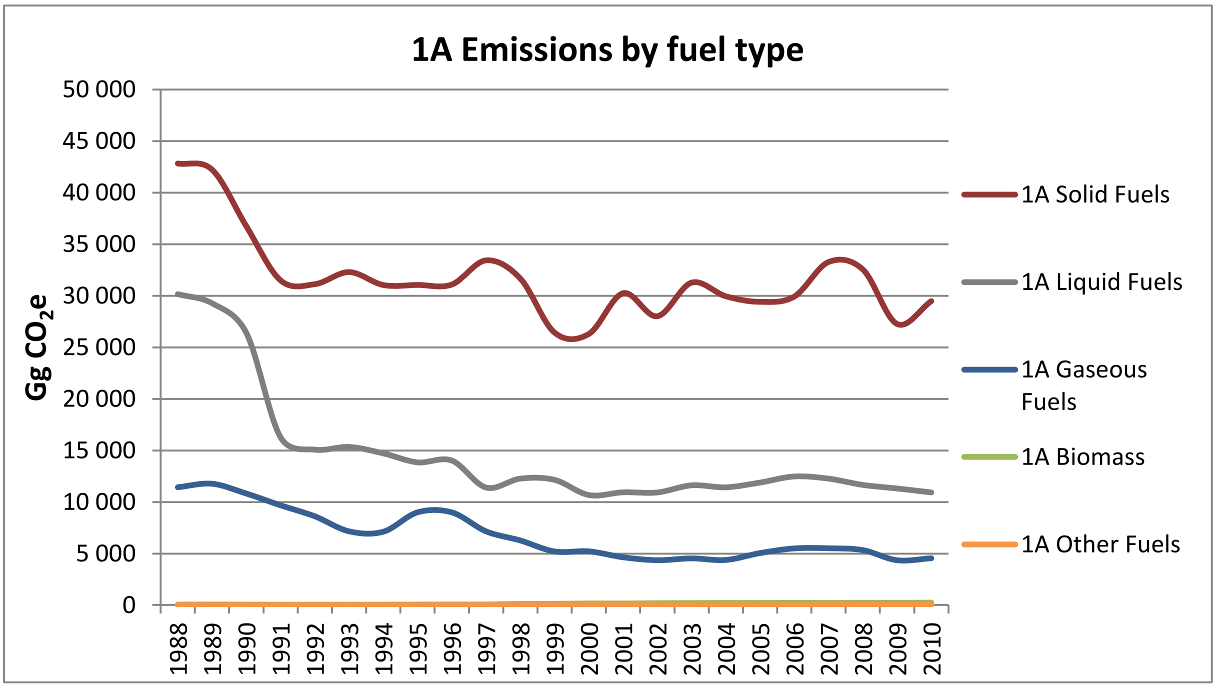


Figure 13 Total GHG emissions from Fuel combustion by fuel type

In 2010, 65.2% of the emission from fuel combustion were from solid fuels, 24.2% were from liquid fuels, and 10.0% were from gaseous fuels.

The general trend here is an increase in the percentage of solid fuels, mostly due to the energy industries growth and a decrease in liquid and gaseous fuels share due to the decrease of the industry sector.

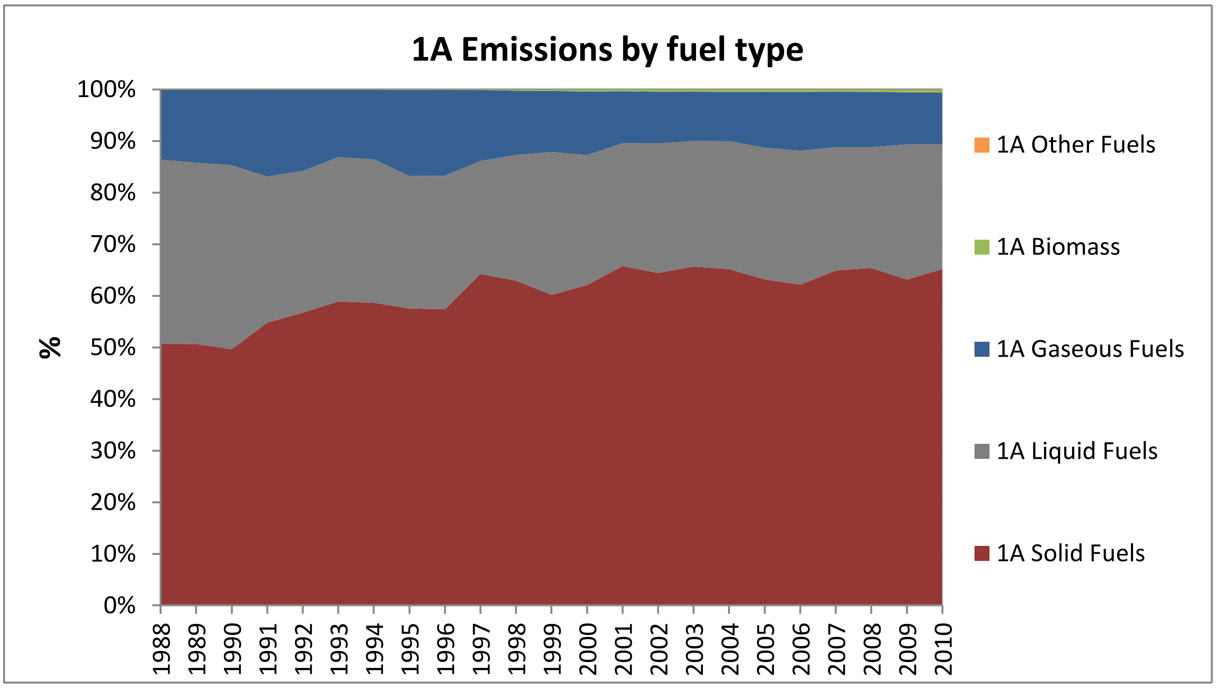


Figure 14 Total GHG emissions from Fuel combustion by fuel type

Table 28 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	83 718.94	29 908.16	42 397.13	11 413.65	NO	NA,NO
1989	82 570.78	29 013.87	41 807.37	11 749.53	NO	NA,NO
1990	73 334.11	26 133.80	36 397.96	10 802.36	NO	NA,NO
1991	56 962.65	16 121.56	31 178.02	9 663.07	NO	NA,NO
1992	54 282.18	14 912.79	30 772.45	8 596.94	NO	NA,NO
1993	54 163.95	15 087.63	31 934.07	7 142.25	NO	NA,NO
1994	52 267.29	14 425.26	30 738.98	7 103.05	NO	NA,NO
1995	53 235.16	13 473.37	30 781.88	8 979.92	NO	NA,NO
1996	53 407.75	13 647.50	30 785.52	8 974.73	NO	NA,NO
1997	51 429.48	11 136.17	33 155.31	7 138.00	NO	NA,NO
1998	49 603.84	11 943.90	31 403.27	6 256.66	NO	NA,NO
1999	43 252.28	11 832.58	26 226.40	5 193.30	NO	NA,NO
2000	41 732.67	10 411.13	26 116.82	5 204.72	NO	NA,NO
2001	45 410.52	10 707.66	30 072.83	4 630.03	NO	NA,NO
2002	42 843.64	10 683.29	27 813.67	4 346.67	NO	NA,NO
2003	46 949.44	11 384.49	31 041.75	4 523.20	NO	NA,NO
2004	45 419.19	11 296.70	29 749.29	4 369.35	NO	3.8533
2005	46 008.22	11 753.68	29 216.17	5 035.25	NO	3.1109
2006	47 551.03	12 340.89	29 722.57	5 485.86	NO	1.7006
2007	50 710.21	12 138.44	33 065.11	5 498.17	NO	8.4888
2008	49 216.00	11 531.12	32 353.97	5 319.90	NO	11.0107
2009	42 665.88	11 203.11	27 104.17	4 337.19	NO	21.4117
2010	44 682.53	10 828.24	29 298.15	4 526.59	NO	29.5501
Decrease 1988-2010	46.63%	63.80%	30.90%	60.34%	-	-
Decrease 1990-2010	39.07%	58.57%	19.51%	58.10%	-	-
Decrease 2009-2010	-4.73%	3.35%	-8.09%	-4.37%	-	-38.01%

Table 29 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	20.3374	5.0385	12.3492	0.5674	2.3823	NA,NO
1989	20.2211	5.3492	12.0059	0.5872	2.2788	NA,NO
1990	16.8430	4.6747	9.4798	0.5222	2.1663	NA,NO
1991	13.1507	2.4694	8.7873	0.5289	1.3650	NA,NO
1992	15.2376	2.6343	10.4794	0.5221	1.6017	NA,NO
1993	15.6065	2.8308	10.8839	0.4549	1.4370	NA,NO
1994	12.9777	2.6220	8.2241	0.4659	1.6657	NA,NO
1995	12.0686	2.5685	6.7165	0.5903	2.1933	NA,NO
1996	13.6381	2.1996	8.4130	0.5824	2.4431	NA,NO
1997	11.2468	1.5647	6.8237	0.4305	2.4278	NA,NO
1998	13.4859	1.8095	6.6711	0.3779	4.6273	NA,NO
1999	11.4473	1.7425	4.5568	0.2805	4.8676	NA,NO
2000	11.7538	1.4995	3.4486	0.3040	6.5017	NA,NO
2001	10.2482	1.4070	2.4554	0.2552	6.1307	NA,NO
2002	13.0526	1.3462	4.1077	0.2391	7.3597	NA,NO
2003	14.2310	1.3145	4.9604	0.2472	7.7089	NA,NO

CH_4 (Gg)	1.A. Fuel Combustion	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2004	13.2310	1.1289	3.8168	0.2700	8.0133	0.0020
2005	12.9013	1.0948	3.4944	0.3757	7.9349	0.0016
2006	13.6620	1.0880	3.7108	0.4432	8.4194	0.0006
2007	12.8015	0.9777	3.3411	0.4869	7.9915	0.0044
2008	12.8446	0.8756	3.0336	0.4619	8.4656	0.0080
2009	11.9474	0.8312	2.1259	0.4183	8.5571	0.0151
2010	13.3387	0.6908	2.8334	0.4909	9.3001	0.0234
Decrease 1988-2010	34.41%	86.29%	77.06%	13.49%	-290.38%	-
Decrease 1990-2010	20.81%	85.22%	70.11%	5.99%	-329.31%	-
Decrease 2009-2010	-11.64%	16.89%	-33.28%	-17.37%	-8.68%	-55.45%

Table 30 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	1.0950	0.4690	0.5734	0.0208	0.0318	NA,NO
1989	1.0936	0.4763	0.5655	0.0214	0.0304	NA,NO
1990	1.1172	0.5776	0.4910	0.0197	0.0289	NA,NO
1991	0.7898	0.3202	0.4284	0.0176	0.0236	NA,NO
1992	0.8037	0.3413	0.4205	0.0157	0.0262	NA,NO
1993	1.0894	0.6147	0.4380	0.0130	0.0237	NA,NO
1994	1.2199	0.7629	0.4172	0.0129	0.0270	NA,NO
1995	1.4868	1.0219	0.4148	0.0163	0.0338	NA,NO
1996	1.5177	1.0483	0.4163	0.0163	0.0367	NA,NO
1997	1.2512	0.7513	0.4442	0.0130	0.0427	NA,NO
1998	1.4208	0.9186	0.4219	0.0114	0.0690	NA,NO
1999	1.3313	0.8975	0.3523	0.0095	0.0720	NA,NO
2000	1.2000	0.7477	0.3493	0.0095	0.0935	NA,NO
2001	1.1595	0.6559	0.4046	0.0084	0.0906	NA,NO
2002	1.1751	0.6840	0.3748	0.0079	0.1083	NA,NO
2003	1.2064	0.6614	0.4180	0.0082	0.1188	NA,NO
2004	0.8708	0.3356	0.4023	0.0087	0.1239	0.0003
2005	0.8838	0.3495	0.3971	0.0115	0.1256	0.0002
2006	0.9137	0.3615	0.4045	0.0131	0.1346	0.0001
2007	0.9342	0.3422	0.4519	0.0145	0.1250	0.0006
2008	0.9230	0.3425	0.4386	0.0139	0.1269	0.0011
2009	0.7971	0.2855	0.3710	0.0139	0.1247	0.0020
2010	0.8439	0.2717	0.4014	0.0162	0.1514	0.0031
Decrease 1988-2010	22.93%	42.07%	29.99%	21.88%	-376.71%	-
Decrease 1990-2010	24.46%	52.96%	18.24%	17.45%	-424.24%	-
Decrease 2009-2010	-5.88%	4.82%	-8.19%	-17.21%	-21.42%	-55.45%

Table 31 GHG emissions in 1.A. Fuel Combustion

GHG (Gg)	TJ	1.A. Fuel Combustion	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	1 035 499.56	84 485.46	30 159.36	42 834.21	11 432.01	59.8751	NO
1989	1 024 084.47	83 334.44	29 273.85	42 234.81	11 768.50	57.2738	NO
1990	917 015.09	74 034.13	26 411.03	36 749.24	10 819.42	54.4463	NO
1991	710 180.93	57 483.66	16 272.69	31 495.37	9 679.63	35.9810	NO
1992	669 816.72	54 851.30	15 073.91	31 122.88	8 612.76	41.7608	NO
1993	659 098.02	54 829.40	15 337.64	32 298.41	7 155.83	37.5097	NO
1994	636 803.71	52 917.99	14 716.81	31 041.00	7 116.84	43.3408	NO
1995	659 844.23	53 949.50	13 844.08	31 051.50	8 997.38	56.5330	NO
1996	662 734.64	54 164.63	14 018.68	31 091.23	8 992.02	62.6966	NO
1997	616 674.76	52 053.52	11 401.95	33 436.30	7 151.07	64.2092	NO
1998	601 272.48	50 327.50	12 266.65	31 674.14	6 268.13	118.5773	NO
1999	532 305.89	43 905.37	12 147.39	26 431.30	5 202.12	124.5499	NO
2000	517 432.58	42 351.49	10 674.39	26 297.53	5 214.04	165.5310	NO
2001	548 321.90	45 985.19	10 940.53	30 249.83	4 638.01	156.8235	NO
2002	524 631.42	43 482.01	10 923.62	28 016.11	4 354.14	188.1370	NO
2003	571 901.86	47 622.28	11 617.13	31 275.49	4 530.95	198.7104	NO
2004	559 574.66	45 966.97	11 424.44	29 954.16	4 377.70	206.6908	3.9771
2005	573 490.13	46 553.14	11 885.01	29 412.65	5 046.70	205.5617	3.2091
2006	596 158.91	48 121.17	12 475.79	29 925.89	5 499.22	218.5359	1.7395
2007	622 609.90	51 268.66	12 265.06	33 275.36	5 512.89	206.5810	8.7649
2008	601 726.17	49 771.87	11 655.69	32 553.64	5 333.92	217.1111	11.5072
2009	528 368.44	43 163.88	11 309.06	27 263.84	4 350.27	218.3571	22.3502
2010	546 927.59	45 224.26	10 926.98	29 482.10	4 541.93	242.2431	31.0091
Decrease 1988-2010	47.18%	46.47%	63.77%	31.17%	60.27%	-304.58%	-
Decrease 1990-2010	40.36%	38.91%	58.63%	19.77%	58.02%	-344.92%	-
Decrease 2009-2010	-3.51%	-4.77%	3.38%	-8.14%	-4.41%	-10.94%	-38.74%

3.3.7 KEY CATEGORIES

The methodology and results of the key category analysis is presented in Chapter 1.5. Table 32 presents the key source categories of 1 A Fuel Combustion Activities.

Table 32 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	LA88, LA10, TA
1A1a – Solid Fuels	Public Electricity and Heat Production	CO_2	LA88, LA10, TA
1A1a – Gaseous Fuels	Public Electricity and Heat Production	CO_2	LA88, LA10, TA
1A1b – Liquid Fuels	Petroleum Refining	CO_2	LA88, LA10
1A2a – Solid Fuels	Iron and Steel	CO_2	LA88, LA08, TA
1A2a – Gaseous Fuels	Iron and Steel	CO_2	LA09
1A2b – Solid Fuels	Non-Ferrous Metals	CO_2	LA04
1A2c – Liquid Fuels	Chemicals	CO_2	LA08
1A2c – Solid Fuels	Chemicals	CO_2	LA10
1A2c – Gaseous Fuels	Chemicals	CO_2	LA10

IPCC Category	Source Categories	Key Category	
		GHG	KCA
1A2d – Liquid Fuels	Pulp, Paper and Print	CO_2	LA88, TA
1A2d – Soild Fuels	Pulp, Paper and Print	CO_2	LA02
1A2e – Liquid Fuels	Food Processing, Beverages and Tobacco	CO_2	LA88, TA
1A2e – Gaseous Fuels	Food Processing, Beverages and Tobacco	CO_2	LA10
1A2f – Liquid Fuels	Other	CO_2	LA88, LA10, TA
1A2f – Solid Fuels	Other	CO_2	LA88, LA10, TA
1A2f – Gaseous Fuels	Other	CO_2	LA10
1A3b – Liquid Fuels	Road Transportation	CO_2	LA88, LA10, TA
1A3c – Liquid Fuels	Railways	CO_2	LA93
1A3e – Gaseous Fuels	Other Transportation	CO_2	LA10
1A4a – Liquid Fuels	Commercial/Institutional	CO_2	LA09
1A4b – Liquid Fuels	Residential	CO_2	LA88, TA
1A4b – Solid Fuels	Residential	CO_2	LA88, LA10, TA
1A4c – Liquid Fuels	Agriculture/Forestry/Fisheries	CO_2	LA88, LA10, TA
1A5a – Liquid Fuels	Other	CO_2	LA88
1A5a – Gaseous Fuels	Other	CO_2	LA88

*LA88 = Level Assessment 1988; LA10 = Level Assessment 2010; TA = Trend Assessment 1988–2010

3.3.8 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.

3.3.9 METHODOLOGICAL ISSUES

3.3.9.1 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)

3.3.9.2 Choice of Emission factor

3.3.9.2.1 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 cintent listed in Table 34 and default oxidation factors listed in Table 33 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 33 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 34 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			

Fuel	Carbon content [t/TJ]	EF CO_2 [t/TJ] (excl. oxidation factor)	EF CO_2 [t/TJ] (incl. oxidation factor)
Primary Fuels			
Anthracite*	26.8	98.2667	96.3013
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 inTable 36 and Table 37.

3.3.9.2.2 Country specific emission factors for CO2 for solid fuels

Emission data reported under the European Emission Trading Scheme

A total of 155 operators have provided their verified CO_2 emission reports required under the EU ETS for the years 2007-2010. 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 only the largest 24 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 2010 are applied the respective annual emission factors and for the years 1988 to 2006 is applied an average EF, calculated as a weighted average.

The following country-specific carbon contents were calculated:

Table 35 Country-specific carbon content for solid fuels [t/TJ]

Fuel	1988-2006	2007	2008	2009	2010
Anthracite	27.4064	27.1402	28.0454	27.7332	**27.1044**
Lignite	29.4642	29.2070	29.7465	29.3712	**29.4522**
Other Bituminous Coal	26.6301	27.3644	26.7991	26.4847	**26.0058**
Petroleum Coke	26.3032	26.6389	26.4331	25.9058	**26.1723**

The following emission factors excluding oxidation factor were calculated:

Table 36 Country-specific emission factors excl. oxidation factor for CO_2 for solid fuels [t/TJ]

Fuel	1988-2006	2007	2008	2009	2010
Anthracite	100.4900	99.5139	102.8330	101.6884	**99.3830**
Lignite	108.0354	107.0924	109.0704	107.6943	**107.9913**
Other Bituminous Coal	97.6439	100.3361	98.2634	97.1105	**95.3546**
Petroleum Coke	96.4450	97.6760	96.9214	94.9878	**95.9651**

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

Table 37 Country-specific emission factors incl. oxidation factor for CO_2 for solid fuels [t/TJ]

Fuel	1988-2006	2007	2008	2009	2010
Anthracite	98.4802	97.5236	100.7763	99.6547	**97.3953**
Lignite	105.8747	104.9506	106.8890	105.5404	**105.8315**
Other Bituminous Coal	95.6910	98.3294	96.2981	95.1683	**93.4475**
Petroleum Coke	94.5161	95.7225	94.9830	93.0881	**94.0458**

3.3.9.2.3 Country specific emission factors for CO2 for gaseous fuels

CC/ERT/ARR/2010/37, §82

In the development of its estimates, Bulgaria has primarily utilized default EFs obtained from the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and, in some cases, the 2006 IPCC Guidelines. The use of EFs from the 2006 IPCC Guidelines is usually warranted because the circumstances indicate that, for the specific Bulgarian situation, there is no default EF available from the other two IPCC sources. However, the ERT reminds Bulgaria that, if available, methods and default EFs from the Revised 1996 IPCC Guidelines and the IPCC good practice guidance are to be used. The ERT also recommends that the Party:

(a) Review its use of default EFs from the 2006 IPCC Guidelines in order to clearly define and confirm the need for their use;

(b) Develop and use country-specific EFs, which are considered to be the best solution, if available.

As CO_2 emissions from natural gas are a key category in several subsectors and following the previous ARR 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 2007-2010
- "Melrose Resources" OOD and "Oil and Gas Exploration and Production" AD - the companies licensed for oil and gas extraction for the period 2004-2010 and 1999-2010

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, N2 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 current country-specific emission factor for natural gas is about 1.6% lower than the default emission factor, which was previously used.

Table 38 Country-specific carbon contents and emission factors for CO_2 for gaseous fuels [t/TJ]

	1988-2006	2007	2008	2009	2010
Carbon content	15.0557	15.0501	15.0479	15.0647	**15.0658**
EF excl. oxidation factor	55.2044	55.1839	55.1758	55.2371	**55.2413**
EF incl. oxidation factor	54.9284	54.9079	54.8999	54.9609	**54.9650**

Since all gas companies and the National Statistics 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 regarding those conditions.

The following default emission factors for CH_4 are applied (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. Emission factors for sludge gas and black liquor are not available in the 1996 Guidelines.

Table 39 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

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

Table 40 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

Choice of emission factors for mobile sources

The emission factors for mobile sources are presented in Chapter 3.3.12 TRANSPORT (CRF 1.A.3)

3.3.9.3 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 subsector 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 subsector.

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 1990-2010. 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 2.

The national energy balance is provided by NSI and presented in Annex 4. 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].

3.3.9.3.1 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 3.

For liquid fuels the balances provide an 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 41 Selected Net Calorific Values for 2010

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	24 049	27.400
Coking Coal	-	-
Other Bituminous Coal	25.497	28 263
Lignite and Sub-bituminous Coal	6 944	17 067
BKB & Patent Fuel	12 294	16 827
Coke Oven / Gas Coke	-	28 500
Gaseous fuels		
Natural Gas [TJ/1000 m3]	0.033641	

For all NCVs please consult Annex 3.

3.3.9.4 Uncertainties and time-series consistency in CRF 1.A

STATIONARY COMBUSTION

3.3.9.4.1 Uncertainty of AD

Solid fuels

About 89% of solid fuels consumption comes from national lignite production, another 9 % of solid fuels (anthracite and bituminous coal) are imported predominantly from Russia and Ukraine. Furthermore coking coal is imported from US and Australia. Except for electricity production, solid fuels are used in the chemical industry, for cement production, 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 subsectors 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 m3 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 subsectors 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%

3.3.9.4.2 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 7.

3.3.9.5 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.

3.3.9.5.1 Activity data checks

Trend analysis was performed regarding the activity data for all subsectors 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 of the subsectors 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.

3.3.9.5.2 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.

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

3.3.9.6.1 Country-specific emission factors

CC/ERT/ARR/2010/37, §72

During the review, it was noted that there have been some allocation issues with respect to Bulgaria's solid fuel AD. For example, the national energy balance combines lignite and brown coal data together in one fuel category and "other bituminous" and anthracite coal data together into a second category in the years before 2004. The contractor which developed the stationary model software (Denkstatt) explained that the lignite CO_2 *EF was used for the first coal category and the "other bituminous" EF was used for the second. As the lignite factor is the higher of the two, the EF used provides a conservative emission estimate. However, the "other bituminous" factor is lower than that for anthracite, so this approximation generates a potential underestimate. During the review week, Bulgaria provided the ERT with a revised* CO_2 *estimate for solid fuels, which more appropriately applies the anthracite EF to the combined anthracite and other bituminous coal data category. This change was incorporated in the 22 October 2010 resubmission.*

Following the recommendation from the latest ARR, 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.

For the 2010 submission, the country specific emission factors were calculated as a weighted average from the ETS reports for 2008 and applied to all the years. For the 2011 submission, the country specific factors were recalculated as a weighted average from all reports for 2007, 2008 and 2009. For the 2012 submission were applied the annual emission factors for the years 2007-2010, and an average emission factor for the years 1988-2006. The differences in the country-specific factors can be found in Table 35.

3.3.9.6.2 Identified errors

The calculation model was reorganized in order to implement the possibility to use different emission factors for each year. The calculation formulas were thoroughly checked and the following errors were identified:

The quantities of fuels reported as Energy industry own use in Oil refineries for the years 1988 and 1989 were omitted. They are now properly allocated to category 1A1b.
The emission factor for Residual fuel oil was applied to Other petroleum products. The correct EF is now used for the calculations.

3.3.9.6.3 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.

Further source-specific recalculations are described in detail in the relevant subcategories.

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

CC/ERT/ARR/2010/37, §66

The ERT found that the Party had used a mixture of automated and manual data entry with copy-and-paste actions in its calculation procedures for the energy sector. The manual actions carry the risk of transcription and other errors in the emission estimation process. The ERT recommends that Bulgaria explore the possibility of developing and implementing more automated procedures (e.g. electronic links and formulae) to manage data entry, as recommended by the previous ERT. The ERT also recommends that Bulgaria expend further efforts to reduce errors in the energy section of its NIR.

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 were made between the numbers in the calculation models and the CRF tables generated between CRF reported. A planned improvement is to develop a fully automated check between the data in the calculation models and the CRF tables.

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,
- and the own consumption of the energy sector.

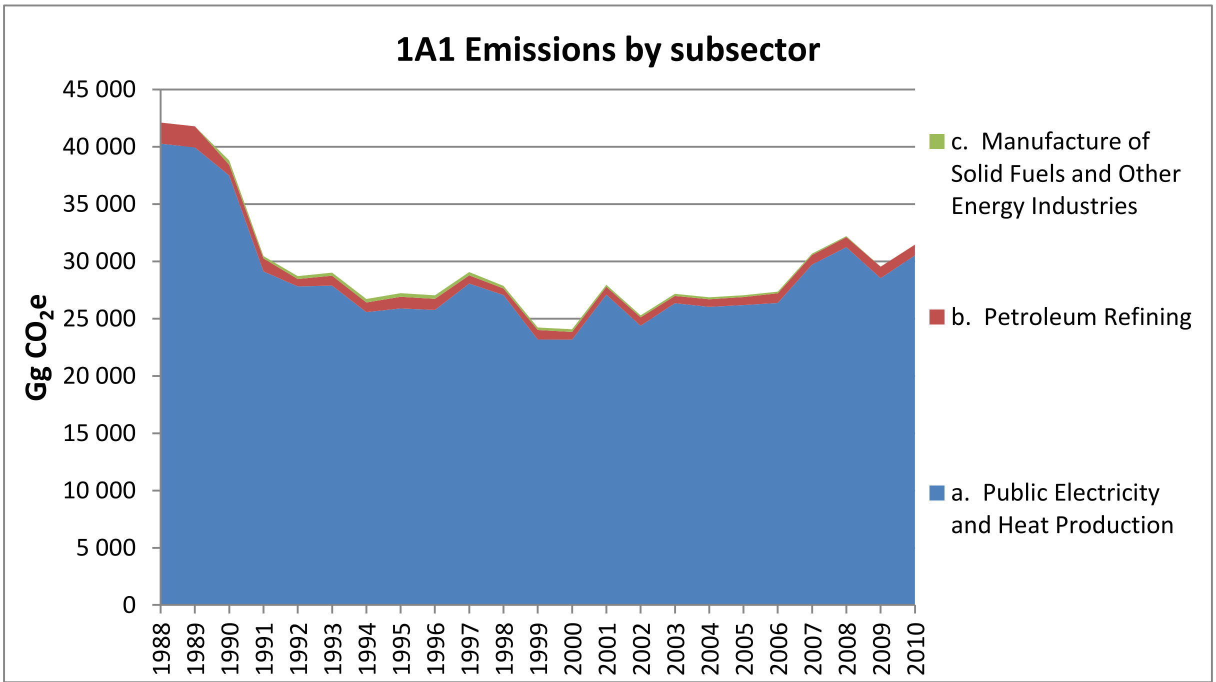


Figure 15 Total GHG emissions from 1.A.1 Energy industries by subsector

For 2010 the general trend in CRF category 1.A.1 is a decrease in the emissions of 25.3% compared to base year and an increase of 6.5% 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.

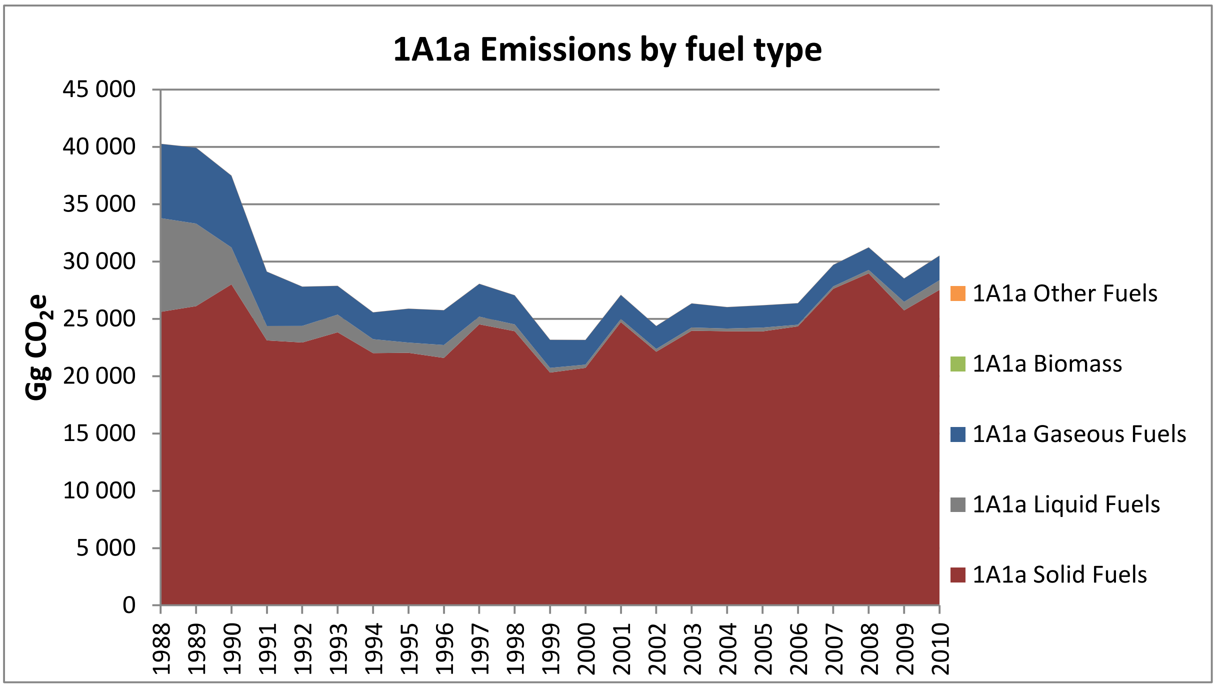


Figure 16 GHG emissions from 1.A.1.a Public Electricity and Heat Production

The share of CRF category 1.A.1.a from the total GHG emissions is 48.3% for the year 2010. The share of this subcategory from CRF category 1.A Fuel combustion is 67.5% for the year 2010.

Table 42 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	23 083.59	410.65	20 220.74	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	4.5920	NO
2010	30 393.20	840.01	27 406.50	2 146.69	9.0720	NO
Decrease 1988-2010	24.26%	89.70%	-7.49%	66.85%	-	-
Decrease	18.65%	73.84%	1.71%	65.73%	-	-

CO_2 (Gg)	CRF 1.A.1.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1990-2010						
Decrease 2009-2010	-6.98%	-12.86%	-6.94%	-5.24%	-97.56%	-

Table 43 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	0.3149	0.0265	0.2500	0.0371	0.0012	NO
2010	0.3364	0.0277	0.2672	0.0391	0.0024	NO
Decrease 1988-2010	50.68%	91.32%	-9.21%	66.87%	-	-
Decrease 1990-2010	34.07%	77.97%	1.14%	65.75%	-	-
Decrease 2009-2010	-6.82%	-4.61%	-6.85%	-5.23%	-97.56%	-

Table 44 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
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

N_2O (Gg)	CRF 1.A.1.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
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	0.0002	NO
2010	0.3837	0.0055	0.3740	0.0039	0.0003	NO
Decrease 1988-2010	8.23%	91.42%	-9.21%	66.87%	-	-
Decrease 1990-2010	7.51%	78.23%	1.14%	65.75%	-	-
Decrease 2009-2010	-6.86%	-5.68%	-6.85%	-5.23%	-97.56%	-

Table 45 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	244 787.15	23 175.87	411.99	20 309.36	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	271 363.23	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	296 750.32	28 529.26	746.46	25 740.91	2 041.81	0.0767	NO
2010	309 595.33	30 519.22	842.29	27 528.06	2 148.72	0.1515	NO
Decrease 1988-2010	33.99%	24.22%	89.71%	-7.50%	66.85%	-	-
Decrease 1990-2010	27.37%	18.61%	73.86%	1.71%	65.73%	-	-
Decrease 2009-2010	-4.33%	-6.98%	-12.84%	-6.94%	-5.24%	-97.56%	-

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

CC/ERT/ARR/2010/37, §72

In the previous annual review report, the ERT recommended that Bulgaria 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. Although, during the review week, Bulgaria attempted to reallocate utility combined heat and power plants to public electricity and heat production, this revised allocation was not formally submitted in its 22 October 2010 resubmission. The ERT reiterates the recommendation of the previous annual review report that Bulgaria implement this reallocation of emissions and report on it in the next annual submission.

Due to a technical mistake in the 13 August 2010 submission, the emissions from gaseous fuels from Main Activity Producer Heat Plants were reported in CRF category 1.A.2.f and the emissions from Autoproducer Electricity Plants were reported in CRF category 1.A.1.a. During the in-country review the error was spotted and corrected in the calculation model, but since there wasn't a change in the total emissions, the reallocation was not submitted in the 10 November 2010 submission.

Following the recommendations from the latest ARR, the emissions from gaseous fuels were reallocated to the respective subcategories:

- CRF category 1.A.1.a: Main Activity Producer Electricity Plants; Main Activity Producer CHP Plants, Main Activity Producer Heat Plants
- CRF category 1.A.2.f: Autoproducer Electricity Plants, Autoproducer CHP Plants, Autoproducer Heat Plants

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.

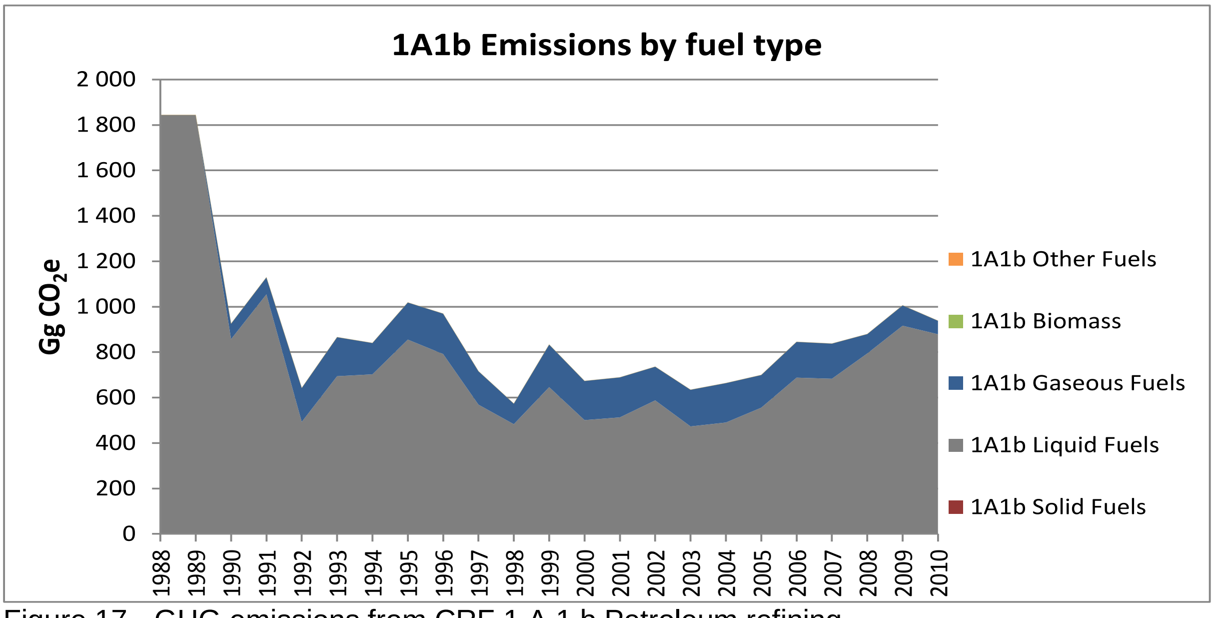


Figure 17 GHG emissions from CRF 1.A.1.b Petroleum refining

The share in total GHG emissions of this subsector from sector 1A Fuel Combustion is 2.1% for the year 2010 and from the total GHGs emissions is 1.5% for the year 2010.

Table 46 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
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	1 004.44	914.81	NO	89.63	NO	NO
2010	936.95	877.39	NO	59.56	NO	NO
Decrease 1988-2010	49.03%	52.27%	-	-	-	-
Decrease 1990-2010	-1.41%	-2.54%	-	12.82%	-	-
Decrease 2009-2010	6.72%	4.09%	-	33.55%	-	-

Table 47 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

CH_4 (Gg)	CRF 1.A.1.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
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	0.0231	0.0215	NO	0.0016	NO	NO
2010	0.0211	0.0200	NO	0.0011	NO	NO
Decrease 1988-2010	70.66%	72.16%	-	-	-	-
Decrease 1990-2010	5.24%	4.79%	-	12.88%	-	-
Decrease 2009-2010	8.55%	6.65%	-	33.55%	-	-

Table 48 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	0.0036	0.0035	NO	0.0002	NO	NO
2010	0.0033	0.0032	NO	0.0001	NO	NO
Decrease 1988-2010	77.07%	77.82%	-	-	-	-
Decrease 1990-2010	6.98%	6.76%	-	12.88%	-	-
Decrease 2009-2010	8.84%	7.68%	-	33.55%	-	-

Table 49 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

GHG (Gg)	TJ	CRF 1.A.1.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
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
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	14 353.89	1 006.05	916.34	NO	89.72	NO	NO
2010	13 197.43	938.42	878.80	NO	59.62	NO	NO
Decrease 1988-2010	45.01%	49.12%	52.35%	-	-	-	-
Decrease 1990-2010	2.20%	-1.39%	-2.53%	-	12.82%	-	-
Decrease 2009-2010	8.06%	6.72%	4.10%	-	33.55%	-	-

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).

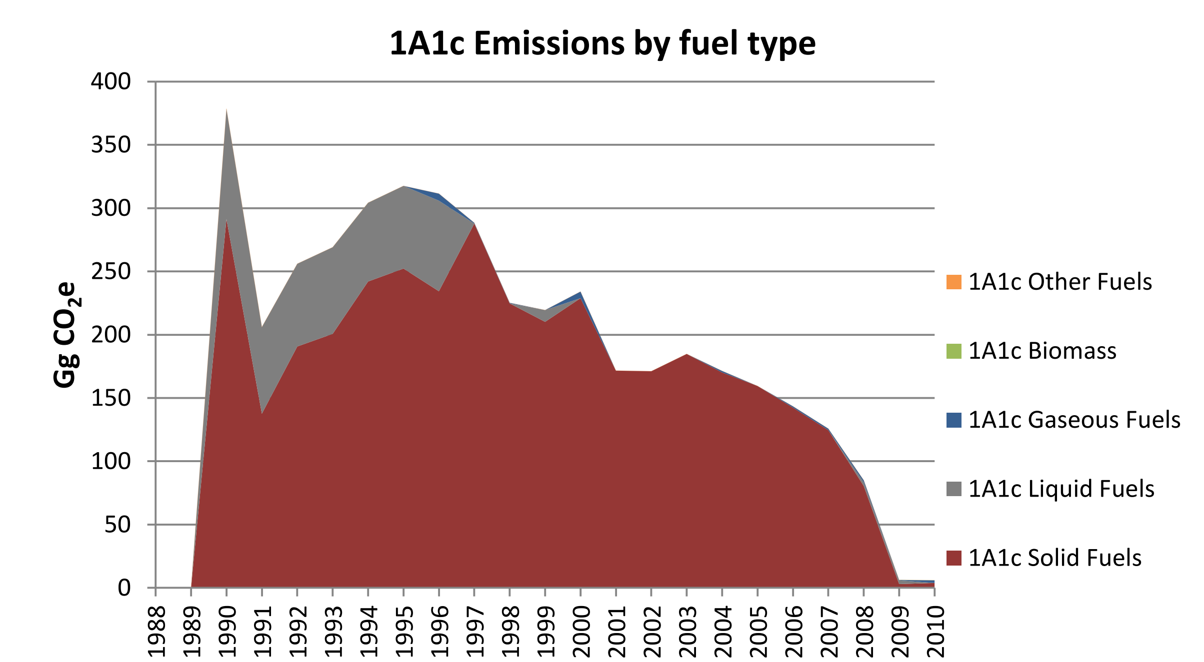


Figure 18 GHG emissions from 1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries

The share in total GHG emissions from sector 1A is 0.01% for the year 2010 and from total GHG emissions 0.01% for the year 2010. The emissions from this subsector has decreased by 3.8% compared to last year. This sector has shrunk drastically due to the closure of the only I&S plant in Bulgaria, which was operating coke ovens. 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 natural gas in transformation sector.

Table 50 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	0.2240	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

CO_2 (Gg)	CRF 1.A.1.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2009	6.22	2.87	3.00	0.35	NO	NO
2010	5.98	NO	3.85	2.13	NO	NO
Decrease 1988-2010	-	-	-	-	-	-
Decrease 1990-2010	98.42%	-	98.68%	-	-	-
Decrease 2009-2010	3.91%	-	-28.23%	-514.33%	-	-

Table 51 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	0.0094	0.0036	0.0058	NO	NO	NO
1991	0.0057	0.0028	0.0029	NO	NO	NO
1992	0.0064	0.0027	0.0037	NO	NO	NO
1993	0.0067	0.0028	0.0039	NO	0.0000	NO
1994	0.0074	0.0025	0.0048	NO	0.0000	NO
1995	0.0077	0.0027	0.0050	NO	NO	NO
1996	0.0076	0.0029	0.0046	0.0001	0.0000	NO
1997	0.0054	NO	0.0053	0.0000	NO	NO
1998	0.0042	NO	0.0042	0.0000	0.0001	NO
1999	0.0044	0.0004	0.0040	NO	NO	NO
2000	0.0045	NO	0.0045	0.0001	NO	NO
2001	0.0034	NO	0.0034	NO	0.0000	NO
2002	0.0034	NO	0.0034	NO	NO	NO
2003	0.0038	NO	0.0038	NO	NO	NO
2004	0.0036	NO	0.0035	0.0000	0.0000	NO
2005	0.0033	NO	0.0033	NO	NO	NO
2006	0.0029	NO	0.0029	0.0000	NO	NO
2007	0.0025	NO	0.0025	0.0000	NO	NO
2008	0.0017	0.0000	0.0016	0.0000	NO	NO
2009	0.0001	0.0000	0.0000	0.0000	NO	NO
2010	0.0001	NO	0.0000	0.0000	NO	NO
Decrease 1988-2010	-	-	-	-	-	-
Decrease 1990-2010	99.16%	-	99.32%	-	-	-
Decrease 2009-2010	6.53%	-	-25.87%	-514.29%	-	-

Table 52 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	0.0017	0.0007	0.0010	NO	NO	NO
1991	0.0008	0.0006	0.0003	NO	NO	NO

N_2O (Gg)	CRF 1.A.1.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1992	0.0013	0.0005	0.0008	NO	NO	NO
1993	0.0013	0.0006	0.0008	NO	0.0000	NO
1994	0.0014	0.0005	0.0009	NO	0.0000	NO
1995	0.0014	0.0005	0.0008	NO	NO	NO
1996	0.0015	0.0006	0.0009	0.0000	0.0000	NO
1997	0.0013	NO	0.0013	0.0000	NO	NO
1998	0.0011	NO	0.0010	0.0000	0.0000	NO
1999	0.0009	0.0001	0.0008	NO	NO	NO
2000	0.0009	NO	0.0008	0.0000	NO	NO
2001	0.0006	NO	0.0006	NO	0.0000	NO
2002	0.0005	NO	0.0005	NO	NO	NO
2003	0.0005	NO	0.0005	NO	NO	NO
2004	0.0004	NO	0.0004	0.0000	0.0000	NO
2005	0.0004	NO	0.0004	NO	NO	NO
2006	0.0004	NO	0.0004	0.0000	NO	NO
2007	0.0004	NO	0.0004	0.0000	NO	NO
2008	0.0002	0.0000	0.0002	0.0000	NO	NO
2009	0.0000	0.0000	0.0000	0.0000	NO	NO
2010	0.0001	NO	0.0001	0.0000	NO	NO
Decrease 1988-2010	-	-	-	-	-	-
Decrease 1990-2010	96.43%	-	94.17%	-	-	-
Decrease 2009-2010	-20.36%	-	-25.87%	-514.29%	-	-

Table 53 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	4 172.80	225.23	NO	224.73	0.49	0.0037	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

GHG (Gg)	TJ	CRF 1.A.1.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2010	78.26	6.00	NO	3.87	2.13	NO	NO
Decrease 1988-2010	-	-	-	-	-	-	-
Decrease 1990-2010	98.88%	98.42%	-	98.67%	-	-	-
Decrease 2009-2010	6.53%	3.85%	-	-28.22%	-514.33%	-	-

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).

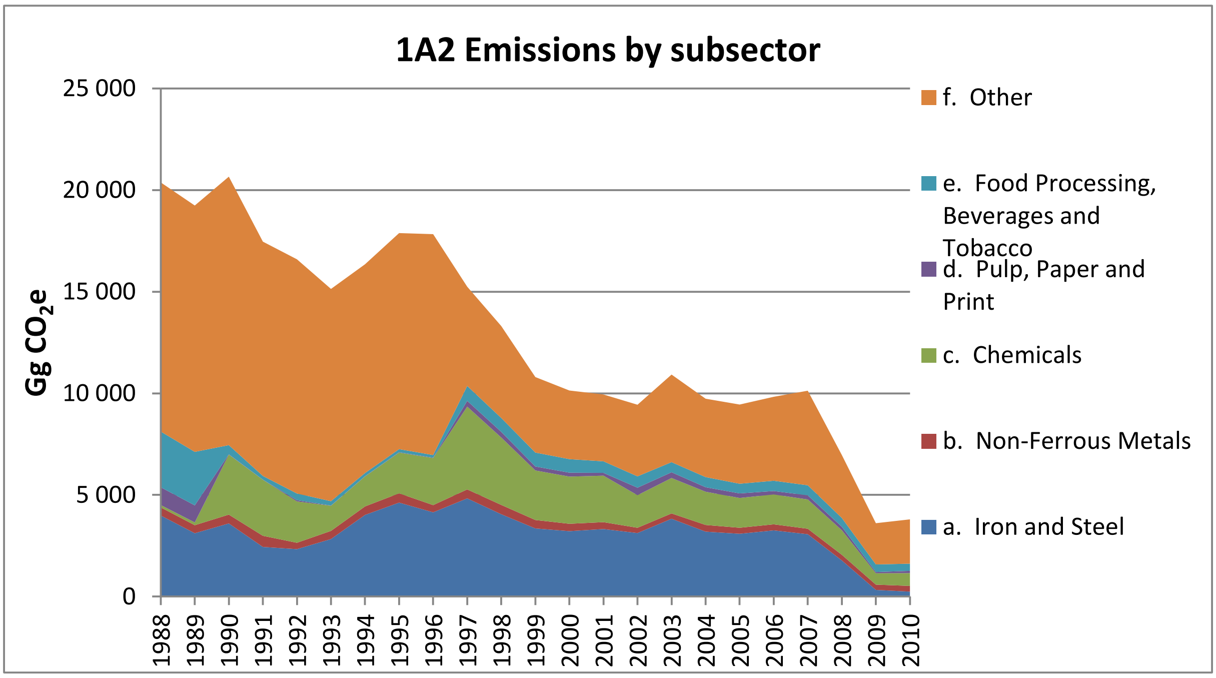


Figure 19 Total GHG emissions from 1.A.2 Manufacturing Industries and Construction by subsector

The general trend in CRF category 1.A.2 is a decrease of 81.4% compared to base year and an increase of 5.2% compared to last year.

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.

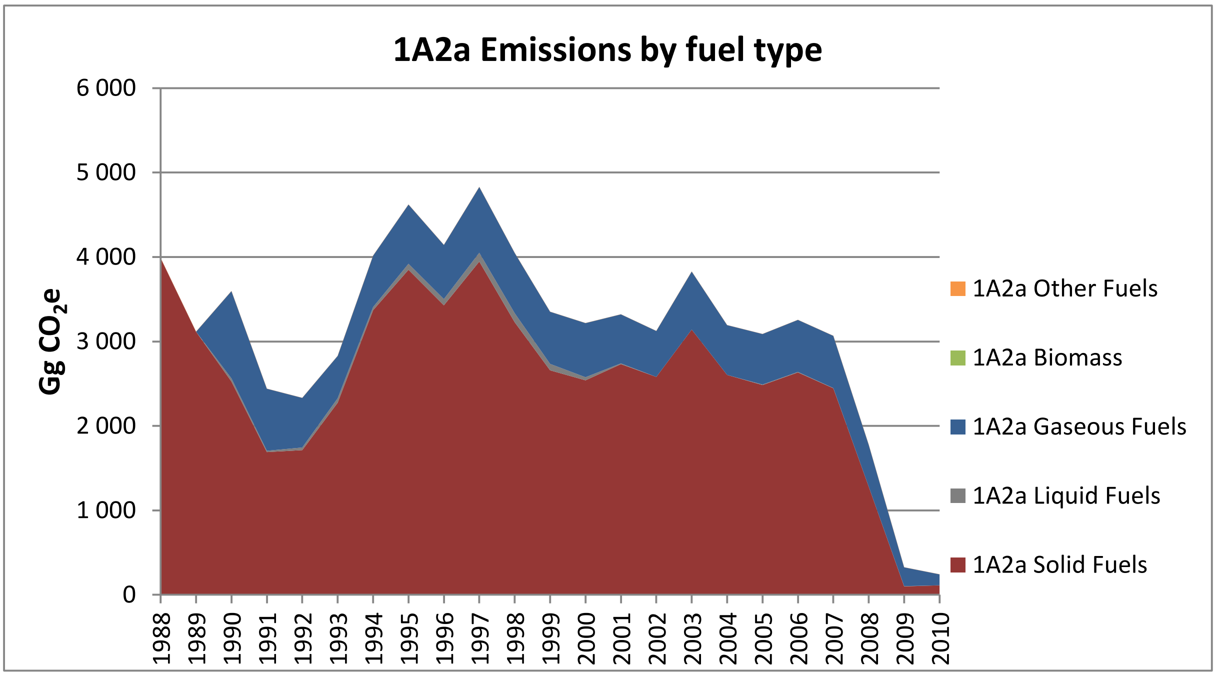


Figure 20 GHG emissions from 1.A.2.a. Iron and Steel

The share of CRF category 1.A.2.a. from the GHG emissions from CRF cateogry 1A is 4.7% for the year 1988 and 0.5% for the year 2010. The drastic decrease in the emissions since 2009 in this subsector is due to the closure of the biggest iron and steel plant in Bulgaria at the end of 2008.

Table 54 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	3 965.17	NO	3 965.17	NO	NO	NO
1989	3 098.37	NO	3 098.37	NO	NO	NO
1990	3 580.86	36.95	2 512.09	1 031.82	NO	NO
1991	2 431.50	15.43	1 682.39	733.67	NO	NO
1992	2 323.20	30.90	1 705.55	586.75	0.1120	NO
1993	2 817.48	52.35	2 264.15	500.98	0.1120	NO
1994	3 999.38	37.03	3 354.39	607.96	0.2240	NO
1995	4 602.65	70.81	3 831.54	700.30	0.3360	NO
1996	4 126.42	73.95	3 412.73	639.75	0.2240	NO
1997	4 810.19	104.17	3 928.20	777.82	0.2240	NO
1998	4 032.70	107.27	3 213.02	712.42	NO	NO
1999	3 339.05	76.43	2 646.56	616.07	0.2240	NO
2000	3 205.56	36.80	2 529.01	639.75	0.3360	NO
2001	3 307.78	9.19	2 718.96	579.63	0.7840	NO
2002	3 111.69	NO	2 568.34	543.35	0.5600	NO
2003	3 812.21	NO	3 126.49	685.72	0.6720	NO
2004	3 180.53	NO	2 591.45	589.07	0.5600	NO
2005	3 075.96	6.17	2 472.75	597.03	0.5600	NO
2006	3 242.76	6.14	2 621.44	615.18	0.3360	NO
2007	3 054.36	3.10	2 433.99	617.27	0.4480	NO
2008	1 769.08	NO	1 273.50	495.58	0.4480	NO
2009	325.00	2.92	98.94	223.14	0.3360	NO
2010	241.88	NO	111.58	130.30	0.2240	NO
Decrease	93.90%	-	97.19%	-	-	-

CO_2 (Gg)	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988-2010						
Decrease 1990-2010	93.25%	-	95.56%	87.37%	-	-
Decrease 2009-2010	25.57%	-	-12.78%	41.60%	33.33%	-

Table 55 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	0.3792	NO	0.3792	NO	NO	NO
1989	0.2974	NO	0.2974	NO	NO	NO
1990	0.2574	0.0010	0.1624	0.0939	NO	NO
1991	0.1164	0.0004	0.0492	0.0668	NO	NO
1992	0.1046	0.0008	0.0503	0.0534	0.0000	NO
1993	0.1105	0.0014	0.0634	0.0456	0.0000	NO
1994	0.1564	0.0010	0.1000	0.0553	0.0001	NO
1995	0.1783	0.0019	0.1125	0.0637	0.0001	NO
1996	0.1589	0.0020	0.0986	0.0582	0.0001	NO
1997	0.1839	0.0027	0.1103	0.0708	0.0001	NO
1998	0.1581	0.0028	0.0904	0.0648	NO	NO
1999	0.1156	0.0020	0.0574	0.0561	0.0001	NO
2000	0.1112	0.0010	0.0519	0.0582	0.0001	NO
2001	0.1323	0.0002	0.0791	0.0528	0.0002	NO
2002	0.1308	NO	0.0812	0.0495	0.0002	NO
2003	0.1577	NO	0.0951	0.0624	0.0002	NO
2004	0.1383	NO	0.0845	0.0536	0.0002	NO
2005	0.1251	0.0002	0.0704	0.0543	0.0002	NO
2006	0.1257	0.0002	0.0694	0.0560	0.0001	NO
2007	0.1310	0.0001	0.0746	0.0562	0.0001	NO
2008	0.0893	NO	0.0440	0.0451	0.0001	NO
2009	0.0300	0.0001	0.0095	0.0203	0.0001	NO
2010	0.0227	NO	0.0108	0.0119	0.0001	NO
Decrease 1988-2010	94.01%	-	97.15%	-	-	-
Decrease 1990-2010	91.17%	-	93.35%	87.38%	-	-
Decrease 2009-2010	24.28%	-	-13.14%	41.61%	33.33%	-

Table 56 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	0.0472	NO	0.0472	NO	NO	NO
1989	0.0358	NO	0.0358	NO	NO	NO
1990	0.0345	0.0003	0.0324	0.0019	NO	NO
1991	0.0230	0.0001	0.0216	0.0013	NO	NO
1992	0.0231	0.0002	0.0218	0.0011	0.0000	NO
1993	0.0307	0.0004	0.0294	0.0009	0.0000	NO
1994	0.0450	0.0003	0.0436	0.0011	0.0000	NO
1995	0.0514	0.0006	0.0495	0.0013	0.0000	NO
1996	0.0461	0.0006	0.0443	0.0012	0.0000	NO

N_2O (Gg)	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1997	0.0531	0.0008	0.0509	0.0014	0.0000	NO
1998	0.0438	0.0008	0.0417	0.0013	NO	NO
1999	0.0358	0.0006	0.0341	0.0011	0.0000	NO
2000	0.0336	0.0003	0.0321	0.0012	0.0000	NO
2001	0.0363	0.0001	0.0352	0.0011	0.0000	NO
2002	0.0341	NO	0.0330	0.0010	0.0000	NO
2003	0.0416	NO	0.0403	0.0012	0.0000	NO
2004	0.0345	NO	0.0334	0.0011	0.0000	NO
2005	0.0331	0.0001	0.0320	0.0011	0.0000	NO
2006	0.0352	0.0001	0.0340	0.0011	0.0000	NO
2007	0.0328	0.0000	0.0317	0.0011	0.0000	NO
2008	0.0176	NO	0.0167	0.0009	0.0000	NO
2009	0.0018	0.0000	0.0013	0.0004	0.0000	NO
2010	0.0018	NO	0.0015	0.0002	0.0000	NO
Decrease 1988-2010	96.28%	-	96.80%	-	-	-
Decrease 1990-2010	94.91%	-	95.33%	87.38%	-	-
Decrease 2009-2010	0.91%	-	-13.14%	41.61%	33.33%	-

Table 57 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	42 820.20	3 987.76	NO	3 987.76	NO	NO	NO
1989	34 644.20	3 115.70	NO	3 115.70	NO	NO	NO
1990	43 869.73	3 596.97	37.07	2 525.53	1 034.37	NO	NO
1991	30 115.06	2 441.08	15.48	1 690.12	735.49	NO	NO
1992	27 967.88	2 332.56	31.00	1 713.35	588.20	0.0019	NO
1993	31 702.47	2 829.33	52.51	2 274.60	502.22	0.0019	NO
1994	44 048.15	4 016.63	37.14	3 370.02	609.46	0.0037	NO
1995	51 053.43	4 622.32	71.02	3 849.26	702.04	0.0056	NO
1996	45 709.79	4 144.04	74.17	3 428.53	641.33	0.0037	NO
1997	54 538.19	4 830.52	104.48	3 946.29	779.74	0.0037	NO
1998	46 247.23	4 049.61	107.59	3 227.84	714.18	NO	NO
1999	38 810.88	3 352.58	76.66	2 658.33	617.59	0.0037	NO
2000	37 835.45	3 218.30	36.91	2 540.05	641.33	0.0056	NO
2001	37 800.54	3 321.83	9.22	2 731.53	581.07	0.0131	NO
2002	35 559.15	3 124.99	NO	2 580.29	544.69	0.0094	NO
2003	43 561.51	3 828.42	NO	3 140.99	687.42	0.0112	NO
2004	36 641.61	3 194.11	NO	2 603.57	590.53	0.0094	NO
2005	35 567.90	3 088.85	6.19	2 484.14	598.51	0.0094	NO
2006	37 171.28	3 256.31	6.16	2 633.45	616.70	0.0056	NO
2007	35 120.60	3 067.29	3.11	2 445.38	618.80	0.0075	NO
2008	21 427.39	1 776.42	NO	1 279.60	496.81	0.0075	NO
2009	5 049.00	326.18	2.93	99.55	223.69	0.0056	NO
2010	3 452.76	242.90	NO	112.28	130.62	0.0037	NO
Decrease 1988-2010	91.94%	93.91%	-	97.18%	-	-	-
Decrease 1990-2010	92.13%	93.25%	-	95.55%	87.37%	-	-

GHG (Gg)	TJ	CRF 1.A.2.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
Decrease 2009-2010	31.62%	25.53%	-	-12.78%	41.60%	33.33%	-

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.

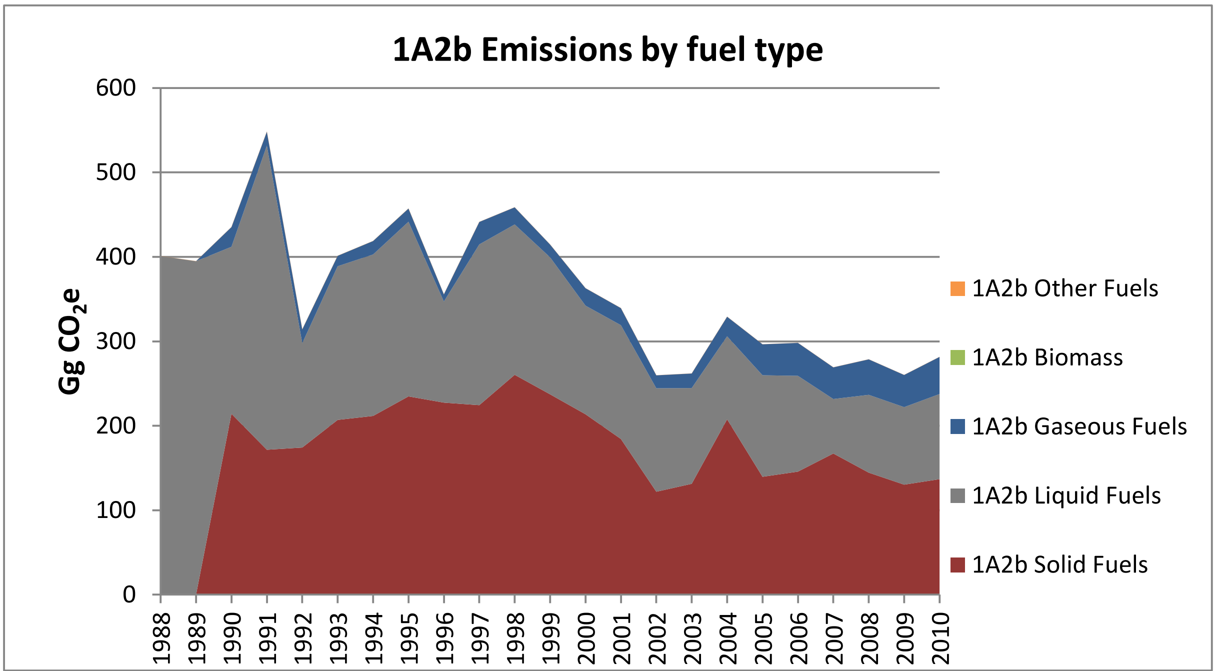


Figure 21 GHG emissions from CRF 1.A.2.b. Non-Ferrous Metals

The share in total GHG emissions from sector 1.A is 0.5% for the year 1988 and 0.6% for the year 2010. The share in total GHG emissions from total GHGs emissions is 0.3% for the year 1988 and 0.4% for the year 2010.

Table 58 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	412.74	161.79	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

CO_2 (Gg)	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
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	277.47	91.91	143.61	41.95	NO	NO
2009	259.09	91.57	129.49	38.04	NO	NO
2010	280.39	100.57	135.95	43.88	0.1120	NO
Decrease 1988-2010	29.87%	74.85%	-	-	-	-
Decrease 1990-2010	35.31%	49.01%	36.15%	-88.45%	-	-
Decrease 2009-2010	-8.22%	-9.83%	-4.99%	-15.35%	-	-

Table 59 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	0.0105	0.0105	NO	NO	NO	NO
1989	0.0104	0.0104	NO	NO	NO	NO
1990	0.0275	0.0053	0.0201	0.0021	NO	NO
1991	0.0272	0.0096	0.0161	0.0015	NO	NO
1992	0.0220	0.0035	0.0164	0.0015	0.0007	NO
1993	0.0262	0.0050	0.0194	0.0011	0.0006	NO
1994	0.0270	0.0052	0.0199	0.0014	0.0004	NO
1995	0.0296	0.0057	0.0221	0.0014	0.0005	NO
1996	0.0255	0.0033	0.0213	0.0008	0.0001	NO
1997	0.0287	0.0051	0.0210	0.0024	0.0001	NO
1998	0.0312	0.0048	0.0244	0.0018	0.0002	NO
1999	0.0282	0.0044	0.0223	0.0014	0.0001	NO
2000	0.0256	0.0037	0.0200	0.0019	0.0001	NO
2001	0.0230	0.0038	0.0173	0.0018	0.0000	NO
2002	0.0163	0.0035	0.0114	0.0014	NO	NO
2003	0.0171	0.0033	0.0123	0.0016	NO	NO
2004	0.0243	0.0026	0.0195	0.0021	0.0002	NO
2005	0.0199	0.0035	0.0131	0.0033	NO	NO
2006	0.0205	0.0033	0.0137	0.0035	NO	NO
2007	0.0208	0.0017	0.0157	0.0034	0.0000	NO
2008	0.0198	0.0024	0.0136	0.0038	NO	NO
2009	0.0184	0.0027	0.0122	0.0035	NO	NO
2010	0.0199	0.0031	0.0128	0.0040	0.0000	NO
Decrease 1988-2010	-89.28%	70.63%	-	-	-	-
Decrease 1990-2010	27.53%	41.14%	36.32%	-88.32%	-	-
Decrease 2009-2010	-8.33%	-14.42%	-4.75%	-15.34%	-	-

Table 60 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

N_2O (Gg)	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	0.0032	0.0032	NO	NO	NO	NO
1989	0.0031	0.0031	NO	NO	NO	NO
1990	0.0044	0.0016	0.0028	0.0000	NO	NO
1991	0.0051	0.0028	0.0023	0.0000	NO	NO
1992	0.0034	0.0010	0.0023	0.0000	0.0001	NO
1993	0.0043	0.0014	0.0027	0.0000	0.0001	NO
1994	0.0044	0.0015	0.0028	0.0000	0.0001	NO
1995	0.0048	0.0016	0.0031	0.0000	0.0001	NO
1996	0.0039	0.0009	0.0030	0.0000	0.0000	NO
1997	0.0045	0.0015	0.0029	0.0000	0.0000	NO
1998	0.0048	0.0014	0.0034	0.0000	0.0000	NO
1999	0.0044	0.0013	0.0031	0.0000	0.0000	NO
2000	0.0038	0.0010	0.0028	0.0000	0.0000	NO
2001	0.0035	0.0010	0.0024	0.0000	0.0000	NO
2002	0.0025	0.0009	0.0016	0.0000	NO	NO
2003	0.0026	0.0009	0.0017	0.0000	NO	NO
2004	0.0036	0.0008	0.0027	0.0000	0.0000	NO
2005	0.0028	0.0009	0.0018	0.0001	NO	NO
2006	0.0028	0.0008	0.0019	0.0001	NO	NO
2007	0.0028	0.0005	0.0022	0.0001	0.0000	NO
2008	0.0027	0.0007	0.0019	0.0001	NO	NO
2009	0.0025	0.0007	0.0017	0.0001	NO	NO
2010	0.0026	0.0007	0.0018	0.0001	0.0000	NO
Decrease 1988-2010	17.28%	76.74%	-	-	-	-
Decrease 1990-2010	41.11%	53.39%	36.32%	-88.32%	-	-
Decrease 2009-2010	-6.03%	-7.71%	-4.75%	-15.34%	-	-

Table 61 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	4 633.67	414.70	162.27	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

GHG (Gg)	TJ	CRF 1.A.2.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
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
2008	3 323.27	278.72	92.19	144.48	42.05	NO	NO
2009	3 130.74	260.24	91.83	130.28	38.13	NO	NO
2010	3 422.10	281.62	100.86	136.78	43.99	0.0019	NO
Decrease 1988-2010	35.03%	29.78%	74.85%	-	-	-	-
Decrease 1990-2010	32.46%	35.31%	49.01%	36.15%	-88.45%	-	-
Decrease 2009-2010	-9.31%	-8.22%	-9.83%	-4.99%	-15.35%	-	-

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.

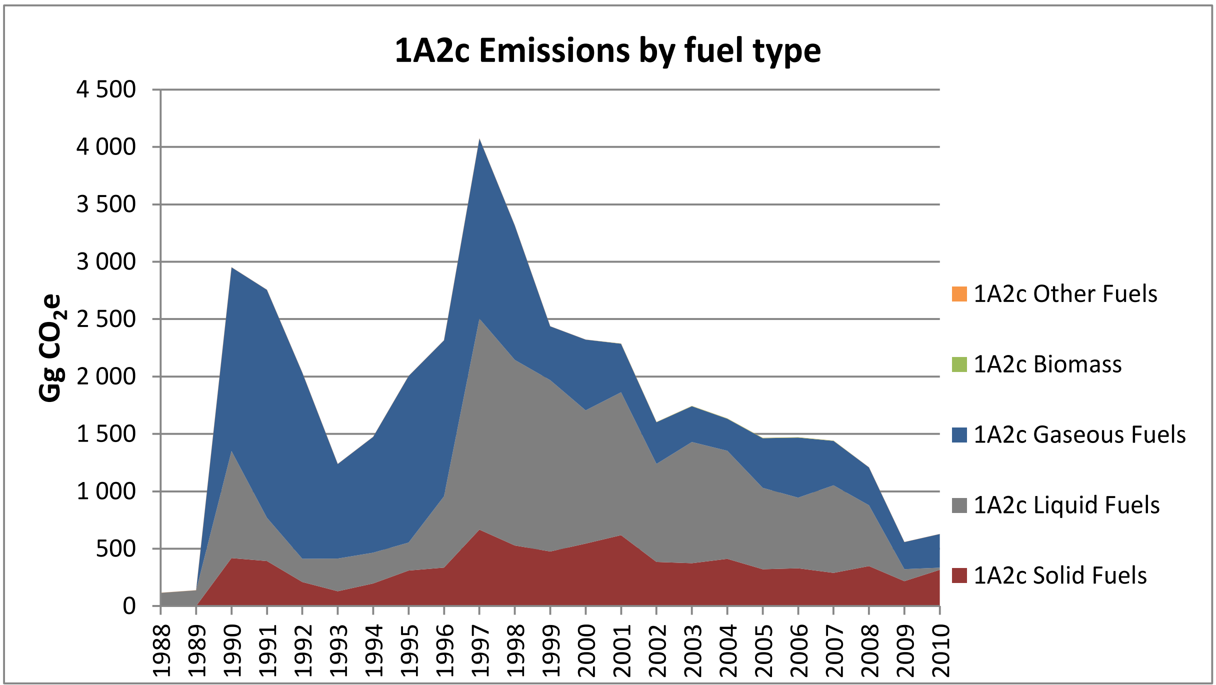


Figure 22 GHG emissions from CRF 1.A.2.c. Chemicals

The share in total GHG emissions from sector 1.A is 0.1% for the year 1988 and 1.4% for the year 2010.

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 62 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	2 943.46	930.31	415.79	1 597.36	NO	NO
1991	2 748.01	376.35	390.18	1 981.48	NO	NO
1992	2 028.08	202.03	208.33	1 617.73	0.5600	NO
1993	1 234.82	284.22	128.44	822.16	0.1120	NO
1994	1 470.62	267.74	195.88	1 007.00	0.2240	NO
1995	1 998.71	243.57	307.62	1 447.52	0.2240	NO
1996	2 308.46	619.34	333.30	1 355.82	0.7840	NO
1997	4 061.12	1 832.51	661.85	1 566.76	6.2720	NO
1998	3 305.89	1 612.53	524.60	1 168.76	2.8000	NO
1999	2 429.81	1 488.91	472.75	468.15	3.2480	NO
2000	2 314.00	1 158.24	541.13	614.63	7.9520	NO
2001	2 277.72	1 241.80	614.04	421.88	104.6080	NO
2002	1 596.48	851.79	382.17	362.51	100.8000	NO
2003	1 735.00	1 053.23	371.17	310.60	155.2320	NO
2004	1 626.33	939.12	409.03	278.17	170.2400	NO
2005	1 457.57	707.55	318.80	431.23	189.3920	NO
2006	1 462.83	613.76	327.33	521.74	194.6560	NO
2007	1 434.55	761.24	287.31	386.00	128.9120	NO
2008	1 204.65	528.97	346.21	329.47	0.1120	NO
2009	555.86	104.55	215.71	235.60	0.1120	NO
2010	625.27	18.66	313.81	292.80	0.2240	NO
Decrease 1988-2010	-441.00%	83.85%	-	-	-	-
Decrease 1990-2010	78.76%	97.99%	24.53%	81.67%	-	-
Decrease 2009-2010	-12.49%	82.15%	-45.47%	-24.28%	-100.00%	-

Table 63 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	0.0032	0.0032	NO	NO	NO	NO
1989	0.0037	0.0037	NO	NO	NO	NO
1990	0.2395	0.0544	0.0397	0.1454	NO	NO
1991	0.2373	0.0200	0.0370	0.1804	NO	NO
1992	0.1763	0.0089	0.0199	0.1473	0.0002	NO
1993	0.1003	0.0132	0.0123	0.0748	0.0000	NO
1994	0.1224	0.0120	0.0187	0.0917	0.0001	NO
1995	0.1703	0.0092	0.0293	0.1318	0.0001	NO
1996	0.1755	0.0202	0.0317	0.1234	0.0002	NO
1997	0.2669	0.0574	0.0652	0.1426	0.0017	NO
1998	0.2149	0.0564	0.0514	0.1064	0.0008	NO
1999	0.1586	0.0687	0.0464	0.0426	0.0009	NO
2000	0.1696	0.0587	0.0528	0.0559	0.0021	NO
2001	0.1878	0.0616	0.0598	0.0384	0.0280	NO
2002	0.1299	0.0333	0.0366	0.0330	0.0270	NO
2003	0.1508	0.0452	0.0358	0.0283	0.0416	NO
2004	0.1539	0.0419	0.0410	0.0253	0.0456	NO

CH_4 (Gg)	CRF 1.A.2.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2005	0.1578	0.0355	0.0322	0.0393	0.0507	NO
2006	0.1664	0.0336	0.0332	0.0475	0.0521	NO
2007	0.1428	0.0437	0.0295	0.0351	0.0345	NO
2008	0.0987	0.0343	0.0344	0.0300	0.0000	NO
2009	0.0503	0.0072	0.0216	0.0214	0.0000	NO
2010	0.0596	0.0007	0.0322	0.0266	0.0001	NO
Decrease 1988-2010	-1789.67%	79.23%	-	-	-	-
Decrease 1990-2010	75.12%	98.80%	18.81%	81.68%	-	-
Decrease 2009-2010	-18.51%	90.85%	-48.85%	-24.27%	-100.00%	-

Table 64 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	0.0009	0.0009	NO	NO	NO	NO
1989	0.0011	0.0011	NO	NO	NO	NO
1990	0.0120	0.0035	0.0056	0.0029	NO	NO
1991	0.0104	0.0017	0.0052	0.0036	NO	NO
1992	0.0069	0.0011	0.0028	0.0029	0.0000	NO
1993	0.0047	0.0015	0.0017	0.0015	0.0000	NO
1994	0.0060	0.0015	0.0026	0.0018	0.0000	NO
1995	0.0083	0.0016	0.0041	0.0026	0.0000	NO
1996	0.0115	0.0046	0.0044	0.0025	0.0000	NO
1997	0.0256	0.0134	0.0091	0.0029	0.0002	NO
1998	0.0206	0.0112	0.0072	0.0021	0.0001	NO
1999	0.0155	0.0080	0.0065	0.0009	0.0001	NO
2000	0.0144	0.0056	0.0074	0.0011	0.0003	NO
2001	0.0190	0.0062	0.0084	0.0008	0.0037	NO
2002	0.0147	0.0054	0.0051	0.0007	0.0036	NO
2003	0.0175	0.0064	0.0050	0.0006	0.0055	NO
2004	0.0178	0.0055	0.0057	0.0005	0.0061	NO
2005	0.0156	0.0036	0.0045	0.0008	0.0068	NO
2006	0.0153	0.0027	0.0047	0.0009	0.0070	NO
2007	0.0125	0.0031	0.0041	0.0007	0.0046	NO
2008	0.0070	0.0016	0.0048	0.0006	0.0000	NO
2009	0.0037	0.0003	0.0030	0.0004	0.0000	NO
2010	0.0052	0.0001	0.0045	0.0005	0.0000	NO
Decrease 1988-2010	-447.51%	86.64%	-	-	-	-
Decrease 1990-2010	56.77%	96.40%	18.81%	81.68%	-	-
Decrease 2009-2010	-39.21%	50.71%	-48.85%	-24.27%	-100.00%	-

Table 65 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

GHG (Gg)	TJ	CRF 1.A.2.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1990	46 524.87	2 952.20	932.54	418.35	1 601.32	NO	NO
1991	45 130.56	2 756.23	377.28	392.56	1 986.38	NO	NO
1992	34 274.09	2 033.93	202.57	209.61	1 621.73	0.0094	NO
1993	20 176.02	1 238.39	284.96	129.23	824.20	0.0019	NO
1994	23 939.76	1 475.03	268.45	197.08	1 009.50	0.0037	NO
1995	32 606.49	2 004.87	244.25	309.51	1 451.11	0.0037	NO
1996	36 398.34	2 315.72	621.19	335.34	1 359.18	0.0131	NO
1997	59 758.11	4 074.67	1 837.88	666.05	1 570.64	0.1047	NO
1998	48 485.39	3 316.79	1 617.18	527.91	1 171.65	0.0468	NO
1999	34 050.90	2 437.94	1 492.84	475.74	469.31	0.0542	NO
2000	32 980.41	2 322.01	1 161.19	544.53	616.15	0.1328	NO
2001	32 199.06	2 287.56	1 245.00	617.89	422.93	1.7466	NO
2002	22 846.60	1 603.78	854.15	384.53	363.41	1.6830	NO
2003	25 545.20	1 743.60	1 056.17	373.47	311.37	2.5918	NO
2004	24 046.26	1 635.08	941.70	411.67	278.86	2.8424	NO
2005	22 939.10	1 465.73	709.40	320.87	432.29	3.1622	NO
2006	23 465.45	1 471.06	615.30	329.47	523.03	3.2501	NO
2007	22 244.07	1 441.43	763.12	289.21	386.95	2.1524	NO
2008	17 273.02	1 208.89	530.19	348.42	330.28	0.0019	NO
2009	8 004.60	558.07	104.78	217.11	236.18	0.0019	NO
2010	8 803.38	628.13	18.71	315.88	293.53	0.0037	NO
Decrease 1988-2010	-458.52%	-441.79%	83.86%	-	-	-	-
Decrease 1990-2010	81.08%	78.72%	97.99%	24.49%	81.67%	-	-
Decrease 2009-2010	-9.98%	-12.55%	82.14%	-45.50%	-24.28%	-100.00%	-

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.

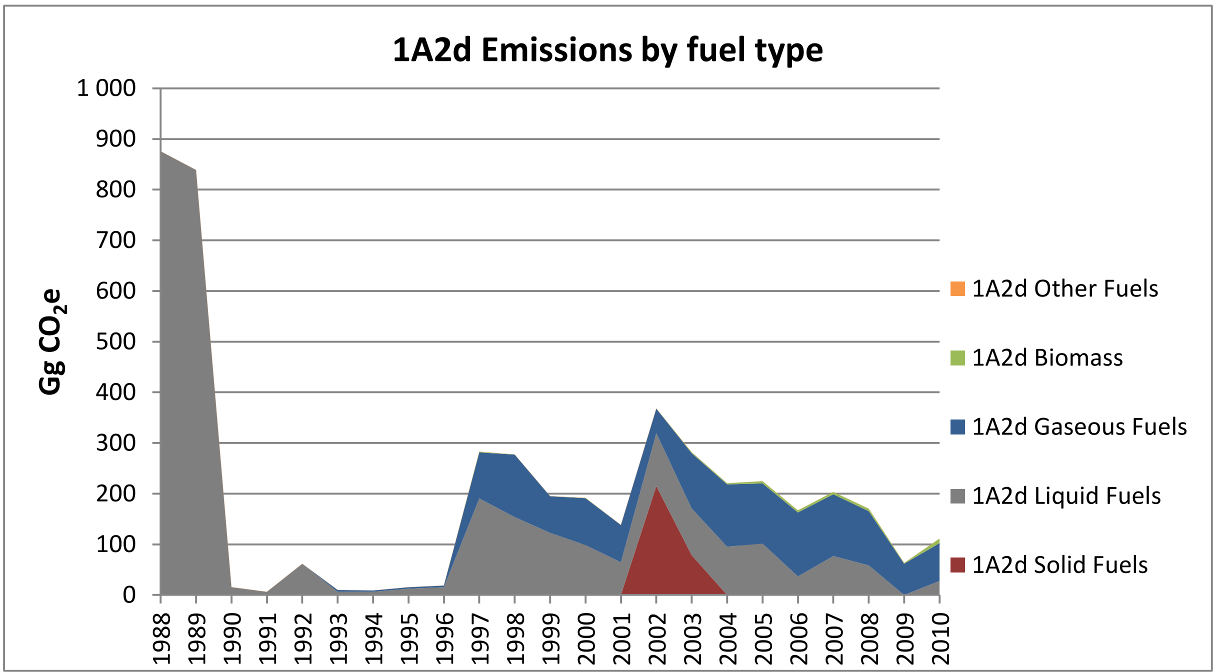


Figure 23 GHG emissions from CRF 1.A.2.d. Pulp, Paper and Print

The share in total GHG emissions from sector 1.A is 1.0% for the last year and the share from total GHGs emissions is 0.2% the year 2010.

Table 66 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
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	194.38	122.26	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	290.4160	NO
2009	61.53	NO	NO	61.53	86.6880	NO
2010	102.02	27.57	NO	74.45	540.8480	NO
Decrease 1988-2010	88.32%	96.84%	-	-	-	-
Decrease 1990-2010	-562.73%	-79.11%	-	-	-	-
Decrease 2009-2010	-65.80%	-	-	-20.99%	-523.90%	-

Table 67 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	0.0228	0.0228	NO	NO	NO	NO
1989	0.0218	0.0218	NO	NO	NO	NO
1990	0.0004	0.0004	NO	NO	NO	NO
1991	0.0002	0.0002	NO	NO	NO	NO
1992	0.0016	0.0016	NO	NO	NO	NO
1993	0.0005	0.0002	NO	0.0003	NO	NO
1994	0.0004	0.0002	NO	0.0002	0.0000	NO
1995	0.0007	0.0003	NO	0.0003	0.0001	NO
1996	0.0007	0.0004	NO	0.0003	0.0000	NO
1997	0.0374	0.0050	NO	0.0082	0.0242	NO
1998	0.0187	0.0040	NO	0.0112	0.0035	NO
1999	0.0118	0.0032	NO	0.0066	0.0020	NO
2000	0.0214	0.0026	NO	0.0084	0.0104	NO

CH_4 (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2001	0.0093	0.0017	NO	0.0067	0.0009	NO
2002	0.0321	0.0027	0.0217	0.0044	0.0033	NO
2003	0.0521	0.0024	0.0079	0.0099	0.0318	NO
2004	0.0492	0.0025	NO	0.0112	0.0356	NO
2005	0.0840	0.0026	NO	0.0108	0.0705	NO
2006	0.0804	0.0010	NO	0.0115	0.0680	NO
2007	0.0856	0.0020	NO	0.0111	0.0726	NO
2008	0.0890	0.0015	NO	0.0097	0.0778	NO
2009	0.0288	NO	NO	0.0056	0.0232	NO
2010	0.1524	0.0007	NO	0.0068	0.1449	NO
Decrease 1988-2010	-568.26%	96.84%	-	-	-	-
Decrease 1990-2010	-37134.24%	-75.95%	-	-	-	-
Decrease 2009-2010	-428.71%	-	-	-20.98%	-523.90%	-

Table 68 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	0.0068	0.0068	NO	NO	NO	NO
1989	0.0066	0.0066	NO	NO	NO	NO
1990	0.0001	0.0001	NO	NO	NO	NO
1991	0.0001	0.0001	NO	NO	NO	NO
1992	0.0005	0.0005	NO	NO	NO	NO
1993	0.0001	0.0001	NO	0.0000	NO	NO
1994	0.0001	0.0001	NO	0.0000	0.0000	NO
1995	0.0001	0.0001	NO	0.0000	0.0000	NO
1996	0.0001	0.0001	NO	0.0000	0.0000	NO
1997	0.0049	0.0015	NO	0.0002	0.0032	NO
1998	0.0019	0.0012	NO	0.0002	0.0005	NO
1999	0.0014	0.0010	NO	0.0001	0.0003	NO
2000	0.0023	0.0008	NO	0.0002	0.0014	NO
2001	0.0008	0.0005	NO	0.0001	0.0001	NO
2002	0.0044	0.0008	0.0030	0.0001	0.0004	NO
2003	0.0063	0.0007	0.0011	0.0002	0.0042	NO
2004	0.0057	0.0007	NO	0.0002	0.0047	NO
2005	0.0104	0.0008	NO	0.0002	0.0094	NO
2006	0.0096	0.0003	NO	0.0002	0.0091	NO
2007	0.0105	0.0006	NO	0.0002	0.0097	NO
2008	0.0110	0.0005	NO	0.0002	0.0104	NO
2009	0.0032	NO	NO	0.0001	0.0031	NO
2010	0.0197	0.0002	NO	0.0001	0.0193	NO
Decrease 1988-2010	-187.54%	96.84%	-	-	-	-
Decrease 1990-2010	-15921.06%	-75.95%	-	-	-	-
Decrease 2009-2010	-513.08%	-	-	-20.98%	-523.90%	-

Table 69 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
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	195.05	122.62	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	4 663.00	220.53	95.26	NO	123.05	2.2178	NO
2005	5 829.70	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	5 297.90	170.27	58.38	NO	107.04	4.8489	NO
2009	1 893.60	63.13	NO	NO	61.69	1.4474	NO
2010	6 543.50	111.32	27.66	NO	74.63	9.0302	NO
Decrease 1988-2010	42.60%	87.29%	96.84%	-	-	-	-
Decrease 1990-2010	-3098.19%	-620.93%	-79.10%	-	-	-	-
Decrease 2009-2010	-245.56%	-76.32%	-	-	-20.99%	-523.90%	-

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.

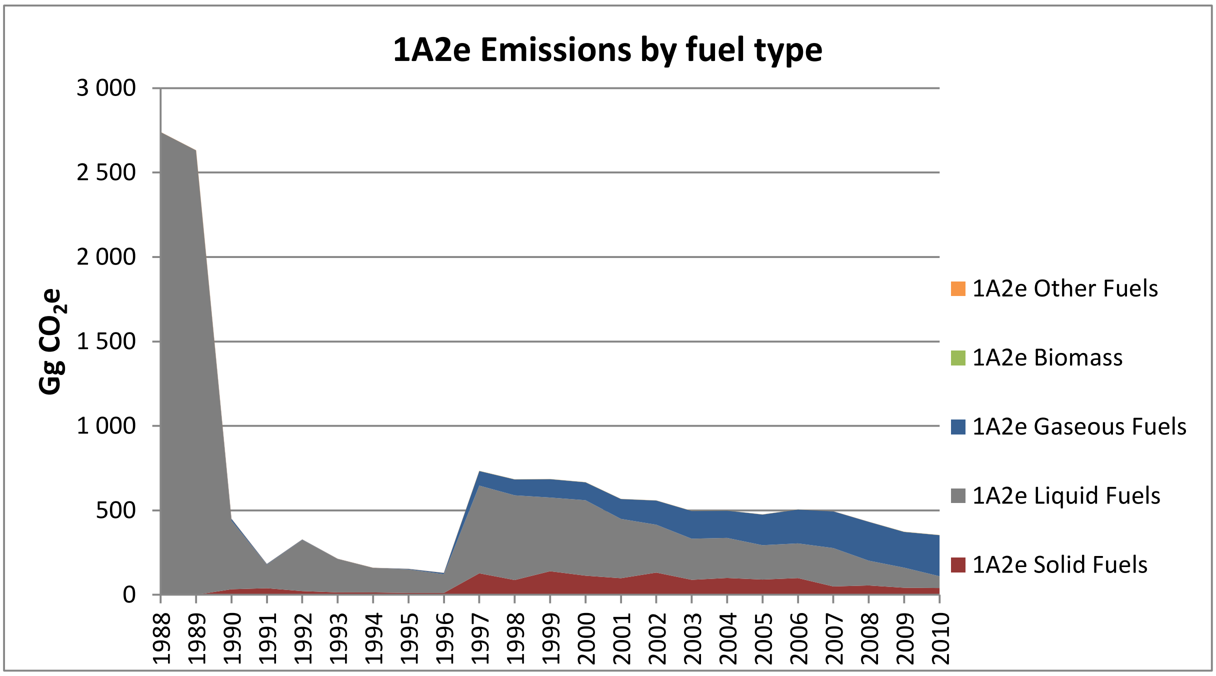


Figure 24 GHG emissions from 1.A.2.e. Food Processing, Beverages and Tobacco

The share in total GHG emissions from sector 1.A is 0.8% for the last year and the share from total GHGs emissions is 0.6% the year 2010.

Table 70 CO_2 emissions in CRF 1.A.2.e. Food Processing, Beverages and Tobacco

CO_2 (Gg)	CRF 1.A.2.d.	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	682.44	435.14	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
Decrease 1988-2010	87.11%	97.44%	-	-	-	-

CO_2 (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
Decrease 1990-2010	21.57%	82.75%	-21.46%	-2034.03%	-	-
Decrease 2009-2010	5.15%	41.14%	4.24%	-14.91%	26.98%	-

Table 71 CH_4 emissions in 1.A.2.e. Food Processing, Beverages and Tobacco

CH_4 (Gg)	CRF 1.A.2.d.	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
Decrease 1988-2010	47.83%	96.59%	-	-	-	-
Decrease 1990-2010	-148.48%	77.49%	-32.48%	-2032.61%	-	-
Decrease 2009-2010	4.87%	36.78%	2.00%	-14.90%	26.98%	-

Table 72 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	0.0216	0.0216	NO	NO	NO	NO
1989	0.0208	0.0208	NO	NO	NO	NO
1990	0.0037	0.0033	0.0004	0.0000	NO	NO
1991	0.0017	0.0011	0.0005	0.0000	NO	NO
1992	0.0028	0.0024	0.0003	0.0000	0.0001	NO
1993	0.0018	0.0016	0.0002	0.0000	0.0000	NO
1994	0.0014	0.0012	0.0002	0.0000	0.0000	NO
1995	0.0013	0.0011	0.0001	0.0000	0.0001	NO
1996	0.0012	0.0009	0.0002	0.0000	0.0001	NO
1997	0.0076	0.0040	0.0018	0.0002	0.0016	NO
1998	0.0064	0.0039	0.0012	0.0002	0.0011	NO

N_2O (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1999	0.0065	0.0034	0.0020	0.0002	0.0010	NO
2000	0.0066	0.0035	0.0016	0.0002	0.0013	NO
2001	0.0052	0.0028	0.0014	0.0002	0.0008	NO
2002	0.0052	0.0022	0.0018	0.0003	0.0009	NO
2003	0.0043	0.0019	0.0012	0.0003	0.0008	NO
2004	0.0045	0.0018	0.0014	0.0003	0.0009	NO
2005	0.0039	0.0016	0.0013	0.0003	0.0007	NO
2006	0.0043	0.0016	0.0014	0.0004	0.0009	NO
2007	0.0031	0.0018	0.0007	0.0004	0.0002	NO
2008	0.0026	0.0011	0.0008	0.0004	0.0003	NO
2009	0.0034	0.0008	0.0006	0.0004	0.0016	NO
2010	0.0027	0.0005	0.0006	0.0004	0.0012	NO
Decrease 1988-2010	87.56%	97.78%	-	-	-	-
Decrease 1990-2010	28.12%	85.35%	-32.48%	-2032.61%	-	-
Decrease 2009-2010	21.93%	43.17%	2.00%	-14.90%	26.98%	-

Table 73 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	9 379.56	685.36	436.45	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
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
Decrease 1988-2010	83.11%	87.09%	97.44%	-	-	-	-
Decrease 1990-2010	-1.63%	21.46%	82.76%	-21.53%	-2034.03%	-	-
Decrease 2009-2010	3.05%	5.19%	41.14%	4.22%	-14.91%	26.98%	-

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 subsectors from 1.A.2 subsector.

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)

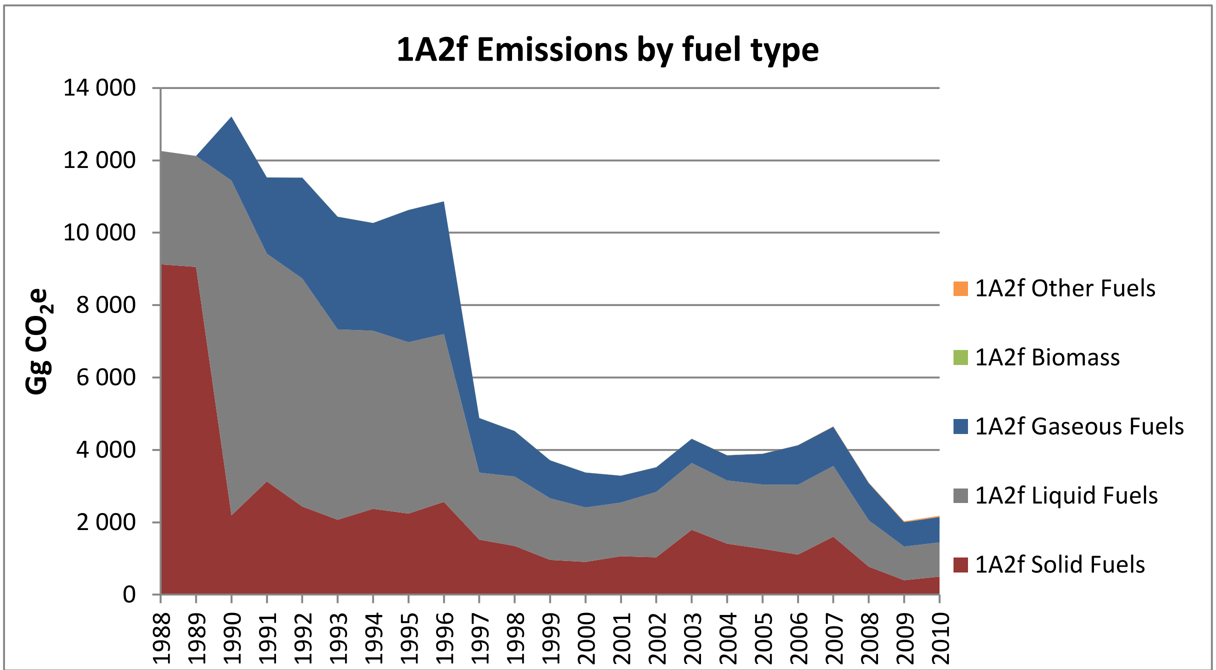


Figure 25 GHG emissions from 1.A.2.f. Other industries

The share in total GHG emissions from sector 1.A is 4.8% for the last year and the share from total GHGs emissions is 3.5% the year 2010.

Up to 1997 there was a significantly higher consumption in this sector, since the complete amount of fuels used by autoproducers CHP and heat plants was reported. The national statistics changed their methodologies after 1997 report in autoproducers all electricity produced and heat sold. Effectively, after the consumption was properly reallocated to the other subcategories from 1.A.2.

Table 74 CO_2 emissions in 1.A.2.f. Other industries

CO_2 (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988	12 192.34	3 122.90	9 069.45	NO	NO	NO

CO_2 (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
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	168.0000	NO
1992	11 482.56	6 281.37	2 419.75	2 781.44	144.4800	NO
1993	10 407.60	5 244.81	2 056.65	3 106.13	136.3040	NO
1994	10 233.06	4 904.60	2 357.59	2 970.88	144.9280	NO
1995	10 592.78	4 721.59	2 226.50	3 644.68	136.5280	NO
1996	10 828.20	4 623.00	2 546.88	3 658.33	125.1040	NO
1997	4 861.80	1 844.74	1 510.81	1 506.25	178.5280	NO
1998	4 503.51	1 912.64	1 337.23	1 253.64	181.5520	NO
1999	3 698.47	1 697.15	954.42	1 046.90	183.6800	NO
2000	3 362.35	1 499.04	899.76	963.55	128.8000	NO
2001	3 274.08	1 476.99	1 055.66	741.43	143.8080	NO
2002	3 507.65	1 800.72	1 026.41	680.53	179.0880	NO
2003	4 288.09	1 840.97	1 780.38	666.74	200.1440	NO
2004	3 837.84	1 741.26	1 399.34	693.38	205.3403	3.8533
2005	3 879.63	1 771.79	1 257.70	847.03	146.2755	3.1109
2006	4 113.51	1 922.93	1 100.06	1 088.82	179.8774	1.7006
2007	4 631.53	1 948.66	1 591.90	1 082.48	160.7257	8.4888
2008	3 083.79	1 279.24	767.64	1 025.90	169.0876	11.0107
2009	2 017.43	927.22	396.18	672.62	243.7678	21.4117
2010	2 168.89	943.14	495.32	700.87	258.3982	29.5501
Decrease 1988-2010	82.21%	69.80%	94.54%	-	-	-
Decrease 1990-2010	83.53%	89.77%	77.26%	60.27%	-	-
Decrease 2009-2010	-7.51%	-1.72%	-25.03%	-4.20%	-6.00%	-38.01%

Table 75 CH_4 emissions in 1.A.2.f. Other industries

CH_4 (Gg)	CRF 1.A.2.d.	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
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	0.3852	0.0503	0.1500	0.1371	0.0478	NO
1998	0.3497	0.0522	0.1348	0.1141	0.0486	NO
1999	0.2889	0.0474	0.0970	0.0953	0.0492	NO
2000	0.2531	0.0387	0.0921	0.0877	0.0345	NO
2001	0.2524	0.0387	0.1078	0.0675	0.0385	NO
2002	0.2594	0.0451	0.1044	0.0619	0.0480	NO
2003	0.3421	0.0465	0.1812	0.0607	0.0536	NO
2004	0.3091	0.0453	0.1450	0.0631	0.0538	0.0020
2005	0.2922	0.0452	0.1301	0.0771	0.0382	0.0016
2006	0.3099	0.0480	0.1141	0.0991	0.0480	0.0006

CH_4 (Gg)	CRF 1.A.2.d.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2007	0.3545	0.0488	0.1625	0.0986	0.0402	0.0044
2008	0.2488	0.0319	0.0778	0.0934	0.0377	0.0080
2009	0.1910	0.0228	0.0405	0.0612	0.0514	0.0151
2010	0.2064	0.0220	0.0518	0.0638	0.0455	0.0234
Decrease 1988-2010	79.14%	73.59%	94.29%	-	-	-
Decrease 1990-2010	67.21%	91.29%	76.03%	60.30%	-	-
Decrease 2009-2010	-8.10%	3.49%	-27.97%	-4.19%	11.60%	-55.45%

Table 76 N_2O emissions in 1.A.2.f. Other industries

N_2O (Gg)	CRF 1.A.2.d.	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	0.0438	0.0143	0.0204	0.0027	0.0064	NO
1998	0.0420	0.0149	0.0184	0.0023	0.0065	NO
1999	0.0348	0.0131	0.0132	0.0019	0.0066	NO
2000	0.0299	0.0112	0.0124	0.0018	0.0046	NO
2001	0.0322	0.0110	0.0147	0.0013	0.0051	NO
2002	0.0349	0.0129	0.0143	0.0012	0.0064	NO
2003	0.0468	0.0134	0.0251	0.0012	0.0071	NO
2004	0.0412	0.0125	0.0200	0.0013	0.0072	0.0003
2005	0.0371	0.0123	0.0180	0.0015	0.0051	0.0002
2006	0.0374	0.0132	0.0158	0.0020	0.0064	0.0001
2007	0.0437	0.0132	0.0226	0.0020	0.0054	0.0006
2008	0.0272	0.0084	0.0108	0.0019	0.0050	0.0011
2009	0.0221	0.0063	0.0057	0.0012	0.0069	0.0020
2010	0.0239	0.0062	0.0072	0.0013	0.0061	0.0031
Decrease 1988-2010	84.25%	75.13%	94.29%	-	-	-
Decrease 1990-2010	76.87%	91.33%	74.51%	60.30%	-	-
Decrease 2009-2010	-8.33%	1.75%	-27.97%	-4.19%	11.64%	-55.45%

Table 77 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

GHG (Gg)	TJ	CRF 1.A.2.f.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
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	68 849.22	4 883.47	1 850.23	1 520.27	1 509.98	2.9808	NO
1998	63 636.58	4 523.88	1 918.36	1 345.75	1 256.74	3.0313	NO
1999	53 225.75	3 715.33	1 702.22	960.56	1 049.49	3.0668	NO
2000	47 288.28	3 376.94	1 503.33	905.53	965.93	2.1505	NO
2001	44 550.79	3 289.37	1 481.21	1 062.49	743.27	2.4011	NO
2002	46 580.57	3 523.92	1 805.67	1 033.04	682.21	2.9901	NO
2003	54 901.47	4 309.79	1 846.09	1 791.97	668.39	3.3417	NO
2004	50 715.07	3 857.09	1 746.08	1 408.58	695.10	3.3510	3.9771
2005	51 240.25	3 897.28	1 776.56	1 266.00	849.13	2.3824	3.2091
2006	55 712.56	4 131.62	1 928.02	1 107.35	1 091.51	2.9920	1.7395
2007	60 412.14	4 652.54	1 953.78	1 602.32	1 085.16	2.5077	8.7649
2008	42 717.66	3 097.45	1 282.52	772.63	1 028.44	2.3525	11.5072
2009	29 361.48	2 028.29	929.67	398.78	674.29	3.2054	22.3502
2010	30 813.90	2 180.64	945.54	498.66	702.60	2.8328	31.0091
Decrease 1988-2010	76.72%	82.21%	69.81%	94.54%	-	-	-
Decrease 1990-2010	82.62%	83.49%	89.78%	77.25%	60.27%	-	-
Decrease 2009-2010	-4.95%	-7.51%	-1.71%	-25.04%	-4.20%	11.63%	-38.74%

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

CC/ERT/ARR/2010/37, §169

During the review week, Bulgaria explained that waste is used as an alternative fuel in cement production and confirmed that emissions arising from this activity are not included in the inventory. The ERT concluded that this is a potential underestimate of emissions and that emissions from this activity relate to energy recovery and, as such, are to be reported in the energy sector in line with the IPCC good practice guidance. The ERT recommends that Bulgaria provide relevant information in its next annual submission on incineration facilities and the composition of incinerated waste streams, including references to the corresponding section in the energy sector explaining the emission allocation.

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 plant 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 calculations.

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.

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, 2006 and 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 78 Transport sector categories

Number	Category	CO_2	CH_4	N_2O	Method
CRF 1.A.3.a	Civil aviation (domestic)	✓	✓	✓	TIER 1
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/2010/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 – 2010 are shown in Table 79.

Table 79 Fuels for CRF 1.A.3 Transport in TJ 1988 - 2010

CRF 1A3 Transport	a. Civil Aviation	b. Road Transportation	c. Railways	d. Navigation	e. Other Transport
AD	TJ	TJ	TJ	TJ	TJ
1988	1372	96173	NA,NO	NA,NO	NO
1989	1376	102096	NA,NO	NA,NO	NO
1990	1899	81973	4357	761	1777
1991	1514	47124	3574	42	NO
1992	1522	48787	4600	85	NO
1993	1398	55426	5129	129	40
1994	1406	51629	3805	171	40
1995	1282	56070	3146	171	40
1996	1158	55898	2170	254	40
1997	1076	56439	1819	85	472
1998	904	70062	1734	129	3719
1999	2239	72408	1607	132	3296
2000	860	68599	1607	NA,NO	6887
2001	1893	71090	1396	NA,NO	5777
2002	1119	75330	1311	NA,NO	5821
2003	990	85180	1184	NA,NO	3665
2004	820	91021	1200	NA,NO	5631
2005	561	98606	1227	NA,NO	9042
2006	1035	106223	1214	NA,NO	9538
2007	1720	100528	1058	NA,NO	10974
2008	560	106490	1354	NA,NO	10808
2009	990	106336	846	NA,NO	5846
2010	646	104286	846	NA,NO	5896

The fuel consumption in 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.

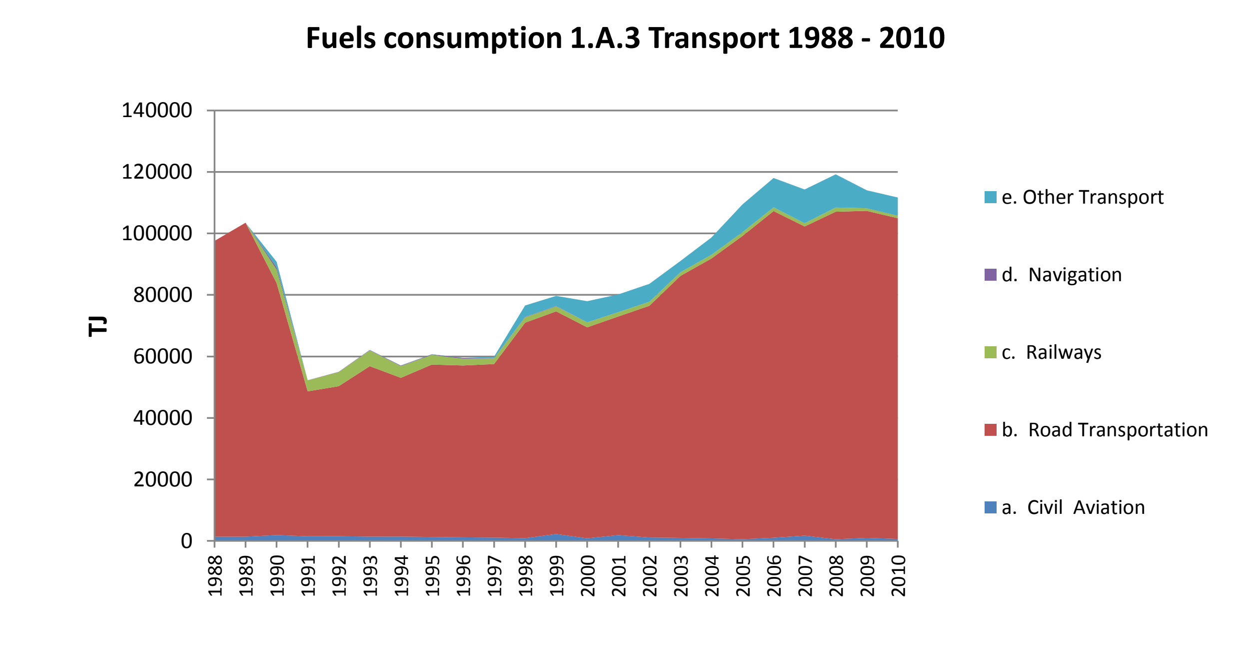


Figure 26 Fuels for CRF 1.A.3 transport for 1988 - 2010

In period 1988 to 1991 the fuel consumption decreased by 51%. But since 1991 the fuel consumption increased by 114% mainly due to road transport. The share of the transport categories is for the period of the inventory is the following:

Number	Category	Share of fuel consumption (1988-2010)
CRF 1.A.3.a	Civil aviation (domestic)	1,4 %
CRF 1.A.3.b	Road transport	91,6%
CRF 1.A.3.c	Railways	2,3%
CRF 1.A.3.d	Navigation	0,1%
CRF 1.A.3.e	Other Transport	4,5%

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

The consumption of jet kerosene in domestic aviation decrease with 46% from 1990 to 1998 due to the change in the political situation and national crises in 1996 – 1997. Afterwards the trend fluctuates from year to year, as for the period of 2007 – 2010 there is a decrease of 62,5% in emissions, related to the economic instability of the period and the fuel consumption patterns.

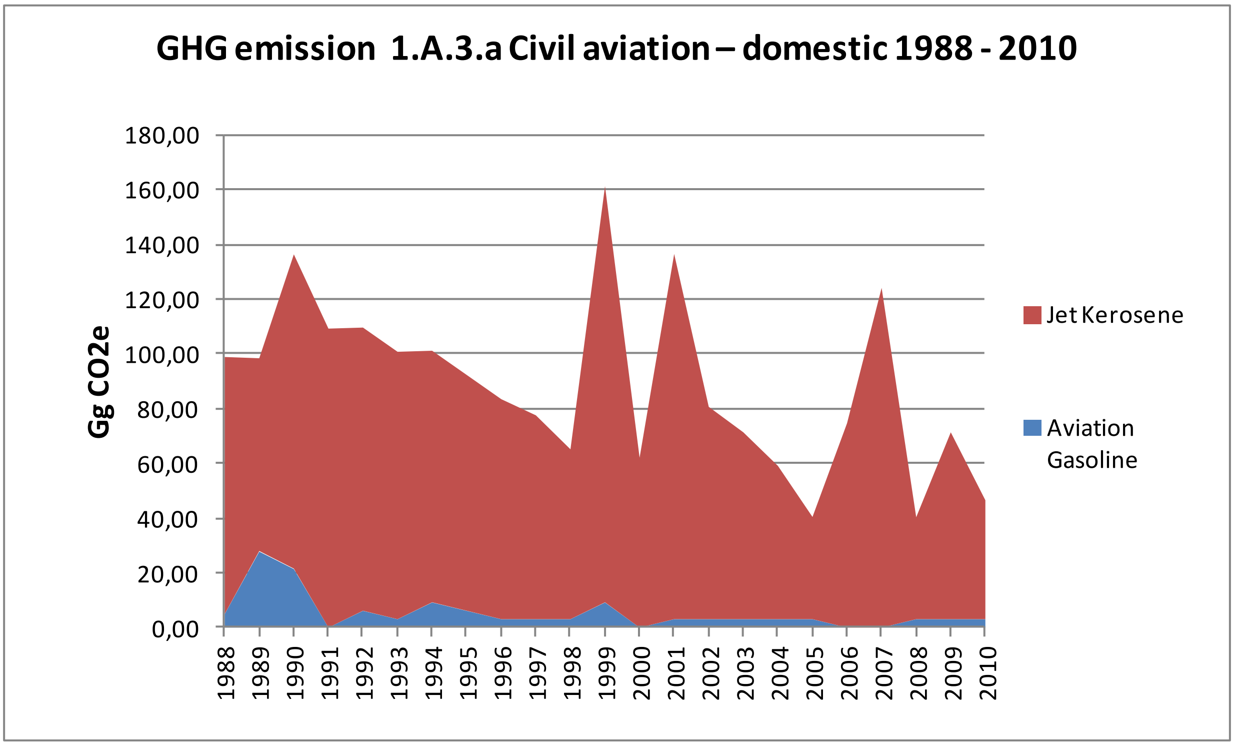


Figure 27 GHG emission in CRF 1.A.3.a Civil aviation – domestic (1988 - 2010)

3.3.12.2.2.1 Methodological issues

3.3.12.2.2.1.1 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. Therefore, greenhouse gas emissions from domestic aviation are calculated according to tier 1 and following the IPCC 1996, 2006 Guidelines.

Emissions are calculated according to the following equation (IPCC GPG 2000, page 2.57, equation 2.7)

Emissions = Fuel Consumption • Emission Factor

3.3.12.2.2.1.2 Activity data

Fuel consumption is obtained from Energy balance and converted into energy units using the CS NCV. Activity data and relevant NCV are listed in Table 80 and Table 81.

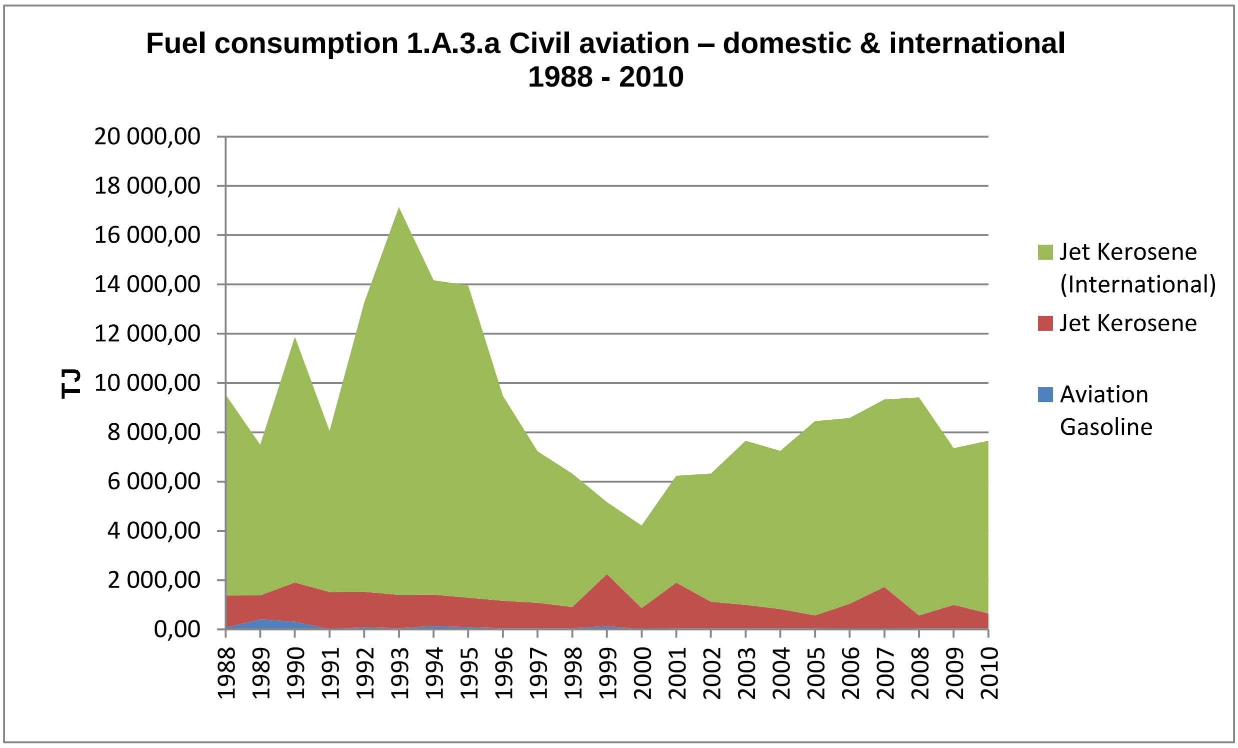


Figure 3 Fuel consumption in CRF 1.A.3.a Civil aviation – domestic & international 1988 - 2010

3.3.12.2.2.1.3 Emission factors

The 2006 IPCC Guidelines default GHG EFs for Domestic Aviation and Kerosene - Type Jet Fuel - have been applied (Table 3.6.4 for Tier 1 (2006 IPCC Guidelines, Chapter 3.6.1.2 CHOICE OF EMISSION FACTORS). Carbon dioxide emission factors are based on the fuel type and carbon content.

Table 80 Activity data for Aviation gasoline, emissions and emission factors for IPCC Sub-category 1A3a – Domestic Aviation: 1988-2010

	Aviation Gasoline				EF CO_2	CO_2 emission	EF N_2O	N_2O emission	EF CH_4	CH_4 emission
Year	Gg	t	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	1.61	1,613.64	71.00	44.00	69.3000	4.9203	0.0020	0.0001	0.0005	0.00004
1989	9.09	9,090.91	400.00	44.00	69.3000	27.7200	0.0020	0.0008	0.0005	0.00020
1990	7.00	7,000.00	308.00	44.00	69.3000	21.3444	0.0020	0.0006	0.0005	0.00015
1991	0.00	0.00	NO	44.00	69.3000	NO	0.0020	NO	0.0005	NO
1992	2.00	2,000.00	88.00	44.00	69.3000	6.0984	0.0020	0.0002	0.0005	0.00004
1993	1.00	1,000.00	44.00	44.00	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002
1994	3.00	3,000.00	132.00	44.00	69.3000	9.1476	0.0020	0.0003	0.0005	0.00007
1995	2.00	2,000.00	88.00	44.00	69.3000	6.0984	0.0020	0.0002	0.0005	0.00004
1996	1.00	1,000.00	44.00	44.00	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002
1997	1.00	1,000.00	44.00	44.00	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002
1998	1.00	1,000.00	44.00	44.00	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002
1999	3.00	3,000.00	132.00	44.00	69.3000	9.1476	0.0020	0.0003	0.0005	0.00007
2000	0.00	0.00	NO	44.00	69.3000	NO	0.0020	NO	0.0005	NO
2001	1.00	1,000.00	44.00	44.00	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002
2002	1.00	1,000.00	44.00	44.00	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002
2003	1.00	1,000.00	44.00	44.00	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002
2004	1.00	1,000.00	43.96	43.96	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002
2005	1.00	1,000.00	43.96	43.96	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002
2006	0.00	0.00	NO	44.00	69.3000	NO	0.0020	NO	0.0005	NO
2007	0.00	0.00	NO	44.00	69.3000	NO	0.0020	NO	0.0005	NO
2008	1.00	1,000.00	43.96	43.96	69.3000	3.0465	0.0020	0.0001	0.0005	0,00002
2009	1.00	1,000.00	43.96	43.96	69.3000	3.0465	0.0020	0.0001	0.0005	0,00002
2010	1.00	1,000.00	44.00	44.00	69.3000	3.0492	0.0020	0.0001	0.0005	0.00002

Table 81 Activity data for Kerosene - Type Jet Fuel - emissions and emission factors for IPCC Sub-category 1A3a – Domestic Aviation: 1988-2010

	Kerosene - Type Jet Fuel				EF CO_2	CO_2 emission	EF N_2O	N_2O emission	EF CH_4	CH_4 emission
Year	Gg	t	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	30.26	30,260.22	1,301.19	43.00	71.500	93.035	0.0020	0.0026	0.0005	0.0007
1989	22.70	22,695.17	975.89	43.00	71.500	69.776	0.0020	0.0020	0.0005	0.0005
1990	37.00	37,000.00	1,591.00	43.00	71.500	113.757	0.0020	0.0032	0.0005	0.0008
1991	35.20	35,201.70	1,513.67	43.00	71.500	108.228	0.0020	0.0030	0.0005	0.0008
1992	33.34	33,341.45	1,433.68	43.00	71.500	102.508	0.0020	0.0029	0.0005	0.0007
1993	31.48	31,481.20	1,353.69	43.00	71.500	96.789	0.0020	0.0027	0.0005	0.0007
1994	29.62	29,620.94	1,273.70	43.00	71.500	91.070	0.0020	0.0025	0.0005	0.0006
1995	27.76	27,760.69	1,193.71	43.00	71.500	85.350	0.0020	0.0024	0.0005	0.0006
1996	25.90	25,900.44	1,113.72	43.00	71.500	79.631	0.0020	0.0022	0.0005	0.0006
1997	24.00	24,000.00	1,032.00	43.00	71.500	73.788	0.0020	0.0021	0.0005	0.0005
1998	20.00	20,000.00	860.00	43.00	71.500	61.490	0.0020	0.0017	0.0005	0.0004

	Kerosene - Type Jet Fuel				EF CO_2	CO_2 emission	EF N_2O	N_2O emission	EF CH_4	CH_4 emission
Year	Gg	t	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1999	49.00	49,000.00	2,107.00	43.00	71.500	150.651	0.0020	0.0042	0.0005	0.0011
2000	20.00	20,000.00	860.00	43.00	71.500	61.490	0.0020	0.0017	0.0005	0.0004
2001	43.00	43,000.00	1,849.00	43.00	71.500	132.204	0.0020	0.0037	0.0005	0.0009
2002	25.00	25,000.00	1,075.00	43.00	71.500	76.863	0.0020	0.0022	0.0005	0.0005
2003	22.00	22,000.00	946.00	43.00	71.500	67.639	0.0020	0.0019	0.0005	0.0005
2004	18.00	18,000.00	776.16	43.12	71.500	55.495	0.0020	0.0016	0.0005	0.0004
2005	12.00	12,000.00	517.44	43.12	71.500	36.997	0.0020	0.0010	0.0005	0.0003
2006	24.00	24,000.00	1,034.88	43.12	71.500	73.994	0.0020	0.0021	0.0005	0.0005
2007	40.00	40,000.00	1,720.00	43.00	71.500	122.980	0.0020	0.0034	0.0005	0.0009
2008	12.00	12,000.00	516.00	43.00	71.500	36.894	0.0020	0.0010	0.0005	0.0003
2009	22.00	22,000.00	946.00	43.00	71.500	67.64	0.0020	0.002	0.0005	0.0005
2010	14.00	14,000.00	602.00	43.00	71.500	43,04	0.0020	0.001	0.0005	0.0003

Uncertainties

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

AD 5 %

EF CO_2: ±5 %

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

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

3.3.12.2.2.2 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.

3.3.12.2.2.3 Source-specific recalculations

No recalculations have been done of the entire time series for 2012 submission.

The emissions for 2010 are calculated with the same approach based on:

- National energy balance
- Using IPCC default emission factors

The emissions of sector CRF 1.A.3.a are estimated in line with IPCC good practice guidance and 2006 IPCC Guidelines.
The Eurostat energy balance provides a fuel split between domestic and international aviation, thus no assumption regarding the split of Jet kerosene had to be done (FCCC/ARR/2009/BGR § 78 and **FCCC/ARR/2010/BGR § 69**).

In general the TACCC is improved (**FCCC/ARR/2010/BGR § 69**).

3.3.12.2.2.4 Source-specific planned improvements

A planned improvement is the application of a higher Tier method for 2013 submission. For Tier 2 data on the number of landing/take-off cycles (LTOs) and aircraft types is required. Data for LTO are already available and will be used for the next calculations. However, more detailed country specific data on aircraft types is to be collected for the application of a higher tier for domestic and international aviation.

3.3.12.2.3 CRF 1.A.3.b Road transport

3.3.12.2.3.1 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 , which are presented below.

Special feature of Bulgarian vehicle fleet is its age structure. In 2010 more than 50% from the vehicles are above 15 years and for about 27 % are more than 20 years old.

The total number of registered vehicles in Bulgaria for the period 1988 – 2010 is presented in the next table.

Table 82 Number of vehicles, 1988 - 2010

Vehicle type	Trucks	Special cars	Trucks Trailer	Busses	Passenger cars	Motor-cycles	Motopeds
1988					1220784		
1989	139123	38265	15277	32893	1269958	221416	279077
1990	146128	39857	15502	33763	1317437	225533	281270
1991	157841	40124	16357	35561	1358976	226853	282137
1992	170232	40092	17194	37083	1411278	228334	282792
1993	185824	40282	18118	39280	1505451	230635	283963
1994	195786	40427	18970	40610	1587873	232386	284571
1995	203257	40605	19920	41019	1647571	233365	285901
1996	207858	40247	21982	40835	1707023	234950	286760
1997	210960	40051	21806	40422	1730506	236260	288690
1998	220948	41078	21320	41487	1809350	233952	281749

1999	230131	41332	21399	41971	1908392	235181	284031
2000	237655	41798	21735	42306	1992748	236327	286047
2001	245962	42464	23624	42870	2085730	237756	288290
2002	255412	43241	24446	43172	2174081	239631	290631
2003	268098	44408	25389	43687	2309343	242441	293228
2004	296001	34597	21680	36000	2438383	93269	44686
2005	311038	35736	22828	37161	2538092	97851	48846
2006*	208295	24012	17797	22130	1767742	42880	33374
2007	239769	26974	21547	23265	2081517	50918	39400
2008	273570	29568	25591	24622	2366196	60110	46801
2009	290784	30613	27024	24448	2502020	66330	51265
2010	304436	31329	29021	23857	2602400	70388	54983

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 2010 the road transport consumed 93% from the total energy in the sector.

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

3.3.12.2.4 Emission trend

The decrease of 51% from 1988 to 1991 is affected by the political and economic situation in that period. Diesel fuel consumption decreased with 76% from 1988 to 1994, followed by rapid increase, due to the cheaper price of diesel compared to the gasoline. For the period of 1988-2009 the fuel consumption shares for diesel and gasoline were 46,3% and 43,9% compromising a total of 90%. The small difference is a result of the increasing demand for diesel since 2000. The development in diesel fuel consumption as of the beginning of 2000 is characterized by increasing fuel use for diesel passenger cars and heavy duty vehicles. A possible reason for this trend could be the European Automobile Manufacturers Association's commitment on the reduction of CO_2 emissions from passenger cars (Commission Recommendation 1999/125/EC) (Vestreng et al., 2009). The beginning of 2000 is marked with a steady trend for gasoline, while diesel use is growing up to 2007.

In 2010 there is an increase in the total consumption of transport fuels. However, the trend differs for the specific fuels. While there is a decrease in gasoline and diesel consumption of 6 % and 2%, respectively, from 2009 to 2010, the trend for biodiesel and CNG reflects a growth of 255% (incl. the biodiesel for blending) and 34%. Compared to the base year the consumption of gasoline shows a drop by 55% for 2009 and 58% for 2010.

In comparison to 2009, the fuel consumption development slightly changed in 2010, where gasoline and diesel consumption were responsible for 24,5% and 57,0% of the total fuels consumed. The share of LPG decreased slightly to comprise 15,0% from the total, whereas CNG and biodiesel represented 2,6% and 0,8% due to both fuel type consumption growth in 2010.

The energy balance provides activity data for the 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.

For the period of the inventory, the substantial growth in the road transport emissions of CO_2 is correlated with the increasing number of vehicles and traffic intensity due to the evolving economic activity (excluding the economic crisis of 2009).

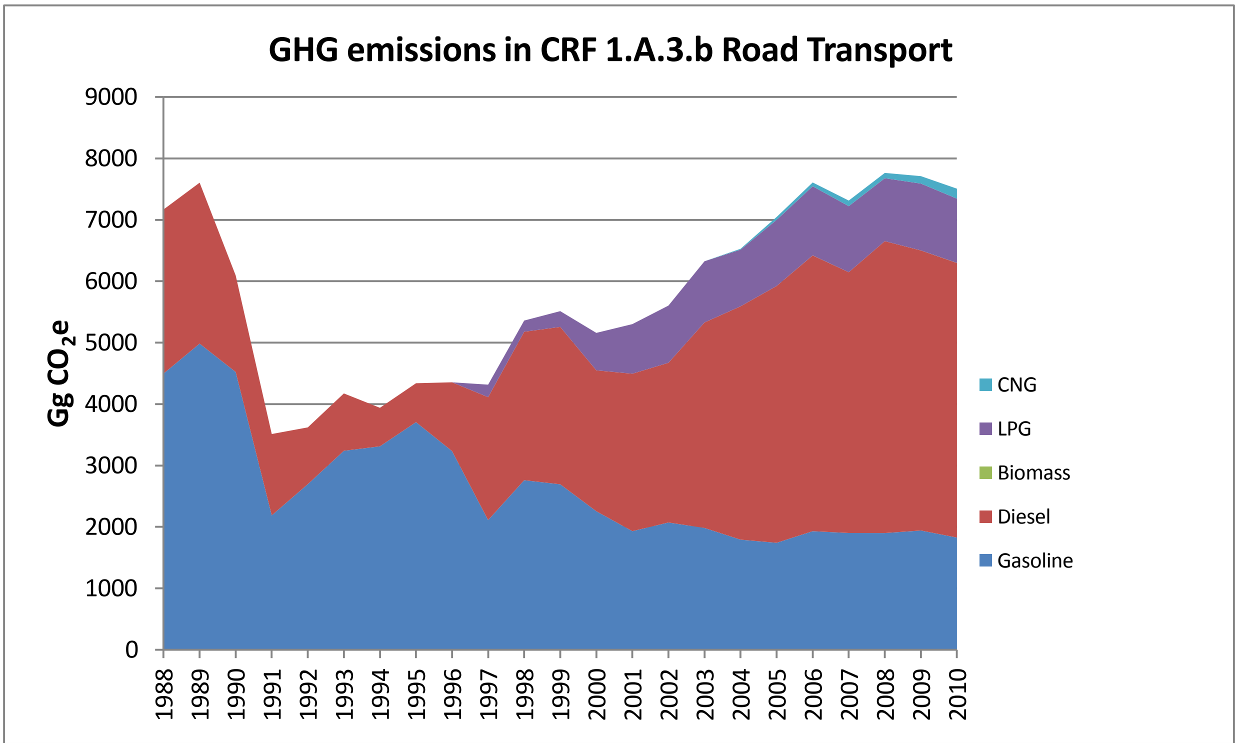


Figure 28 GHG emissions in CRF 1.A.3.b Road transport 1988 - 2010

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 4,7% compared to base year levels being 7169,5 Gg CO_2e in 1988 and reached levels of 7508,2 Gg CO_2e in 2010. However, that growth in 2010 compared to 1991 is calculated at 113,8%. 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 motopeds. 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 2010, passenger cars and heavy duty vehicles account for 61,6% and 21,5% of total GHG CO_2e emissions respectively, dependent on the intensification of passenger and goods transportation. The remaining 16,6% were shared among light-duty vehicles, buses and 2-wheelers.

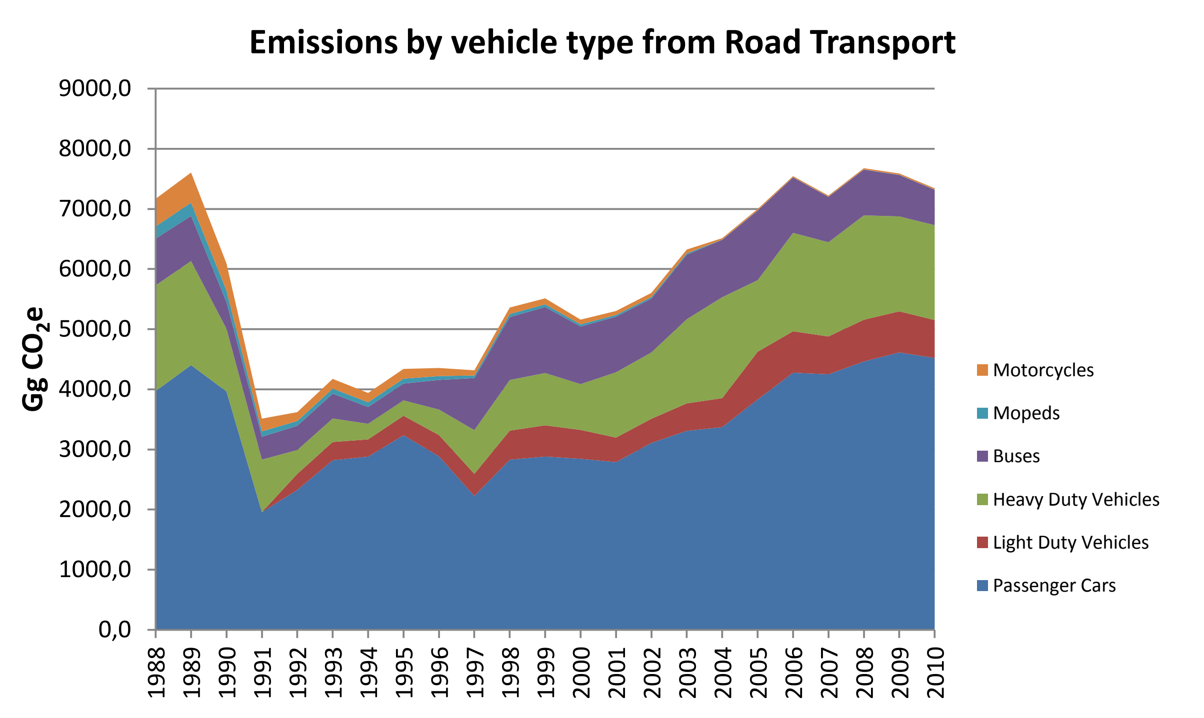


Figure 29 Emissions allocated to vehicle categories for the period 1988-2010

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 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.

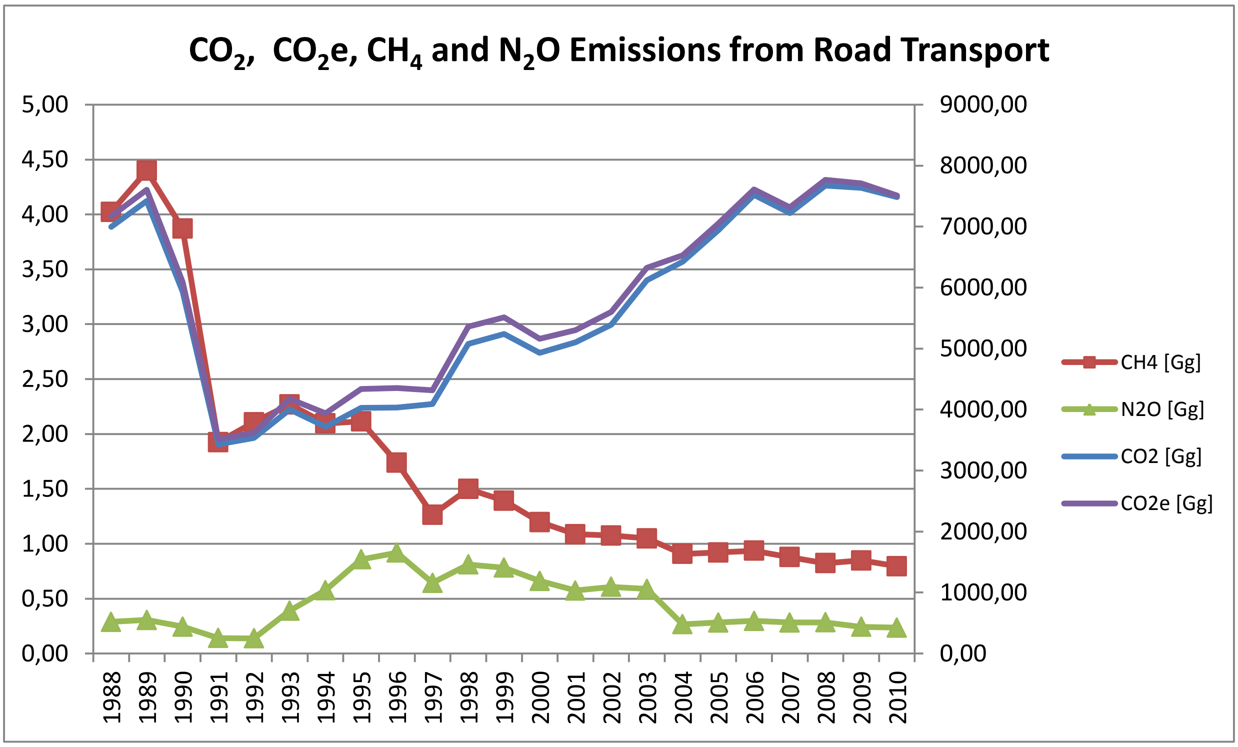


Figure 30 CO_2, CO_2e, CH_4 and N_2O emissions trends for the period 1998-2010

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

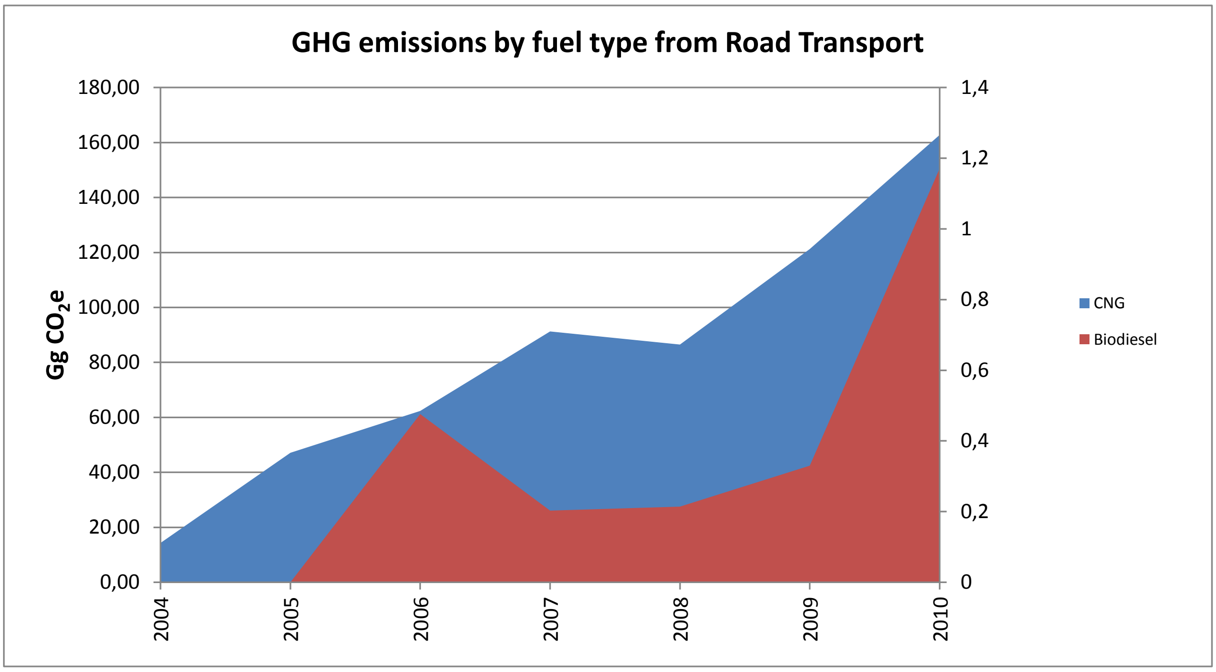


Figure 31 Emissions by biodiesel and CNG from Road Transport for the period 2004-2010

Tier 1 is applied to calculate the emissions from biodiesel and CNG, as there was insufficient data to use the COPERT model for those fuels. Biodiesel is reported under different categories in the Energy balances, once as fuel for blending in the Oil questionnaire and second time as “other liquid biofuels” for direct sale to customers in the Renewable questionnaire. Since it is not possible for COPERT to report separately the emissions from gas/diesel oil and biodiesel reported as "other liquid biofuels", the emissions from biodiesel are calculated separately using Tier 1. As it can be noticed from the figure above, biodiesel for transportation entered the market in 2006 in contrast to CNG that has been in use since 2004. The CO_2e emissions for 2010 are considerably higher compared to 2009 as it follows the fuel consumption increase reported for this year. CO_2 emissions from biodiesel are not included in the calculations according to the IPCC guidelines.

3.3.12.2.4.1 Methodological issues

3.3.12.2.4.1.1 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 4, Version 9, model methodology corresponding to Tier 2, according to the IPCC 2006 guidelines and GPG. 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 the EF calculation for NO2 emissions and emission factors of heavy metals.

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.

3.3.12.2.4.1.2 Activity data

Fuel consumption (liquid, gaseous and biofuels) is obtained from the Energy balance and converted into energy units using the CS NCV.

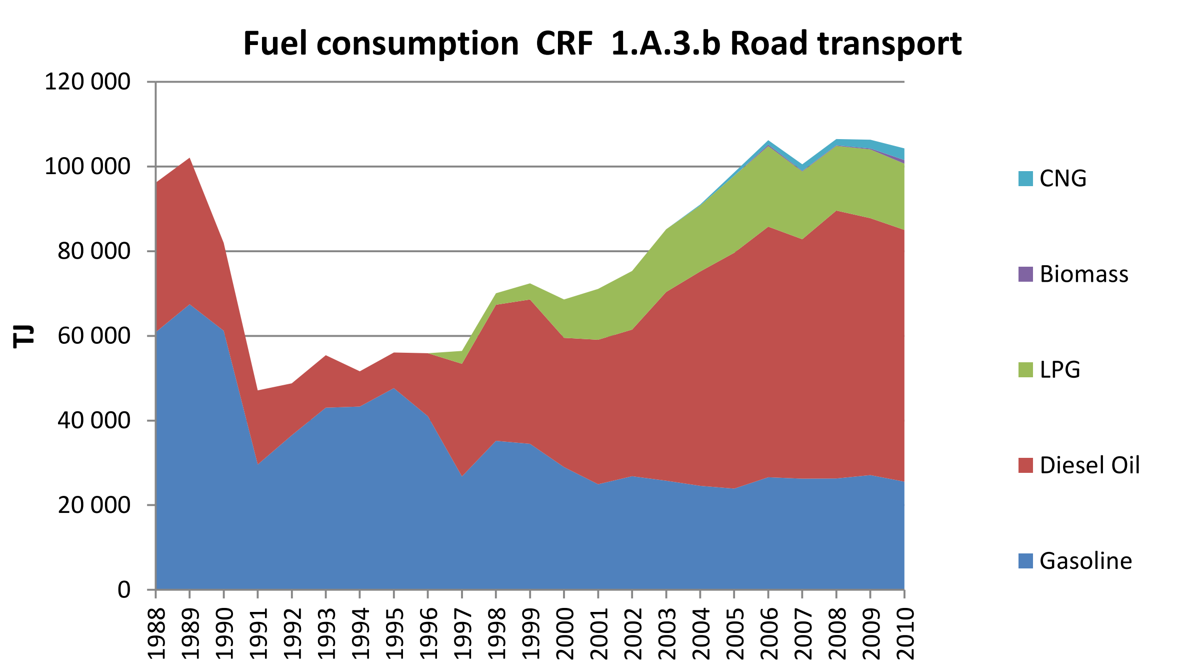


Figure 32 Fuel consumption in CRF 1.A.3.b Road transport (1988 - 2010)

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 15,1km 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 2010 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 2005-2010 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 9 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 0,2% (National Statistical Institute).

Values for fuel volatility (RVP – Reid Vapour Pressure) are available for the period 2006-2010. 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 24km/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 36,2km/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 37km/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 19,4km/h (Krzywkowska 2004), and for trolleybuses –

14,4km/h (MottMacDonald 2009). These numbers vary back in the years as Table 83 shows (Breshkov, 2005).

Table 83 Average operational speed (km/h)

Vehicle type/ Year	2009	2006	2002	1995	1989
Trolleybus	14,4		14	14	14
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 84 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 and technology classes was provided.

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.

The Slovenian vehicle distribution does not include LPG driven passenger cars for the period before 2008. In Bulgaria, the LPG consumption for road transport started in 1997. The ratio LPG/Gasoline for the period 1997-2010, as reported by the Ministry of inferior, for each year in the period 2006-2010, 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.

As mentioned above, the steep decline of the number of the vehicles in 2006, which were not re-registered by their owners. Nevertheless, the exact per cent age of vehicles out of service is not known and relevant scrappage curve could not be applied. Consequently, this specific case affects the mileage distribution.

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 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 match the statistical with the calculated fuel consumption.

All the other required data (Fuel Injection, Evaporation Control, Evaporation distribution, Slope factor, Load factor) used for calculation of emissions using COPERT 4, version 9 program are input as default according to the COPERT.

3.3.12.2.4.1.3 Emission factors

According to the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, 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 9. 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.

Table 85 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	71,7	60,7	2,9	74,5	9,2	3,1
1989	71,7	60,4	2,9	74,5	9,2	3,1
1990	71,7	60,1	2,9	74,5	9,3	3,1
1991	71,7	59,6	2,9	74,5	9,2	3,1
1992	71,7	54,9	3,0	74,5	8,2	2,3
1993	71,6	50,4	8,4	74,5	8,1	2,2
1994	71,5	46,9	12,9	74,5	8,1	2,1
1995	71,4	42,9	17,6	74,5	8,0	2,1
1996	71,3	39,5	21,7	74,5	7,9	2,0
1997	71,2	37,1	21,8	74,5	7,8	1,9
1998	71,1	34,2	21,2	74,5	7,5	1,8
1999	71,0	31,1	20,6	74,5	7,3	1,7
2000	71,0	28,3	19,9	74,5	7,0	1,6
2001	70,9	26,1	19,1	74,5	6,7	1,5
2002	70,9	23,6	18,7	74,5	6,2	1,5
2003	70,8	21,8	18,1	74,5	5,7	1,4
2004	70,8	17,0	5,6	74,5	5,1	1,5
2005	70,8	15,6	5,4	74,5	4,4	1,6
2006	70,7	14,1	4,9	75,3	3,9	1,7
2007	70,7	13,0	4,5	74,5	3,2	1,7
2008	70,6	12,2	4,1	74,5	2,8	1,8
2009	70,6	11,6	2,4	74,5	2,5	1,9
2010	70,6	10,2	1,9	74,5	1,8	2,2

Table 86 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	kg/TJ	t/TJ	kg/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

Fuel type	LPG			CNG		
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
1994	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO
1996	NO	NO	NO	NO	NO	NO
1997	65,7	20,5	3,1	NO	NO	NO
1998	65,7	19,7	3,3	NO	NO	NO
1999	65,7	18,7	3,6	NO	NO	NO
2000	65,7	17,8	3,8	NO	NO	NO
2001	65,7	17,1	3,8	NO	NO	NO
2002	65,7	16,3	3,9	NO	NO	NO
2003	65,7	15,7	3,9	NO	NO	NO
2004	57,9	13,3	3,5	56,1	92,0	3,0
2005	57,9	12,7	3,5	56,1	92,0	3,0
2006	57,9	12,1	3,4	56,1	92,0	3,0
2007	65,7	13,1	3,8	56,1	92,0	3,0
2008	65,7	12,4	3,6	56,1	92,0	3,0
2009	65,7	11,8	3,4	56,1	92,0	3,0
2010	65,7	10,8	3,0	56,1	92,0	3,0

3.3.12.2.4.2 Uncertainties

The following default uncertainties are assumed (2006 IPPC, chapter 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

3.3.12.2.4.3 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.

3.3.12.2.4.4 Source-specific recalculations

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 into the national road transport inventory.

FCCC/ARR/2010/BGR §76 Allocation of activity data for consumption of residual fuel oil from road transport in 1A3c Railway for the period 1991 – 1996.

FCCC/ARR/2010/BGR §69 In general the TACCC is improved.

3.3.12.2.4.5 Source-specific planned improvements

- Investigation of the country specific parameters used in the COPERT IV model concerning the car fleet and vehicle split
- Require more detailed information from the Ministry of Internal affairs on vehicles distribution and technology split

3.3.12.2.5 Railways (CRF 1.A.3.c)

Railways transport, CO_2 emissions, is defined as a key category and represents the third contributor to the Transport sector emissions in 2010.

3.3.12.2.5.1 Source category description

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.

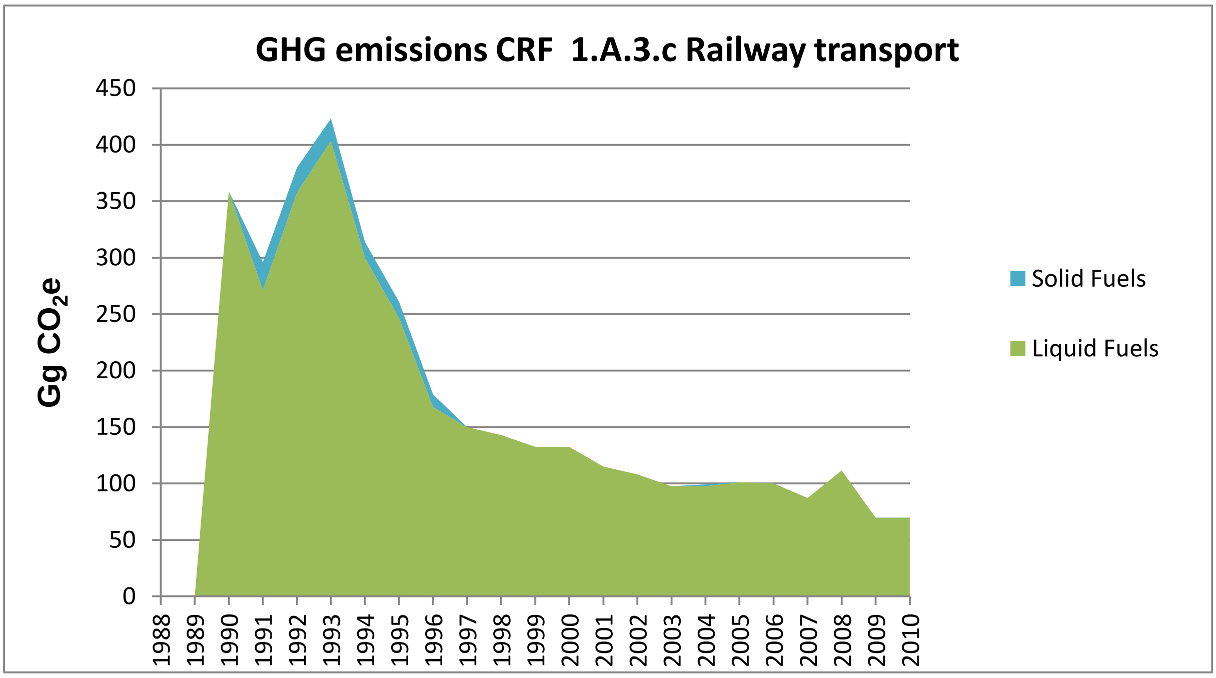


Figure 33 GHG emissions in CRF 1.A.3.d Railway transport (1988 - 2010)

As it can be observed from the figure above, emissions from Railway transport decreased steeply since 1993 with 84% to 2010. 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.

3.3.12.2.5.2 Methodological issues

Following the recommendations of ERT set out in FCCC/ARR/2010/BGR §75 the emissions from Railway are calculated based on Revised 1996 IPCC Guidelines and IPCC good practice guidance. Where there are not emission factors in the Revised 1996 IPCC Guidelines, the 2006 IPCC Guidelines is used.

3.3.12.2.5.2.1 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.

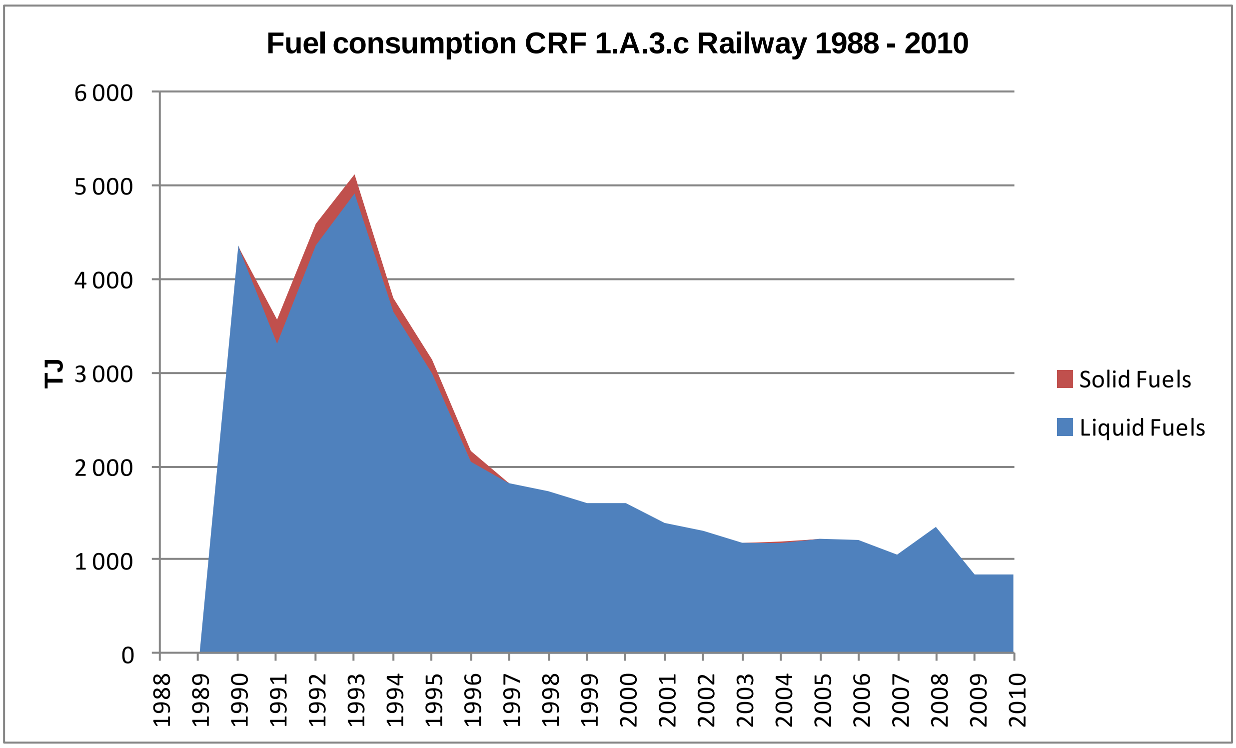


Figure 34 Fuel consumption in CRF 1.A.3.d Railway transport (1988 - 2010)

Fuel consumption from Railway transport constitute 0,76% of the total Transport sector and thus as a category does not contribute significantly to the total emissions from the Transport sector in Bulgaria.

3.3.12.2.5.3 Methodology

Following the recommendations of ERT set out in FCCC/ARR/2010/BGR §75 the emissions from Railway are calculated based on Revised 1996 IPCC Guidelines and IPCC good practice guidance. Where there are not emission factors in the Revised 1996 IPCC Guidelines, the 2006 IPCC Guidelines 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.

3.3.12.2.5.3.1 Emission factors

The Revised 1996 IPCC Guidelines and the 2006 IPCC Guidelines default GHG EFs for liquid and solid fuels have been applied. 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.

3.3.12.2.5.3.2 Activity data

The energy balance provides activity data for consumption of residual fuel oil in road transport in the period 1991 – 1996.

Table 87 Activity data of Gas-Diesel Oil, emissions and emission factors for IPCC Sub-category 1A3c – Railways 1988-2010

	Gas-Diesel Oil				EF* CO_2	CO_2 emission	EF* N_2O	N_2O emission	EF* CH_4	CH_4 emission
	Gg	t	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	0.00	0.00	NO	42.30	73.0	NO	0.030	NO	0.004	NO
1989	0.00	0.00	NO	42.30	73.0	NO	0.030	NO	0.004	NO
1990	103.00	103 000.00	4 356.90	42.30	73.0	318.054	0.030	0.131	0.004	0.018
1991	68.00	68 000.00	2 876.40	42.30	73.0	209.977	0.030	0.086	0.004	0.012
1992	91.00	91 000.00	3 849.30	42.30	73.0	280.999	0.030	0.115	0.004	0.016
1993	106.00	106 000.00	4 483.80	42.30	73.0	327.317	0.030	0.135	0.004	0.019
1994	78.00	78 000.00	3 299.40	42.30	73.0	240.856	0.030	0.099	0.004	0.014
1995	69.00	69 000.00	2 918.70	42.30	73.0	213.065	0.030	0.088	0.004	0.012
1996	41.00	41 000.00	1 734.30	42.30	73.0	126.604	0.030	0.052	0.004	0.007
1997	43.00	43 000.00	1 818.90	42.30	73.0	132.780	0.030	0.055	0.004	0.008
1998	41.00	41 000.00	1 734.30	42.30	73.0	126.604	0.030	0.052	0.004	0.007
1999	38.00	38 000.00	1 607.40	42.30	73.0	117.340	0.030	0.048	0.004	0.007
2000	38.00	38 000.00	1 607.40	42.30	73.0	117.340	0.030	0.048	0.004	0.007
2001	33.00	33 000.00	1 395.90	42.30	73.0	101.901	0.030	0.042	0.004	0.006
2002	31.00	31 000.00	1 311.30	42.30	73.0	95.725	0.030	0.039	0.004	0.005
2003	28.00	28 000.00	1 184.40	42.30	73.0	86.461	0.030	0.036	0.004	0.005
2004	28.00	28 000.00	1 184.40	42.30	73.0	86.461	0.030	0.036	0.004	0.005
2005	29.00	29 000.00	1 226.70	42.30	73.0	89.549	0.030	0.037	0.004	0.005
2006	29.00	29 000.00	1 214.17	41.87	73.0	88.635	0.030	0.036	0.004	0.005
2007	25.00	25 000.00	1 057.50	42.30	73.0	77.198	0.030	0.032	0.004	0.004
2008	32.00	32 000.00	1 353.60	42.30	73.0	98.813	0.030	0.041	0.004	0.006
2009	20.00	20 000.00	846.00	42.30	73.0	61.76	0.030	0.03	0.004	0.004
2010	20.00	20 000.00	846.00	42.30	73.0	61.76	0.030	0.03	0.004	0.004

** Revised 1996 IPCC Guidelines, Table 1-49*

Table 88 Activity data of Residual Fuel Oil, emissions and emission factors for IPCC Sub-category 1A3c – Railways 1988-2010

	Residual Fuel Oil	EF* CO_2	CO_2 emission	EF* N_2O	N_2O emission	EF* CH_4	CH_4 emission

	Gg	t	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
1989	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
1990	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
1991	11.00	11 000.00	440.00	40.00	77.400	34.056	0.0003	0.00013	0.003	0.001
1992	13.00	13 000.00	520.00	40.00	77.400	40.248	0.0003	0.00016	0.003	0.002
1993	11.00	11 000.00	440.00	40.00	77.400	34.056	0.0003	0.00013	0.003	0.001
1994	9.00	9 000.00	360.00	40.00	77.400	27.864	0.0003	0.00011	0.003	0.001
1995	2.00	2 000.00	80.00	40.00	77.400	6.192	0.0003	0.00002	0.003	0.0002
1996	8.00	8 000.00	320.00	40.00	77.400	24.768	0.0003	0.00010	0.003	0.001
1997	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
1998	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
1999	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2000	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2001	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2002	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2003	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2004	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2005	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2006	0.00	0.00	NO	39.77	77.400	NO	0.0003	NO	0.003	NO
2007	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2008	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2009	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO
2010	0.00	0.00	NO	40.00	77.400	NO	0.0003	NO	0.003	NO

**For CO_2 2006 IPCC stationnary combustion is used (Table 2.2), there is no information in the Revised 1996 IPCC Guidelines. For N_2O and CH_4 Revised 1996 IPCC Guidelines is used (Table 1-15 and Table 1-16).*

3.3.12.2.5.4 Uncertainties and time-series consistency

The following default uncertainties are assumed (2006 IPPC, chapter 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 %		

3.3.12.2.5.5 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 (due to the Energy balance)

Documentation and archiving of all information required in NIR, Background documentation and archive.

3.3.12.2.6 Navigation (CRF 1.A.3.d)

GHG emissions from navigation are not defined as key source.

3.3.12.2.6.1 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. Still, it is unclear where the loading of fuel happens – it is assumed that mainly the logistic companies prefer to load outside BG – either in RO or on their way in another country.

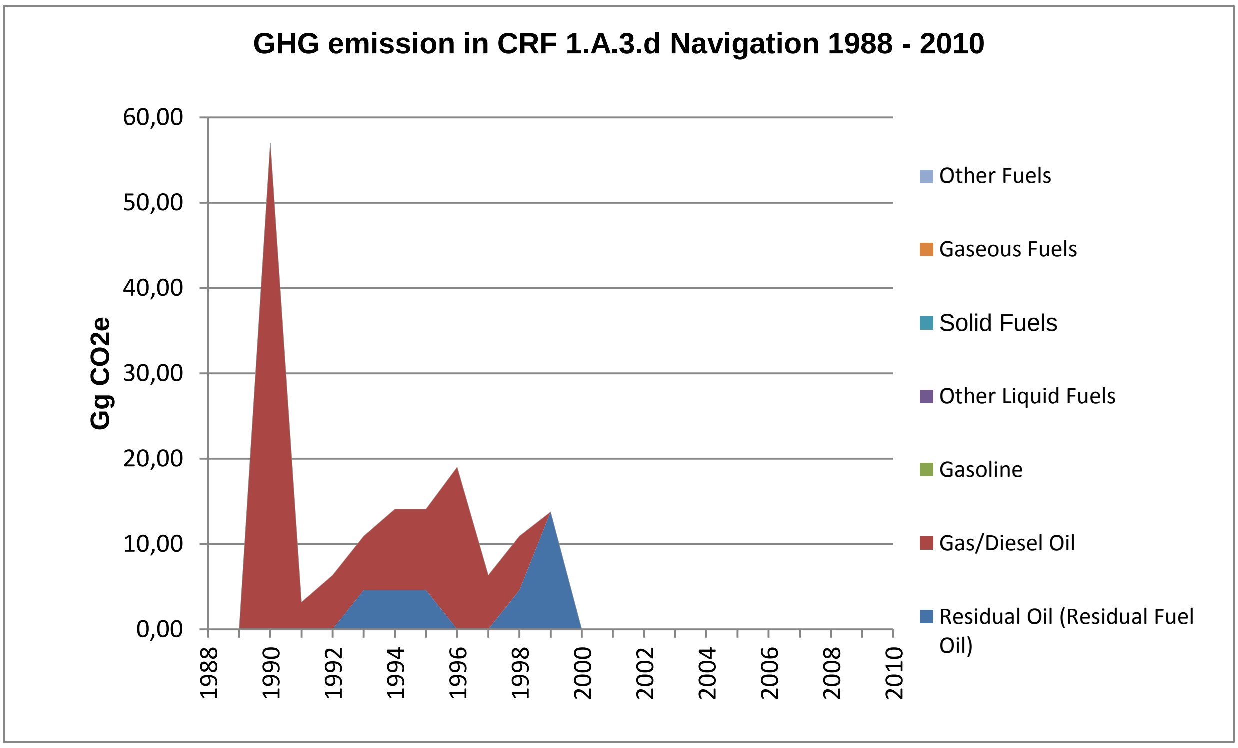


Figure 35 GHG emissions in CRF 1.A.3.d Navigation (1988 - 2010)

3.3.12.2.6.2 Methodological issues

3.3.12.2.6.2.1 Activity data

Fuel consumption (liquid) is obtained from Eurostat Energy balance and converted into energy units using the CS NCV (see below).

3.3.12.2.6.2.2 Methodology

The 2006 IPCC Guidelines Tier 1 approach has been applied (Equation 3.5.1. Water-Borne Navigation Equation

Emissions = Σ(Fuel Consumedab • Emission Factorab)

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)

3.3.12.2.6.2.3 Emission factors

The 2006 IPCC Guidelines default GHG EFs for Gas-Diesel Oil and Residual Fuel Oil oil have been applied. The emission factors are provided in the following tables:

Table 89 Activity data, emissions and emission factors for IPCC Sub-category 1A3d – Navigation: 1988-2010

	Gas-Diesel Oil				EF* CO_2	CO_2 emission	EF* N_2O	N_2O emission	EF* CH_4	CH_4 emission
	Gg	t	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	Gg	Gg
1988	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
1989	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
1990	18.00	18,000.00	761.40	42.30	74.100	56.420	0.002	0.00011	0.007	0.000
1991	1.00	1,000.00	42.30	42.30	74.100	3.134	0.002	0.00001	0.007	0.000
1992	2.00	2,000.00	84.60	42.30	74.100	6.269	0.002	0.00001	0.007	0.000
1993	2.00	2,000.00	84.60	42.30	74.100	6.269	0.002	0.00001	0.007	0.000
1994	3.00	3,000.00	126.90	42.30	74.100	9.403	0.002	0.00002	0.007	0.000
1995	3.00	3,000.00	126.90	42.30	74.100	9.403	0.002	0.00002	0.007	0.000
1996	6.00	6,000.00	253.80	42.30	74.100	18.807	0.002	0.00004	0.007	0.000
1997	2.00	2,000.00	84.60	42.30	74.100	6.269	0.002	0.00001	0.007	0.000
1998	2.00	2,000.00	84.60	42.30	74.100	6.269	0.002	0.00001	0.007	0.000
1999	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2000	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2001	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2002	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2003	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2004	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2005	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2006	0.00	0.00	NO	41.87	74.100	NO	0.002	NO	0.007	NO
2007	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2008	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2009	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO
2010	0.00	0.00	NO	42.30	74.100	NO	0.002	NO	0.007	NO

Table 90 Activity data, emissions and emission factors for IPCC Sub-category 1A3d – Navigation: 1988-2010

	Residual Fuel Oil				EF* CO_2	CO_2 emission	EF* N_2O	N_2O emission	EF* CH_4	CH_4 emission
	Gg	t	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	t	Gg	t
1988	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
1989	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
1990	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
1991	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
1992	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
1993	1.00	1,000.00	40.00	44.00	77.400	3.406	0.086	0.004	0.010	0.0005
1994	1.00	1,000.00	40.00	44.00	77.400	3.406	0.086	0.004	0.010	0.0005
1995	1.00	1,000.00	40.00	44.00	77.400	3.406	0.086	0.004	0.010	0.0005
1996	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
1997	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
1998	1.00	1,000.00	40.00	44.00	77.400	3.406	0.086	0.004	0.010	0.000
1999	3.00	3,000.00	132.00	44.00	77.400	10.217	0.086	0.011	0.010	0.001
2000	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
2001	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
2002	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
2003	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
2004	0.00	0.00	NO	43.96	77.400	NO	0.086	NO	0.010	NO
2005	0.00	0.00	NO	43.96	77.400	NO	0.086	NO	0.010	NO
2006	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
2007	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
2008	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
2009	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO
2010	0.00	0.00	NO	44.00	77.400	NO	0.086	NO	0.010	NO

***For* CO_2 *2006 IPCC stationnary combustion is used (Table 2.2), there is no information in the Revised 1996 IPCC Guidelines.*CO_2*For* N_2O *and* CH_4 *an upper values from table 3.4.1 IPCC 2006 are used.*

3.3.12.2.6.3 Uncertainties and time-series consistency

The following default uncertainties are assumed (2006 IPPC, chapter 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 %		

3.3.12.2.6.4 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.

3.3.12.2.6.5 Source-specific planned improvements

Investigation whether it would be possible to update country specific emission factor (CS EF) for liquid fuels.

3.3.12.3 Other (CRF 1.A.3.e)

3.3.12.3.1 Source category description

The off-road 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 2010, because of the CO_2 emissions from pipeline transport mainly.

3.3.12.3.2 Methodological issues

3.3.12.3.2.1 Activity data

Fuel consumption (liquid) is obtained from Eurostat Energy balance and converted into energy units using the CS NCV (see below).

3.3.12.3.2.2 Methodology

The 2006 IPCC Guidelines Tier 1 approach has been applied. Emissions from off-road vehicles are estimated using the methodologies used for mobile sources, as presented in Section 3.2.

3.3.12.3.2.3 Emission factors

The 2006 IPCC Guidelines default GHG EFs for Gas-Diesel Oil and Residual Fuel Oil have been applied. The applied EF for the calculation of pipeline transportation are mentioned in Chapter 3.3.9.2.3, Country specific emission factors, sector Energy.

Table 91 Activity data, emissions and emission factors for IPCC Sub-category 1A3e Other: 1988-2010

	Gas-Diesel Oil				EF CO_2	CO_2 emission	EF N_2O	N_2O emission	EF CH_4	CH_4 emission
	Gg	t	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1989	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1990	42.00	42 000.00	1 776.60	42.30	74.100	131.646	0.029	0.051	0.004	0.007
1991	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1992	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1993	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1994	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1995	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1996	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1997	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1998	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
1999	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2000	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2001	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2002	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2003	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2004	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2005	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2006	0.00	0.00	NO	41.87	74.100	NO	0.029	NO	0.004	NO
2007	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2008	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2009	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO
2010	0.00	0.00	NO	42.30	74.100	NO	0.029	NO	0.004	NO

Table 92 Activity data, emissions and emission factors for IPCC Sub-category 1A3e – Other: 1988-2010

	Gas-Diesel Oil				EF CO_2	CO_2 emission	EF N_2O	N_2O emission	EF CH_4	CH_4 emission
	Gg	t	TJ	NCV GJ/t	(t/TJ)	Gg	(t/TJ)	Gg	(t/TJ)	Gg
1988	0.00	0.00	0.000	40.00	77.400	NO	0.086	NO	0.010	NO
1989	0.00	0.00	0.000	40.00	77.400	NO	0.086	NO	0.010	NO
1990	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
1991	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
1992	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
1993	1.00	1 000.00	40.000	40.00	77.400	3.096	0.086	0.003	0.010	0.000
1994	1.00	1 000.00	40.000	40.00	77.400	3.096	0.086	0.003	0.010	0.000
1995	1.00	1 000.00	40.000	40.00	77.400	3.096	0.086	0.003	0.010	0.000
1996	1.00	1 000.00	40.000	40.00	77.400	3.096	0.086	0.003	0.010	0.000
1997	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
1998	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
1999	2.00	2 000.00	80.000	40.00	77.400	6.192	0.086	0.007	0.010	0.001

2000	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
2001	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
2002	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
2003	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
2004	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
2005	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
2006	0.00	0.00	NO	39.77	77.400	NO	0.086	NO	0.010	NO
2007	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
2008	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
2009	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO
2010	0.00	0.00	NO	40.00	77.400	NO	0.086	NO	0.010	NO

3.3.12.3.3 Uncertainties and time-series consistency

Greenhouse gas emissions from off-road 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, and so it is reasonable to assume as a default that the values in section 3.2.1.2 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 IPPC Guidelines, Chapter 3, Table 3.2.2 Uncertainty Assessment):

AD	+/-5 %		EF CO_2	EF N_2O	EF CH_4
		Gas / Diesel Oil	1% / -2%	208% / -67%	144% /-59%

3.3.12.3.4 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.

3.3.12.3.5 Source specific QA/QC recalculations

Recalculations have been done of the entire time series regarding the pipeline transportation.

The emissions are calculated with the same approach based on

Eurostat energy balance
Country specific Net Caloric Values (NCV)
Using IPCC default emission factor
The emissions of sector CRF 1.A.3.e are estimated in line with IPCC good practice guidance and 2006 IPCC Guidelines.
The Eurostat energy balance provides a split between Gas-Diesel Oil and Residual Fuel Oil
In general TACCC is improved.

3.3.13 OTHER SECTORS (CRF 1.A.4)

Sub-sector Other sectors includes the following groups:

Commercial / Institutional (1.A.4.a);
Residential (1.A.4.b);
Agriculture / Forestry / Fisheries (1.A.4.c);

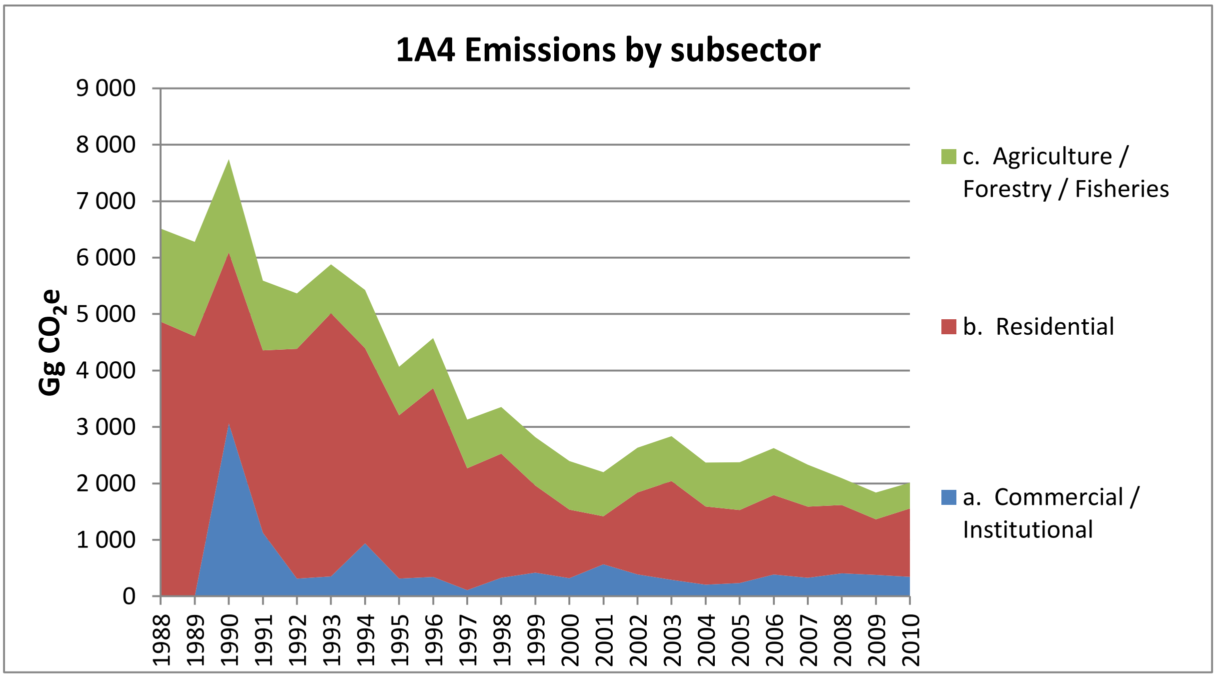


Figure 36 Total GHG emissions from 1.A.4 Other Sectors

The general trend in CRF category 1.A.4 is a decrease of 69.1% compared to base year and an increase of 9.5% compared to last year.

3.3.13.1 Commercial/Institutional 1.A.4.a.

Category 1.A.4.a. Commercial/Institutional covers emissions from fuel combustion in the commercial and Institutional sectors.

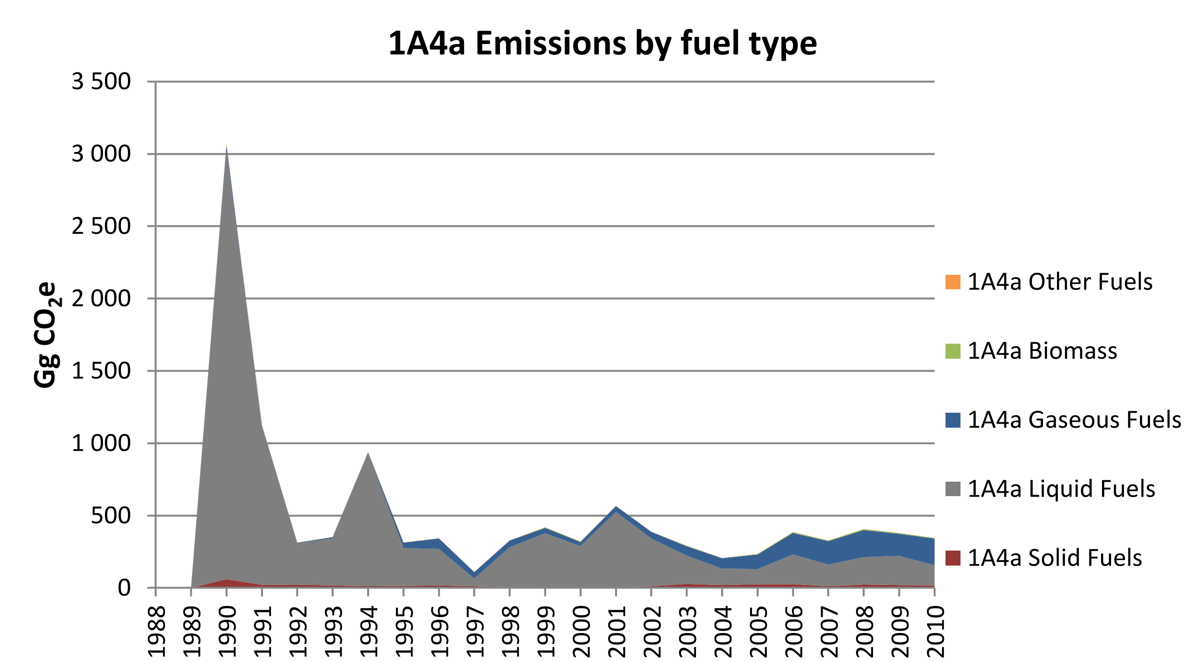


Figure 37 GHG emissions from CRF 1.A.4.a. Commercial/Institutional

The share in total GHG emissions from sector 1.A is 0.8% for the last year and the share from total GHGs emissions is 0.5% the year 2010.

Before 1990 there was no consumption reported in this sector, instead it was reported in sector 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	1 121.76	1 095.28	21.09	5.39	4.4800	NO
1992	310.01	282.14	21.79	6.08	18.8160	NO
1993	349.45	324.69	16.75	8.01	12.8800	NO
1994	933.29	912.81	12.07	8.40	13.6640	NO
1995	311.55	259.71	14.08	37.77	13.3280	NO
1996	340.22	250.93	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	385.36	327.98	11.55	45.83	NO	NO
2003	286.01	194.65	26.90	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	73.9116	NO
2010	339.90	138.16	17.32	184.42	50.7290	NO
Decrease	-	-	-	-	-	-

CO_2 (Gg)	CRF 1.A.4.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1988-2010						
Decrease 1990-2010	88.87%	95.32%	70.99%	-375.83%	-	-
Decrease 2009-2010	8.61%	31.33%	7.85%	-21.36%	31.37%	-

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	0.0437	0.0290	0.0022	0.0005	0.0120	NO
1992	0.0737	0.0205	0.0023	0.0006	0.0504	NO
1993	0.0613	0.0244	0.0017	0.0007	0.0345	NO
1994	0.0774	0.0388	0.0012	0.0008	0.0366	NO
1995	0.0540	0.0134	0.0015	0.0034	0.0357	NO
1996	0.0632	0.0213	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	0.1974	0.0261	0.0028	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	0.2611	0.0272	0.0019	0.0138	0.2181	NO
2010	0.1570	0.0179	0.0018	0.0168	0.1205	NO
Decrease 1988-2010	-	-	-	-	-	-
Decrease 1990-2010	-75.59%	77.59%	70.00%	-375.51%	-	-
Decrease 2009-2010	39.87%	34.26%	6.66%	-21.35%	44.74%	-

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
1991	0.0092	0.0087	0.0003	0.0000	0.0002	NO
1992	0.0033	0.0023	0.0003	0.0000	0.0007	NO
1993	0.0033	0.0026	0.0002	0.0000	0.0005	NO
1994	0.0079	0.0072	0.0002	0.0000	0.0005	NO
1995	0.0028	0.0021	0.0002	0.0001	0.0005	NO
1996	0.0029	0.0020	0.0002	0.0001	0.0004	NO
1997	0.0007	0.0004	0.0002	0.0001	NO	NO

N_2O (Gg)	CRF 1.A.4.a.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
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	0.0042	0.0016	0.0003	0.0003	0.0020	NO
2010	0.0031	0.0010	0.0003	0.0003	0.0015	NO
Decrease 1988-2010	-	-	-	-	-	-
Decrease 1990-2010	87.58%	95.69%	70.00%	-375.51%	-	-
Decrease 2009-2010	26.45%	37.07%	6.66%	-21.35%	27.02%	-

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	14 873.66	1 125.53	1 098.59	21.23	5.40	0.3016	NO
1992	4 347.14	312.58	283.29	21.94	6.10	1.2667	NO
1993	4 831.79	351.77	326.01	16.86	8.03	0.8671	NO
1994	12 472.11	937.36	915.86	12.16	8.42	0.9199	NO
1995	4 454.36	313.57	260.64	14.17	37.86	0.8973	NO
1996	5 012.80	342.43	252.01	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	5 401.84	387.30	329.73	11.63	45.94	NO	NO
2003	4 629.11	291.47	195.68	27.08	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
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	6 343.79	378.72	202.27	18.92	152.33	5.1997	NO
2010	5 916.11	344.15	138.86	17.43	184.88	2.9832	NO
Decrease 1988-2010	-	-	-	-	-	-	-
Decrease 1990-2010	85.61%	88.76%	95.31%	70.98%	-375.83%	-	-
Decrease 2009-2010	6.74%	9.13%	31.35%	7.84%	-21.36%	42.63%	-

3.3.13.2 Residential 1.A.4.b.

Category 1.A.4.b. Residential covers emissions from fuel combustion in the residential sector.

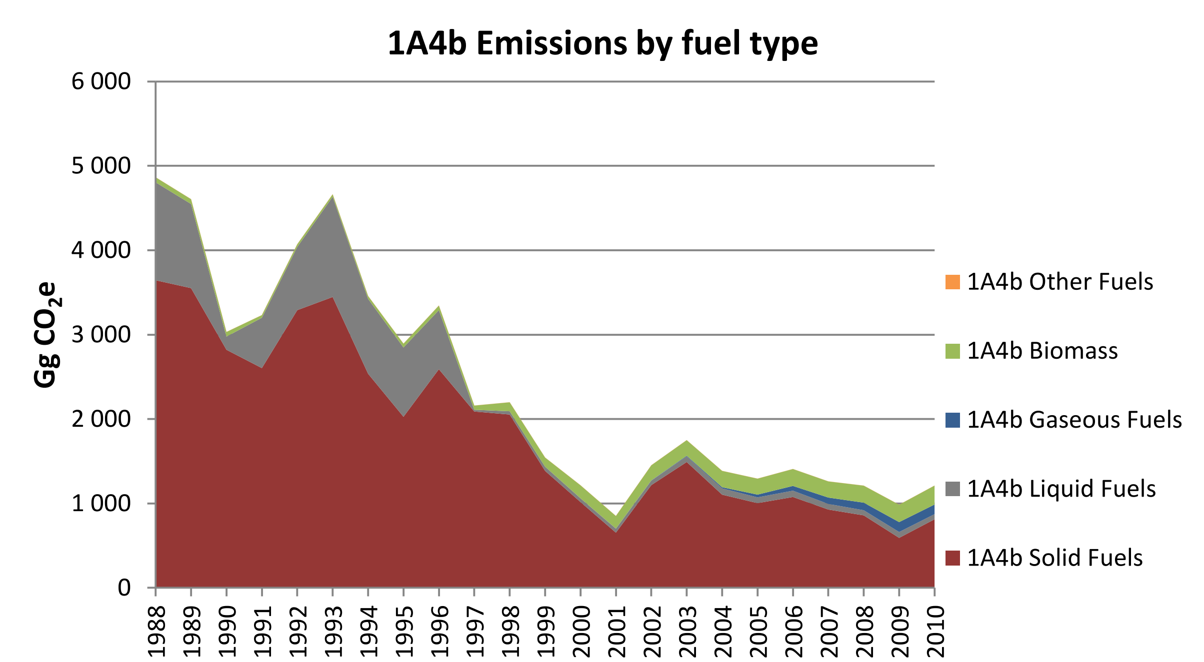


Figure 38 GHG emissions from CRF 1.A.4.b. Residential

The share in total GHG emissions from sector 1.A is 2.7% for the last year and the share from total GHGs emissions is 1.9% the year 2010.

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	1 191.93	52.39	1 136.63	2.92	2 667.1680	NO
2003	1 466.48	66.75	1 392.62	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

CO_2 (Gg)	CRF 1.A.4.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
2010	932.64	60.77	758.33	113.53	3 334.1280	NO
Decrease 1988-2010	79.54%	94.74%	77.72%	-	-274.88%	-
Decrease 1990-2010	66.58%	61.05%	71.22%	-	-312.26%	-
Decrease 2009-2010	-26.12%	12.42%	-37.08%	2.87%	-8.86%	-

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	13.2877	0.1332	10.7722	NO	2.3823	NO
1989	12.9080	0.1101	10.5191	NO	2.2788	NO
1990	10.4734	0.0134	8.2936	NO	2.1663	NO
1991	9.1018	0.0615	7.7833	NO	1.2570	NO
1992	11.1487	0.0977	9.7649	NO	1.2861	NO
1993	11.6203	0.1545	10.2859	NO	1.1799	NO
1994	9.0406	0.1114	7.5722	NO	1.3569	NO
1995	7.9831	0.1016	6.0737	NO	1.8078	NO
1996	9.9921	0.0859	7.7490	NO	2.1573	NO
1997	8.1727	0.0016	6.1844	NO	1.9866	NO
1998	10.3468	0.0041	6.1060	NO	4.2366	NO
1999	8.4039	0.0049	4.1015	NO	4.2975	NO
2000	9.1482	0.0042	3.0045	0.0000	6.1395	NO
2001	7.8613	0.0043	1.9298	0.0002	5.9271	NO
2002	10.7444	0.0047	3.5953	0.0003	7.1442	NO
2003	11.7480	0.0059	4.3681	0.0006	7.3734	NO
2004	10.9704	0.0065	3.2467	0.0012	7.7160	NO
2005	10.4843	0.0056	2.9424	0.0029	7.5333	NO
2006	11.1394	0.0063	3.1519	0.0051	7.9761	NO
2007	10.3166	0.0055	2.6797	0.0069	7.6245	NO
2008	10.5372	0.0050	2.4933	0.0081	8.0307	NO
2009	9.9417	0.0059	1.7217	0.0106	8.2035	NO
2010	11.3488	0.0052	2.4026	0.0103	8.9307	NO
Decrease 1988-2010	14.59%	96.09%	77.70%	-	-274.88%	-
Decrease 1990-2010	-8.36%	61.13%	71.03%	-	-312.26%	-
Decrease 2009-2010	-14.15%	11.68%	-39.55%	2.88%	-8.86%	-

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	0.0885	0.0064	0.0503	NO	0.0318	NO
1989	0.0845	0.0050	0.0491	NO	0.0304	NO
1990	0.0679	0.0004	0.0387	NO	0.0289	NO
1991	0.0556	0.0025	0.0363	NO	0.0168	NO
1992	0.0684	0.0056	0.0456	NO	0.0171	NO
1993	0.0726	0.0089	0.0480	NO	0.0157	NO
1994	0.0596	0.0062	0.0353	NO	0.0181	NO
1995	0.0580	0.0055	0.0283	NO	0.0241	NO

N_2O (Gg)	CRF 1.A.4.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1996	0.0696	0.0046	0.0362	NO	0.0288	NO
1997	0.0554	0.0000	0.0289	NO	0.0265	NO
1998	0.0852	0.0002	0.0285	NO	0.0565	NO
1999	0.0766	0.0002	0.0191	NO	0.0573	NO
2000	0.0960	0.0002	0.0140	0.0000	0.0819	NO
2001	0.0882	0.0001	0.0090	0.0000	0.0790	NO
2002	0.1122	0.0001	0.0168	0.0000	0.0953	NO
2003	0.1189	0.0002	0.0204	0.0000	0.0983	NO
2004	0.1182	0.0002	0.0152	0.0000	0.1029	NO
2005	0.1144	0.0001	0.0137	0.0001	0.1004	NO
2006	0.1213	0.0002	0.0147	0.0001	0.1063	NO
2007	0.1144	0.0001	0.0125	0.0001	0.1017	NO
2008	0.1190	0.0001	0.0116	0.0002	0.1071	NO
2009	0.1178	0.0002	0.0080	0.0002	0.1094	NO
2010	0.1306	0.0001	0.0112	0.0002	0.1191	NO
Decrease 1988-2010	-47.64%	97.86%	77.70%	-	-274.88%	-
Decrease 1990-2010	-92.27%	61.02%	71.03%	-	-312.26%	-
Decrease 2009-2010	-10.91%	9.08%	-39.55%	2.88%	-8.86%	-

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	36 668.20	1 452.34	52.53	1 217.33	2.92	179.5576	NO
2003	40 314.90	1 750.04	66.92	1 490.67	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
Decrease 1988-2010	33.15%	75.10%	94.75%	77.71%	-	-274.88%	-
Decrease 1990-2010	-9.28%	60.04%	61.05%	71.21%	-	-312.26%	-

GHG (Gg)	TJ	CRF 1.A.4.b.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
Decrease 2009-2010	-12.38%	-23.02%	12.41%	-37.25%	2.87%	-8.86%	-

3.3.13.3 Agriculture/Forestry/Fisheries 1.A.4.c.

Category 1.A.4.c. Agriculture/Forestry/Fisheries covers emissions from fuel combustion in the agriculture, forestry and fisheries sectors.

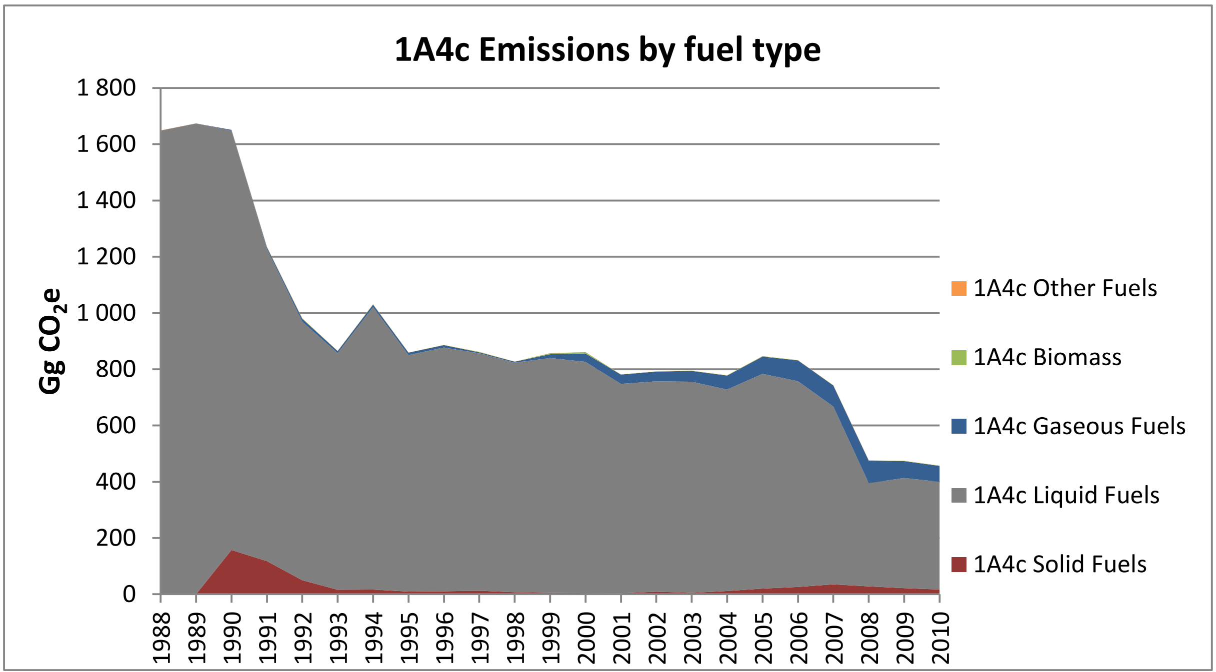


Figure 39 GHG emissions from CRF 1.A.4.c. Agriculture/Forestry/Fisheries

The share in total GHG emissions from sector 1.A is 1.0% for the last year and the share from total GHGs emissions is 0.7% the year 2010.

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	821.96	812.07	6.62	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

CO_2 (Gg)	CRF 1.A.4.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
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
Decrease 1988-2010	72.38%	76.78%	-	-	-	-
Decrease 1990-2010	72.26%	74.31%	89.29%	-1628.43%	-	-
Decrease 2009-2010	3.55%	2.26%	22.17%	5.62%	8.50%	-

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	0.2237	0.2237	NO	NO	NO	NO
1989	0.2271	0.2271	NO	NO	NO	NO
1990	0.6624	0.2022	0.4599	0.0003	NO	NO
1991	0.5440	0.1506	0.3479	0.0006	0.0450	NO
1992	0.3585	0.1244	0.1468	0.0009	0.0864	NO
1993	0.1734	0.1138	0.0473	0.0007	0.0117	NO
1994	0.2316	0.1350	0.0495	0.0008	0.0462	NO
1995	0.1537	0.1136	0.0283	0.0008	0.0111	NO
1996	0.1770	0.1174	0.0312	0.0008	0.0276	NO
1997	0.2178	0.1141	0.0362	0.0003	0.0672	NO
1998	0.1440	0.1105	0.0206	0.0003	0.0126	NO
1999	0.2701	0.1129	0.0145	0.0012	0.1416	NO
2000	0.3087	0.1111	0.0117	0.0027	0.1833	NO
2001	0.1325	0.1006	0.0094	0.0030	0.0195	NO
2002	0.1600	0.1011	0.0255	0.0031	0.0303	NO
2003	0.1588	0.1013	0.0144	0.0035	0.0396	NO
2004	0.1777	0.0969	0.0337	0.0045	0.0426	NO
2005	0.2339	0.1027	0.0591	0.0056	0.0666	NO
2006	0.2199	0.0987	0.0766	0.0067	0.0378	NO
2007	0.2227	0.0853	0.1012	0.0068	0.0294	NO
2008	0.1653	0.0492	0.0818	0.0073	0.0270	NO
2009	0.1677	0.0523	0.0640	0.0054	0.0459	NO
2010	0.1486	0.0515	0.0501	0.0051	0.0420	NO
Decrease 1988-2010	33.54%	77.00%	-	-	-	-
Decrease 1990-2010	77.56%	74.56%	89.11%	-1627.27%	-	-
Decrease 2009-2010	11.35%	1.64%	21.81%	5.63%	8.50%	-

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	0.0134	0.0134	NO	NO	NO	NO
1989	0.0136	0.0136	NO	NO	NO	NO
1990	0.0143	0.0121	0.0021	0.0000	NO	NO
1991	0.0113	0.0090	0.0016	0.0000	0.0006	NO

N_2O (Gg)	CRF 1.A.4.c.	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels
1992	0.0093	0.0075	0.0007	0.0000	0.0012	NO
1993	0.0072	0.0068	0.0002	0.0000	0.0002	NO
1994	0.0090	0.0081	0.0002	0.0000	0.0006	NO
1995	0.0071	0.0068	0.0001	0.0000	0.0001	NO
1996	0.0076	0.0070	0.0001	0.0000	0.0004	NO
1997	0.0079	0.0068	0.0002	0.0000	0.0009	NO
1998	0.0069	0.0066	0.0001	0.0000	0.0002	NO
1999	0.0088	0.0068	0.0001	0.0000	0.0019	NO
2000	0.0092	0.0067	0.0001	0.0001	0.0024	NO
2001	0.0064	0.0060	0.0000	0.0001	0.0003	NO
2002	0.0066	0.0061	0.0001	0.0001	0.0004	NO
2003	0.0067	0.0061	0.0001	0.0001	0.0005	NO
2004	0.0066	0.0058	0.0002	0.0001	0.0006	NO
2005	0.0074	0.0061	0.0003	0.0001	0.0009	NO
2006	0.0069	0.0059	0.0004	0.0001	0.0005	NO
2007	0.0061	0.0051	0.0005	0.0001	0.0004	NO
2008	0.0038	0.0029	0.0004	0.0001	0.0004	NO
2009	0.0041	0.0031	0.0003	0.0001	0.0006	NO
2010	0.0040	0.0031	0.0002	0.0001	0.0006	NO
Decrease 1988-2010	70.52%	77.20%	-	-	-	-
Decrease 1990-2010	72.31%	74.79%	89.11%	-1627.27%	-	-
Decrease 2009-2010	3.81%	1.07%	21.81%	5.63%	8.50%	-

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	11 218.31	827.12	816.45	7.08	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
Decrease 1988-2010	70.73%	72.26%	76.78%	-	-	-	-
Decrease 1990-2010	69.99%	72.30%	74.31%	89.28%	-1628.42%	-	-
Decrease 2009-2010	3.72%	3.60%	2.26%	22.15%	5.62%	8.50%	-

3.4 FUGITIVE EMISSIONS FROM SOLID FUELS AND OIL AND NATURAL GAS (CRF 1.B)

Fugitive emissions have significant share of total GHG emissions. They have share of 1.9 % of total GHG emissions for 2010. The fugitive emissions from gas and oil are also key source and had a share of approx. 0.7 % of total GHG emissions. The fugitive emissions from solid fuels are approx. 1.2 % of total GHG emissions.

3.4.1 SOURCE CATEGORY (CRF SOURCE CATEGORY NUMBER)

3.4.1.1 Coal mining (CRF 1B1)

This category includes fugitive methane emissions only.

The coal mining in Bulgaria is being carried out by strip mining and underground mining. The main domestic coals are lignite coals and they are mined by surface mining in the Maritza Iztok mining complex. The annual production amounts to 25.5 million tons. Local lignite has low calorific value – up to 1500 kcalories in kg, and high content of humidity and sulphur which makes them high energy consuming and low quality coals.

3.4.1.2 Extraction, refining, transportation and distribution of oil and natural gas (CRF 1B2)

Unlike fugitive emissions from coal mining emissions covered in this section (Oil and Gas) are a lot more complex and complicated. This section covers methane, carbon dioxide and nitrous oxide emissions.

The following tables show the trends of methane fugitive emissions from oil and gas systems: see Table 106 and

Table 107.

The CH_4 fugitive emissions from the transmission and distribution gas networks in the industry and households are estimated by the length of pipelines.

The natural gas consumption is reduced more than double in 2010, compared to 1988. It was due to curtail of industrial production from the fertilizer factories and it could not be compensated by the increasing gas consumption of households in the last years.

The quantities of transited natural gas have a steady growing trend.

Table 105 Activity data and CH_4 emissions from CRF 1.B.1 Coal mining and Handling 1988-2009

Year	1.B.1.a Coal Mining and Handling						1.B.1.b Solid Fuel Transformation	
	i. Underground Mines			ii. Surface Mines				
	AD	Post-mining EM	Mining EM	AD	Post-mining EM	Mining EM	AD	Emission
Units	kt	Gg	Gg	kt	Gg	Gg	kt	Gg
1988	4097,64	6,86	49,42	30049	2,01	24,16	1400,00	0,07
1989	4115,76	6,89	49,64	30182	2,02	24,27	1208,00	0,06
1990	3848,00	6,45	46,41	27827	1,86	22,37	1854,00	0,09
1991	3159,00	5,29	38,10	25231	1,69	20,29	1004,00	0,05
1992	3589,00	6,01	43,28	26735	1,79	21,49	1161,00	0,06
1993	3682,00	6,17	44,40	25350	1,70	20,38	1295,00	0,06
1994	3328,00	5,57	40,14	25429	1,70	20,44	1519,00	0,07
1995	3381,00	5,66	40,77	27449	1,84	22,07	1693,00	0,08
1996	3198,00	5,36	38,57	28104	1,88	22,60	1491,00	0,07
1997	2779,00	4,65	33,51	26929	1,80	21,65	1656,00	0,08
1998	1970,00	3,30	23,76	28141	1,89	22,63	1189,00	0,06
1999	1458,00	2,44	17,58	23840	1,60	19,17	1090,00	0,05
2000	1621,00	2,72	19,55	24811	1,66	19,95	1325,00	0,06
2001	1248,00	2,09	15,05	25363	1,70	20,39	1148,00	0,06
2002	1354,00	2,27	16,33	24664	1,65	19,83	1072,00	0,05
2003	1560,00	2,61	18,81	25739	1,72	20,69	1188,00	0,06
2004	383,00	0,64	4,62	26102	1,75	20,99	1174,00	0,06
2005	585,00	0,98	7,06	24110	1,62	19,38	1051,00	0,05
2006	161,00	0,27	1,94	25517	1,71	20,52	947,00	0,05
2007	475,00	0,80	5,73	27978	1,87	22,49	751,00	0,04
2008	556,00	0,93	6,71	28233	1,89	22,70	434,00	0,02
2009	698,00	1,17	8,42	26488	1,77	21,30	0,00	0,00
2010	756,00	1,27	9,12	28649	1,92	23,03	0,00	0,00

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. Expolaration	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	93,2	3,4	559,1	0,4	1234,0	6153,7	50.0	0,4	175,2	93,2	10,4	93,2	10,4
1989	93,2	3,4	559,1	0,3	1350,0	6334,8	50.0	0,5	181,2	93,2	8,3	93,2	8,3
1990	69,9	2,6	352,8	0,5	1469,0	6717,0	50.0	0,9	120,0	69,9	14,0	69,9	14,0
1991	67,6	2,5	191,6	0,4	1619,0	5661,0	50.0	0,2	90,6	67,6	10,0	67,6	10,0
1992	61,8	2,3	107,2	1,4	1644,0	5012,0	50.0	0,3	74,8	61,8	37,0	61,8	37,0
1993	50,1	1,8	242,3	2,5	1769,0	4670,0	50.0	0,3	73,5	50,1	68,0	50,1	68,0
1994	42,0	1,5	296,0	2,1	1919,0	4674,0	50.0	0,3	82,9	42,0	56,0	42,0	56,0
1995	50,1	1,8	340,0	1,8	2044,0	5638,0	50.0	0,9	96,6	50,1	49,0	50,1	49,0
1996	37,3	1,4	295,8	1,5	2205,0	5761,0	50.0	1,6	96,9	37,3	41,0	37,3	41,0
1997	32,6	1,2	253,7	1,3	2370,0	4599,0	60.0	1,0	104,3	32,6	34,0	32,6	34,0
1998	38,5	1,4	236,3	1,1	2410,0	3848,0	100.0	1,0	80,7	38,5	29,0	38,5	29,0
1999	46,6	1,7	240,4	1,0	2540,0	3322,0	200.0	1,0	60,5	46,6	27,0	46,6	27,0
2000	49,0	1,8	226,0	0,6	2645,0	3616,0	300.0	1,2	78,3	49,0	15,0	49,0	15,0
2001	39,6	1,4	227,6	0,9	2540,0	3361,0	500.0	1,5	69,1	39,6	23,0	39,6	23,0
2002	43,1	1,6	222,1	0,8	2645,0	2935,0	700.0	1,7	58,2	43,1	20,0	43,1	20,0
2003	35,0	1,3	214,3	0,6	2645,0	3058,0	911.0	2,2	59,4	35,0	16,0	35,0	16,0
2004	35,0	1,3	224,7	12,4	2645,0	3092,0	1268.0	2,7	63,5	35,0	330,0	35,0	330,0
2005	35,0	1,3	263,1	17,9	2645,0	3466,0	1577.0	3,9	74,1	35,0	526,0	35,0	526,0
2006	32,6	1,2	302,4	17,4	2645,0	3539,0	1870.0	5,6	73,9	32,6	510,0	32,6	510,0
2007	30,3	1,1	301,8	11,0	2645,0	3582,0	2290.0	6,3	77,9	30,3	290,0	30,3	290,0
2008	28,0	1,0	304,0	7,3	2645,0	3508,0	2710.0	7,2	74,7	28,0	214,0	28,0	214,0
2009	29,1	1,1	265,7	0,6	2645,0	2609,0	3164.0	6,6	46,8	29,1	17,0	29,1	17,0
2010	26,8	1,0	232,9	2,7	2645,0	2795,0	3493.0	7,2	51,0	26,8	73,0	26,8	73,0

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. Expolaration	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
1988	0,0181	0,0090	0,4920	0,0888	1,6536	0,0335	48,9703	0,0619	0,8112	0,0019	0,0020	0,0000
1989	0,0181	0,0090	0,4920	0,0708	1,8090	0,0335	50,6504	0,0637	0,8112	0,0015	0,0020	0,0000
1990	0,0136	0,0068	0,3105	0,1142	1,9685	0,0335	33,5389	0,1186	0,6084	0,0025	0,0015	0,0000
1991	0,0131	0,0065	0,1686	0,0856	2,1695	0,0335	25,3291	0,0324	0,5881	0,0018	0,0014	0,0000
1992	0,0120	0,0060	0,0943	0,3189	2,2030	0,0335	20,8993	0,0449	0,5374	0,0067	0,0013	0,0001
1993	0,0097	0,0048	0,2132	0,5759	2,3705	0,0335	20,5564	0,0434	0,4360	0,0124	0,0011	0,0001
1994	0,0081	0,0041	0,2605	0,4797	2,5715	0,0335	23,1770	0,0477	0,3650	0,0102	0,0009	0,0001
1995	0,0097	0,0048	0,2992	0,4179	2,7390	0,0335	26,9955	0,1304	0,4360	0,0089	0,0011	0,0001
1996	0,0072	0,0036	0,2603	0,3482	2,9547	0,0335	27,0838	0,2285	0,3245	0,0075	0,0008	0,0001
1997	0,0063	0,0032	0,2233	0,2967	3,1758	0,0402	29,1636	0,1338	0,2839	0,0062	0,0007	0,0001
1998	0,0075	0,0037	0,2079	0,2470	3,2294	0,0670	22,5612	0,1398	0,3346	0,0053	0,0008	0,0001
1999	0,0090	0,0045	0,2115	0,2247	3,4036	0,1340	16,9212	0,1417	0,4056	0,0049	0,0010	0,0001
2000	0,0095	0,0047	0,1989	0,1301	3,5443	0,2010	21,8971	0,1645	0,4259	0,0027	0,0010	0,0000
2001	0,0077	0,0038	0,2003	0,1936	3,4036	0,3350	19,3202	0,2122	0,3448	0,0042	0,0008	0,0000
2002	0,0084	0,0042	0,1954	0,1707	3,5443	0,4690	16,2786	0,2349	0,3752	0,0036	0,0009	0,0000
2003	0,0068	0,0034	0,1886	0,1355	3,5443	0,6104	16,5998	0,3098	0,3042	0,0029	0,0007	0,0000
2004	0,0068	0,0034	0,1978	2,8221	3,5443	0,8496	17,7415	0,3800	0,3042	0,0601	0,0007	0,0007
2005	0,0068	0,0034	0,2315	4,0597	3,5443	1,0566	20,7188	0,5464	0,3042	0,0957	0,0007	0,0011
2006	0,0063	0,0032	0,2662	3,9478	3,5443	1,2529	20,6595	0,7851	0,2839	0,0928	0,0007	0,0010
2007	0,0059	0,0029	0,2656	2,4893	3,5443	1,5343	21,7742	0,8786	0,2636	0,0528	0,0006	0,0006
2008	0,0054	0,0027	0,2675	1,6510	3,5443	1,8157	20,8912	1,0050	0,2434	0,0389	0,0006	0,0004
2009	0,0057	0,0028	0,2338	0,1382	3,5443	2,1199	13,0708	0,9267	0,2535	0,0031	0,0006	0,0000
2010	0,0052	0,0026	0,2049	0,6240	3,5443	2,3403	14,2565	0,9992	0,2332	0,0133	0,0006	0,0001

3.4.1.3 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, 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			iv. Refining / Storage
AD	National Energy Balance	AD	National Energy Balance
EF	2006 IPCC Guidelines	EF	Revised 1996 IPPC Guidelines
Em = EF x AD			Em = EF x AD
ii. Production			
AD	National Energy Balance		
EF	Revised 1996 IPPC Guidelines		
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 IPPC Guidelines	AD	National Energy Balance
Em = EF x AD		EF	Revised 1996 IPPC Guidelines
iii. Transmission			Em = EF x AD
AD	National Energy Balance		in residential and commercial sectors
EF	2006 IPCC Guidelines	AD	National Energy Balance
Em = EF x AD		EF	Revised 1996 IPPC Guidelines
iv. Distribution			Em = EF x AD
AD	National Energy Balance		
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 IPPC Guidelines
Em = EF x AD			Em = EF x AD
ii. Gas			ii. Gas

AD	National Energy Balance	AD	National Energy Balance
EF	Revised 1996 IPPC 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	2006 IPCC Guidelines
Em = EF x Conv. Factor x AD	
1.B.1.b Solid Fuel Transformation	
AD	National Energy Balance
EF	2006 IPCC Guidelines
Em = EF x AD	

Some of 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.

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.

Besides the fugitive CH_4 and CO_2 emissions, significant NMVOCs emissions from gasoline refueling at gasoline stations, and from its delivery from refineries, as well as NOx, CO and NMVOCs emissions from burning the refinery flame torch, can be seen. These emissions were structured and calculated in sector Industrial processes.

As part of planned improvement N_2O emission are calculated. These emissions do not create any significant increase to the overall fugitive emissions.

3.4.1.4 Uncertainties and time-series consistency

The uncertainty of this emission source category was estimated as follows:

200 % for coal mining;

50 % for oil and natural gas systems.

3.4.1.5 Source-specific QA/QC and verification, if applicable

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

3.4.1.6 Source-specific recalculations, if applicable, including changes made in response to the review process

There are significant recalculations in category 1B1 mainly due to changes in activity data provided by National Statistical institute. Changes are related to the different methodology of reporting coal type quantities during the years and allocation method between coal types. This year activity data is standardized and there is no need for expert allocation between coal types. From this year on activity data for coals will be used directly from the energy balance of National Statistical Institute.

High decrease in GHG emission in category 1B1 is caused by last year intention to avoid underestimation. It was clear that calculations for 2009 were overestimated, but due to lack of activity data decision for overestimation was taken.

There are also some changes in used EF. All EF in category 1B2 are for developed countries from 2006 IPCC – Table 4.2.4.

3.4.1.7 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 2010.

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 2010 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 2010 the most important emitting category is Mineral products (mainly clinker production) which share in the total Industrial processes emissions is 64.45%. The second category by share is Chemical Industry (ammonia and nitric acid production) with 26.52%, followed by Consumption of Halocarbons and SF_6 with 7.63% share and finally Metal Production (steel) with 1.40%.

These results are presented in the following table:

Table 108 GHG Emission trends in CRF 2 Industrial processes, 1988 - 2010

	Emissions [Gg CO_2 eq]		Share [%]		Trend
	Base year*	2010	Base year*	2010	1988 – 2010 [%]
2 Industrial processes	12404,17	3852,01	100,00	100,00	-68,95
2.A Mineral products	4373,68	2482,48	35,26	64,45	-43,24
2.B Chemical Industry	5026,88	1021,68	40,53	26,52	-79,68
2.C Metal Production	2992,53	53,79	24,13	1,40	-98,20
2F Consumption of Halocarbons and SF_6	3,46	294,05	0,03	7,63	8400,59

* Base year 1988

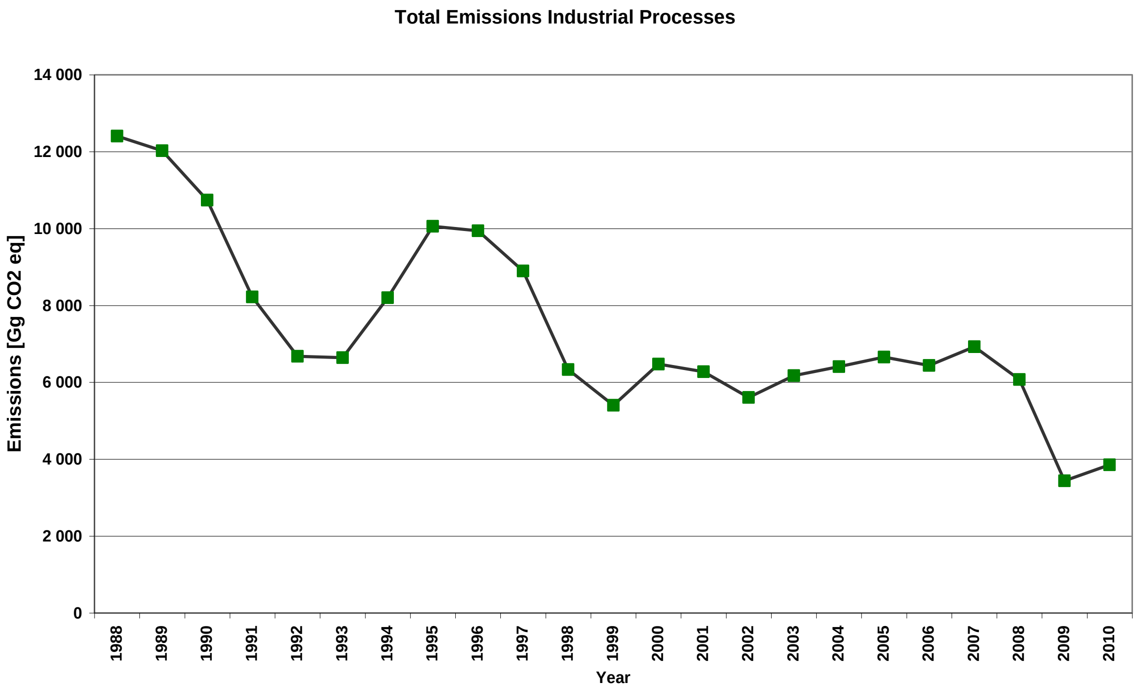


Figure 40 CO_2 Emission trends for CRF Sector 2 Industrial Processes for 1988-2010

In the year 2010, 6.27% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes, compared to 9.66% in the base year 1988. In 2010, greenhouse gas emissions from Category 2 Industrial Processes are 3852.01 Gg CO_2 equivalent compared to 12404.16 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 68.95% in 2010 while the biggest reduction (compared to the base year) is in Metal Production category – 98.20%.

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 – 2010 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 2010.

Table 109 GHG emissions from CRF 2 Industrial Processes by gas in the base year and in 2010

GHG	Base year*	2010	Base year*	2010
	CO_2 equivalent [Gg CO_2 eq]		[%]	
Total	12404,17	3852,01	100,00	100,00
CO_2	10520,13	3289,32	84,81	85,39
CH_4	90,04	1,14	0,73	0,03
N_2O	1790,54	267,50	14,43	6,94
HFCs	0,00	280,94	0,00	7,29
PFCs	0,00	0,04	0,00	0,00
SF_6	3,46	13,07	0,03	0,34

*1988 for: CO_2, CH_4, N_2O

*1995 for: HFCs, PFCs, SF_6.

The most important GHG of the industrial processes sector is CO_2 with 85.39% of the total emissions from this category in 2010, followed by N_2O with 6,94 %, HFCs with 7,29%, SF_6 with 0, 43%, CH_4 with 0.03% and finally PFCs with <0,01%.

Table 110 GHG Emissions from CRF 2 Industrial Processes by gases from 1988 to 2010

GHG emissions [Gg CO_2 eq]							
Year	**Total**	**CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**
1988	12 404,17	10 520,13	90,04	1 790,54	0,00	0,00	3,46
1989	12 025,64	10 356,81	89,60	1 575,57	0,00	0,00	3,66
1990	10 740,72	9 163,07	70,47	1 503,30	0,00	0,00	3,87
1991	8 219,71	7 151,81	51,64	1 011,44	0,00	0,00	4,82
1992	6 677,91	5 788,35	48,92	836,30	0,00	0,00	4,33
1993	6 643,31	5 867,35	56,80	714,56	0,01	0,00	4,59
1994	8 200,31	7 313,70	73,86	807,89	0,02	0,00	4,85
1995	10 060,95	8 759,22	81,21	1 213,00	2,39	0,00	5,13
1996	9 940,72	8 606,84	76,08	1 248,17	4,20	0,00	5,43
1997	8 898,65	7 867,49	81,26	937,78	6,38	0,00	5,75
1998	6 330,55	5 726,62	65,43	522,29	10,14	0,00	6,08
1999	5 400,62	4 911,16	55,87	412,81	14,34	0,00	6,43
2000	6 475,54	5 806,22	56,81	587,76	17,95	0,00	6,80
2001	6 275,53	5 586,18	55,27	598,29	28,60	0,00	7,20
2002	5 604,40	5 004,69	48,36	502,55	41,17	0,00	7,62
2003	6 176,75	5 500,07	59,26	550,67	58,69	0,00	8,06
2004	6 408,92	5 647,87	49,63	624,59	78,31	0,00	8,53
2005	6 656,68	5 794,71	46,98	705,41	101,02	0,00	8,56
2006	6 437,68	5 680,26	45,01	539,34	164,18	0,00	8,89
2007	6 926,06	6 072,53	40,47	604,11	199,71	0,00	9,24
2008	6 074,58	5 162,75	21,54	579,97	300,72	0,00	9,60
2009	3 438,26	2 886,52	1,35	271,88	268,52	0,01	9,97
2010	3 852,01	3 289,32	1,14	267,50	280,94	0,04	13,07

The emission trends of the three GHG – CO_2, CH_4 and N_2O, are presented on the following figure.

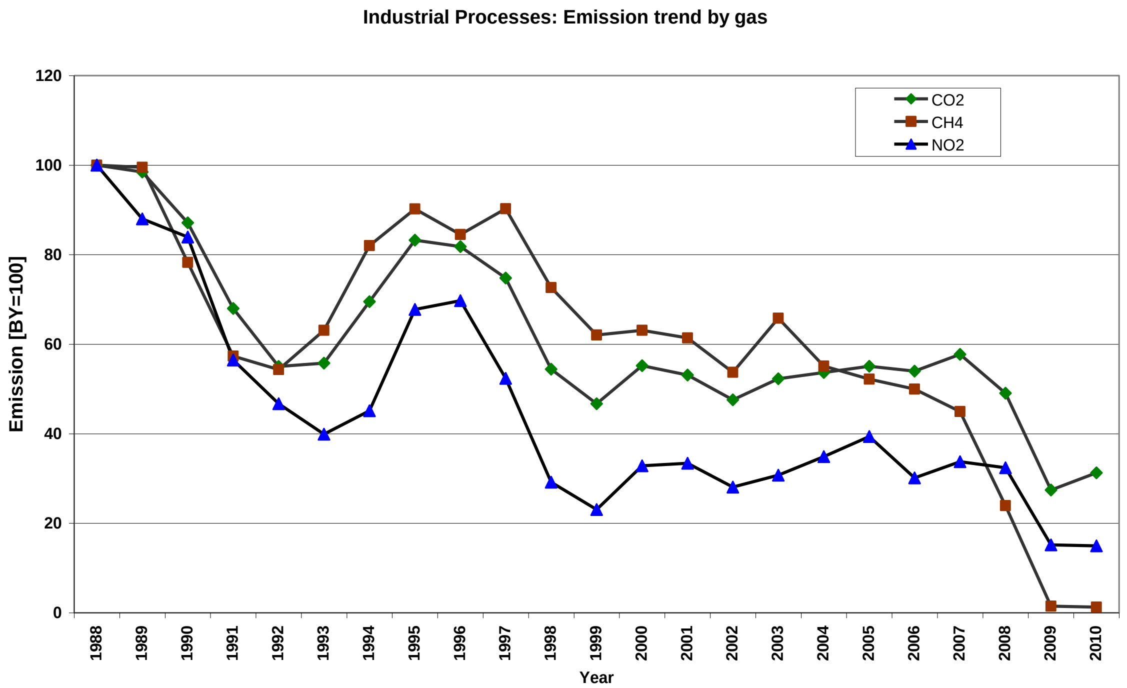


Figure 41 Industrial Processes: Emission trend by gas – CO_2, N_2O, CH_4

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 64.45% and 26.52%, respectively, of the emissions from this sector in 2010.

Table 111 GHG Emissions from CRF 2 Industrial Processes by sector 1988 to 2010

GHG emissions [Gg CO_2 eq]				
Year	**Mineral Products**	**Chemical Industry**	**Metal Production**	**Consumption of Halocarbons and SF_6**
1988	4373,68	5026,88	2992,53	3,46
1989	4256,89	4810,42	2947,78	3,66
1990	3906,81	4693,99	2130,83	3,87
1991	2586,34	3968,87	1656,63	4,82
1992	2008,83	3210,18	1451,61	4,34
1993	1962,88	2899,99	1772,38	4,59
1994	2408,68	3213,09	2569,82	4,87
1995	3239,55	4060,58	2749,17	7,52
1996	3238,07	4087,08	2601,66	9,63
1997	2621,89	3359,65	2900,79	12,12
1998	1991,95	1878,15	2440,43	16,22
1999	1816,01	1363,07	2199,25	20,77
2000	2120,11	2147,30	2183,37	24,75
2001	2256,93	2007,21	1975,60	35,79
2002	2272,35	1399,15	1884,11	48,79
2003	2343,27	1422,51	2344,22	66,75
2004	2594,58	1720,89	2006,62	86,83
2005	2808,80	1876,19	1862,12	109,58
2006	2939,66	1489,88	1835,07	173,07
2007	3460,41	1617,47	1639,23	208,95
2008	3474,00	1573,47	716,79	310,32
2009	2215,62	864,69	79,44	278,51
2010	2482,48	1021,68	53,79	294,05

Figure 42 presents greenhouse gas emissions from IPCC Category 2 Industrial Processes by sub category for the years 1988 to 2010.

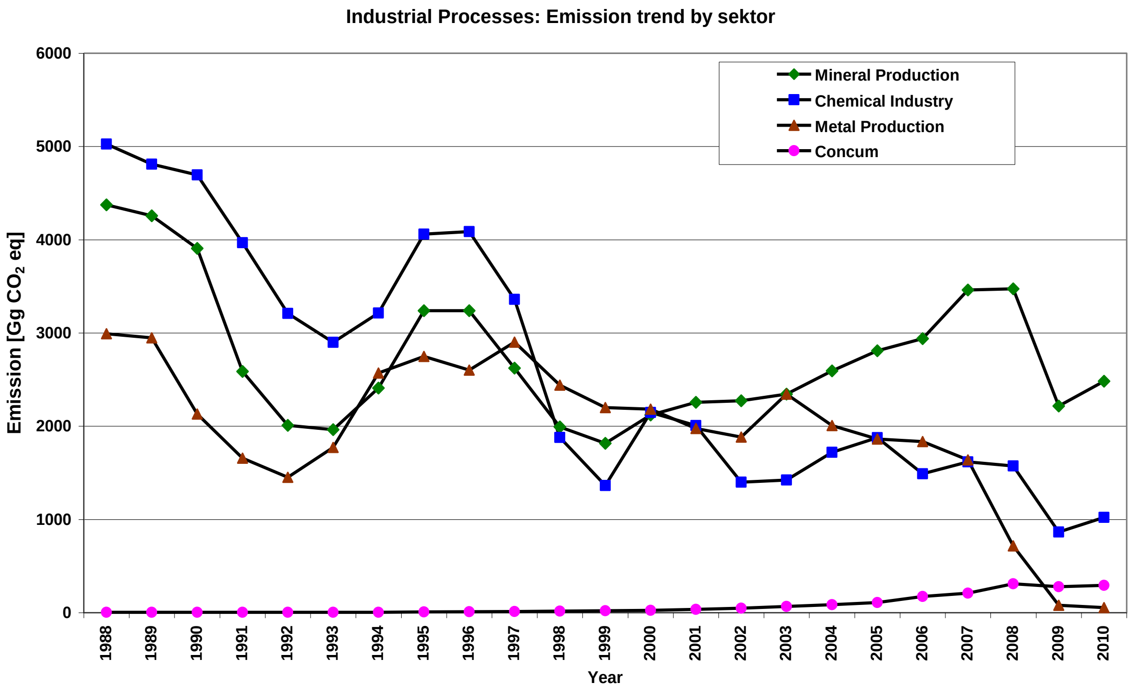


Figure 42 CRF 2 Industrial Processes: Emission trend by sector – [Gg CO_2 eq]

There is general reduction of the total emission in the Industrial Processes sector in 2010 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 2010 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 68.95% in 2010 while the biggest reduction (compared to the base year) is in Metal Production category – 98.20%, followed by Chemical Industry with 79.68% and Mineral Products with 43.24%.

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 2010 is about 44%.

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 2010 the market was recovered.

In 2010 the emission reduction in the entire Industrial Processes sector is observed in the Mineral Products category. One reason for the general sector production reduction is the reduction in the construction works. There is a significant reduction in the production rates of some of the clinker plants as well as in the ceramics plants. A factor for the lime production reduction, hence for the Mineral Products sector, is the ceased operation (in November 2008) of one of the lime producers (integrated steel making plant). In 2010 the increase of the sector production varies from 10% to 20% for the different categories compared to 2009.

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 2007-2010. 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.

During 2010 cement produced 99.6% are Portland cement, i.e. the other types of cement are only 0.4% from the total annual national production. All types of produced cements are according to BSS EN 197-127.

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 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 2010 compared to 2009. This is mainly due to that one from the 5th existing/operational installation was the decrease substantially its production with 96% during 2010.

[27] Cement. Composition, specifications and conformity criteria for low heat common cements

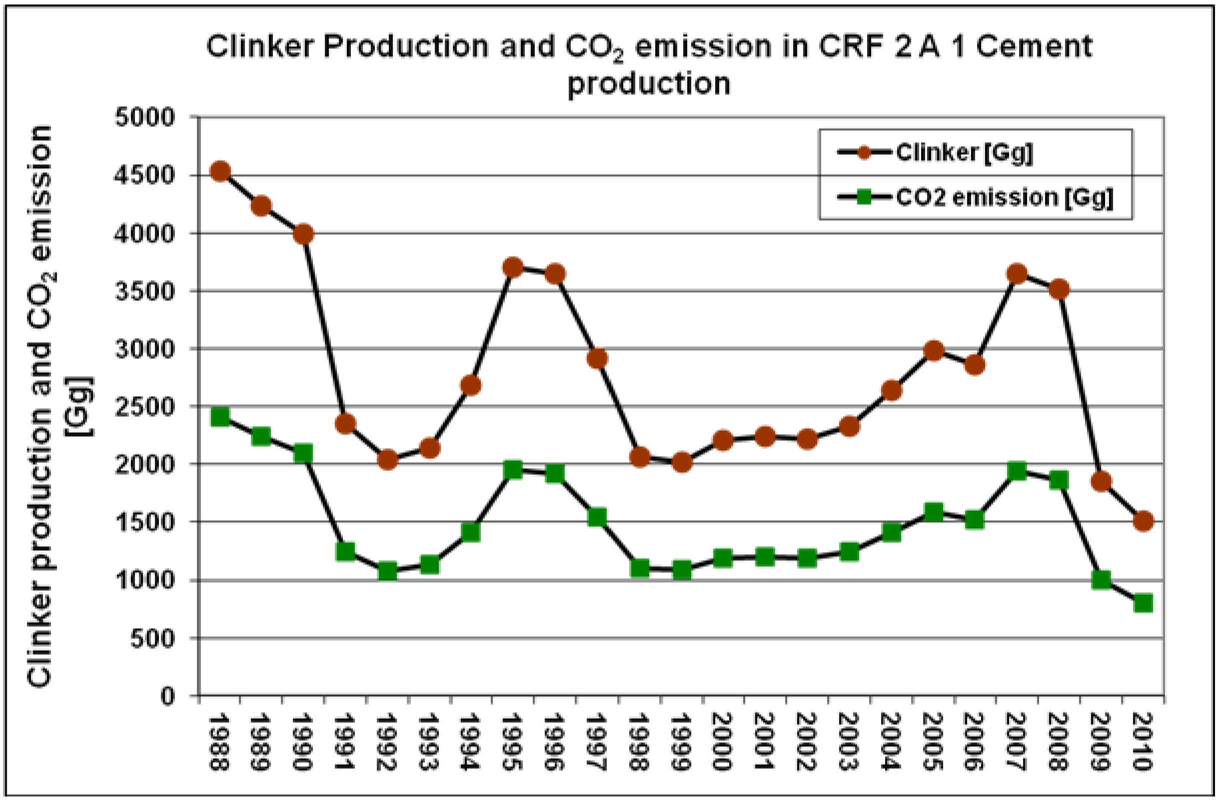


Figure 43 Clinker Production and CO_2 emission in CRF 2 A 1 Cement production

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. 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 = 0,531647• CP • 1.0 = 0,531647• CP **(for 2010)**

The 2010 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 2010. 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	2406,36
1989	4232,71	0,785	0,659	1,092	0,012	0,531	2245,83
1990	3986,62	0,785	0,655	1,092	0,012	0,527	2100,43
1991	2354,10	0,785	0,655	1,092	0,012	0,527	1239,98
1992	2041,10	0,785	0,656	1,092	0,011	0,527	1075,59
1993	2143,81	0,785	0,655	1,092	0,012	0,528	1131,19
1994	2680,61	0,785	0,655	1,092	0,012	0,527	1412,45
1995	3700,60	0,785	0,656	1,092	0,012	0,528	1953,60
1996	3645,10	0,785	0,655	1,092	0,012	0,527	1922,10
1997	2921,99	0,785	0,656	1,092	0,012	0,528	1542,18
1998	2063,45	0,785	0,660	1,092	0,012	0,531	1096,52
1999	2018,72	0,785	0,666	1,092	0,013	0,537	1084,77
2000	2211,23	0,785	0,668	1,092	0,012	0,537	1187,81
2001	2239,65	0,785	0,668	1,092	0,012	0,538	1204,32
2002	2222,32	0,785	0,666	1,092	0,012	0,536	1190,90
2003	2327,30	0,785	0,665	1,092	0,013	0,536	1247,57
2004	2644,37	0,785	0,664	1,092	0,013	0,535	1415,94
2005	2981,62	0,785	0,660	1,092	0,013	0,532	1586,36
2006	2859,79	0,785	0,659	1,092	0,013	0,531	1519,30
2007	3644,85	0,785	0,660	1,092	0,013	0,532	1940,55
2008	3509,82	0,785	0,658	1,092	0,013	0,531	1862,44
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
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.

All 15 verification reports (for 2008, 2009 and 2010) are public available at http://nfp-bg.eionet.eu.int/bul/About/RR/R_TE/Verif_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.

Recommendation of FCCC/ARR/2010/BGR **Clinker production -** CO_2
91. The ERT commends Bulgaria for the improvement in its documentation of methodologies, AD, EFs, and so on, in the NIR. However, the ERT identified improvements including for the NIR to include, in separate sections, information on: carbide production and ferroalloys production; flue gas desulphurization; missing detail on the non-confidential

country-specific parameters (e.g. calcium oxide (CaO) and magnesium oxide (MgO) contents, the types of cement and lime produced, etc.); and EFs and AD (e.g. for limestone and dolomite use, feedstocks for ammonia and iron and steel production) in the cement, lime, limestone and dolomite, soda ash, glass, ceramics and iron and steel sections. In some cases, the calculation sheets lack transparency in: the labelling of data sources; calculations and assumptions; and QC. The ERT recommends that Bulgaria revise the chapter on industrial processes in the NIR to ensure that it provides the level of information to understand the basis and rationale behind AD, EFs and parameters, assumptions and methods where possible, and to further elaborate its calculation sheets with details of data sources, assumptions and QC.

Description of the types of cement and produced is included.

92. The ERT notes that recalculations undertaken in this sector have resulted in considerable improvement to the industrial processes inventory. Recalculations have been performed to account for higher-tier 2/3 methods and country-specific data that have been used in the subsector consumption of halocarbons and SF_6 and in the activities cement, lime, glass, ceramics, nitric acid production, ammonia production and steel production (using data for electric arc furnaces). These recalculations have been performed for all years of the inventory time series.

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):

$$\mathbf{CaCO_3 \text{ (high-purity limestone)} + heat = CaO \text{ (quicklime)} + CO_2}$$

Currently there are 4 lime producing plants in Bulgaria which fall under IPPC and EU ETS. They produce quicklime and 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 increase of the total emission in the sector in 2010 compared to 2009. This is mainly due to that the biggest producer increases the lime production with 45% in 2010. This lead to increase of the quicklime production which for the whole sector is about 45%.

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.

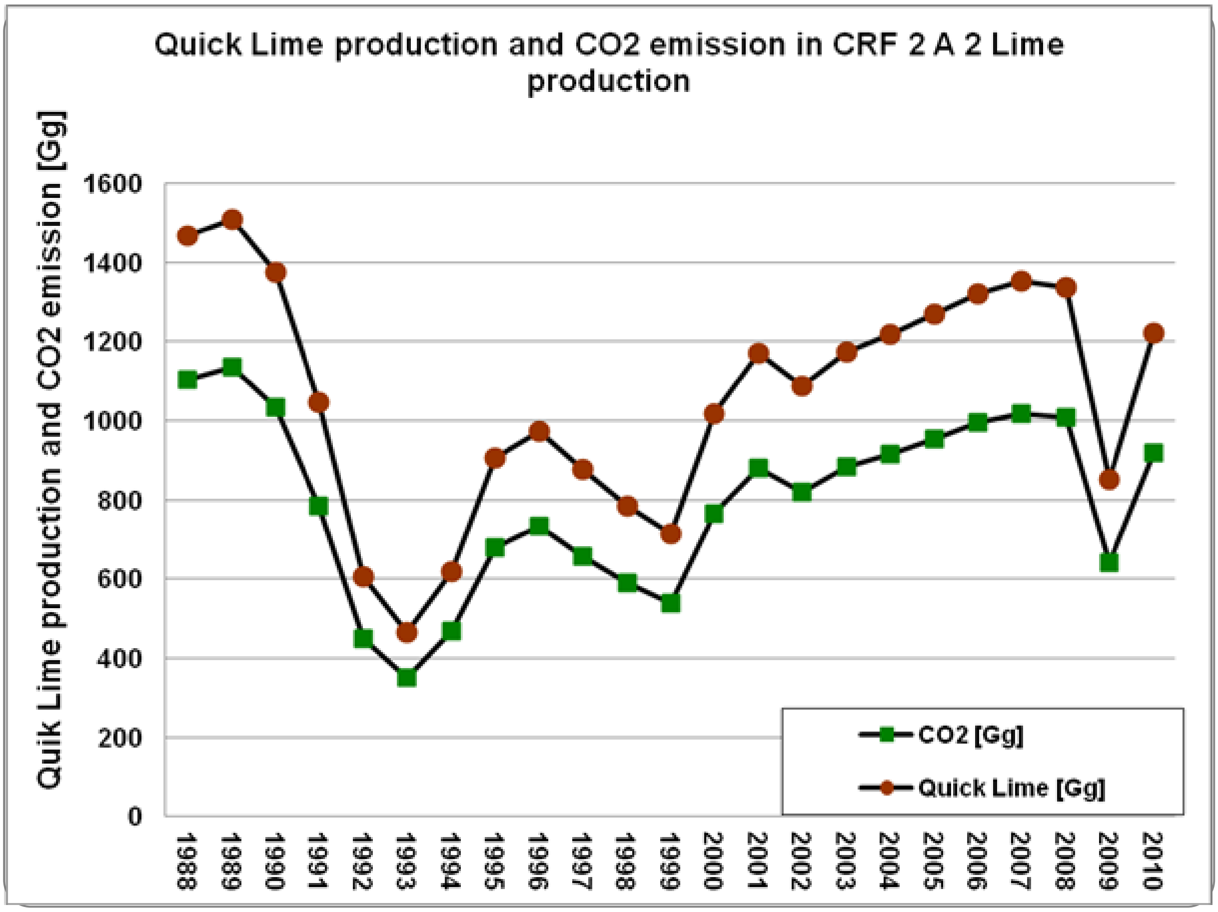


Figure 44 Lime Production and CO_2 emission in CRF 2.A.2 Lime production

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 2000 GPG (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 2000 GPG 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.

Issue 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 [kg CO_2/ ton 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	0,752	640,62
2010	1222,43	0,752	919,57

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

Improvements with regard to transparency, documentation and archiving of all information required in NIR, background documentation and archive.

In general the TACCC is improved.

The recommendations of the ARR, which were very helpful, are fully incorporated and leaded to recalculation.

During the review the new calculations were presented and discussed. The incorporation of the revised methodology, new activity data, emission factor and CaO content lead to a recalculation compared to submission of the NIR and CRF (August 2010). In the submission of the CRF tables (November 2010) the new data were already included.

Recommendation of FCCC/ARR/2010/BGR **Lime production -** CO_2

95. Bulgaria estimated CO_2 emissions from lime production using IPCC default EFs for high-calcium quicklime (785 kg CO_2/t high-calcium quicklime) from the IPCC good practice guidance. During the review week, Bulgaria confirmed that for the years 1988-1997, its national statistics separated the production of high-calcium and dolomitic quicklime with a ratio of between 86/14 and 92/8 (calcium/dolomitic). However, for the years 1998-2008, the Party's national statistics did not separate the production of calcium and dolomitic quicklime and 100 per cent calcium quicklime production is assumed. The ERT concluded that this is an underestimation.

During the review the new calculations were presented and discussed; the data are now revised due to the following recommendations.

96. In response to questions from the ERT, Bulgaria submitted revised estimates on 9 October 2010 and further clarification on 8 November 2010 on the sources of data requested by the ERT. The ERT concluded that these estimates have been prepared in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. The ERT recommends that Bulgaria report on this recalculation, including its rationale, in its next annual submission. The ERT also recommends that Bulgaria include information in its next annual submission on data sources, EFs and associated parameters, methods and assumptions to ensure that all estimates can be independently verified.

During the review the new calculations were presented and discussed. The incorporation of the revised methodology, new activity data, emission factor and CaO content lead to a recalculation. The description of these revisions is provided above.

111. For lime production:

(a) Obtain from the Association of Lime Producers country-specific data on the content and type of lime produced, country-specific ratio and EFs;

(b) Increase transparency in the reporting of this activity in the NIR.

Not all companies are not member of the Association of Lime Producers and unfortunately the biggest company is also not member. Furthermore the input (type of limestone) of the non-members are different to these of the members. Therefor the data from the association is only used for verification. In the future it is intended to get plant specific data.

A full description of the revised methodology, new activity data, emission factor and CaO content is provided above.

4.2.2.6 SOURCE SPECIFIC PLANNED IMPROVEMENTS

Further check on the scope of all plants producing lime (activity data and relevant parameter) to ensure completeness of the emissions.

4.2.3 LIMESTONE AND DOLOMITE USE (CRF 2.A.3)

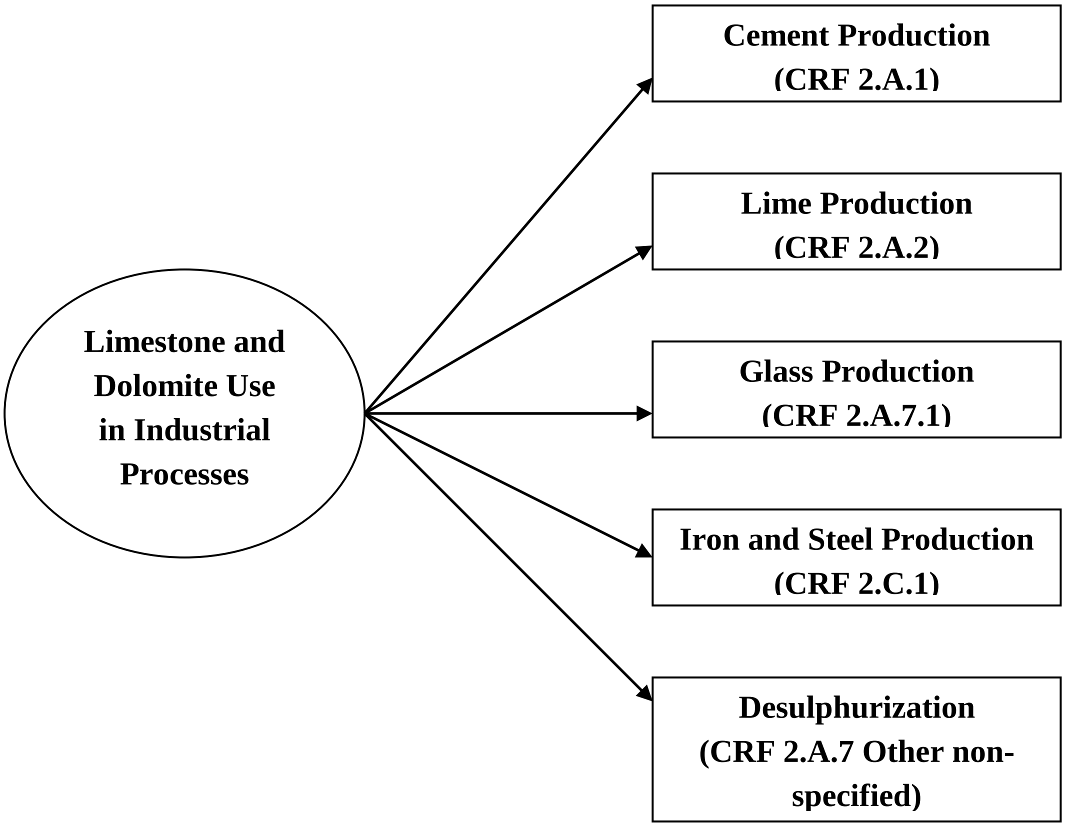
4.2.3.1 SOURCE CATEGORY DESCRIPTION

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.

Recommendation of FCCC/ARR/2010/BGR   Limestone and dolomite use - CO_2

102. Bulgaria reported emissions from limestone and dolomite use under a number of categories, namely cement, lime, glass, ceramics and bricks production, based on detailed data collected from industry. Further, Bulgaria reported lime production used in the iron and steel industry under limestone and dolomite use. In response to a question from the ERT during the review week, Bulgaria confirmed that it does not collect national statistics on total limestone and dolomite use and therefore could not verify that all emissions from limestone and dolomite use are accounted for in the GHG inventory submitted on 13 August 2010. In response to further questions from the ERT on 9 October 2010 and 8 November 2010, Bulgaria provided additional information in its resubmission of 22 October 2010 to confirm that there were no additional users of limestone and dolomite compared with those already accounted for in the 13 August 2010 resubmission, and also confirmed double counting in emissions (limestone and dolomite use (2.A.3) and lime production (2.A.2) that had been subsequently rectified by the Party in its resubmission of 22 October 2010. In its response, Bulgaria also confirmed that it would continue to look for data on total production, imports and exports to cross-check estimates in the future. The ERT recommends that Bulgaria provide this information in its next annual submission, including in the respective chapter of the NIR a description and a table that illustrate the production, imports and exports, and users of limestone and dolomite and to which categories emissions are attributed if estimates are to be included under the category glass production reported under other (mineral products).

A description of how the emissions from the limestone and dolomite usage are reported as well as diagram describing where they are accounted is provided.

112. For limestone and dolomite: to update and revise AD and EFs and to improve documentation of these in the NIR.

A description of how the emissions from the limestone and dolomite usage are reported as well as diagram describing where they are accounted is provided.

4.2.3.2 SOURCE SPECIFIC PLANNED IMPROVEMENTS

Continue looking for data on total production, imports and exports to cross-check estimates in the future.

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 increase of the total emission in the sector in 2010 compared to 2009. This is mainly due to the increase of soda ash use in another sectors (glass production, metal production, ceramics and etc.).

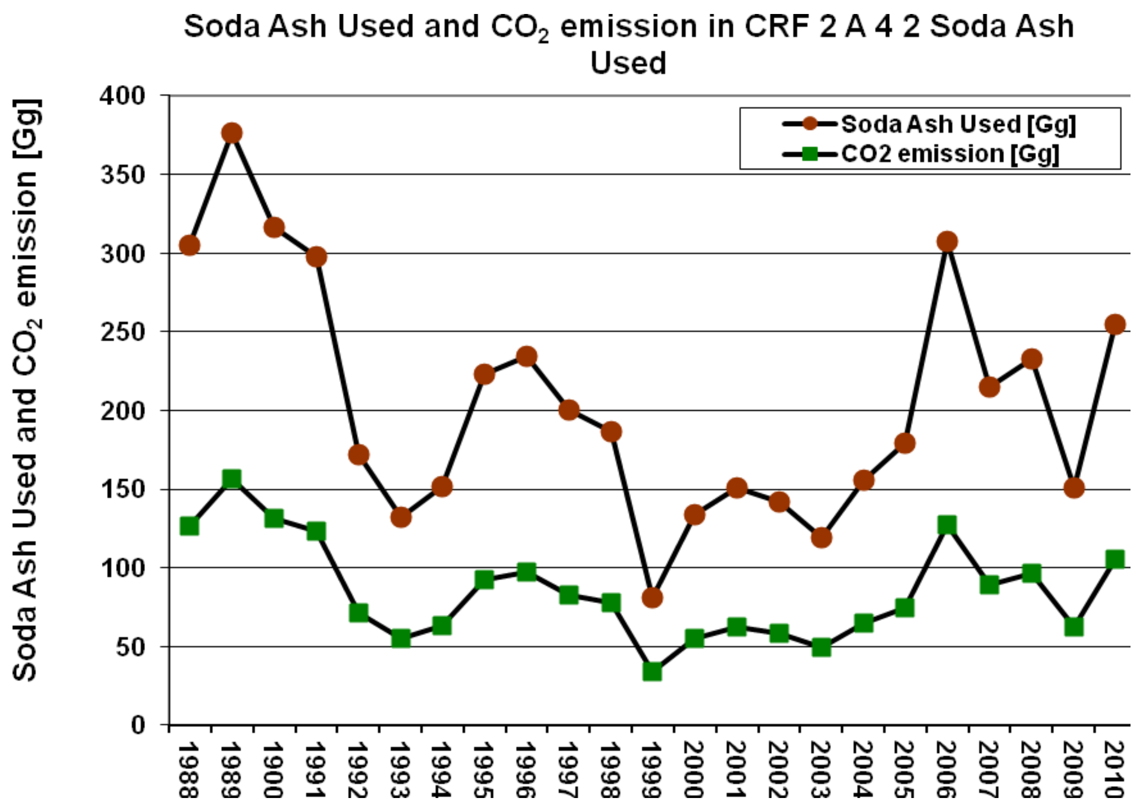


Figure 45 Soda ash used and CO_2 emission in CRF 2.A.4.2

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:

$$\textbf{TOTAL } CO_2 = \textbf{AD} \bullet \textbf{EF}$$

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

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 2010.

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).

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
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

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

The following improvements were undertaken:

Revision of the reporting of Soda ash production considering the applied technological process in order to avoid double counting.
Revision of the activity data for Soda ash use of the entire time series by using soda ash mass balance based on plant specific (EU ETS reports) and statistical data.

Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive.

In general the TACCC is improved.

The recommendations of the ARR, which were very helpful, are fully incorporated and leaded to recalculation.

Recommendation of FCCC/ARR/2010/BGR	Soda ash production and use – CO_2

103. Bulgaria estimated emissions from soda ash use based on detailed data collected from industry and with use of the factor 415 kg CO_2/t sodium carbonate (Na2CO3) based on the stoichiometry of the chemical process. However, Bulgaria confirmed that it does not collect statistics on total national soda ash use and could not verify that all emissions from soda ash use are accounted for in the GHG inventory submitted on 13 August 2010, hence there could be an underestimate in emissions. Further, the ERT found that Bulgaria had collected additional industry-specific data on emissions from the use of soda ash in the glass industry, and that reported emissions from the use of soda ash in the glass industry (59.5 Gg CO_2) are higher than the emissions for soda ash submitted on 13 August 2010 (57.3 Gg CO_2).

104. In its questions on 9 October 2010, the ERT recommended that Bulgaria revise its emission estimates from soda ash use taking into account specific data from the glass industry and by obtaining statistics on soda ash production, imports and exports. In response to questions from the ERT, Bulgaria submitted revised estimates on 22 October 2010 for soda ash use using statistics on soda ash production, imports and exports obtained from the NSI. The EF for these revised estimates is based on the stoichiometric ratio of Na2CO3. The ERT is satisfied that these emission estimates are prepared in line with the Revised 1996 IPCC Guidelines. The ERT recommends that Bulgaria provide this information in its next annual submission and that it include in the chapter of the NIR on soda ash use a description and a table that illustrate the production, imports and exports, and users of soda ash and which categories (glass, ceramics) emissions are attributed to.

A full description of the revised activity data and emission factor is provided above.

113. For soda ash production and use: to improve QA/QC procedures and to confirm emission estimates by comparing with emissions calculated using alternative approaches.

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 increase of the total emission in the sector in 2010 compared to 2009. This is mainly due to the slightly increase in production after the economical crises.

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.

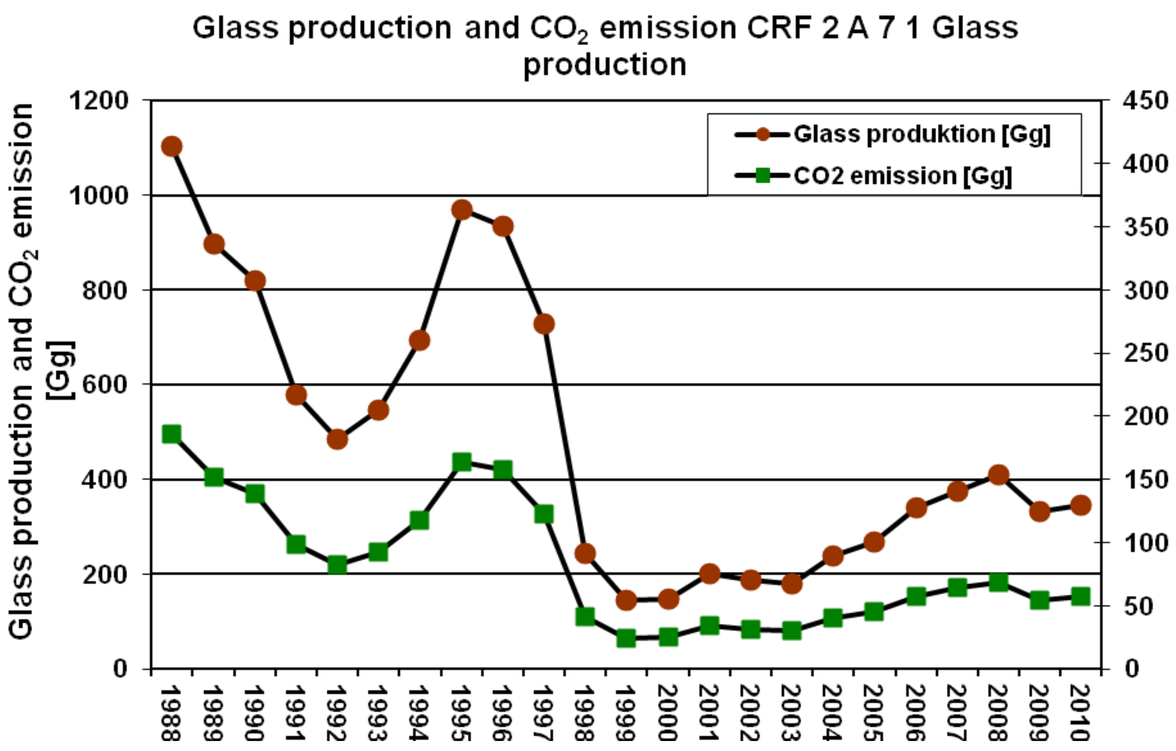


Figure 46 Glass Production and CO_2 emission in CRF 2.A.7.1. Glass production

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 and that good practice guidance has not yet been developed for the glass production (2000 IPCC GPG, 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 - 2010 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 - 2010 plant specific (for five plants) emission factors were calculated on the basis of data from IPPC and ETS reports (see Table 115). 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 were available for the years 2007 - 2010. For the time series 1988 – 2010 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:

In order to avoid double counting, the quantity 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.3Glass 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
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

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

The following improvements were undertaken:

Revision of the activity data by using IPPC permits reports and EU ETS data as well as statistical data for crosscheck.
Revision of the emission factor for glass production based on plant specific data.
Revision of the emission estimates taking into account CaO and MgO content from industry-specific data and statistical data. With this revision the previous emissions underestimation is corrected.
Improvements with regard to transparency, documentation and archiving of all information required in NIR, background documentation and archive.
In general the TACCC is improved.

The recommendations of the ARR, which were very helpful, are fully incorporated and leaded to recalculation.

Recommendation of FCCC/ARR/2010/BGR **Glass production –** CO_2

106. During the review week, Bulgaria identified an underestimate in the emissions from glass production contained in the 13 August 2010 annual submission (49.77 Gg CO_2). This underestimate was identified by the Party after its analysis of plant-specific (EU ETS and IPPC) data on emissions from lime used in the glass industry (68.33 Gg CO_2).

107. In its questions on 9 October 2010, the ERT recommended that Bulgaria revise its emission estimates for glass production using the industry-specific data the Party had presented to the ERT during the review week. In response to the questions from the ERT, Bulgaria submitted revised estimates on 22 October 2010 for lime use in glass production taking into account CaO and MgO content from industry-specific data. Bulgaria confirmed that emissions from soda ash use have been excluded from these estimates and that these emissions are reported separately as part of the emission estimates under the category soda ash use. The ERT concluded that these estimates have been prepared in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. The ERT recommends that Bulgaria describe clearly in its NIR the data sources, EFs and associated parameters, methods and assumptions to ensure that all estimates can be independently verified and that it consider reporting emissions under the category limestone and dolomite.

A full description of the revised activity data and emission factor is provided above as well as a comment in Limestone and dolomite use chapter on the allocation of emissions is made.

114. For glass production: to revise the EF by obtaining country-specific information on the annual cullet ratio.

4.2.5.7 SOURCE SPECIFIC PLANNED IMPROVEMENTS

Further checks with the operators of the glass production plants with regard to the cullet ratio in order to improve the QA/QC;
Further checks with NSI on the differences between statistical data and data reported under IPPC on the glass production.
Further checks with one of the plants operators on their AD and emission reports.

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.

There is general reduction of the total emission in the sector in 2010 compared to 2009. This is mainly due to the standstill in construction works after the world economic crisis in 2009 which lead to a reduction of the production processes. The total reduction in ceramics production sector is 14%.

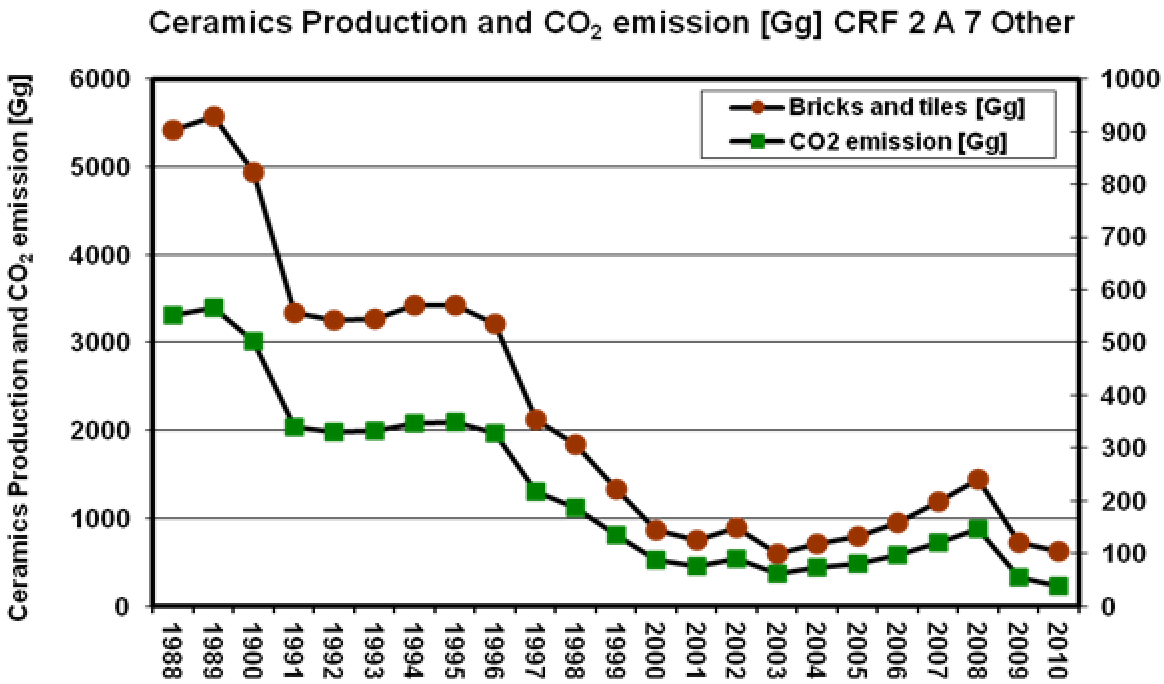


Figure 47 Ceramics Production and CO_2 emission in CRF 2 A 7 "Other (mineral products)"

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 IPPC production data for 2009 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: m3, 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 116). 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 m3 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	5419,08	0,102	551,22
1989	5571,17	0,102	566,69
1990	4929,78	0,102	501,45
1991	3338,48	0,102	339,59
1992	3255,69	0,102	331,16
1993	3268,13	0,102	332,43
1994	3418,26	0,102	347,70
1995	3428,06	0,102	348,70
1996	3218,09	0,102	327,34
1997	2124,06	0,102	216,06
1998	1845,24	0,102	187,70
1999	1329,34	0,102	135,22
2000	859,69	0,102	87,45
2001	745,66	0,102	75,85
2002	892,53	0,102	90,79
2003	598,29	0,102	60,86
2004	716,09	0,102	72,84
2005	790,03	0,102	80,36
2006	947,76	0,102	96,40
2007	1188,96	0,102	120,94
2008	1450,24	0,102	147,52
2009	725,03	0,074	53,75
2010	621,63	0,062	38,25

* 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

The following improvements were undertaken:

Revision of the conversion factor used to obtain the ceramic production data.
Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive.
In general the TACCC is improved.

The recommendations of the ARR, which were very helpful, are fully incorporated and leaded to recalculation.

Recommendation of FCCC/ARR/2010/BGR	Other (mineral products) – CO_2
115. For ceramics: to obtain conversion factors for different types of ceramics from the NSI with a view to estimating country-specific AD and to ensure their consistency. Also, the Party identified that it could obtain the mass of carbonate consumed or the mass of limestone or dolomite consumed with a view to exploring the use of a higher-tier method to estimate emissions	

4.2.6.7 SOURCE SPECIFIC PLANNED IMPROVEMENTS

Further checks with NSI and producers on the conversion factors for different ceramic products from NSI in order to estimate country specific activity data and ensure their consistency.
Obtaining the mass of carbonate consumed or mass of limestone or dolomite respectively consumed in order to explore the possibility to apply higher tier method to estimate the emissions.

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:

<u>Use of adsorbents in fluidised bed combustion systems</u>

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).

<u>Wet scrubbers</u>

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).

Currently there are three large combustion plants (LCP) in Bulgaria applying desulphurization for the flue gas cleaning. Two of them have desulphurization installations applying wet scrubbing process and the third 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. After that the next desulphurization installations started to operate in 2006, 2008 and 2009.

In 2005 there was only one plant with such instillations and during that year its boilers with desulphurization installations had reduced capacity.

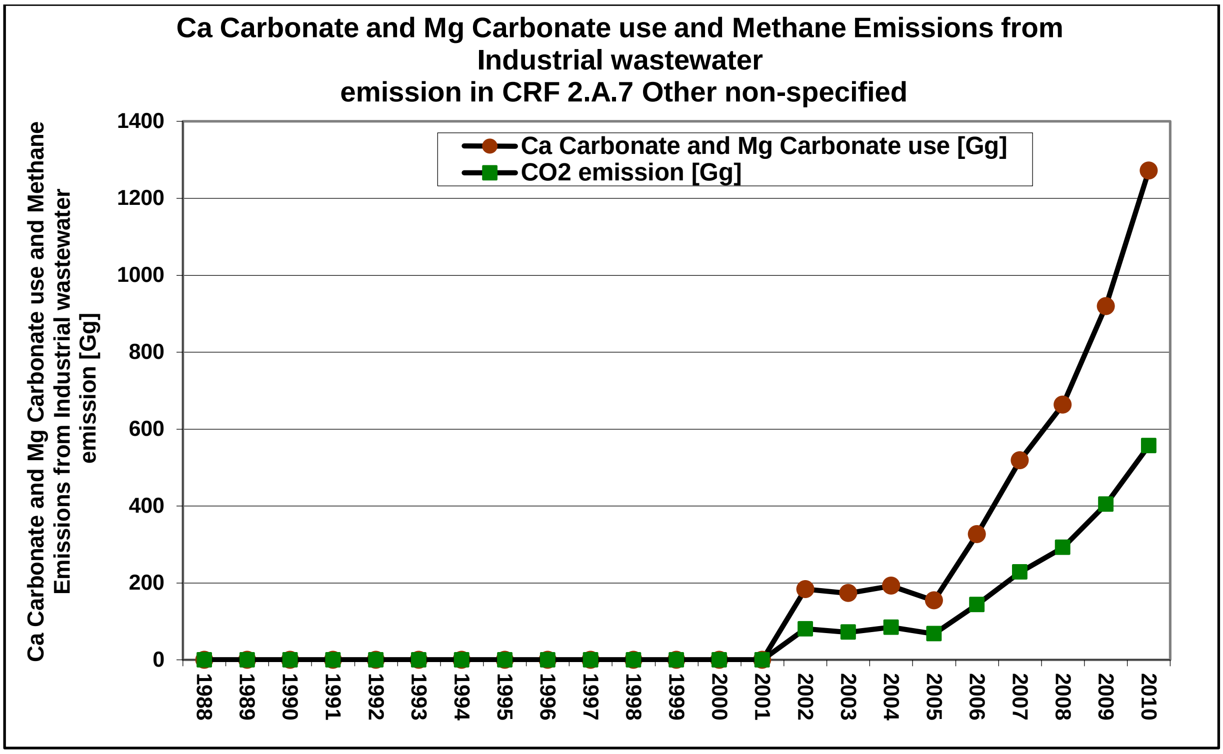


Figure 48 Ca Carbonate and Mg Carbonate use and CO_2 emission in CRF 2.A.7 Other non-specified

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:

$$CO_2 \textbf{ Emissions = (MCa • EFCa) + (MMg • EFMg)}$$

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 Ca Carbonate and Mg Carbonate 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 CaC2]	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

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.
UE ETS reports

4.2.7.6 SOURCE SPECIFIC RECALCULATIONS

The following improvements were undertaken:

Revision of the activity data using plant specific information on emissions and Ca Carbonate and Mg Carbonate used.
Revision of the emission taking into account the pure carbonates used in the process.
Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive.
In general the TACCC is improved.

Recommendation of FCCC/ARR/2010/BGR Desulphurization (CRF 2.A.7 Other non-specified) – CO_2

85. However, the ERT also notes that to take full account of the recommendations in the 2009 annual review report more work is still needed in the:

(a) Documentation of methodologies, data sources and assumptions in the NIR;

(b) Allocation of emissions to the correct IPCC category in the CRF tables (e.g. for desulphurization under limestone and dolomite use);

(c) Completeness of the inventory;

(d) QC activities to identify discrepancies between the NIR and CRF tables;

(e) Methodology to estimate emissions from iron and steel production.

A full description of desulphurization process emissions, as well as AD, EFs and emissions, is included. Due to the specific nature of the desulphurization process and its application in LCP its emissions are reported under separate sub-category. Information about these emissions and their allocation is given also in the Limestone and dolomite use chapter.

91. The ERT commends Bulgaria for the improvement in its documentation of methodologies, AD, EFs, and so on, in the NIR. However, the ERT identified improvements including for the NIR to include, in separate sections, information on: carbide production and ferroalloys production; flue gas desulphurization; missing detail on the non-confidential country-specific parameters (e.g. calcium oxide (CaO) and magnesium oxide (MgO) contents, the types of cement and lime produced, etc.); and EFs and AD (e.g. for limestone and dolomite use, feedstocks for ammonia and iron and steel production) in the cement, lime, limestone and dolomite, soda ash, glass, ceramics and iron and steel sections. In some cases, the calculation sheets lack transparency in: the labelling of data sources; calculations and assumptions; and QC. The ERT recommends that Bulgaria revise the chapter on industrial processes in the NIR to ensure that it provides the level of information to understand the basis and rationale behind AD, EFs and parameters, assumptions and methods where possible, and to further elaborate its calculation sheets with details of data sources, assumptions and QC.

A full description of desulphurization process emissions is included.

118. The ERT recommends that Bulgaria continue to:

(a) Develop its expertise within ExEA in planning, preparing and managing inventories for the industrial processes and solvent sectors;

(b) Enhance the level of engagement with industry with a view to improving the quality of AD, EFs and uncertainty data;

(c) Further involve industry in its inventory QA/QC and development of estimates and to include this information in the NIR;

(d) Improve documentation in the NIR with a specific focus on descriptions of methodologies used (e.g. iron and steel production) and the rationale for their selection, AD, EFs and other parameters used, data sources, assumptions, allocation of emissions within the industrial processes sector (e.g. desulphurization under limestone and dolomite), discussion on the completeness of the industrial processes and solvent sectors, and on QA/QC applied in the inventory, especially in the underlying calculation sheets used to derive emission estimates.

A full description of desulphurization process emissions is included.

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 increase by 22% of the total emission in the sector in 2010 compared to 2009. This is mainly due to the recovery of the market after the world economic crisis in 2009 which lead to a reduction of the production processes rates.

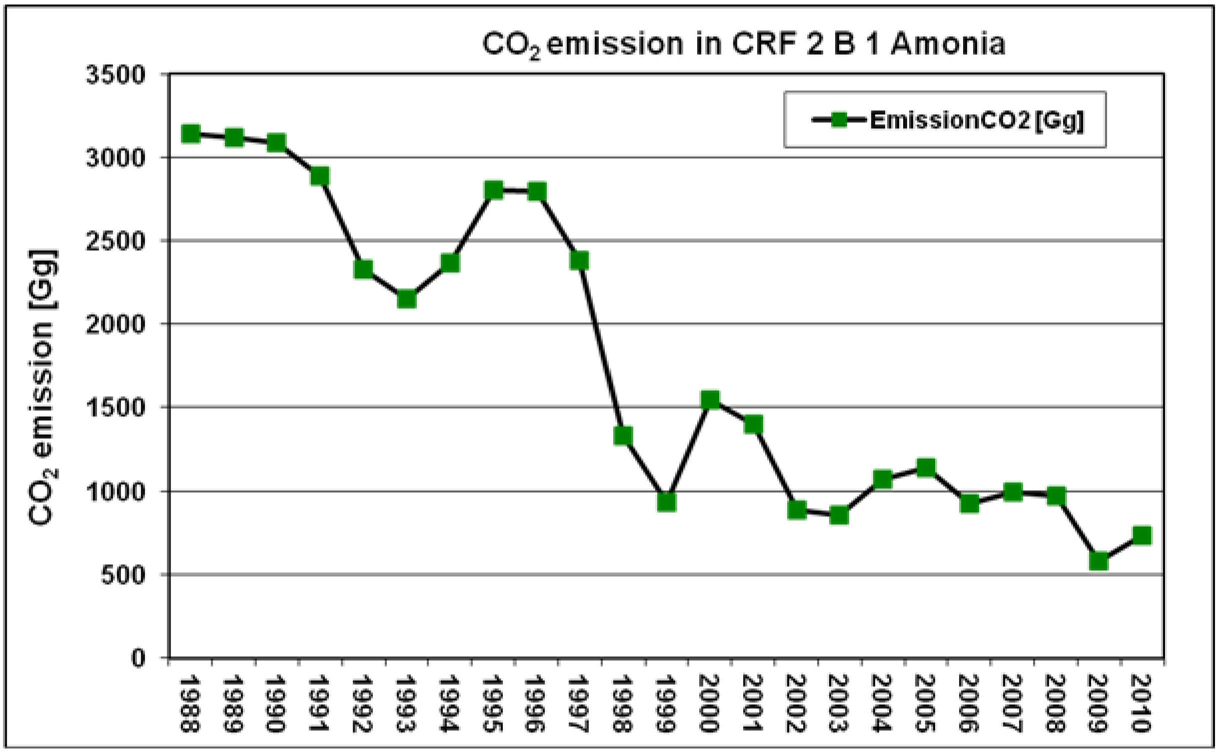


Figure 49 Ammonia Production and CO_2 emission in CRF 2 B 1 Ammonia production

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 (2000 IPCC GPG, 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

$$E_{CO_2} = \sum_{i} TFR_i \times CCF_i \times COF_i \times \frac{44}{12} - R_{CO_2}$$

Where:

ECO_2 = 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

RCO_2 = CO_2 recovered for downstream use (urea production, CO_2)

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	3137,88
1989	PS data / NSI	C	C	3116,78
1990	PS data / NSI	C	C	3086,81
1991	PS data / NSI	C	C	2890,50
1992	PS data / NSI	C	C	2325,68
1993	PS data / NSI	C	C	2149,38
1994	PS data / NSI	C	C	2368,19
1995	PS data / NSI	C	C	2805,43
1996	PS data / NSI	C	C	2798,13
1997	PS data / NSI	C	C	2383,00
1998	PS data / NSI	C	C	1329,30
1999	PS data / NSI	C	C	932,63
2000	PS data / NSI	C	C	1541,96
2001	PS data / NSI	C	C	1396,47
2002	PS data / NSI	C	C	883,95
2003	PS data	C	C	857,83
2004	PS data	C	C	1067,66
2005	PS data	C	C	1140,71
2006	PS data	C	C	924,75
2007	PS data	C	C	990,64
2008	PS data	C	C	970,16
2009	PS data	C	C	576,77
2010	PS data	C	C	735,28

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 Section 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

No source specific recalculations are made.

The recommendations of the ARR, which were very helpful, are fully incorporated and leaded to recalculation.

Recommendation of FCCC/ARR/20109/BGR	**Ammonia production –** CO_2
116. For nitric acid production, ammonia production and iron and steel production: to obtain plant-specific estimates of uncertainty and to resolve the issue of confidentiality in relation to AD	

4.3.1.7 SOURCE SPECIFIC PLANNED IMPROVEMENTS

It is good practice to obtain uncertainty estimates at the plant level; thus for the next submission the plant operator will be asked for this.
Regarding the confidentially issues a discussion with the plant operators will be done.

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:

$$4\ NH_3 + 5\ O_2 = 4\ NO + 6\ H_2O$$

Nitrous oxide, nitrogen and water are formed simultaneously in accordance with the following equations:

$$4\ NH_3 + 3\ O_2 = 2\ N_2 + 6\ H_2O$$

$$4\ NH_3 + 4\ O_2 = 2\ N_2O + 6\ H_2O$$

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 HNO3 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 2% reduction of the total emission in the sector in 2010 compared to 2009 although the increase of the production with 23%. This is mainly due to the improvement of the technology. This is connected with the increase of the Ammonia production which is performed by the same plants.

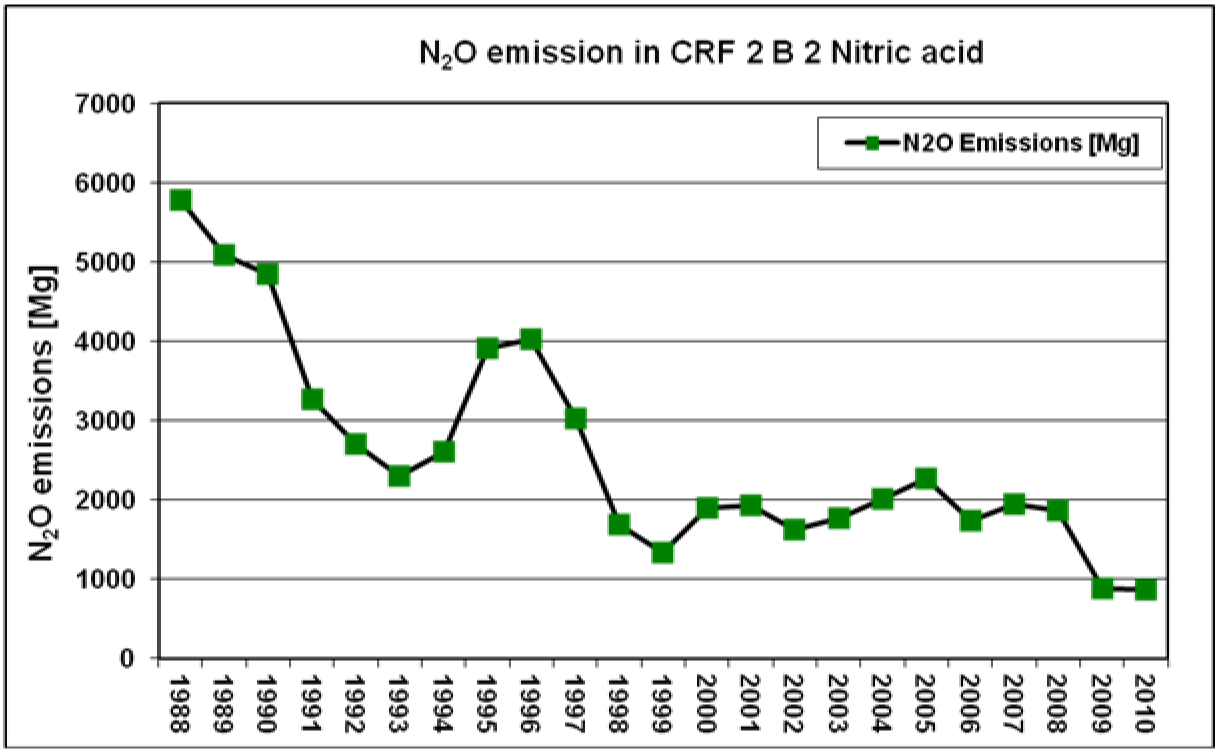


Figure 50 Nitric acid production and N_2O emission in CRF 2 B 2 Nitric acid production

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, 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 2010 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 2010 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	5,78
1989	PS data / NSI	C	C	5,08
1990	PS data / NSI	C	C	4,85
1991	PS data / NSI	C	C	3,26
1992	PS data / NSI	C	C	2,70
1993	PS data / NSI	C	C	2,31
1994	PS data / NSI	C	C	2,61
1995	PS data / NSI	C	C	3,91
1996	PS data / NSI	C	C	4,03
1997	PS data / NSI	C	C	3,03
1998	PS data / NSI	C	C	1,68
1999	PS data / NSI	C	C	1,33
2000	PS data	C	C	1,90
2001	PS data	C	C	1,93
2002	PS data	C	C	1,62
2003	PS data	C	C	1,78
2004	PS data	C	C	2,01
2005	PS data	C	C	2,28
2006	PS data	C	C	1,74
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

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 Section 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

No source specific recalculations are made.

Recommendation of FCCC/ARR/2010/BGR	**Nitric acid production – N_2O**

116. For nitric acid production, ammonia production and iron and steel production: to obtain plant-specific estimates of uncertainty and to resolve the issue of confidentiality in relation to AD.

SOURCE SPECIFIC PLANNED IMPROVEMENTS

It is good practice to obtain uncertainty estimates at the plant level; thus for the next submission the plant operator will be asked for this.
Requesting information regarding measurement method
Regarding the confidentially issues a discussion with the plant operator will be done.

4.3.3 CARBIDE PRODUCTION AND USE (CRF 2.B.4.2)

4.3.3.1 SOURCE CATEGORY DESCRIPTION

Soda ash 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 increase by 17% of the total emission in the sector in 2010 compared to 2009. This is mainly due to the recovery of the market after the world economic crisis in 2009 which lead to a reduction of the production processes rates.

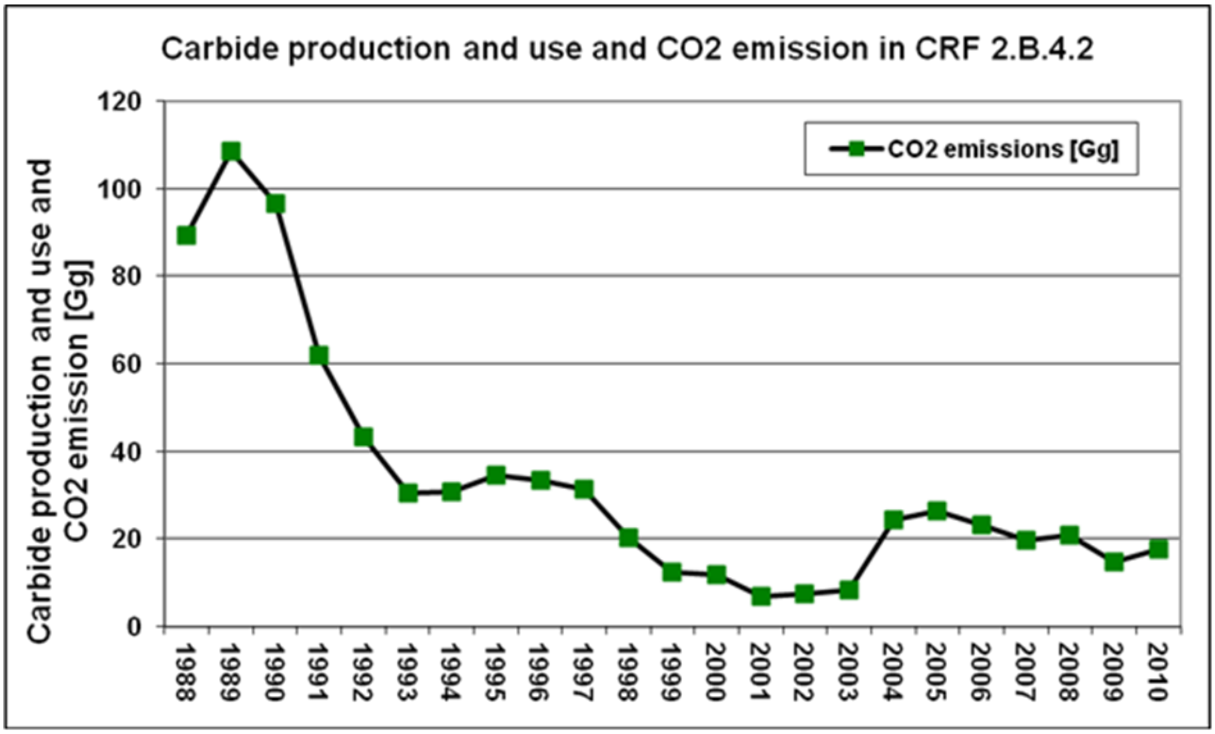


Figure 51 Carbide production and use and CO_2 emission in CRF 2.B.4.2

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:

$$\textbf{TOTAL } CO_2 = (AD_p \bullet EF_p) + (AD_u \bullet EF_u)$$

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
2009	C	C	14,69
2010	C	C	17,76

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 Section 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

The following improvements were undertaken:

Revision of the activity data for Carbide production and use of the entire time series by using statistical and plant specific data.
Default emission factors from the Revised 1996 IPCC Guidelines are used
Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive.
In general the TACCC is improved.

The recommendations of the ARR, which were very helpful, are fully incorporated and leaded to recalculation.

Recommendation of FCCC/ARR/2010/BGR **Carbide production –** CO_2

91. The ERT commends Bulgaria for the improvement in its documentation of methodologies, AD, EFs, and so on, in the NIR. However, the ERT identified improvements including for the NIR to include, in separate sections, information on: carbide production and ferroalloys production; flue gas desulphurization; missing detail on the non-confidential country-specific parameters (e.g. calcium oxide (CaO) and magnesium oxide (MgO) contents, the types of cement and lime produced, etc.); and EFs and AD (e.g. for limestone and dolomite use, feedstocks for ammonia and iron and steel production) in the cement, lime, limestone and dolomite, soda ash, glass, ceramics and iron and steel sections. In some cases, the calculation sheets lack transparency in: the labelling of data sources; calculations and assumptions; and QC. The ERT recommends that Bulgaria revise the chapter on industrial processes in the NIR to ensure that it provides the level of information to understand the basis and rationale behind AD, EFs and parameters, assumptions and methods where possible, and to further elaborate its calculation sheets with details of data sources, assumptions and QC.

A full description of emissions estimations from carbide production is included.

105. The ERT found that Bulgaria did not have a reference for the 2.19 t CO_2/t carbide produced EF used in the 13 August 2010 resubmission. The ERT recommends that Bulgaria review this EF and, where emissions cannot be estimated using a country-specific estimate based on coke and other reducing agents used in the process, apply the default EF from the Revised 1996 IPCC Guidelines. The ERT also recommends that Bulgaria describe clearly in its NIR the data sources, EFs and associated parameters, methods and assumptions to ensure that all estimates can be independently verified.

A full description of emissions estimations, including revised AD, EFs and emissions, from carbide production is included.

4.3.3.7 SOURCE SPECIFIC PLANNED IMPROVEMENTS

Obtaining plant specific data in order to apply higher tier methodology.
Investigation on the quantity of the reducing agent.
Obtaining uncertainty estimates at the plant level.
Regarding the confidentially issues a discussion with the plant operator will be done.

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%).[28]

The following steel making processes are present in Bulgaria:

Basic oxygen steelmaking

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:

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[28] (ftp://ftp.jrc.es/pub/eippcb/doc/isp_bref_1201.pdf)

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-Decarburisation)

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 2010 compared to 2009. This is mainly due to the stable fluctuation on the production of the second biggest steel plant.

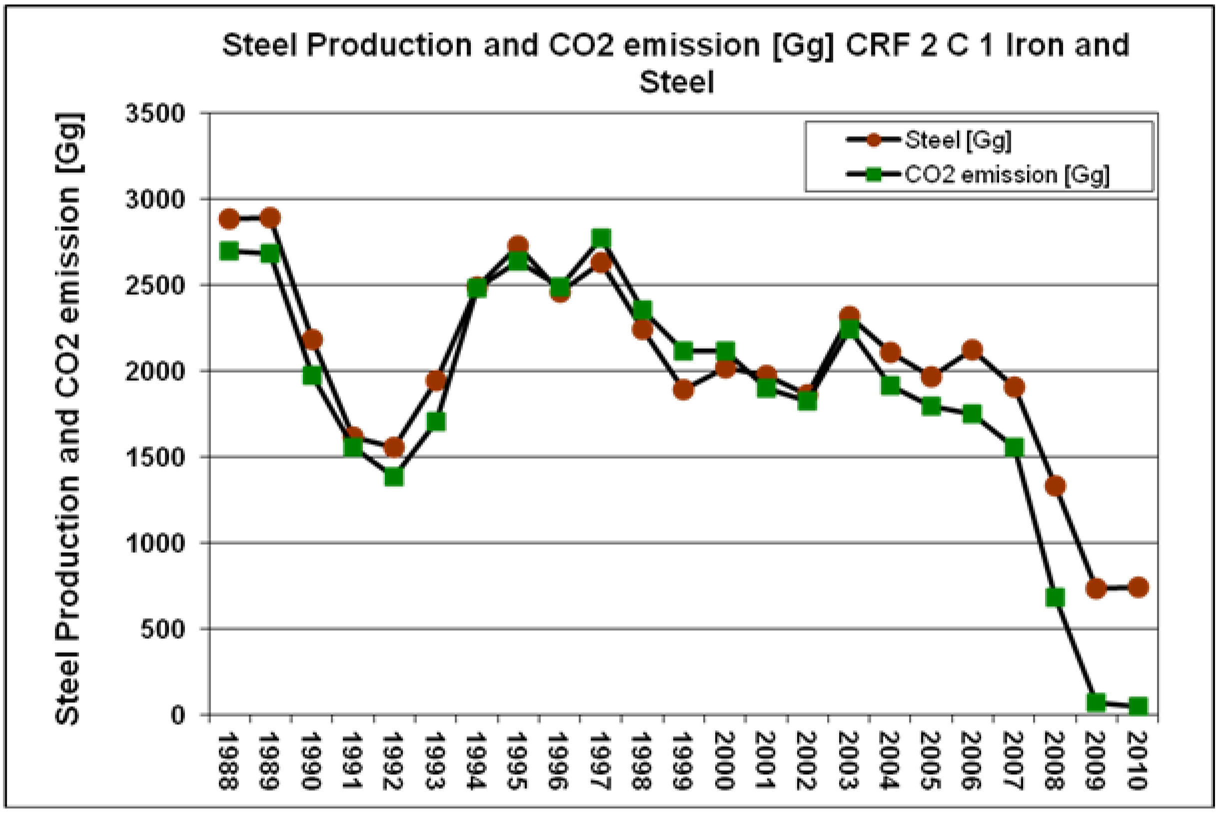

Figure 52 Iron and Steel Production and CO_2 emission in CRF 2 C 1 Iron and Steel production

4.4.1.3 METHODOLOGICAL ISSUES

4.4.1.3.1 Method

The CO_2 emissions from the sector are calculated using country specific data from EU ETS reports. Data for 2010 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

Country specific emission factor was developed for the EAF steel based on data from EU ETS reports for the period 2007 - 2009. 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, 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	0,938	2700,41
1989	BAMI / WSA	2890,00	0,928	2682,87
1990	BAMI / WSA	2180,00	0,905	1973,45
1991	BAMI / WSA	1616,00	0,964	1558,62
1992	BAMI / WSA	1552,00	0,893	1386,68
1993	BAMI / WSA	1942,00	0,878	1704,87
1994	BAMI / WSA	2490,00	0,996	2479,83
1995	BAMI / WSA	2724,00	0,968	2637,25
1996	BAMI / WSA	2457,00	1,014	2491,66
1997	BAMI / WSA	2628,00	1,054	2770,63
1998	BAMI / WSA	2242,00	1,051	2356,40
1999	BAMI / WSA	1889,00	1,119	2114,56
2000	BAMI / WSA	2022,00	1,044	2111,96
2001	BAMI / WSA	1972,00	0,962	1898,00
2002	BAMI / WSA	1860,00	0,980	1822,41
2003	BAMI / WSA	2316,00	0,969	2245,33
2004	BAMI / WSA	2106,00	0,909	1913,61
2005	BAMI / WSA	1969,00	0,913	1797,33
2006	BAMI / WSA	2124,00	0,823	1748,69
2007	BAMI / WSA / ETS	1909,00	0,816	1557,29
2008	BAMI / WSA / ETS	1330,00	0,513	682,83
2009	BAMI / WSA / ETS	731,35	0,100	73,15
2010	BAMI / WSA / ETS	746,06	0,070	52,23

As can be seen in Table 123 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.

In 2010 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 and 2010 decrease 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 2000 IPCC GPG (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

The following improvements were undertaken:

Introduction of Tier 2 estimation method for EAF in line with 2000 GPG using CO_2 emissions reported under ETS
Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive.
In general the TACCC is improved.

The recommendations of the ARR, which were very helpful, are fully incorporated and leaded to recalculation.

Recommendation of FCCC/ARR/2010/BGR Iron and Steel Production – CO_2

97. Bulgaria reported emissions from the production of steel under iron and steel production (2.C.1), whereas emissions from iron production are included in iron and steel production in the energy sector (1.A.2.a). This is not consistent with the IPCC good practice guidance. The ERT reiterates the recommendation from the previous annual review report that Bulgaria estimate emissions from iron production using data on the amount of reducing agent (coke) collected or derived from national statistics and/or from industry. The ERT notes that page 28 under section 3.1.3 of the IPCC good practice guidance provides a method for estimating the reducing agent needed for iron production from the mass balance of the chemical formula to reduce iron ore. The ERT also recommends that Bulgaria describe clearly in its NIR the data sources, EFs and associated parameters, methods and assumptions to ensure that all estimates can be independently verified.

98. The ERT identified a copy-and-paste error in the CRF tables for steel production, which resulted in an overestimate in CO_2 emissions for the year 2008.

99. The ERT commends Bulgaria on its use of a country-specific methodology for estimating emissions from electric arc furnaces (EAFs). However, the ERT notes that Bulgaria uses default EFs from the 2006 IPCC Guidelines to estimate CO_2 emissions from basic oxygen furnaces (BOF) and open hearth furnaces (OHF) without providing a justification as to why these factors improve the quality of the estimates and better represent national circumstances. The ERT also notes that these BOF and OHF EFs include CO_2 emissions from iron production; therefore, Bulgaria's emission estimates double count on some of the iron production emissions accounted for in the energy sector. With respect to steel production, the ERT recommends that Bulgaria:

(a) Revise its methodology for estimating steel production emissions following the IPCC good practice guidance;

(b) Estimate emissions from BOF and OHF using the difference between iron and steel carbon contents obtained from industry and, if this information is not available, apply expert judgement on the range of carbon contents contained in the IPCC good practice guidance (iron (3.5 per cent) and steel (0.5.2 per cent);

(c) Ensure that any carbon retained in the steel and estimated from the steelmaking processes (EAF, BOF, OHF) are balanced with the estimates for iron production to minimize double counting of CO_2 emissions;

(d) Describe clearly in its NIR the data sources, EFs and associated parameters, methods and assumptions to ensure that all estimates can be independently verified.

4.4.1.7 SOURCE SPECIFIC PLANNED IMPROVEMENTS

Research on the possibilities to obtain country and plant specific data for emissions from BOF and OHF considering that the plant using them has ceased operation (also including information on different parameters such as the quantity of the produced Sinter, Crude iron, Scrap, etc.)

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).

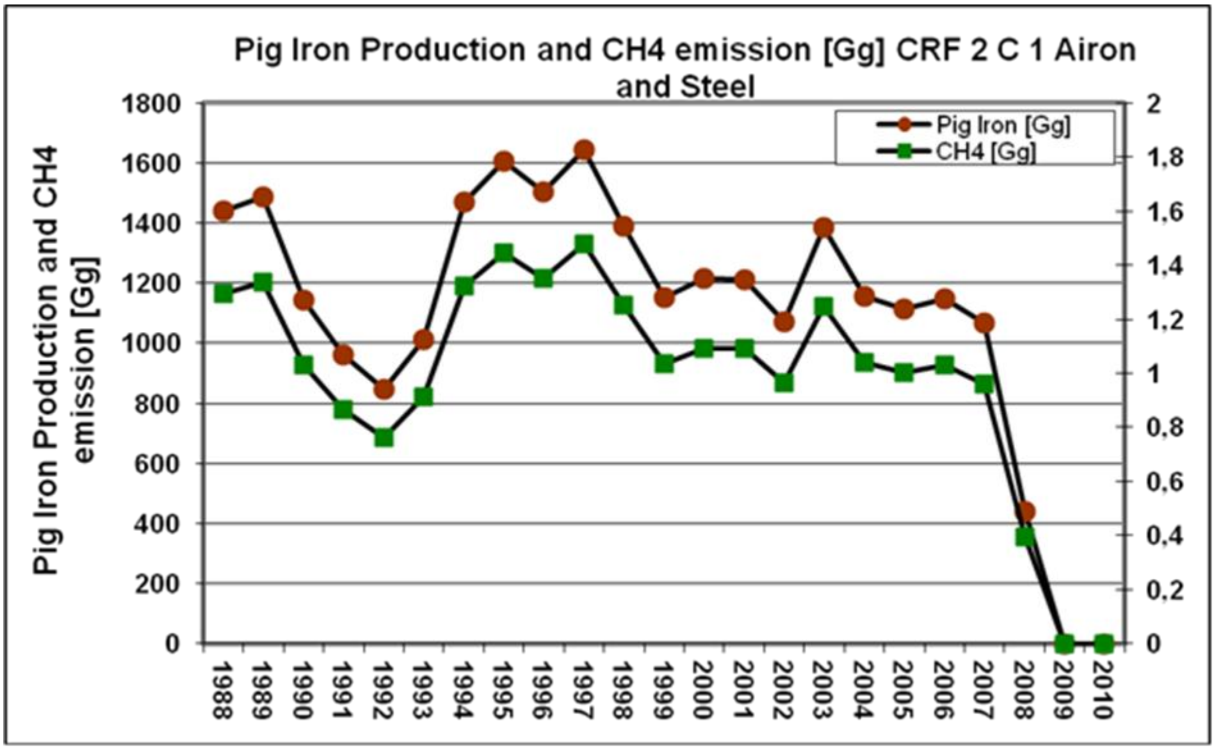

Figure 53 Pig iron Production and CH_4 emission in CRF 2.C.1.2 Pig iron production

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 in the Energy Chapter.

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
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

Year	Pig Iron Production [kt/y]	Emission Factor [t CH_4/ kt production]	CH_4 Emissions [kt CH_4]
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

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 Section 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

Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive.

In general the TACCC is improved.

4.4.2.7 SOURCE SPECIFIC PLANNED IMPROVEMENTS

The only pig iron production plant has ceased operation.

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).

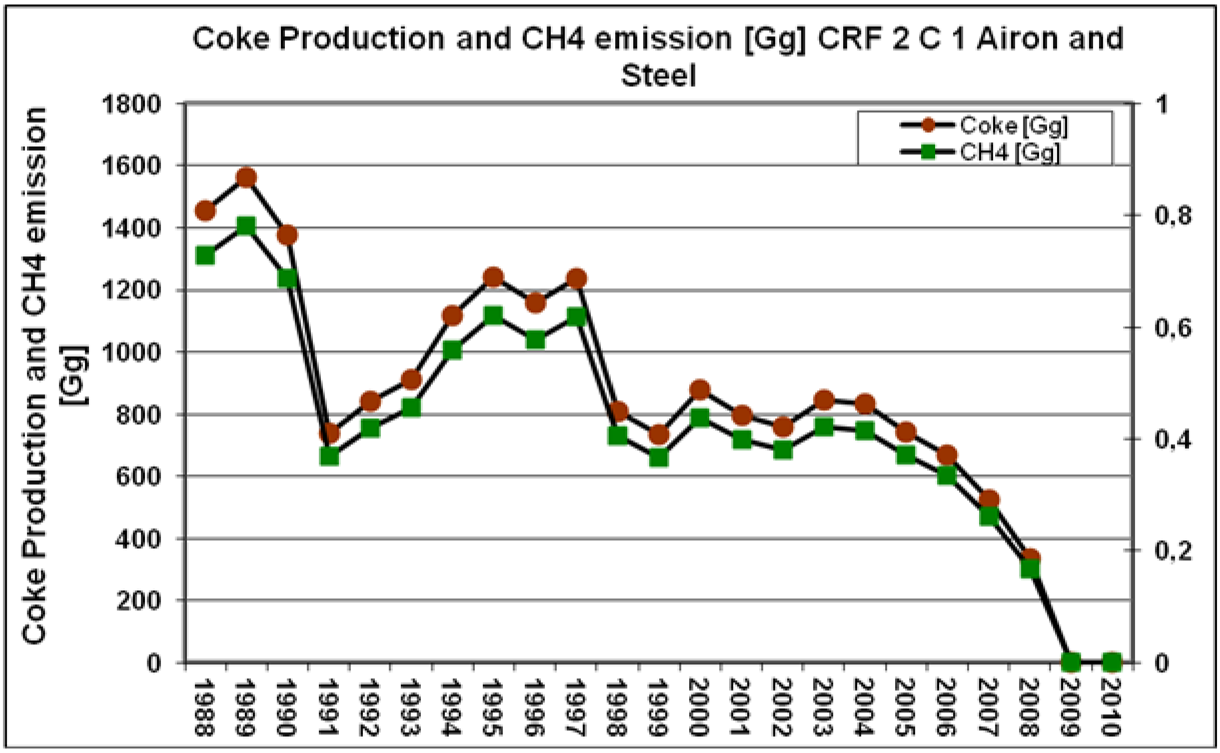

Figure 54 Coke Production and CH_4 emission in CRF 2.C.1.4 Coke production

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 [kg CH_4/ ton 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

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 Section 1.6.

Aggregated national coke production data and default emission factor are used.

4.4.3.6 SOURCE SPECIFIC RECALCULATIONS

Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive.
In general the TACCC is improved.

The recommendations of the ARR, which were very helpful, are fully incorporated and leaded to recalculation.

4.4.3.7 SOURCE SPECIFIC PLANNED IMPROVEMENTS

The only coke production plant has ceased operation.

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 2010:

Table 126 Summary of the results for 2010

Sector	Actual emission 2010	Potential emission 2010	Actual share	Potential share
	Gg CO_2-eq.	Gg CO_2-eq.	%	%
Solvents	0.00	0.00	0.00%	0.00%
Aerosols	9.63	4.52	3.27%	0.08%
Foams	40.11	311.17	13.64%	5.83%
Domestic refrigeration	5.47	84.69	1.86%	1.59%
Commercial and industrial refrigeration	39.22	416.57	13.34%	7.80%
Transport refrigeration	3.66	11.94	1.25%	0.22%
Domestic AC	58.81	2913.82	20.00%	54.57%
Stationary AC	13.52	145.74	4.60%	2.73%
Mobile AC	107.59	907.71	36.59%	17.00%
Fire protection	2.94	58.88	1.00%	1.10%
Electrical equipment	13.07	484.93	4.45%	9.08%
Total	294.01	5339.96	100.00%	100.00%

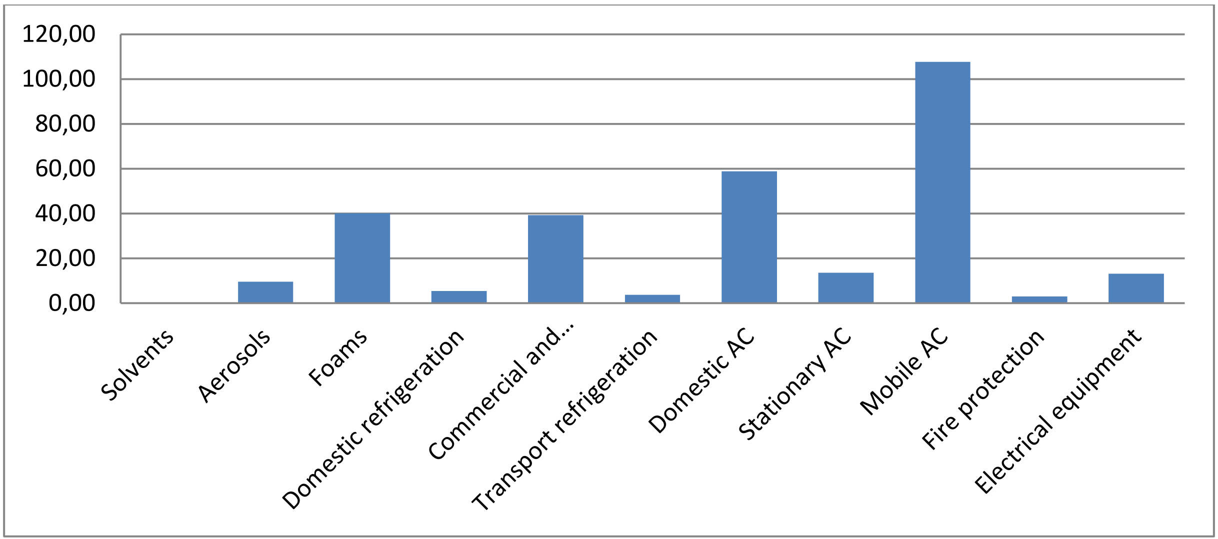

Figure 55 Actual emissions for 2010 [Gg CO_2-eq.]

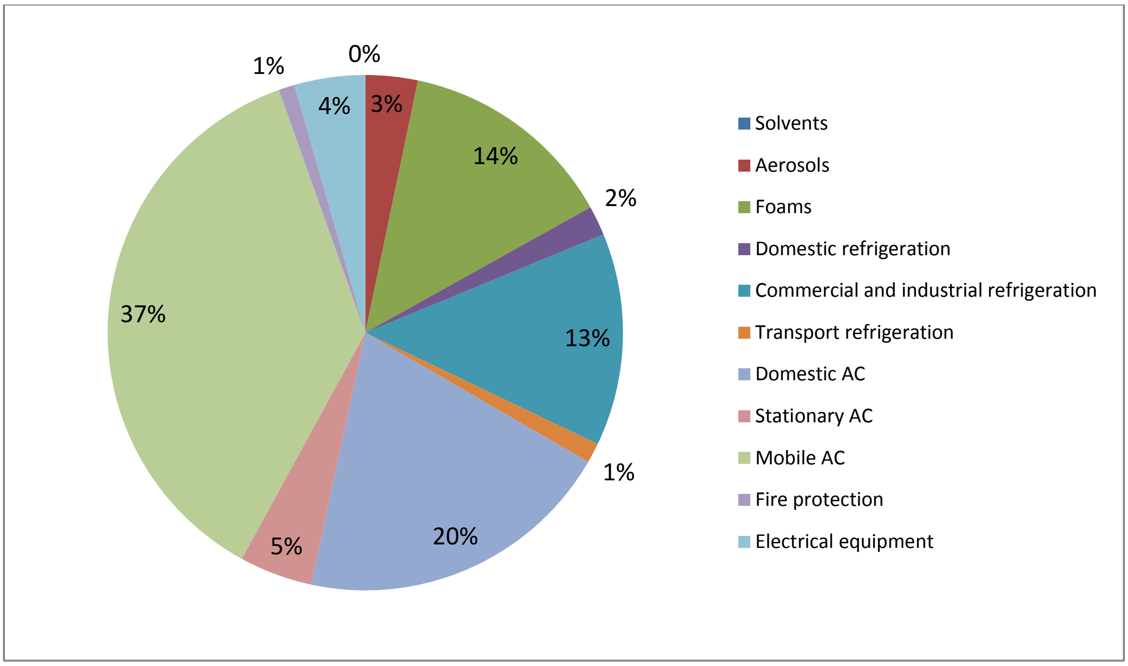

Figure 56 Actual emissions for 2010 [Gg CO_2-eq.]

The following table and figurerepresent the actual emissions for the whole time:

Table 127 Actual emissions [Gg CO_2-eq.]

Year	Solvents	Aerosols	Foams	Domestic Ref	Industrial and Commercial Ref	Transport Ref	Domestic AC	Stationary 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	0.00	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	6.27	NO	5.75
1998	NO	1.01	NO	0.08	NO	0.08	NO	NO	8.97	NO	6.08
1999	NO	1.61	NO	0.12	NO	0.14	NO	NO	12.47	NO	6.43
2000	NO	0.69	NO	0.16	0.67	0.24	NO	0.13	16.05	NO	6.80
2001	NO	0.30	NO	0.18	4.53	0.35	0.78	1.47	20.46	0.53	7.20
2002	NO	0.74	NO	0.20	8.38	0.49	1.98	2.81	25.90	0.66	7.62
2003	NO	1.18	NO	0.22	12.24	0.69	3.92	4.15	35.48	0.82	8.06
2004	NO	1.71	NO	0.24	16.09	1.02	8.33	5.49	44.40	1.02	8.53
2005	NO	2.36	NO	0.26	19.95	1.45	12.64	6.83	56.26	1.27	8.56
2006	NO	6.52	31.40	0.99	23.80	2.37	17.38	8.16	71.97	1.59	8.89

Year	Solvents	Aerosols	Foams	Domestic Ref	Industrial and Commercial Ref	Transport Ref	Domestic AC	Stationary AC	Mobil AC	Fire protecion	Electrical equipment
2007	NO	8.79	41.53	2.02	27.66	2.90	22.01	9.50	83.33	1.98	9.24
2008	NO	8.76	116.87	3.14	31.51	3.45	27.00	10.84	96.69	2.47	9.60
2009	NO	10.30	51.40	3.59	35.36	3.80	45.10	12.18	104.09	2.71	9.97
2010	NO	9.63	40.11	5.47	39.22	3.66	58.81	13.52	107.59	2.94	13.07

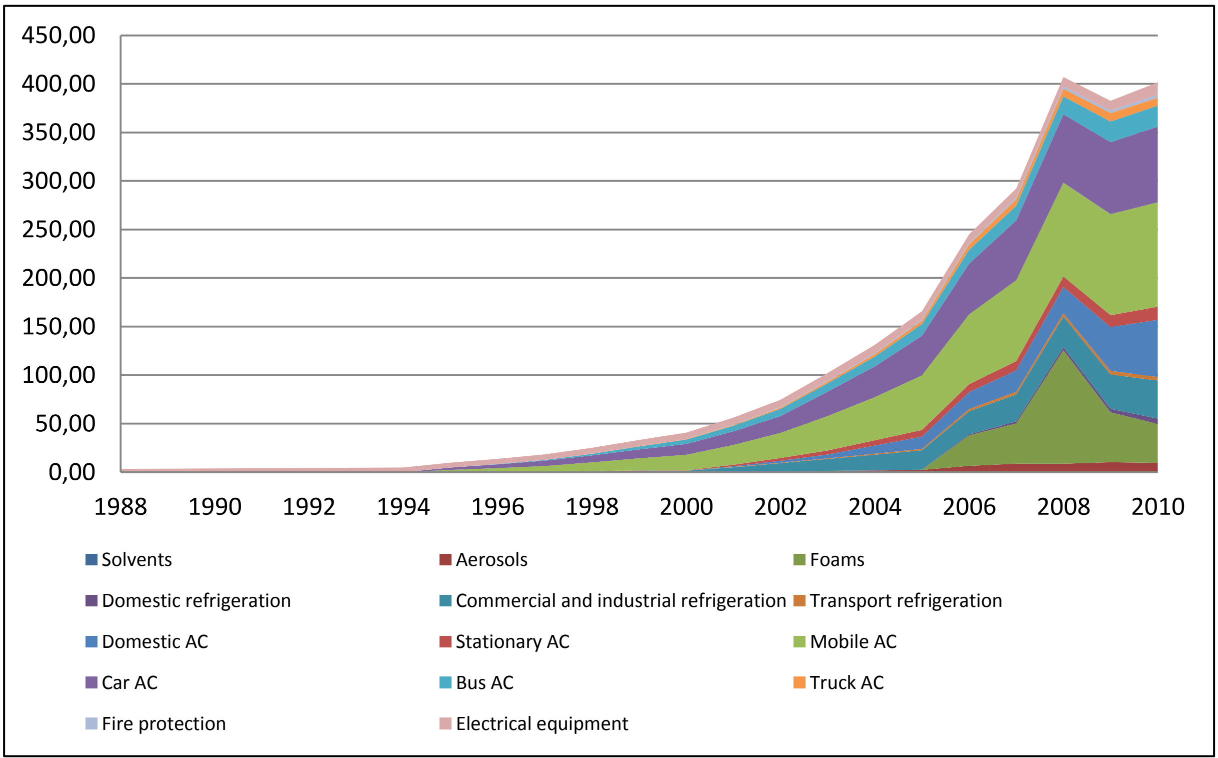

Figure 57 Actual emissions [Gg CO_2-eq.]

The following table and figure represent the potential emissions for the whole time series:

Table 128 Potential emissions [Gg CO_2-eq.]

Year	Solvents	Aerosols	Foams	Domestic Ref	Industrial and Commercial Ref	Transport Ref	Domestic AC	Stationary 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	8.63	NO	NO	NO	NO	16.30	NO	199.69
1995	NO	NO	NO	13.80	NO	0.06	NO	NO	18.17	NO	211.27

Year	Solvents	Aerosols	Foams	Domestic Ref	Industrial and Commercial Ref	Transport Ref	Domestic AC	Stationary AC	Mobil AC	Fire protection	Electrical equipment
1996	NO	NO	NO	19.56	NO	0.22	NO	NO	33.09	NO	223.52
1997	NO	NO	NO	26.66	NO	0.39	NO	NO	52.03	NO	236.49
1998	NO	1.01	NO	38.72	NO	0.68	NO	NO	76.32	NO	250.20
1999	NO	0.60	NO	53.05	NO	1.30	NO	NO	103.63	NO	264.72
2000	NO	0.09	NO	60.70	37.87	1.81	NO	13.25	131.08	NO	280.07
2001	NO	0.21	NO	67.62	75.74	2.51	79.18	26.50	169.82	10.55	296.31
2002	NO	0.53	NO	73.96	113.61	3.45	156.91	39.75	210.44	13.16	313.50
2003	NO	0.65	NO	80.27	151.48	4.80	333.07	53.00	301.43	16.40	331.68
2004	NO	1.07	NO	85.19	189.35	6.31	505.70	66.25	378.98	20.45	350.92
2005	NO	1.29	NO	87.90	227.22	10.92	695.29	79.49	492.93	25.49	364.61
2006	NO	5.23	31.40	90.11	265.09	12.73	880.22	92.74	615.79	31.79	378.83
2007	NO	3.57	57.23	91.49	302.96	13.53	1080.03	105.99	741.86	39.63	393.60
2008	NO	5.19	301.94	91.03	340.83	16.02	1804.19	119.24	859.58	49.41	408.95
2009	NO	5.11	316.19	88.83	378.70	14.13	2352.51	132.49	883.19	54.15	424.90
2010	NO	4.52	311.17	84.69	416.57	11.94	2913.82	145.74	907.71	58.88	484.93

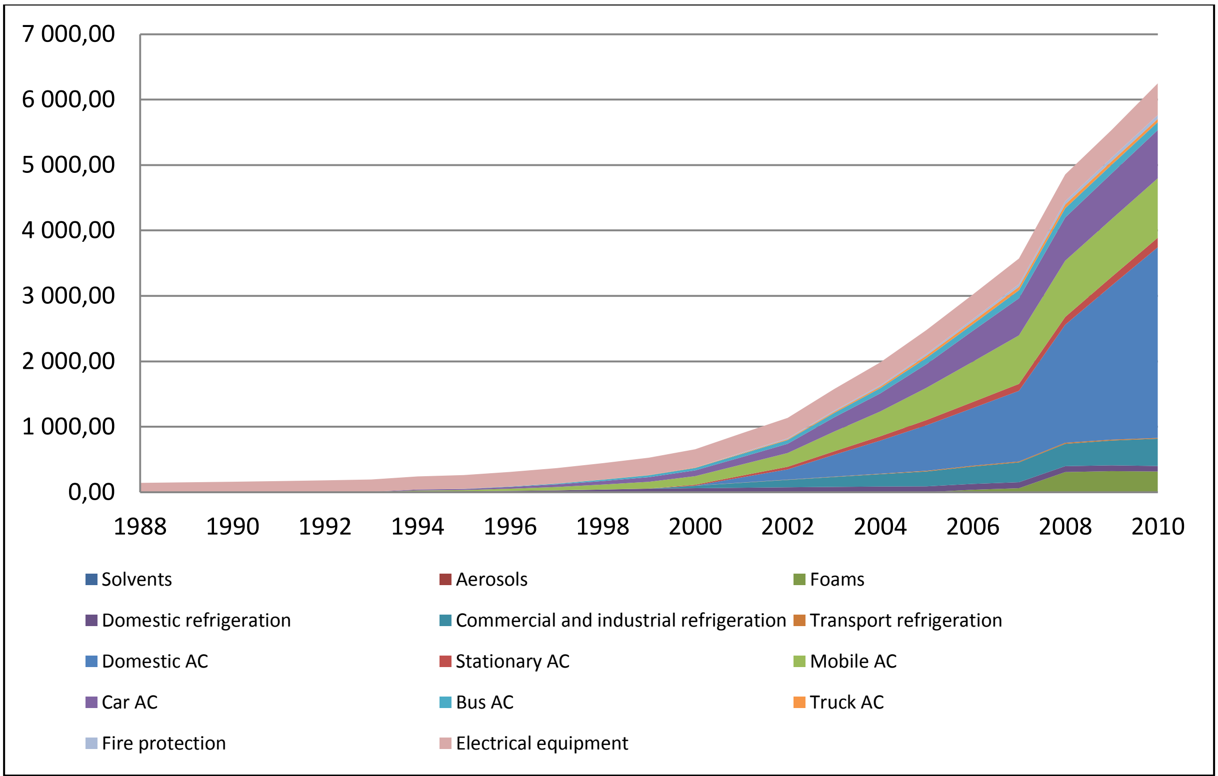

Figure 58 Potential emissions [Gg CO_2-eq.]

4.6 REFRIGERATION AND AIR CONDITIONING

4.6.1 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.

4.6.1.1 Domestic refrigeration (2.IIA.F.1.1)

In Bulgaria it is assumed that there is no production of domestic refrigeration using HFCs. The producers have switched for CFCs 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 129 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	314	314	NO	NO	NO	NO
1992	741	1054	NO	NO	2	NO
1993	1215	2266	NO	NO	6	NO
1994	1777	4035	NO	NO	12	NO
1995	2638	6661	NO	NO	20	NO
1996	3416	10057	NO	NO	32	NO
1997	4558	14585	NO	NO	45	NO
1998	5912	20453	NO	NO	62	NO
1999	7571	27963	NO	NO	89	NO
2000	6010	33888	NO	NO	122	NO
2001	5460	39247	NO	NO	140	NO
2002	5035	44164	NO	NO	156	NO
2003	5027	49058	NO	NO	171	NO
2004	3969	52880	NO	NO	185	NO
2005	2280	55002	NO	NO	197	NO
2006	2458	56980	NO	NO	203	558
2007	2614	58683	NO	NO	208	1344
2008	2061	59353	NO	NO	211	2203
2009	1071	58470	NO	NO	210	2551
2010	1019	56676	NO	NO	205	4000

4.6.1.2 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 very difficult to determine the annual inflow of new refrigerant for this sector due to the its heterogeneity. The following four tables represent the activity date for the subsector:

Table 130 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	2399	4286	NO	42	214	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
2002	2617	6428	NO	46	429	NO
2003	2835	8571	NO	50	643	NO
2004	3053	10714	NO	53	857	NO
2005	3271	12857	NO	57	1071	NO
2006	3490	14999	NO	61	1286	NO
2007	3708	17142	NO	65	1500	NO
2008	3926	19285	NO	69	1714	NO
2009	4144	21428	NO	73	1929	NO
2010	4362	23571	NO	76	2143	NO

Table 131 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	491	876	NO	9	44	NO
2002	535	1315	NO	9	88	NO
2003	580	1753	NO	10	131	NO
2004	624	2191	NO	11	175	NO
2005	669	2629	NO	12	219	NO
2006	714	3067	NO	12	263	NO
2007	758	3505	NO	13	307	NO
2008	803	3944	NO	14	351	NO
2009	847	4382	NO	15	394	NO
2010	892	4820	NO	16	438	NO

Table 132 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	5935	10601	NO	104	530	NO
2002	6474	15902	NO	113	1060	NO
2003	7014	21203	NO	123	1590	NO
2004	7553	26503	NO	132	2120	NO
2005	8093	31804	NO	142	2650	NO
2006	8632	37104	NO	151	3180	NO
2007	9172	42405	NO	161	3710	NO
2008	9711	47706	NO	170	4241	NO
2009	10251	53006	NO	179	4771	NO
2010	10790	58307	NO	189	5301	NO

Table 133 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

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
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	5880	10504	NO	103	525	NO
2002	6415	15756	NO	112	1050	NO
2003	6949	21008	NO	122	1576	NO
2004	7484	26260	NO	131	2101	NO
2005	8018	31512	NO	140	2626	NO
2006	8553	36764	NO	150	3151	NO
2007	9087	42016	NO	159	3676	NO
2008	9622	47268	NO	168	4202	NO
2009	10156	52520	NO	178	4727	NO
2010	10691	57772	NO	187	5252	NO

4.6.1.3 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, 2008 and 2009 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 134 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
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	27	27	NO	0	NO	NO
1996	73	94	NO	0	5	NO
1997	94	169	NO	1	19	NO
1998	197	331	NO	1	34	NO
1999	457	723	NO	3	63	NO
2000	331	925	NO	2	127	NO
2001	476	1229	NO	3	170	NO
2002	633	1626	NO	4	232	NO
2003	914	2221	NO	5	313	NO
2004	1082	2836	NO	6	434	27
2005	3352	5537	NO	20	557	73
2006	1553	5922	NO	9	1064	94
2007	1518	6087	NO	9	1147	197
2008	3398	7823	NO	20	1184	457
2009	1059	7094	NO	6	1450	331
2010	373	6137	NO	5	1289	476

Table 135 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	0	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
2003	9	21	NO	0	2	NO
2004	14	32	NO	0	3	NO
2005	5	32	NO	0	5	NO
2006	NO	27	NO	NO	5	NO
2007	NO	23	NO	NO	4	NO
2008	NO	20	NO	NO	3	NO
2009	NO	17	NO	NO	3	NO
2010	NO	14	NO	NO	3	NO

Table 136 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	12	12	NO	0.1	NO	NO
2009	30	39	NO	0.2	2	NO
2010	NO	46	NO	NO	6	NO

Table 137 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
1993	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO
1995	4	4	NO	0.02	NO	NO
1996	11	14	NO	0.06	1	NO
1997	14	24	NO	0.08	3	NO
1998	18	37	NO	0.11	5	NO
1999	23	53	NO	0.14	7	NO
2000	47	89	NO	0.28	11	NO
2001	63	134	NO	0.38	18	NO
2002	89	196	NO	1	27	NO
2003	125	281	NO	1	39	NO
2004	165	385	NO	1	56	4
2005	251	547	NO	2	77	11
2006	319	741	NO	2	109	14
2007	254	827	NO	2	148	18
2008	212	850	NO	1.3	165	23
2009	49	682	NO	0.3	170	47
2010	53	535	NO	0.3	136	63

Table 138 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	1	0.5	NO	0.00	NO	NO
1996	1	2	NO	0.01	0.1	NO
1997	2	3	NO	0.01	0.4	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
1998	2	5	NO	0.01	1	NO
1999	3	7	NO	0.02	1	NO
2000	6	11	NO	0.04	1	NO
2001	8	17	NO	0.05	2	NO
2002	12	25	NO	0	3	NO
2003	16	36	NO	0	5	NO
2004	21	50	NO	0	7	1
2005	33	71	NO	0	10	1
2006	43	98	NO	0	14	2
2007	32	108	NO	0	20	2
2008	27	111	NO	0.2	22	3
2009	6	89	NO	0.0	22	6
2010	6	69	NO	0.0	18	8

Table 139 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	4	4	NO	0.02	NO	NO
1996	11	14	NO	0.07	0.8	NO
1997	14	25	NO	0.08	2.8	NO
1998	18	38	NO	0.11	5	NO
1999	24	55	NO	0.14	8	NO
2000	49	92	NO	0.29	11	NO
2001	66	139	NO	0.39	18	NO
2002	91	202	NO	1	28	NO
2003	129	289	NO	1	40	NO
2004	170	396	NO	1	58	4
2005	257	562	NO	2	79	11
2006	327	760	NO	2	112	14
2007	262	850	NO	2	152	18

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
2008	219	873	NO	1.3	170	24
2009	51	701	NO	0.3	175	49
2010	55	550	NO	0.3	140	66

4.6.1.4 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 140 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	12	NO	NO
2001	12961	21228	NO	13	303	NO
2002	20422	40928	NO	14	708	NO
2003	44458	84082	NO	16	1289	NO
2004	44786	126395	NO	17	2456	NO
2005	49975	172749	NO	18	3603	NO
2006	50114	217994	NO	19	4850	NO
2007	54878	266782	NO	20	6070	NO
2008	181126	440509	NO	21	7378	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
2009	143660	572336	NO	23	11810	NO
2010	150142	707260	NO	24	15194	NO

Table 141 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	9698	9676	NO	21	NO	NO
2001	14246	23498	NO	24	401	NO
2002	21952	44518	NO	26	906	NO
2003	46571	89471	NO	28	1591	NO
2004	46998	133565	NO	30	2874	NO
2005	52386	181784	NO	32	4135	NO
2006	52620	228870	NO	34	5500	NO
2007	57575	279573	NO	36	6836	NO
2008	186492	457763	NO	39	8263	NO
2009	148354	593199	NO	41	12877	NO
2010	155061	731795	NO	43	16422	NO

Table 142 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

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
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	970	961	NO	10	NO	NO
2001	1067	1921	NO	11	96	NO
2002	1164	2882	NO	12	192	NO
2003	1261	3842	NO	13	288	NO
2004	1358	4803	NO	14	384	NO
2005	1455	5763	NO	15	480	NO
2006	1552	6724	NO	16	576	NO
2007	1649	7684	NO	16	672	NO
2008	1746	8645	NO	17	768	NO
2009	1843	9605	NO	18	864	NO
2010	1940	10566	NO	19	961	NO

Table 143 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

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
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	29168	126831	NO	36	3530	NO
2007	31857	154313	NO	38	4337	NO
2008	99007	248089	NO	40	5190	NO
2009	79288	319633	NO	43	7701	NO
2010	82888	392819	NO	45	9656	NO

4.6.1.5 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 and buses - as each of them has its own specifics that need to be addressed. The following table represents the activity date for the subsector:

Table 144 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
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	15795	13978	NO	NO	1817	NO
1996	14668	25455	NO	NO	3190	NO
1997	19395	40023	NO	NO	4826	NO
1998	25581	58707	NO	NO	6898	NO
1999	30602	79715	NO	NO	9594	NO
2000	33461	100829	NO	NO	12347	NO
2001	45540	130629	NO	NO	15740	NO
2002	51177	161880	NO	NO	19926	NO
2003	97283	231871	NO	NO	27292	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	93805	291521	NO	NO	34155	NO
2005	130929	379173	NO	NO	43277	NO
2006	149871	473685	NO	NO	55360	NO
2007	161074	570661	NO	NO	64098	NO
2008	164929	661215	NO	NO	74374	NO
2009	98226	679374	NO	NO	80067	NO
2010	100310	698235	NO	NO	81321	1442

4.6.2 METHODOLOGICAL ISSUES

4.6.2.1 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 5.47 Gg CO_2-eq. for 2010 and potential emissions of 84.69 Gg CO_2-eq. for the observed period (1988-2010). 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). 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 are not yet occuring since the lifetime of the equipment is expected to be at least 15 years. The calculations are based on Tier 2a method.

4.6.2.2 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 2010. Therefore, their emissions are calculated, even the small amounts of HFC used. The main substance used is HFC-134a, and R-413A (a mixture of PFC-218, HFC-134a and HC-600a as a percentage of 9:88:3, respectively). For additional charges over the years, HFC-134a, R-401A and R-413A are used. Tier 2a method, default emission factor for emissions from operation of 15% and emission factor for emissions from installation of 0.6% (AEAT, 2003) were used, which fully coincide with the given limits of the Guidelines (IPCC, 2006). Equipment lifetime is set to 9 years.

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, 2011), 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, as well as an EF of 0,6% (AEAT, 2003) for emissions from manufacturing, which falls within the boundaries set by the Guidelines (IPCC, 2006). 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.

4.6.2.3 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. Results from last year's submission differ, since according to more recent information from expert judgement (MOEW experts), equipment with HFCs before 2000 has not been used in the country. Emissions from disposal are included as well with average lifetime of 15 years. The results are based on Tier 2a.

4.6.2.4 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. However, as it will hereinafter be seen, in this work, that quantities over 1.5 kg for bus air-conditioners are used.

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. However, for Bulgaria this is not absolutely proven and sure.

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. Uncertainties and time-series consistency

4.6.2.5 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.

4.6.2.6 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 1996-2010 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%.

4.6.2.7 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.

4.6.2.8 Stationary air conditioning (2.IIA.F.1.5)

Data about domestic AC is based on quantities of equipment imported into the country for the period 2000-2005 and then extrapolated based on the import of goods and services. Admission was made that before 1999 the majority of equipment was using CFCs and therefore, the calculations do not include the years before 2000. From 2000 to 2007 experts' judgement (MOEW experts) conclude that the imported conditioners contain CFCs (80%). Therefore, results compared to last year's submission are lower. 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 2010 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%.

4.6.2.9 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 2000-2008. 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 2000-2010 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 2010. 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.

4.6.3 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.

4.6.4 SOURCE-SPECIFIC RECALCULATIONS

4.6.4.1 Domestic refrigeration (2.IIA.F.1.1)

Emissions compared to last year's submissions are higher due to the modification of the extrapolation model and the input of more accurate and increased data.

4.6.4.2 Commercial and industrial refrigeration (2.IIA.F.1.2 and 2.IIA.F.1.4)

Compared to previous year's submission results, due to new expert judgement statements (MOEW experts), this year's submission contains no quantities of HFCs before 2000. It was concluded that no equipment with such refrigerants has been imported within the country before 2000. Nevertheless, emissions result higher due to higher and more accurate results obtained from REIW reports.

4.6.4.3 Transport refrigeration (2.IIA.F.1.3)

Emissions compared to last year's submission are lower due to elimination of assumptions which have led to overestimating of the results within the motor transport refrigeration sub-sector (e.g. new literature researched showed that in 2010 there are still about 25% AC working with CFCs).

4.6.4.4 Stationary air conditioning (2.IIA.F.1.5)

Recalculation is performed due to change in the extrapolation model for the years before 2010.

4.6.4.5 Mobile air conditioning (2.IIA.F.1.6)

Emissions for car AC occur higher compared to the last year's submission since new and more accurate extrapolation was developed and recalculations were performed.

4.6.5 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

In general, the research for data collection over the whole subsector should be continued, since it represents over 75% of the total F-gas emissions for the country.

4.7 FOAM BLOWING(CRF 2.F.2)

4.7.1 SOURCE CATEGORY DESCRIPTION

Several 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.

One of the largest manufacturers of XPS, using HFCs is on the Bulgarian market since 2005. With its appearance, the reported quantities for HFC imports have increased significantly. These data are used to calculate the emissions, as the company has not sent back detailed questionnaire.

4.7.2 METHODOLOGICAL ISSUES

The data about quantities of HFCs were obtained from questionnaires and annual reports of RIEWs. Market research in Bulgaria showed mainly use of HFC-134a and HFC-152a, 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 51,40 Gg CO_2-eq. actual emissions in 2010 and 316,19 Gg CO_2-eq. potential emissions.

Activity data for Foam blowing – HFC-152a, HFC-134a could not be reported, because it is confidential.

4.7.3 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).

4.7.4 SOURCE-SPECIFIC QA/QA AND VERIFICATION

No source-specific QA/QC and verification is obtained.

4.7.5 SOURCE-SPECIFIC RECALCULATIONS

No source-specific recalculations are to be performed.

4.7.6 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Recent attempts for deeper research on the field did not lead to any significant results on revealing new production sites, using HFCs, as well as to clarify the exported quantities of HFC-expanded products. Therefore, it should be planned for the next year's submission a additional research to be performed.

4.8 FIRE EXTINGIUSHERS(CRF 2.F.3)

4.8.1 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 145 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	739	704	NO	NO	35	NO
2002	218	877	NO	NO	44	NO
2003	271	1094	NO	NO	55	NO
2004	338	1364	NO	NO	68	NO
2005	422	1700	NO	NO	85	NO
2006	526	2120	NO	NO	106	NO
2007	655	2643	NO	NO	132	NO
2008	817	3295	NO	NO	165	NO
2009	165	3295	NO	NO	165	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
2010	165	3295	NO	NO	165	NO

Table 146 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	3107	2959	NO	NO	148	NO
2002	915	3689	NO	NO	184	NO
2003	1140	4600	NO	NO	230	NO
2004	1422	5735	NO	NO	287	NO
2005	1773	7150	NO	NO	357	NO
2006	2210	8914	NO	NO	446	NO
2007	2755	11114	NO	NO	556	NO
2008	3435	13856	NO	NO	693	NO
2009	2408	15490	NO	NO	774	NO
2010	2490	17123	NO	NO	856	NO

4.8.2 METHODOLOGICAL ISSUES

For this study data from the Ministry of Interior on banked HFC quantities in fire fighting equipment was used, according to which the mainly used HFC is HFC-227ea (80%) and to a lesser extent - HFC-125. Using default EF of 5% of the IPCC Guidelines, 1996, the results obtained based on Tier 2a show actual emissions of 2.94 Gg CO_2-eq. and 58.88 Gg CO_2-eq. potential emission for both gases in 2010.

4.8.3 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.

4.8.4 SOURCE-SPECIFIC QA/QA AND VERIFICATION

No source-specific QA/QC and verification is obtained.

4.8.5 SOURCE-SPECIFIC RECALCULATIONS

No source-specific recalculations be performed.

4.8.6 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

No source-specific planned improvements are to be performed.

4.9 AEROSOLS (CRF 2.F.4)

4.9.1 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 147 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

4.9.2 METHODOLOGICAL ISSUES

According to the IPCC Guidelines, 2006, 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 1988-2010, the default EF of 50% for the first year and 100% for the next year (IPCC, 2006), emissions were calculated as 4.52 Gg CO_2-eq. potential emissions in 2010 and 9.63 Gg CO_2-eq. real emissions in 2010. 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.

4.9.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The great difference between the reported emission for the last year's submission and now, comes from the substitution of extrapolated and assumed emissions concerning MDIs with real data from operators. Uncertainty is assumed to be around 30% for the whole subsector.

4.9.4 SOURCE-SPECIFIC QA/QA AND VERIFICATION

Data is verified by MOEW expert.

4.9.5 SOURCE-SPECIFIC RECALCULATIONS

The results obtained related to MDIs are recalculated due to the obtaining of real accurate data for the country. Therefore, assumed and extrapolated data, based on foreign data and information sources is substituted and recalculated.

4.9.6 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Additional data research for 2004 might be useful for next year's submission, due to information from the MOEW that there were some companies operating with HFC in 2004.

4.10 SOLVENTS (2.F.5)

Research showed that this activity is not applicable for Bulgaria and emissions are not ocurring.

4.11 OTHER APPLICATION USING ODS SUBSTITUDES (CRF SOURCE CATEGORY NUMBER)

Research showed that this activity is not applicable for Bulgaria and emissions are not ocurring.

4.12 SEMICONDUCTOR MANUFACTURING (CRF SOURCE CATEGORY NUMBER)

Research showed that this activity is not applicable for Bulgaria and emissions are not ocurring.

4.13 EELECTRICAL EQUIPMENT (CRF 2.F.6)

4.13.1 SOURCE CATEGORY DESCRIPTION

In 2009, The ExEA has conducted a study concerning the determination of banked quantities of SF_6 in the country. In 2010, this study was extended - 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 148 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

4.13.2 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 16,000 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 13.07 Gg CO_2-eq. and potential emissions of 484.93 Gg CO_2-eq. were calculated.

4.13.3 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.

4.13.4 SOURCE-SPECIFIC QA/QA AND VERIFICATION

No source-specific QA/QC and verification is performed.

4.13.5 SOURCE-SPECIFIC RECALCULATIONS

Methodology is not changed for this sector, however due to revised activity data, results increase compared to the previous year.

4.13.6 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

No source-specific planned improvements are to be performed.

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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 Guideline
Calculation of N_2O emission from CRF sector 3 D.1 are based on emission factor in accordance with 2006 IPCC Guideline

5.1.1 EMISSION TRENDS

Greenhouse gas emissions in this sector decrease by 95 % between 1988 and 2010. 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 - 2010. The emission factors are in accordance with the EMEP/EEA air pollutant emission inventory guidebook – 2009[29]. The activity data are provided mainly by the National Statistics Institute – NSI.

The trend of NMVOC and CO_2 emissions is presented in Table 149 and Table 150 and also in Figure 59.

[29] In the following referred as EMEP/EEA Guidebook (2009)

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.

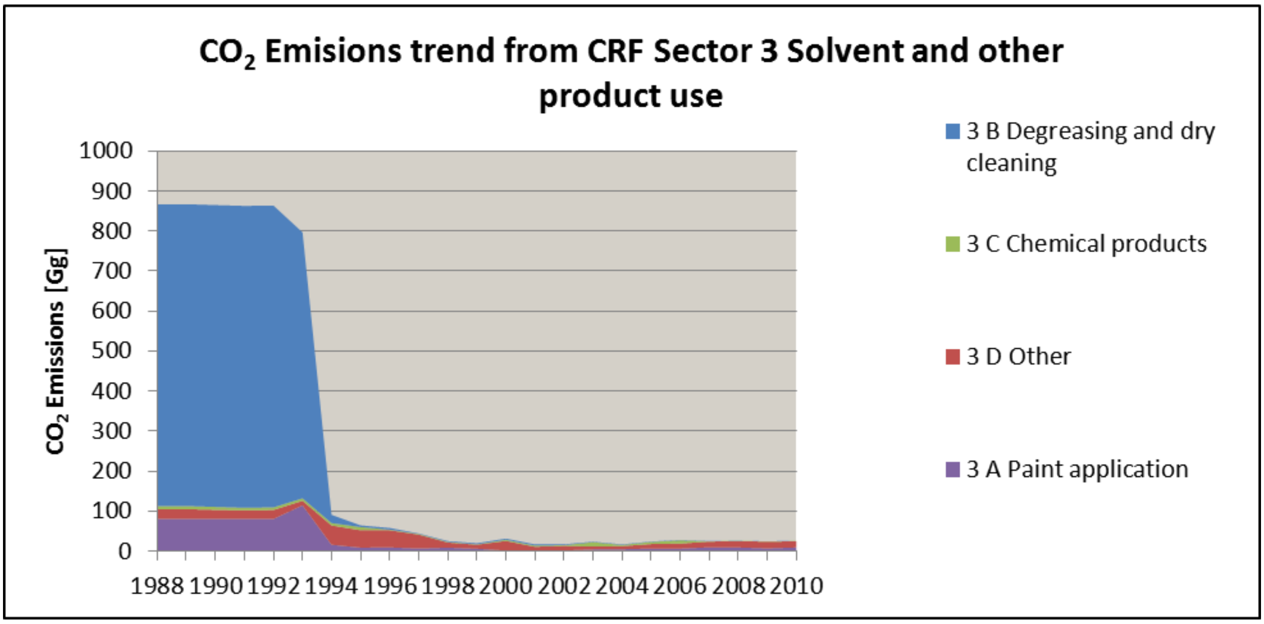

Figure 59 Trend of CO_2 emissions from CRF sector 3 Solvent and other product use

Table 149 Trend of NMVOC emissions from CRF sector 3 Solvent and other product use 1988 - 2010, 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	0.22	0.276	0.105	5.144	1.77	12.162

Table 150 Trend of CO_2 emissions from CRF sector 3 Solvent and other product use 1988 - 2010, Gg

	3 A	3 B	3 C	3 D			Total
Sub-categories	Paint Application	Degreasing and Dry Cleaning	Chemical Products, Manufacturing and Processing	Pharmacy	Use of lacquers and solvents	Vegetable Oil Production	
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	0.497	0.61	0.231	11.326	3.898	25.762

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 – 2010. The activity data are provided by the only Bulgarian Plant operator – NEOHIM AD.
The trend of N_2O emissions is presented in Table 151.

Table 151 Trend of N_2O emissions from CRF sector 3 Solvent and other product use 1988 - 2010, 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

5.2 SOURCE CATEGORY

5.2.1 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[30] systematic and has current reporting format under the LRTAP Convention – the NFR[31] format.

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[30] **SNAP** (Selected Nomenclature for sources of Air Pollution) 90 or 97 respectively means the stage of development.

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:

- SNAP 060103 Paint application: construction and buildings
- SNAP 060104 Paint application: domestic use

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 activity 060105)
- Paint application: boat building (SNAP activity 060106)
- Paint application: wood (SNAP activity 060107)
- Other industrial paint application (SNAP activity 060108)

Other coating application (3.A.3), which includes:

- Other non-industrial paint application (SNAP activity 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
- SNAP activity 060403 Printing industry
- SNAP activity 060404 Fat, edible and non-edible oil extraction
- SNAP activity 060405 Application of glues and adhesives
- SNAP activity 060406 Preservation of wood
- Vegetable Oil Production
- Pharmacy

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[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

[31] **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

5.2.2 METHODOLOGICAL ISSUES

5.2.2.1 Methods

The Tier 1 method has been used to estimate emissions from 3.A, 3.B, 3.C and 3D5.

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.

5.2.2.2 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.

5.2.2.3 Emission Factors

The default emission factors for NMVOC are taken from the EMEP/EEA Guidebook (2009) and EMEP/EEA guidebook – 2006.

The default emission factors used for assessment of emissions of NMVOC from 3.A, 3.B, 3.C and 3D are presented in the next Table 152.

Table 152 Emission factors used for estimation of NMVOC emissions in CRF sector 3 Solvents 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	960	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
060302	Polyvinylchloride processing	10	g/kg product	
060303	Polyurethane foam processing	120	g/kg foam processed	
060304	Polystyrene foam	60	g/kg foam	

SNAP activity	Name of activity	Emission factor	Unit	Reference
	processing		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

5.2.3 ACTIVITY DATA

The activity data for estimation of emissions in sector 3 A 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 – 2010.

The possibilities for using activity data in National Register under the European Solvents Directive 1999/13/EC are also checked. For some categories as 060307 Paints manufacturing, the activity data for the last four 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.

5.2.4 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of the GHG emissions is presented in

Table 153 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

5.2.5 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).

5.2.6 SOURCE-SPECIFIC RECALCULATIONS

No recalculations.

5.2.7 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, 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.

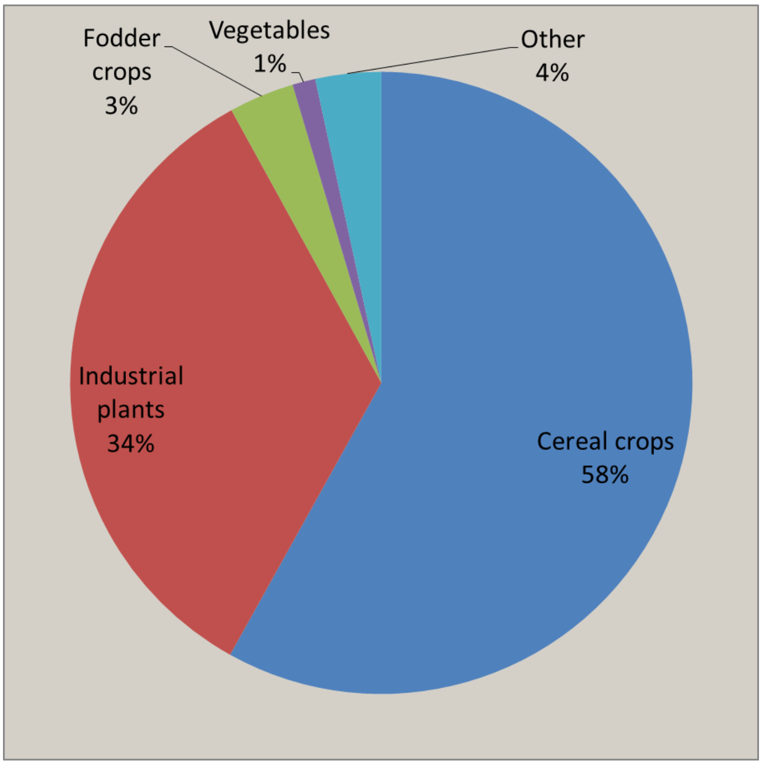

Figure 60 Arable land, used agricultural area and area of agricultural designation in the period in 2008 (ha)

6.2 EMISSION TRENDS

In the year 2010 the sector agriculture contributed 10,43% to the total of Bulgaria's greenhouse gas emissions (without LULUCF). The trend of GHG emissions from 1988 to 2010 shows a decrease of 69,25% for this sector due to decrease in activity data. (Table 154)

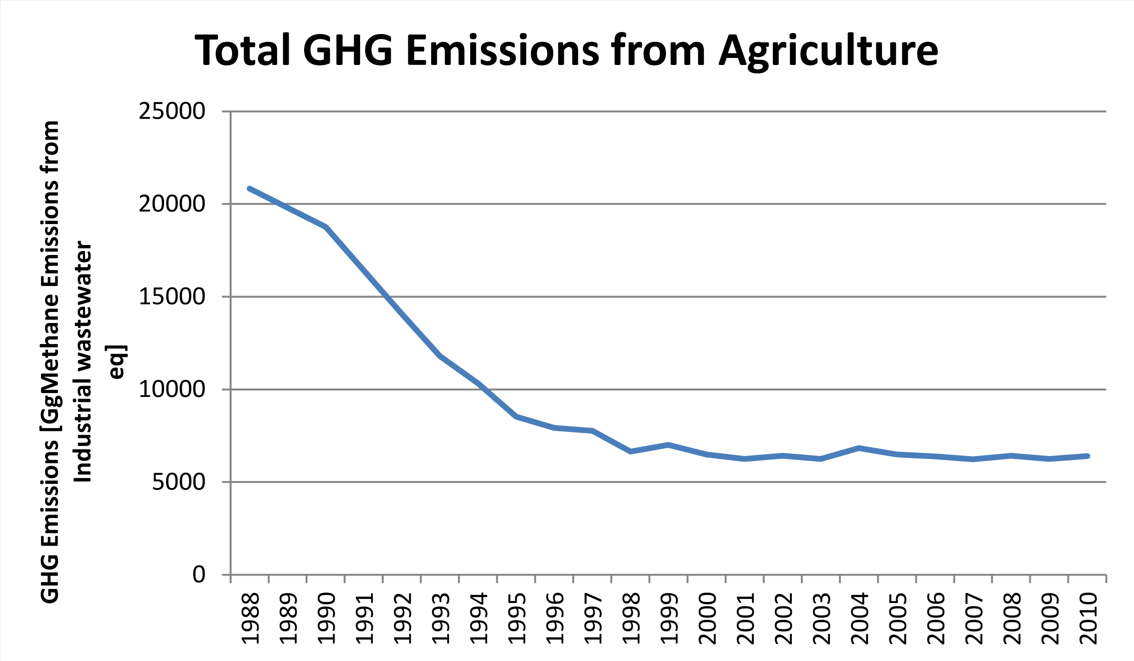

Figure 61 Trend of GHG Emissions from agriculture

6.2.1 EMISSION TRENDS PER GAS

CH_4 emissions form 36,7% of the total emissions in the sector in CO_2-eq in 2010. A steady trend of emissions decrease is observed after 2002 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 63,3% for the year 2010. The biggest share in these emissions have the Agricultural soils category with 88,6%. N_2O emissions from manure management and field burning of agricultural residues are of an order of magnitude smaller and in total are about 11,4% from the aggregated N_2O emissions of the sector.

Since 1988 CH_4 emissions from agriculture decreased by 73,95% and N_2O emissions by 65,65%. The trend is presented in Table 135.

Table 154 Emissions of greenhouse gases from agriculture 1988 – 2009.

Year	GHG emissions [Gg]	
	CH_4	N_2O
1988	429,99	38,08
1989	427,80	34,90
1990	426,02	31,68
1991	413,51	24,96
1992	364,89	20,68
1993	287,18	18,59
1994	227,12	17,92
1995	188,00	14,78
1996	172,13	13,90
1997	154,30	14,61
1998	137,28	12,16
1999	133,66	13,56

Year	GHG emissions [Gg]	
	CH_4	N_2O
2000	123,48	12,55
2001	106,95	12,93
2002	113,40	13,01
2003	124,23	11,72
2004	125,35	13,58
2005	123,07	12,58
2006	125,05	12,10
2007	121,80	11,86
2008	117,88	12,75
2009	114,43	12,42
2010	111,99	13,08

6.2.2 EMISSION TRENDS PER SUB CATEGORY

Table 155 and Figure 62 present total GHG emissions and trend 1988–2010 from agriculture by sub-categories as well as the contribution to the overall inventory emissions. Important categories are 4.D agricultural soils (56,07%) and 4.B Manure management (21,37%) followed by 4.A Enteric Fermentation (20,42%).

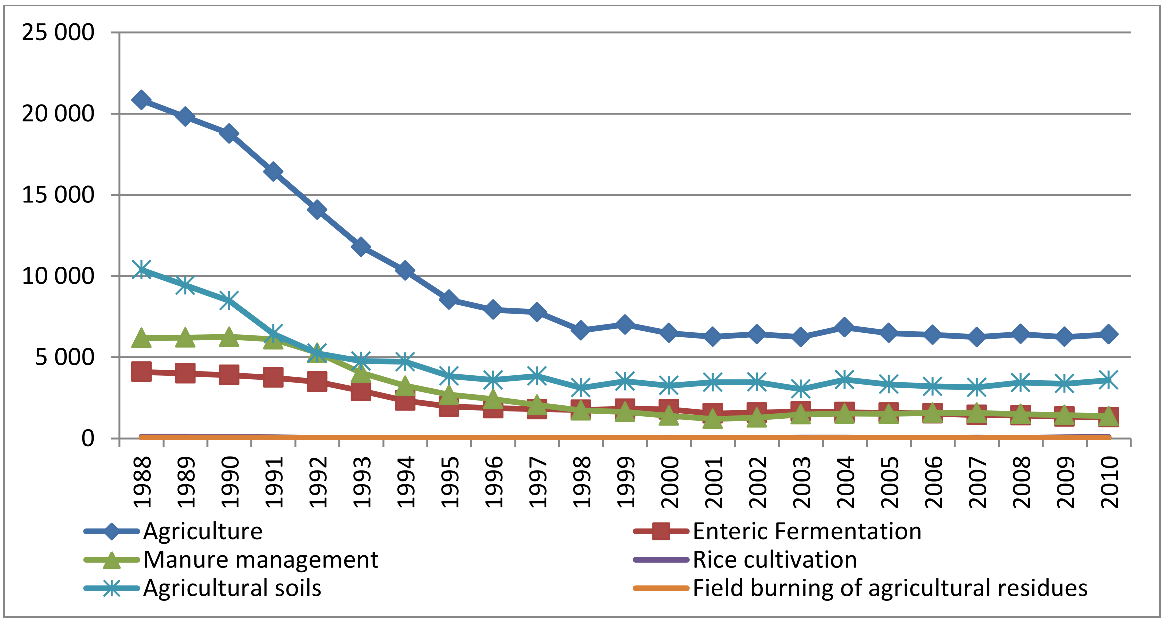

Figure 62 GHG emission trends 1988–2010 by categories (Gg CO_2-eq)

Table 155 GHG emissions 1988–2008 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	20833,04	4101,04	6186,32	114,24	10382,74	48,69
1989	19802,74	3996,60	6204,90	114,60	9425,35	61,29
1990	18768,38	3898,12	6259,88	88,96	8470,64	50,80
1991	16419,76	3747,34	6096,92	68,91	6448,64	57,95
1992	14073,30	3484,66	5273,24	38,01	5237,73	39,66
1993	11792,47	2929,93	4044,52	26,20	4763,16	28,67

Year	GHG emissions [Gg CO_2 equivalent] by categories					
	4	4.A	4.B	4.C	4.D	4.F
1994	10325,93	2325,50	3244,24	6,95	4719,52	29,72
1995	8529,54	1958,32	2687,00	11,59	3839,00	33,63
1996	7924,05	1860,08	2422,71	21,89	3599,48	19,89
1997	7770,53	1802,43	2067,19	31,87	3840,00	29,04
1998	6652,66	1756,95	1725,82	33,63	3110,29	25,96
1999	7010,39	1819,51	1631,21	11,90	3520,86	26,91
2000	6482,83	1779,54	1395,56	30,00	3256,32	21,42
2001	6254,38	1536,68	1202,50	32,73	3457,31	25,15
2002	6415,13	1588,80	1282,38	43,95	3468,84	31,16
2003	6240,69	1651,93	1482,47	47,41	3036,65	22,23
2004	6843,16	1619,00	1527,61	45,33	3614,98	36,24
2005	6485,32	1575,93	1511,67	39,34	3329,71	28,66
2006	6377,43	1534,35	1573,96	42,69	3197,83	28,61
2007	6233,27	1443,49	1579,37	54,21	3140,75	15,44
2008	6428,02	1417,09	1494,54	42,35	3440,56	33,48
2009	6252,12	1344,94	1438,29	69,82	3367,32	31,75
2010	6405,90	1307,91	1369,10	100,61	3591,83	36,45
Share	**-**	**20,42%**	**21,37%**	**1,57%**	**56,07%**	**0,57%**

As can be seen inFigure 62 and Table 155 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.

6.2.3 KEY CATEGORIES

Table 156 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 N_2O from Nitrogen used in Agriculture	N_2O	Yes
4B9	Manure Management - swine	CH_4	Yes
4D2	Pasture, Range and Paddock Manure	N_2O	Yes

6.2.4 COMPLETENESS

Table 157 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 157 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 REGARDING NITROGEN COMPOUNDS	✓ NO	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	-	✓

IPCC Category		CH_4		N_2O
4.B.14	Other	Other management	-	✓
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

To ensure TACCC for the future submission, emissions from field burning of agricultural residues has been recalculated for the whole time series due to acquisition of country specific data for C and N fractions of the different plant species as well as country specific data about the number of burned fields.

6.3 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.

6.3.1 SOURCE CATEGORY DESCRIPTION

CH_4 emissions in CO_2-eq. were 1307,9 Gg in the year 2010. The decrease for the year 2010 is 2,75% compared to 2009 and is due to a distribution of the basic type of animals. Compared to base year a decrease of 68,1% is observed.

CH_4 emissions from the enteric fermentation of domestic livestock are given in Table 158.

Table 158 Greenhouse gas emissions from enteric fermentation by sub-categories 1988–2010.

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&A 7	4.A.8
	total	Mature Dairy	Mature Non-Dairy	Young	Buffalo	Sheep	Goats	Horses, Mules & asses	Swine
1988	195,29	68,94	9,79	37,55	1,39	63,63	2,17	65,80	6,06
1989	190,31	68,95	9,48	36,36	1,31	60,21	2,16	62,37	6,11
1990	185,62	67,89	9,23	35,37	1,28	57,68	2,17	59,85	6,34
1991	178,44	65,93	8,66	33,19	1,34	55,03	2,33	57,36	6,39
1992	165,94	64,18	7,56	28,97	1,39	50,29	2,63	52,92	5,50
1993	139,52	58,16	5,79	22,20	1,30	39,53	2,91	42,44	4,37
1994	110,74	49,65	3,87	14,85	1,08	29,40	3,22	32,62	3,56
1995	93,25	42,12	2,94	11,26	0,85	24,21	3,68	27,89	3,04
1996	88,58	39,42	2,61	9,99	0,75	23,07	4,07	27,14	3,09
1997	85,83	39,83	2,31	8,84	0,69	21,61	4,21	25,81	2,73
1998	83,66	40,78	2,13	8,16	0,60	20,15	4,54	24,69	2,24
1999	86,64	44,33	2,25	8,61	0,58	19,22	5,03	24,26	2,40
2000	84,74	44,20	2,32	11,68	0,53	15,75	4,47	20,22	1,91
2001	73,18	38,54	2,12	11,80	0,43	11,56	3,54	15,10	1,21
2002	75,66	39,43	2,55	12,91	0,39	11,38	3,57	14,96	1,34
2003	78,66	39,46	3,12	15,07	0,42	11,53	3,70	15,23	1,52
2004	77,10	40,18	2,85	13,68	0,44	11,31	3,61	14,92	1,47
2005	75,04	39,55	2,61	12,82	0,44	11,36	3,32	14,68	1,41
2006	73,06	38,64	2,64	12,40	0,45	11,09	2,89	13,98	1,47
2007	68,74	36,64	2,74	10,79	0,47	10,59	2,61	13,20	1,43
2008	67,48	35,72	2,84	10,78	0,50	10,18	2,31	12,49	1,25
2009	64,04	33,56	2,86	9,93	0,48	9,62	1,98	11,59	1,14
2010	62,28	33,28	2,84	9,70	0,48	9,22	1,79	11,02	1,05
Share	-	53,43%	4,56%	15,58%	0,78%	14,81%	2,88%	17,69%	1,68%
Trend 1988–2010	68,11%	51,73%	70,97%	74,16%	65,33%	85,51%	17,53%	83,26%	82,76%

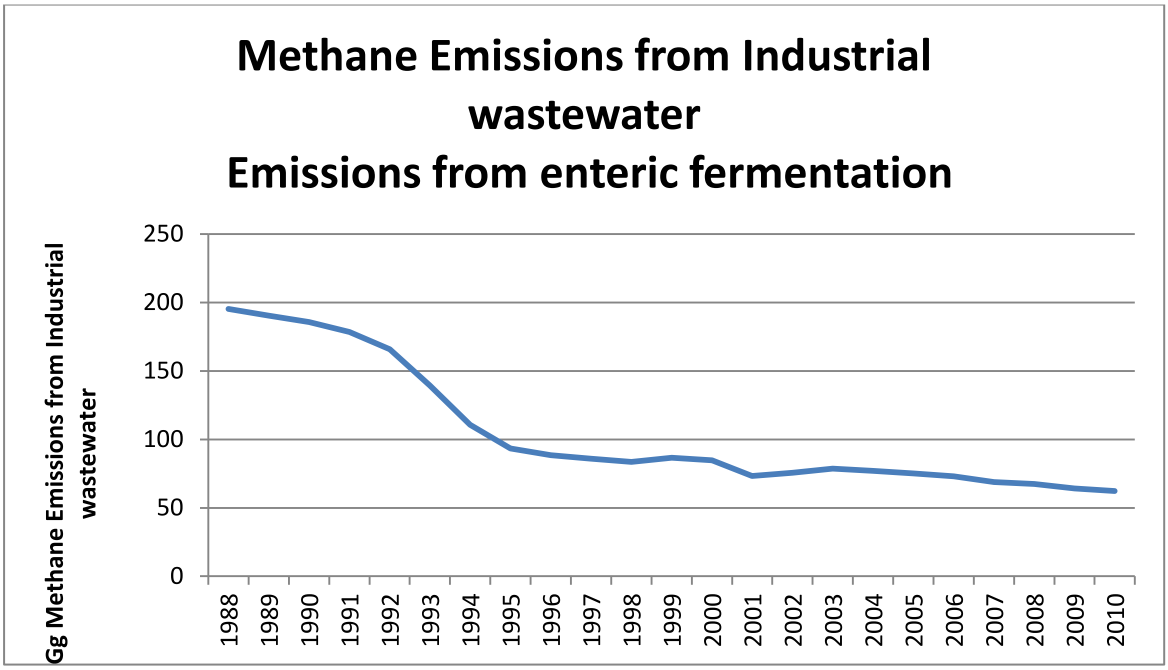

Figure 63 Enteric Fermentation from livestock – CH_4 emission from enteric fermentation

Figure 63 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.

6.3.2 METHODOLOGICAL ISSUES

6.3.2.1 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.

6.3.2.2 Emission factors

Country specific emission factors are used. They are calculated from the specific gross energy intake and the methane conversion rate.

$$EF_i = \frac{GE_i \times Ym_i \times 365}{55.65}$$

With i = each livestock category

EF_i expressed in kg CH_4/head/year

Ym Methane conversion rate

GE =Gross energy intake

The factor 55.65 expressed in MJ/kg of CH_4

➔ See equation 4.14 in the 2000 IPCC-GPG.

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 (Ym) is taken from the IPCC guidelines.

Tier 2 method – cattle

For dairy cattle, the EF has been calculated by combining the following activity data, coefficients and parameters. Bulgarian specific values for dairy cows were derived from feed intake data and energy content of food in dependency of annual milk yields

Table 159 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
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
CH_4 conversion rate (average)	%	Table 4.8 - GPG_2000
Implied Emission Factor - CH_4	kg CH_4/head/year	Eq. 4.14 - GPG_2000
CH_4 emissions	Gg	-

For the other cattle categories, IEF's are obtained by combining slightly different parameters which are listed in Table 160.

Table 160 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
CH_4 Conversion Rate (average)	%	table 4.8 – 2000 IPCC-GPG

Tier 1 method – all farm animal categories but cattle and sheep

For farm animals, other than cattle and sheep, the IEF is the default enteric fermentation EF for developed countries presented in Table 4-3 of the Revised 1996 IPCC Guidelines. More details are provided in

Table 161.

Table 161 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 162 and Table 163)
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

6.3.2.3 Activity data

Farm animals' population size per year is shown in Table 162.

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 1990-2010.

Table 162 Domestic livestock populations 1988–2010 (I).

Year	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	1.006,86	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

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 2009 data but there is an annual attribution error. The cattle rapid decline in cattle numbers in the period 1992-1994 is due to reforms in agricultural holdings in this period.

Table 163 Domestic livestock populations 1988–2010 (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	35856163	4723469
1989	559,69	6.484,38	205,97	1.497,37	122,41	4076,5	351,51	36770381	4843903
1990	535,52	6.204,34	197,08	1.432,71	120,45	4225,2	349,19	34523496	4547912
1991	514,06	5.955,66	189,18	1.375,28	117,16	4259,1	347,42	28423852	3744383
1992	468,41	5.426,78	172,38	1.253,15	114,85	3664,0	335,32	21959947	2892868
1993	368,47	4.268,97	135,60	985,79	113,99	2910,6	322,03	18369903	2419937
1994	274,41	3.179,21	100,99	734,14	113,41	2375,5	305,86	21149368	2786087
1995	229,09	2.654,12	84,31	612,89	123,08	2028,8	294,69	20819728	2742662
1996	216,93	2.513,21	79,83	580,35	141,78	2063,1	301,10	16671619	2196216
1997	204,83	2.373,11	75,38	548,00	160,50	1820,2	273,06	15390859	2027497
1998	187,70	2.174,62	69,08	502,16	148,34	1490,1	239,41	13692690	1803790
1999	179,04	2.074,24	65,89	478,98	129,79	1600,6	189,01	13453345	1772261
2000	142,63	1.652,50	52,49	381,60	137,20	1276,4	140,67	15528734	2045659
2001	106,45	1.233,33	36,37	264,40	140,67	809,9	145,50	15221816	2005228
2002	106,54	1.234,38	37,36	271,60	145,50	892,5	147,17	14636459	1928117
2003	105,59	1.223,32	42,21	292,34	138,51	1014,4	134,99	17673159	1849544
2004	104,48	1.210,50	39,47	291,08	125,66	981,9	128,28	18239400	1970250
2005	99,63	1.233,17	36,14	278,44	124,00	937,2	130,23	17182200	2331350
2006	97,55	1.207,74	36,87	276,68	121,50	977,8	130,23	17582000	2254000
2007	106,91	1.157,90	36,48	279,61	120,00	950,6	130,23	17192500	2235000
2008	102,40	1.113,38	35,54	249,31	144,14	836,1	130,23	16095500	2028000
2009	79,07	1.087,72	33,64	237,11	171,68	756,7	139,80	15883 500	1 591 000
2010	72,49	1.041,76	27,21	242,67	142,15	696,9	135,6	14063 000	1 871 000

(1)broiler and layer chickens, roosters, chicks

(2)ducks, geese, turkeys, guinea-fowls, wild poultry

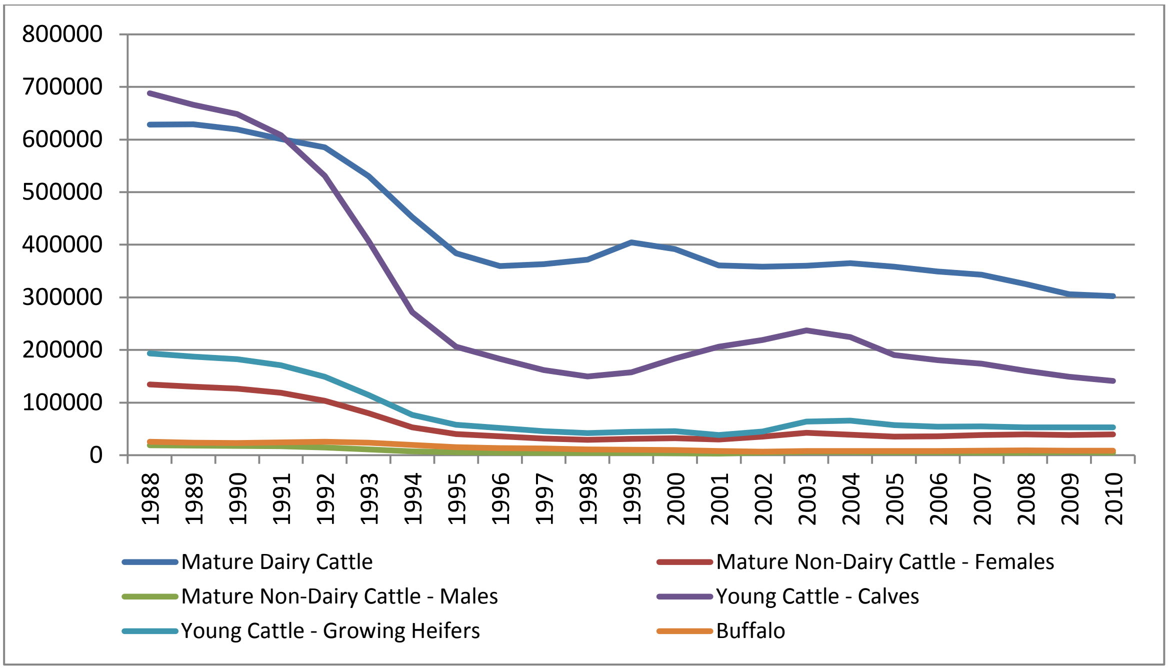

Figure 64 Domestic livestock populations (I)

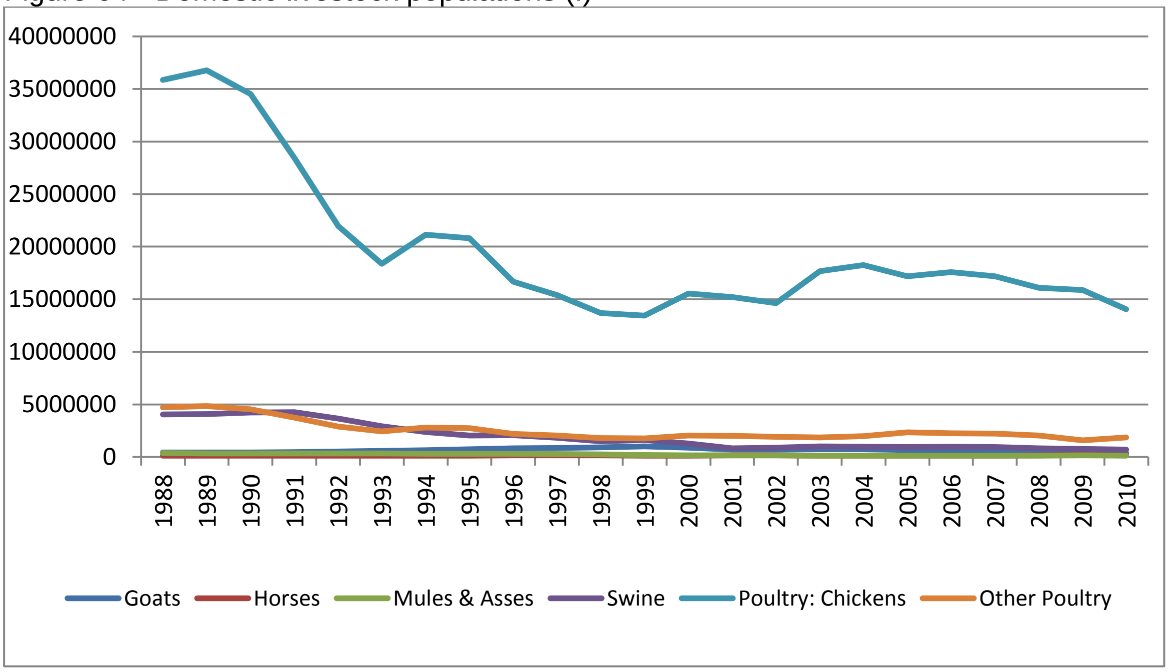

Figure 65 Domestic livestock populations (II)

6.3.2.3.1 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 2000-2010, the milk yield has decreased by 6%. 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 2010 is 3.76%

Table 164 Milk yield, gross energy intake and emission factors for dairy cattle: 2000 – 2010

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	110,40
2006	4456	281,37	110,73
2007	4091	271,40	106,80
2008	4346	279,02	109,80
2009	4344	278,94	109,77
2010	4366	279,57	110,02

Source: Ministry of Agriculture and food, Agrostatistics Department

6.3.2.3.2 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 145.

Table 165 Live-weight for farm animals reported in the inventory

<table>
<tr><th>Livestock category</th><th colspan="2">Live-weight in kg</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">331.2</td></tr>
<tr><td>4A1 – Cattle – Young Cattle – Growing Heifers</td><td colspan="2">439.1</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>16.1</td></tr>
<tr><td>Weight at weaning</td><td>12.9</td></tr>
<tr><td>4A8 – Swine</td><td colspan="2">105,80</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">5.3</td></tr>
</table>

Source: Ministry of agriculture and food, Agrostatiscs department

6.3.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty from methane emissions from this source is 50%.

Table 166 Uncertainty of sub-sector Enteric Fermentation for 2010, %

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		2	20	20
4.A.3	Sheep		2	20	20
4.A.4	Goats		2	20	20
4.A.6	Horses		2	20	20
4.A.7	Mules and Asses		2	20	20
4.A.8	Swine		2	20	20
4.A.9	Poultry		2	20	20

Uncertainty values are the default ones from the IPCC Guidelines

6.3.4 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.

6.3.5 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Acuisition of data for estimating emissions from sheep manure management with TIER 2 method

6.4 MANURE MANAGEMENT

6.4.1 SOURCE CATEGORY DESCRIPTION

CH_4 and N_2O emissions from manure management are given in Table 167 and Table 168.

Table 167 CH_4 emissions from Manure management 1988 –2010, 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	227,64	2,88	0,29	1,11	0,23	1,34	0,08	0,26	186,13	34,93
1989	229,97	2,88	0,28	1,07	0,22	1,27	0,08	0,26	187,71	35,82
1990	234,49	2,83	0,27	1,05	0,21	1,21	0,08	0,25	194,56	33,63
1991	229,89	2,75	0,26	0,98	0,22	1,16	0,08	0,25	196,11	27,69
1992	195,87	2,68	0,22	0,86	0,23	1,06	0,09	0,24	168,71	21,39
1993	145,47	2,42	0,17	0,65	0,21	0,83	0,10	0,24	122,58	17,89
1994	115,07	2,06	0,11	0,44	0,18	0,62	0,12	0,24	90,35	20,60
1995	93,10	1,74	0,09	0,33	0,14	0,51	0,13	0,26	69,29	20,28
1996	81,88	1,63	0,08	0,29	0,12	0,49	0,15	0,30	62,25	16,24
1997	66,00	1,64	0,07	0,26	0,11	0,45	0,15	0,34	47,67	14,99
1998	51,17	1,68	0,06	0,24	0,10	0,42	0,16	0,31	34,59	13,34
1999	45,58	1,82	0,07	0,25	0,09	0,40	0,18	0,27	29,18	13,10
2000	36,62	1,81	0,07	0,34	0,09	0,33	0,16	0,29	18,25	15,13
2001	31,37	1,58	0,06	0,34	0,07	0,24	0,13	0,30	13,65	14,83
2002	34,61	1,63	0,07	0,38	0,06	0,24	0,13	0,31	17,37	14,26
2003	42,61	1,64	0,09	0,44	0,07	0,24	0,13	0,29	22,38	17,16
2004	44,91	1,68	0,08	0,41	0,07	0,24	0,13	0,26	24,17	17,72
2005	45,22	1,66	0,08	0,38	0,07	0,24	0,12	0,26	25,51	16,75
2006	49,03	1,63	0,08	0,37	0,07	0,23	0,10	0,26	29,02	17,12
2007	49,99	1,54	0,08	0,32	0,08	0,22	0,09	0,25	30,50	16,74
2008	47,30	1,51	0,08	0,32	0,08	0,21	0,08	0,30	28,89	15,67
2009	46,04	1,41	0,09	0,30	0,08	0,20	0,07	0,36	27,96	15,41
2010	43,76	1,40	0,08	0,29	0,08	0,19	0,06	0,30	27,50	13,70
Share 2010	-	3,20%	0,18%	0,66%	0,18%	0,43%	0,14%	0,69%	62,84%	31,31%
Trend 1988–2010	-80,8%	-51,4%	-72,4%	-73,9%	-65,2%	-85,8%	-25,0%	15,4%	-85,2%	-60,8%

Table 168 N_2O emissions from Manure management 1988 –2010, 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 Horses	4.B.8 Swine	4.B.9 Poultry
1988	4,54	1,14	0,21	0,80	0,0014	1,48	0,09	0,04	0,14	0,44
1989	4,44	1,14	0,20	0,77	0,0013	1,41	0,09	0,04	0,14	0,46
1990	4,31	1,12	0,20	0,75	0,0013	1,35	0,09	0,04	0,15	0,43
1991	4,09	1,09	0,18	0,70	0,0014	1,29	0,10	0,04	0,15	0,35
1992	3,74	1,06	0,16	0,61	0,0014	1,18	0,11	0,04	0,13	0,27
1993	3,19	0,95	0,12	0,47	0,0013	0,93	0,12	0,04	0,16	0,23
1994	2,67	0,80	0,08	0,31	0,0011	0,69	0,14	0,04	0,19	0,26
1995	2,36	0,68	0,06	0,23	0,0009	0,58	0,16	0,04	0,20	0,26
1996	2,27	0,63	0,05	0,20	0,0008	0,55	0,17	0,04	0,25	0,21
1997	2,20	0,63	0,05	0,18	0,0007	0,52	0,18	0,05	0,26	0,19
1998	2,10	0,64	0,04	0,16	0,0006	0,47	0,19	0,05	0,25	0,17
1999	2,17	0,69	0,04	0,17	0,0006	0,45	0,22	0,04	0,30	0,17
2000	2,02	0,66	0,05	0,19	0,0005	0,36	0,19	0,04	0,26	0,19
2001	1,75	0,62	0,04	0,20	0,0004	0,27	0,15	0,04	0,16	0,19
2002	1,79	0,63	0,05	0,23	0,0004	0,27	0,15	0,05	0,16	0,18
2003	1,90	0,65	0,07	0,27	0,0004	0,27	0,16	0,04	0,17	0,21
2004	1,89	0,67	0,06	0,26	0,0004	0,26	0,15	0,04	0,15	0,22
2005	1,81	0,67	0,06	0,23	0,0005	0,27	0,14	0,04	0,13	0,21
2006	1,76	0,65	0,06	0,22	0,0005	0,26	0,12	0,04	0,12	0,22
2007	1,71	0,64	0,06	0,22	0,0005	0,25	0,11	0,04	0,11	0,21
2008	1,62	0,61	0,06	0,20	0,0005	0,24	0,10	0,05	0,08	0,20
2009	1,52	0,57	0,06	0,19	0,0005	0,23	0,08	0,05	0,06	0,19
2010	1,45	0,56	0,06	0,19	0,0005	0,22	0,08	0,04	0,05	0,17
Share 2010	-	38,79%	4,29%	12,83%	0,03%	15,31%	5,28%	3,08%	3,38%	12,02%

The analysis of Table 168 shows a decrease of 4,8% 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. 80,8%% reduction. N_2O Emissions have decreased by 4,5% compared to the previous year and 68% compared to the base year

6.4.2 METHODOLOGICAL ISSUES

6.4.2.1 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 (GPG, Equation 4.17):

$$EF_i = VS_i \times 365 \times B_{o_i} \times 0{,}67 \times \sum_{k}^{j} MCF_{jk} \times MS_{ijK}$$

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

$B0_i$ = 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 169 Methane conversion factors

AWMS	Allocation by climate	MCF
Anaerobic lagoon	Temperate	90%
Liquid system	Temperate	45%
Daily spread	Temperate	0.5%
Solid storage	Temperate	1.5%
Pasture range and paddock	Cool	1%
Pit storage <30days<	Temperate	22.5%
Other	Temperate	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 intraploted data is provided in Table 170

Table 170 AWMS distribution for cattle and swine

	Cattle			Swine		
	Solid storage	Dry lot	Pasture range paddock	Anaerobic lagoon	Solid storage	Dry lot
1988	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%
1989	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%
1990	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%
1991	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%
1992	33,5%	47,0%	19,5%	92,0%	8,0%	0,0%
1993	35,2%	44,6%	20,2%	84,0%	12,5%	3,5%
1994	36,7%	42,3%	21,0%	75,7%	17,3%	7,0%
1995	38,4%	40,0%	21,6%	67,8%	22,0%	10,2%
1996	40,0%	37,7%	22,3%	59,7%	26,6%	13,7%
1997	41,6%	35,4%	23,0%	51,6%	31,3%	17,1%
1998	43,2%	33,1%	23,7%	45,5%	36,0%	20,5%
1999	44,8%	30,7%	24,5%	35,4%	40,6%	24,0%
2000	46,4%	28,4%	25,2%	27,4%	45,3%	27,4%
2001	45,0%	31,5%	23,5%	32,6%	42,8%	24,6%
2002	43,6%	34,3%	22,1%	37,9%	40,3%	21,8%
2003	42,2%	37,5%	20,3%	43,2%	37,8%	19,0%
2004	40,7%	40,6%	18,7%	48,4%	35,3%	16,3%
2005	39,3%	43,6%	17,1%	53,7%	32,9%	13,5%
2006	36,8%	46,1%	17,1%	58,7%	29,3%	12,0%
2007	34,3%	48,7%	17,0%	63,6%	25,7%	10,7%
2008	32,8%	51,1%	16,1%	68,6%	22,1%	9,3%

2009	29,2%	53,7%	17,1%	73,5%	18,6%	7,9%
2010	26,7%	56,1%	17,2%	78,6%	15,0%	6,4%

6.4.2.2 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>

$$N_{ex_{(awms)}} = \underset{T}{\quad} [\, N_{(T)} \times N_{ex_{(T)}} \times AWMS_{(T)}]$$

$Nex_{(AWMS)}$ = 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

N_2O <u>emission per animal waste management system:</u>

$$N_2O_{(AWMS)} = \quad [N_{ex_{(AWMS)}} \times EF3_{(AWMS)}]$$

$N_2O_{(AWMS)}$ = 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]

$EF3_{(AWMS)}$ = 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 170).

6.4.2.3 Nitrogen excretion

Table 171 Nitrogen excretion values of other 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	30,44
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	8,91 2,46 5,09 8,71 12,65 13,47 13,47 13,47
Poultry Chickens	0,6
Other Poultry	0,6

6.4.2.4 Emission factors

N_2O emission factors of the IPCC GPG have been used for all AWMS.

Emission factors applied in the Bulgarian inventory are listed in the following table:

Table 172 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, Table 4.12
Liquid system	0.001	IPCC GPG, Table 4.12
Daily spread	0.00	IPCC GPG, Table 4.12
Solid storage	0.020	IPCC GPG, Table 4.12
Pasture range, paddock	0.020	IPCC GPG, Table 4.12
Pit storage <30days<	0.001	IPCC GPG, Table 4.12
Other	0.001	IPCC GPG, Table 4.12

6.4.2.5 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 1990-2010.

Animal numbers are the same as the ones used for calculating emissions from enteric fermentation and are presented in Table 162 and Table 163, except pigs are dividied into sub-categories in order to estimate more accurately the nitrogen excretion. Division of pigs is presented in Table 173. Data for estimating nitrogen excretion from cattle is shown in Table 174.

Table 173 Activity data for estimating nitrogen excretion from swine

		2007	2008	2009	2010
Pigs < 20 kg	Population size	178521	146496	135654	127246
	Kg Manure/day	1,5	1,5	1,5	1,5
Pigs 20-50 kg	Population size	167503	163994	162787	141764
	Kg Manure/day	3,1	3,1	3,1	3,1
Pigs 50 -80 kg	Population size	132921	126151	117215	107584
	Kg Manure/day	5,3	5,3	5,3	5,3
Pigs 80 -110 kg	Population size	234795	198574	161380	142807
	Kg Manure/day	7,7	7,7	7,7	7,7
Pigs > 110 kg, breeding pigs and boars	Population size	226561	236893	200915	179689
	Kg Manure/day	8,2	8,2	8,2	8,2
Kg N in 1000 Kg manure		4,5	4,5	4,5	4,5
Weighted Nex		8,76	8,78	9,06	8,98

Table 174 Activity data for estimating nitrogen excretion from cattle

		2007	2008	2009	2010
Mature dairy cattle	Population size	343015	325277	305713	302461
	Kg Manure/day	40,0	40,0	40,0	40,0
Mature non-dairy cattle	Population size	43036	44506	44635	44607
	Kg Manure/day	30,0	30,0	30,0	30,0
Fattering claves under 1 year	Population size	73624	67799	62464	58238
	Kg Manure/day	15,0	15,0	15,0	15,0
Other calves under 1 year	Population size	100577	93101	86432	83124
	Kg Manure/day	15,0	15,0	15,0	15,0
Bovine 1-2 years	Population size	12756	13826	13463	13210
	Kg Manure/day	30,0	30,0	30,0	30,0
Heifers	Population size	42157	38972	39525	40005
	Kg Manure/day	30,0	30,0	30,0	30,0
Kg N in 1000 Kg manure		4,9	4,9	4,9	4,9

6.4.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of CH_4 emissions from this source is 50% and of N_2O emissions - 300%.

Table 175 Uncertainty of sub-sector Manure Management for 2010, %

CRF categories	Key Category	GHG	Activity data uncertainty, %	Emission factor uncertainty, %	Combined uncertainty, %
4B	N_2O emission from Manure Management	N_2O	2	300	300.0
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

6.4.4 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.

Source-specific recalculations

The full time series is recalculated due to the newly determined emission factors.

Animal type	Reason for recalculation	Recalculated period
4B1– Cattle	Change in awms distribution and nitrogen excretion	1988-2010
4B8 - Swine	Change in awms distribution and nitrogen excretion	1988-2010

6.4.5 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Collection of data for dividing sheep 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.

6.5 RICE CULTIVATION (CRF SECTOR 4C)

6.5.1 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 11977 ha in 2010.

100,61 Gg CH_4 CO_2-eq. has been emitted in 2010. Emissions increase by 30.6% compared to the year 2010 is due to the increase of the areas of rice crops.

In Bulgaria rice is produced under the continuously flooded water regime with season length of 103 days and one harvest per year[32].

6.5.2 METHODOLOGICAL ISSUES

6.5.2.1 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.

6.5.2.2 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	
Scaling factor organic amendments	2	Table 4.22 IPCC GPG 2000
Emission factor	40	IPCC Reference manual

6.5.2.3 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.

[32] as proposed in table 4-11 in IPPC Reference Manual 1996

6.5.2.4 Uncertainties and time-series consistency

The uncertainty of methane emissions from this source is 20%

6.5.2.5 Source-specific QA/QC and verification

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

6.5.2.6 Source-specific planned improvements

Collection of data to ensure TACCC (see above).

6.6 AGRICULTURAL SOILS (CRF SECTOR 4D)

6.6.1 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 2010.

Direct emissions result of:

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 1991 Gg CO_2-eq. in 2010. The emission increase by 8,1% in 2010 compared to 2009

Indirect N_2O emissions were 1210,3 Gg CO_2-eq. in 2010. The emissions from this increase by 5,7% compared to 2009.

The emissions from pasture animals increase by 5,7% compared to 2009.

6.6.2 METHODOLOGICAL ISSUES

6.6.2.1 Methods

The IPCC Tier 1a and – where applicable – Tier 1b method was applied and IPCC default emission factors were used.

Table 176 N_2O emissions factors for agricultural soils.

Category	Emission Factor [t N_2O-N/t N]	Source
4.D.1 Direct Soil Emissions		
Synthetic fertilizers (mineral fert.)	0.0125	IPCC GPG (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 NexGRAZ	IPCC Guidelines (Table 4.22)
4.D.3 Indirect soil emissions		
Atmospheric deposition	0.01/ t of volatized nitrogen	IPCC GPG (Table 4.18)
Nitrogen leaching (and run-off)	0.025/ t N-loss by leaching	IPCC GPG (Table 4.18)

6.6.2.2 Emission factors

Emission factors are the default ones from the IPCC Guidelines. So far, there are no assessments of these emission factors, which result from measurements in the country.

6.6.2.3 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 Supplies.

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)

6.6.3 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 177 Uncertainty of sub-sector Manure Management for 2010, %

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

6.6.4 SOURCE-SPECIFIC QA/QC

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

6.6.5 SOURCE-SPECIFIC RECALCULATIONS

The parameters of manure processing were slightly modified in compliance with the IPCC Guidelines.

6.6.6 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Collection of data for implementation higher TIER and ensure TACCC (see above).

6.7 FIELD BURNING OF AGRICULTURAL RESIDUES (CRF SECTOR 4F)

6.7.1 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.

1067 Gg CO_2-eq. aggregated GHGs have been emitted in 2010. The increase is 5%, compared to the year 2009, on the assumption that 10% (1996 IPCC GL-RM, page 4.83) of the vegetal residues, left on the fields after yielding crop, are burned.

Methodological issues

According to the provisions in IPCC GPG 2000, the calculation methodology took into account IPCC 1996 default emissions ratios (Table 4-16 of Reference Manual). Emission ratios are presented in Table 149.

Table 178 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 179 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

6.7.2 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.

6.7.3 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.

6.7.4 SOURCE-SPECIFIC RECALCULATIONS

Full recalculation of the time has been made in submissions 2012 due to revision of the amount of agricultural residues burned in the fields.

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.

The first three categories are of biggest importance for Bulgaria as they cover around 87% of the territory of the country.

Table 180 Level assessment of the key category including LULUCF – base year 1988

Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% incl.	cumul. %
5A1 Forests remaining Forests	CO_2	0	13816.77	9.5%	27.0%
5B1 Cropland remaining Cropland	CO_2	0	1011.50	0.7%	94.0%
5A2 Land use change to Forests	CO_2	0	975.96	0.7%	94.7%

Table 181 Level assessment of the key category including LULUCF - inventoried year 2010

Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% incl.	cumul. %
5A1 Forests remaining Forests	CO_2	0	9552.34	12.5%	48.5%
5A2 Land use change to Forests	CO_2	0	1335.34	1.8%	69.1%
5B1 Cropland remaining Cropland	CO_2	0	1115.99	1.5%	72.1%
5B2 Land use change to Cropland	CO_2	0	1011.50	1.3%	74.8%
5C2 Land use change to Grassland	CO_2	0	786.64	1.0%	82.9%
5E2 Land use change to Settlements	CO_2	0	528.24	0.7%	89.9%

7.1.1 SECTOR COVERAGE

In the 2012 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 emission of CH_4 and N_2O is estimated for those sub-categories, where it occurs. The completeness of the estimated emissions from sources and removals by sinks is shown in Table 182 Overview of subcategories of CRF Sector 5 – LULUCF: status of emission estimates for CO_2, CH_4 and N_2O.

Table 182 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	NO	NO
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
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

Table 183 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	-14177.44	-14791.05	1326.10	-786.64	NE, NO	74.15	NO
1989	-14041.56	-14817.16	1488.09	-786.64	NE, NO	74.15	NO
1990	-13892.94	-14824.76	1644.31	-786.64	NE, NO	74.15	NO
1991	-13775.25	-14860.89	1798.12	-786.64	NE, NO	74.15	NO
1992	-13449.37	-14712.63	1975.76	-786.64	NE, NO	74.15	NO
1993	-12709.07	-14261.97	2265.39	-786.64	NE, NO	74.15	NO
1994	-12491.35	-14276.56	2497.70	-786.64	NE, NO	74.15	NO
1995	-12963.51	-14863.53	2612.51	-786.64	NE, NO	74.15	NO
1996	-10589.41	-12593.55	2716.64	-786.64	NE, NO	74.15	NO
1997	-10610.44	-12597.10	2699.16	-786.64	NE, NO	74.15	NO
1998	-10562.78	-12341.00	2490.71	-786.64	NE, NO	74.15	NO

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
1999	-10473.40	-12196.51	2435.60	-786.64	NE, NO	74.15	NO
2000	-8867.84	-10549.84	2394.49	-786.64	NE, NO	74.15	NO
2001	-8676.52	-10381.44	2314.71	-786.64	90.65	86.20	NO
2002	-9094.65	-10883.01	2355.29	-786.64	102.98	116.74	NO
2003	-9054.85	-11008.11	2503.81	-786.64	115.07	121.02	NO
2004	-9266.89	-11154.79	2417.93	-786.64	127.09	129.52	NO
2005	-9078.34	-11190.56	2534.53	-786.64	139.61	224.71	NO
2006	-8615.24	-10705.59	2461.33	-786.64	151.71	263.95	NO
2007	-7389.26	-9395.05	2276.16	-786.64	164.10	352.18	NO
2008	-8644.90	-10741.05	2227.97	-786.64	176.21	478.61	NO
2009	-8816.29	-10946.74	2343.64	-786.64	189.09	384.36	NO
2010	-8631.27	-10864.00	2290.17	-786.64	200.94	528.24	NO

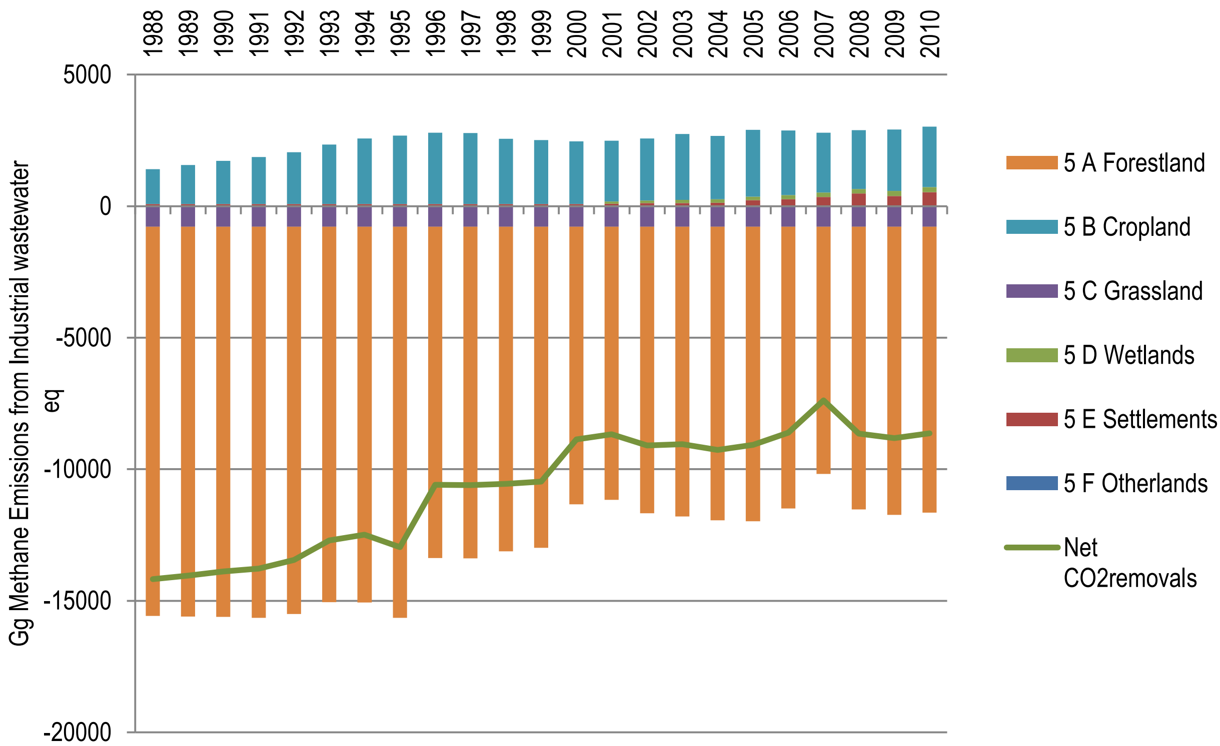

Figure 66 LULUCF emissions and removals 1988 – 2009 CO_2 eq.

The results from the figure show that the land use, land use changes and forestry are serving as sink of greenhouse gases for Bulgaria. The two categories – "Forest land" and "Grassland" are removals of CO2. All other categories are sources of CO2 emissions. The trend of net CO2 removals (CO_2 eq) from LULUCF decreases by 39.12% compared with the base year, reaching its lowest points in years 2006 and 2007. The reason for the decrease of the uptakes of CO2 emissions is mainly due to the change in wood stock, which in the 2000-ies was smaller than in the 90-ies. The trend of total removals after the year 2007 is going up due to an increase in net removals from Forest land and a slight decrease in croplands' emissions. The net changes of the carbon stock in the biomass cause biggest effect on the final results, obtained for the whole sector. Over the period 1990-2010 a permanent trend is observed for increasing the tree biomass stock (by 47% for the coniferous species and by 23% for the deciduous).

In spite of the decrease observed, the share of the removals from the total GHG emissions (in CO2eq) 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% from the total GHG emissions in CO2eq, while in the inventoried year the share is -14%.

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 Wetlands and Settlements increase last couple of years due to changes from other land use to Settlements and Wetlands (mostly for reservoirs) according to the risen infrastructural activities since Bulgaria’s joined the EU.

7.1.3 METHODOLOGY

The inventory is based on the principles envisaged in the 2003 IPCC GPG. All the land-use changes were traced down and reported for a transition period of 20 years after which they are reported in the respective categories.

7.1.4 LAND AREA REPRESENTATION AND LAND USE TRANSITION MATRIX

7.1.4.1 Information on approaches and database used for representing land areas

Table 184 presents the data for the areas by types of land-use and land-use changes for the base and the inventoried year as well as the net change between the period.

To achieve the full time series of 1988-2010 for the areas staying in a certain category land-use and the converted lands, data from different statistical sources are used.

The data or the total area of the forest territories for the separate years, as well as the relative share of the coniferous and deciduous, forests out of yield and other vegetation are obtained from the Forestry fund reports (Executive Forest Agency).

Statistical data for the area are used for the annual crops and perennials from 1988 until 2010 - until 1999 from National Statistical Yearbook, from year 2000 - Agrostatistics and Strategies Department at MAF. Agrostatistics provides information for the changes between croplands with annual crops to croplands with perennials as well as between croplands and grasslands over the period 2000-2008. The land-use changes within the cropland category for the years 2009 and 2010 are extrapolated.

Concerning the total area of the grasslands for the single years for the period 1988-2009 statistical information is used (Executive Forestry Agency for the whole time series, National Statistical Yearbook – up to 1999), Agrostatistics and Strategies Department at MAF from year 2000 on. Agrostatistics provides information also on the changes in the land-use, between lands, separately with annual crops and perennials and grasslands in the period 2000-2008.

Information on the areas from the category “Wetlands” for single years (1994, 1996, 1999 and 2000) were obtained from the cadastral maps of the agricultural fund of Bulgaria (Balance by Type of Territories as per their Designation, Cadastre Agency) and from Corine Land Cover that provides data for the years 1990, 2000 and 2006 (Executive Environmental Agency).

The information for the areas of the settlements for the single years (1996, 1998, 1999, 2000) was obtained from the cadastral maps of the agricultural fund of Bulgaria (Balance by Type of Territories as per their Designation, Cadastre Agency) and from Corine Land Cover for the years 1990, 2000 and 2006.

Rocks and landslides from Forest lands are referred to under category "Other Lands" from the statistics in the forest territory (Forestry fund reports, the Executive Forestry Agency).

Major problem is the limited information on the changes and the conversion between the separate categories. When data for completing the information are missing, information from available statistics were used as well as probability assumptions on land-use changes and estimates to level off the occurring land area changes were carried out.

It was assumed that the shares of the individual land-use categories that contribute to the specific LUC behave like the ratios of the total areas of these land-use categories in Bulgaria. The time series of the available 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 change-areas was fitted to the different trends in these two periods. This approach for estimation of LUC between the categories was used to trace the changes during the time series.

In accordance with the IPCC GPG, Bulgaria reports the LUC areas in the LUC categories for a transition period of 20 years. Therefore, activity data back to 1968 are 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.

Additional information on the methodology for collecting data or the areas is presented in the chapters for the different types of land-use.

Table 184 Areas by Type of Land use and land use changes for the base year and the last year of inventory

area in kha	1988	2010	2010-1988
5.A Forest Land - Total	3 603	3847	244
5A1. Forest land remaining forest land	3 445	3612	167
5A1a. Forest land remaining forest land - coniferous	1 168	1053	-115
5A1b. Forest land remaining forest land - deciduous	2 188	2456	267
5A1c. Forest land remaining forest land - out of yield	21	22	1
5A1d .Forest land remaining forest land – other vegetation	67	81	14
5A2. LUC in forest land	158	235	77
5A2.1.a Annual Cropland in forest land	103	142	39
5A2.1.b Perennial Cropland in forest land	6	9	4
5A2.2 Grassland in forest land	38	66	29
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	11	17	6
5.B Cropland - Total	3 922	3795	-127
Cropland annual	3 547	3548	1
Cropland perennial	375	247	-128
5B1. Cropland remaining cropland	3 610	3483	-127
5B1a annual cropland remaining annual cropland	3 210	3211	1
5B1b perennial cropland remaining perennial cropland	298	170	-128
5B1c LUC perennial cropland in annual cropland	63	63	0

area in kha	1988	2010	2010-1988
5B1d LUC annual cropland in perennial cropland	39	39	0
5B2. LUC in cropland	312	312	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	274	274	0
5B2.2b Grassland in perennial cropland	38	38	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	2 008	1817	-192
5C1. Grassland remaining grassland	1 759	1568	-192
5C2. LUC in grassland	249	249	0
5C2.1 Forest land in grassland	0	0	0
5C2.2.a Annual cropland in grassland	230	230	0
5C2.2.b Perennial cropland in grassland	20	20	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	202	212	10
5D1. Wetlands remaining wetlands	202	202	0
5D2. LUC in wetlands	0	10	10
5D2.1 Forest land in wetlands	0	4	4
5D2.2.a Annual Cropland in wetlands	0	4	4
5D2.2.b Perennial Cropland in wetlands	0	0	0
5D2.3 Grassland in wetlands	0	2	2
5D2.4 Settlement in wetlands	0	0	0
5D2.5 Other land in wetlands	0	0	0
5 E Settlements	807	832	25
5E1. Settlements remaining settlements	802	799	-3
5E2. LUC in settlements	5	33	27
5E2.1 Forest land in settlements	0	2	2
5E2.2.a Annual Cropland in settlements	3	19	16
5E2.2.b Perennial Cropland in settlements	0	1	1
5E2.3 Grassland in settlements	2	10	8
5E2.4 Wetlands in settlements	0	0	0
5E2.5 Other land in settlements	0	0	0
5 F Other land	557	596	39
5F1. Other land remaining other land	557	596	39
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 Bulgaria	**11 100**	**11100**	

7.1.4.2 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories. Development of land use transition matrix

Reporting in Sector 5 is based on broad land 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.

When developing the land use transition matrix (Table 185) 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. According to IPCC GPG (2003) and the activity data available, approach 1 has been used. 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. Because of lack of annual information for land use changes (LUC) Bulgaria used the following method.

The remaining LUC areas to forests were assumed to stem from cropland and grassland and other lands. It was assumed that the shares of the individual land-use categories annual cropland, perennial cropland, grassland and other lands that contribute to these LUC areas to forests behave like the ratios of the total areas of these land-use categories in Bulgaria. 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.

According to the LUCs to cropland it was assumed that the changes may occur only from grassland. There is information on LUC to cropland from grassland (and in reverse) for period 2000-2008, which is verified with Corine Land Cover and extrapolated for the years before that and also for 2009 and 2010. The overall balance of the area and area changes over the time series fits after the extrapolations. The same approach was used to trace the LUCs to grassland.

The LUC to wetlands was assumed to stem from forests, cropland and grassland and that the shares of these individual land use categories to the LUCs to wetland behave like the ratios of the total areas of these land use categories in Bulgaria.

Concerning the LUCs to settlements there is information for LUC from forest land and agricultural land to settlements, which is available for the years 2001 to 2010. These reported land-use changes to settlement fit very well to the increases in settlement area in these years as it was assessed by Corine Land Cover. 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 2010, was assumed to be the same as the share of the totals of these land-use categories. The LUC to settlements for the year before 2001 and for 2009 are extrapolated.

The LUC matrix is presented on Table 185. It was developed in a general way, including information on net changes in the area from the base year to the year of the inventory.

Table 185 Matrices for annual land use and land use changes for Bulgaria over the period 1988-2010

kha	FL	CL	GL	WL	SL	OL	1987
FL	3594.94				0.02		3594.97
CL	5.41	3906.76	12.47		0.17		3924.81
GL	1.85	15.61	1996.00		0.08		2013.55
WL				202.29			202.29
SL					806.81		806.81
OL	0.65					557.12	557.77
1988	3602.85	3922.37	2008.47	202.29	807.08	557.12	11100.19

kha	FL	CL	GL	WL	SL	OL	1988
FL	3602.83				0.02		3602.85
CL	5.41	3903.18	12.47		0.17		3921.24
GL	1.87	15.61	2007.52		0.08		2025.08
WL				202.27			202.27
SL					807.12		807.12
OL	0.63					541.00	541.63
1989	3610.74	3918.79	2019.99	202.27	807.39	541.00	11100.19

kha	FL	CL	GL	WL	SL	OL	1989
FL	3610.72				0.02		3610.74
CL	5.41	3896.14	12.47		0.17		3914.19
GL	1.87	15.61	2006.79		0.08		2024.35
WL				202.25			202.25
SL					807.42		807.42
OL	0.63					540.60	541.23
1990	3618.63	3911.74	2019.26	202.25	807.69	540.60	11100.19

kha	FL	CL	GL	WL	SL	OL	1990
FL	3618.61				0.02		3618.63
CL	5.42	3896.14	12.47		0.17		3914.20
GL	1.87	15.61	2006.49		0.08		2024.05
WL				202.23			202.23
SL					807.73		807.73
OL	0.62					532.73	533.35
1991	3626.52	3911.75	2018.96	202.23	808.00	532.73	11100.19

kha	FL	CL	GL	WL	SL	OL	1991
FL	3626.50				0.02		3626.52
CL	5.42	3896.01	12.47		0.17		3914.07
GL	1.88	15.61	2007.51		0.08		2025.08
WL				202.21			202.21
SL					808.04		808.04
OL	0.61					523.66	524.27
1992	3634.41	3911.62	2019.98	202.21	808.31	523.66	11100.19

kha	FL	CL	GL	WL	SL	OL	1992
FL	3634.39				0.02		3634.41
CL	5.43	3896.48	12.47		0.17		3914.55
GL	1.88	15.61	2008.60		0.08		2026.17
WL				202.19			202.19
SL					808.34		808.34
OL	0.60					513.93	514.53
1993	3642.30	3912.08	2021.07	202.19	808.62	513.93	11100.19

kha	FL	CL	GL	WL	SL	OL	1993
FL	3642.28				0.02		3642.30
CL	5.44	3896.88	12.47		0.17		3914.96
GL	1.88	15.61	2005.24		0.08		2022.81
WL				202.17			202.17
SL					808.65		808.65
OL	0.60					508.71	509.30
1994	3650.19	3912.49	2017.71	202.17	808.92	508.71	11100.19

kha	FL	CL	GL	WL	SL	OL	1994
FL	3650.17				0.02		3650.19
CL	5.50	3947.05	12.47		0.17		3965.19
GL	1.84	15.61	1971.56		0.08		1989.09
WL				202.15			202.15
SL					808.96		808.96
OL	0.57					484.05	484.62
1995	3658.08	3962.66	1984.03	202.15	809.23	484.05	11100.19

kha	FL	CL	GL	WL	SL	OL	1995
FL	3658.06				0.02		3658.08
CL	5.51	3947.58	12.47		0.17		3965.73
GL	1.85	15.61	1975.59		0.08		1993.13
WL				202.13			202.13
SL					809.26		809.26
OL	0.55					471.31	471.86
1996	3665.97	3963.19	1988.06	202.13	809.54	471.31	11100.19

kha	FL	CL	GL	WL	SL	OL	1996
FL	3665.95				0.02		3665.97
CL	5.65	4058.98	12.47		0.17		4077.26
GL	1.77	15.61	1904.61		0.08		1922.07
WL				202.11			202.11
SL					809.57		809.57
OL	0.50					422.72	423.21
1997	3673.86	4074.58	1917.08	202.11	809.84	422.72	11100.19

kha	FL	CL	GL	WL	SL	OL	1997
FL	3673.84				0.02		3673.86
CL	5.66	4058.88	12.47		0.17		4077.17
GL	1.77	15.61	1907.42		0.08		1924.88
WL				202.09			202.09
SL					809.88		809.88
OL	0.48					411.83	412.31
1998	3681.75	4074.49	1919.89	202.09	810.15	411.83	11100.19

kha	FL	CL	GL	WL	SL	OL	1998
FL	3681.72				0.02		3681.75
CL	5.66	4059.86	12.47		0.17		4078.16
GL	1.76	15.61	1899.48		0.08		1916.94
WL				202.07			202.07
SL					810.18		810.18
OL	0.48					410.61	411.09
1999	3689.64	4075.47	1911.96	202.07	810.46	410.61	11100.19

kha	FL	CL	GL	WL	SL	OL	1999
FL	3689.61				0.02		3689.64
CL	5.05	4059.86	12.47		0.17		4077.54
GL	2.37	15.61	1899.48		0.08		1917.54
WL				202.04			202.04
SL					810.49		810.49
OL	0.50					402.43	402.93
2000	3697.52	4075.47	1911.96	202.04	810.76	402.43	11100.19

kha	FL	CL	GL	WL	SL	OL	2000
FL	3697.10			0.41	0.01		3697.52
CL	9.85	4058.77	12.47	0.42	0.51		4082.01
GL	4.58	15.61	1881.93	0.21	0.25		1902.58
WL				202.04			202.04
SL					812.10		812.10
OL	0.97					402.96	403.94
2001	3712.50	4074.38	1894.40	203.08	812.87	402.96	11100.19

kha	FL	CL	GL	WL	SL	OL	2001
FL	3711.97			0.41	0.12		3712.50
CL	9.87	4027.81	12.47	0.42	0.65		4051.22
GL	4.56	15.61	1857.53	0.21	0.33		1878.23
WL				203.08			203.08
SL					813.88		813.88
OL	1.07					440.20	441.28
2002	3727.47	4043.42	1870.00	204.12	814.98	440.20	11100.19

kha	FL	CL	GL	WL	SL	OL	2002
FL	3726.98			0.41	0.07		3727.47
CL	9.75	3979.72	12.47	0.41	0.71		4003.07
GL	4.65	15.61	1892.00	0.21	0.36		1912.82
WL				204.12			204.12
SL					815.94		815.94
OL	1.06					435.70	436.76
2003	3742.44	3995.33	1904.47	205.16	817.09	435.70	11100.19

kha	FL	CL	GL	WL	SL	OL	2003
FL	3741.95			0.42	0.08		3742.44
CL	9.76	3968.66	12.47	0.41	0.63		3991.93
GL	4.70	15.61	1908.74	0.21	0.32		1929.58
WL				205.16			205.16
SL					818.16		818.16
OL	1.01					411.90	412.91
2004	3757.42	3984.27	1921.21	206.20	819.19	411.90	11100.19

kha	FL	CL	GL	WL	SL	OL	2004
FL	3756.81			0.42	0.19		3757.42
CL	9.46	3810.22	12.47	0.40	2.32		3834.86
GL	4.99	15.61	2005.26	0.22	1.16		2027.24
WL				206.20			206.20
SL					817.64		817.64
OL	1.13					455.70	456.83
2005	3772.39	3825.83	2017.73	207.24	821.30	455.70	11100.19

kha	FL	CL	GL	WL	SL	OL	2005
FL	3771.82			0.42	0.15		3772.39
CL	9.50	3821.89	12.47	0.40	2.44		3846.69
GL	4.93	15.61	1977.37	0.22	1.22		1999.34
WL				207.24			207.24
SL					819.60		819.60
OL	1.12					453.81	454.93
2006	3787.36	3837.50	1989.84	208.28	823.41	453.81	11100.19

kha	FL	CL	GL	WL	SL	OL	2006
FL	3786.65			0.42	0.29		3787.36
CL	9.59	3812.83	12.47	0.40	2.96		3838.25
GL	4.90	15.61	1944.11	0.22	1.48		1966.32
WL				208.28			208.28
SL					820.78		820.78
OL	1.20					478.01	479.20
2007	3802.34	3828.43	1956.58	209.31	825.51	478.01	11100.19

kha	FL	CL	GL	WL	SL	OL	2007
FL	3801.08			0.43	0.83		3802.34
CL	9.94	3808.52	12.47	0.40	2.41		3833.73
GL	5.06	15.61	1933.49	0.22	1.21		1955.58
WL				209.31			209.31
SL					823.17		823.17
OL	1.23					474.82	476.05
2008	3817.31	3824.12	1945.96	210.35	827.62	474.82	11100.19

kha	FL	CL	GL	WL	SL	OL	2008
FL	3816.78			0.43	0.10		3817.31
CL	9.40	3760.24	12.47	0.40	2.08		3784.59
GL	4.57	15.61	1821.55	0.21	1.04		1842.97
WL				210.35			210.35
SL					826.51		826.51
OL	1.54					616.92	618.46
2009	3832.28	3775.84	1834.02	211.39	829.73	616.92	11100.19

kha	FL	CL	GL	WL	SL	OL	2009
FL	3831.54			0.43	0.31		3832.28
CL	9.60	3779.81	12.47	0.40	3.88		3806.16
GL	4.60	15.61	1804.49	0.20	1.94		1826.83
WL				211.39			211.39
SL					825.71		825.71
OL	1.51					596.30	597.81
2010	3847.26	3795.41	1816.96	212.43	831.84	596.30	11100.19

The data shows that over the period 1988-2010 the areas in the categories "Forest land", "Wetlands" and "Settlements" and "Other land" have increased by 244.40 kha, 10.14 kha, 24.75 kha and 39.18 kha and they have decreased in the categories "Cropland", "Grassland" by 126.95 kha and 191.52 kha respectively.

Explanation on missing fit of the land-use changes and area changes of some subcategories are explained in the specific chapters.

7.1.5 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.

7.2 FOREST LAND (5.A.)

7.2.1 DESCRIPTION OF THE CATEGORY

Forests in Bulgaria cover an area of 3 847 256 ha which represents 34.5 % of the country's territory. The inventory of the greenhouse gases for the Forest category, in accordance with the IPCC GPG, includes an assessment of the changes in the carbon stock in 5 pools – aboveground biomass, belowground biomass, deadwood, and litter and soil organic matter. The available data base in Bulgaria allows the changes in the carbon stocks to be determined 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 (0-30 cm). When estimate the net change in the stock of the soil carbon pool, dead wood and litter for subcategory FL remaining FL Tier 1 (IPCC GPG 2003) method was applied.

7.2.1.1 Trends in the emissions/removals in forests

The net uptake of CO2 from forests over the period 1988-2010 is within the limits of 10887.70 Gg CO_2 eq. and 14792.73 Gg CO_2 eq., the average quantity is 12423.52 Gg CO_2 eq.The contribution of the subcategory "Forests Remaining Forests" is almost 10 times bigger compared to the subcategory "Lands Converted to Forests".

Emissions/uptake of CO2 by the soils in the subcategory "Forest remaining Forest" are considered with Tier 1 as stable in time and equal to 0 (1988-2010) For the subcategory "Lands Converted to Forests" the biggest changes in the carbon stock in the soils occurs when converting grassland to forests– emissions of 354 Gg CO_2. The trends in the change of the area of subcategory "Forest land Remaining Forest land" and of "Lands Converted to Forests" are presented on Figure. Over the inventory period the total forest area, as well as the area of the subcategory "Forest land Remaining Forest land" are increasing. The changes are as a result of the abandonment of the previous land management and regeneration by forest mainly with deciduous tree species. The coniferous forests decrease after 1996 as a result of forest conversions to deciduous forests.

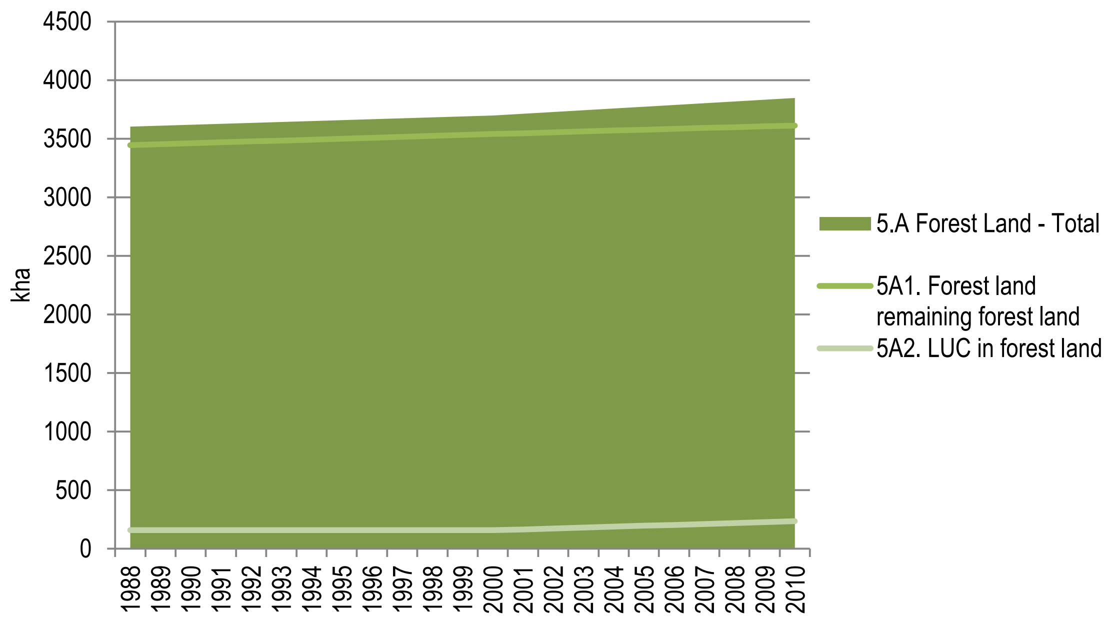

Figure 67 Trends of the changes in the areas of forest land – forest remaining forests and lands converted to forests.

Over the reporting period 1988-2010 the data for the total annual net emissions and removals of carbon dioxide (biomass, litter and soils) are presented in Table 186

Table 186 Emissions/removals of CO2 in Forests Remaining Forests and Lands Converted to Forests (Gg CO_2 equivalent)

year	5A Total FL	5A1 FLrFL	5A2 LUC to FL	5A2-1 CL to FL	5A2-2 GL to FL	5A2-3 WL to FL	5A2-4 SM to FL	5A2-5 OL to FL
1988	-14806.73	-13830.77	-975.96	-657.44	-103.15	0.00	0.00	-215.38
1989	-14824.73	-13847.93	-976.80	-657.59	-102.73	0.00	0.00	-216.48
1990	-14860.10	-13883.15	-976.95	-656.70	-102.66	0.00	0.00	-217.59
1991	-14878.23	-13900.01	-978.22	-657.10	-102.58	0.00	0.00	-218.54
1992	-14890.59	-13908.47	-982.12	-660.35	-102.48	0.00	0.00	-219.30
1993	-14878.47	-13887.26	-991.21	-668.96	-102.39	0.00	0.00	-219.87
1994	-14890.90	-13892.37	-998.53	-675.79	-102.41	0.00	0.00	-220.33
1995	-14882.17	-13880.46	-1001.70	-678.31	-103.12	0.00	0.00	-220.27
1996	-12666.53	-11664.31	-1002.22	-679.46	-102.83	0.00	0.00	-219.93
1997	-12623.48	-11621.27	-1002.21	-679.38	-104.28	0.00	0.00	-218.55
1998	-12577.47	-11581.15	-996.32	-675.66	-103.73	0.00	0.00	-216.93
1999	-12477.92	-11481.26	-996.66	-677.92	-103.44	0.00	0.00	-215.30
2000	-12515.56	-11553.05	-962.51	-657.38	-91.19	0.00	0.00	-213.94
2001	-11066.14	-10233.08	-833.05	-561.72	-49.83	0.00	0.00	-221.50
2002	-11104.07	-10217.12	-886.95	-595.37	-60.63	0.00	0.00	-230.95
2003	-11181.40	-10238.25	-943.15	-633.52	-69.45	0.00	0.00	-240.19
2004	-11193.48	-10203.32	-990.16	-662.63	-79.13	0.00	0.00	-248.40
2005	-11239.64	-10193.91	-1045.74	-702.34	-84.56	0.00	0.00	-258.84
2006	-10831.39	-9731.54	-1099.85	-732.68	-97.97	0.00	0.00	-269.20
2007	-10869.27	-9724.79	-1144.48	-753.21	-110.31	0.00	0.00	-280.95
2008	-10925.66	-9738.23	-1187.43	-776.30	-119.18	0.00	0.00	-291.95
2009	-11023.81	-9745.15	-1278.66	-828.52	-141.18	0.00	0.00	-308.96
2010	-11085.61	-9750.27	-1335.34	-858.79	-151.10	0.00	0.00	-325.44

Table 187 CO_2 Emissions from forest wildfires 1988-2009

year	area burnt (ha)	CO_2 emission Gg CO_2 equivalent	CH_4 emission Gg CO_2 equivalent	N_2O emission Gg CO_2 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
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

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 data for the total forest area for the single years, as well as the relative share of the coniferous and deciduous and forests out of yield are obtained from the reports of the forestry fund (Executive Forestry Agency). The country is divided territorially into forestry management units and for each of them a forestry management plan is being developed (FMP). Forest management plans are the basis documents for planning and management in forest strengthening the sustainable utilization of the forest resources. 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. When developing the FMP a complete forest-inventory is used for all forests- state and non state (Bogdanov, K. 1991, Mihov, I. 2000). 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. All forests in Bulgaria are managed and utilized in accordance with forest management projects, plans and programmes. These plans are prepared according to the ownership and 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 for the: forest areas (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 5 year (e.g. 1985, 1990, 1995, 2000, 2005, 2010) and are submitted to the Regional Forestry Offices and in the Executive Forestry Agency. The assessment of the whole territory of the country has been carried out within 10 years. For the future, large scale inventories are planned that cover Bulgaria within one year. The data for the forest area are presented by the National Statistical Institute, as well as by the Statistical Office of the European Union, Eurostat.Every five years data are submitted to the FRA / Forest Recourses Assessment(s), under the Forestry Department of the UN Food and Agriculture Organization, FAO. For the period of the inventory an increase of the forest area has been registered.Specific data on the amount of areas and their previous land-uses that became forests are not available. Therefore, the following procedure was carried out to estimate the areas of LUCs to forests and their previous land uses. “Cropland”, “Grassland” and “Other land” were considered as possible land-use categories where new forest areas may stem from. Wetland areas were rather constant in the observed period and slightly increased in the last years. Settlements show a steady increase in the observed period. Therefore (and for the various problems that arise when converting these categories to forests), it was assumed that there was no forest area increase on basis of wetlands or settlements. Due to the location of “Other land” and its unsuitability for other land-uses (other land constitutes rocky and scarcely vegetated areas) it was assumed that the decrease in other land was caused by land-use change to forest land. The remaining LUC areas to forests (that result after adding the LUCs of forest land to other land-uses to the observed net increases in forest area) were assumed to stem from cropland and grassland. It was assumed that the shares of the individual land-use categories annual cropland, perennial cropland and grassland that contribute to these LUC areas to forests behave like the ratios of the total areas of these land-use categories in Bulgaria. The time series of forest areas and other available area statistics show different trends in the years after 2000 and before. Therefore, the time series was divided into these two periods and the land-use change-areas from cropland and grassland to forest land was fitted to the different trends in these two periods.

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)

The reports on the forest fund in Bulgaria are the main data source for determining the emission/removals of greenhouse gases from forests. Due to this reason the definition for the purposes of the current report is the same applied in Bulgaria.

For defining forest, Bulgaria uses the definition in the Bulgarian Forest Act:

An amendment to the Forest Act has been done in March 2011. The definition of the forest has been changed by covering the requirements of the Kyoto protocol. The definition for forest according to the Forest act (2011) is: “***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".

According to the old Forest act (1997 amended and supplemented until 2009): *Forest is an area, covered with forest tree species on area not less than 0.1 ha*. All forests in Bulgaria, are managed.

Forest Fund according to the Forest Act is a territory, with a main purpose to be forest and covers forests, bushes and land for afforestation and non timber production lands, listed in the cadastre. Urbanized areas, separated settlements and agricultural lands are not included in the Forest Fund.

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

When defining the changes in the carbon stock in the living biomass the IPCC GPG 2003 is being followed. The conversion coefficients used are specific for Bulgaria and the ones given in the IPCC GPG 2003 tables. Tier 2 is applied and the main database includes: forest area by types of forests (coniferous and deciduous), and the tree stock (stemwood and branches) by forest type obtained from the forest fund reports (1FF 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 stemwood 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.)$^{-1}$

A revision of the coefficient used in preparation of the inventory has been done due to availability of the new NFI data (for 2010). This results in recalculation of the emission factors comparing whit the previos inventory. The new emission factors are used for the entire time series.

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 are 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 for which data on the wood stock are available and 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 188 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 (BEF2) for converting the stemwood+branches stock into a total aboveground biomass. Since the Bulgarian NFI assesses also the stock of branches the used biomass expansion factor does not need to account for this tree compartment, so BEF2 has only to add the leaf biomass. To estimate this specific BEF2 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 189 presents the values for BEF_2 .

Table 189 Biomass expansion factor for converting stemwood +branches into total aboveground biomass (BEF2)

Types of forests	Coniferous	Deciduous
BEF_2	1.08	1.03
Mean	1.05	

Due to the lack of specific data for Bulgaria, for the ratio root to shoot (R), coefficients presented in the IPCC Good Practice Guidance for LULUCF, adapted to the conditions in the country (Table 190) 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 190 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 and it is 0.5 tonnes C, due to the lack of national data.

A permanent trend in increasing the volume stock in Bulgarian forest is observed. However, the carbon stock in living biomass has decreased significally since 2000. The drop in 2001 is by 11% compared to 2000. The reason is that the carbon stock in living biomass from coniferous forests goes down by 33% since 2000. This is caused by the increase in harvesting rate in coniferous forest in the years after 2000, which affects the net increase in the volume stock.

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 forest remaining forestsChanges in carbon stock in litter

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

Source of information for the contents of organic carbon in soils and litter is the database of the ICP "Assessment and Monitoring of Air Pollution Effects on Forests"-UN/ECE Convention on Long Range Transboundary Air Pollution (EEA-MOEW)". Regular assessments have been carried out since 1986.

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, manner of their management and the implemented silviculture practices. This approach follows IPCC GPG 2003 Tier 1.

For the current inventory a model stock of organic carbon in the soils was assigned. The source of information for the contents of organic carbon in soils 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. Regular assessments in Bulgaria have been carried out since 1986. At present, 41 European countries as well as the United States of America and Canada are participating in the Programme, which includes assessments according to harmonised methods following this ICP Forests Manual and which has developed into an important platform for the exchange of expert knowledge. Bulgaria follows ICP Forests Manual methodological approach for soil sampling, assessment, monitoring and analysis, including soil organic carbon. In ICP Forests Manual http://www.icp-forests.org/pdf/FINAL_soil.pdf

The average value based on the chronological row of data is used as the model stock of organic carbon in soils. The average value is calculated after combining the data of the most widely spread soil groups (groups by WRB, 2006 - Cambisols, Luvisols, Regosols, Lepthosols).

For carrying out the estimations the database in the monitoring system of the forest ecosystems (ICP Forests) is divided into 2 periods: the first period 1986-1997 and the second period – 1998-2008. The first period includes data from the start of the program ICP Forests in Bulgaria till the first compilation of the European database for the soils in 1997 (Vanmechelen, L., R. Groenemans, E. Van Ranst. 1997. Forest Soil Condition in Europe). The second period groups the data till 2008.

The average stock of the organic carbon in the soils from the two periods is calculated as the sum of the carbon stocks in the single soil layers. Depending on how the samples were taken in the different years the layers are as follows: 0-5 cm, 5-10 cm, 10-20 cm, 20-40 cm; 0-10 cm, 10-20 cm, 20-40 cm or 0-20cm, 20-40 cm. An average value was taken from the three options calculated for the layer 0- 30 cm.The average organic carbon stock calculated for the layer 0-30 cm in the period 1986-1997 was 54.56 t C/ha and for the period 1998-2008 was 49.18 t C/ha. The data for both periods are combined and the resulting mean of 51.89 t C/ha (N=1480) is used as a model stock. The contents of organic carbon in the soils over the last 20 years is assumed as being stable, i.e. when inventorying the emissions/removals of carbon in the mineral soils the annual change in the stock is taken as 0.

Histosols cover 0,06% of the total area of Bulgaria and are spread mostly in protected areas, where all anthropogenic impacts are forbidden. Anyway there is no peat extraction and draining of soils and other anthropogenic activities that affect the water regime, the temperature on their surface and the species. Due to this reasons Histosols are not subject to evaluation.

7.2.4.1.3 Forest fires

In the current report only emissions of CO2, CH_4 and N_2O from uncontrolled fires were calculated as in the forests in Bulgaria no controlled fires are being carried out. The emissions of CO2 are reported in chapter Forest land Remaining Forest land. Tier 1 was 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.

Data for the areas affected by fires (A) were obtained from the Executive Forestry Agency and the National Parks in Bulgaria – Rila, Pirin and Central Balkan. Thus all forest areas were covered by these data. The forest areas destroyed by fires in the period of the inventory range between 223 ha and 57 915 ha per year.

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 was used (IPCC Good Practice Guidance for LULUCF). The values of the emission factors (D) were taken from Table 3.A.1.16 from the IPCC GPG (for CO2- 1531, for CH4 - 7.1 and for N_2O- 0.11).

Comparatively highest values of the emissions of CH_4 and N_2O were obtained in the years 2000 -210 Gg CO_2 equivalent, 2007 - 157 Gg CO_2 equivalent and 1993-1994 -by 66 Gg CO_2 equivalent.

Emissions from wildfires are presented in Table 151.

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. Information from the Executive Forestry Agency was used. The changes in the carbon stocks and emissions and removals of greenhouse gases of lands converted to forests over the last 20 years were 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) were used. An average annual increment of the stock (stemwood and branches) of age class I was determined of 6.5 m3/ha/y, obtained by dividing the stock of the stands of Ist class age by average age of 10 years. This value is used for all land use changes to forests.

In the Inventory 2012, the value for D of the first age class forest has been recalculated due to new NFI data (2010). The weighed mean value for wood density was determined (D) 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 is used for all land use changes to forests.

There are no specific values for the biomass expansion factor (BEF2) 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 used biomass expansion factor does not need to account for this tree compartment, so BEF2 has only to add the leaf biomass. To estimate this specific BEF2 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 age class of the Bulgarian forests presents the values for BEF2 .

Table 191 Biomass expansion factor for converting stemwood+branches into total aboveground biomass (BEF2) 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 age class I 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. In Table information is presented on the emissions and uptake of CO_2 as a result of the land-use change to forests.

For estimating the biomass changes equation 3.2.22 from IPCC GPG was 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 the 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. After the recommendation made by ERT during the last in-country review, Bulgaria decided to report carbon stock changes in litter separately from the carbon stock changes in soils.

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.

7.2.4.2.2.3 Changes in the carbon stock in soils

Emissions/removals of carbon by the mineral soils were evaluated through the annual change in the carbon stock using the equation:

$$\Delta C_{mineral\ soil} \ = \ (SOC_{ref} \ - SOC_{non\ forest\ land}) \cdot A_{Aff} \ / \ T_{Aff}$$

where:

$\Delta C_{mineral\ soil}$ - annual change in the carbon stock in mineral soils in the year of assessment, tonnes C/ yr

SOC_{ref} – stable carbon stock in forests for a certain soil type, tonnes C/ ha

$SOC_{non\ forest\ land}$ - stable carbon stock in the soil in a previous type of land-use (croplands, grasslandsand and other lands), tonnes C/ ha

A_{Aff} - total afforestated 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 from forest ecosystems (SOCref) values from the Chapter Forest land Remaining Forest land are used - 51.89 t C/ha.

For the stable stock of organic carbon in soils of previous types of land-use the values obtained for annual or perennial cropland, grassland and other land are used (see related chapters).

7.2.5 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

For CO_2 emissions and removals, the uncertainties have been calculated using Tier 1 method for combining 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 192 and Table 193. The total uncertainty for Forestland remaining forestland is ± 146.0% while for Land converted to Forestland is ± 122.5 %. 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 -157.8% and 144.6%, taking

into account all the carbon pools estimated. As for Land converted to Forestland the uncertainty is estimated to be equal to -111.1% and 130.4% 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 ANNEX 7.

Table 192 Tier 1- Uncertainties of the emission factors and the activity data and sources of information

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
B cut - yield biomass	10	National Statistical Institute
B peak - biomass of the growth	75	Default, IPCC GPG 2003
Abogeground 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	39.6	empirical data
Soil C stock in annual cropland	64.7	empirical data
Soil C stock in perenial cropland	62.2	empirical data
Soil C stock in grassland	88.6	empirical data
Area	3	for industrial countries, IPCC 2006
Area - LUC	10	expert judgment

Table 193 Uncertainties of the emission factors and the activity data and sources of information for emissions from forest fires

Inputs	Uncertainty, %	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 2004
D - Emission factor for CH_4	75%	Default, IPCC GPG 2005
D - Emission factor for N_2O	75%	Default, IPCC GPG 2006

Table 194 Tier 1 Uncertainty calculation and reporting

IPCC Source category		GHG	Base year emissions (1988)	Year 2010 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
A		B	C	D	E	F	G
			[Gg CO_2 equivalent]	[Gg CO_2 equivalent]	%	%	%
5A	Forest land	CO_2	-14791.1	-10864.0	16	131	131.94
5A1	Forestland remaining forestland	CO_2	-13830.8	-9750.3	3	146	146.04
5A2	Land converted to Forestland	CO_2	-976.0	-1335.3	10	122	122.52
5A1	Forest fires	CO_2	14.0	197.9	25	99	102.10
5A2	Forest fires	CH_4	1.4	19.3	25	99	102.10
5A3	Forest fires	N_2O	0.3	4.4	25	99	102.10

7.2.6 DATA VERIFICATION CATEGORY-SPECIFIC QA/QC AND VERIFICATION, IF APPLICABLE

See Chapter 7.8

7.2.7 CATEGORY-SPECIFIC RECALCULATIONS

Recalculations took place in Submission 2011 due to two reasons:

Changes in the area of Forest land
Recalculation of the emission factors used in preparation of the inventory
The area of Forest land remaining Forest land was recalculated for the whole time series taking into account the results of a project implemented in the end of 2011 in the terms of an ongoing Bulgarian improvement process of reporting the supplementary information under the article 3.3 of the KP (details for the project and its implementation are given in Chapter 11). In the Submission 2011 it was identified that the net increase in forest land was not only due to AR activities but also due to inclusion of area, which were forested before 1990. In order to distinguish from the estimation of the AR units those new forest areas which were forested before 1.1.1990, Bulgaria examined the Forest Management Plans for all State Forest Enterprises. Like this all changes in forest area from 1991-2010 for each and every SFE were traced and identified. Therefore, 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 were added to the total forest area in 1990 and the years after according to Forestry Fund Reporting Form 1FF. Like that the total forest area (particularly those of forest land remaining forest land) in 1991 and in the years after was adjusted by using interpolation. In order to have a complete and consistent time series the forest area and the area of forests remaining forests for the years 1990, 1989 and 1988 were extrapolated. In order to adjust properly the area of forest land category it was necessary to aggregate one more subcategory – "other vegetation" which includes vegetation that currently fall below, but are expected to exceed the threshold of forest definition. In the previous inventories these areas were reported under coniferous and deciduous forest. In Submission 2012 only the area of other vegetation is reported. There is no estimation of removals for this sub-category, which results in a decrease of the CO_2 removals from FLrFL by 2% annually. As a result of the area

adjustment, the net increase in forest decreased by 24% (from 319 to 244 kha) which resulted in a drop in the removals from LUC to Forest land by approximately 38% on an annual basis. There is a significant change in removals from living biomass in FLrFL for the years 2006-2010. This is because of update in volume stock according to NFI data 2010.

The recalculation of the emission factors used in estimating changes in living biomass in forest land remaining forests and LUC to forests is due to availability of new NFI data.

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

The information used was obtained from the National Statistical Institute (until 1999) and from Agrostatistics and Strategies Directorate of MAF (since 2000).

The category "Cropland" is divided into two subcategories – annual crops (arable lands and kitchen garden) and perennials (vineyards, fruit and berry plantation and nurseries).

Statistical data till 2000 includes arable lands and artificial and complex grasslands. Due to the different statistical methodology there is a difference between the data gathered till 1988 and after 2000.

There is no peat extraction and draining of soils and other anthropogenic activities that affect the water regime, the temperature on their surface and the species. Due to this reasons Histosols are not subject to evaluation.

Over the last 20 years no liming was applied on mineral soils, which also are not subject to evaluation. Emissions/removals are estimated for the categories in Table 196

Table 195 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

In 2010 the total area of the croplands was 3795 kha, of which 3483 kha were annual crops and 255 kha – perennials. Conversion of lands to cropland is total of 247 kha.

The annual emissions from 1988 until 2010 range from 1326 Gg CO2 eq. to 2699 Gg CO2 eq. Major source of the emissions is the carbon stock change in the soils when converting grassland to cropland.

Table 196 Land- use and land- use changes in the category Cropland (kha) (other land- use changes are not occurring)

year	5.B Cropland Total	5B1 Cropland remaining Cropland Total	5B1a annual cropland remaining annual cropland	5B1b perennial cropland remaining perennial cropland	5B2 LUC in Cropland	5B2.2a Grassland in annual cropland	5B2.2b Grassland in perennial cropland
1988	3922.37	3610.22	3547.11	375.26	312.15	274.18	37.97
1989	3918.79	3606.65	3545.53	373.26	312.15	274.18	37.97
1990	3911.74	3599.60	3536.29	375.46	312.15	274.18	37.97
1991	3911.75	3599.60	3539.29	372.46	312.15	274.18	37.97
1992	3911.62	3599.47	3553.16	358.46	312.15	274.18	37.97
1993	3912.08	3599.94	3588.63	323.46	312.15	274.18	37.97
1994	3912.49	3600.34	3617.03	295.46	312.15	274.18	37.97
1995	3962.66	3650.51	3679.20	283.46	312.15	274.18	37.97
1996	3963.19	3651.04	3683.73	279.46	312.15	274.18	37.97
1997	4074.58	3762.44	3796.13	278.46	312.15	274.18	37.97
1998	4074.49	3762.34	3777.03	297.46	312.15	274.18	37.97
1999	4075.47	3763.32	3782.01	293.46	312.15	274.18	37.97
2000	4075.47	3763.32	3782.01	293.46	312.15	274.18	37.97
2001	4074.38	3762.23	3782.89	291.48	312.15	274.18	37.97
2002	4043.42	3731.27	3757.71	285.70	312.15	274.18	37.97
2003	3995.33	3683.19	3719.77	275.56	312.15	274.18	37.97
2004	3984.27	3672.12	3705.34	278.93	312.15	274.18	37.97
2005	3825.83	3513.68	3562.80	263.03	312.15	274.18	37.97
2006	3837.50	3525.35	3576.77	260.72	312.15	274.18	37.97
2007	3828.43	3516.29	3554.93	273.50	312.15	274.18	37.97
2008	3824.12	3511.98	3549.58	274.54	312.15	274.18	37.97
2009	3775.84	3463.70	3520.86	254.98	312.15	274.18	37.97
2010	3795.41	3483.27	3548.01	247.40	312.15	274.18	37.97

Table 197 Net emissions (+)/removals (-)of CO2 in Croplands Remaining Croplands and Lands Converted to Croplands (Gg CO_2 equivalent)

year	Cropland total	Cropland remaining Cropland	LUC to Cropland	Grassland converted to Cropland	N_2O emissions (CO_2 eq) from convertion of GL to CL
1988	1326.10	151.92	1174.18	1011.50	162.68
1989	1488.09	313.91	1174.18	1011.50	162.68
1990	1644.31	470.13	1174.18	1011.50	162.68
1991	1798.12	623.94	1174.18	1011.50	162.68
1992	1975.76	801.58	1174.18	1011.50	162.68
1993	2265.39	1091.21	1174.18	1011.50	162.68
1994	2497.70	1323.53	1174.18	1011.50	162.68
1995	2612.51	1438.33	1174.18	1011.50	162.68
1996	2716.64	1542.46	1174.18	1011.50	162.68
1997	2699.16	1524.98	1174.18	1011.50	162.68
1998	2490.71	1316.53	1174.18	1011.50	162.68
1999	2435.60	1261.42	1174.18	1011.50	162.68

year	Cropland total	Cropland remaining Cropland	LUC to Cropland	Grassland converted to Cropland	N_2O emissions (CO_2 eq) from convertion of GL to CL
2000	2394.49	1220.31	1174.18	1011.50	162.68
2001	2314.71	1140.53	1174.18	1011.50	162.68
2002	2355.29	1181.11	1174.18	1011.50	162.68
2003	2503.81	1329.63	1174.18	1011.50	162.68
2004	2417.93	1243.75	1174.18	1011.50	162.68
2005	2534.53	1360.35	1174.18	1011.50	162.68
2006	2461.33	1287.15	1174.18	1011.50	162.68
2007	2276.16	1101.98	1174.18	1011.50	162.68
2008	2227.97	1053.79	1174.18	1011.50	162.68
2009	2343.64	1169.46	1174.18	1011.50	162.68
2010	2290.17	1115.99	1174.18	1011.50	162.68

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.

For the total, annual and perennial cropland areas in the single years of 1988 – 2009 agricultural statistics are available (National Statistical Yearbooks, Structure of Agricultural holdings in Bulgaria published every crop years since 2000). These statistics give also information for the LUCs between annual and perennial cropland and between annual as well as perennial cropland and grassland between the years 2000 and 2008. Due to methodological changes there is a consistency break in the areas from 1999 to 2000 that would result in an unrealistic decrease of the cropland area for more than 700 kha between these two years. The periods before and after 2000 show rather smooth trends. Also the results of Corine Land Cover that are available for the years 1990, 2000 and 2006 don't give evidence for such a dramatic decrease in the cropland area. Therefore, it was assumed that this change is merely the result of the methodological change in the statistics. To level out this break the cropland area of 1999 was assumed to be the same as in 2000. The years after 2000 (which are based on a better assessment system) were kept as they are. For the years before 1999 the annual changes of the cropland areas of the time series 1988 to 1999 were taken exactly and adjusted to the new area figure for 1999 to give a new time series of annual cropland areas.

LUC areas between cropland and grassland and from cropland to settlement are available for the years 2000 to 2008 and 2001 to 2008, respectively. The LUC area form cropland to forest land was estimated as described under forest land. For the same reasons as described for the LUCs from wetland and settlement to forest land it was assumed that there is no LUCs from wetland and settlement to cropland. In the forest land chapter there is also an explanation why a LUC from other land to cropland is considered as unlikely. Therefore it was assumed that the only possible changes from other land use to cropland may occur between grassland and cropland. As it can be seen from the Table the LUCs to cropland result in a fixed value. The lasts are resulted after extrapolation for the whole time series. Because of lack of annual information for LUC the following approach was used:

Agrostatistics provide the information for LUC from GL to CL and LUC from annual to perennial and perennial to annual for the period of 8 years – 2000-2008. The amount of total change for the whole time series since 1990 is verified by Corine land cover. Then in order to get the annual changes in those cases the amount of total change for the period 2000 to 2008 was divided by 8. Those annual changes were applied for the years before 2000 and as well for 2009. The overall balance of the area and area changes over the time series fits after the extrapolations.). For single periods of this time series the fit is less good than for the whole period 1988 – 2000. However, any further adjustments would have needed a change of the officially available data, unrealistic high LUC areas for single sub-periods and/or the introduction of LUCs that are considered as unlikely. Therefore, this technique was considered as sufficient to get a consistent area statistic.

Bulgaria reports all LUC for a 20 years transition period according to IPCC GPG 2003. Although the extrapolated values back to 1969 were used.

7.3.3 DEFINITIONS AND CLASSIFICATION SYSTEMS USED AND THEIR COMPLIANCE WITH THE LULUCF CATEGORIES

According to the information for the agricultural fund in the National Statistical Yearbook and the Agrostatistics and Strategies Directorate of MAF within the category "Cropland" fall annual crops (arable lands and kitchen gardens) and perennials (vineyards, fruit and berry plantation and nurseries).

Arrable 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.

Perennials/ permanent crops include fruit and berry plantation, vineyards and other permanent crops (bamboo, mulberry, red wicker for baskets), 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.)

Here is presented information on emissions/uptake of CO_2 in the subcategory "Cropland Remaining Cropland". They are divided into annual crops and perennials.

Concerning changes in the carbon stocks in the annual crops remaining annual crops it is assumed that the increase and the loss of biomass for a year are equal. So changes in the carbon stocks in annual crops remaining annual crops are assumed to be 0.

7.3.4.1.1 Changes in the carbon stocks in the biomass of perennials

A Tier 1 method is used because of the lack of information for the biomass changes over the last 20 years. National data on the dynamics of the biomass in the perennials influenced by the changes in the land-use, related to the land ownership restoration and the way they are managed are missing. The IPCC Guidance is used.

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 between 1988 and 2010 ranges from 375 kha to 247 kha. In the period 1988-2010 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 changes in the land ownership. Over the last years new perennial plantations have been planted.

To determine the annual change in the biomass carbon stock of the perennials the following equation was used:

$$\begin{aligned}&\mathit{Annual\ change\ in\ the\ biomass\ carbon\ stock}\\&\quad = \mathit{area\ of\ the\ perennials\ remaining\ perennials}\\&\quad \cdot \mathit{coefficient\ of\ accumulation\ of\ carbon}\\&\quad - (\mathit{area\ of\ the\ perennials}\ 30\ \mathit{year\ earlier}^{1} \cdot 0.033\\&\quad \cdot \mathit{coefficient\ of\ accumulation\ of\ biomass});\end{aligned}$$

$$^{1}\ \mathit{excluding\ area\ lost\ through\ land-use\ change}$$

For the aboveground biomass stock at maturity the value 63 tonnes C.ha-1 was adopted, and for the annual accumulation - 2,1 tonnes C.ha-1.y-1 (IPCC Guidance).

Table 198 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

In 2010 63 kha were in the land-use change class "Perennials converted to annual croplands".

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 (∆CGrowth).

$$\mathit{The\ annual\ change\ \ of\ carbon\ stock\ in\ biomass} = A_{conversion}(L_{conversion} + \Delta C_{growth})$$

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 ∆CGrowth was calculated on the basis of the data for the yields from annual crops from the National Statistical Yearbook (cereals, industrial crops, vegetables, fodder crops) for 1995, 2000 and 2005. The absolutely dry weight of those 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 ratios according to Table 199 Coefficients used for calculating the total biomass of the annual cropsare used (Bodenfruchtbarkeitsbeirat 2001 (pers. comm.) and the root-to-shoot ratios published by West, T.O.,2008 were used. 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 199 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 whole of 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.

7.3.4.1.3 Changes in the carbon stock in the biomass of annual crops converted to perennials

In 2010 39 kha were in the land use change class 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-1y-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 (AConversion) multiplied by the annual carbon stock growth of the perennial biomass (∆CGrowth = 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.

$$Annual\ change\ in\ carbon\ stock\ in\ biomass = \ area\ of\ the\ converted\ lands\ for\ 20\ yeats \cdot \Delta C_{growth}\ + (actual\ annual\ area\ of\ conversion \cdot L_{conversion})$$

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 whole of the biomass is taken away (CAfter=0).

For the carbon stock immediately before the conversion the value calculated for Bulgaria is used: 3 tonnes C ha-1y (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 the soil is performed at 30 cm. The carbon stock of the plant residues on the surface (dead organic matter) or the changes in the non-organic carbon (in the carbonate minerals) is not estimated. The inventory is carried out for the mineral soils only. The emissions of organic and limed soils are not assessed, because there is no use of peat or other type of impact on Histosols under annual crops and perennials, as well as no liming of the croplands.

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 stocks from 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 the current inventory a standard stock of organic carbon in the soils was allotted. Source of information is the National System for Environment Monitoring (EAEW-MOEW). Since 2004 a national network for soil monitoring in the agricultural lands is working. The summarized results for the period 2004-2008 are used to calculate the standard carbon stock in the soil in annual crops - 63,2 t C/ha and perennials – 53 t C/ha. The standard carbon stocks in soils are used in case of inventory of carbon emissions/removals when the land-use has been changed.

7.3.4.1.4.1 Changes in the carbon stock in the soils of lands with perennials converted to annual crops

In 2010 63 kha were in the land- use change class of perennials converted to annual crops. The assessment of emissions/removals of CO_2 is done on the basis of an average stock of organic carbon in soils under annual crops and perennials.

The average annual change in the carbon stock in mineral soils of perennials, converted to annual crops (ΔSOC20) was calculated using the equation:

$$\Delta SOC_{20} = \frac{SOC_0 - SOC_{0-T}}{20} = 0.51\ tC/ha$$

where,

SOC_0 – carbon stocks in the soils after 20 years of transition = 63.2 t C/ha,

SOC_{0-T} – carbon stock in the soils before the conversion = 53 t C/ha.

To find the net change in the carbon stock in the soil, the annual change (ΔSOC20) was 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

In 2010 39 kha were in the land-use change class of annual crops converted to perennials.

The average change in the carbon stock in mineral soils of lands under annual crops converted to perennials (ΔSOC20) is calculated using the equation:

$$\Delta SOC_{20} = \frac{SOC_0 - SOC_{0-T}}{20} = -0.51\ tC/ha$$

where,

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 = 63.2 t C/ha.

To find the net change in the carbon stock in the soil, the annual change (ΔSOC20) is multiplied by the converted area.

7.3.4.1.5 Liminng

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)

The analysis of the data concerning the converted lands areas shows that in Bulgaria forest areas are not converted to croplands.

7.3.4.2.2 Grassland converted to croplands (5.B.2.2.)

The total area on which the land use is changed from grassland to cropland over the period 1988-2010 is 312 kha, where 274 kha of them were converted to annual crops and 38 kha - to perennials. The average annual change in the area of grassland converted to cropland is 16 kha and the conversion is mainly in annual crops – 14 kha.

Considering the whole 20-year period this leads to emission release of 1174.18 Gg CO2 eq.

The data on the areas of grassland converted to croplands are presented in Table 196.

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 (CAfter) is equal to 0. To calculate the carbon stock in the living biomass of grassland before the conversion (CBefore) the calculated value (6.4 t C ha-1) for Bulgaria is used. The calculations are made 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 (∆CGrowth) is = 3,0 tonnes C ha-1. The approach for determining the ∆CGrowth 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 was used according to IPCC GPG (2,1 tC/ha y), for the whole period of conversion – 20 years.

$$Annual\ change\ in\ carbon\ stock\ in\ biomass = \ area\ of\ the\ converted\ lands\ for\ 20\ yeats \cdot \Delta C_{growth} \ + (actual\ annual\ area\ of\ conversion \cdot L_{conversion})$$

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 were used. A standard stock for the organic carbon in soils was estimated.

The average annual change in the carbon stock in the soils of grassland converted to annual crops (∆CLGSoils), is calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{SOC_0 - SOC_{0-T}}{20} = -0.88\ tC/ha$$

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 = 63.22 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 lands under grassland converted to annual crops was calculated by multiplying the emission factor (-0.88 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 were used.

The average annual change in the carbon stock in the soils of grassland (ΔCLGSoils), converted to perennials is calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{SOC_0 - SOC_{0-T}}{20} = -1.40\ tC/ha$$

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 = 80.99 t C/ha,

SOC_{0-T} – carbon stock in the soils before the conversion = 53 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

This point reviews emissions of N_2O as a result of the conversion of grassland to cropland. The area of the lands converted to cropland is obtained from Table 196, and the annual emissions for N_2O are calculated using default values (Tier 1) 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), 2004-2008.

For annual crops C/N = 10,67
For perennials C/N = 10,17

Table 200 Basic statistics for C/N ratio in soils under croplands

C/N ratio	Valid N	Mean	Minimum	Maximum	Std.Dev.
in perennials	23	10,17647	6,208955	15,65641	2,683385
in annual	268	10,66506	3,149660	23,45736	2,930262

7.3.5 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

For CO_2 emissions and removals, the uncertainties have been calculated using Tier 1 method for combining 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 192. The total uncertainty for Cropland remaining cropland is ±184.0 % while for Land converted to Cropland is ±415.5 %. The total uncertainty for N_2O emissions in soils of Land converted to Cropland is ±449.8 % 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 -209.6% and 204.9%, taking into account all the carbon pools estimated. The uncertainty values derived from the resulting asymmetrical PDF for Land converted to Cropland are estimated to be -368.1% and -507.9% 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 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 recalculations in CO_2 emissions from Cropland category are due to changes in the area of cropland remaining cropland and respective subcategories. These changes took place after area adjustments in FL category and LUC to forests. After the calculations CO_2 emissions form CLrCL decreased by 11% in the base 1988 year, but increased by 8-10% in the last 5 years from the time series. There is also a minor change in the total CL area for 2009. It was identified that in its Submission 2011 Bulgaria omitted 23.5 kha from CL total area, which come from "family gardens"

7.3.8 PLANNED IMPROVEMENTS CATEGORY-SPECIFIC PLANNED IMPROVEMENTS, IF APPLICABLE (E.G., METHODOLOGIES, ACTIVITY DATA, EMISSION FACTORS, ETC.), INCLUDING THOSE IN RESPONSE TO THE REVIEW PROCESS

See Chapter 7.9

7.4 GRASSLAND (5.C.)

7.4.1 DESCRIPTION OF THE CATEGORY

The information used was obtained form the National Statistical Institute (until 1999) and from Agrostatistics and Strategies Directorate of MAF (since 2000).

The category "Grassland" includes pastures and meadows (agricultural funds) and meadows in the forest fund.

In this category emissions/removals grassland remaining grassland and lands converted to grassland are evaluated. In 2009 the total area of the grassland was 1834 kha. This includes grassland of intensive and extensive use

The annual removals of CO_2 from grassland in the country are 786.64 Gg CO_2 eq. The emissions from subcategory "Grassland Remaining Grassland" is assumed to be 0. CO_2 emissions/removals occur only when converting lands to grassland.

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 pool of deadwood and litter are not reported for grassland as they do not exist in grassland.

Table 201 Categories assessed for emissions/removals

Categories
5.C. Grassland-total
5.C.1. Grassland remaining grasland
5.C.2. Land converted to grasland
5.C.2.1. Forest land converted to grasland
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. Settelments converted to grasland
5.C.2.5. Other land converted to grasland

Table 202 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	2019.26	1769.84	249.43	229.53	19.90
1991	2018.96	1769.53	249.43	229.53	19.90
1992	2019.98	1770.56	249.43	229.53	19.90
1993	2021.07	1771.65	249.43	229.53	19.90
1994	2017.71	1768.29	249.43	229.53	19.90
1995	1984.03	1734.60	249.43	229.53	19.90
1996	1988.06	1738.64	249.43	229.53	19.90
1997	1917.08	1667.66	249.43	229.53	19.90
1998	1919.89	1670.46	249.43	229.53	19.90
1999	1911.96	1662.53	249.43	229.53	19.90
2000	1911.96	1662.53	249.43	229.53	19.90
2001	1894.40	1644.97	249.43	229.53	19.90
2002	1870.00	1620.57	249.43	229.53	19.90
2003	1904.47	1655.05	249.43	229.53	19.90
2004	1921.21	1671.79	249.43	229.53	19.90
2005	2017.73	1768.31	249.43	229.53	19.90
2006	1989.84	1740.41	249.43	229.53	19.90
2007	1956.58	1707.16	249.43	229.53	19.90
2008	1945.96	1696.54	249.43	229.53	19.90

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
2009	1834.02	1584.60	249.43	229.53	19.90
2010	1816.96	1567.53	249.43	229.53	19.90

Table 203 Emissions (+)/removals of CO2 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	-786,64	0,00	-786,64	-786,64
1989	-786,64	0,00	-786,64	-786,64
1990	-786,64	0,00	-786,64	-786,64
1991	-786,64	0,00	-786,64	-786,64
1992	-786,64	0,00	-786,64	-786,64
1993	-786,64	0,00	-786,64	-786,64
1994	-786,64	0,00	-786,64	-786,64
1995	-786,64	0,00	-786,64	-786,64
1996	-786,64	0,00	-786,64	-786,64
1997	-786,64	0,00	-786,64	-786,64
1998	-786,64	0,00	-786,64	-786,64
1999	-786,64	0,00	-786,64	-786,64
2000	-786,64	0,00	-786,64	-786,64
2001	-786,64	0,00	-786,64	-786,64
2002	-786,64	0,00	-786,64	-786,64
2003	-786,64	0,00	-786,64	-786,64
2004	-786,64	0,00	-786,64	-786,64
2005	-786,64	0,00	-786,64	-786,64
2006	-786,64	0,00	-786,64	-786,64
2007	-786,64	0,00	-786,64	-786,64
2008	-786,64	0,00	-786,64	-786,64
2009	-786,64	0,00	-786,64	-786,64
2010	-786,64	0,00	-786,64	-786,64

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

For the total grassland areas in the single years of 1988 – 2010 agricultural statistics are available (National Statistical Yearbooks, Agrostatistics). Agrostatistics gives also information for the LUCs between annual as well as perennial cropland and grassland between the years 2000 and 2008. LUC areas between cropland and grassland and from grassland to settlement are available for the years 2000 to 2008 and 2001 to 2008, respectively. The LUC area form grassland to forest land was estimated as described under forest land. For the same reasons as described for the LUCs from wetland and settlement to forest land it was assumed that there is no LUCs from wetland and settlement to grassland. In the forest land chapter there is also an explanation why a LUC from other land to grassland is considered as unlikely. Therefore, it was assumed that the only possible changes from other land use to grassland may occur between grassland and cropland. As it can be seen from the Table the LUCs to cropland result in a fixed value. The last ones are resulted after extrapolation for the whole time series. Because of lack of annual information for LUC the following approach was used:

Agrostatistics provide the information for LUC from CL to GL for the period of 8 years – 2000-2008. The amount of total change for the whole time series since 1990 is verified by Corine land cover. Then in order to get the annual changes in those cases the amount of total change for the period 2000 to 2008 was divided by 8. Those annual changes were applied for the years before 2000 and for the 2009 and 2010. The overall balance of the area and area changes over the time series fits after the extrapolations. For single periods of this time series the fit is less good than for the whole period 1988 – 2000. However, any further adjustments would have needed a change of the officially available data, unrealistic high LUC areas for single sub-periods and/or the introduction of LUCs that are considered as unlikely. Therefore, this technique was considered as sufficient to get a consistent area statistic.

Anyway, an extrapolation of the available LUC areas from cropland to grassland (and grassland to cropland) for the years 2000 to 2008 to the years before 2000 and for the year 2009 results in a deviation between the sum of all LUC areas from/to grassland and the overall grassland area change across the time series that is on average 0.08 kha/year (the decrease in grassland according to the total grassland areas is 0.08 kha/year lower than the LUC areas from/to grassland suggest). An improvement of the fit is for the moment not possible since all other land use and land use change categories fit well. The problem is that the totals of the available land area statistics (and their adaptations) show this difference in the LUC area across the time series (the sum of the LUC areas across the whole time series does not give zero). So, some category has to cover this difference. Only cropland and grassland areas have the problem of a consistency break and needed an adaptation in time series. Therefore, only these two categories offer possibilities for covering the difference. The approach to use the grassland category only for the needed levelling out tends to overestimate the emissions since grassland has a high C stock (particularly in soil). So, estimates on basis of too high LUC areas from grassland to other uses represent the more conservative approach of the two possible ones.

Bulgaria reports all LUC for a 20 years transition period according to IPCC GPG 2003. Although the extrapolated values back to 1969 were used.

Due to methodological changes there is a consistency break in the grassland areas from 1999 to 2000 that would result in an unrealistic increase of the grassland area for more than 400 kha between these two years. The amount of the area of grassland show rather smooth trends in periods before and after 2000. Also the results of Corine Land Cover which are available for the years 1990, 2000 and 2006 do not give evidence for such a dramatic increase in the grassland area. Therefore, it was assumed that this change is merely the result of the methodological change in the statistics. To level out this break the grassland area of 1999 was assumed to be the same as in 2000. The years after 2000 (which are based on a better assessment system) were kept as they are. For the years before 1999 the annual changes of the grassland areas of the time series 1988 to 1999 were taken exactly and adjusted to the new area figure for 1999 to give a new time series of annual grassland areas.

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.)

In 2010 the total area of the grassland remaining grassland is 1567 kha.

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 compliance 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. Since 20 years there has been no liming of grassland.

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 past 20 years forests were not converted to grassland.

7.4.4.2.2 Lands under annual crops converted to grassland

In 2010 the area of the cropland converted to grassland is 249 kha. The larger part ofthem – 229 kha - are lands under annual crops converted to grassland. The removals of carbon during the conversions from cropland to grassland is calculated to 786.64 Gg CO2.

7.4.4.2.2.1 Changes in the carbon stock in the living biomass of the annual crops converted to grassland

Specific data for the country are used. The average value of the aboveground and belowground biomass of the annual crops is 3 t C ha-1 (Section 7.3.4.2).

For the carbon stock in the living biomass of grassland also specific data are used. Source of information for the aboveground biomass from 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 were used to aggregate the annual growth of the total stock of the biomass in the grassland (aboveground and belowground)

$$B_{total} = \quad B_{cut} \cdot 0.5 \;\; + (B_{peak\ aboveground} \cdot 0.5) \;\; \cdot (1 + R)$$

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 were 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

The area of the converted lands in 2010 is 20 kha. To calculate the stock of carbon in the living biomass of perennials the same equation was used as for annual crops. Due to the lack of national data for C_{before} the default value from the IPCC GPG is taken - 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

To assess the emissions/removals of carbon specific data for the country were used. A standard stock for the organic carbon in soils was estimated. Source of information was the National System for Environmental Monitoring (EAEW-MOEW). Since 2004 a national network for monitoring of the soils in the agricultural land has been operating. It is assumed that the summarized results over the period 2004-2008 refer to 2008 and were used to calculate the standard stock of carbon in the soil of grassland. The stock was determined on the basis of sample points and then the average value was calculated – 80,99±35 t C/ha (N=76) for a depth of 0-30 cm. This value is used to evaluate the emissions/removals of carbon in case of land-use change areas to grassland.

The average annual change in the carbon stock in the soils of lands under annual crops (∆CLGSoils), converted to grassland is calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{SOC_0 - SOC_{0-T}}{20} = 1.40\ tC/ha$$

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 = 80.99 t C/ha,

SOC_{0-T} – carbon stock in the soils before the conversion = 63.20 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 was calculated by multiplying the emission factor (0.88 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

To assess the emissions/removals of carbon specific data for the country were used. A standard stock was estimated for the organic carbon in soils. Source of information was the National System for Environmental Monitoring (EAEW-MOEW). The summarized results over the period 2004-2008 refer to 2008 and were used to calculate the standard stock of carbon in the soil of grassland. The stock was determined on the basis of sample points and then the average value was calculated – 80.99±35 t C/ha for a depth of 0-30 cm. It is used to estimate the emissions/removals of carbon for land-use changes to grassland.

The average annual change in the carbon stock in the soils of lands under perennials ($\Delta C_{LGSoils}$), converted to grassland is calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{SOC_0 - SOC_{0-T}}{20} = 1.40\ tC/ha$$

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 lands under perennials converted to grassland was calculated by multiplying the emission factor (1.40 tC ha^{-1} y^{-1}) by the area of the converted territory.

7.4.5 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

For CO_2 emissions and removals, the uncertainties have been calculated using Tier 1 method for combining 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 192. The total uncertainty for Land converted to Grassland is ±444.8%.

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 in asymmetric PDF for Land converted to Grassland is estimated to -568.8% and 422.1% 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 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

NA

7.4.8 PLANNED IMPROVEMENTS CATEGORY-SPECIFIC PLANNED IMPROVEMENTS, IF APPLICABLE (E.G., METHODOLOGIES, ACTIVITY DATA, EMISSION FACTORS, ETC.), INCLUDING THOSE IN RESPONSE TO THE REVIEW PROCESS

See Chapter 7.9

7.5 WETLANDS (5.D)

Due to the lack of information it s 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 202 kha to 210 kha for the period 1988-2010. Table 204presents data on the area of the wetlands.

Table 204 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.2.1 Forest land in wetlands	5.D.2.2.a Annual Cropland in wetlands	5.D.2.3 Grassland in wetlands
1988	202.29	202.29	0.00	0.00	0.00	0.00
1989	202.27	202.27	0.00	0.00	0.00	0.00
1990	202.25	202.25	0.00	0.00	0.00	0.00
1991	202.23	202.23	0.00	0.00	0.00	0.00
1992	202.21	202.21	0.00	0.00	0.00	0.00
1993	202.19	202.19	0.00	0.00	0.00	0.00
1994	202.17	202.17	0.00	0.00	0.00	0.00
1995	202.15	202.15	0.00	0.00	0.00	0.00
1996	202.13	202.13	0.00	0.00	0.00	0.00
1997	202.11	202.11	0.00	0.00	0.00	0.00
1998	202.09	202.09	0.00	0.00	0.00	0.00
1999	202.07	202.07	0.00	0.00	0.00	0.00
2000	202.04	202.04	0.00	0.00	0.00	0.00
2001	203.08	202.04	1.04	0.41	0.42	0.21
2002	204.12	202.04	2.08	0.82	0.84	0.42
2003	205.16	202.04	3.12	1.24	1.25	0.63
2004	206.20	202.04	4.15	1.66	1.66	0.84
2005	207.24	202.04	5.19	2.07	2.05	1.07
2006	208.28	202.04	6.23	2.49	2.45	1.29
2007	209.31	202.04	7.27	2.92	2.85	1.50
2008	210.35	202.04	8.31	3.34	3.24	1.72
2009	211.39	202.04	9.35	3.78	3.64	1.93
2010	212.43	202.04	10.39	4.21	4.04	2.13

It was assumed that during the period of inventory the conversion to wetlands comes out from forests, annual crops and grassland. The emissions of carbon dioxide from the wetlands lands are presented in Table 205.

Table 205 Emissions (+)/removals of CO2 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.2.1 Forests converted to Wetlands	5.D.2.2 Cropland converted to Wetlands	5.D.2.3 Grassland converted to Wetlands
1988	0.00	NE	0.00	0.00	0.00	0.00
1989	0.00	NE	0.00	0.00	0.00	0.00
1990	0.00	NE	0.00	0.00	0.00	0.00
1991	0.00	NE	0.00	0.00	0.00	0.00
1992	0.00	NE	0.00	0.00	0.00	0.00
1993	0.00	NE	0.00	0.00	0.00	0.00
1994	0.00	NE	0.00	0.00	0.00	0.00
1995	0.00	NE	0.00	0.00	0.00	0.00
1996	0.00	NE	0.00	0.00	0.00	0.00
1997	0.00	NE	0.00	0.00	0.00	0.00
1998	0.00	NE	0.00	0.00	0.00	0.00
1999	0.00	NE	0.00	0.00	0.00	0.00
2000	0.00	NE	0.00	0.00	0.00	0.00
2001	90.65	NE	90.65	73.16	9.45	8.03

year	5.D Wetlands Total	5.D.1 Wetlands remaining Wetlands	5.D.2 Land converted to Wetlands	5.D.2.1 Forests converted to Wetlands	5.D.2.2 Cropland converted to Wetlands	5.D.2.3 Grassland converted to Wetlands
2002	102.98	NE	102.98	77.64	14.27	11.07
2003	115.07	NE	115.07	81.78	19.00	14.28
2004	127.09	NE	127.09	85.89	23.73	17.48
2005	139.61	NE	139.61	90.39	28.16	21.07
2006	151.71	NE	151.71	94.66	32.78	24.28
2007	164.10	NE	164.10	99.28	37.36	27.45
2008	176.21	NE	176.21	103.62	41.94	30.65
2009	189.09	NE	189.09	109.01	46.58	33.50
2010	200.94	NE	200.94	113.22	51.24	36.48

Note: In CRF tables version.3.2 for 5.D.1 the reporting of this subcategory "wetland remaining wetland" is voluntary and should be considered as "NE".

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

For wetlands the cadastral map of Bulgaria (the Cadastre Agency – Balance by type of territories according to their purpose) provides areas only for single years (1994, 1996, 1998, 1999, 2000). Corine Land Cover offers wetland areas for the years 1990, 2000 and 2006 and represents a better coverage of the relevant reporting period. However, due to its coarse resolution Corine Land Cover is not able to assess small rivers adequately and underestimates the total wetland area. A comparison between the cadastral information and the Corine data gives evidence for this problem. To get a more realistic wetland area for the whole time series the Corine Land Cover wetland areas were used, but adjusted with a correction factor to meet the total wetland area according to the cadastral map. The changes in the wetland area across the time period were taken out of the Corine information. This results in a rather stable wetland area for Bulgaria with slight increases in the years after 2000 (in total 8 kha for the whole time series). According to the trends, it was assumed that the wetland area increases by approximately 1 kha per year in the years 2001 to 2010, while the minor change before (0.02 kha per year) was neglected in the estimates. The LUC to wetlands was assumed to stem from forests, cropland and grassland and that the shares of these individual land use categories to the LUCs to wetland behave like the ratios of the total areas of these land use categories in Bulgaria. It is considered as unlikely that settlements or other land change to wetlands and wetlands change to any other land uses. The rationale in behind has been given in other chapters and is best expressed by the stable wetland area across time.

7.5.2 DEFINITIONS

It is assumed that in the 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.

7.5.3 METHODOLOGY

7.5.3.1 Lands converted to wetlands (5.D.2)

7.5.3.1.1 Forests converted to wetlands (5D.2.1)

Conversion of forests to wetlands have been occuring since 2001.

The annual emissions as a result of the lost biomass and the changes in the carbon stock in litter pool and soils are presented in Table.

7.5.3.1.1.1 Changes in the carbon stock in living biomass of forests converted to wetlands

The annual change of the carbon stock in the living biomass of forests converted to wetlands is determined using equation 3.5.6 of IPCC GPG.

$$The\ annual\ change\ in\ the\ carbon\ stock = anual\ area\ of\ forest\ converted\ to\ wetlands \cdot (B_{after} - B_{before}) \cdot CF$$

where,

B_{before} – living biomass of the forests immediately before the conversion to wetland, t d.m;./ha.

B_{after} – living biomass of the forests immediately after the conversion to wetlands, t d.m../ha (Tier 1 = 0),

CF –carbon fraction in dry matter (DM.) (under Tier1 is = 0,5), t C/(t/d.m.).

The average stock of carbon in the living biomass of the forest of Bulgaria is 45.1 t C/ha. To calculate it data for the stemwood and branch stock were used and the conversion factors as described in Chapter Forests Remaining Forests.

7.5.3.1.1.2 Changes in carbon stock in dead organic matter of forest converted to wetlands

The calculation of the emissions from litter pool (humic and fumic layer) as a result of the conversion of forests to wetlands was made by using national data for the carbon stocks in litter (humic and fumic) in forests (5.4 tC/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 Wetlands, so the carbon stock here is considered as 0 tC/ha.

The average annual C stock in deadwood is 2.4 tC/ha which represents 5% of the average annual C stock in Bulgaria.

7.5.3.1.1.3 Changes in the carbon stock in the soils of forests converted to wetlands

Changes in the carbon stock in the soils when converting forests to wetlands are calculated using the equation:

$$\Delta C_{wl} = \sum A \cdot \frac{SOC_{\ after} - SOC_{before}}{20}$$

where:

A – area of the converted areas for a transition period of 20 years, ha.

SOC_{before} – carbon stock in the soil in forests immediately before the conversion, tC/ ha = 51.89t C/ha

$SOC_{\ after}$ - carbon stock in the soil 20 years after the conversion, t C/ha. The stock of carbon in the soils 20 years after the conversion is assumed to be 0 (by default IPCC GPG).

7.5.3.1.2 Croplands converted to wetlands (5D.2.2)

7.5.3.1.2.1 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 croplands lands 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 n 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.

7.5.3.1.2.2 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 wetlands lands 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 = 63.2 t C/ha (values calculated for Bulgaria, chapter 7.3.)

$SOC_{\ after}$ – 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).

7.5.3.1.3 Grassland converted to wetlands (5D.2.3)

7.5.3.1.3.1 Changes in the carbon stock in living biomass of grassland converted to wetlands

The annual change in the carbon stock in the living biomass of grassland converted to wetlands is calculated using equation 3.5.6. of IPCC GPG.

$$\begin{aligned}&\mathit{The\ annual\ change\ in\ the\ carbon\ stock}\\&\quad = \mathit{anual\ area\ of\ cropland\ converted\ to\ wetlands} \cdot (B_{after} - B_{before}) \cdot CF\end{aligned}$$

where,

B_{before} – living biomass of grassland immediately before the conversion to water areas, t.d.m./ha.

B_{after} – living biomass immediately after the conversion, t d.m./ha (for Tier 1 = 0),

CF –carbon fraction in the dry matter (under Tier 1 = 0.5 t C/t d.m.).

The average annual stock of carbon in the grassland determined for Bulgaria is 6.4 t C/ha and how it is determined is presented in chapter 7.4.

7.5.3.1.3.2 Changes in the carbon stocks in the soils of grassland converted to wetlands

The change in the carbon stock in the soils when converting grassland to wetlands is calculated using the equation:

$$\Delta C_{wl} = \sum A \cdot \frac{SOC_{\ after} - SOC_{before}}{20}$$

where:

A – the area for the converted lands for a transition period of 20 years, ha.

SOC_{before} – carbon stock in the soil immediately before the conversion, t C/ ha = 81 t C/ha (value calculated for Bulgaria)

$SOC_{\ after}$ - carbon stock in the soil, 20 years after the conversion, t C/ ha. The carbon stock in the soil 20 years after the conversion is assumed to be 0 (by default)

7.5.4 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

For CO_2 emissions and removals, the uncertainties have been calculated using Tier 1 method for combining 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 192. The total uncertainty for Land converted to Wetlands is ±26.5 %.

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 -23.9% and 28.9% 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 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 recalculations in LUC to WL sub-category are due to the following reasons:

Area adjustments made in FL category
Changes in the figure of biomass loss when converting FL to WL due to new NFI data
Recalculations in reporting changes from DOM

7.5.7 PLANNED IMPROVEMENTS CATEGORY-SPECIFIC PLANNED IMPROVEMENTS, IF APPLICABLE (E.G., METHODOLOGIES, ACTIVITY DATA, EMISSION FACTORS, ETC.), INCLUDING THOSE IN RESPONSE TO THE REVIEW PROCESS

See Chapter 7.9

7.6 SETTLEMENTS (5.E.)

In this category only the emissions and the removals from the subcategories "Lands Converted to Settlements" were calculated. It is assumed that dead wood and litter do not exist in the settlements. By 2010 the area for this category is 831.84 kha (Table 206). The area converted to settlements over the period (1990-2010) is 32.76 kha, and the emissions from the change in the carbon stock in the biomass and the soil are presented in Table 207

The land-use change to settlements origins from the categories Forests (data provided by the Executive Forestry Agency), Cropland and Grassland (data provided by the Ministry of Agriculture and Food).

Table 206 Land- use and land- use changes in the category Settelments (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	807.08	801.63	5.45	0.44	3.17	0.17	1.67
1989	807.39	801.94	5.45	0.44	3.17	0.17	1.67
1990	807.69	802.24	5.45	0.44	3.17	0.17	1.67
1991	808.00	802.55	5.45	0.44	3.17	0.17	1.67

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
1992	808.31	802.86	5.45	0.44	3.17	0.17	1.67
1993	808.62	803.17	5.45	0.44	3.17	0.17	1.67
1994	808.92	803.47	5.45	0.44	3.17	0.17	1.67
1995	809.23	803.78	5.45	0.44	3.17	0.17	1.67
1996	809.54	804.09	5.45	0.44	3.17	0.17	1.67
1997	809.84	804.39	5.45	0.44	3.17	0.17	1.67
1998	810.15	804.70	5.45	0.44	3.17	0.17	1.67
1999	810.46	805.01	5.45	0.44	3.17	0.17	1.67
2000	810.76	805.31	5.45	0.44	3.17	0.17	1.67
2001	812.87	806.92	5.95	0.43	3.49	0.18	1.84
2002	814.98	808.20	6.78	0.53	3.96	0.21	2.08
2003	817.09	809.44	7.65	0.58	4.47	0.24	2.36
2004	819.19	810.79	8.40	0.64	4.92	0.26	2.59
2005	821.30	809.51	11.79	0.81	6.96	0.37	3.66
2006	823.41	808.08	15.33	0.94	9.11	0.48	4.80
2007	825.51	805.72	19.79	1.21	11.77	0.62	6.19
2008	827.62	803.66	23.97	2.01	13.90	0.73	7.32
2009	829.73	802.82	26.91	2.09	15.72	0.83	8.27
2010	831.84	799.08	32.76	2.37	19.24	1.01	10.13

Table 207 Emissions (+)/removals of CO2 in Settelments Remaining settelments and Lands Converted to settelments (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	74.15	NE	74.15	7.69	40.49	25.97
1989	74.15	NE	74.15	7.69	40.49	25.97
1990	74.15	NE	74.15	7.69	40.49	25.97
1991	74.15	NE	74.15	7.69	40.49	25.97
1992	74.15	NE	74.15	7.69	40.49	25.97
1993	74.15	NE	74.15	7.69	40.49	25.97
1994	74.15	NE	74.15	7.69	40.49	25.97
1995	74.15	NE	74.15	7.69	40.49	25.97
1996	74.15	NE	74.15	7.69	40.49	25.97
1997	74.15	NE	74.15	7.69	40.49	25.97
1998	74.15	NE	74.15	7.69	40.49	25.97
1999	74.15	NE	74.15	7.69	40.49	25.97
2000	74.15	NE	74.15	7.69	40.49	25.97
2001	86.20	NE	86.20	6.23	51.56	28.40
2002	116.74	NE	116.74	24.70	60.14	31.90
2003	121.02	NE	121.02	17.75	67.45	35.83
2004	129.52	NE	129.52	19.55	70.80	39.16
2005	224.71	NE	224.71	39.02	131.06	54.63
2006	263.95	NE	263.95	34.23	158.75	70.97
2007	352.18	NE	352.18	60.14	200.96	91.07
2008	478.61	NE	478.61	157.46	213.90	107.24
2009	384.36	NE	384.36	35.69	227.68	120.99
2010	528.24	NE	528.24	72.89	307.67	147.68

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

For settlements the cadastral map of Bulgaria (the Cadastre Agency – Balance by type of territories according to their purpose) provides areas only for single years (1996, 1998, 1999, 2000). Corine Land Cover (ExEA-1990,2000,2006) offers settlement areas for the years 1990, 2000 and 2006 and represents a better coverage of the relevant reporting period. However, due to its coarse resolution Corine Land Cover is not able to assess traffic lines in landscape adequately and underestimates the total settlement area. A comparison between the cadastral information and the Corine data gives evidence for this problem. To get a more realistic settlement area for the whole time series the Corine Land Cover settlement areas were used, but adjusted with a correction factor to meet the total settlement area according to the cadastral map. The changes in the settlement area across the time period were taken out of the Corine information. This results in a steady increase of the settlement area across time.

For the years 2001 to 2010 the LUC areas from forest land and agricultural land to settlements are available (Forestry Agency and MAF). These reported LUC changes to settlement fit very well to the increases in settlement area in these years as assessed by Corine Land Cover. Due to this fit and probability reasons (LUCs from settlement to other land- uses and LUCs from wetland and other land to settlement are considered unlikely – see other chapters) no more adaptations in the areas statistics were needed for these years. The shares of annual cropland, perennial cropland and grassland within the available figure for the total area of agricultural land that changed to settlement between 2001 and 2008 was assumed to be the same as the totals of these land-use categories. For the years before 2001 the mean increase in settlement area was estimated. With 0.3 kha per year it was clearly lower in this period than in the most recent years (around 4 kha per year) reflecting the risen infrastructural activities since Bulgaria's joining the EU. It was assumed that the shares of forest land, cropland and grassland contributing to this 0.3 kha increase in settlement area per year were the same as in the period 2001 to 2009.

7.6.2 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 fall within this category. All settlements are managed lands.

7.6.3 METHODOLOGY

7.6.3.1 Land use change to settlements (5.E.2.)

7.6.3.1.1 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. The average change over the transition period between the years 1988-2006 ranges about 0.51 kha, but since Bulgaria joined EU the average changes for the transition period raised to 1.92 kha. The emissions of CO_2 are presented in Table

7.6.3.1.1.1 Changes in the carbon stock in living biomass of forests converted to settlements

An estimate of the biomass in the settlements was made by using national data for the relative share of the green areas in the city of Sofia (Kovachev, A, 2005) which is 2.63%.

The annual increase of the carbon stock in the biomass is calculated on the basis of the share of the green areas in the settlements and the following growth rates: for perennials (trees, bushes) it is 0.03 t C/ha.y, and for the annual plants – 0.09 t C/ha.y. These growth rates were derived from a detailed biomass study for Vienna (and is also used for the related estimates in Austria) together with the share of green area in the settlement area as derived from the data for Sofia (NIR of Austria, 2009).

7.6.3.1.1.2 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 tC/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 tC/ha.

The average annual C stock in deadwood is 2.4 tC/ha which represents 5% of the average annual C stock in Bulgaria.

7.6.3.1.1.3 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 was made by using national data for the carbon stocks in the soils in forests (51.89 t C/ha) and the carbon stocks in the soils of the settlements (1.87 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 30 cm depth (73.57 t C/ha), corrected as per the relative share of the green areas in Sofia (2.63%).

7.6.3.1.2 Croplands converted to settlements

In 2010 the area of the croplands converted to settlements for a period of 20 years are 19.24 kha.

7.6.3.1.2.1 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 207.

7.6.3.1.2.2 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 (63.2 t C/ha) and perennials (53 t C/ha), and values of the carbon stock in the soil of the settlements – 1.87 t C/ha.

7.6.3.1.3 Grassland converted to settlements (5.E.2.3.)

The areas converted from grassland to settlements for a transition period of 20 years are 10.13 kha in 2010.

7.6.3.1.3.1 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.

7.6.3.1.3.2 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 (81 t C/ha).

7.6.4 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The total uncertainty for Land converted to Settlements is ±75 % based on expert judgment.

7.6.5 DATA VERIFICATION CATEGORY-SPECIFIC QA/QC AND VERIFICATION, IF APPLICABLE

See Chapter 7.8

7.6.6 CATEGORY-SPECIFIC RECALCULATIONS

The recalculations in LUC to SM sub-category are due to the following reasons:

Area adjustments made in FL category

Changes in the figure of biomass loss when converting FL to SM due to new NFI data
Recalculations in reporting changes from DOM

7.6.7 PLANNED IMPROVEMENTS CATEGORY-SPECIFIC PLANNED IMPROVEMENTS, IF APPLICABLE (E.G., METHODOLOGIES, ACTIVITY DATA, EMISSION FACTORS, ETC.), INCLUDING THOSE IN RESPONSE TO THE REVIEW PROCESS

See Chapter 7.9

7.7 OTHER LAND(5.F)

For the total area of other land in the single years of the reporting period information from the cadastral map of Bulgaria (the Cadastre Agency – Balance by type of territories according to their purpose) are available. They show a slight decrease in the area of other land by 82 kha (in total) across the period 1988-2008. According to the rationale described in the forest land chapter it is assumed that this other land was lost completely to forest land. Due to the same considerations and the steady decrease in area of this category a LUC from any other land-use to other land is considered as unlikely.

However, the total area of other land is reported according to the IPCC GPG 2003 that suggest to report under other land the difference between the area of all other land use categories and the total area of Bulgaria. If the other land area was reported according to the available statistics the sum of all land categories would be approximately 3 % lower than the real area of Bulgaria. From that low difference it is assumed that the used statistics provide a good picture on the land-use and land-use change in Bulgaria. Nevertheless, there is an increase in the total area of Other land category in years 2009 and 2010 which may be considered as unlikely. The increase is resulted after the difference between the area of all other land use categories and the total area of Bulgaria was reported under Other land category. It was noticed that in these years the decrease in Cropland and Grassland is much higher than in previous years. In other hand the activity data for the other categories – Forestland, Settlement, Wetlands does not show such increase in their area. Like this the difference between the area of all land use categories and the total area of Bulgaria is about 3.60%. At the beginning of May 2012, a new data form aerial photographs form MAF will be available to use. We believe that by using the new data this higher differences will be fixed for the next Submission.

Due to the assumed lack of a LUC to other land no emissions/removals were estimated for this subcategory.

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 used activity data 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 Forestry 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 2013 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.

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 68

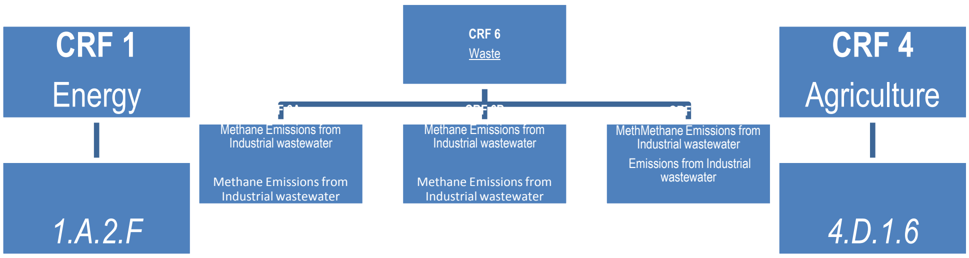

Figure 68 Allocation of Emission from waste handling and their reporting categories

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 208.

Table 208 Trend in GHG emissions from Waste by sub-sectors for 1988-2010

Gases/Category	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
CH_4											
6A Solid waste disposal on Land	212.14	218.98	224.65	231.03	236.21	239.69	241.90	242.91	242.79	243.14	239.60
6B Wastewater handling	106.18	103.54	118.58	89.65	71.16	65.21	62.36	68.16	66.67	60.35	53.59
CO_2											
6C Waste incineration	19.04	19.54	20.35	20.71	19.39	20.86	21.20	21.49	21.20	21.38	35.42
6D Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O											
6B Waste water handling	0.75	0.75	0.72	0.72	0.71	0.71	0.70	0.65	0.64	0.64	0.63
6C Waste incineration	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.05

Gases/Category	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CH_4												
6A Solid waste disposal on Land	234.51	230.65	226.71	221.19	215.81	210.67	205.78	200.45	195.99	191.06	190.41	181.03
6B Waste water handling	46.32	42.97	37.43	38.78	65.40	63.99	36.63	36.95	37.43	36.26	31.75	33.34
CO_2												
6C Waste incineration	28.89	62.99	40.24	39.32	44.52	70.40	56.06	52.77	35.44	43.19	33.89	14.17
6D Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O												
6B Waste water handling	0.63	0.63	0.61	0.60	0.60	0.60	0.55	0.54	0.54	0.54	0.53	0.53
6C Waste incineration	0.04	0.08	0.05	0.05	0.06	0.09	0.07	0.07	0.04	0.06	0.04	0.02

The total annual GHG emission in CO_2 equivalent per year emitted from Waste sector and the trend of emissions of CH_4, CO_2 and N_2O, for the period 1988-2010 is presented in the following figure.

The Figure below presents the quantity of CO_2 emission from whole waste sector.

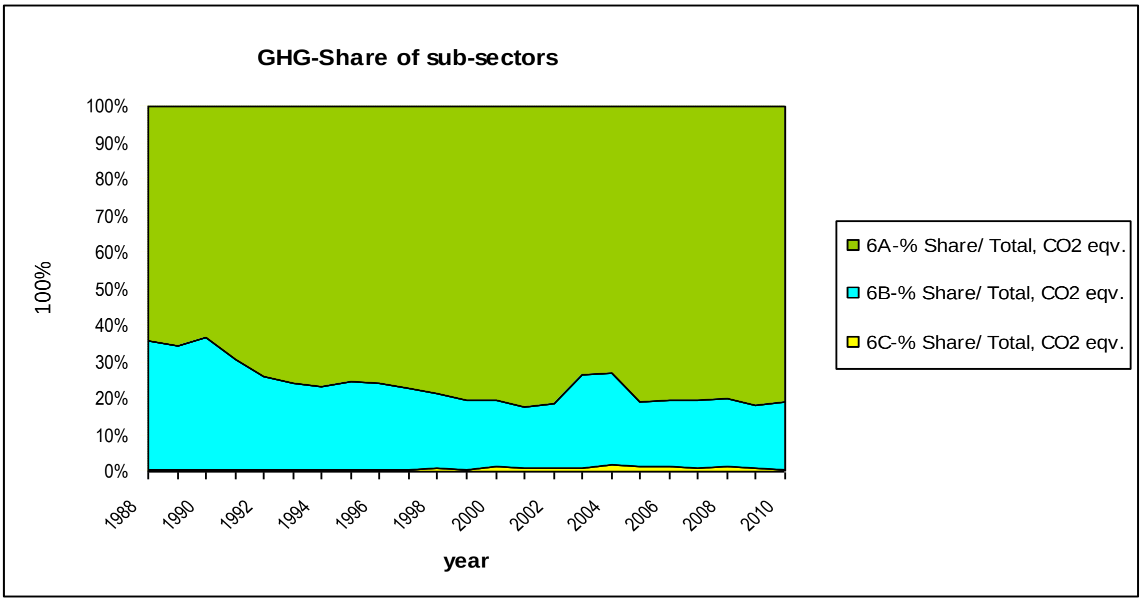

Figure 2 GHG emissions from Waste sector

Emissions from the waste sector in the year 2010 are about 4686 Gg CO_2 equivalents, and they are around 9 % including LULUCF and around 10 % excluding LULUCF of national total GHGs emissions from Bulgaria.

Solid Waste Disposal on Land contributes over 81.13%, Wastewater Handling about 18.45% and Waste Incineration about 0.41% sector's total emissions.

Emissions from the waste sector in 2010 decreased by 29.36 % (4685.59 Gg CO_2e in 2010 compared to 6943.94 Gg CO_2-eq in 1988) compared to the base year.

Figure below presents the quantity of CO_2 emissions from the whole waste sector.

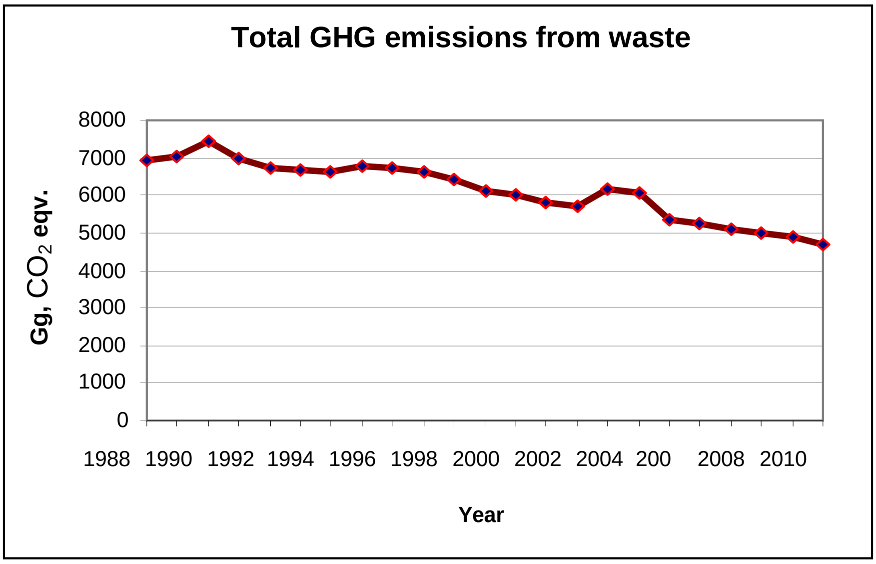

Figure 3 GHG emissions from Waste sector

8.1.2 KEY CATEGORIES

The Table 2 described the key categories of the waste sector and type of emitted greenhouse emissions.

Table 2 Key categories, Waste sector (Tier 1)

CRF categories	Category	Key category Y/N	GHG	Assessment of Key Source	Assessment of Key Source
				excluding LULUCF	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 209 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	▲	NO
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
6C Waste Incineration	Incineration of different type of hazardous waste	▲	NO	NO
6D Other waste	Different type of waste(compost production and etc.	NA	NA	NA

8.2 SOLID WASTE DISPOSAL ON LAND (CRF SECTOR 6A)

8.2.1 SOURCE CATEGORY DESCRIPTION

This category produces emissions of other micropollutants such as non-methane volatile organic compounds as well as smaller amounts of nitrous oxide (N_2O), nitrogen oxides (NOx) and carbon monoxide (CO). In this report only CH_4 is addressed.

At present, in our country are used country specific data, where they are available. Default value, are used when such data are not available.

The main option of waste disposal in Bulgaria is the land storage method.

According to IPCC Guidelines recommended is starting year from 1950 or earlier for completed calculations.

Approximately 98% of municipal solid waste generated in the country has been deposited in 2010. The landfills are classified as manage and unmanaged (see below: Activity data).

8.2.2 EMISSION TREND

Methane emissions are shown in the Table 210 and Figure 69, respectively from manage and unmanaged sites.

Table 210 CH_4 emissions from SWDS

Year	CH_4 emissions		Share of populations land filled on	
	managed	unmanaged	managed	unmanaged
	Gg	Gg	%	%
1988	0.00	212.14	0	100
1989	0.00	218.98	0	100
1990	0.00	224.65	0	100
1991	0.00	231.03	0	100
1992	0.00	236.21	0	100
1993	0.00	239.69	0	100
1994	0.00	241.90	0	100
1995	0.00	242.91	0	100
1996	0.00	242.79	0	100
1997	0.00	243.14	0	100
1998	0.00	239.60	0	100
1999	0.00	234.51	0	100
2000	2.74	230.65	31.25%	68.75%
2001	4.86	226.71	26.19%	73.81%
2002	6.27	221.19	26.47%	73.53%
2003	7.88	215.81	30.57%	69.43%
2004	9.48	210.67	32.42%	67.58%
2005	11.05	205.78	32.62%	67.38%
2006	12.45	200.45	35.35%	64.65%
2007	14.54	195.99	45.34%	54.66%
2008	17.07	191.06	48.34%	51.66%
2009	19.88	190.41	53.03%	46.97%
2010	17.70	181.03	55.38%	44.62%

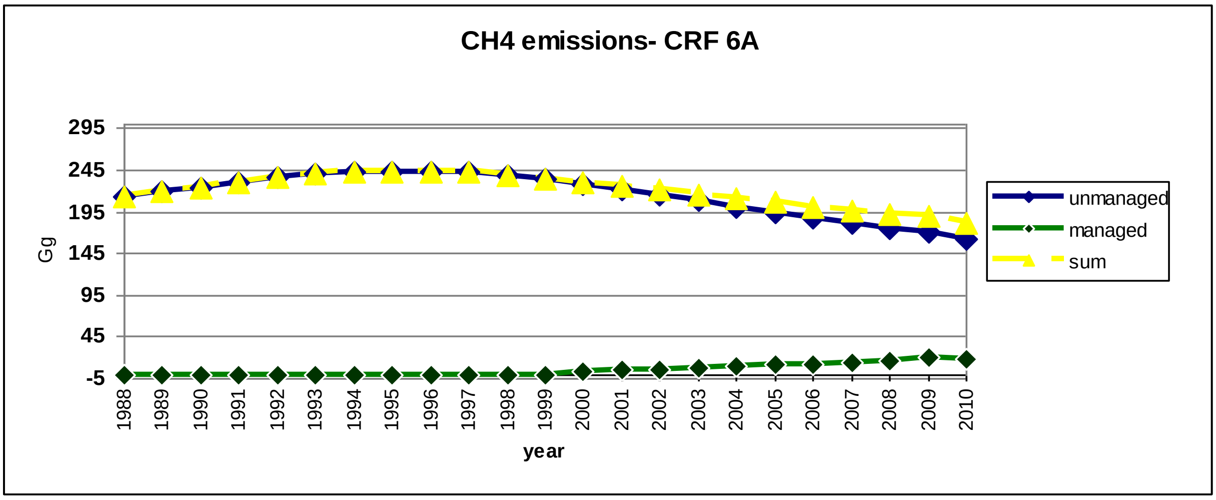

Figure 69 CH_4 Emissions from SWDS

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;
- Manage 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, Chapter 5, eq. 5.1)

$$CH_4 \text{ generated in year } t (Gg/yr) = \sum_x \left[A \bullet k \bullet MSW_T(x) \bullet MSW_F(x) \bullet L0(x) \right] \bullet e^{-k(t-x)}$$

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, 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 available and country specific data.

The table below presents the summarized sources of initial activity data.

Table 211 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	
1950-2000	CS	NSI	CS	NSI	CS	NSI	D	IPCC GPG	not defined as such	all unmanaged	IPCC GPG
2000-2002	CS	NSI	CS	NSI	CS	NSI	D	IPCC GPG	CS	CS	MOEW
2002-2010	CS	NSI	CS	NSI	CS	NSI	CS	MOEW	CS	CS	MOEW

Directive 1999/31/EC; b)Program for implementing Directive 1999/31/EC

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
National waste management programme (2009–2013)
National strategic plan for diversion of biodegradable waste going to landfills (2010-2020);
National strategic plan on sewage sludge management (2012-2020 - under development)
National green public procurement action plan 2012-2014 г.
MANAGEMENT OF SPECIFIC WASTE STREAMS RELATED WITH THE CLIMATE CHANGES
WASTE PREVENTION POLICY
BIOWASTE MANAGEMENT
MUNICIPAL WASTE MANAGEMENT
Details about activity data for the whole period (1950-2010), are given -Figure 70

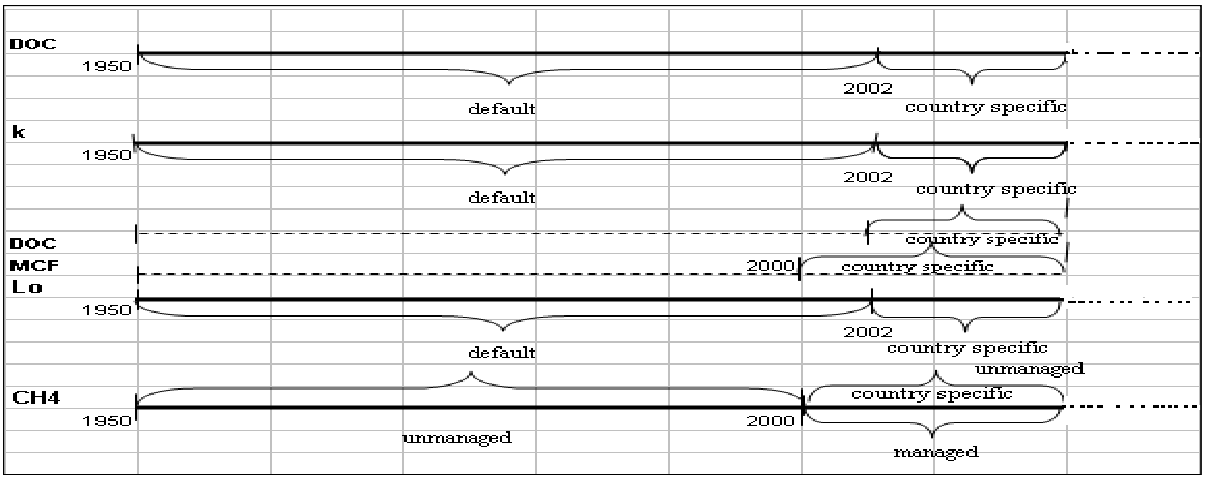

Figure 70 Regarding activity data

Statistical survey on municipal and construction waste is exhaustive and with an annual periodicity (Regulation No 2152/2002 /EC on the waste statistics). Data is provided by municipal authorities in whose territory for non-hazardous waste landfills are operating. In order to obtain the total quantity of waste generated in the country, data about collected waste is added by an estimate about the waste from settlements without organized waste collection. The estimate is obtained on the basis of average per capita amount of waste in settlements with organized waste collection, multiplied by the number of inhabitants in settlements without organized waste collection.

To provide a full range of data for the entire period the NSI have implemented Regression model to obtain the data:

NSI interpolate data for the waste before 1979 year;

NSI has data on waste after 1979 year;

From a historical perspective can be concluded that the population of the country don't have a proper culture to promote recycling of waste. Nearly all of the generated waste in the country is landfilled. Approximately around 95-97% from generated MSW was land filled. At the beginning of 90 years, began to develop in society and promote practices for separate collection of household waste and their subsequent recycling. Since 1999, NSI began to collect waste data on new method and thus increases the quality of collecting and analyzing information on waste generated and disposed. From this base year respondents to submit the required information are municipalities that are primarily responsible for waste management at municipal level. Furthermore, a change in the collection of information already started to impose practical and legal tools to promote alternative methods of waste treatment method than landfilled and in the same time increasing requirements for landfills which are remains for correct exploitation.

The emission of methane on basis of the activity data are calculated for the entire period 1950-2010, 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 199/31/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 199/31/EC on the landfill of waste, p.21) Table 189 show the morphological composition of the waste % allocated according to distribution of population..

Table 212 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):

$$DOC = (0.4 \bullet A) + (0.17 \bullet B) + (0.15 \bullet C) + (0.3 \bullet D)$$

Equation 3

With the above equation are calculated the value of the decomposed organic structure of the waste for the country at 2010 as a whole:

DOC = 11.65%

DOC was estimated by using country-specific data on waste composition and quantities based on compiled data from 2002 to 2010. 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 213 below show the f four components (A, B, C, and D).

Table 213 Waste composition

Year	waste composition %		degradable waste, %	DOC
2002	A	16.52%		
2002	B	10.22%		
2002	C	18.05%		
2002	D	1.76%	46.54%	0.1158
2003	A	16.53%		
2003	B	10.22%		
2003	C	18.05%		
2003	D	1.75%	46.55%	0.1158
2004	A	16.55%		
2004	B	10.23%		
2004	C	18.07%		
2004	D	1.76%	46.60%	0.1160
2005	A	16.58%		
2005	B	10.21%		
2005	C	18.11%		
2005	D	1.75%	46.65%	0.1161
2006	A	16.62%		
2006	B	10.19%		
2006	C	18.18%		
2006	D	1.75%	46.74%	0.1163
2007	A	16.63%		
2007	B	10.21%		
2007	C	18.17%		
2007	D	1.75%	46.76%	0.1164
2008	A	16.63%		
2008	B	10.17%		
2008	C	18.21%		
2008	D	1.75%	46.76%	0.1164
2009	A	16.62%		
2009	B	10.15%		
2009	C	18.23%		
2009	D	1.75%	46.74%	0.1163
2010	A	16.66%		
2010	B	10.13%		
2010	C	18.28%		
2010	D	1.75%	46.81%	0.1165

The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH_4 generation.
MCF account 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 214 below:

Table 214 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 manage 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 manage and unmanaged, is considered the fact if the landfills meet the requirements laid down in EU Directive 1993/31/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 2010 inventory year the values are:

Lomanaged landfills = 0.043 $GgCH_4$/Gg waste

Lounmanaged landfills = 0.034 $GgCH_4$/Gg 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 2010.

Country doesn't have 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 215.

Table 215 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 2010 inventory year is:

k=0.0498 (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 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).
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). For 2010 were calculated the methane recovery. Before that is zero (IPCC Good Practice Guidance).
Oxidation factor (OX). The default oxidation factor in the IPCC Guidelines is zero (IPCC Good Practice Guidance).
Table 216 summarizes the parameters used to calculate emissions of methane from Solid waste Disposal Sites by IPCC Tier 2 method.

Table 216 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	2,362	0,950	0,1500	NO	0,5	0,050	38	212.14
1989	8767.31	2,634	0,950	0,1500	NO	0,5	0,050	39	218.98
1990	8669.27	2,535	0,950	0,1500	NO	0,5	0,050	40	224.65
1991	8595.47	2,710	0,950	0,1500	NO	0,5	0,050	41	231.03
1992	8484.86	2,605	0,950	0,1500	NO	0,5	0,050	42	236.21
1993	8459.76	2,382	0,950	0,1500	NO	0,5	0,050	43	239.69
1994	8427.42	2,217	0,950	0,1500	NO	0,5	0,050	44	241.90
1995	8384.72	2,054	0,950	0,1500	NO	0,5	0,050	45	242.91
1996	8340.94	1,888	0,950	0,1500	NO	0,5	0,050	46	242.79
1997	8283.20	1,724	0,950	0,1500	NO	0,5	0,050	47	243.14
1998	8230.37	1,557	0,950	0,1500	NO	0,5	0,050	48	239.60
1999	8190.88	1,385	0,772	0,1500	NO	0,5	0,050	49	234.51
2000	8149.47	1,420	0,774	0,1500	NO	0,5	0,050	50	230.65
2001	7891.10	1,390	0,799	0,1500	NO	0,5	0,050	51	226.71
2002	7845.84	1,378	0,808	0,1158	NO	0,5	0,047	52	221.19
2003	7801.27	1,375	0,816	0,1158	NO	0,5	0,047	53	215.81
2004	7761.05	1,351	0,808	0,1160	NO	0,5	0,047	54	210.67
2005	7718.75	1,306	0,855	0,1161	NO	0,5	0,047	55	205.78
2006	7679.29	1,266	0,775	0,1163	NO	0,5	0,047	56	200.45
2007	7640.24	1,189	0,899	0,1164	NO	0,5	0,048	57	195.99
2008	7606.55	1,302	0,929	0,1164	NO	0,5	0,048	58	191.06
2009	7563.71	1,290	0,961	0,1163	NO	0,5	0,048	59	190.41

2010	7504.87	1,129	0.984	0,1165	NO	0,5	0,050	60	181.03

8.2.4 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

To ensure consistency over time, it is good practice (IPCC GPG) a time series should be developed using the same methods. For entire time series we apply the same FOD methods for emission calculation.

Table 217 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.

After preparation of final draft of this chapter an audit was carried out to check. 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.
Activities included in Improvement plan -submission 2010 were achieved, according to §159 and §164 from FCCC/ARR/2010/BGR.

8.2.6 SOURCE SPECIFIC RECALCULATION

In order to improve the quality emissions estimates and the whole national inventory, the following main brief describe recalculations were done:

Recalculated were the Annual MSW at the SWDS for 2000, 2001, 2002 and 2006, due to technical inaccuracies, and the differences between last submissions are around 2%.

8.2.7 SOURCE–SPECIFIC IMPROVEMENT PLAN

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

In the future we are planning to improve emission calculation, including emissions from waste composting activities.

8.3 WASTEWATER HANDLING (CRF SECTOR 6B)

8.3.1 SOURCE CATEGORY DESCRIPTION

This sector includes CH_4 emissions when treated or disposed anaerobically and indirect N_2O emissions for the period 1988-2010 .CO_2 emission 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 1988-2010. The calculation of the emissions is separated in two subcategories:

6B1 – Industrial wastewater treatment;

6B2 – Domestic/commercial wastewater treatment

The methods of the wastewater handling depend on quantity, type, condition and the necessary degree of treatment.

8.3.2 EMISSION TREND

Methane emissions from wastewater treatment are shown on the following figures. We divide the emission by domestic and industrial origin.

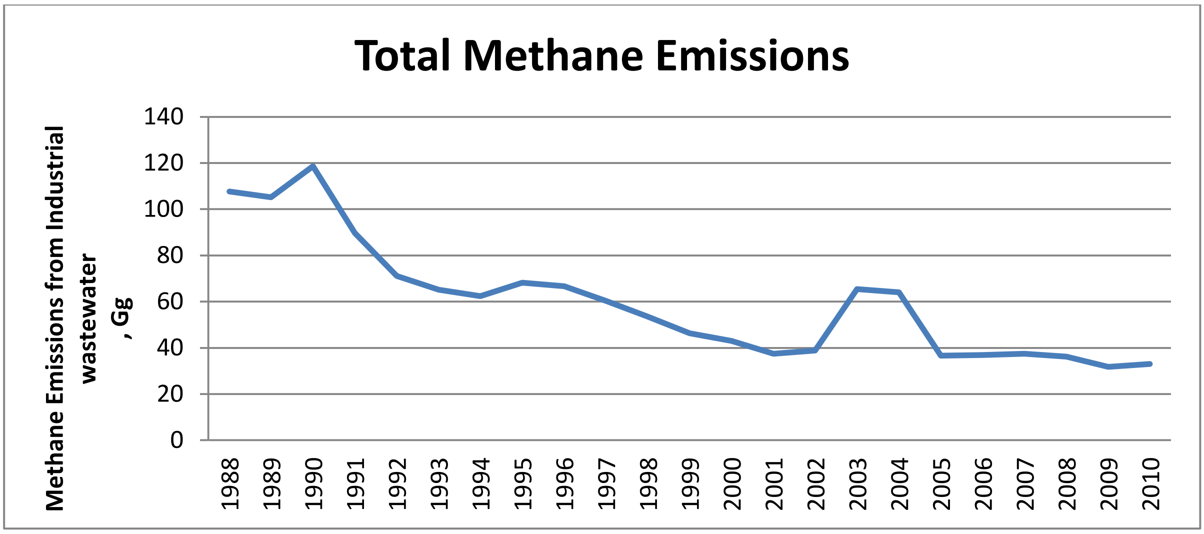

Figure 71 CH_4 emissions from wastewater handling

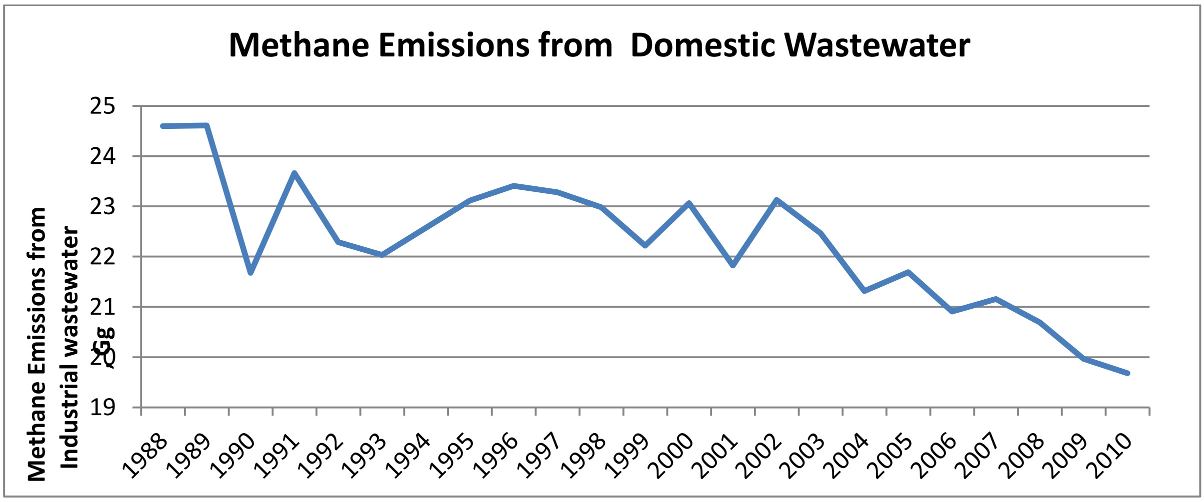

Figure 72 CH_4 emissions from Domestic Wastewater

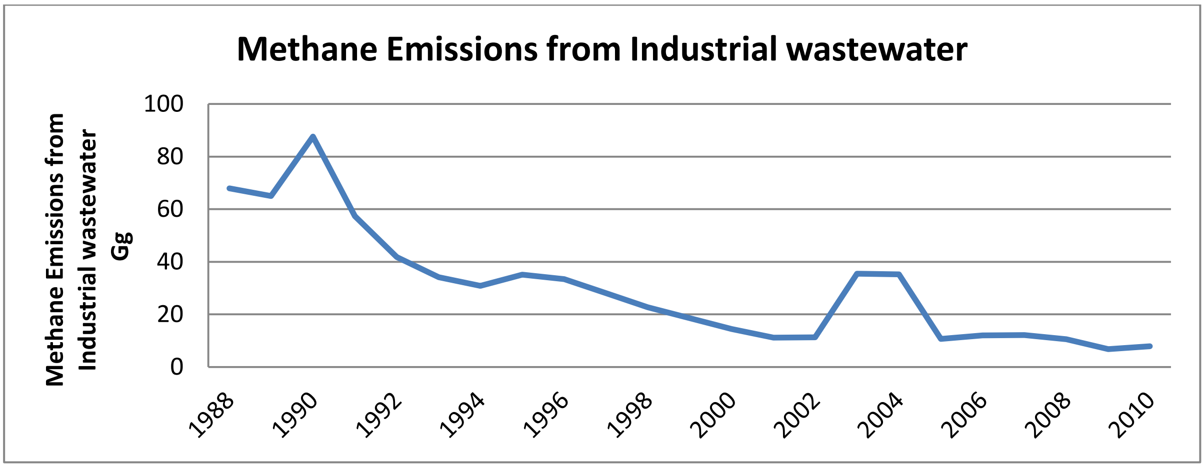

Figure 73 CH_4 emissions from Industrial wastewater

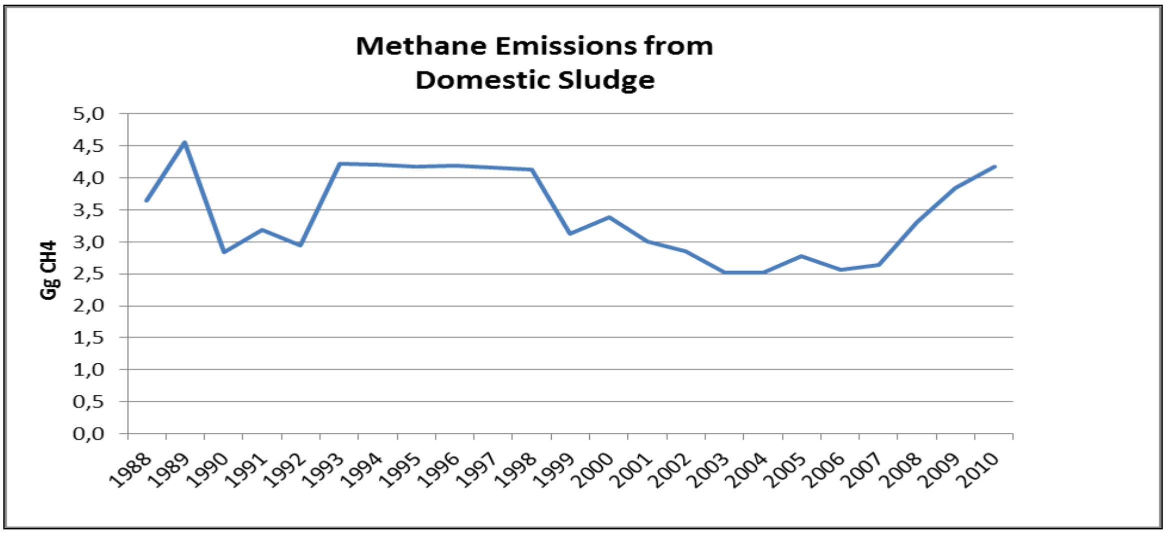

Figure 74 CH_4 emissions from Domestic Sludge

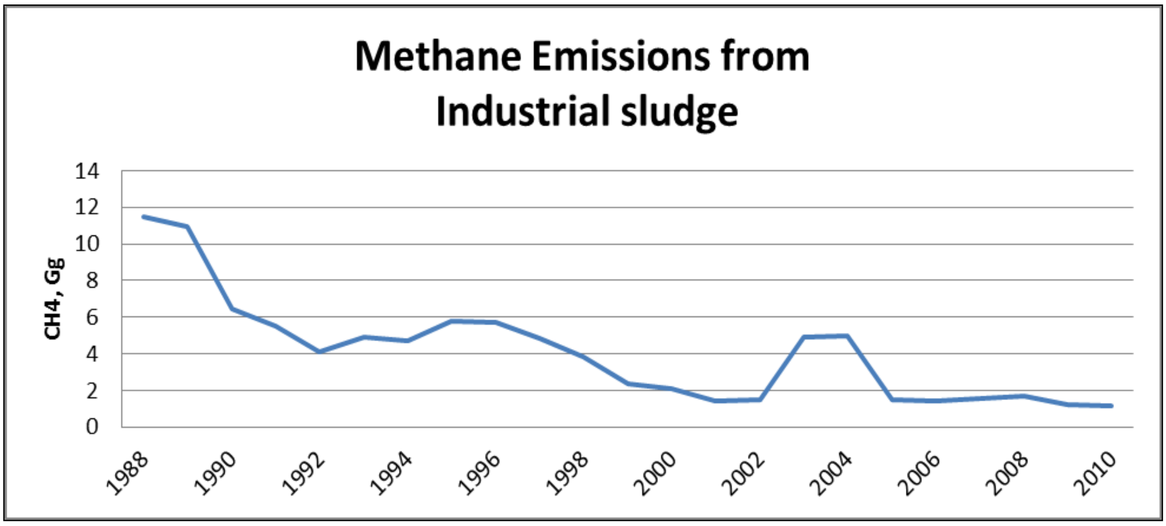

Figure 75 CH_4 emissions from Industrial Sludge

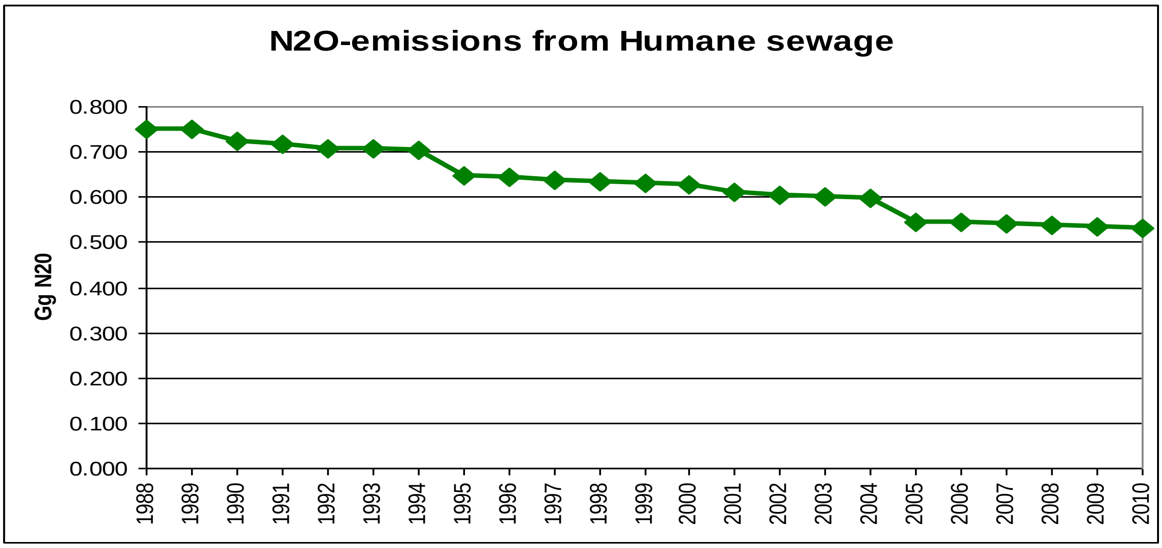

Figure 76 N_2O emissions from Human sewage

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.

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 in1996 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 7. In bolded outline are shown the potential methane sources.

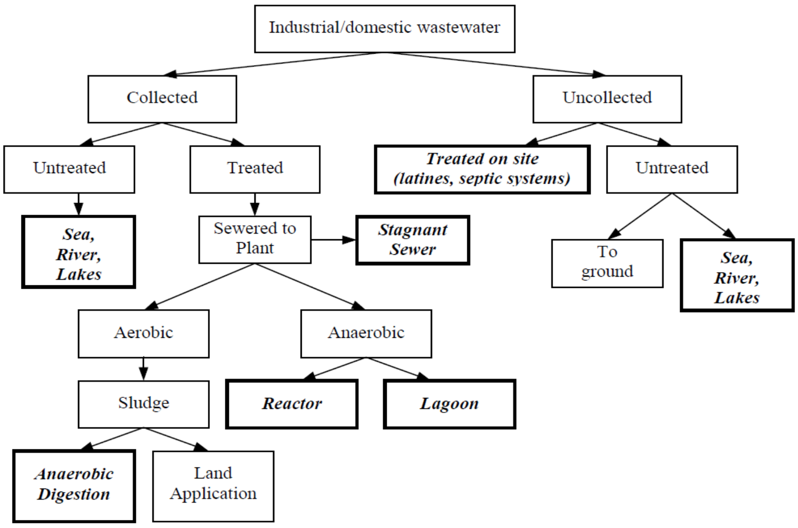

Figure 77 Potential CH_4 sources

We define type of wastewater treatment system and the discharge pathways for the whole country. Based on the data by the National Statistical Institute, we point out three categories of methane emissions sources.

In the first category are the waters without treatment discharged in the water sources (sea, rivers and lakes).

In the second category are the waters discharged trough sewer systems into centralized anaerobic wastewater treatment plant. In the general case they are amortized

In the third category are the water discharged trough stagnant sewers.

Following the 2006 IPCC Guidelines, table 6.3, page.6.13

Table 218 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:

For the first category - waters without treatment discharged in the water sources (sea, rivers and lakes) MCF =0,1

For the second category - waters discharged trough sewer system into centralized anaerobic wastewater treatment plant – MCF = 0,3

And for the third category - waters discharged trough stagnant sewer – MCF = 0,5

8.3.3.2 Methodology for calculation of the methane emissions of domestic sludge handling.

The average quantity of sludge is 5% from the quantity of wastewater. To define the MCF of sludge we analyze the type 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 we using 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, should be 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 219 Industrial wastewater treated on site

Year	Total industrial	Treated on site		Non treated on site	
	thou.m3	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%
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%

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 220 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, typing systems and receiving water for the whole country. Based on data from NSI we define these three categories of types of systems, sources of methane emissions, as well as domestic waste water.

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 N2O 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 221 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	23,062
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

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 222 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	7436389,55	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

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 223 CH_4 emissions from Industrial 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	1704936963	0,049	83,19
1989	1872299405	0,047	75,60
1990	1703558681	0,051	87,64
1991	1286361947	0,045	57,28
1992	1028932113	0,041	41,79
1993	849473507	0,040	34,07
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

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 224 CH_4 emissions from Industrial 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	89733524	0,111	9,98
1989	84184270	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	0,092	1,55

8.3.5 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

Table 225 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 SPECIFIC CHECKS ON QUALITY OF DATA AND CALCULATIONS

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

According to source specific improvement plan (NIR 2011) for inventory 2010 are planned recalculation of CH_4 emissions for whole time series from domestic and industrial treatment of wastewater.

Recalculations for whole time series was made for sub sector waste water, based on new detailed country specific data, achieved by planned project for completed the CS EF.

A comparative assessment of difference between emissions, based on current calculations and last subsequent adoption of the CRF (2011) are presented in table below.

Table 226 Comparative assessment

CATEGORIES	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2011-B. Wastewater Handling	102.20	91.73	80.36	65.4	60.8	53.63	50.74	62.73	60.18	53.02	47.47
2012-B. Wastewater Handling	106.18	103.54	118.58	89.65	71.16	65.21	62.36	68.16	66.67	60.35	53.59
% difference	4%	11%	32%	27%	15%	18%	19%	8%	10%	12%	11%
Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2011-B. Wastewater Handling	43.19	41.28	35.6	34.32	70.94	71.11	35.54	37.52	37.43	34.68	32.63
2012-B. Wastewater Handling	46.32	42.97	37.43	38.78	65.4	63.99	36.63	36.95	37.43	36.26	31.75
% difference	7%	4%	5%	12%	-8%	-11%	3%	-2%	0%	4%	-3%

8.3.8 SOURCE SPECIFIC IMPROVEMENT PLAN

For inventory 2011 we are planning the following main activities:

Estimate the CH_4 recovery from wastewater treatment facilities.;
Send the questionnaire about methane to operators of treatment facilities

8.4 WASTE INCINERATION (CRF CATEGORY 6.C)

8.4.1 SOURCE CATEGORY DESCRIPTION

The waste incineration is an alternative treatment method, to reduce waste volume, toxicity and environmental impact.

The incineration of waste is defined like well controlled incineration process on liquid and solid waste in incineration plants.

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, NH3, 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 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 practices to incinerate clinical waste. Additionally in emission inventory in waste sector are included emission from hazardous waste and sewage sludge.

The methods for quality assessment of greenhouse gases, vary, because are totally different factors and parameters influencing to emissions level.

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 227 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 227 Quantity of incinerated type of waste and respectively emissions- CO_2 and N_2O

Year	CO_2 emissions					N_2O emisions	
	Hazardous waste	HW	Clinical waste	CW	CO_2 -Total	Hazardous waste	CW
	Gg/year						
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
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	24.59	7.47	0.017

The emissions trends are presented in the next figures.

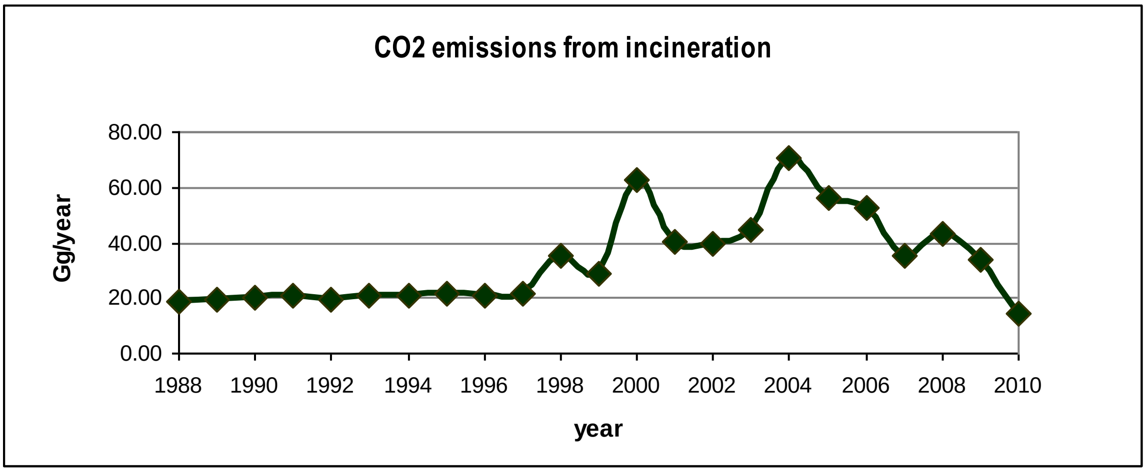

Figure 78 CO_2 Emissions trends for Waste Incineration

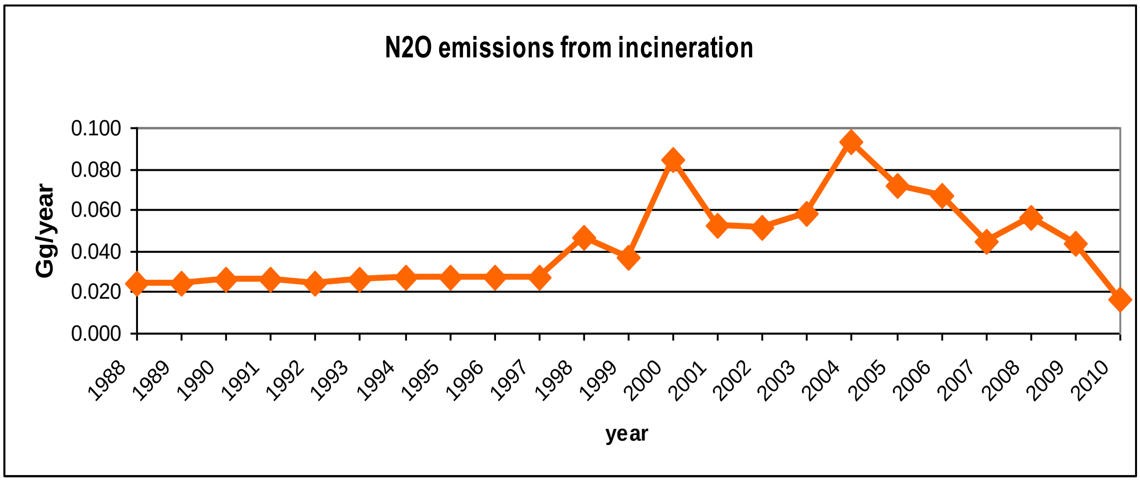

Figure 79 N_2O Emissions trends for Waste Incineration

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.

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 are key categories 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.

Most of the country practically calculated emissions total, not separately type by type of waste and then summarized the emissions.

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 choices 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**

1996 Revised Guidelines and GPG 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).

$$CO2emissions\,(Gg/yr) = \sum_i (IW_i \bullet CCW_i \bullet FCF_i \bullet EF_i \bullet 44/12)$$

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)

$$N2O\,emissions(Gg/yr) = \sum i\left(W_i \bullet EF_i\right) \bullet 10^{-6}$$

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)

$$N_2O\ emissions(Gg/yr) = \sum i\left(Wi \bullet ECi \bullet FGVi\right) \bullet 10^{-9}$$

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 apply first of above equation.

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 date 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 2010 the main source of activity data are operators of incineration plants, process without energy recovery.

According Directive 2008/98/EC waste incineration without energy recovery is regulated with code D10 (landfill incineration).

Currently in country operated 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 don't 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 shall cease 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 2010, thought questionnaire, inserting the data about:

- Type of incineration plant
- Capacity of installation
- Year of commissioning the installation
- Reconstructions of the installation (change, year and etc.)
- Type of incinerated waste for period: 1988-2009
- Quantity of incinerated waste
- Characteristics of incinerated waste

For period 1988-2009 was sent the same questionnaires to 49 incineration plants.

The Table 228 below presents the summarized data about quantity and type of incinerated waste and share of large incineration plants, for whole time series.

Table 228 Quantity of waste and type of incineration plant

Year	Total inc. Gg	№1Gg	№1%	№2Gg	№2%	№3Gg	№3%	Other %
1988	11.604	10.70	92%	0.00	0%	0.56	5%	3%
1989	11.909	11.00	92%	0.00	0%	0.56	5%	3%
1990	12.405	11.50	93%	0.00	0%	0.56	5%	3%
1991	12.618	11.70	93%	0.00	0%	0.56	4%	3%
1992	11.817	10.90	92%	0.00	0%	0.56	5%	3%
1993	12.716	11.80	93%	0.00	0%	0.56	4%	3%
1994	12.921	12.00	93%	0.00	0%	0.56	4%	3%
1995	13.082	12.10	93%	0.00	0%	0.56	4%	3%
1996	12.901	11.90	92%	0.00	0%	0.56	4%	4%
1997	13.009	12.00	92%	0.00	0%	0.56	4%	4%
1998	21.562	20.56	95%	0.00	0%	0.56	3%	2%
1999	17.589	16.58	94%	0.00	0%	0.56	3%	3%
2000	38.355	37.33	97%	0.00	0%	0.56	1%	1%
2001	24.495	23.46	96%	0.00	0%	0.56	2%	2%
2002	23.927	22.86	96%	0.00	0%	0.56	2%	2%
2003	27.143	25.73	95%	0.34	1%	0.56	2%	2%
2004	42.908	41.28	96%	0.60	1%	0.39	1%	2%
2005	34.175	31.97	94%	0.87	3%	0.59	2%	2%
2006	32.271	29.88	93%	0.94	3%	0.54	2%	3%
2007	21.651	19.66	91%	1.13	5%	0.67	3%	1%
2008	26.365	24.93	95%	0.82	3%	0.62	2%	0%
2009	20.776	19.48	94%	0.71	3%	0.59	3%	0%
2010	8.754	7.47	85%	0.74	8%	0.54	6%	0%

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.

The next table show the emission factors and default value (table 5.6, p.5.29, IPCC GPG), 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 work out in detail and summarized on the national level.

Table 229 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

Where practical, emission factors should be derived from direct emission measurement on the plant level .Emission factors differ with facility and type of waste.

If site-specific N_2O emissions factors are not available, default factors can be used (table 5.7, p.5.30, IPCC GPG)

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 230 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

8.4.5 SOURCE SPECIFIC RECALCULATION

No specific recalculations for 2010.

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 1988-2010 (emission data 1988-2010) 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 231 Summary of GHG emission recalculations in submission 2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
Total (Net Emissions)			
1. Energy			
A. Fuel Combustion (Sectoral Approach)		√	EFs for solid and gaseous fuels were recalculated and applied for all subsectors in 1A. The caclulation model was changed in order to use yearly emissions factors for 2007 to 2010.
1. Energy Industries			
2. Manufacturing Industries and Construction			
3. Transport	√	√	All emissions from 1A3b; see section on Road transport, due to the updated version of COPERT, default data, country specific activity data changes; Pipeline transport - see 1.A.3.e in sector Transport
4. Other Sectors			
5. Other			
B. Fugitive Emissions from Fuels			
1. Solid Fuels		√	New activity data
2. Oil and Natural Gas		√	New emission factors
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
G. Other			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
3. Solvent and Other Product Use			
4. Agriculture			
A. Enteric Fermentation			
B. Manure Management		√	Obtained CS activity data, corrected EFs
C. Rice Cultivation			
D. Agricultural Soils		√	Obtained CS activity data
E. Prescribed Burning of Savannas			
F. Field Burning of Agricultural Residues		√	Obtained CS activity data
G. Other			
5. Land Use, Land-Use Change and Forestry			
A. Forest Land		√	for more information please see Chapter 7.2.7 in NIR
B. Cropland		√	for more information please see Chapter 7.3.7 in NIR
C. Grassland			
D. Wetlands		√	for more information please see Chapter 7.5.6 in NIR
E. Settlements		√	for more information please see Chapter 7.6.6 in NIR
F. Other Land		√	There is change in the area of OL due to area adjustment in FL and other categories
G. Other			
6. Waste			
A. Solid Waste Disposal on Land			
B. Waste-water Handling	√	√	CH4 from 6B1 and 6B2; see NIR chapter 8.3
C. Waste Incineration			
D. Other			
7. Other (as specified in Summary 1.A)			
Memo Items:			
International Bunkers			
Aviation			
Marine			
Multilateral Operations			
CO2 Emissions from Biomass			

10.1.2 KP-LULUCF INVENTORY

The reported AR areas in Submission 2012 has been updated and corrected since the last 2011 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 2010 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 232 Recalculation difference of Bulgaria's greenhouse gas emissions compared to the previous submission.

	1988 (Base year)	2009
	Recalculation Difference [%]	
Total	**3.12%**	**-1.01%**
CO_2	1.38%	4.71%
CH_4	2.11%	-0.55%
N_2O	-0.49%	-0.15%
HFC, PFC, SF_6	0.00%	-1.90%

Emissions without LULUCF

Table 233 presents the recalculation differences of national total GHG emissions for all years.

Table 233 Recalculation Difference of National Total GHG Emissions.

Year	National Total GHG emissions without LUCF		
	Submission 2011 [Gg CO_2e]	Submission 2012 [Gg CO_2e]	Recalculation Difference [%]
1988*	124477,47	128399,39	3,15
1989	121874,85	125974,26	3,36
1990	111401,25	114297,70	2,60
1991	89438,41	91979,16	2,84
1992	83329,71	85237,92	2,29
1993	81394,12	82787,60	1,71
1994	79154,98	80205,47	1,33
1995	80813,75	81534,82	0,89
1996	80350,14	80946,44	0,74
1997	77006,80	77402,20	0,51
1998	71381,10	71428,43	0,07
1999	64125,84	63818,64	-0,48
2000	63344,25	62891,89	-0,71
2001	66359,46	65695,47	-1,00
2002	63052,22	62553,92	-0,79
2003	68299,82	67634,77	-0,97
2004	67559,68	66470,04	-1,61
2005	67109,92	66361,45	-1,12
2006	68296,98	67403,27	-1,31
2007	71763,28	70907,85	-1,19
2008	69028,81	68633,37	-0,57
2009	59493,04	58895,14	-1,00

**Base year is 1988 for all gases*

10.2.2 KP-LULUCF INVENTORY

In Submission 2011 the net CO2 emissions/removals for 2009 from the activities under Article 3.3 of the Kyoto Protocol have a figure of -1672.81 GgCO2 eq. while in Submission 2012 after the recalculation that took place the figure of the net removals is -1222.72 GgCO2 eq, which are by 27% less 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 233 and Figure 25 Bulgaria's greenhouse gas emissions as reported in the UNFCCC submission 2012 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.

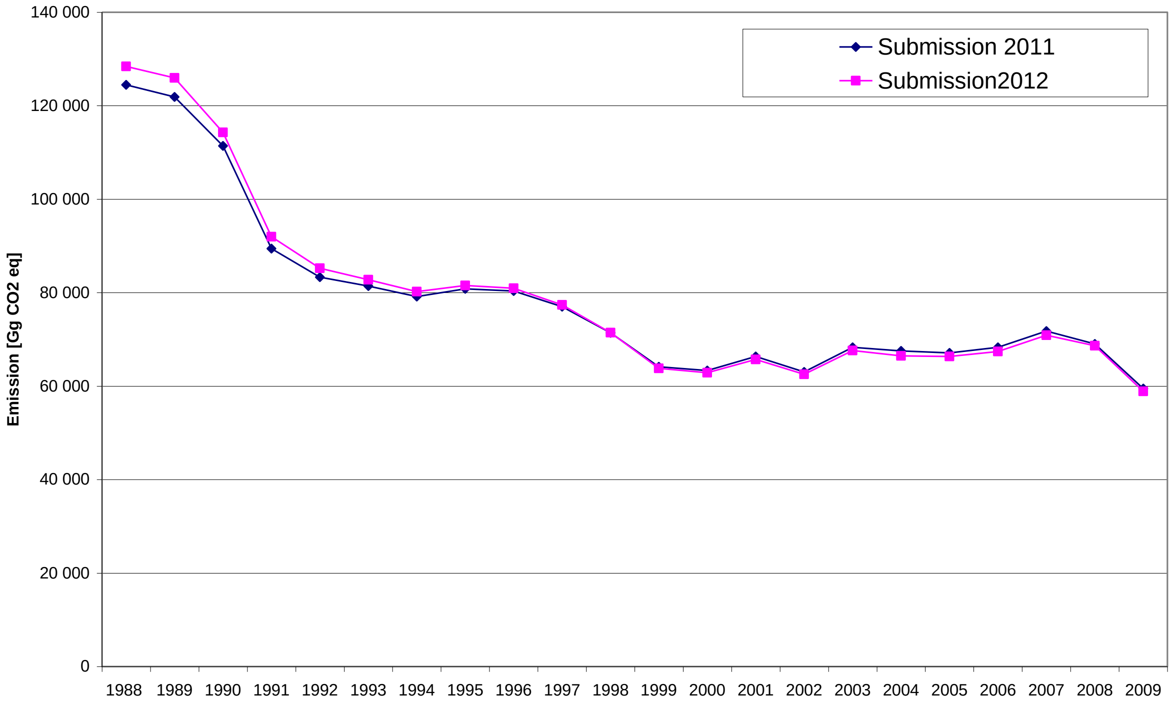

Figure 80 Emission estimates of the submission 2010 and recalculated value

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

Improvements made in response to the review process. 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 234 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 2012 and 2013	Adequately planned and implemented in 2012	All recommendations (from FCCC/ARR/2009/BGR and FCCC/ARR/2010/BGR) were already implemented in Submission 2010 and 2011
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 and management of the emissions inventory.	High priority 30/09/2010	Extension of the staff, engaged in planning, preparation and management of inventory Order № 110/30.04.2010 by the	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
	Training of the staff within the project with the Federal Environment Agency of Austria (workshops in the period December 2009 to June 2010)		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 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	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
	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	Training of the staff in the frame of contracts with external consultants	Adequately planned and implemented in 2012
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) with other non-governmental institutions, universities and private consultants Support of external auditors for improvement of QA procedures	High priority 13/08/2010	Signed Contracts with external consultants for supporting the preparation of 2010 GHGs inventory and NIR: Forestry University Denkstatt Ltd Bulgarian Academy of Science, Geophysical Institute Branch Assosiation for Cement Industry	Adequately planned and implemented in 2010 (FCCC/ARR/2010/BGR § 203)
	FCCC/ARR/2010/BGR Sustainable development of inventory planning,	High priority 2011	Signed new contracts with the same consultants for the 2011	Adequately planned and implemented in 2011

Issue	Planned improvement for 2010 and next submissions	Priority high - medium -low	Status of implementation	Comments
	preparation and management (§ 37)	submission 15/04/2011	submission	
	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
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. 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	High priority 2011 submission 15/04/2011	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
	Continue to Improve implementation of QA/QC in the next submission Support of external auditors for improvement of QA procedures	High priority 2012 submission 15/04/2012	Since November 2011, a project for "Improvement of National Quality Management System for GHG Inventories" has been started in collaboration with the Austrian Environment Agency. The outcome of the project is	Complete implementation in the next submission 2013

Issue	Planned improvement for 2010 and next submissions	Priority high - medium -low	Status of implementation	Comments
			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).	
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 next submissions	High priority 13/08/2010	Contract with external consultants Denkstatt 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 (Order № RD-218/05.03.2010 by the Minister of Environment and Water)	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
	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 15/04/2011	Signed Contract with consultant Denkstatt 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 15/04/2012	➢ 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
Industrial processes (CRF sector 2)	**FCCC/ARR/2009/BGR** Revising of the AD with ETS, EPRTR, IPPC permits data Revising of the EF. Investigation whether it would be possible to update country specific emission factors Sector specific QA/QC procedures were implemented in 2010 submission. 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). 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 (Order № RD-218/05.03.2010 by the Minister of Environment and Water). 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 To 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 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).	High priority 2011 submission 15/04/2011		Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory
	➢ Continue support of external auditors are envisaged for next submissions ➢ Continue comparison of emissions using alternative approaches ➢ Continue to develop expertise and level of engagement with industry ➢ Continue the assessment of underestimates in the industrial processes sector, namely missing	High priority 2012 submission 15/04/2012		Adequately planned and implemented in 2012

Issue	Planned improvement for 2010 and next submissions	Priority high - medium -low	Status of implementation	Comments
	activities under limestone and dolomite use and under soda ash use			
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 Denkstatt 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 Using of appropriate notation keys Improved QA/QC activities	High priority 2011 submission 15/04/2011	Signed Contract with consultant Denkstatt for Preparation of 2011F-gases inventory in Industrial processes Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory	Adequately planned and implemented in 2011
	Continue the research on the F-gases Refrigeration and air-conditioning subsector in order to improve the current assumptions.	High priority 2012 submission 15/04/2012		
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
	Obtaining additional data and comparing data for some sources using the National VOC Register. Check if it is possible to provide the necessary activity	Medium priority 2013		Planned to be implemented in Submission 2013

Issue	Planned improvement for 2010 and next submissions	Priority high - medium -low	Status of implementation	Comments
	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.	submission 15/04/2013		
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 Ministry of Agriculture and Food Food and Agriculture Organization of the United Nations (FAO) Documentation and archiving of all information required in NIR, Background documentation and archive. Support of external auditors are envisaged for 2010 and next submissions	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 Improved 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 Food and Agriculture Organization of the United Nations (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 CH_4 emissions from mature dairy cattle in the agriculture sector; Estimation of CH_4 emissions from cattle (mature, non-mature and young) in the agriculture sector; Estimation of CH_4 emissions from manure management in the agriculture sector; 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 activities Documentation and archiving of all information required in NIR, Background documentation and archive.	High priority 2011 submission 15/04/2011	Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory	
	Obtaining more precise data on animal populations by climate zone within the country	High priority 2012		Adequately planned and implemented in 2012

Issue	Planned improvement for 2010 and next submissions	Priority high - medium -low	Status of implementation	Comments
	Use higher-tier methods to estimate emissions from agricultural soils;	submission 15/04/2012		
LAND-USE, LAND-USE CHANGES AND FORESTRY (CRF sector 5) **KP-LULUCF (see Chapter 10.4.3)**	**FCCC/ARR/2009/BGR** Incorporation of the results from successfully completed 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 13/08/2010 2011 submission 15/04/2011 2011 submission 15/04/2011	For the NIR2010 a complete new and changed estimate was carried out for 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	Adequately planned and implemented in 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	High priority 2011 submission 15/04/2011	See Chapter 7.9 BG NIR 2011	

Issue	Planned improvement for 2010 and next submissions	Priority high - medium -low	Status of implementation	Comments
	in NIR, Background documentation and archive.			
	➢ 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.	High priority 2012 Submission 15/04/2012	Planned to be implemented in Submission 2013	All recommendations (from FCCC/ARR/2009/BGR and FCCC/ARR/2020/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.
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 (Order № RD-218/05.03.2010 by the Minister of Environment and Water). 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 2011 submission 15/04/2011	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 6 C Waste Incineration, based on revised AD for entire time series (IPA questionnaire) Documentation and archiving of all information required in NIR, Background documentation and archive.	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 15/04/2011	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.	High priority 2013 submission 15/04/2013	The complete new and changed estimation was carried out for the sub-sector CRF 6 B Wastewater treatment. Documentation and archiving of all information required in NIR, Background documentation and archive.	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
	➢ Improve consistency between CRF and NIR ➢ Estimate of CH4 emissions from waste composting activities; ➢ Estimate a CH4 recovery from wastewater treatment facilities; ➢ Send the questionnaire about methane to operators of treatment facilities	High priority 2012 submission 15/04/2012	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.	
National registry	**FCCC/ARR/2010/BGR §206к,l** (k) Make publicly available information required by paragraph 45 (account information), paragraph 46 (Article 6 JI, project information) and paragraph 47 (holding and transaction information) of the annex to 13/CMP.1. If any part of this information is deemed confidential, the Party should include an explicit statement in its NIR and on its public website indicating exactly which data are confidential, referencing the relevant regulations; (l) The ERT reiterates a recommendation from both the 2008 and 2009 SIARs that the Party report changes to the national registry system from the previous reporting year as required by paragraph 32 (a.j) of the annex to decision 15/CMP.1.	High priority 2011 submission 15/04/2011	Implemented in 2010 JI projects' publicly accessible information: http://bg-server1.etr.moew.government.bg/iaos/projects.php Accounts holding's publicly accessible information: http://bg-server1.etr.moew.government.bg/iaos/contacts.php Changes to the national registry system from the previous reporting year as required by paragraph 32 (a.j) of the annex to decision 15/CMP.1. will be included in the final NIR – 15/04/2011	

11 KP-LULUCF

11.1 GENERAL INFORMATION

11.1.1 DEFINITION OF FOREST AND ANY OTHER CRITERIA

Forest Fund according to the Forest Act is a territory, with a main purpose to be forest and covers forests, bushes and land for afforestation and non timber production lands, listed in the cadastre. Urbanized areas, separated settlements and agricultural lands are not included in the Forest Fund.

For defining forest, Bulgaria uses the definition in the Bulgarian Forest Act:

An amendment to the Forest Act has been done in March 2011. The definition of the forest has been changed by covering the requirements of the Kyoto protocol. The definition for forest according to the Forest act (2011) is**: “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”.**

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.”
According to the old Forest act (1997 amended and supplemented until 2009): Forest is an area, covered with forest tree species on area not less than than 0.1 ha[33].

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.

[33] The forest definition for Bulgaria according to Forest Act (1997 amended and supplemented until 2009) under the Kyoto protocol slightly differs from the forest definition from the Forest Act, taking into account that in the Forest Act only the area is determined, but when the forests are assessed and inventoried all the requirements for forest definition described in the Decision 16/CMP.1 are met (e.g. height and crown cover), so that would not affect the reporting under KP. This difference will not have an impact on the reporting to KP, FAO or other international organizations

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
The management of the State Forestry Fund and the control over the lands and forests in the Forest Fund are responsibility of the Executive Forest Agency within the Ministry of Agriculture and Food – a legal person on a budget.

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 Forestry Agency after coordination with other stakeholder ministries and organizations.

The Executive Forestry Agency is responsible for a Register for all the forests and lands in the Forest Fund. The Register compiles information for the ownership, the area and type of forests and the changes in these forests. The Register is public and is made on basis of a model, approved by the Executive Director of the Executive Forestry Agency, coordinated with the National Statistics Institute. The reporting is made on types and categories of forests, on ownership, on village areas, municipalities, districts and for the country as a total, as well as on State Forestries, State Hunting Areas and Regional Forestry Boards. In case of change of the ownership, the new owner is responsible to inform the relevant State Forestry in 14 days. The Executive Forestry Agency makes account of the changes in the ownership of all forests and lands in the Forest Fund, and supports a national database with information for the changes.

11.1.2 ELECTED ACTIVITIES UNDER ARTICLE 3, PARAGRAPH 4, OF THE KYOTO PROTOCOL

Bulgaria may choose to account for anthropogenic greenhouse gas emissions by sources and removals by sinks resulting from any or all of the following human-induced activities, other than afforestation, reforestation and deforestation, under Article 3, paragraph 4, in the first commitment period:

"Forest management" as a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner

"Cropland management" as a system of practices on land on which agricultural crops are grown and on land that is set aside or temporarily not being used for crop production

"Grazing land management" as a system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced.

"Revegetation" as a direct human-induced activity to increase carbon stocks on sites through the establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of afforestation and reforestation contained here

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 for the entire commitment period at the end of the commitment period.

The area of forest land reported for Afforestation/Reforestation and Deforestation under the Kyoto Protocol has the base year 1990. All LUC from and to forests are considered to be direct human induced ARD. AR activities are reported together.

The information about ARD areas is based on the NFI (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 reports on the forest fund in Bulgaria are the main data source for determining the emission/removals of greenhouse gases from forests (see chapter 11.2.2). Due to this reason the definition for the purposes of the current report is the same applied in Bulgaria.

The definition for forest according to the amendment in 2011 Forest act is: "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.

All forests in Bulgaria, are managed .

The total AR area for the period 1990-2010 was 227.43 kha.

Table 235 AR areas observed between the NFI period 1990-2010, (Executive Forestry Agency)

Categories of land use changes according to the IPCC GPG 2003	Land use changes to forest land (% of total conversion to forest land)	Land use changes to forest land [1000 ha]
Cropland (5 A.2.1)	64%	144.77
Grassland (5 A.2.2)	28%	63.23
Wetlands (5 A.2.3)	0%	0.00
Settlements (5 A.2.4)	0%	0.00
Others (5 A.2.5)	9%	19.43
Total	100%	227.43

As shown in ARs mainly occur from croplands - 64%. ARs from grasslands and otherlands have lower values - 28% and 9 %, respectively.

The total D area for the period 1990-2009 was 6.55 kha

Table 236 D areas observed between the NFI period 1990-2010 (Executive Forestry Agency)

Categories of land use changes from forests according to the IPCC GPG 2003	Land use changes from forest land (% of total conversion of forest land)	Land use changes from forest land [1 000 ha]
Cropland (5 B.2.1)	0%	0
Grassland (5 C.2.2)	0%	0
Wetlands (5 D.2.3)	63%	4.16
Settlements (5 E.2.4)	37%	2.40
Others (5 F.2.5)	0%	0
Total	100%	6.55

Ds occur from wetlands – 63 % and settlements – 37%.

In NIR 2011 it was described that an increase of the forest area has been registered for the period of accounting AR units (1990-2009). The net increase of the forest area was equal to 282 kha. In NIR 2011 it was described that increase in forest area was not only due to afforestation and reforestation activities begun after 1 January 1990. The increase in forest area was also due to the inclusion of new areas in the reporting forms for the forestry fund (1FF). The inclusion comes as a result of forest inventories which have been carried out for each particular State Forest Enterprise during the time series. The new areas meet all requirements for forest definition in Bulgaria, as well as definition for forest under the KP. However part of the new areas do not meet the requirement of not being forest land before 1 January 1990. This was the reason Bulgaria to report its AR units as preliminary in Submission 2011.

The reported AR areas in Submission 2012 has been updated and corrected since the last 2011 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 below).

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[34].

Bulgaria in its Submission 2012 has implemented the following improvement steps in order to fulfil the reporting requirement set out in paragraph 8 (a) of the annex to decision 15/CMP.1 and to ensure that the re-estimated AR units began on or after 1 January 1990.

In order to distinguish from the estimation of the AR units those new forest areas which were forested before 1.1.1990, Bulgaria has examined the Forest Management Plans (FMPs – see below) for all State Forest Enterprises (SFE)[35], which were inventoried in the period 2001-2010 (NFI for 2011 was not completed yet). Like this all changes in forest area from 1991-2010 for each and every SFE has been traced and identified when inspection of the FMPs for the period of 2001-2010 had been performed[36]. For those SFE, where there is an increase[37] in the forest area since 1990, the increase was derived into:

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.

And the new forested areas with stands of the youngest age class, which are due to afforestation and reforestation activities on barren areas or re-growth on grassland or on croplands.

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) (this Forestry Fund Reporting Form is the data basis for the reported forest area figures in the last submissions). 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 methods. In order to get a complete and consistent time series, the area for the years 1988-1990 has been extrapolated using the average increase in forests for the period 1991-2000.

The new forest areas between 2010 and 1990 according to point b represent the AR areas. Those new forest areas are included in the FMPs, which by itself is evidence that the AR areas are direct-human induced.

[34] Bulgaria has chosen to account for its Art.3.3 emissions/removals at the end of the commitment period.

[35] The country territory is divided into almost 180 State Forest Enterprises. The forest inventory 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.

[36] Forest Inventory is annually performed on 18 from 180 SFE. For 10 years cycles all 180 SFE are surveyed. So the changes in forest area detected in NFI 2001, represent the changes in those particular SFEs for the period 1991-2001; the changes in forest area detected in NFI 2002, represent the changes in SFEs for the period 1992-2002; ….. the changes in forest area detected in NFI 2010, represent the changes in those particular SFEs for the period 2000-2010.

[37] For some of the SFE, where the increase in the forest cover is significant, its forest maps showing the differences are provided

These improvements have been performed by the experts from Executive Forest Agency, by using the following sources of information (results are given in Table 237):

Forest Inventory and FMPs[38];
Forestry Fund Reporting Form 1FF39 (forest area) for the 1990;
Forest maps
These improvement steps represent a comprehensive and time consuming assessment that cannot provide the final figures for all AR areas before the 2014 submission. In the submissions before 2014 a steady revision of the AR areas cannot be circumvented due to the needed inspection of the full period 1.1.1990 to 31.12.2012 and due to the statistical nature of the assessments.

Table 237 Results from the revision of the FMPs for all SFEs for the period 2001-2010, representing the net AR activities since 1992 till 2010

State Forest Enterprises	Area in ha for 1991	Area in ha for 2010.	Planted or seeded in ha 1992-2000	Planted or seeded in 2001-2010	Regrowth in ha. 1992-2000	Regrowth in ha 2001-2010	Forest area forested before 1990
I. DISTRICT VIDIN							
1. Vidin	25 249	31 679	-	-	1 438.3	4 991.7	-
2. Belogradjik	27 185	27 605	620	-	-	3 127.8	906
3. Midjur	16 532	23 885	-	-	70.1	2 555.5	494.6
Total	**68 965**	**83 169**	**620**	**-**	**1 508.4**	**10 675.0**	**1 400.6**
II. DISTRICT MONTANA							
1. Montana	27 219	14 804	-	27.2	542.1	-	191.6
2. Chiprovtsi	-	15 312	1.2	-	18.9	815.7	818.1
3. Berkovitsa	23 199	26 195	59.1	-	195.7	1 979.7	19.5
4. Lom	4 712	6 060	-	50	110	580	608
5. Govejda	14 820	16 364	-	2 264.0	-	-	22
6. Burziya	6 902	6 523					83
Total	**76 852**	**85 258**	**60.3**	**2 341.2**	**866.7**	**3 395.6**	**1 742.2**
III. DISTRICT OF VRATSA							
1. Vratsa	22 240	24 355	-	-	287.8	641	1 068.2
2. Mezdra	24 265	29 920	756.9	867.1	2 109.4	1 739.2	300.4
3. Oryahovi	4 113	4 162	-	-	-	49	-

[38] 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.

[39] 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	Area in ha for 1991	Area in ha for 2010.	Planted or seeded in ha 1992-2000	Planted or seeded in 2001-2010	Regrowth in ha. 1992-2000	Regrowth in ha 2001-2010	Forest area forested before 1990
Total	**50 618**	**58 437**	**756.9**	**867.1**	**2 397.2**	**2 429.2**	**1 368.6**
IV. DISTRICT OF PLEVEN							
1. Pleven	20 126	30 877	2 174.1	-	4 767.0	3 489.4	320.5
2. Nikopol	10 743	13 046	-	39.5	-	210	2 053.5
Total	**30 869**	**43 923**	**2 174.1**	**39.5**	**4 767.0**	**3 699.4**	**2 374.0**
V. DISTRICT OF LOVECH							
1. Lovech	19 195	26 155	35.3	3 657.4	-197.6	4 061.1	407.5
2. Teteven	20 748	17 663	118.6	54.3	11.4	18.6	455.7
3. Ribaritsa	15 720	19 869	-	1	-	76.3	1.9
4. Cherni Vit	10 027	11 977	-	-	504.5	12.5	433.4
5. Troyan	31 033	25 130	35.3	-	-	1 407.0	367.7
6. Rusalka, Apriltsi	12 021	12 797	-	-	334.9	357.1	84
7. Cherni Osam	12 966	13 347	-	-	0.4	312.4	68
8. Borima	-	7 713	-	-	-	-	-
9. Lesidren	17 586	32 038	158.6	91.3	-	1 186.4	-
10. Lukovit	13 338	-	-	-	-	-	-
Total	**152 634**	**166 689**	**347.8**	**3 804.0**	**653.6**	**7 431.4**	**1 818.2**
VI. DISTRICT OF GABROVO							
1. Gabrovo	25 279	28 563	35.7	8.2	-	3 229.9	10.2
2. Sevlievo	20 543	22 379	-	-	1 525.2	299.4	11.4
3. Rositsa	14 168	14 608	-	-	-	350.2	89.8
4. Plachkovtsi	19 762	27 064	-	-	1 327.0	5 898.0	77
Total	**79 752**	**92 614**	**35.7**	**8.2**	**2 852.2**	**9 777.5**	**188.4**
VII. DISTRICT OF VELIKO TARNOVO							
1. Bolyarka, V.Tarnovo	31 699	42 485	504	841.8	-	9 440.2	-
2. Svishtov	3 847	4 622	-	657.9	12.9	-	404.2
3. Gorna Oryahovitsa	18 929	20 289	211.2	12	4.4	738	94.1
4. Elena	30 179	33 202	-	2.8	-	2 736.1	284.1
5. Buinovtsi	14 960	15 080	-	33.1	-	-	86.9
Total	**99 614**	**115 678**	**715.2**	**1 547.6**	**17.3**	**12 914.3**	**869.6**
VIII. DISTRICT OF ROUSSE							
1. Dunav, Rousse	16 297	18 448	-	192	-	850	1 109.0
2. Byala	15 033	19 849	-	3 372.9	-	858.8	584.3
Total	**31 330**	**38 297**	**-**	**3 564.9**	**-**	**1 708.8**	**1 693.3**
IX. DISTRICT OF TARGOVISHTE							
1. Tyrgovishte	15 569	16 880	-	-	16.1	93.5	196.1.1
2. Omurtag	26 433	28 583	3	242.8	-	1 306.8	767.7
3. Cherni Lom, Popovo	24 782	28 171	900	422.9	1 848.7	386.1	757.3

State Forest Enterprises	Area in ha for 1991	Area in ha for 2010.	Planted or seeded in ha 1992-2000	Planted or seeded in 2001-2010	Regrowth in ha. 1992-2000	Regrowth in ha 2001-2010	Forest area forested before 1990
Total	**66 784**	**73 634**	**903**	**665.7**	**1 864.8**	**1 786.4**	**1 630.1**
X. DISTRICT OF SHUMEN							
1. Shumen	15 847	15 749	478.9	0.5	760.5	-	169.4
2. Preslav	16 756	16 060	183.6	-	-	546.8	84.4
3. Varbitsa	15 117	18 020	221.2	-	-	394.8	-
4. Smyadovo	17 410	17 406	-	-	91.4	276.6	404.2
5. Palamara, Venets	29 650	33 482	587.9	40.8	-	1 596.0	100
Total	**94 780**	**100 717**	**1 471.6**	**41.3**	**851.9**	**2 814.2**	**758**
XI. DISTRICT OF RAZGRAD							
1. Razgrad	20 484	22 042	775.1	1 235.1	-	448.7	166.3
2. Seslav	27 917	29 821	-	-	-	213.4	623.4
3. Iri-Hisar	13 139	13 139	-	-	-	-	-
Total	**61 540**	**65 002**	**775.1**	**1 235.1**	**-**	**662.1**	**789.7**
XII. DISTRICT OF SILISTRA							
1. Silistra	25 037	23 789	-	665	-	395.1	3 599.1
2. Karakuz	16 844	24 210	311.4	30.8	-	615.1	452.1
3. Tutrakan	8 590	10 360	74.9	921.8	157.9	85.4	579.4
Total	**50 471**	**58 359**	**386.3**	**1 617.6**	**157.9**	**1 095.6**	**4 630.6**
XIII. DISTRICT OF DOBRICH							
1. Dobrich	23 478	16 715	1 198.7	266.2	123.3	246.5	2 466.4
2. Balchik	11 918	14 111	788.2	176.2	-	183.3	1 045.3
3. Tervel	10 737	14 186	586.5	46.1	-	495	2 321.4
4. General Toshevo	-	13 988	2 267.8	108.5	26	93	428.6
Total	**46 133**	**59 000**	**4 841.2**	**597**	**149.3**	**1 017.8**	**6 261.7**
XIV. DISTRICT OF VARNA							
1. Varna	30 138	31 371	-	-	455.7	-	777.3
2. Suvorovo	11 066	11 445	27.7	25.4	-	321.8	4.1
3. Provadiya	19 536	12 221	394.3	-	-	470.5	173.1
4. Tsonevo	12 024	22 298	644.4	650.2	437.6	69.3	119.6
5. Sherba	12 041	13 012	-	-	-	599.3	371.7
6. Staro Oryahovo	23 241	23 464	-	-	-	-	223
Total	**108 046**	**113 811**	**1 066.4**	**675.6**	**893.3**	**1 460.9**	**1 668.8**
XV. DISTRICT OF BOURGAS							
1. Bourgas	21 693	17 687	428	254	162.4	406.3	1 426.6
2. Nesebar	29 598	34 721	24.6	104.1	188.9	502.6	2 167.6
3. Aytos	39 807	41 486	252.4	106.5	250.8	932.5	136.8
4. Karnobat	6 834	25 750	69.7	-	-	144.5	1 242.2
5. Sadovo	35 767	20 045	136.3	31	775	-	795.3
6. Sredets	34 007	36 100	16.6	13.9	-	777.3	1 385.2
7. Ropotamo	9 418	14 768	88	12.1	88.6	76.7	521.7

State Forest Enterprises	Area in ha for 1991	Area in ha for 2010.	Planted or seeded in ha 1992-2000	Planted or seeded in 2001-2010	Regrowth in ha. 1992-2000	Regrowth in ha 2001-2010	Forest area forested before 1990
8. Novo Panicharevo	19 202	20 325	133	7	-	226	39
9. Tsarevo	27 546	27 878	-	-	-	609	-
10. Gramatikovo	19 252	20 453	-	-	33.8	128.5	1 234.5
11. Kosti	12 534	12 848	57	-	79	248	-
12. Malko Tarnovo	30 587	20 550	3.3	-	162.1	133.9	3 985.3
13. Zvezdets	-	19 568	-	18.1	-	1 394.5	3 833.8
Total	**286 245**	**312 089**	**1 208.9**	**546.7**	**1 740.6**	**5 579.8**	**16 768.0**
XVI. DISTRICT OF YAMBOL							
1. Tundja, Yambol	17 978	18 903	-	-	18.3		906.7
2. Elhovo	25 539	28 359	194.2	683.4	-	566.7	1 375.7
Total	**43 517**	**47 262**	**194.2**	**683.4**	**18.3**	**566.7**	**2 282.4**
XVII. DISTRICT OF SLIVEN							
1. Sliven	42 721	45 871	513.4	37.6	-	700	1 899.0
2. Kotel	37 535	40 478	40	-	-	565.5	1 079.5
3. Tvarditsa	26 448	28 014	-	3.2	-	303.2	1 259.6
4. Nova Zagora	9 508	10 195	83	-	-	99.2	504.8
5. Ticha	12 295	12 930	-	12	568	72.6	1 145.7
6. Stara reka	7 431	8 117	-	-	-	67.4	713.3
Total	**135 938**	**145 605**	**636.4**	**52.8**	**568**	**1 807.9**	**6 601.9**
XVIII. DISTRICT OF STARA ZAGORA							
1. Stara Zagora	34 337	36 213	1 248.5	74.8	120.3	392.6	39.8
2. Chirpan	21 352	24 312	46.5	19.7	581.9	634.8	1 551.7
3. Mazalat	27 782	34 609	170.7	94.9	-	272	1 206.7
4. Gurkovo	21 119	22 214	-	-	-	355.6	-
5. Maglij	23 877	23 746	19	121.8	53.7	539.3	-
6. Kazanlak	28 545	23 968	14.1	36.6	-	-	455
Total	**157 012**	**165 062**	**1 498.8**	**347.8**	**755.9**	**2 194.3**	**3 253.2**
XIX. DISTRICT OF HASKOVO							
1. Haskovo	73 978	79 522	-	1 896.7	566.9	2 959.0	121.4
2. Topolovgrad	19 764	20 497	145.8	172	239.8	-	175.4
3. Svilengrad	24 232	27 708	607.2	275.8	354.3	2 107.1	131.6
4. Ivaylovgrad	41 977	47 820	104.5	64.5	244.5	1 859.1	3 570.1
Total	**159 951**	**175 547**	**857.5**	**2 409.0**	**1 405.5**	**6 925.5**	**3998.5**
XX. DISTRICT OF KARDJALI							
1. Kardjali	34 001	21 983	597.8	342.4	-	-	128.9
2. Jenda	3 487	16 918	-	36.9	-	123.3	183.7
3.Momchilgrad	52 266	24 467	21.4	68.5	-	-	885.6
4. Kirkovo	-	28 783	5.8	2.7	-	-	-
5. Krumovgrad	39 848	42 912	139.1	16.8	-	1 024.4	1 883.7

State Forest Enterprises	Area in ha for 1991	Area in ha for 2010.	Planted or seeded in ha 1992-2000	Planted or seeded in 2001-2010	Regrowth in ha. 1992-2000	Regrowth in ha 2001-2010	Forest area forested before 1990
6. Ardino	17 932	18 366	93	56.2	88.6	196.2	-
Total	**147 534**	**153 429**	**857.1**	**523.5**	**88.6**	**1 343.9**	**3 081.9**
XXI. DISTRICT OF SMOLYAN							
1. Smolyan	22 362	21 349	-	45.6	147.5	1 194.1	-
2. Zlatograd	32 671	31 977	-	-	82.4	26.7	-
3. Smilyan	30 526	31 565	-	-	10.8	1 028.2	-
4. Slaveyno	26 975	28 788	-	-	38.4	459	-
5. Pamporovo	8 627	6 296	27.4	-	-	-	-
6. Chepelare	10 895	11 075	-	-	-	120	-
7. Hvoyna	11 444	16 898	37.3	272.7	894.4	-	63.5
8. Shiroka Laka	8 102	9 019	-	-	1.4	568.8	346.8
9. Mihalkovo	13 702	14 488	-	-	356.4	448.2	981.4
10. Izvora	2 238	3 745	12.1	3.2	-	144.2	159.4
11. Devin	12 698	13 645	-	-	43	425	667.1
12. Trigrad	7 680	9 979	255.7	36.1	628.2	595.1	783.9
13. Borino	10 469	12 497	-	-	837.5	160.5	1 030.0
14. Dospat	19 171	20 258	5	35	138	452	457
Total	**217 560**	**231 579**	**337.5**	**392.6**	**3 178.0**	**5 621.8**	**4 489.1**
XXII. DISTRICT OF PLOVDIV							
1. Plovdiv	25 336	24 370	543.5	136.8	-	945.2	5 254.9
2. Hisar	23 239	25 730	1 077.5	49.5	283.4	429.2	651.4
3. Klisura	7 089	6 357	46.8	58.5	-	-	304.5
4. Rozino	12 323	13 686	5.5	4.1	-	-	211.6
5. Karlovo	28 248	30 279	49.1	35.6	148.5	1 130.1	667.7
6. Chekeritsa	12 646	21 062	28.5	26.1	-	254.3	260.7
7. Parvomai	9 192	9 506	111.5	23.9	-	178.6	-
8. Asenovgrad	24 662	27 811	85.6	280.5	124.6	1 670.1	988.2
9. Kormish, Laki	19 106	21 196	200.4	34.4	1 098.9	612.2	144.1
10. Krichim	7 873	9 001	-	-	608.8	47.4	471.8
Total	**169 714**	**188 998**	**2 148.4**	**649.4**	**2 264.2**	**5 267.1**	**8 954.9**
XXIII. DISTRICT OF PAZARDJIK							
1. Pazardjik	24 390	25 434	-	2	-	59	983
2. Panagurishte	37 158	37 786	370.9	50.1	-	-	207
3. Belovo	22 634	24 350	43.5	52.3	356.8	198.8	1 064.6
4. Yundola	4 831	4 824	-	-	-	-	-
5. Alabak	26 165	25 626	107	121	-	238.4	456.7
6. Chepino	2 529	10 973	-	-	-	124.1	134.8
7. Chehlyovo	14 929	8 256	-	-	18	25	-
8. Selishte	15 472	15 925	79.9	13.6	-	148.7	210.8
9. Shiroka Polyana	15 060	10 704	-	-	-	86.4	147.7

State Forest Enterprises	Area in ha for 1991	Area in ha for 2010.	Planted or seeded in ha 1992-2000	Planted or seeded in 2001-2010	Regrowth in ha. 1992-2000	Regrowth in ha 2001-2010	Forest area forested before 1990
10. Rodopi	2 486	7 147	-	-	-	34.5	36.4
11. Beglika	12 350	12 581	-	-	-	86.4	144.6
12. Borovo	14 538	15 120	-	-	-	104.5	477.5
13. Batak	9 520	9 888	-	-	-	98.7	269.3
14. Rakitovo	18 255	19 320	92.8	109.2	69.7	14.3	779
15. Peshtera	18 580	19 418	478.3	118.1	21.4	17.4	202.8
Total	**238 897**	**247 352**	**1 172.4**	**466.3**	**465.9**	**1 236.2**	**5 114.2**
XXIV. DISTRICT OF BLAGOEVGRAD							
1. Blagoevgrad	24 222	24 705	15.7	130.8	-	1 541.3	211.3
2. Simitli	30 136	33 979	422.8	235.2	300.9	1 079.7	388.3
3. Kresna	22 516	23 274	-	-	92.2	234.8	431
4. Stumyani	18 450	20 760	-	-	-	148.5	970.5
5. Parvomay	18 422	17 786	253	42.7	-	442.1	0.3
6. Petrich	10 727	11 253	-	-	-	264.1	78.8
7. Sandanski	22 122	22 261	242.5	-	57.1	290.3	107.3
8. Katuntsi	26 366	27 944	-	-	62	48	909.8
9. Gotse Delchev	28 748	29 049	46.2	42.5	129	176	-
10. Dikchan, Satovcha	17 729	17 870	60	91	-	-	-
11. Garmen	24 657	26 574	39.6	2.5	-	62	-
12. Mesta	16 789	11 563	48.9	81.8	1.2	5.5	-
13. Dobrinishte	12 021	16 781	28.7	80	359	639.1	-
14. Eleshnitsa	16 510	16 650	178.7	131.7	-	-	-
15. Yakoruda	19 967	21 103	1 162.2	688	-	-	-
16. Belitsa	10 351	11 139	99.8	268.7	-	218.5	-
17. Razlog	18 023	19 334	112	54.4	461	-	-
Total	**337 756**	**352 025**	**2 710.1**	**1 849.3**	**1 462.4**	**5 149.9**	**3 097.3**
XXVI. DISTRICT OF KUSTENDIL							
1. Osogovo	46 949	57 907	-	-	867.9	5 990.0	3 175.5
2. Nevestino	21 353	22 872	407.1	525.3	510.2	485.4	515.6
3. Dupnitsa	45 428	45 780	-	-	-	67.8	284.2
Total	**113 730**	**126 559**	**407.1**	**525.3**	**1 378.1**	**6 543.2**	**3 975.3**
XXVI. DISTRICT OF PERNIK							
1. Radomir	24 496	20 235	3 834.0	212	-	124.3	134.3
2. Zemen	15 029	18 357	28.4	52.7	740	764.3	1 742.6
3. Breznik	8 884	10 304	153	110.1	-	980.4	176.5
4. Tran	29 326	31 500	955.6	-	797	-	421.4
5. Vitoshko-Studena	-	8 694	-	-	-	-	128.4
Total	**77 735**	**89 090**	**4 971.0**	**374.8**	**1 537.0**	**1 869.0**	**2 603.2**
XXVII. DISTRICT OF SOFIA							
1. Sofia	49 478	54 186	-	2 382.3	-	123.3	265.7

State Forest Enterprises	Area in ha for 1991	Area in ha for 2010.	Planted or seeded in ha 1992-2000	Planted or seeded in 2001-2010	Regrowth in ha. 1992-2000	Regrowth in ha 2001-2010	Forest area forested before 1990
2. Svogue	46054	44 734	-	405.2	239.7	265.6	222.1
3. Vitinya	7 723	16 921	-	-	-	-	-
4. Botevgrad	40 497	33 657	-	110	-	1 425.0	307.1
5. Godedj	10 093	10 976	-	-	14.5	242.7	625.8
6. Etropole	20 756	22 523	144.1	11.1	-	1 335.3	276.5
7. Pirdop	42 773	44 526	-	46	-	823.9	883.1
8. Elin Pelin	24 539	19 766	25	74	150	629	21.9
9. Aramliets	-	9 332	-	25.1	-	3.1	-
10. Ihtima	27 362	23 843	-	56.5	214.3	304.5	274.6
11. Kostenets	18 864	20 951	13.8	208.4	315.6	408.7	264.5
12. Samokov	64 626	67 301	-	-	191.6	2 607.2	14.2
13. Iskar	3 270	3 398	-	-	-	-	128
Total	**356 035**	**372 114**	**182.9**	**3 318.6**	**1 125.7**	**8 168.3**	**3 283.5**
Total for the Country	3 460 012	3 761 299	31 335.9	29 144.3	32 967.8	113 141.9	94 697.1

11.2.2 METHODOLOGY USED TO DEVELOP THE LAND TRANSITION MATRIX

The data for the total forest area for the single years, as well as the relative share of the coniferous and deciduous and forests out of yield are obtained from the reports for the forestry fund (Executive Forestry Agency). The country is divided territorially into forestry management units and for each of them a forestry management plan is being developed (FMP). The plans contain reporting forms for the forestry fund (FF) including information for the: forest areas (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 (e.g. 1985, 1990, 1995, 2000, 2005) and are submitted to the Regional Forestry Offices and in the Executive Forestry Agency. When developing the FMP a complete forest-inventory is used for all forests (state and non state) (Bogdanov, K. 1991, Mihov, I. 2000). All research and assessment system is laid down in the Ordinance on the Forestry Planning and the Lands from the Forest Fund and of the Game management Regions of Republic of Bulgaria. The assessment of the whole territory of the country has been carried out within 10 years. For the future, large scale inventories are planned that cover Bulgaria within one year.

The data for the forest area are presented by the National Statistical Institute, as well as by the Statistical Office of the European Union, Eurostat.

Every five years data are submitted to the FRA / Forest Recourses Assessment(s), under the Forestry Department of the UN Food and Agriculture Organization, FAO.

For the period of the inventory an increase of the forest area has been registered.

The total area of forest land in the single years and its share of coniferous, deciduous and forests out of yield come from the national forest inventory (source of information- Executive Forestry Agency). The time series shows an increase in forest area.

The total increase in forest area for all years of the reported time series and the annual losses of forest areas to settlements or wetlands for the period 2001-2008 are known. However, specific data on the amount of AR areas according to their previous land uses as well as further areas of deforestations for other years or other land uses are not available. Therefore, the following procedure was carried out to estimate the areas of LUCs to forests and their previous land uses.

As it was mentioned above the forest area of Bulgaria is annually assessed. Data for forest lands and changes to/from forests were obtained by National Forest Inventories. From this statistic, the annual net change of forest area can be derived for the whole time series since 1.1.1990. These net changes in forest areas plus the annual deforestation areas must represent the annual AR areas to be consistent with the known annual increase in forest area (provided, as in the case of Bulgaria, that all forests are managed, see also IPCC GPG,Table 4.2.1).

The deforestation areas for settlements in the time period 2000 -2008 are also known. For the years before 2000 the same share of previous forest land in the increase of settlement area (which is known) was assumed, and on basis of these two information the annual deforestation areas to settlements for the years before 2000 were derived. Deforestations to cropland and grassland can be excluded due to the legal provisions. The observed increase in wetlands (from 2001 to 2008) suggests also a deforestation for wetlands due to probability reasons. This deforestation area was assumed to have the same share as the share of forest land in the totals of forest land, cropland plus grassland (it was assumed that the wetlands increase comes from such lands). Other land decreased across the time series, so it was assumed that there is no deforestation to other land.

On basis of these statistics and derived areas, the annual AR and D areas were estimated according to the equations (1) and (2). These estimates were based on means for certain periods of similar years to achieve more robust results.

$$AR_x = FL_x - FL_{x-1} + D_{WLx} + D_{SMx} \quad (1)$$

$$D_x = D_{WLx} + D_{SMx} \quad (2)$$

Where,

AR – AR area

X - year

FL – forest area

D – D area

D_{WL} – D area for wetlands

D_{SM} – D area for settlements

The AR areas (that result after adding the D areas to the observed net increases in forest area) were assumed to stem from cropland and grassland. The LUC into forest land is a result mainly of re-growth. This is defined as human induced promotion, as the re-growth in this case is a result of the abandonment of the agricultural land, which in fact leads to a direct human induced seeding from the adjacent forests and (re-)growth of managed forests (all forests in Bulgaria are managed and reported as such).The changes are reported during the the forest inventory. All the LUC from and to forests are documented in the Forest managements plans, which are developed on a legal base.

Cropland, grassland and other land were considered as possible land use categories where AR areas may stem from. Wetland areas were rather constant in the observed period and slightly increased in the last years. Settlements show a steady increase in the observed period. Therefore (and for the various problems that arise when converting these categories to forests), it was assumed that there was no forest area increase on basis of wetlands or settlements. The other land in Bulgaria showed a steady decrease in the observed period. Due to the location of other land and its unsuitability for other land uses (other land constitutes rocky and scarcely vegetated areas) it was assumed that the decrease in other land was caused by land use changes to forest land. The remaining AR areas (that result after adding the D areas to the observed net increases in forest area) were assumed to stem from cropland and grassland. It was assumed that the shares of the individual land use categories annual cropland, perennial cropland and grassland that contribute to these AR areas behave like the ratios of the total areas of these land use categories in Bulgaria. The time series of forest areas and other available area statistics show different trends in the years after 2000 and before. Therefore, the time series was divided into these two periods and the AR areas from cropland and grassland was fitted to the different trends in these two periods.

Information for D areas is only available for changes to settlements in the period 2001 to 2008. For the years before 2001 it was assumed that the observed (smaller) increase in settlement area was also caused by D of forest areas in an amount that was estimated by the total increase in settlement area adjusted according to the share of the categories forest land and agricultural lands in the increase of settlement area after 2001. There is also an increase in wetland areas in Bulgaria from 2001 on. It was assumed that this increase in wetland area is also caused on basis of D of forest land (together with agricultural land) in amount that represents the increase in wetland adjusted by the ratio forest land to agricultural land in Bulgaria.

The resulting AR and D areas for the reported time series fit to the observed net increase in forest area in Bulgaria for that period.

Table 238 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	182.24	NO						182.241
	Deforestation		4,04						4,04
Article 3.4 activities	Forest Management (if elected)		NA	NA					0
	Cropland Management (if elected)	NA	NA		NA	NA	NA		NA
	Grazing Land Management (if elected)	NA	NA		NA	NA	NA		0
	Revegetation (if elected)	NA			NA	NA	NA		NA
Other		15.48	1,25	0	0	0	0	10897.19	10913.91
Total area at the end of the current inventory year		278,36	5,29	0	0	0	0	10897.19	11100,19

Table 239 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	197.71	NO						197.71
	Deforestation		5,29						5,79
Article 3.4 activities	Forest Management (if elected)		NA	NA					0,00
	Cropland Management (if elected)	NA	NA		NA	NA	NA		NA
	Grazing Land Management (if elected)	NA	NA		NA	NA	NA		0,00
	Revegetation (if elected)	NA			NA	NA	NA		NA
Other		14.76	0,53	0,00	0,00	0,00	0,00	10 881,90	10 897,19
Total area at the end of the current inventory year		212.47	5,82	0,00	0,00	0,00	0,00	10 881,90	11 100,19

Table 240 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	212.47	NO						212.47
	Deforestation		5.82						5,82
Article 3.4 activities	Forest Management (if elected)		NA	NA					0,00
	Cropland Management (if elected)	NA	NA		NA	NA	NA		NA
	Grazing Land Management (if elected)	NA	NA		NA	NA	NA		0,00
	Revegetation (if elected)	NA			NA	NA	NA		NA
Other		14.96	0.73	0,00	0,00	0,00	0,00	10 866.21	10 881,90
Total area at the end of the current inventory year		227.43	6.58	0,00	0,00	0,00	0,00	10 866.21	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 forest inventory in Bulgaria. It 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. 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. The territory of the sub-compartment is between 1-25 ha.

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 Forest Management plan.

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

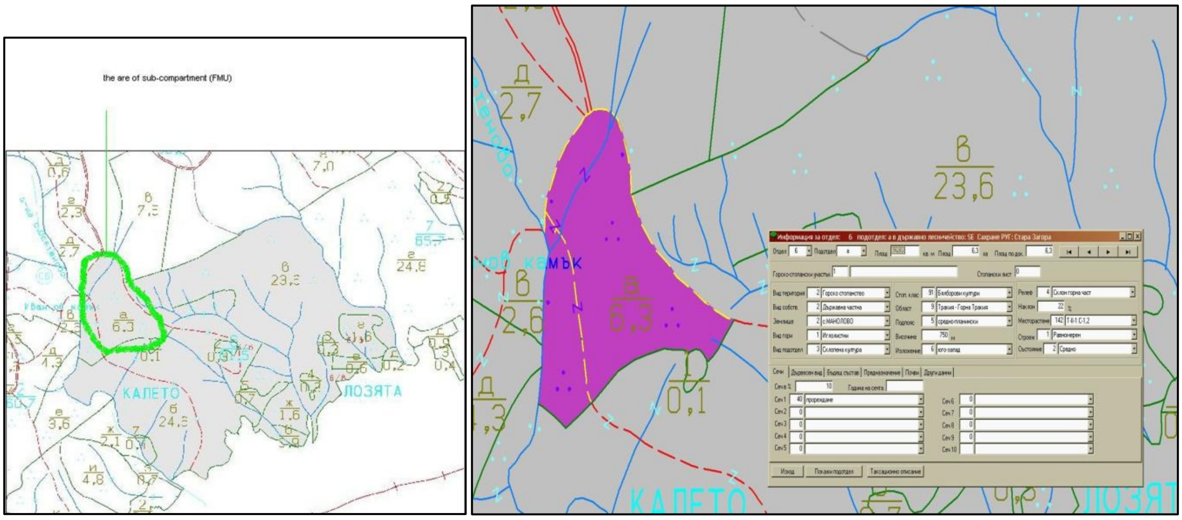

Figure 81 A map of one SFE (on left side), showing a compartment (in grey colour and) and a sub-compartment (green line). On the right side - the area of sub-compartment and its details in the table.

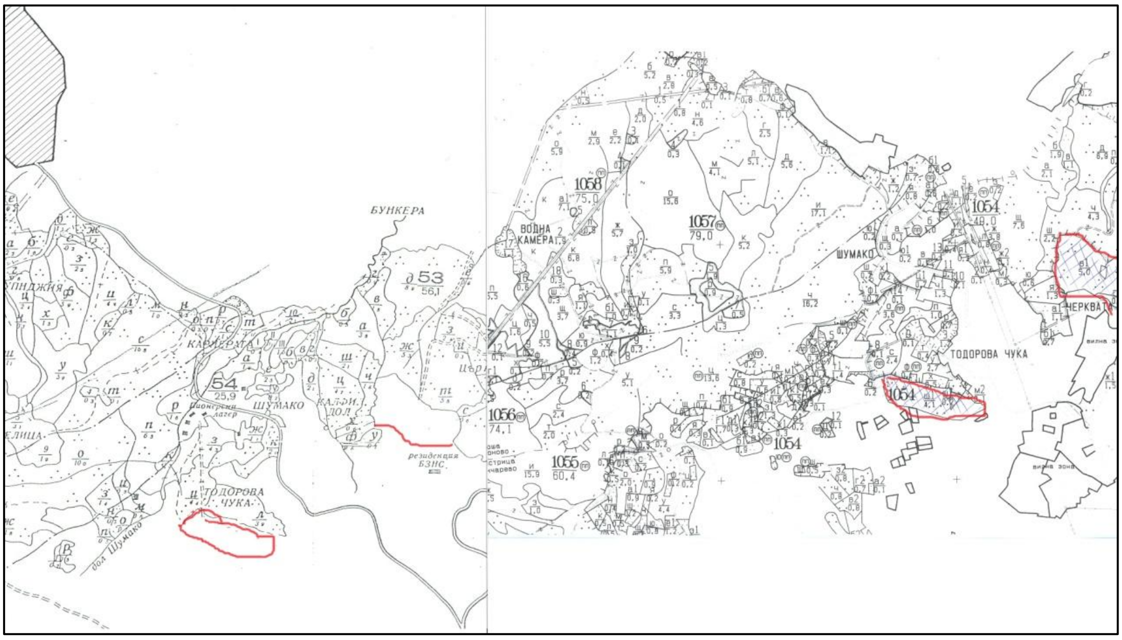

Figure 82 A map of the area of one SFE before (left) and now (right), which trace the changes in the territory (on red).

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 - 5 A 2 IPCC GPG).

The methods to derive the activity data were described before in chapter 11.2.

The emission factors were estimated in the following manner:

11.3.1.2 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) were used. An average annual increment of the stock (stemwood and branches) of age class Ist was determined of 6.28 m3/ha/y, obtained by dividing the stock of the stands of age class I by average age of 10 years. This value is used for the AR areas from all previous land use types. An average annual increment of the stock (stemwood and branches) of IInd age class was determined of 12.16 m3/ha/y.

There are no specific values for the biomass expansion factor (BEF2) 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 used biomass expansion factor does not need to account for this tree compartment, so BEF2 has only to add the leaf biomass. To estimate this specific BEF2 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 the in the first age class of the Bulgarian forests Table 241 presents the values for BEF2.

Table 241 Biomass expansion factor for converting stemwood +branches into total aboveground biomass (BEF2) for the first age class

Types of forests	Coniferous	Deciduous
BEF2	1.10	1.08
Mean	1.09	

The weighed mean value for wood density was determined (D) 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 is used for all land use changes to forests.

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 of age class I.

The calculated average annual increment of carbon stock in the living biomass in lands converted to forests is 2.25 tonnes C/ha-1y-1 for the Ist age class . This constant value is used for all AR areas of the Ist age class and multiplied with the total AR areas of the Ist age class.

The emission factors and estimates for the 2nd age class (AR areas that change into the 2nd age class since 2008) were calculated with the same approach as for age class I but using the specific figures of age class II. The resulting annual increment is 4.28 tonnes C/ha-1y-1 for the 2nd age class.

The losses of biomass of previous land used in the year of AR were estimated on basis of the country specific (or default) biomass stocks for annual and perennial cropland (3.00

tonnes C/ha-1 and 63 tonnes C/ha-1, respectively), for grassland (6.40 tonnes C/ha-1) and other land (0 tonnes C/ha-1y) - see related chapters of these subsectors.

For D areas the loss in living tree biomass per ha in the year of D is calculated with 48.9 tonnes C/ha. It is estimated on basis of an average for the standing stemwood and branch stock in Bulgarian forests based on NFIs expanded and converted with the related country specific (or default) expansion/conversion factors: wood densities (0.43 t/m3 for coniferous, 0.60 t/m^3 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.). These used figures are the same as for the estimates of the forest land sector and the methods are described there more specifically (see related chapter). This value is then multiplied with the D area in the year of the D activity.

For the biomass growth of the following land uses at the Bulgarian D areas (wetlands and settlements) the following values were taken: 0 t C ha-1y-1 for wetlands and 0.09 t C ha-1y-1 and 0.03 t C ha-1y-1 for annual plants and perennial plants in settlements, respectively. Growth of annual plants is accounted only in the year of D, while the growth of the perennial plant at the D areas continues. These used emission factors are the same as for the respective sectors and a description of the underlying methods and assumptions can be found in the related chapters of these subsectors.

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 D areas the used dead wood stock per ha that is removed due to the D activity is the same as for the estimates of land-use-changes from forests to other uses. Due to the lack of own data 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 value is then 2.4 t C ha-1.

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 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 the 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. After the last in-country, following the recommendation made by ERT during review, Bulgaria decided to report carbon stock changes in litter separately from the carbon stock changes in soils.

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 (including litter) from forest ecosystems (SOCref) a country specific value is used = 51.89 t C/ha.

For the stable stock of organic carbon in soils of previous types of land-use the country specific values obtained for annual or perennial cropland, grassland and other land are used:

- annual crops: 63.2 t C/ha
- perennial crops: 53 t C/ha
- grasslands: 80.99 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 used soil C stocks for wetlands and settlements were:

- Wetlands: 0 t C/ha
- Settlements: 2.1 t C/ha

A descripiton of the methods of deriving all these soil C stocks can be found in the related 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.

Net carbon stock changes in litter are not reported separately. The used forest soil C stock includes the total humus layer (litter). So the estimates of the soil C stock changes account for the changes in the litter. Any further estimates for the litter layer would lead to a double accounting of this carbon pool.

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

Tier 2 method, based on Monte Carlo simulation technique, has been implemented to assess uncertainty for emissions and removals from ARD activities. 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. The number of the applied iterations is 10000. Details on the results are given below.

Table 242 Statistics of the Monte Carlo analysis for activites under Art.3.3 of the KP, 2008

	Trials	Min	Median	Mean	Max	Std. Dev.	uncertainty %
AR Biomass	10000	-2980	-1251	-1269	-137	373	-62.4; 52.2
AR Litter	10000	-2749	-158	-194	-14	139	-186.2; 76.7
AR Soil	10000	-1992	334	380	4386	695	-330.6; 399.1
D Biomass	10000	25	223	223	453	57	-50.1; 51.1
D Dead wood	10000	6	11	11	20	2	-29.3; 34.0
D Litter	10000	0	4	5	47	4	-76.9; 183.8
D Soil	10000	20	49	50	105	10	-34.4; 44.2
ARD activites	10000	-3695	-819	-794	3044	804	**-192.1; 212.5**

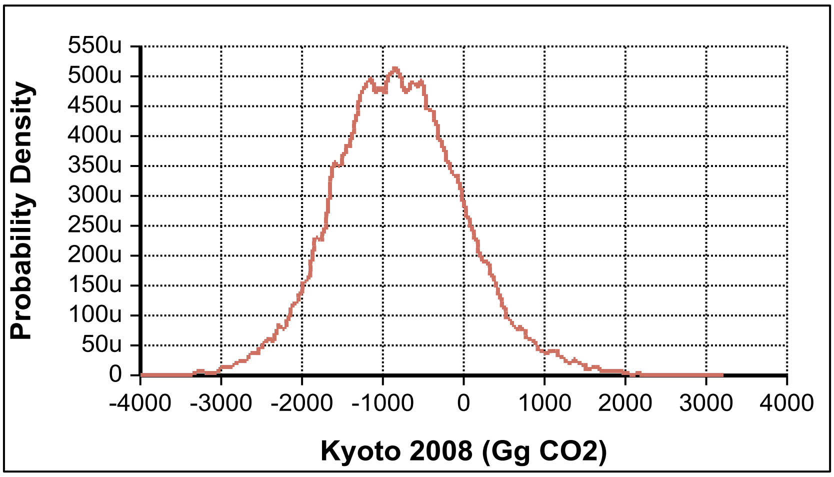

Figure 83 Probability density function resulting from Monte Carlo analysis activites under Art.3.3 of the KP, 2008

Table 243 Table Statistics of the Monte Carlo analysis for activites under Art.3.3 of the KP, 2009

	Trials	Min	Median	Mean	Max	Std. Dev.	uncertainty %
AR Biomass	10000	-3265	-1405	-1424	-245	398	-59.4; 50.2
AR Litter	10000	-2955	-170	-209	-16	149	-186.2; 76.7
AR Soil	10000	-2142	354	404	4709	746	-333.7; 402.1
D Biomass	10000	44	94	94	150	14	-28.1; 31.6
D Dead wood	10000	2	5	5	9	1	-29.7; 34.3
D Litter	10000	0	5	6	51	4	-77.0; 184.1
D Soil	10000	22	53	54	116	11	-34.4; 44.1
ARD activites	10000	-4085	-1093	-1070	3132	860	**-153.1; 168.2**

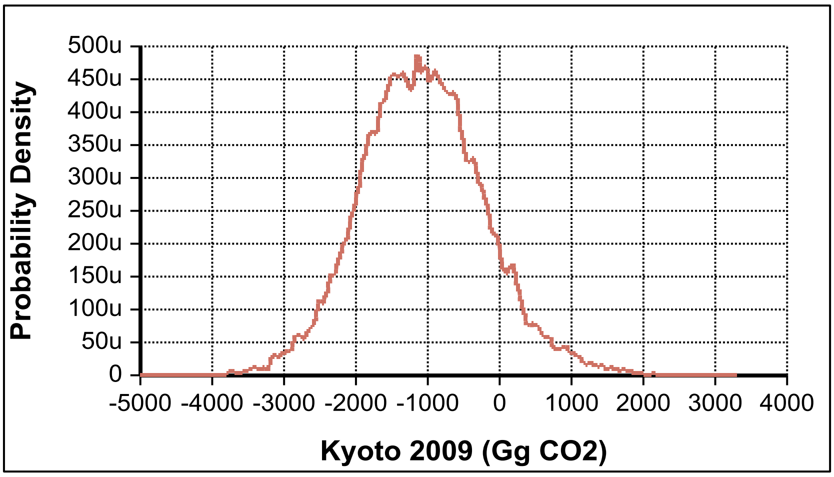

Figure 84 Probability density function resulting from Monte Carlo analysis activites under Art.3.3 of the KP, 2009

Table 244 Statistics of the Monte Carlo analysis for Kyoto Art.3.3, 10

	Trials	Min	Median	Mean	Max	Std. Dev.	uncertainty %
AR Biomass	10000	-3786	-1575	-1598	-375	415	-55.1; 49.5
AR Litter	10000	-2237	-178	-218	-15	157	-181.9; 77.1
AR Soil	10000	-2413	370	421	3650	759	-322.1; 389.1
D Biomass	10000	41	131	131	220	24	-35.4; 36.3
D Dead wood	10000	3	7	7	12	1	-29.4; 33.5
D Litter	10000	0	5	6	58	4	-77.0; 183.9
D Soil	10000	25	60	61	130	12	-34.4; 44.1
ARD activites	10000	-4781	-1218	-1190	2255	886	**-139.4; 153.8**

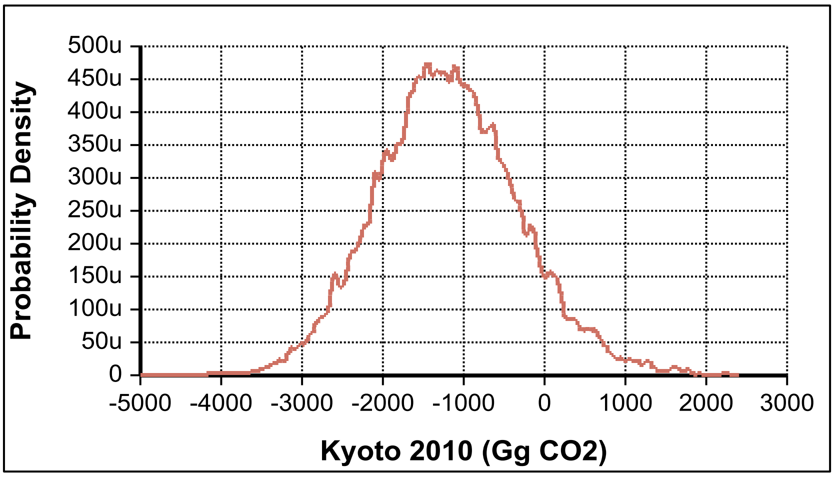

Figure 85 Probability density function resulting from Monte Carlo analysis activites under Art.3.3 of the KP, 2010

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 2010 the following ARD activities were presumed: AR at 14960 ha, D at 730 ha.

11.4 ARTICLE 3.3

11.4.1 INFORMATION THAT DEMONSTRATES THAT ACTIVITIES UNDER ARTICLE 3.3 BEGAN ON OR AFTER 1 JANUARY 1990 AND BEFORE 31 DECEMBER 2012 AND ARE DIRECT HUMAN-INDUCED

As it was described in Chapter 11.2.1, a steady revision of the data in forest land area has been performed in year 2011 in order to demonstrate that the activities under art. 3.3 began on or after 1st January 1990 (results are given in Table 237). The results from the net change in the forest area since 1992 is provided in the table below. As this data represents the increase in forests by districts since 1992, data for the years 1990-1991 has been extrapolated (Table 246).

On basis of these statistics and derived areas, the annual AR and D areas were estimated according to the equations (1) and (2). These estimates were based on means for certain periods of similar years to achieve more robust results.

$$AR_x = FL_x - FL_{x-1} + D_{WLx} + D_{SMx} \ (1)$$

$$D_x = D_{WLx} + D_{SMx} \ (2)$$

where,

AR – AR area

X - year

FL – forest area

D – D area

D_{WL} – D area for wetlands

D_{SM} – D area for settlements

Table 245 Net area change in Forest land since 1992 due to afforestation and regrowth, ha

District	afforestation	regrowth	Total
Vidin	620	12 183.40	12 803.40
Montana	2 401.5	4 262.3	6 663.8
Vrats	1 624.0	4 826.4	6 450.4
Pleven	2 213.6	8 466.4	10 680.0
Lovech	4 151.8	8 085.0	12 236.8
Gabrovo	43.9	12 629.7	12 673.6
Veliko Tarnovo	2 262.8	12 931.6	15 194.4
Rousse	3 564.9	1 708.8	5 273.7
Targovishte	1 568.7	3 651.2	5 219.9
Shumen	1 512.9	3 666.1	5 179.0
Razgrad	2 010.2	662.1	2 672.3
Silistra	2 003.9	1 253.5	3 257.4

District	afforestation	regrowth	Total
Dobrich	5 438.2	1 167.1	6 605.3
Varna	1 742.0	2 354.2	4 096.2
Burgas	1 755.6	7 320.4	9 076.0
Yambol	877.6	585	1 462.6
Sliven	689.2	2 375.9	3 065.1
Stara Zagora	1 846.6	2 950.3	4 796.9
Haskovo	3 266.5	8 331.0	11 597.5
Kardjali	1 380.6	1 432.5	2 813.1
Smolyan	730.1	8 799.8	9 529.9
Plovdiv	2 797.8	7 531.3	10 329.1
Pazardjik	1 638.7	1 702.1	3 340.8
Blagoevgrad	4 559.4	6 612.3	11 171.7
Kyustendil	932.4	7 921.3	8 853.7
Pernik	5 345.8	3 406.0	8 751.8
Sofia	3 501.5	9 294.0	12 795.5
Total	**60 480.2**	**146 109.7**	**206 589.9**

Table 246 AR estimates

Years	AR	FLx - FLx-1	Planted or seeded (kha)	Regrowth (kha)	Dx
1992-2010	213.097	206.589	60.479	146.110	6.508
1991	7.167	7.145	3.482	3.663	0.022
1990	7.167	7.145	3.482	3.663	0.022
Total	**227.430**	**220.879**			**6.552**

The AR areas (that result after adding the D areas to the observed net increases in forest area) were assumed to stem mainly from cropland and grassland. As It can be observed in Table 246, 30% of the LUC to forest land is based on planting and seeding activites on non-forest lands such as agricultural land, meadows and grassland, which is considered as a direct human-induced. The rest 70% of the LUC into forest land is a result mainly of re-growth. This is defined as human induced promotion, as the re-growth in this case is a result of the abandonment of the agricultural land, which in fact leads to a direct human induced seeding from the adjacent forests and (re-)growth of managed forests (all forests in Bulgaria are managed and reported as such).The changes are reported during the forest inventory. Those new forest areas are included in the FMPs, which by itself is evidence that the AR areas are direct-human induced.

As regards Deforestation activities, Forest Act (both the old and the new one) 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**.

More details are given below.

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%.

All changes of designation of forest are registered in Executive Forest Agency for each year for the period 2000-2009. 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 for each year (2000-2010) was used as data source for D reporting. For the period before 2000 on basis of the information about previous forest area (1990-2000) and the increase in the settlements and wetlands areas for the same period it was assumed the same share of deforestation activities was occurred before 2000. Thus the D activities for the years before 2000 were derived from the information on D activities for 2000-2009.

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 defense 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 defense or the security of the country;

2. when the change of the designation is connected with the fulfillment 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 National Forest Inventory is used.

According to the Law 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 p 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 (15/CMP.1 (par.8.b) "Deforestation" is the direct human-induced conversion of forested land to non-forested land.) 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 managements plans, projects or programs. According to this, all activities like felling are planned and described in detail. All felling activities are carried out under the Regulation for felling where are describe the type of felling and the conditions for carrying them 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 situations of such areas allowed (obligations for replanting etc., see above). 2) Deforestation areas that followed all needed administrative steps 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 cuttings they are only done in the cases described down here and always 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.

The Regulation describes the ways of transforming coppice into high stem stands. This transformation is not done with the means of the clear cuttings, but thinings and fulfilling the requirements of the tree coverage and thus reported as Forest.

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 REVEGETATION, 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 247 Key category analysis

Category	Net CO_2	Abs	%	sum
Annual Cropland converted to Forestlandstland	-917.235	917.235	54%	53.90%
Other land converted to Forestland	-362.310	362.310	21%	75.20%
Grassland converted to Forestland	-165.113	165.113	10%	84.90%
Perennial Cropland converted to Forestland	51.408	51.408	3%	87.92%
Forest land converted to wetland	124.278	124.278	7%	95.23%
Forest land converted to settlements	81.251	81.251	5%	100%
Settlement converted to Forestland	NO	0.000	0%	100%
Wetland converted to Forestland	NO	0.000	0%	100%
Forest land converted to grassland	IE,NO	0.000	0%	100%
Forest land converted to other land	IE,NO	0.000	0%	100%
Forestland converted to annual cropland	IE,NO	0.000	0%	100%
Forestland converted to perennial cropland	IE,NO	0.000	0%	100%
Total emissions/removals		1701.596		

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 2010 is submitted (SEF_BG_2012_1_9-1-46 5-1-2012.xls). The SEF has been generated with the SEF application version 1.2, provided by the secretariat at 15 of January 2011.

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 2011;

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 2011;

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 2011;

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.

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 Registry's website:

http://bg-server1.etr.moew.government.bg/

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 Annex XVI of the EU Registry Regulation No 916/2007/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://nfp-bg.eionet.eu.int/bul/About/RR/R_TE/registry/index.html

Joint implementation (JI) projects' publicly accessible information:

http://bg-server1.etr.moew.government.bg/iaos/projects.php

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 name and contact information: the full name, mailing address, telephone number, facsimile number and e-mail address of the representative of the account holder. According to Annex XVI of the EU Registry Regulation No 916/2007/EC this information is published unless the registry administrator allows account holders to request keeping all or some of this information confidential and the account holder requested the registry administrator in writing not to display all or some of this information.

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 916/2007/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 916/2007/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 916/2007/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 916/2007/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)[40].

Bulgaria calculated the Commitment Period Reserve (CPR) **307 135 300** t CO_2 eq in accordance with a Decision 11/CMP.1 Annex Paragraph 6:
90% of the assigned amount (AAU) or fife 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 (2010)	**307 135 275,8** tonnes CO_2-eq

12.6 KP-LULUCF ACCOUNTING

In Table 248 data on accounting for the KP-LULUCF activities based on the reporting for the year 2010 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 248 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	Net emissions/removals(1)				Accounting Parameters (7)	Accounting Quantity (8)
	2008	2009	2010	Total(6)		
A. Article 3.3 activities						
A.1. Afforestation and Reforestation						-3 693,53
A.1.1. Units of land not harvested since the beginning of the commitment period(2)	-1 077,56	-1 222,72	-1 393,25	-3 693,53		-3 693,53
A.1.2. Units of land harvested since the beginning of the commitment period(2)						NO

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

Bulgaria	NO	NO	NO	NO		NO
A.2. Deforestation	289,34	159,41	205,53	654,28		654,28
B. Article 3.4 activities						
B.1. Forest Management (if elected)	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)	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00
B.3. Grazing Land Management (if elected)	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00
B.4. Revegetation (if elected)	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.

13 INFORMATION ON CHANGES IN NATIONAL SYSTEM

There are no changes in National System for the reported period.

14 INFORMATION ON CHANGES IN NATIONAL REGISTRY

According to article 7 of the Kyoto Protocol each party included in Annex 1 Bulgaria shall incorporate in its annual GHG inventory the necessary supplementary information for the purposes of ensuring compliance with article 3 of the Kyoto Protocol and decision 15/CMP.1 (Paragraph 22).

Paragraph 22 of the annex to decision 15/CMP.1 requires Annex I Parties to include in its NIR information on any changes that have occurred in its national registry, compared with information reported in its last submission, including information submitted in accordance with paragraph 32 of the annex to decision 15/CMP.1.

Parties may wish to provide this information here in summary form using tables and complemented with a general discussion. The Party may wish to explore the use of internal document cross-referencing to refer a reader to annex 6 of the NIR that contains more detailed information on the change(s) to a national registry and any other additional and detailed information submitted by the Party in support of this requirement.

National Focal Points of Parties may wish to consider obtaining from the national registry system administrator guidance documentation on the SIAR and SEF in order to ensure that its annual submission includes all information required by paragraph §22 of the annex to decision 15/CMP.1. These guidance documents include in table format explicit reporting requirements and correspondence to decision text (13/CMP.1; 15/CMP.1).

In the following description of the changes in the Bulgarian National Registry since the previous submission in October 2010 is presented.

Registry administrator

No changes to the Registry administrator of the national registry occurred during the reported period except the additional administrator.

The registry administrator designated by Bulgaria to maintain the national registry is:

Executive Environment Agency

Address: 136 Tzar Boris III Blvd., P.O. Box 251, 1618 Sofia, Bulgaria

Tel.:+359 2 9559011, Fax: +359 2 9559015, E-mail: registry@ eaa.government.bg

Contact persons:

	Name	E-Mail	Phone / Fax
1	Ms. Sophia Nenova	snenova@eea.government.bg	Tel.: +359 2 940 64 Fax +359 2 955 90 38
2	Mr. Aglika Yordanova	registry@eea.government.bg	
3	Mr. George Venkov	gvenkov@kontrax.bg	Tel.: +359 2 9609581
4	Mr. Ivan Dilov	idilov@kontrax.bg	Tel.: +359 2 9609562

Consolidated system with other parties

The name of the other parties with the party cooperates by maintaining their national registries in a consolidated system.

No change of cooperation arrangement occurred during the reported period.

Database structure and capacity

A description of the database structure to be used in the national registry.

No changes to the database or the capacity of the national registry occurred during the reported period.

Conformity with data exchange standards(des)

A description of how the national registry conforms to the technical standards for data exchange between registry systems for the purpose of ensuring the accurate, transparent and efficient exchange of data between national registries, the clean development mechanism registry and the transaction log (decision 19/CP.7, paragraph 1)

No changes concerning conformity with data exchange standards occurred during the reported period.

Minimization of discrepancies

A description of the procedures employed in the national registry to minimize discrepancies in the issuance, transfer, acquisition, cancellation and retirement of ERUs, CERs, tCERs, lCERs, AAUs and/or RMUs, and replacement of tCERs and lCERs, and of the steps taken to terminate transactions where a discrepancy is notified and to correct problems in the event of a failure in terminating the transactions

No changes of discrepancies procedures occurred during the reported period.

Overview of security measures

An overview of security measures employed in the national registry to prevent unauthorized manipulations and to prevent operator error and of how these measures are kept up to date.

Bulgarian registry was closed for operation on 29 June 2010 after the final Decision of the Enforcement Branch of the Compliance Committee to suspend the eligibility of Bulgaria to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol. (CC-2010-1-13/Bulgaria/EB).

The ENFORCEMENT BRANCH OF THE COMPLIANCE COMMITTEE concludes that the information now available is sufficient to conclude that the question of implementation put before the branch has now been resolved. Bulgaria is since 04 February 2011 fully eligible to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol. (CC-2010-1-17/Bulgaria/EB).

On the 30 December 2010 the Council of Ministers of Bulgaria adopted a revised *Ordinance on the functioning of the National registry for accounting of the issuance, holding, transfer, transfer and cancellation of quotas for greenhouse gases.*

In the new Ordinance are included additional requirements for the package of documents, submitted for user registration and when carrying out a transaction. These requirements are as follows:

For carrying-out a transaction the following is necessary:

To transfer allowances from one account to another designated representative should send a request by submitting an application in a form approved by the Executive Director of the ExEA and posted on the website of the ExEA. The application is sent to the registry administrator by email and on paper.
The application should contain:

1. name of the holder of the account, from which the allowances shell be transferred;
2. designation and number of the account, from which the allowances shell be transferred;
3. type and number of allowances to be transferred;
4. name of the holder of the account, to which transfer allowances;
5. designation and account number to which transfer allowances;
6. name of the receiving register;
7. information about the person making the transfer (or authorized agent registry administrator).

When the transfer has to be made by the registry administrator, the application should be signed and sealed by the account holder and by the authorized representatives of the account.

The Executive Environment Agency (ExEA) in its capacity of Administrator of the National Register has undertaken the measures, described below:

The option for voluntary suspension of access to the accounts, i.e. unabeling the user to logon to registered users, is offered to all registered users. In those cases the registry administrator sends by e-mail daily reports for the account balance and transaction history.
The requirement to choose additional authorized representative for each account shell be included in the General Conditions for the use of the registry.
An additional software module has been developed and implemented. The module monitors and records the unauthorized attempts to penetrate the system in order to increase the security level of the registry. These data is submitted to the Security authorities.
The registry administrators undertake active measures to determine such trials by duly blocking the addresses, suspected for malicious access.

List of the information publicly accessible

A list of the information publicly accessible by means of the user interface to the national registry.

According to paragraph 45 to decision 13/CMP, the necessary information is available at the

http://bg-server1.etr.moew.government.bg/iaos/contacts.php

No changes of the information publicly accessible occurred during the reported period.

According to decision 13/CMP, the following information is available at the : website of the registry: **http://bg-server1.etr.moew.government.bg/**

Reports:

Report type

Report date

Compliance status

Operator Holding Account Created

Operator Holding Account Updated

Operator Holding Account Unchanged

Account Details Created

Account Details Updated

Account Details Unchanged

User Details Created

User Details Updated

User Details Unchanged

No changes of the information publicly accessible occurred during the reported period.

According to paragraph 46 to decision 13/CMP,the information following:

Project name a unique name for the project

Project location:The party and town or region in wich the project is located

Years of issuance

All publicly information relating to the project is available at the adress:

http://bg-server1.etr.moew.government.bg/iaos/projects.php

No changes of the information publicly accessible occurred during the reported period.

The registry terms and conditions ,operators guide,forms and guidance for opening the holding accounts are availables at the website of Executive Environment Agency

http://nfp-bg.eionet.eu.int/bul/About/RR/R_TE/registry/index.html

No changes of the information publicly accessible occurred during the reported period.

The Internet address of the interface to its national registry:

http://bg-server1.etr.moew.government.bg/

No change of the registry Internet address occurred during the reporting period.

Disaster recovery

A description of measures taken to safeguard, maintain and recover data in order to ensure the integrity of data storage and the recovery of registry services in the event of a disaster:

No change of data integrity measures occurred during the reporting period.

Results of any test procedures

The results of any test procedures that might be available or developed with the aim of testing the performance, procedures and security measures of the national registry undertaken pursuant to the provisions of decision 19/CP.7 relating to the technical standards for data exchange between registry systems.

In 2010, the Bulgarian registry was performed successful. There were no changes related to test procedures during the reporting period.

15 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 developng countries due to our national climate change policy.

The majority of bulgrian 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 249 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 prices and externalities.	**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), the introduction of the EU ETS and technical inspection (e.g. for cars) etc; The Energy Law in its part on combined heat and power generation introduces the requirements of the related EU directives and the use of instruments such as green certificates and 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 by all electricity produced from high efficient cogeneration, and for district heating companies to buy all utilized waste thermal energy. The Renewable and Alternative Energy and Bio Fuels Law 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

Action	Implementation by the Party
	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 Law on amendment and supplement of the Law on the Corporate Income Tax Act and also in the Law on amendment and supplement of the Personal Income Tax Law, regarding the activities of the newly established fund "Energy efficiency" The ongoing liberalization of energy market is in line with EU policies and directives. The main instrument addressing externalities is the emission trading under the EU ETS.
Removing subsidies associated with the use of environmentally unsound and unsafe technologies.	No subsidies for environmentally unsound and unsafe technologies have been identified.
Cooperating in the technological development of nonenergy uses of fossil fuels and supporting developing country Parties to this end.	Bulgaria doesn't participate in such type of activities.

Action	Implementation by the Party
Cooperating in the development, diffusion, and transfer of less-greenhouse-gas-emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort.	Currently advanced low carbon technology aren't a focus area in Bulgaria. Our research and development is oriented on improving efficiency of currently available technologies. Preliminary survey according suitable geological structures and their potential are envisaged. At the moment, there is no CCS programme in Bulgaria.
Strengthening the capacity of developing country Parties identified in Article 4, paragraphs 8 and 9, of the Convention for improving efficiency in upstream and downstream activities relating to fossil fuels, taking into consideration the need to improve the environmental efficiency of these activities.	Bulgaria doesn't participate in such type of activities.
Assisting developing country Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies.	Currently Bulgaria doesn't participate in such type of activities.

16 OTHER INFORMATIONS

16.1 REFERENCES

1st - National Waste Management Program for the period 1998 to 2002. (adopted by Decision № 254 of the Council of Ministers from 20.04.1999);

Program for the implementation of Directive 199/31/EC on the landfill of waste (march 2003);

National Waste Management Program 2003-2007;

Draft National Strategy –Development of a national strategy for reducing the quantity of municipal biodegradable waste constituents for deposition on landfills sites in Bulgaria;

Annual State of the Environment Report 2007;

Operational Program Environment 2007-2013;

Statistical Yearbook 2008

Sustainable development in the European Union 2009 monitoring report of the EU sustainable development strategy;

Regulation No 2152/2002 /EC on the waste statistics;

AECOM. (2010). Preperation of General Transport Master Plan.

André, M. (2006). Real-world driving cycles for measuring cars pollutant emissions – Part B: Driving cycles according to vehicle power.

Eggleston S., Buendia L., Miwa K., Ngara T. and Tanabe K. (2010). 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2 Energy.

Krzywkowska, G. (2004). Next Stop: Sustainable Transport, A Survey of Public Transport in Six Cities of Central and Eastern Europe. The Regional Environmental Center for Central and Eastern Europe.

MottMacDonald. (2009). General plan for traffic organization on the territory of Sofia Municipality.

MRDPW, M. o. (2010). Priorities for the construction of road infrastructure of Bulgaria to 2020 for roads with national and European significance.

Ntziachristosa L., Melliosa G., Kouridisa C., Papageorgioua T., Theodosopouloua M., Samaras Z., Zierockb K., Kouvaritakisc N., Panosc E., Karkatsoulisc P., Schillingd S., Meréteie T., Aladár Bodore P., Damjanovicf S., Petitf A. (2008). Final Report, European Database of Vehicle Stock for the Calculation and Forecast of Pollutant and Greenhouse Gases Emissions with TREMOVE and COPERT.

Samaras Z., Ntziachristosa L., S. Eggleston, N. Gorißen, D. Hassel, A.-J. Hickman, R. Joumard, R.Rijkeboer, L. White and K.-H. Zierock (2000). COPERT III Computer programme to calculate emissions from road transport, Methodology and emission factors (Version 2.1).

United Nations, Framework Convention on Climate Change, (2004). Estimation of emissions from road transport, Methodological issues, Issues relating to greenhouse gas inventories.

Vestreng V., Ntziachristos L., Semb A., Tarrasón L., Reis S., S. A. Isaksen I. (2009). European road transport emission trends linked to policy developments.

Kioutsioukisa I., Kouridisa C., Gkatzofliasa D., Dilarab P., Ntziachristosc L. (2010). Uncertainty and Sensitivity Analysis of National Road Transport Inventories Compiled with COPERT 4.

IPCC Guidelines

Revised 1996 IPCC Guidelines;
2006 IPCC Guidelines;
IPCC- Good Practice Guidance;
EMEP/EEA air pollutant emission inventory guidebook – 2009
Farm animal breeds in Bulgaria ISBN 13: 978-954-91309-7-3
Agrarian report 2010
Agrostatistics bulletins №154, №152 & №159

Legal Documents

Law to limit the harmful impact of waste on the environment (SG№/86 from 30.09.1997);
Directive 1999/31/EC on the landfill of waste of 26.04.1999;
Waste Management Act (STN№86/30.09.2003,.STN№41/01.06.2010);
Ordinance № 3 on waste classification (SG 44/25.05.2004);
Ordinance No 8 on the conditions and requirements for construction and operation of landfills and other facilities and installations for waste disposal and recovery (SG 83/24.09.2004);
Ordinance № 9 on the order and the formats on which information for waste activities is provided, as for the order for keeping public register of the issued permits, registration documents and of the closed facilities and operations (SG №95/ 26.10.2004);
Ordinance on the order and the way of recovery of sludge from waste water treatment through its use in the agriculture (SG112/23.12.2004);
Ordinance on the requirements for treatment and transportation of waste oils and waste oil product (SG № 90/2005, in force since 01.01.2006);
Law on statistics (*SG 57/25 June 1999)*
Ordinance No 6 on the conditions and requirements for construction and operation of incineration-plants and co-incineration plants (SG 78/07.09.2004)
Ordinance No 7 on the requirements for sites determined for placing of waste treatment facilities (SG 81/17.09.2004)
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
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16.2 REFERENCE-SECTOR WASTE

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Ordinance No 7 on the requirements for sites determined for placing of waste treatment facilities (SG 81/17.09.2004)

16.3 ACRONYMS AND ABBREVIATIONS

AMD – Air Monitoring Department

ARR - Annual review report

BGNIS – Bulgarian National Inventory System

CAA – Clean Air Act`

CRF – Common Reporting Format

EIU – Emission Inventory Unit

EPA – Environmental Protection Act

ETPD – Emission Trading Permit Department

ERT - Expert Review Team

ExEA – Executive Environment Agency

GHGs - Greenhouse gases

IIR – Informative Inventory Report

IPPCD – Integrated Pollution Prevention and Control Department

LMBPAD – Land Monitoring Biodiversity and Protected Areas

MAF – Ministry of Agriculture and Food

MEE – Ministry of Economy and Energy

MI/RCD – Ministry of Interior/Road Control Department

MTITC - Ministry of Transport, Information Technologies and Communications

MoEW – Ministry of Environment and Waters

NIR – National Inventory Report

NSI – National Statistical Institute

QA/QC – Quality Assurance and Quality Control

QMS – Quality Management System

EFA – Executive Forestry Agency

TCCCA – Transparency, Consistency, Comparability, Completeness, Accuracy

WD – Waste Department

UNFCCC - United Nations Framework Convention on Climate Change

UNECE/CLRTAP - Convention on Long-range Transboundary Air Pollution

ETS (EU ETS)- European Union emissions trading scheme

E-PRTR - European Pollutant Release and Transfer Register

NSI-National Statistic Institute

BACI- Bulgarian Association of Cement Industry

CKD- cement kiln dust

ISO 9001 and 14 001 standards, EMAS.

EAF- electric arc furnaces

BOF- basic oxygen furnace

AOD-Argon-Oxygen-Decarburisation

VOD-Vacuum-Oxygen-Decarburi-sation

WSA- World Steel Association

OHF- Open Hearth Furnaces

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 CO2-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: CO2, CH4, N2O, HFC, PFC and SF6. 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 252 and Table 254 present results from the Level Assessment of the key category analysis excluding LULUCF

Table 249 present results from the Trend Assessment of the key category analysis excluding LULUCF

Table 253 and Table 255 present results from the Level Assessment of the key category analysis including LULUCF

Table 251 presents results from the Trend Assessment of the key category analysis including LULUCF.

Table 250 Key category Analysis T1: Trend assessment excluding LULUCF

Trend assessment excluding LULUCF								
Source	**Gas**	**Fuel/Cat.**	**1988 (BY) Gg CO_2-eq.**	**2010 Gg CO_2-eq.**	**% excl. (2010)**	**Trend**	**Contribution to Trend**	**cumul. %**
1A1a	CO_2	**Solid Fuels**	25 497,3	27 406,5	44,62%	0,517521	35,08%	35,08%
1A2f	CO_2	**Solid Fuels**	9 069,4	495,3	0,81%	0,130791	8,87%	43,95%
1A3b	CO_2	**Diesel Oil**	2 631,3	4 430,1	7,21%	0,107915	7,32%	51,26%
1A1a	CO_2	**Liquid Fuels**	8 155,6	840,0	1,37%	0,104185	7,06%	58,33%
1A2a	CO_2	**Solid Fuels**	3 965,2	111,6	0,18%	0,060754	4,12%	62,45%
6A	CH_4		4 455,0	3 801,6	6,19%	0,056837	3,85%	66,30%
4B8	CH_4		3 908,7	577,5	0,94%	0,043979	2,98%	69,28%
2C1	CO_2		2 700,4	52,2	0,09%	0,042184	2,86%	72,14%
1A2e	CO_2	**Liquid Fuels**	2 731,9	69,9	0,11%	0,042097	2,85%	74,99%
1A1a	CO_2	**Gaseous Fuels**	6 476,1	2 146,7	3,49%	0,032378	2,19%	77,19%
1A4b	CO_2	**Solid Fuels**	3 403,0	758,3	1,23%	0,029594	2,01%	79,20%
2B1	CO_2		3 137,9	735,3	1,20%	0,026062	1,77%	80,96%
2B2	N_2O		1 790,5	267,5	0,44%	0,020046	1,36%	82,32%
1A2f	CO_2	**Liquid Fuels**	3 122,9	943,1	1,54%	0,018745	1,27%	83,59%
4D1	N_2O		5 553,9	2 110,0	3,43%	0,018616	1,26%	84,85%
4D3	N_2O		3 660,4	1 210,3	1,97%	0,018405	1,25%	86,10%
1A4b	CO_2	**Liquid Fuels**	1 155,6	60,8	0,10%	0,016744	1,14%	87,24%
4A3	CH_4		1 336,2	193,7	0,32%	0,015163	1,03%	88,26%
1A4c	CO_2	**Liquid Fuels**	1 639,9	380,8	0,62%	0,013739	0,93%	89,20%
2A2	CO_2		1 103,3	919,6	1,50%	0,013331	0,90%	90,10%
1A2d	CO_2	**Liquid Fuels**	873,2	27,6	0,04%	0,013276	0,90%	91,00%
3	CO_2		866,6	25,7	0,04%	0,013232	0,90%	91,90%
6B	CH_4		2 229,7	700,2	1,14%	0,012472	0,85%	92,74%
2A1	CO_2		2 406,4	805,2	1,31%	0,011774	0,80%	93,54%
2A7	CO_2		737,5	652,0	1,06%	0,010183	0,69%	94,23%
4D2	N_2O		1 168,4	271,6	0,44%	0,009780	0,66%	94,89%
1A3b	CO_2	**Gasoline**	4 364,4	1 805,3	2,94%	0,009618	0,65%	95,55%

Table 251 Key category Analysis T1: Trend assessment including LULUCF

Trend assessment including LULUCF								
Source	Gas	Fuel/Cat.	1988 (BY) Gg CO_2-eq.	2010 Gg CO_2-eq.	% incl. (2010)	Trend	Contribution to Trend	cumul. %
1A1a	CO_2	**Solid Fuels**	25497,3	27 406,5	35,99%	0,352347	27,44%	27,44%
1A2f	CO_2	**Solid Fuels**	9069,4	495,3	0,65%	0,106689	8,31%	35,74%
1A1a	CO_2	**Liquid Fuels**	8155,6	840,0	1,10%	0,086045	6,70%	42,45%
1A3b	CO_2	**Diesel Oil**	2631,3	4 430,1	5,82%	0,076526	5,96%	48,40%
5A1	CO_2		13816,8	9 552,3	12,55%	0,058065	4,52%	52,93%
1A2a	CO_2	**Solid Fuels**	3965,2	111,6	0,15%	0,049276	3,84%	56,76%
4B8	CH_4		3908,7	577,5	0,76%	0,036852	2,87%	59,63%
6A	CH_4		4455,0	3 801,6	4,99%	0,036815	2,87%	62,50%
2C1	CO_2		2700,4	52,2	0,07%	0,034155	2,66%	65,16%
1A2e	CO_2	**Liquid Fuels**	2731,9	69,9	0,09%	0,034127	2,66%	67,82%
1A1a	CO_2	**Gaseous Fuels**	6476,1	2 146,7	2,82%	0,031223	2,43%	70,25%
5B1	CO_2		151,9	1 116,0	1,47%	0,025988	2,02%	72,27%
1A4b	CO_2	**Solid Fuels**	3403,0	758,3	1,00%	0,025676	2,00%	74,27%
2B1	CO_2		3137,9	735,3	0,97%	0,022773	1,77%	76,04%
5A2	CO_2		976,0	1 335,3	1,75%	0,020666	1,61%	77,65%
4D1	N_2O		5553,9	2 110,0	2,77%	0,020033	1,56%	79,21%
4D3	N_2O		3660,4	1 210,3	1,59%	0,017724	1,38%	80,59%
1A2f	CO_2	**Liquid Fuels**	3122,9	943,1	1,24%	0,017364	1,35%	81,95%
2B2	N_2O		1790,5	267,5	0,35%	0,016808	1,31%	83,25%
1A4b	CO_2	**Liquid Fuels**	1155,6	60,8	0,08%	0,013652	1,06%	84,32%
4A3	CH_4		1336,2	193,7	0,25%	0,012693	0,99%	85,31%
5E2	CO_2		74,1	528,2	0,69%	0,012272	0,96%	86,26%
5B2	CO_2		1011,5	1 011,5	1,33%	0,012079	0,94%	87,20%
1A3b	CO_2	**Gasoline**	4364,4	1 805,3	2,37%	0,012050	0,94%	88,14%
1A4c	CO_2	**Liquid Fuels**	1639,9	380,8	0,50%	0,011988	0,93%	89,07%
6B	CH_4		2229,7	700,2	0,92%	0,011726	0,91%	89,99%
2A1	CO_2		2406,4	805,2	1,06%	0,011413	0,89%	90,88%
1A2d	CO_2	**Liquid Fuels**	873,2	27,6	0,04%	0,010776	0,84%	91,71%
3	CO_2		866,6	25,7	0,03%	0,010736	0,84%	92,55%

Trend assessment including LULUCF								
Source	Gas	Fuel/Cat.	1988 (BY) Gg CO_2-eq.	2010 Gg CO_2-eq.	% incl. (2010)	Trend	Contribution to Trend	cumul. %
5C2	CO_2		786,6	786,6	1,03%	0,009394	0,73%	93,28%
2A2	CO_2		1103,3	919,6	1,21%	0,008569	0,67%	93,95%
4D2	N_2O		1168,4	271,6	0,36%	0,008535	0,66%	94,61%
4A1	CH_4		2441,8	962,3	1,26%	0,007939	0,62%	95,23%

Table 252 Key category Analysis T1: Level Assessment excluding LULUCF 1988

Level Assessment excluding LULUCF 1988					
Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% excl.	cumul. %
1A1a	CO_2	Solid Fuels	25 497,3	19,9%	19,9%
1A2f	CO_2	Solid Fuels	9 069,4	7,1%	26,9%
1A1a	CO_2	Liquid Fuels	8 155,6	6,4%	33,3%
1A1a	CO_2	Gaseous Fuels	6 476,1	5,0%	38,3%
4D1	N_2O		5 553,9	4,3%	42,6%
1A5a	CO_2	Gaseous Fuels	4 937,6	3,8%	46,5%
6A	CH_4		4 455,0	3,5%	50,0%
1A3b	CO_2	Gasoline	4 364,4	3,4%	53,4%
1A2a	CO_2	Solid Fuels	3 965,2	3,1%	56,4%
4B8	CH_4		3 908,7	3,0%	59,5%
4D3	N_2O		3 660,4	2,9%	62,3%
1A4b	CO_2	Solid Fuels	3 403,0	2,7%	65,0%
2B1	CO_2		3 137,9	2,4%	67,4%
1A2f	CO_2	Liquid Fuels	3 122,9	2,4%	69,9%
1A5a	CO_2	Liquid Fuels	2 781,7	2,2%	72,0%
1A2e	CO_2	Liquid Fuels	2 731,9	2,1%	74,2%
2C1	CO_2		2 700,4	2,1%	76,3%
1A3b	CO_2	Diesel Oil	2 631,3	2,0%	78,3%
4A1	CH_4		2 441,8	1,9%	80,2%
2A1	CO_2		2 406,4	1,9%	82,1%
6B	CH_4		2 229,7	1,7%	83,8%

Level Assessment excluding LULUCF 1988					
Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% excl.	cumul. %
1A1b	CO_2	Liquid Fuels	1 838,2	1,4%	85,3%
2B2	N_2O		1 790,5	1,4%	86,7%
1B1a	CH_4	natural gas	1 731,5	1,3%	88,0%
1A4c	CO_2	Liquid Fuels	1 639,9	1,3%	89,3%
4B13	N_2O		1 384,1	1,1%	90,4%
4A3	CH_4		1 336,2	1,0%	91,4%
4D2	N_2O		1 168,4	0,9%	92,3%
1A4b	CO_2	Liquid Fuels	1 155,6	0,9%	93,2%
2A2	CO_2		1 103,3	0,9%	94,1%
1B2b	CH_4		1 067,0	0,8%	94,9%
1A2d	CO_2	Liquid Fuels	873,2	0,7%	95,6%

Table 253 Key category Analysis T1: Level Assessment including LULUCF 1988

Level Assessment including LULUCF 1988					
Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% incl.	cumul. %
1A1a	CO_2	Solid Fuels	25 497,3	17,5%	17,5%
5A1	CO_2		13 816,8	9,5%	27,0%
1A2f	CO_2	Solid Fuels	9 069,4	6,2%	33,3%
1A1a	CO_2	Liquid Fuels	8 155,6	5,6%	38,9%
1A1a	CO_2	Gaseous Fuels	6 476,1	4,5%	43,3%
4D1	N_2O		5 553,9	3,8%	47,2%
1A5a	CO_2	Gaseous Fuels	4 937,6	3,4%	50,6%
6A	CH_4		4 455,0	3,1%	53,6%
1A3b	CO_2	Gasoline	4 364,4	3,0%	56,6%
1A2a	CO_2	Solid Fuels	3 965,2	2,7%	59,4%
4B8	CH_4		3 908,7	2,7%	62,0%
4D3	N_2O		3 660,4	2,5%	64,6%
1A4b	CO_2	Solid Fuels	3 403,0	2,3%	66,9%
2B1	CO_2		3 137,9	2,2%	69,1%
1A2f	CO_2	Liquid Fuels	3 122,9	2,1%	71,2%

Level Assessment including LULUCF 1988					
Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% incl.	cumul. %
1A5a	CO_2	Liquid Fuels	2 781,7	1,9%	73,1%
1A2e	CO_2	Liquid Fuels	2 731,9	1,9%	75,0%
2C1	CO_2		2 700,4	1,9%	76,9%
1A3b	CO_2	Diesel Oil	2 631,3	1,8%	78,7%
4A1	CH_4		2 441,8	1,7%	80,3%
2A1	CO_2		2 406,4	1,7%	82,0%
6B	CH_4		2 229,7	1,5%	83,5%
1A1b	CO_2	Liquid Fuels	1 838,2	1,3%	84,8%
2B2	N_2O		1 790,5	1,2%	86,0%
1B1a	CH_4	natural gas	1 731,5	1,2%	87,2%
1A4c	CO_2	Liquid Fuels	1 639,9	1,1%	88,4%
4B13	N_2O		1 384,1	1,0%	89,3%
4A3	CH_4		1 336,2	0,9%	90,2%
4D2	N_2O		1 168,4	0,8%	91,0%
1A4b	CO_2	Liquid Fuels	1 155,6	0,8%	91,8%
2A2	CO_2		1 103,3	0,8%	92,6%
1B2b	CH_4		1 067,0	0,7%	93,3%
5B2	CO_2		1 011,5	0,7%	94,0%
5A2	CO_2		976,0	0,7%	94,7%
1A2d	CO_2	Liquid Fuels	873,2	0,6%	95,3%

Table 254 Key category Analysis T1: Level Assessment excluding LULUCF 2010

Level Assessment excluding LULUCF 2010					
Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% excl.	cumul. %
1A1a	CO_2	Solid Fuels	27 406,5	44,6%	44,6%
1A3b	CO_2	Diesel Oil	4 430,1	7,2%	51,8%
6A	CH_4		3 801,6	6,2%	58,0%
1A1a	CO_2	Gaseous Fuels	2 146,7	3,5%	61,5%
4D1	N_2O		2 110,0	3,4%	64,9%
1A3b	CO_2	Gasoline	1 805,3	2,9%	67,9%

Level Assessment excluding LULUCF 2010					
Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% excl.	cumul. %
4D3	N_2O		1 210,3	2,0%	69,9%
1A3b	CO_2	Liquefied Petroleum Gases (LPG)	1 028,0	1,7%	71,5%
4A1	CH_4		962,3	1,6%	73,1%
1A2f	CO_2	Liquid Fuels	943,1	1,5%	74,6%
2A2	CO_2		919,6	1,5%	76,1%
1A1b	CO_2	Liquid Fuels	877,4	1,4%	77,6%
1A1a	CO_2	Liquid Fuels	840,0	1,4%	78,9%
2A1	CO_2		805,2	1,3%	80,2%
1A4b	CO_2	Solid Fuels	758,3	1,2%	81,5%
1B1a	CH_4	natural gas	742,1	1,2%	82,7%
2B1	CO_2		735,3	1,2%	83,9%
1A2f	CO_2	Gaseous Fuels	700,9	1,1%	85,0%
6B	CH_4		700,2	1,1%	86,2%
2A7	CO_2		652,0	1,1%	87,2%
4B8	CH_4		577,5	0,9%	88,2%
1A2f	CO_2	Solid Fuels	495,3	0,8%	89,0%
1B2b	CH_4		457,1	0,7%	89,7%
4B13	N_2O		445,5	0,7%	90,4%
1A4c	CO_2	Liquid Fuels	380,8	0,6%	91,1%
1A3e	CO_2	Gaseous Fuels	324,1	0,5%	91,6%
1A2c	CO_2	Solid Fuels	313,8	0,5%	92,1%
1A2c	CO_2	Gaseous Fuels	292,8	0,5%	92,6%
4B9	CH_4		287,7	0,5%	93,0%
HFCs	CO_2e		280,9	0,5%	93,5%
4D2	N_2O		271,6	0,4%	93,9%
2B2	N_2O		267,5	0,4%	94,4%
1A2e	CO_2	Gaseous Fuels	242,6	0,4%	94,8%
4A3	CH_4		193,7	0,3%	95,1%

Table 255 Key category Analysis T1: Level Assessment including LULUCF 2010

Level Assessment including LULUCF 2010					
Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% incl.	cumul. %
1A1a	CO_2	Solid Fuels	27 406,5	36,0%	36,0%
5A1	CO_2		9 552,3	12,5%	48,5%
1A3b	CO_2	Diesel Oil	4 430,1	5,8%	54,4%
6A	CH_4		3 801,6	5,0%	59,3%
1A1a	CO_2	Gaseous Fuels	2 146,7	2,8%	62,2%
4D1	N_2O		2 110,0	2,8%	64,9%
1A3b	CO_2	Gasoline	1 805,3	2,4%	67,3%
5A2	CO_2		1 335,3	1,8%	69,1%
4D3	N_2O		1 210,3	1,6%	70,7%
5B1	CO_2		1 116,0	1,5%	72,1%
1A3b	CO_2	Liquefied Petroleum Gases (LPG)	1 028,0	1,4%	73,5%
5B2	CO_2		1 011,5	1,3%	74,8%
4A1	CH_4		962,3	1,3%	76,1%
1A2f	CO_2	Liquid Fuels	943,1	1,2%	77,3%
2A2	CO_2		919,6	1,2%	78,5%
1A1b	CO_2	Liquid Fuels	877,4	1,2%	79,7%
1A1a	CO_2	Liquid Fuels	840,0	1,1%	80,8%
2A1	CO_2		805,2	1,1%	81,8%
5C2	CO_2		786,6	1,0%	82,9%
1A4b	CO_2	Solid Fuels	758,3	1,0%	83,8%
1B1a	CH_4	natural gas	742,1	1,0%	84,8%
2B1	CO_2		735,3	1,0%	85,8%
1A2f	CO_2	Gaseous Fuels	700,9	0,9%	86,7%
6B	CH_4		700,2	0,9%	87,6%
2A7	CO_2		652,0	0,9%	88,5%
4B8	CH_4		577,5	0,8%	89,2%
5E2	CO_2		528,2	0,7%	89,9%
1A2f	CO_2	Solid Fuels	495,3	0,7%	90,6%
1B2b	CH_4		457,1	0,6%	91,2%
4B13	N_2O		445,5	0,6%	91,8%

Level Assessment including LULUCF 2010					
Source	Gas	Fuel/Cat.	GHG emission [Gg CO_2 eq]	% incl.	cumul. %
1A4c	CO_2	Liquid Fuels	380,8	0,5%	92,3%
1A3e	CO_2	Gaseous Fuels	324,1	0,4%	92,7%
1A2c	CO_2	Solid Fuels	313,8	0,4%	93,1%
1A2c	CO_2	Gaseous Fuels	292,8	0,4%	93,5%
4B9	CH_4		287,7	0,4%	93,9%
HFCs	CO_2e		280,9	0,4%	94,2%
4D2	N_2O		271,6	0,4%	94,6%
2B2	N_2O		267,5	0,4%	95,0%
1A2e	CO_2	Gaseous Fuels	242,6	0,3%	95,3%

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 256 and Table 258 for 2010, while in Table 257 Table 259 the results, including LULUCF categories, are shown.

Table 256 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	N_2O	0,012	500,009	6,238	0,290	0,290	1
6	6A	Solid Waste Disposal on Land	CH_4	0,039	85,440	3,292	0,153	0,444	2
15	4D1	Direct soil emissions	N_2O	0,013	250,018	3,155	0,147	0,591	3
28		All others	CO_2e	0,045	49,978	2,226	0,104	0,694	4
26	4D2	Pasture, Range and Paddock Manure	N_2O	0,007	250,018	1,658	0,077	0,771	5
1	1A1a	Solid Fuels	CO_2	0,351	2,236	0,784	0,037	0,808	6
7	4B8	Swine	CH_4	0,030	20,100	0,599	0,028	0,836	7
4	1A1a	Liquid Fuels	CO_2	0,071	7,616	0,538	0,025	0,861	8
3	1A3b	Diesel Oil	CO_2	0,073	5,831	0,427	0,020	0,881	9
23	6B	Waste Water Handling	CH_4	0,008	42,426	0,359	0,017	0,897	10
8	2C1	Iron and Steel Production	CO_2	0,029	11,180	0,320	0,015	0,912	11
22	3	Solvent and other product use	CO_2	0,009	31,623	0,284	0,013	0,926	12
9	1A2e	Liquid Fuels	CO_2	0,029	7,616	0,217	0,010	0,936	13
18	4A3	Sheep	CH_4	0,010	20,100	0,207	0,010	0,945	14
2	1A2f	Solid Fuels	CO_2	0,089	2,236	0,198	0,009	0,955	15
12	2B1	Ammonia Production	CO_2	0,018	7,826	0,138	0,006	0,961	17
11	1A4b	Solid Fuels	CO_2	0,020	5,385	0,108	0,005	0,966	17
13	2B2	Nitric Acid Production	N_2O	0,014	7,616	0,103	0,005	0,971	18

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	T*U	Relevant trend assessment excluding LULUCF	Cumulative Percentage	T2
17	1A4b	Liquid Fuels	CO_2	0,011	8,602	0,098	0,005	0,975	19
14	1A2f	Liquid Fuels	CO_2	0,013	7,616	0,097	0,005	0,980	20
5	1A2a	Solid Fuels	CO_2	0,041	2,236	0,092	0,004	0,984	21
19	1A4c	Liquid Fuels	CO_2	0,009	8,602	0,080	0,004	0,988	22
21	1A2d	Liquid Fuels	CO_2	0,009	7,616	0,069	0,003	0,991	23
25	2A7	Other – DeSOx, Glass and Bricks	CO_2	0,007	8,113	0,056	0,003	0,994	24
10	1A1a	Gaseous Fuels	CO_2	0,022	2,236	0,049	0,002	0,996	25
27	1A3b	Gasoline	CO_2	0,007	5,831	0,038	0,002	0,998	26
20	2A2	Lime Production	CO_2	0,009	2,828	0,026	0,001	0,999	27
24	2A1	Cement Production	CO_2	0,008	2,828	0,023	0,001	1,000	28

Table 257 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
17	4D3	Indirect Emissions	N_2O	0,014	500,009	6,901	0,163	0,163	1
5	5A1	Forest Land remaining Forest Land	CO_2	0,045	149,451	6,757	0,160	0,323	2
23	5B2	Land converted to Cropland	CO_2	0,009	415,466	3,908	0,092	0,416	3
16	4D1	Direct soil emissions	N_2O	0,016	250,018	3,900	0,092	0,508	4
12	5B1	Cropland remaining Cropland	CO_2	0,020	184,043	3,724	0,088	0,596	5
30	5C2	Land converted to Grassland	CO_2	0,007	444,813	3,254	0,077	0,673	6
8	6A	Solid Waste Disposal on Land	CH_4	0,029	85,440	2,449	0,058	0,731	7
34		All others	CO_2e	0,048	49,978	2,383	0,056	0,787	8
15	5A2	Land converted to Forest Land	CO_2	0,016	122,520	1,972	0,047	0,834	9
32	4D2	Pasture, Range and Paddock Manure	N_2O	0,007	250,018	1,662	0,039	0,873	10
22	5E2	Land converted to Settlements	CO_2	0,010	75,000	0,717	0,017	0,890	11
1	1A1a	Solid Fuels	CO_2	0,274	2,236	0,614	0,015	0,905	12
7	4B8	Swine	CH_4	0,029	20,100	0,577	0,014	0,919	13
3	1A1a	Liquid Fuels	CO_2	0,067	7,616	0,510	0,012	0,931	14
26	6B	Waste Water Handling	CH_4	0,009	42,426	0,387	0,009	0,940	15
4	1A3b	Diesel Oil	CO_2	0,060	5,831	0,347	0,008	0,948	17
9	2C1	Iron and Steel Production	CO_2	0,027	11,180	0,297	0,007	0,955	17
29	3	Solvent and other product use	CO_2	0,008	31,623	0,264	0,006	0,961	18
10	1A2e	Liquid Fuels	CO_2	0,027	7,616	0,202	0,005	0,966	19
21	4A3	Sheep	CH_4	0,010	20,100	0,199	0,005	0,971	20
2	1A2f	Solid Fuels	CO_2	0,083	2,236	0,186	0,004	0,975	21

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	T*U	Relevant trend assessment including LULUCF	Cumulative Percentage	T2
14	2B1	Ammonia Production	CO_2	0,018	7,826	0,139	0,003	0,978	22
33	4A1	Cattle	CH_4	0,006	20,100	0,124	0,003	0,981	23
13	1A4b	Solid Fuels	CO_2	0,020	5,385	0,108	0,003	0,984	24
18	1A2f	Liquid Fuels	CO_2	0,014	7,616	0,103	0,002	0,986	25
19	2B2	Nitric Acid Production	N_2O	0,013	7,616	0,100	0,002	0,989	26
20	1A4b	Liquid Fuels	CO_2	0,011	8,602	0,091	0,002	0,991	27
6	1A2a	Solid Fuels	CO_2	0,038	2,236	0,086	0,002	0,993	28
25	1A4c	Liquid Fuels	CO_2	0,009	8,602	0,080	0,002	0,995	29
28	1A2d	Liquid Fuels	CO_2	0,008	7,616	0,064	0,002	0,996	30
24	1A3b	Gasoline	CO_2	0,009	5,831	0,055	0,001	0,998	31
11	1A1a	Gaseous Fuels	CO_2	0,024	2,236	0,054	0,001	0,999	32
27	2A1	Cement Production	CO_2	0,009	2,828	0,025	0,001	1,000	33
31	2A2	Lime Production	CO_2	0,007	2,828	0,019	0,000	1,000	34

Table 258 Key category Analysis T2: Level Assessment excluding LULUCF 2010

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	L*U	Level assessment excluding LULUCF	Cumulative Percentage	T2
7	4D3	Indirect Emissions	N_2O	0,020	500,009	9,852	0,271	0,271	1
5	4D1	Direct soil emissions	N_2O	0,034	250,018	8,588	0,236	0,507	2
3	6A	Solid Waste Disposal on Land	CH_4	0,062	85,440	5,288	0,145	0,652	3
35		All others	CO_2e	0,049	49,978	2,458	0,068	0,720	4
16	1B1a	natural gas	CH_4	0,012	200,250	2,419	0,066	0,786	5
24	4B	N2O em. from Manure Management	N_2O	0,007	300,007	2,176	0,060	0,846	6
31	4D2	Pasture, Range and Paddock Manure	N_2O	0,004	250,018	1,105	0,030	0,876	7
1	1A1a	Solid Fuels	CO_2	0,446	2,236	0,998	0,027	0,904	8
19	6B	Waste Water Handling	CH_4	0,011	42,426	0,484	0,013	0,917	9
2	1A3b	Diesel Oil	CO_2	0,072	5,831	0,421	0,012	0,929	10
23	1B2b	Oil and Natural Gas	CH_4	0,007	50,249	0,374	0,010	0,939	11
9	4A1	Cattle	CH_4	0,016	20,100	0,315	0,009	0,947	12
29	4B9	Poultry	CH_4	0,005	50,040	0,234	0,006	0,954	13
30	2F	HFCs	CO_2e	0,005	50,990	0,233	0,006	0,960	14
21	4B8	Swine	CH_4	0,009	20,100	0,189	0,005	0,966	15
6	1A3b	Gasoline	CO_2	0,029	5,831	0,171	0,005	0,970	17
10	1A2f	Liquid Fuels	CO_2	0,015	7,616	0,117	0,003	0,973	17
12	1A1b	Liquid Fuels	CO_2	0,014	7,616	0,109	0,003	0,976	18

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	L*U	Level assessment excluding LULUCF	Cumulative Percentage	T2
13	1A1a	Liquid Fuels	CO_2	0,014	7,616	0,104	0,003	0,979	19
8	1A3b	LPG	CO_2	0,017	5,831	0,098	0,003	0,982	20
17	2B1	Ammonia Production	CO_2	0,012	7,826	0,094	0,003	0,985	21
20	2A7	Other – DeSOx, Glass and Bricks	CO_2	0,011	8,113	0,086	0,002	0,987	22
4	1A1a	Gaseous Fuels	CO_2	0,035	2,236	0,078	0,002	0,989	23
15	1A4b	Solid Fuels	CO_2	0,012	5,385	0,066	0,002	0,991	24
34	4A3	Sheep	CH_4	0,003	20,100	0,063	0,002	0,993	25
25	1A4c	Liquid Fuels	CO_2	0,006	8,602	0,053	0,001	0,994	26
11	2A2	Lime Production	CO_2	0,015	2,828	0,042	0,001	0,995	27
14	2A1	Cement Production	CO_2	0,013	2,828	0,037	0,001	0,996	28
32	2B2	Nitric Acid Production	N_2O	0,004	7,616	0,033	0,001	0,997	29
26	1A3e	Gaseous Fuels	CO_2	0,005	5,099	0,027	0,001	0,998	30
18	1A2f	Gaseous Fuels	CO_2	0,011	2,236	0,026	0,001	0,999	31
22	1A2f	Solid Fuels	CO_2	0,008	2,236	0,018	0,000	0,999	32
27	1A2c	Solid Fuels	CO_2	0,005	2,236	0,011	0,000	0,999	33
28	1A2c	Gaseous Fuels	CO_2	0,005	2,236	0,011	0,000	1,000	34
33	1A2e	Gaseous Fuels	CO_2	0,004	2,236	0,009	0,000	1,000	35

Table 259 Key category Analysis T2: Level Assessment including LULUCF 2010

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	L*U	Level assessment including LULUCF	Cumulative Percentage	T2
2	5A1	Forest Land remaining Forest Land	CO_2	0,125	149,451	18,749	0,293	0,293	1
9	4D3	Indirect Emissions	N_2O	0,016	500,009	7,948	0,124	0,418	2
6	4D1	Direct soil emissions	N_2O	0,028	250,018	6,928	0,108	0,526	3
12	5B2	Land converted to Cropland	CO_2	0,013	415,466	5,519	0,086	0,612	4
19	5C2	Land converted to Grassland	CO_2	0,010	444,813	4,595	0,072	0,684	5
4	6A	Solid Waste Disposal on Land	CH_4	0,050	85,440	4,266	0,067	0,751	6
10	5B1	Cropland remaining Cropland	CO_2	0,015	184,043	2,697	0,042	0,793	7
40		All others	CO_2e	0,047	49,978	2,364	0,037	0,830	8
8	5A2	Land converted to Forest Land	CO_2	0,018	122,520	2,149	0,034	0,864	9
21	1B1a	natural gas	CH_4	0,010	200,250	1,952	0,031	0,894	10
30	4B	N2O em. from Manure Management	N_2O	0,006	300,007	1,755	0,027	0,922	11
37	4D2	Pasture, Range and Paddock Manure	N_2O	0,004	250,018	0,892	0,014	0,936	12
1	1A1a	Solid Fuels	CO_2	0,360	2,236	0,805	0,013	0,948	13
27	5E2	Land converted to Settlements	CO_2	0,007	75,000	0,520	0,008	0,957	14

T1	Source	Fuel/Cat.	GHG	Share	Uncertainty	L*U	Level assessment including LULUCF	Cumulative Percentage	T2
24	6B	Waste Water Handling	CH_4	0,009	42,426	0,390	0,006	0,963	15
3	1A3b	Diesel Oil	CO_2	0,058	5,831	0,339	0,005	0,968	17
29	1B2b	Oil and Natural Gas	CH_4	0,006	50,249	0,302	0,005	0,973	17
13	4A1	Cattle	CH_4	0,013	20,100	0,254	0,004	0,977	18
35	4B9	Poultry	CH_4	0,004	50,040	0,189	0,003	0,980	19
36	2F	HFCs	CO_2e	0,004	50,990	0,188	0,003	0,983	20
26	4B8	Swine	CH_4	0,008	20,100	0,152	0,002	0,985	21
7	1A3b	Gasoline	CO_2	0,024	5,831	0,138	0,002	0,987	22
14	1A2f	Liquid Fuels	CO_2	0,012	7,616	0,094	0,001	0,989	23
16	1A1b	Liquid Fuels	CO_2	0,012	7,616	0,088	0,001	0,990	24
17	1A1a	Liquid Fuels	CO_2	0,011	7,616	0,084	0,001	0,991	25
11	1A3b	LPG	CO_2	0,014	5,831	0,079	0,001	0,993	26
22	2B1	Ammonia Production	CO_2	0,010	7,826	0,076	0,001	0,994	27
25	2A7	Other – DeSOx, Glass and Bricks	CO_2	0,009	8,113	0,069	0,001	0,995	28
5	1A1a	Gaseous Fuels	CO_2	0,028	2,236	0,063	0,001	0,996	29
20	1A4b	Solid Fuels	CO_2	0,010	5,385	0,054	0,001	0,997	30
31	1A4c	Liquid Fuels	CO_2	0,005	8,602	0,043	0,001	0,997	31
15	2A2	Lime Production	CO_2	0,012	2,828	0,034	0,001	0,998	32
18	2A1	Cement Production	CO_2	0,011	2,828	0,030	0,000	0,998	33
38	2B2	Nitric Acid Production	N_2O	0,004	7,616	0,027	0,000	0,999	34
32	1A3e	Gaseous Fuels	CO_2	0,004	5,099	0,022	0,000	0,999	35
23	1A2f	Gaseous Fuels	CO_2	0,009	2,236	0,021	0,000	0,999	36
28	1A2f	Solid Fuels	CO_2	0,007	2,236	0,015	0,000	1,000	37
33	1A2c	Solid Fuels	CO_2	0,004	2,236	0,009	0,000	1,000	38
34	1A2c	Gaseous Fuels	CO_2	0,004	2,236	0,009	0,000	1,000	39
39	1A2e	Gaseous Fuels	CO_2	0,003	2,236	0,007	0,000	1,000	40

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)	1A2a
Coal Liquefaction Plants (Transformation)	

Eurostat Category	CRF Category
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
BKB Plants (Energy)	1A1c
Gas Works (Energy)	
Blast Furnaces (Energy)	1A2a
Petroleum Refineries	
Coal Liquefaction Plants (Energy)	
Non-specified (Energy)	
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

Eurostat Category	CRF Category
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: 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	**Liquid fuels:** 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, 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. The quantities which were considered instead are Coke oven coke used in Blast Furnaces (Transformation) and Iron and Steel industry sector.

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	
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)

Eurostat Category	NCVs
Gas Works (Energy)	
Blast Furnaces (Energy)	Used in blast furnaces (net)
Petroleum Refineries	
Coal Liquefaction Plants (Energy)	
Non-specified (Energy)	
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	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)

Eurostat Category	NCVs
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
Gaseous fuels: Natural Gas	Naphtha White spirit Lubricants Bitumen Paraffin waxes Refinery Feedstocks

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.

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:

Fraction of carbon stored	
Lubricants	0.50
Bitumen	1.00
Coal Oils and Tars from Coking Coal	0.75
Naphtha as Feedstock	0.75
Gas/Diesel Oil as Feedstock	0.50
Natural Gas as Feedstock	0.33
LPG as Feedstock	0.80
Ethane as Feedstock	0.80
Other products	0.80

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 260 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	25 571	-	6 682	25 061	-	17 486
1991	-	24 366	26 444	11 669	6 268	26 380	-	18 367
1992	-	27 215	24 369	11 669	6 813	26 380	-	18 359
1993	-	32 481	23 488	11 776	6 838	31 059	-	18 569
1994	-	31 863	24 933	11 583	6 733	30 019	-	18 680
1995	-	30 148	26 020	11 537	6 584	29 832	-	18 683
1996	-	32 804	24 414	11 643	6 680	29 714	-	18 722
1997	-	32 709	25 207	-	7 014	30 061	-	18 757
1998	-	32 684	25 712	-	7 020	30 141	-	17 917
1999	-	32 659	25 897	-	7 025	30 220	-	17 077
2000	-	33 412	23 283	-	6 762	30 117	-	15 739
2001	-	30 480	24 911	-	7 036	29 969	-	16 082
2002	-	27 457	25 527	-	7 089	30 031	-	16 459
2003	-	29 326	24 673	-	7 106	29 955	-	16 490
2004	24 804	28 610	24 227	-	7 161	27 423	33 356	15 976
2005	24 465	28 638	24 365	-	7 079	27 270	32 070	15 125
2006	24 916	25 122	25 131	-	7 010	29 700	34 540	11 712
2007	23 899	27 973	24 645	-	6 973	28 500	37 700	11 504
2008	22 728	28 610	25 527	-	6 987	28 500	35 862	12 568
2009	25 200	-	25 756	-	7 006	28 500	-	12 212
2010	24 812	-	26 171	-	7 004	28 500	-	12 768

For the sectoral approach were used the NCVs per sector, as indicated in ANNEX 2.

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 Information on changes in national registry.

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 2012 was prepared the first 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.

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 261 Tier 1 Uncertainty Calculation and Reporting (level assessment), Gg CO2-eq.(Excluding LULUCF)

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2009	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		CH_4	15,8	7,5	3	50	50,09	0,006	0,000	0,000	0,000	0,000	0,000
1A1		N_2O	134,1	120,0	3	200	200,02	0,391	0,000	0,001	0,087	0,004	0,087
1A1	Gaseous fuel	CO_2	6476,1	2208,4	1	2	2,24	0,080	-0,007	0,017	-0,014	0,024	0,028
1A1	Liquid fuel	CO_2	9993,9	1717,4	3	7	7,62	0,213	-0,024	0,013	-0,167	0,057	0,176
1A1	Solid fuel	CO_2	25497,3	27410,4	1	2	2,24	0,999	0,118	0,214	0,237	0,302	0,384
1A2	Gaseous fuel	CO_2	0,0	1484,9	1	2	2,24	0,054	0,012	0,012	0,023	0,016	0,028
1A2	Liquid fuel	CO_2	7243,4	1159,8	3	7	7,62	0,144	-0,018	0,009	-0,126	0,038	0,131
1A2	Solid fuel	CO_2	13034,6	1096,4	1	2	2,24	0,040	-0,040	0,009	-0,080	0,012	0,081
1A2		CH_4	31,0	10,5	3	50	50,09	0,009	0,000	0,000	-0,002	0,000	0,002
1A2		N_2O	71,8	17,3	3	200	200,02	0,056	0,000	0,000	-0,027	0,001	0,027
1A3a	Liquid fuel	CO_2	98,0	46,1	5	5	7,07	0,005	0,000	0,000	0,000	0,003	0,003
1A3a	Liquid fuel	CH_4	0,0	0,0	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3a	Liquid fuel	N_2O	0,9	0,4	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3b	Diesel Oil	CO_2	2631,3	4430,1	3	5	5,83	0,421	0,025	0,035	0,124	0,146	0,192
1A3b	Gasoline	CO_2	4364,4	1805,3	3	5	5,83	0,172	-0,002	0,014	-0,011	0,060	0,061
1A3b		CH_4	84,5	16,7	3	40	40,11	0,011	0,000	0,000	-0,007	0,001	0,007
1A3b		N_2O	89,3	73,2	3	40	40,11	0,048	0,000	0,001	0,009	0,002	0,010
1A3b	LPG	CO_2	0,0	1028,0	3	5	5,83	0,098	0,008	0,008	0,040	0,034	0,053
1A3b	Gaseous fuel	CO_2	0,0	154,9	3	5	5,83	0,015	0,001	0,001	0,006	0,005	0,008
1A3c	Liquid fuel	CO_2	0,0	61,758	5	5	7,07	0,007	0,000	0,000	0,002	0,003	0,004

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2009	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.		%	%	%	%	%	%	%	%	%
1A3c	Liquid fuel	CH_4	0,0	0,0	5	60	60,21	0,000	0,000	0,000	0,000	0,000	0,000
1A3c	Liquid fuel	N_2O	0,0	0,0	5	60	60,21	0,000	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	CO_2	0,0	324,1	1	5	5,10	0,027	0,003	0,003	0,013	0,004	0,013
1A3e	Gaseous fuel	CH_4	0,0	0,0	1	50	50,01	0,000	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	N_2O	0,0	0,0	1	150	150,00	0,000	0,000	0,000	0,000	0,000	0,000
1A4		CH_4	283,7	244,7	5	50	50,25	0,200	0,001	0,002	0,042	0,013	0,045
1A4		N_2O	31,6	42,7	5	200	200,06	0,139	0,000	0,000	0,043	0,002	0,043
1A4	Gaseous fuel	CO_2	0,0	354,3	5	2	5,39	0,031	0,003	0,003	0,006	0,020	0,020
1A4	Liquid fuel	CO_2	2795,5	579,8	5	7	8,60	0,081	-0,006	0,005	-0,041	0,032	0,052
1A4	Solid fuel	CO_2	3403,0	791,4	2	5	5,39	0,069	-0,007	0,006	-0,033	0,017	0,037
1A5	Stationary	CO_2	8181,5	0,0	5	7	8,60	0,000	-0,030	0,000	-0,213	0,000	0,213
1B1	Solid Fuels	CH_4	1733,0	742,1	10	200	200,25	2,421	-0,001	0,006	-0,135	0,082	0,158
1B2	Oil and Natural Gas	CH_4	1095,0	466,7	5	50	50,25	0,382	0,000	0,004	-0,022	0,026	0,034
2A1	Cement Production	CO_2	2406,4	805,2	2	2	2,83	0,037	-0,003	0,006	-0,005	0,018	0,019
2A2	Lime Production	CO_2	1103,3	919,6	2	2	2,83	0,042	0,003	0,007	0,006	0,020	0,021
2A3	Limestone and Dolomite Use	CO_2	0,0	0,0	5	15	15,81	0,000	0,000	0,000	0,000	0,000	0,000
2A4	Soda Ash	CO_2	126,6	105,7	2	3	3,61	0,006	0,000	0,001	0,001	0,002	0,003
2A7	Other - Glass	CO_2	186,2	57,1	6	60	60,30	0,056	0,000	0,000	-0,015	0,004	0,015
2A7	Other Bricks	CO_2	551,2	38,3	3	5	5,83	0,004	-0,002	0,000	-0,009	0,001	0,009
2A7	Other - DeSOx	CO_2	0,0	556,7	1,5	2,5	2,92	0,026	0,004	0,004	0,011	0,009	0,014
2B1	Ammonia Production	CO_2	3137,9	735,3	3,5	7	7,83	0,094	-0,006	0,006	-0,042	0,028	0,050
2B2	Nitric Acid Production	N_2O	1790,5	267,5	3	7	7,62	0,033	-0,005	0,002	-0,032	0,009	0,033

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2009	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.		%	%	%	%	%	%	%	%	%
2B4.2	Calcium Carbide	CO_2	89,3	17,8	5	10	11,18	0,003	0,000	0,000	-0,002	0,001	0,002
2B5	Other (please specify)	CH_4	9,1	1,1	5	50	50,25	0,001	0,000	0,000	-0,001	0,000	0,001
2C	Metal Production	CH_4	73,3	0,0	10	25	26,93	0,000	0,000	0,000	-0,007	0,000	0,007
2C1	Iron and Steel Production	CO_2	2700,4	52,2	5	10	11,18	0,010	-0,010	0,000	-0,097	0,003	0,097
2C2	Ferroalloys Production	CO_2	218,8	1,6	5	25	25,50	0,001	-0,001	0,000	-0,020	0,000	0,020
2F	ODS substitutes	HFCs	0,0	280,9	10	50	50,99	0,233	0,002	0,002	0,109	0,031	0,114
2F8	Electrical Equipment	SF_6	3,5	13,1	10	50	50,99	0,011	0,000	0,000	0,004	0,001	0,005
2G	Other	CH_4	7,6	0,0	10	50	50,99	0,000	0,000	0,000	-0,001	0,000	0,001
3	Solvent and other product use	CO_2	866,61	25,74	10	30	31,62	0,013	-0,003	0,000	-0,091	0,003	0,091
3	Solvent and other product use	N_2O	33,2	20,2	10	100	100,50	0,033	0,000	0,000	0,003	0,002	0,004
4A1	Cattle	CH_4	2441,8	962,3	2	20	20,10	0,315	-0,002	0,007	-0,032	0,021	0,038
4A.2	Buffalo	CH_4	29,2	10,1	2	50	50,04	0,008	0,000	0,000	-0,001	0,000	0,002
4A.3	Sheep	CH_4	1336,2	193,7	2	20	20,10	0,063	-0,003	0,002	-0,069	0,004	0,070
4A.4	Goats	CH_4	45,7	37,7	2	50	50,04	0,031	0,000	0,000	0,006	0,001	0,006
4A.6	Horses	CH_4	46,2	53,7	2	50	50,04	0,044	0,000	0,000	0,012	0,001	0,012
4A.7	Mules and Asses	CH_4	74,6	28,5	2	50	50,04	0,023	0,000	0,000	-0,003	0,001	0,003
4A.8	Swine	CH_4	127,3	22,0	2	50	50,04	0,018	0,000	0,000	-0,015	0,000	0,015
4B	N_2O em. from Manure Management	N_2O	1406,0	450,0	2	300	300,01	2,200	-0,002	0,004	-0,519	0,010	0,519
4B1	Cattle	CH_4	89,8	37,2	2	20	20,10	0,012	0,000	0,000	-0,001	0,001	0,001
4B.2	Buffalo	CH_4	4,8	1,7	2	50	50,04	0,001	0,000	0,000	0,000	0,000	0,000
4B.3	Sheep	CH_4	28,1	4,1	2	50	50,04	0,003	0,000	0,000	-0,004	0,000	0,004
4B.4	Goats	CH_4	1,6	1,4	2	50	50,04	0,001	0,000	0,000	0,000	0,000	0,000

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2009	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.		%	%	%	%	%	%	%	%	%
4B.6	Horses	CH_4	5,4	6,3	2	50	50,04	0,005	0,000	0,000	0,001	0,000	0,001
4B.7	Mules and Asses	CH_4	8,5	3,2	2	50	50,04	0,003	0,000	0,000	0,000	0,000	0,000
4B.8	Swine	CH_4	3908,7	577,5	2	20	20,10	0,189	-0,010	0,004	-0,201	0,013	0,202
4B.9	Poultry	CH_4	733,5	287,7	2	50	50,04	0,235	0,000	0,002	-0,025	0,006	0,025
4C	Rice Cultivation	CH_4	114,2	100,6	25	80	83,82	0,137	0,000	0,001	0,029	0,028	0,040
4D1	Direct soil emissions	N_2O	5553,9	2110,0	3	250	250,02	8,595	-0,004	0,016	-1,062	0,070	1,065
4D2	Pasture, Range and Paddock Manure	N_2O	1168,4	271,6	3	250	250,02	1,106	-0,002	0,002	-0,559	0,009	0,559
4D3	Indirect Emissions	N_2O	3660,4	1210,3	3	500	500,01	9,859	-0,004	0,009	-2,103	0,040	2,103
4F	Field Burning	CH_4	34,1	24,3	25	50	55,90	0,022	0,000	0,000	0,003	0,007	0,007
4F	Field Burning	N_2O	14,6	12,1	25	200	201,56	0,040	0,000	0,000	0,008	0,003	0,009
6A	Solid Waste Disposal on Land	CH_4	4455,0	3801,6	30	80	85,44	5,292	0,013	0,030	1,041	1,256	1,632
6B	Waste Water Handling	CH_4	2229,7	700,2	30	30	42,43	0,484	-0,003	0,005	-0,086	0,231	0,247
6B	Waste Water Handling	N_2O	232,7	164,4	30	100	104,40	0,280	0,000	0,001	0,041	0,054	0,068
6C	Waste Incineration	CO_2	19,0	14,2	15	100	101,12	0,023	0,000	0,000	0,004	0,002	0,005
Total			**128363,1**	**61379,0**				**14,60**					**3,05**
%			**99,97**	**99,92**									
National Total			**128399,4**	**61427,1**									

Table 262 Tier 1 Uncertainty Calculation and Reporting (level assessment), Gg CO2-eq.(Including LULUCF)

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2009	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		CH_4	15,8	7,5	3	50	50,09	0,006	0,000	0,000	0,000	0,000	0,000
1A1		N_2O	134,1	120,0	3	200	200,02	0,391	0,000	0,001	0,087	0,004	0,087
1A1	Gaseous fuel	CO_2	6476,1	2208,4	1	2	2,24	0,080	-0,007	0,017	-0,014	0,024	0,028
1A1	Liquid fuel	CO_2	9993,9	1717,4	3	7	7,62	0,213	-0,024	0,013	-0,167	0,057	0,176
1A1	Solid fuel	CO_2	25497,3	27410,4	1	2	2,24	0,999	0,118	0,214	0,237	0,302	0,384
1A2	Gaseous fuel	CO_2	0,0	1484,9	1	2	2,24	0,054	0,012	0,012	0,023	0,016	0,028
1A2	Liquid fuel	CO_2	7243,4	1159,8	3	7	7,62	0,144	-0,018	0,009	-0,126	0,038	0,131
1A2	Solid fuel	CO_2	13034,6	1096,4	1	2	2,24	0,040	-0,040	0,009	-0,080	0,012	0,081
1A2		CH_4	31,0	10,5	3	50	50,09	0,009	0,000	0,000	-0,002	0,000	0,002
1A2		N_2O	71,8	17,3	3	200	200,02	0,056	0,000	0,000	-0,027	0,001	0,027
1A3a	Liquid fuel	CO_2	98,0	46,1	5	5	7,07	0,005	0,000	0,000	0,000	0,003	0,003
1A3a	Liquid fuel	CH_4	0,0	0,0	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3a	Liquid fuel	N_2O	0,9	0,4	5	40	40,31	0,000	0,000	0,000	0,000	0,000	0,000
1A3b	Diesel Oil	CO_2	2631,3	4430,1	3	5	5,83	0,421	0,025	0,035	0,124	0,146	0,192
1A3b	Gasoline	CO_2	4364,4	1805,3	3	5	5,83	0,172	-0,002	0,014	-0,011	0,060	0,061
1A3b		CH_4	84,5	16,7	3	40	40,11	0,011	0,000	0,000	-0,007	0,001	0,007
1A3b		N_2O	89,3	73,2	3	40	40,11	0,048	0,000	0,001	0,009	0,002	0,010
1A3b	LPG	CO_2	0,0	1028,0	3	5	5,83	0,098	0,008	0,008	0,040	0,034	0,053
1A3b	Gaseous fuel	CO_2	0,0	154,9	3	5	5,83	0,015	0,001	0,001	0,006	0,005	0,008
1A3c	Liquid fuel	CO_2	0,0	61,758	5	5	7,07	0,007	0,000	0,000	0,002	0,003	0,004
1A3c	Liquid fuel	CH_4	0,0	0,0	5	60	60,21	0,000	0,000	0,000	0,000	0,000	0,000

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2009	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	N_2O	0,0	0,0	5	60	60,21	0,000	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	CO_2	0,0	324,1	1	5	5,10	0,027	0,003	0,003	0,013	0,004	0,013
1A3e	Gaseous fuel	CH_4	0,0	0,0	1	50	50,01	0,000	0,000	0,000	0,000	0,000	0,000
1A3e	Gaseous fuel	N_2O	0,0	0,0	1	150	150,00	0,000	0,000	0,000	0,000	0,000	0,000
1A4		CH_4	283,7	244,7	5	50	50,25	0,200	0,001	0,002	0,042	0,013	0,045
1A4		N_2O	31,6	42,7	5	200	200,06	0,139	0,000	0,000	0,043	0,002	0,043
1A4	Gaseous fuel	CO_2	0,0	354,3	5	2	5,39	0,031	0,003	0,003	0,006	0,020	0,020
1A4	Liquid fuel	CO_2	2795,5	579,8	5	7	8,60	0,081	-0,006	0,005	-0,041	0,032	0,052
1A4	Solid fuel	CO_2	3403,0	791,4	2	5	5,39	0,069	-0,007	0,006	-0,033	0,017	0,037
1A5	Stationary	CO_2	8181,5	0,0	5	7	8,60	0,000	-0,030	0,000	-0,213	0,000	0,213
1B1	Solid Fuels	CH_4	1733,0	742,1	10	200	200,25	2,421	-0,001	0,006	-0,135	0,082	0,158
1B2	Oil and Natural Gas	CH_4	1095,0	466,7	5	50	50,25	0,382	0,000	0,004	-0,022	0,026	0,034
2A1	Cement Production	CO_2	2406,4	805,2	2	2	2,83	0,037	-0,003	0,006	-0,005	0,018	0,019
2A2	Lime Production	CO_2	1103,3	919,6	2	2	2,83	0,042	0,003	0,007	0,006	0,020	0,021
2A3	Limestone and Dolomite Use	CO_2	0,0	0,0	5	15	15,81	0,000	0,000	0,000	0,000	0,000	0,000
2A4	Soda Ash	CO_2	126,6	105,7	2	3	3,61	0,006	0,000	0,001	0,001	0,002	0,003
2A7	Other - Glass	CO_2	186,2	57,1	6	60	60,30	0,056	0,000	0,000	-0,015	0,004	0,015
2A7	Other Bricks	CO_2	551,2	38,3	3	5	5,83	0,004	-0,002	0,000	-0,009	0,001	0,009
2A7	Other - DeSOx	CO_2	0,0	556,7	1,5	2,5	2,92	0,026	0,004	0,004	0,011	0,009	0,014
2B1	Ammonia Production	CO_2	3137,9	735,3	3,5	7	7,83	0,094	-0,006	0,006	-0,042	0,028	0,050
2B2	Nitric Acid Production	N_2O	1790,5	267,5	3	7	7,62	0,033	-0,005	0,002	-0,032	0,009	0,033
2B4.2	Calcium Carbide	CO_2	89,3	17,8	5	10	11,18	0,003	0,000	0,000	-0,002	0,001	0,002

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2009	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.		%	%	%	%	%	%	%	%	%
2B5	Other (please specify)	CH_4	9,1	1,1	5	50	50,25	0,001	0,000	0,000	-0,001	0,000	0,001
2C	Metal Production	CH_4	73,3	0,0	10	25	26,93	0,000	0,000	0,000	-0,007	0,000	0,007
2C1	Iron and Steel Production	CO_2	2700,4	52,2	5	10	11,18	0,010	-0,010	0,000	-0,097	0,003	0,097
2C2	Ferroalloys Production	CO_2	218,8	1,6	5	25	25,50	0,001	-0,001	0,000	-0,020	0,000	0,020
2F	ODS substitutes	HFCs	0,0	280,9	10	50	50,99	0,233	0,002	0,002	0,109	0,031	0,114
2F8	Electrical Equipment	SF_6	3,5	13,1	10	50	50,99	0,011	0,000	0,000	0,004	0,001	0,005
2G	Other	CH_4	7,6	0,0	10	50	50,99	0,000	0,000	0,000	-0,001	0,000	0,001
3	Solvent and other product use	CO_2	866,61	25,74	10	30	31,62	0,013	-0,003	0,000	-0,091	0,003	0,091
3	Solvent and other product use	N_2O	33,2	20,2	10	100	100,50	0,033	0,000	0,000	0,003	0,002	0,004
4A1	Cattle	CH_4	2441,8	962,3	2	20	20,10	0,315	-0,002	0,007	-0,032	0,021	0,038
4A.2	Buffalo	CH_4	29,2	10,1	2	50	50,04	0,008	0,000	0,000	-0,001	0,000	0,002
4A.3	Sheep	CH_4	1336,2	193,7	2	20	20,10	0,063	-0,003	0,002	-0,069	0,004	0,070
4A.4	Goats	CH_4	45,7	37,7	2	50	50,04	0,031	0,000	0,000	0,006	0,001	0,006
4A.6	Horses	CH_4	46,2	53,7	2	50	50,04	0,044	0,000	0,000	0,012	0,001	0,012
4A.7	Mules and Asses	CH_4	74,6	28,5	2	50	50,04	0,023	0,000	0,000	-0,003	0,001	0,003
4A.8	Swine	CH_4	127,3	22,0	2	50	50,04	0,018	0,000	0,000	-0,015	0,000	0,015
4B	N_2O em. from Manure Management	N_2O	1406,0	450,0	2	300	300,01	2,200	-0,002	0,004	-0,519	0,010	0,519
4B1	Cattle	CH_4	89,8	37,2	2	20	20,10	0,012	0,000	0,000	-0,001	0,001	0,001
4B.2	Buffalo	CH_4	4,8	1,7	2	50	50,04	0,001	0,000	0,000	0,000	0,000	0,000
4B.3	Sheep	CH_4	28,1	4,1	2	50	50,04	0,003	0,000	0,000	-0,004	0,000	0,004
4B.4	Goats	CH_4	1,6	1,4	2	50	50,04	0,001	0,000	0,000	0,000	0,000	0,000
4B.6	Horses	CH_4	5,4	6,3	2	50	50,04	0,005	0,000	0,000	0,001	0,000	0,001

IPCC Source category		GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2009	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.		%	%	%	%	%	%	%	%	%
4B.7	Mules and Asses	CH_4	8,5	3,2	2	50	50,04	0,003	0,000	0,000	0,000	0,000	0,000
4B.8	Swine	CH_4	3908,7	577,5	2	20	20,10	0,189	-0,010	0,004	-0,201	0,013	0,202
4B.9	Poultry	CH_4	733,5	287,7	2	50	50,04	0,235	0,000	0,002	-0,025	0,006	0,025
4C	Rice Cultivation	CH_4	114,2	100,6	25	80	83,82	0,137	0,000	0,001	0,029	0,028	0,040
4D1	Direct soil emissions	N_2O	5553,9	2110,0	3	250	250,02	8,595	-0,004	0,016	-1,062	0,070	1,065
4D2	Pasture, Range and Paddock Manure	N_2O	1168,4	271,6	3	250	250,02	1,106	-0,002	0,002	-0,559	0,009	0,559
4D3	Indirect Emissions	N_2O	3660,4	1210,3	3	500	500,01	9,859	-0,004	0,009	-2,103	0,040	2,103
4F	Field Burning	CH_4	34,1	24,3	25	50	55,90	0,022	0,000	0,000	0,003	0,007	0,007
4F	Field Burning	N_2O	14,6	12,1	25	200	201,56	0,040	0,000	0,000	0,008	0,003	0,009
5A1	Forest Land remaining Forest Land	CO_2	-13815,1	-9528,7	3	149	149,45	-26,998	-0,028	-0,083	-4,123	-0,354	4,138
5A2	Land converted to Forest Land	CO_2	-976,0	-1335,3	10	122	122,52	-3,102	-0,008	-0,012	-0,946	-0,165	0,960
5B1	Cropland remainig Cropland	CO_2	151,9	1116,0	3	184	184,04	3,894	0,009	0,010	1,685	0,041	1,686
5B2	Land converted to Cropland	CO_2	1174,2	1174,2	10	415	415,47	9,248	0,006	0,010	2,298	0,145	2,302
5C2	Land converted to Grassland	CO_2	-786,6	-786,6	10	445	444,81	-6,634	-0,004	-0,007	-1,648	-0,097	1,651
5D2	Land converted to Wetlands	CO_2	0,0	200,9	10	25	26,50	0,101	0,002	0,002	0,043	0,025	0,050
5E2	Land converted to Settlements	CO_2	74,1	528,2	10	74	75,00	0,751	0,004	0,005	0,322	0,065	0,328
6A	Solid Waste Disposal on Land	CH_4	4455,0	3801,6	30	80	85,44	5,292	0,013	0,030	1,041	1,256	1,632
6B	Waste Water Handling	CH_4	2229,7	700,2	30	30	42,43	0,484	-0,003	0,005	-0,086	0,231	0,247
6B	Waste Water Handling	N_2O	232,7	164,4	30	100	104,40	0,280	0,000	0,001	0,041	0,054	0,068
6C	Waste Incineration	CO_2	19,0	14,2	15	100	101,12	0,023	0,000	0,000	0,004	0,002	0,005
Total			**114185,7**	**52747,7**				**34,24**					**6,26**

IPCC Source category	GHG	Base year emissions (1988)	Year 2009 emissions	Activity data (AD) uncertainty	Emission factor (EF) uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2009	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.		%	%	%	%	%	%	%	%	%
%		99,97	99,91									
National Total		114221,9	52795,8									

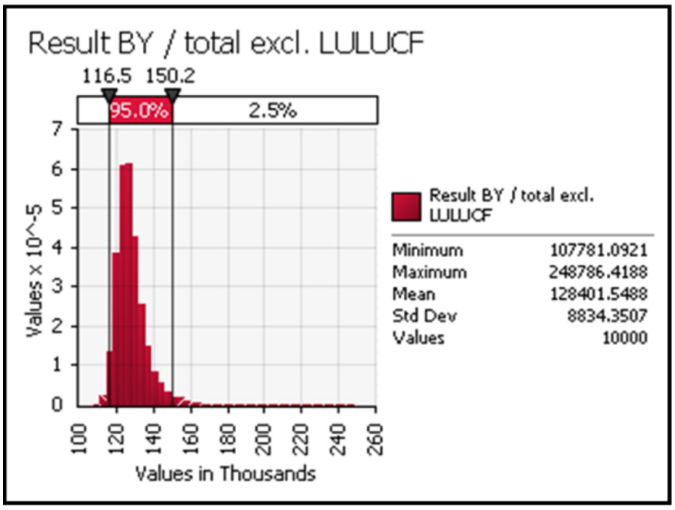
* *Considering LULUCF sector, values for the uncertainty related to activity data and emission factor have been assigned by expert judgment, taking into account the final combined uncertainty.*

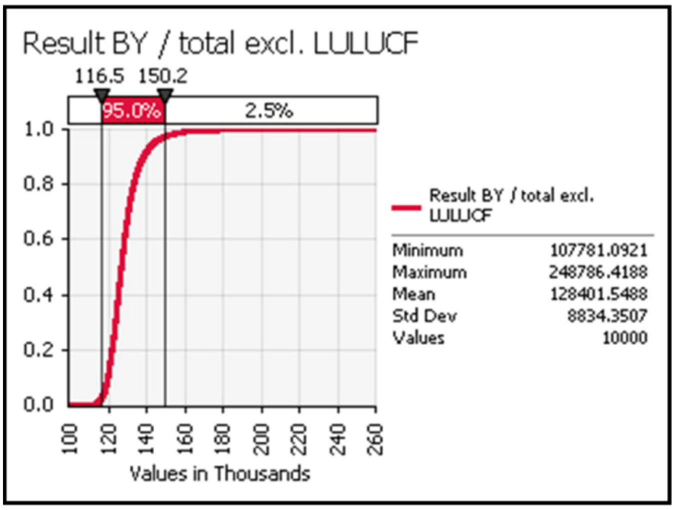
Table 263 Tier 2 Uncertainty assessment

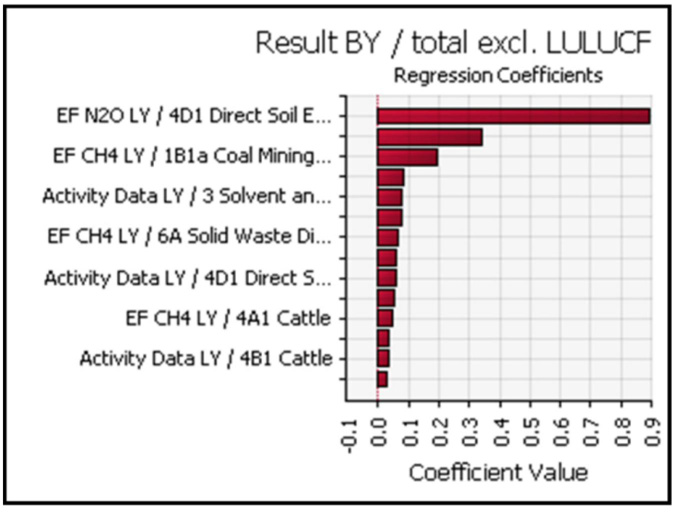
IPCC Source category	Fuel	Gas	Uncertainty in 2010 emissions as % of emissions in the category							Range of likely % change between 2010 and 1988	
			1988 emissions (Gg CO_2 equivalent)	2010 emissions (Gg CO_2 equivalent)	% below (2.5 percentile)	% above (97.5 percentile)	Uncertainty introduced on national total incl. LULUCF in 2010 (%)	Uncertainty introduced on national total excl. LULUCF in 2010 (%)	% change in emissions between 2010 and 1988 (%)	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1A1a	Liquid Fuels	CO_2	8 155,62	840,01	3,3%	3,3%	0,05%	0,05%	-89,7%	2,0%	2,7%
1A1a	Solid Fuels	CO_2	25 497,33	27 406,50	1,7%	1,8%	0,93%	0,80%	7,5%	0,0%	0,0%
1A1a	Gaseous Fuels	CO_2	6 476,06	2 146,69	2,0%	2,0%	0,08%	0,07%	-66,9%	1,7%	1,8%
1A1b	Liquid Fuels	CO_2	1 838,23	877,39	3,3%	3,3%	0,06%	0,05%	-52,3%	16,2%	21,6%
1A2b	Liquid Fuels	CO_2	399,84	100,57	3,3%	3,3%	0,01%	0,01%	-74,8%	5,9%	7,9%
1A2c	Solid Fuels	CO_2	0,00	313,81	1,7%	1,8%	0,01%	0,01%	-	-	-
1A2c	Gaseous Fuels	CO_2	0,00	292,80	2,0%	2,0%	0,01%	0,01%	-	-	-
1A2e	Gaseous Fuels	CO_2	0,00	242,64	2,0%	2,0%	0,01%	0,01%	-	-	-
1A2f	Liquid Fuels	CO_2	3 122,90	943,14	3,3%	3,3%	0,06%	0,05%	-69,8%	7,7%	10,2%
1A2f	Solid Fuels	CO_2	9 069,45	495,32	1,7%	1,8%	0,02%	0,01%	-94,5%	0,0%	0,0%
1A2f	Gaseous Fuels	CO_2	0,00	700,87	2,0%	2,0%	0,03%	0,02%	-	-	-
1A2f	Other Fuels	CO_2	0,00	29,55	20,4%	20,9%	0,01%	0,01%	-	-	-
1A3b	Gasoline	CO_2	4 364,38	1 805,31	3,3%	3,3%	0,11%	0,10%	-58,6%	12,5%	16,6%
1A3b	Diesel Oil	CO_2	2 631,34	4 430,14	3,3%	3,3%	0,28%	0,24%	68,4%	42,3%	56,1%
1A3b	Liquefied Petroleum Gases (LPG)	CO_2	0,00	1 028,00	3,3%	3,3%	0,06%	0,06%	-	-	-
1A3b	Gaseous Fuels	CO_2	0,00	154,85	2,0%	2,0%	0,01%	0,01%	-	-	-
1A3e	Gaseous Fuels	CO_2	0,00	324,07	2,0%	2,0%	0,01%	0,01%	-	-	-
1A4a	Liquid Fuels	CO_2	0,00	138,16	3,3%	3,3%	0,01%	0,01%	-	-	-
1A4a	Gaseous Fuels	CO_2	0,00	184,42	2,0%	2,0%	0,01%	0,01%	-	-	-
1A4b	Solid Fuels	CO_2	3 402,98	758,33	1,7%	1,8%	0,03%	0,02%	-77,7%	0,0%	0,0%
1A4c	Liquid Fuels	CO_2	1 639,94	380,82	3,3%	3,3%	0,02%	0,02%	-76,8%	5,3%	7,1%

2A1	Cement Production	CO_2	2 406,36	805,21	1,4%	1,4%	0,02%	0,02%	-66,5%	0,0%	0,0%
2A2	Lime Production	CO_2	1 103,26	919,57	2,0%	2,0%	0,04%	0,03%	-16,6%	25,7%	27,0%
2A7	Glass	CO_2	186,24	57,11	9,8%	9,9%	0,01%	0,01%	-69,3%	8,9%	11,6%
2A7	$DeSO_x$ installations	CO_2	0,00	556,68	1,1%	1,1%	0,01%	0,01%	-	-	-
2B1	Ammonia Production	CO_2	3 137,88	735,28	1,4%	1,4%	0,02%	0,02%	-76,6%	1,8%	1,9%
3	Solvent and Other Product Use	CO_2	866,61	25,74	100,0%	199,2%	0,08%	0,07%	-97,0%	0,0%	0,0%
1A4b	Solid Fuels	CH_4	226,22	50,45	49,1%	49,1%	0,05%	0,04%	-77,7%	0,0%	0,0%
1A4b	Biomass	CH_4	50,03	187,54	49,2%	49,2%	0,18%	0,15%	274,9%	0,0%	0,0%
1B1a	Coal Mining and Handling	CH_4	1 731,54	742,08	196,5%	196,2%	2,81%	2,42%	-57,1%	0,0%	0,0%
1B2b	Natural Gas	CH_4	1 066,97	457,05	49,2%	49,1%	0,43%	0,37%	-57,2%	0,0%	0,0%
4A1	Cattle	CH_4	2 441,81	962,29	20,0%	20,7%	0,38%	0,32%	-60,6%	0,0%	0,0%
4A3	Sheep	CH_4	1 336,24	193,67	20,0%	20,7%	0,08%	0,07%	-85,5%	0,0%	0,0%
4A4	Goats	CH_4	45,65	37,65	20,0%	20,7%	0,01%	0,01%	-17,5%	0,0%	0,0%
4A6	Horses	CH_4	46,16	53,73	20,0%	20,7%	0,02%	0,02%	16,4%	0,0%	0,0%
4A7	Mules and Asses	CH_4	74,61	28,48	20,0%	20,7%	0,01%	0,01%	-61,8%	0,0%	0,0%
4A8	Swine	CH_4	127,33	21,95	20,0%	20,7%	0,01%	0,01%	-82,8%	0,0%	0,0%
4B1	Cattle	CH_4	89,78	37,24	30,3%	32,0%	0,02%	0,02%	-58,5%	0,0%	0,0%
4B8	Swine	CH_4	3 908,66	577,50	30,3%	32,0%	0,35%	0,30%	-85,2%	0,0%	0,0%
4B9	Poultry	CH_4	733,48	287,72	30,3%	32,0%	0,17%	0,15%	-60,8%	0,0%	0,0%
4C1	Irrigated	CH_4	114,24	100,61	40,7%	71,1%	0,11%	0,10%	-11,9%	0,0%	0,0%
4F	Field Burning of Agricultural Residues	CH_4	34,07	24,31	50,6%	55,6%	0,02%	0,02%	-28,7%	0,0%	0,0%
6A	Solid Waste Disposal on Land	CH_4	4 455,02	3 801,59	30,9%	34,7%	2,42%	2,08%	-14,7%	209,8%	308,7%
6B	Waste-water Handling	CH_4	2 229,73	700,20	43,8%	47,2%	0,62%	0,53%	-68,6%	0,0%	0,0%
1A1a	Solid Fuels	N_2O	106,17	115,95	49,0%	48,9%	0,11%	0,09%	9,2%	0,0%	0,0%
1A3b	Gasoline	N_2O	55,20	14,96	105,8%	106,4%	0,03%	0,03%	-72,9%	44,4%	67,5%
1A3b	Diesel Oil	N_2O	34,09	39,80	49,0%	49,1%	0,04%	0,03%	16,8%	114,4%	151,9%
1A3b	Liquefied Petroleum Gases (LPG)	N_2O	0,00	14,79	49,0%	49,1%	0,01%	0,01%	-	-	-
1A3c	Liquid Fuels	N_2O	0,00	7,87	49,0%	49,1%	0,01%	0,01%	-	-	-
1A4b	Biomass	N_2O	9,85	36,91	49,2%	50,1%	0,04%	0,03%	274,9%	0,0%	0,0%

2B2	Nitric Acid Production	N_2O	1 790,54	267,50	2,2%	2,1%	0,01%	0,01%	-85,1%	1,2%	1,3%
3	Solvent and Other Product Use	N_2O	33,18	20,17	107,2%	264,9%	0,08%	0,07%	-39,2%	0,0%	0,0%
4B13	Solid Storage and Dry Lot	N_2O	1 384,15	445,47	50,3%	100,5%	0,67%	0,58%	-67,8%	0,0%	0,0%
4D1	Direct Soil Emissions	N_2O	5 553,91	2 109,97	70,0%	197,8%	6,11%	5,25%	-62,0%	0,0%	0,0%
4D2	Pasture, Range and Paddock Manure	N_2O	1 168,39	271,56	70,0%	197,8%	0,79%	0,68%	-76,8%	0,0%	0,0%
4D3	Indirect Emissions	N_2O	3 660,43	1 210,31	70,0%	197,8%	3,50%	3,01%	-66,9%	0,0%	0,0%
4F	Field Burning of Agricultural Residues	N_2O	14,62	12,14	50,7%	55,2%	0,01%	0,01%	-16,9%	0,0%	0,0%
5A1	Forest Land remaining Forest Land	N_2O	0,31	4,41	97,2%	96,6%	0,01%		1313,3%	142,9%	398,0%
5B2	Land converted to Cropland	N_2O	162,68	162,68	440,6%	444,7%	1,39%		0,0%	2271,1%	1878,4%
6B	Waste-water Handling	N_2O	232,69	164,43	50,6%	55,5%	0,17%	0,14%	-29,3%	0,0%	0,0%
2F1	Refrigeration and Air Conditioning Equipment	F-gas	0,00	228,31	80,0%	99,9%	0,40%	0,34%	-	-	-
2F2	Foam Blowing	F-gas	0,00	40,11	49,0%	49,0%	0,04%	0,03%	-	-	-
2F4	Aerosols & Metered Dose Inhalers	F-gas	0,00	9,63	50,0%	100,0%	0,01%	0,01%	-	-	-
2F8	Electrical Equipment	F-gas	3,46	13,07	49,3%	51,3%	0,01%	0,01%	277,8%	76,7%	137,7%







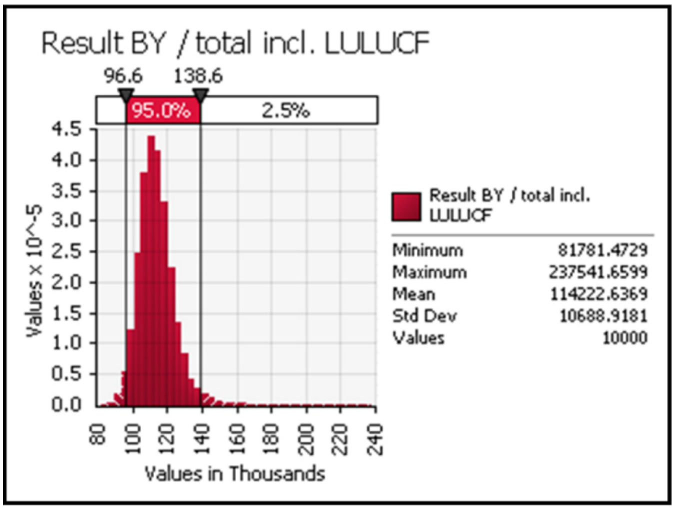
Simulation Summary Information	
Workbook Name	BG_Uncertainties_120410.x
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	138
Number of Outputs	20
Sampling Type	Latin Hypercube
Simulation Start Time	4.11.12 4:13:34
Simulation Duration	00:04:38
Random # Generator	Mersenne Twister
Random Seed	1531735869

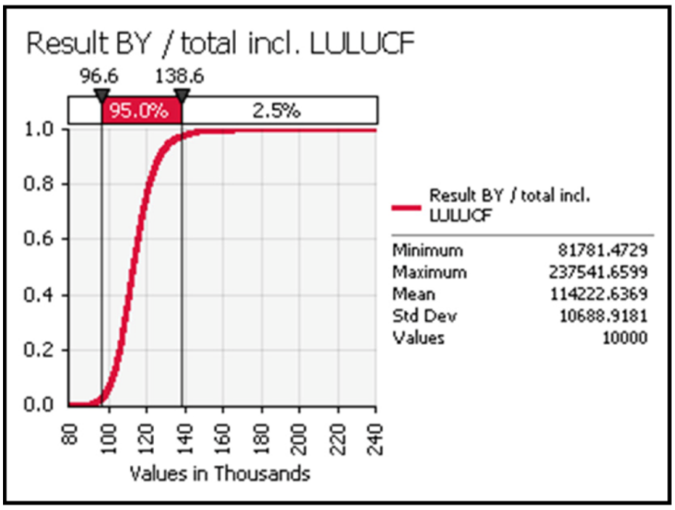
Summary Statistics for Result BY / total e			
Statistics		**Percentile**	
Minimum	107 781	**5%**	118 090
Maximum	248 786	**10%**	119 817
Mean	128 402	**15%**	120 995
Std Dev	8 834	**20%**	122 040
Variance	78045752,19	**25%**	122 975
Skewness	2,411816728	**30%**	123 808
Kurtosis	16,67943183	**35%**	124 558
Median	126 863	**40%**	125 302
Mode	124 616	**45%**	126 077
Left X	116 541	**50%**	126 863
Left P	3%	**55%**	127 665
Right X	150 153	**60%**	128 527
Right P	98%	**65%**	129 487
Diff X	33 612	**70%**	130 532
Diff P	95%	**75%**	131 726
#Errors	0	**80%**	133 309
Filter Min	Off	**85%**	135 328
Filter Max	Off	**90%**	138 316
#Filtered	0	**95%**	143 829

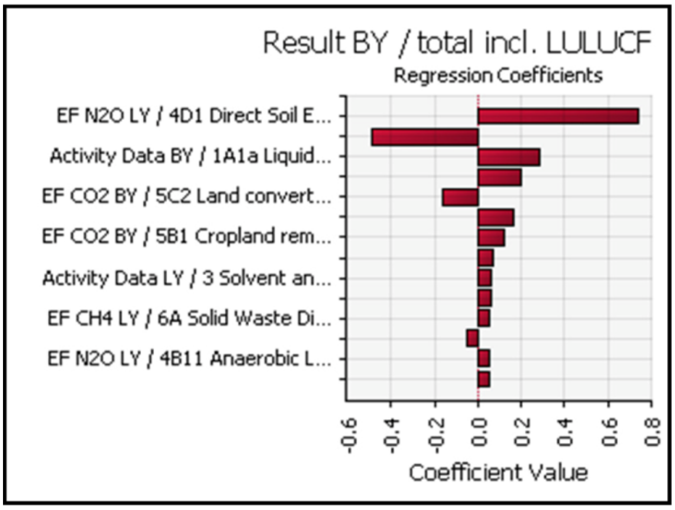
Regression and Rank Information for Res			
Rank	**Name**	**Regr**	**Corr**
1	EF N2O LY / 4D1	0,894	0,765
2	Activity Data BY /	0,341	0,443
3	EF CH4 LY / 1B1a	0,196	0,244
4	EF CH4 LY / 4B1 (	0,082	0,119
5	Activity Data LY /	0,079	0,066
6	Activity Data BY /	0,075	0,085
7	EF CH4 LY / 6A S	0,068	0,099
8	EF N2O LY / 4B11	0,062	0,085
9	Activity Data LY /	0,060	0,069
10	EF CH4 LY / 6B W	0,053	0,077
11	EF CH4 LY / 4A1 (	0,046	0,053
12	EF CO2 LY / 1A1a	0,036	0,043
13	Activity Data LY /	0,035	0,056
14	EF CH4 LY / 1B2b	0,030	0,032

Figure 86 Base year uncertainty, excluding lulucf

Total base year uncertainly excluding LULUCF is 13.8%







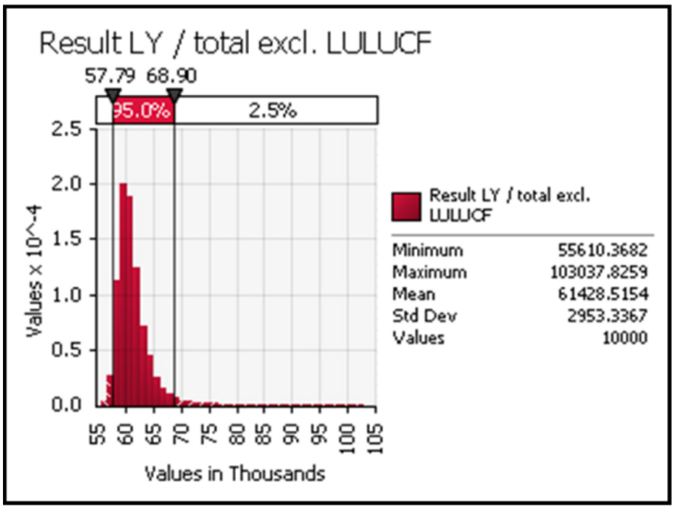
Simulation Summary Information	
Workbook Name	BG_Uncertainties_120410.x
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	138
Number of Outputs	20
Sampling Type	Latin Hypercube
Simulation Start Time	4.11.12 4:13:34
Simulation Duration	00:04:38
Random # Generator	Mersenne Twister
Random Seed	1531735869

Summary Statistics for Result BY / total i			
Statistics		**Percentile**	
Minimum	81 781	**5%**	99 489
Maximum	237 542	**10%**	102 404
Mean	114 223	**15%**	104 353
Std Dev	10 689	**20%**	106 017
Variance	114252969,8	**25%**	107 383
Skewness	1,380070684	**30%**	108 558
Kurtosis	9,623932422	**35%**	109 771
Median	113 111	**40%**	110 923
Mode	114 657	**45%**	112 025
Left X	96 643	**50%**	113 111
Left P	3%	**55%**	114 296
Right X	138 572	**60%**	115 468
Right P	98%	**65%**	116 753
Diff X	41 929	**70%**	118 119
Diff P	95%	**75%**	119 682
#Errors	0	**80%**	121 496
Filter Min	Off	**85%**	123 697
Filter Max	Off	**90%**	126 775
#Filtered	0	**95%**	132 071

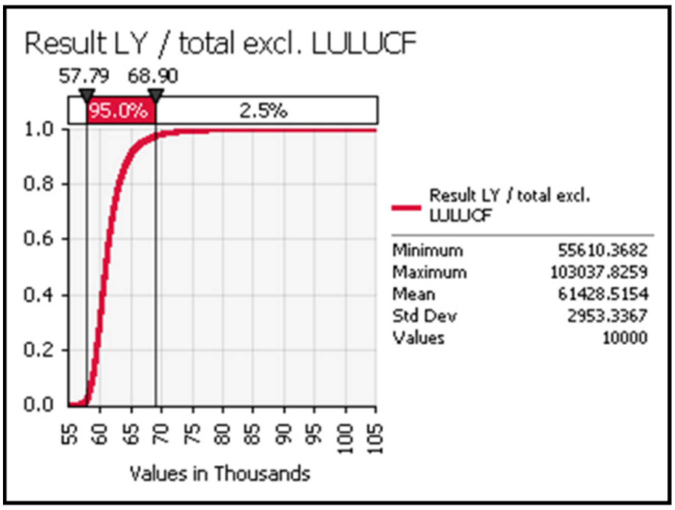
Regression and Rank Information for Res			
Rank	**Name**	**Regr**	**Corr**
1	EF N2O LY / 4D1	0,739	0,572
2	EF CO2 BY / 5A1	-0,488	-0,539
3	Activity Data BY /	0,282	0,317
4	EF CO2 BY / 5B2	0,197	0,223
5	EF CO2 BY / 5C2	-0,164	-0,164
6	EF CH4 LY / 1B1a	0,162	0,168
7	EF CO2 BY / 5B1	0,118	0,125
8	EF CH4 LY / 4B1 (	0,067	0,086
9	Activity Data LY /	0,065	0,041
10	Activity Data BY /	0,062	0,071
11	EF CH4 LY / 6A S	0,056	0,064
12	EF CO2 BY / 5A2	-0,052	-0,055
13	EF N2O LY / 4B11	0,051	0,041
14	Activity Data LY /	0,050	0,056

Figure 87 Base year uncertainty, including lulucf

Total base year uncertainly including LULUCF is 18.7%

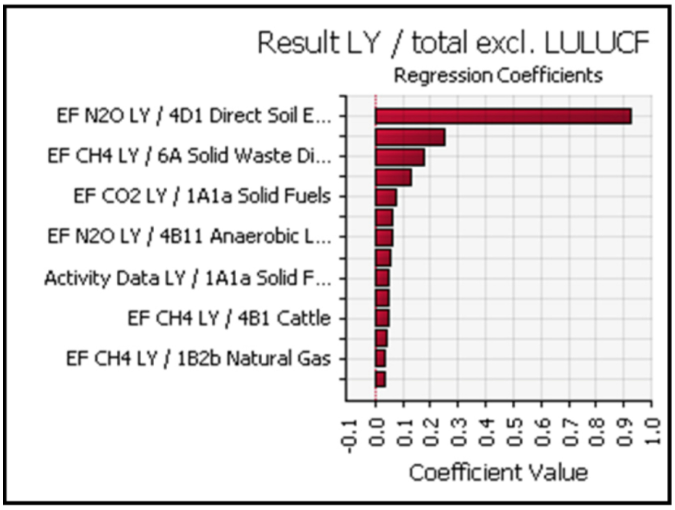


Simulation Summary Information	
Workbook Name	BG_Uncertainties_120410.x
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	138
Number of Outputs	20
Sampling Type	Latin Hypercube
Simulation Start Time	4.11.12 4:13:34
Simulation Duration	00:04:38
Random # Generator	Mersenne Twister
Random Seed	1531735869



Summary Statistics for Result LY / total e

Statistics		Percentile	
Minimum	55 610	**5%**	58 183
Maximum	103 038	**10%**	58 719
Mean	61 429	**15%**	59 064
Std Dev	2 953	**20%**	59 337
Variance	8722197,856	**25%**	59 602
Skewness	2,697022768	**30%**	59 842
Kurtosis	18,90373978	**35%**	60 097
Median	60 820	**40%**	60 323
Mode	60 551	**45%**	60 570
Left X	57 791	**50%**	60 820
Left P	3%	**55%**	61 082
Right X	68 903	**60%**	61 360
Right P	98%	**65%**	61 675
Diff X	11 112	**70%**	62 037
Diff P	95%	**75%**	62 479
#Errors	0	**80%**	62 955
Filter Min	Off	**85%**	63 750
Filter Max	Off	**90%**	64 694
#Filtered	0	**95%**	66 654

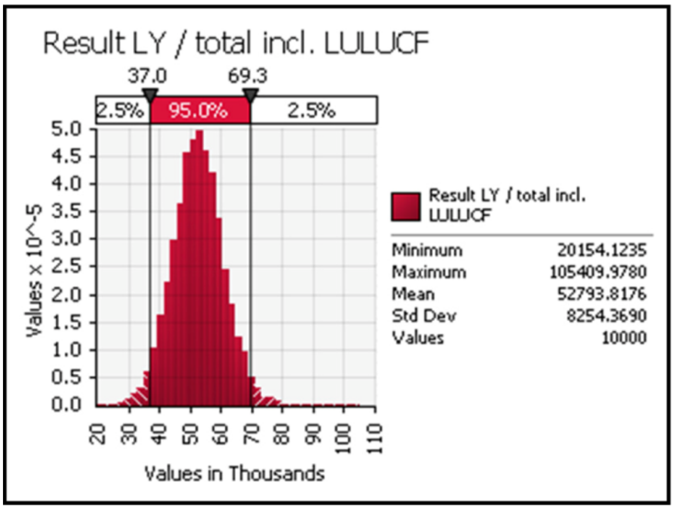


Regression and Rank Information for Res

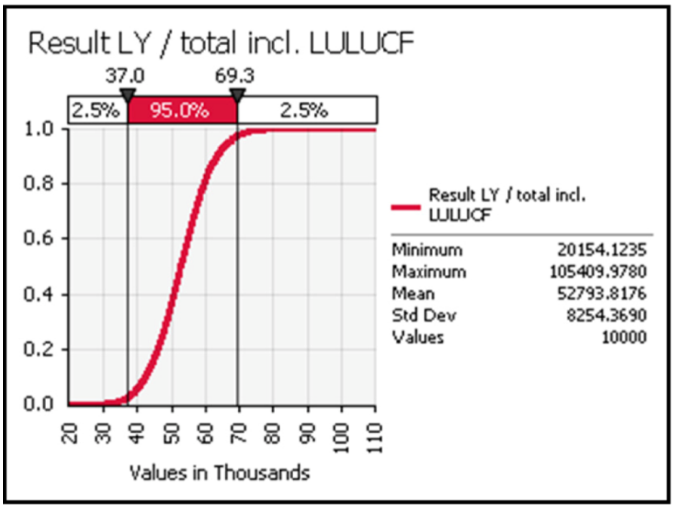
Rank	Name	Regr	Corr
1	EF N2O LY / 4D1	0,925	0,818
2	EF CH4 LY / 1B1a	0,251	0,333
3	EF CH4 LY / 6A S	0,174	0,240
4	Activity Data LY /	0,129	0,162
5	EF CO2 LY / 1A1a	0,074	0,085
6	Activity Data LY /	0,062	0,075
7	EF N2O LY / 4B11	0,060	0,082
8	Activity Data LY /	0,055	0,068
9	Activity Data LY /	0,050	0,065
10	EF CH4 LY / 6B W	0,049	0,079
11	EF CH4 LY / 4B1	0,047	0,078
12	EF CH4 LY / 4A1	0,044	0,053
13	EF CH4 LY / 1B2b	0,038	0,045
14	Activity Data LY /	0,035	0,053

Figure 88 Last year uncertainty, excluding lulucf

Total last year uncertainly excluding LULUCF is 9.6%

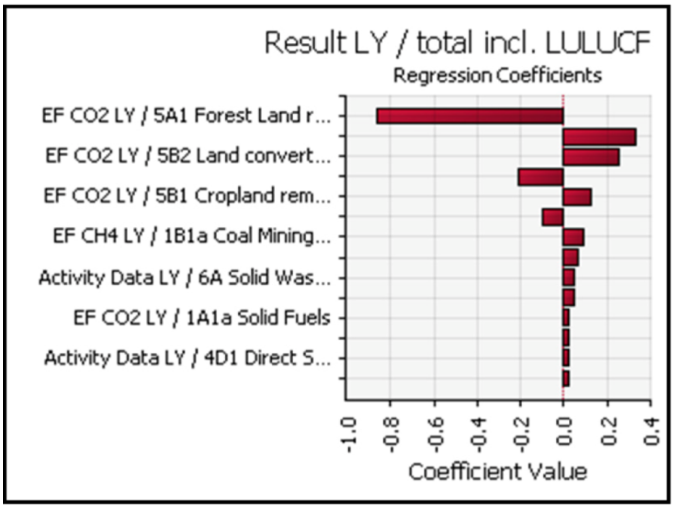


Simulation Summary Information	
Workbook Name	BG_Uncertainties_120410.xl
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	138
Number of Outputs	20
Sampling Type	Latin Hypercube
Simulation Start Time	4.11.12 4:13:34
Simulation Duration	00:04:38
Random # Generator	Mersenne Twister
Random Seed	1531735869



Summary Statistics for Result LY / total i

Statistics		Percentile	
Minimum	20 154	**5%**	39 461
Maximum	105 410	**10%**	42 228
Mean	52 794	**15%**	44 301
Std Dev	8 254	**20%**	45 889
Variance	68134608,28	**25%**	47 313
Skewness	0,147267589	**30%**	48 517
Kurtosis	3,377416104	**35%**	49 582
Median	52 622	**40%**	50 654
Mode	52 176	**45%**	51 686
Left X	36 983	**50%**	52 622
Left P	3%	**55%**	53 700
Right X	69 264	**60%**	54 710
Right P	98%	**65%**	55 816
Diff X	32 281	**70%**	56 958
Diff P	95%	**75%**	58 123
#Errors	0	**80%**	59 487
Filter Min	Off	**85%**	61 042
Filter Max	Off	**90%**	63 332
#Filtered	0	**95%**	66 677



Regression and Rank Information for Res

Rank	Name	Regr	Corr
1	EF CO2 LY / 5A1	-0,863	-0,857
2	EF N2O LY / 4D1	0,331	0,227
3	EF CO2 LY / 5B2	0,255	0,241
4	EF CO2 LY / 5C2	-0,211	-0,193
5	EF CO2 LY / 5B1	0,124	0,126
6	EF CO2 LY / 5A2	-0,099	-0,091
7	EF CH4 LY / 1B1a	0,090	0,085
8	EF CH4 LY / 6A S	0,062	0,048
9	Activity Data LY /	0,046	0,053
10	EF N2O LY / 5B2	0,044	0,044
11	EF CO2 LY / 1A1a	0,026	0,025
12	EF CO2 LY / 5E2	0,023	0,030
13	Activity Data LY /	0,022	0,015
14	EF N2O LY / 4B11	0,021	0,016

Figure 89 Last year uncertainty, including lulucf

Total last year uncertainly including LULUCF is 31.3%

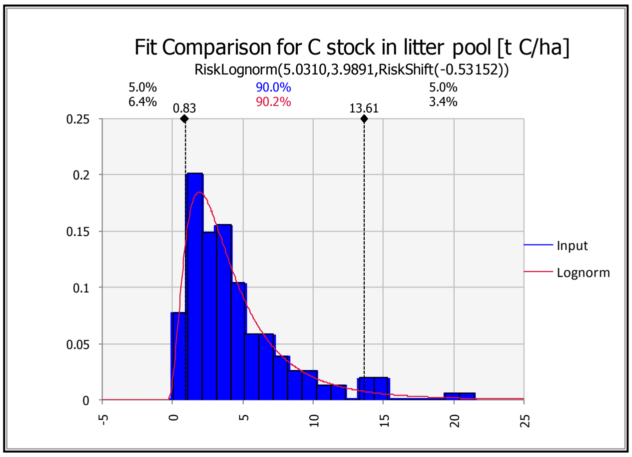
LULUCF Uncertainty assessment (Tier 2)

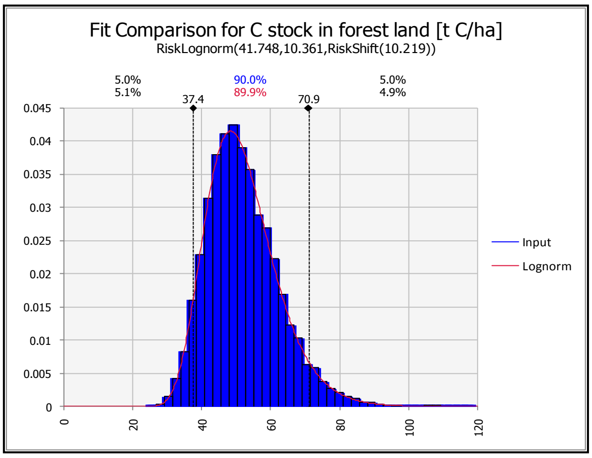
Montecarlo analysis has been carried out for the CO_2 emissions and removals from LULUCF, considering the different reporting pools and the subcategories. The PDF parameters - mean and standard deviation are calculated for all inputs. Normality distribution has been assumed for the most of them. In the case that empirical data were available, the choice of Probability Density Functions was 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, Soil C stock in annual cropland and Soil C stock in grassland. The main criteria to give preference to lognormal are large Coefficient of variation, positive skewness and kurtosis, normality test (Kolmogorov-Smirnov and Shapiro-Wilk) failed and the results from Chi square test for goodness of fit (Table).

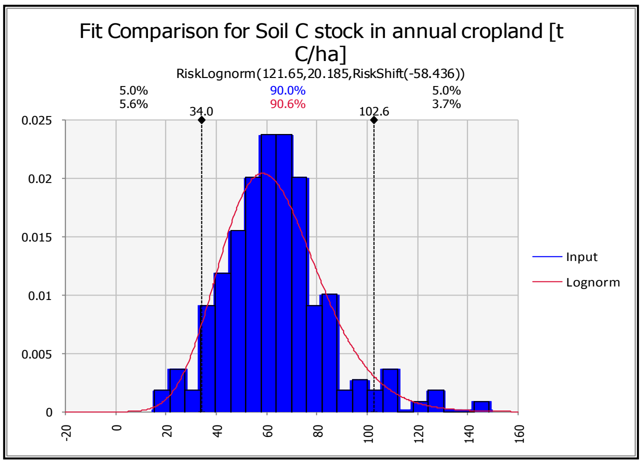
Table 264 Results of statistical analysis of the empirical data of some emission factors

Statistics	CV	Skewness	Kurtosis	Kolmogorov-Smirnov		Shapiro-Wilk	
				K-S	*p*	*W*	*p*
C stock in litter pool	84.8	1.856	4.125	0.175	<0.001	0.823	<0.001
Soil C stock in forestland	20.0	0.803	1.320	0.052	<0.001	--	--
Soil C stock in annuals	32.3	0.771	1.905	0.083	0.004	0.964	<0.001
Soil C stock in grassland	44.3	1.326	2.09	0.105	0.038	0.899	<0.001

Conducted Chi square test for these variables shows that the frequency distributions in the samples are more consistent with lognormal than normal distribution. The follow graphics represent the fitting of empirical distributions to the theoretical model.







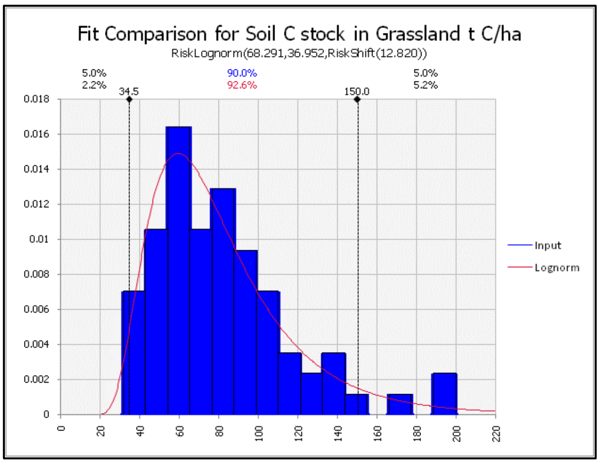


Table 265 Comparison between the uncertainties of the emissions, calculated by means of Tier 1 (Error propagation) and Tier 2 (Monte Carlo analysis)

IPCC Category		Gas	emissions Gg CO_2 eq.	uncertainty Tier 1	uncertainty Tier 2	
5.A. Total Forestland		CO_2	-11085.6	129.3	-139.9	127.7
5.A.1. Forestland remaining forestland		CO_2	-9750.3	146.0	-157.8	144.6
pools	Living biomass	CO_2	-9750.3	146.0	-157.8	144.6
5.A.2 Land converted to Forestland		CO_2	-1335.3	122.5	-111.1	130.4
pools	Living biomass	CO_2	-1589.1	38.5	-58.9	49.6
	Litter	CO_2	-232.0	95.3	-186.3	76.7
	Soil	CO_2	485.8	309.1	-314.0	380.1
5.A.2.1. Cropland converted to Forestland		CO_2	-858.8	154.7	-140.6	165.0
5.A.2.2. Grassland converted to Forestland		CO_2	-151.1	629.0	-494.3	742.8
5.A.2.5. Other land converted to Forestland		CO_2	-325.4	29.7	-32.5	27.4
5.B. Total Cropland		CO_2	2127.5	219.9	-208.0	266.2
5.B.1. Cropland remaining cropland		CO_2	1116.0	184.0	-209.6	204.9
pools	Living biomass	CO_2	-76.9	465.9	-200.7	195.5
	Soil	CO_2	1088.4	384.7	-569.1	464.4
5.B.2. Land converted to cropland		CO_2	1011.5	415.5	-368.1	507.9
pools	Living biomass	CO_2	-76.9	465.9	-476.2	505.6
	Soil	CO_2	1088.4	384.7	-339.6	472.7
5.B.2.2. Grassland converted to cropland		CO_2	1011.5	415.5	-368.1	507.9
5.C. Total Grassland		CO_2	-786.6	444.8	-568.8	422.1
5.C.1. Grassland remaining grassland		CO_2	-	-	-	-
5.C.2. Land converted to grassland		CO_2	-786.6	444.8	-568.8	422.1
pools	Living biomass	CO_2	63.4	460.7	-484.7	450.1
	Soil	CO_2	-850.1	410.2	-515.7	384.7
5.C.2.2. Cropland converted to grassland		CO_2	-786.6	444.8	-568.8	422.1
5.D. Total Wetland		CO_2	200.9	26.5	-23.9	28.9
5.D.1. Wetland remaining wetland		CO_2	-	-	-	-
5.D.2. Land converted to wetlands			200.9	26.5	-23.9	28.9
pools	Living biomass	CO_2	87.0	30.0	-27.5	31.6
	Dead organic matter	CO_2	-4.7	261.6	-327.1	145.2
	Soil	CO_2	118.6	37.8	-30.9	41.4
5.D.2.1. Forestland converted to wetland		CO_2	113.2	28.9	-27.7	30.2
5.D.2.2. Cropland converted to wetland		CO_2	51.2	60.2	-45.8	71.7
5.D.2.3. Grassland converted to wetland		CO_2	36.5	78.1	-54.6	96.1
5.E. Total Settlements		CO_2	528.2	75.0	-	-
5.F. Total Other land		CO_2	-	-	-	-

LULUCF: CO2 Forest Land remaining Forest Land, year 2010

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 266 Statistics of the Monte Carlo analysis for FL remaining FL, 2010

	Coniferous	Deciduous	Total
Trials	10000	10000	10000
Min	-26418	-35224	-40579
Median	-4998	-4308	-9542
Mean	-5276	-4546	-9822
Max	9252	20107	21149
Std. Dev.	3868	6347	7451
uncertainty %	-160.6; 134.8	-288.9; 268.5	**-157.8; 144.6**

The resulting Probability Density Function for whole category is shown in the following figure.

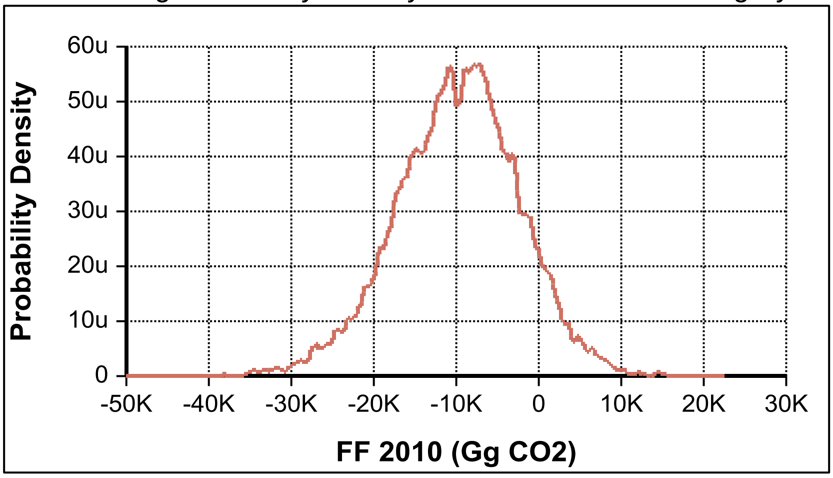


Figure 90 Probability density function resulting from Monte Carlo analysis for the CO2 emissions and removals from Forest Land remaining Forest Land, 2010

LULUCF: CO2 Land converted to Forestland, year 2010

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 267 Statistics of the Monte Carlo analysis for Land converted to Forestland, 2010

	Living biomass	Litter	Soil	Total
Trials	10000	10000	10000	10000
Min	-3624	-3268	-2343	-4184
Median	-1567	-188	421	-1384
Mean	-1589	-231	478	-1335
Max	-293	-17	5307	2618
Std. Dev.	440	165	833	819
uncertainty %	-58.9; 49.6	-186.3; 76.7	-314.0; 380.1	**-111.1; 130.4**

The resulting Probability Density Function for whole category is shown in the following figure.

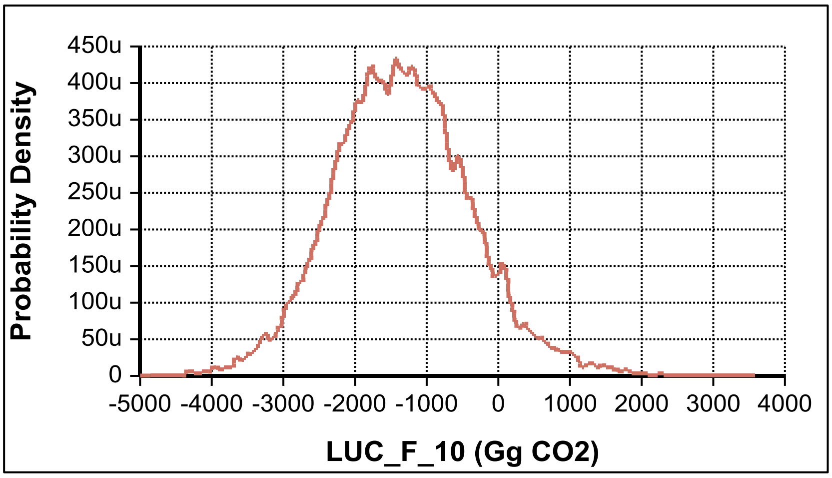


Figure 91 Probability density function resulting from Monte Carlo analysis for the CO2 emissions and removals from Land converted to Forestland, 2010

LULUCF: CO2 Cropland remaining cropland, year 2010

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 268 Statistics of the Monte Carlo analysis for Cropland remaining cropland, 2010

	Living biomass	Soil	Total
Trials	10000	10000	10000
Min	-3028	-621	-3117
Median	1175	-38	1134
Mean	1164	-45	1118
Max	5582	339	5648
Std. Dev.	1165	117	1173
uncertainty %	-200.7; 195.5	-569.1; 464.4	**-209.6; 200.9**

The resulting Probability Density Function for whole category is shown in in the following figure.

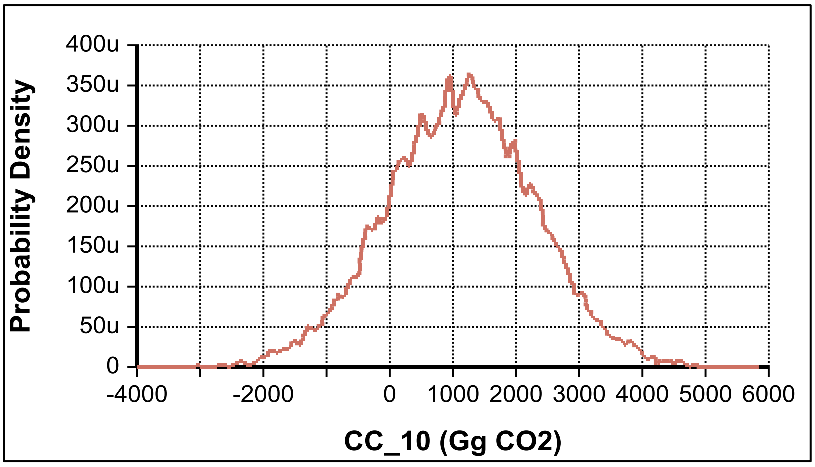


Figure 92 `Probability density function resulting from Monte Carlo analysis for the CO2 emissions and removals from Cropland remaining Cropland, 2010

LULUCF: CO2 Land converted to cropland, year 2010

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 269 Statistics of the Monte Carlo analysis for Land converted to cropland, 2010

	Living biomass	Soil	Total
Trials	10000	10000	10000
Min	-749	-9426	-9692
Median	-82	843	760
Mean	-77	1110	1033
Max	673	17924	17594
Std. Dev.	193	2312	2322
uncertainty %	-477.7; 510.5	-339.6; 472.7	**-368.1; 507.9**

The resulting Probability Density Function for whole category is shown in the following figure

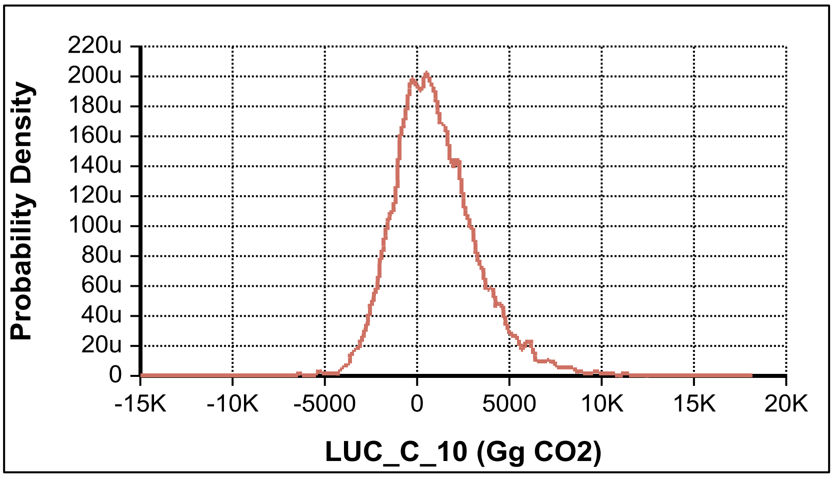


Figure 93 Probability density function resulting from Monte Carlo analysisfor the CO2 emissions and removals from Land converted to cropland, 2010

LULUCF: CO2 Land converted to grassland, year 2010

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 270 Statistics of the Monte Carlo analysis for Land converted to grassland, 2010

	Living biomass	Soil	Total
Trials	10000	10000	10000
Min	-912	-15291	-15209
Median	69	-619	-551
Mean	65	-817	-752
Max	607	6266	6420
Std. Dev.	154	1844	1851
uncertainty %	-487.7; 450.1	-515.7; 384.7	**-568.8; 422.1**

The resulting Probability Density Function for whole category is shown in the following figure

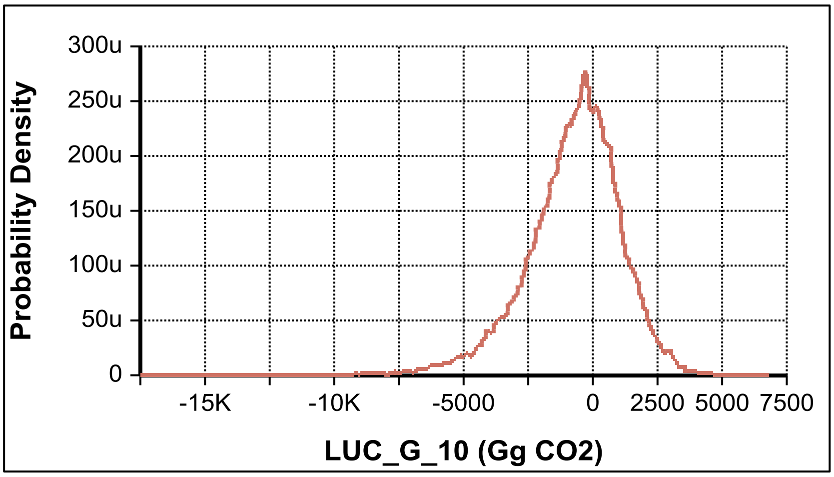


Figure 94 Probability density function resulting from Monte Carlo analysis for the CO2 emissions and removals from Land converted to grassland, 2010

LULUCF: CO2 Land converted to wetland, year 2010

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 271 Statistics of the Monte Carlo analysis for Land converted to Wetland 2010

	Living biomass	Dead organic matter	Soil	Total
Trials	10000	10000	10000	10000
Min	46	-75	62	109
Median	86	-3	116	199
Mean	87	-5	119	201
Max	150	4	242	354
Std. Dev.	13	6	22	27
uncertainty %	-27.5; 31.6	-327.1; 145.2	-30.9; 41.4	**23.9; 28.9**

The resulting Probability Density Function for whole category is shown in the following figure

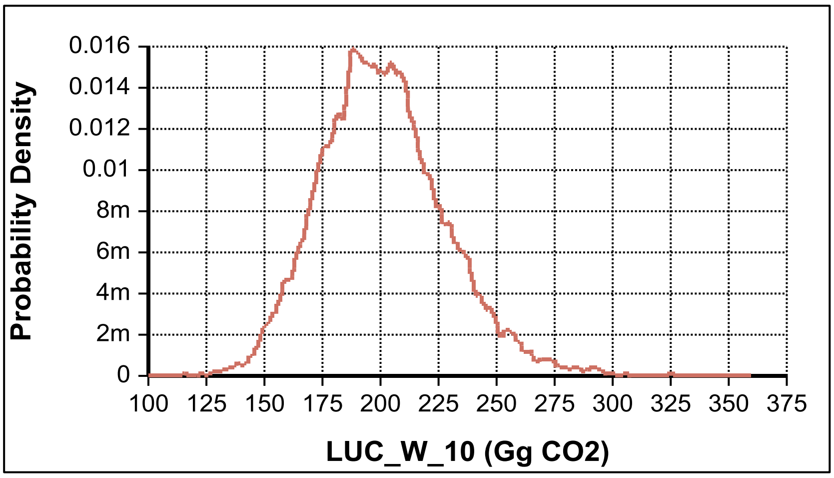


Figure 95 Probability density function resulting from Monte Carlo analysis for the CO2 emissions and removals from Land converted to Wetland, 2010

ANNEX 8 VEHICLE FLEET AND MILEAGE DATA FOR ROAD TRANSPORT

Table 272 Vehicle fleet data for Road transport (number of vehicles) 1988-1998

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gasoline <1,4 l	PRE ECE	0	0	0	0	21342	18075	12777	10537	8303	6682	5400
Gasoline <1,4 l	ECE 15/00-01	0	0	0	0	96940	82209	62087	49854	38910	29808	22540
Gasoline <1,4 l	ECE 15/02	1023092	1053975	1085830	1104395	116231	101485	81978	65165	49795	37205	27066
Gasoline <1,4 l	ECE 15/03	0	0	0	0	215702	205685	188537	163962	136430	107163	82255
Gasoline <1,4 l	ECE 15/04	0	0	0	0	670107	667350	678010	651038	628871	584168	550359
Gasoline <1,4 l	Improved Conventional	0	0	0	0	0	0	0	0	0	0	0
Gasoline <1,4 l	Open Loop	0	0	0	0	0	0	0	0	0	0	0
Gasoline <1,4 l	PC Euro 1 - 91/441/EEC	0	0	0	0	7	89285	159612	246735	322449	321768	319851
Gasoline <1,4 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	63865	136661
Gasoline <1,4 l	PC Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	0	0
Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	0	0
Gasoline <1,4 l	PC Euro 5 - EC 715/2007	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	1767	1434
Gasoline 1,4 - 2,0 l	ECE 15/00-01	0	0	0	0	11805	10477	8583	7100	5725	4388	3363
Gasoline 1,4 - 2,0 l	ECE 15/02	107853	118617	127810	141777	15128	13903	11663	9825	7980	6301	4898
Gasoline 1,4 - 2,0 l	ECE 15/03	0	0	0	0	16625	16981	16823	15855	14775	13494	12153
Gasoline 1,4 - 2,0 l	ECE 15/04	0	0	0	0	117676	121710	135725	140647	142186	136030	134199
Gasoline 1,4 - 2,0 l	Improved Conventional	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
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	0	0	0	0	0	38866	78459	125743	180987	188825	190432
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	41483	104546
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	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
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	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
Gasoline >2,0 l	ECE 15/00-01	0	0	0	0	870	878	806	688	614	533	462
Gasoline >2,0 l	ECE 15/02	3739	4855	5832	7157	1598	1504	1361	1243	1124	988	821
Gasoline >2,0 l	ECE 15/03	0	0	0	0	1469	1553	1692	1646	1603	1443	1349
Gasoline >2,0 l	ECE 15/04	0	0	0	0	5363	6678	9263	11392	12619	12309	12124
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	0	0	0	0	0	2335	4769	7160	10304	12150	13681
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	2204	4965
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	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
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0
Diesel <2,0 l	Conventional	78624	84497	90446	97186	102894	104706	110447	109587	109134	105434	104533

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Diesel <2,0 l	PC Euro 1 - 91/441/EEC	0	0	0	0	0	3989	7450	11684	17467	19350	20758
Diesel <2,0 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	5842	15125
Diesel <2,0 l	PC Euro 3 - 98/69/EC Stage2000	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
Diesel <2,0 l	PC Euro 5 - EC 715/2007	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
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	0	0	0	0	0	461	1092	1763	2896	3604	4123
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	904	2381
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	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
Diesel >2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0
LPG	Conventional	0	0	0	0	0	0	0	0	0	6515	11953
LPG	PC Euro 1 - 91/441/EEC	0	0	0	0	0	0	0	0	0	3613	7294
LPG	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	743	3427
LPG	PC Euro 3 - 98/69/EC Stage2000	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
LPG	PC Euro 5 - EC 715/2007	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
Hybrid Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	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
Hybrid Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	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
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	0	0	0	0	0	0	6845	14799	23040	23369	21477
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	0	0	0	0	0	0	0	0	0	0	9230
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	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
Gasoline <3,5t	LD Euro 5 - 2008 Standards	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
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	0	0	0	0	0	0	8614	21881	34848	48892	51574
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	0	0	0	0	0	0	0	0	0	0	11868
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	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
Diesel <3,5 t	LD Euro 5 - 2008 Standards	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
Rigid <=7,5 t	Conventional	0	0	0	0	28264	29575	29527	28227	26283	24796	22611
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	1517	3704	6154	6517	6586	6929
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	1486	3418	5736
Rigid <=7,5 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0
Rigid <=7,5 t	HD Euro IV - 2005 Standards	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

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Rigid 7,5 - 12 t	Conventional	46061	48166	50372	53581	13237	12864	12072	10908	9777	8796	7624
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	220	488	759	801	821	839
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	208	396	632
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	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
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	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
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	220	488	759	801	821	839
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	208	396	632
Rigid 12 - 14 t	HD Euro III - 2000 Standards	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
Rigid 12 - 14 t	HD Euro V - 2008 Standards	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
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	245	618	1068	1199	1272	1349
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	319	641	1117
Rigid 14 - 20 t	HD Euro III - 2000 Standards	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
Rigid 14 - 20 t	HD Euro V - 2008 Standards	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
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	26	131	309	394	451	510
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	111	245	489
Rigid 20 - 26 t	HD Euro III - 2000 Standards	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
Rigid 20 - 26 t	HD Euro V - 2008 Standards	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
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	26	131	309	394	451	510
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	111	245	489
Rigid 26 - 28 t	HD Euro III - 2000 Standards	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
Rigid 26 - 28 t	HD Euro V - 2008 Standards	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
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	26	131	309	394	451	510
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	111	245	489
Rigid 28 - 32 t	HD Euro III - 2000 Standards	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
Rigid 28 - 32 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0
Rigid >32 t	Conventional	0	0	0	0	127	112	111	117	119	125	110
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	15	56	75	73	72
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	18	26	46
Rigid >32 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Rigid >32 t	HD Euro IV - 2005 Standards	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
Articulated 14 - 20 t	Conventional	46061	48166	50372	53581	16098	15796	14967	13746	12471	11388	10069
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	245	618	1068	1199	1272	1349
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	319	641	1117
Articulated 14 - 20 t	HD Euro III - 2000 Standards	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
Articulated 14 - 20 t	HD Euro V - 2008 Standards	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
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	26	131	309	394	451	510
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	111	245	489
Articulated 20 - 28 t	HD Euro III - 2000 Standards	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
Articulated 20 - 28 t	HD Euro V - 2008 Standards	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
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	26	146	365	469	524	582
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	128	271	531
Articulated 28 - 34 t	HD Euro III - 2000 Standards	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
Articulated 28 - 34 t	HD Euro V - 2008 Standards	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
Articulated 34 - 40 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	15	56	75	73	72
Articulated 34 - 40 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	18	26	46
Articulated 34 - 40 t	HD Euro III - 2000 Standards	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
Articulated 34 - 40 t	HD Euro V - 2008 Standards	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
Articulated 40 - 50 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	15	56	75	73	72
Articulated 40 - 50 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	18	26	46
Articulated 40 - 50 t	HD Euro III - 2000 Standards	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
Articulated 40 - 50 t	HD Euro V - 2008 Standards	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
Articulated 50 - 60 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	0	15	56	75	73	72
Articulated 50 - 60 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	18	26	46
Articulated 50 - 60 t	HD Euro III - 2000 Standards	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
Articulated 50 - 60 t	HD Euro V - 2008 Standards	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
Urban CNG Buses	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Urban CNG Buses	HD Euro III - 2000 Standards	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
Urban Biodiesel Buses	Conventional	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
Urban Biodiesel Buses	HD Euro II - 91/542/EEC Stage II	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
Urban Biodiesel Buses	HD Euro IV - 2005 Standards	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
Urban Buses Midi <=15 t	Conventional	1257	1241	1251	2341	7367	7216	6978	6737	6338	5682	5112
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	181	388	414	439	442	445
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	186	612	1051
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	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
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	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
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
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
Urban Buses Standard 15 - 18 t	HD Euro III - 2000 Standards	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
Urban Buses Standard 15 - 18 t	HD Euro V - 2008 Standards	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
Urban Buses Articulated >18 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	181	388	414	439	442	445
Urban Buses Articulated >18 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	186	612	1051
Urban Buses Articulated >18 t	HD Euro III - 2000 Standards	0	0	0	0	0	0	0	0	0	0	0
Urban Buses Articulated >18 t	HD Euro IV - 2005 Standards	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
Coaches Standard <=18 t	Conventional	14137	14585	15005	14269	7492	8061	8222	8210	7961	7571	7375
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	483	1034	1573	1809	1905	2084
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	203	629	1372
Coaches Standard <=18 t	HD Euro III - 2000 Standards	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
Coaches Standard <=18 t	HD Euro V - 2008 Standards	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
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	0	0	0	0	0	483	1034	1573	1809	1905	2084
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	0	0	0	0	0	0	0	0	203	629	1372
Coaches Articulated >18 t	HD Euro III - 2000 Standards	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
Coaches Articulated >18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0
<50 cm³	Conventional	276901	279077	281270	282137	282792	283963	284571	285901	286760	288690	281749
<50 cm³	Mop - Euro I	0	0	0	0	0	0	0	0	0	0	0

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
<50 cm³	Mop - Euro II	0	0	0	0	0	0	0	0	0	0	0
<50 cm³	Mop - Euro III	0	0	0	0	0	0	0	0	0	0	0
2-stroke >50 cm³	Conventional	0	0	0	0	54550	51343	46722	41942	37859	31901	26601
2-stroke >50 cm³	Mot - Euro I	0	0	0	0	0	0	0	0	0	0	0
2-stroke >50 cm³	Mot - Euro II	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
4-stroke <250 cm³	Conventional	0	0	0	0	116162	112243	107120	102374	97655	93737	87942
4-stroke <250 cm³	Mot - Euro I	0	0	0	0	0	0	0	0	0	0	0
4-stroke <250 cm³	Mot - Euro II	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
4-stroke 250 - 750 cm³	Conventional	217360	221416	225533	226853	44237	52042	60696	68527	73770	79784	84026
4-stroke 250 - 750 cm³	Mot - Euro I	0	0	0	0	0	0	0	0	0	0	0
4-stroke 250 - 750 cm³	Mot - Euro II	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
4-stroke >750 cm³	Conventional	0	0	0	0	13386	15007	17848	20521	25665	30838	35384
4-stroke >750 cm³	Mot - Euro I	0	0	0	0	0	0	0	0	0	0	0
4-stroke >750 cm³	Mot - Euro II	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

Table 273 Vehicle fleet data for Road transport (number of vehicles) 1999-2010

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gasoline <1,4 l	PRE ECE	4286	3591	3148	2677	2558	2339	2429	1613	1918	2194	2327	1945
Gasoline <1,4 l	ECE 15/00-01	16213	12117	9512	7456	6287	5603	4535	2743	3087	3405	3460	2704
Gasoline <1,4 l	ECE 15/02	18220	12620	9131	6629	5250	4130	2706	1494	1587	1697	1642	1203
Gasoline <1,4 l	ECE 15/03	57316	39906	28521	20325	14998	10859	5987	2881	2622	2478	2266	1417
Gasoline <1,4 l	ECE 15/04	499598	445275	393819	334912	281904	220788	169251	82036	69111	56632	42911	25759
Gasoline <1,4 l	Improved Conventional	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline <1,4 l	Open Loop	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline <1,4 l	PC Euro 1 - 91/441/EEC	322059	325798	330529	334291	339200	338008	324877	199396	206049	200198	174301	130363
Gasoline <1,4 l	PC Euro 2 - 94/12/EEC	230060	311501	332842	339153	349854	356265	358053	239995	268220	289735	290099	234631
Gasoline <1,4 l	PC Euro 3 - 98/69/EC Stage2000	0	0	51137	108503	169179	232883	237936	157726	177817	193527	198029	159817
Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	52450	70752	121003	180973	229261	319159
Gasoline <1,4 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	52063
Gasoline 1,4 - 2,0 l	PRE ECE	1196	1046	933	778	758	685	801	585	727	833	856	765
Gasoline 1,4 - 2,0 l	ECE 15/00-01	2430	1777	1396	1091	881	798	694	454	569	587	622	514
Gasoline 1,4 - 2,0 l	ECE 15/02	3452	2427	1757	1280	999	748	537	337	387	449	461	375
Gasoline 1,4 - 2,0 l	ECE 15/03	10505	8722	6804	5185	3889	2846	1964	989	930	916	823	542
Gasoline 1,4 - 2,0 l	ECE 15/04	132337	130006	126506	119942	111937	97614	82213	43095	38353	32660	25431	16289
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	194195	197892	200458	202283	202776	201616	193604	119662	125035	123215	109646	82684
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	170520	224224	244132	252002	261281	266599	269242	176475	197446	212159	210587	168923
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	0	0	26490	54781	83000	108163	112330	75916	87196	95872	98626	81125
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	24511	34612	64567	103616	135185	203256
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	24330
Gasoline >2,0 l	PRE ECE	227	230	242	211	219	229	305	229	308	372	468	429
Gasoline >2,0 l	ECE 15/00-01	360	303	272	223	194	201	221	150	196	238	269	239
Gasoline >2,0 l	ECE 15/02	605	494	396	289	229	194	206	133	151	228	275	235
Gasoline >2,0 l	ECE 15/03	1169	1021	880	699	549	431	331	194	212	332	403	328
Gasoline >2,0 l	ECE 15/04	12101	11839	11539	10994	10004	8673	7378	3939	3650	3459	2873	1928
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	14370	14844	15032	15048	15040	14676	13902	8664	8820	8657	7801	5804
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	9275	12916	14462	15086	15672	16008	16112	10831	12198	13245	13009	10631
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	0	0	2322	4151	6016	8192	9706	6940	8487	9696	10126	8865
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	1328	2102	4287	6966	9326	15326
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	1318
Diesel <2,0 l	Conventional	102298	99524	97670	95145	93398	87789	79063	45729	44806	41624	35216	24648
Diesel <2,0 l	PC Euro 1 - 91/441/EEC	22188	23041	24104	24935	25971	27085	27586	19028	21060	22047	20977	16951
Diesel <2,0 l	PC Euro 2 - 94/12/EEC	28567	41099	47629	57070	70788	81202	88061	65205	75126	83052	87156	73686
Diesel <2,0 l	PC Euro 3 - 98/69/EC Stage2000	0	0	15304	50243	103211	181861	206600	161431	204048	234271	247298	226039
Diesel <2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	51816	70772	130164	204960	277539	400196

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Diesel <2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	0
Diesel >2,0 l	Conventional	9296	8909	8735	8484	8140	7994	7612	6814	7134	7121	6563	5680
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	4532	4805	5039	5262	5466	5726	5975	7423	8279	8646	8393	8575
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	4477	6639	8039	9560	11711	13611	15357	15473	18845	21312	22589	22317
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	0	0	2188	6184	12763	24106	31143	27321	36976	44507	48410	48351
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	6493	12862	27943	46495	62121	115160
Diesel >2,0 l	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	6429
LPG	Conventional	15981	18955	21143	22024	22243	20694	18409	10383	9001	7428	6001	3460
LPG	PC Euro 1 - 91/441/EEC	11157	15205	19407	23696	28117	32209	35057	24155	24710	23167	20576	13852
LPG	PC Euro 2 - 94/12/EEC	8618	15490	21021	26042	31640	37124	42368	31495	34739	35938	36230	26216
LPG	PC Euro 3 - 98/69/EC Stage2000	0	0	2842	7193	13033	20294	23704	17732	19883	20866	21637	15812
LPG	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	5155	7921	13802	20340	26362	34036
LPG	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	0	0	4919
2-Stroke	Conventional	785	532	352	252	186	141	84	55	67	83	95	80
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	19178	15938	9385	7688	6340	4955	5852	2150	1736	1510	1197	562
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	20347	19345	16585	15819	15052	13882	15079	4989	4426	4039	3370	1597
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	20136	28040	27929	27988	27775	27081	28740	6257	6737	6660	6340	2793
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	0	0	4891	9826	13291	15322	18653	7746	7920	7841	7681	4247
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	1238	2828	4899	6095	8656
Gasoline <3,5t	LD Euro 5 - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	1595
Diesel <3,5 t	Conventional	60219	55114	48668	44853	41364	37078	36252	21224	19773	18131	15855	9598
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	49593	47750	44046	42724	41869	40397	43270	25565	24590	23377	21534	13300
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	27807	40460	38727	39087	39982	40408	45523	27308	27978	28564	28286	18266
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	0	0	2793	8392	16821	25614	93720	58245	61460	65279	68575	45584
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	16689	38753	64264	82506	115579
Diesel <3,5 t	LD Euro 5 - 2008 Standards	0	0	0	0	0	0	0	0	0	0	0	21503
Gasoline >3,5 t	Conventional	1100	993	4494	3619	3021	2295	318	217	183	177	124	81
Rigid <=7,5 t	Conventional	19457	17453	14555	12444	10352	7974	6078	4507	4261	4094	3829	2568
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	6922	6803	5772	5054	4352	3544	2993	2364	2268	2248	2083	1460
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	8006	10230	9013	8283	7612	6792	6600	5016	5018	4936	4972	3437
Rigid <=7,5 t	HD Euro III - 2000 Standards	0	0	7617	18680	30875	45429	4629	3670	3669	3677	3685	2607
Rigid <=7,5 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	461	1063	1868	1959	2815
Rigid <=7,5 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	478	1189
Rigid 7,5 - 12 t	Conventional	6619	5755	4057	3445	2933	2470	2062	1516	1356	1226	1112	714
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	833	813	1391	1371	1292	1200	498	404	398	395	373	267
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	910	1252	2412	2501	2512	2476	1389	1245	1310	1344	1395	1064
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	0	0	385	695	974	1293	983	919	1018	1126	1205	974

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	193	412	646	676	883
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	124	461
Rigid 12 - 14 t	Conventional	6619	5755	4057	3445	2933	2470	2062	1516	1356	1226	1112	714
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	833	813	1391	1371	1292	1200	498	404	398	395	373	267
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	910	1252	2412	2501	2512	2476	1389	1245	1310	1344	1395	1064
Rigid 12 - 14 t	HD Euro III - 2000 Standards	0	0	385	695	974	1293	983	919	1018	1126	1205	974
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	193	412	646	676	883
Rigid 12 - 14 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	124	461
Rigid 14 - 20 t	Conventional	8859	7812	6485	5563	4738	3957	3005	2181	1937	1750	1574	1004
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	1375	1390	1748	1762	1685	1577	1047	824	796	764	719	499
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	1718	2304	3334	3627	3760	3891	3256	2906	3021	3057	3121	2359
Rigid 14 - 20 t	HD Euro III - 2000 Standards	0	0	501	1086	1661	2462	3105	3388	3930	4275	4338	3841
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	861	2254	3710	3883	5753
Rigid 14 - 20 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	381	2519
Rigid 20 - 26 t	Conventional	2240	2057	2428	2118	1804	1488	943	665	585	524	463	291
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	542	577	354	395	393	378	549	417	398	369	346	233
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	809	1052	922	1126	1252	1415	1867	1662	1711	1713	1726	1296
Rigid 20 - 26 t	HD Euro III - 2000 Standards	0	0	119	391	688	1169	2122	2466	2912	3153	3133	2878
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	668	1842	3064	3207	4903
Rigid 20 - 26 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	253	2059
Rigid 26 - 28 t	Conventional	2240	2057	2428	2118	1804	1488	943	665	585	524	463	291
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	542	577	354	395	393	378	549	417	398	369	346	233
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	809	1052	922	1126	1252	1415	1867	1662	1711	1713	1726	1296
Rigid 26 - 28 t	HD Euro III - 2000 Standards	0	0	119	391	688	1169	2122	2466	2912	3153	3133	2878
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	668	1842	3064	3207	4903
Rigid 26 - 28 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	253	2059
Rigid 28 - 32 t	Conventional	2240	2057	2428	2118	1804	1488	943	665	585	524	463	291
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	542	577	354	395	393	378	549	417	398	369	346	233
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	809	1052	922	1126	1252	1415	1867	1662	1711	1713	1726	1296
Rigid 28 - 32 t	HD Euro III - 2000 Standards	0	0	119	391	688	1169	2122	2466	2912	3153	3133	2878
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	668	1842	3064	3207	4903
Rigid 28 - 32 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	253	2059
Rigid >32 t	Conventional	97	94	1581	1399	1236	1020	52	37	39	30	31	20
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	73	75	664	664	644	612	68	51	49	48	47	32
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	133	228	1192	1304	1427	1501	318	295	313	314	264	212
Rigid >32 t	HD Euro III - 2000 Standards	0	0	131	312	572	989	322	302	345	377	369	308
Rigid >32 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	153	359	524	536	710
Rigid >32 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	35	401
Articulated 14 - 20 t	Conventional	8859	7812	6485	5563	4738	3957	3005	2181	1937	1750	1574	1004
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	1375	1390	1748	1762	1685	1577	1047	824	796	764	719	499

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	1718	2304	3334	3627	3760	3891	3256	2906	3021	3057	3121	2359
Articulated 14 - 20 t	HD Euro III - 2000 Standards	0	0	501	1086	1661	2462	3105	3388	3930	4275	4338	3841
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	861	2254	3710	3883	5753
Articulated 14 - 20 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	381	2519
Articulated 20 - 28 t	Conventional	2240	2057	2428	2118	1804	1488	943	665	585	524	463	291
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	542	577	354	395	393	378	549	417	398	369	346	233
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	809	1052	922	1126	1252	1415	1867	1662	1711	1713	1726	1296
Articulated 20 - 28 t	HD Euro III - 2000 Standards	0	0	119	391	688	1169	2122	2466	2912	3153	3133	2878
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	668	1842	3064	3207	4903
Articulated 20 - 28 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	253	2059
Articulated 28 - 34 t	Conventional	2337	2151	4005	3516	3041	2508	995	702	623	554	494	310
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	615	652	1017	1059	1037	989	613	471	447	417	393	265
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	942	1280	2114	2430	2675	2916	2181	1957	2021	2027	1990	1510
Articulated 28 - 34 t	HD Euro III - 2000 Standards	0	0	250	703	1260	2158	2448	2771	3257	3529	3502	3178
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	821	2201	3588	3743	5588
Articulated 28 - 34 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	288	2460
Articulated 34 - 40 t	Conventional	97	94	1581	1399	1236	1020	52	37	39	30	31	20
Articulated 34 - 40 t	HD Euro I - 91/542/EEC Stage I	73	75	664	664	644	612	68	51	49	48	47	32
Articulated 34 - 40 t	HD Euro II - 91/542/EEC Stage II	133	228	1192	1304	1427	1501	318	295	313	314	264	212
Articulated 34 - 40 t	HD Euro III - 2000 Standards	0	0	131	312	572	989	322	302	345	377	369	308
Articulated 34 - 40 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	153	359	524	536	710
Articulated 34 - 40 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	35	401
Articulated 40 - 50 t	Conventional	97	94	1581	1399	1236	1020	52	37	39	30	31	20
Articulated 40 - 50 t	HD Euro I - 91/542/EEC Stage I	73	75	664	664	644	612	68	51	49	48	47	32
Articulated 40 - 50 t	HD Euro II - 91/542/EEC Stage II	133	228	1192	1304	1427	1501	318	295	313	314	264	212
Articulated 40 - 50 t	HD Euro III - 2000 Standards	0	0	131	312	572	989	322	302	345	377	369	308
Articulated 40 - 50 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	153	359	524	536	710
Articulated 40 - 50 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	35	401
Articulated 50 - 60 t	Conventional	97	94	1581	1399	1236	1020	52	37	39	30	31	20
Articulated 50 - 60 t	HD Euro I - 91/542/EEC Stage I	73	75	664	664	644	612	68	51	49	48	47	32
Articulated 50 - 60 t	HD Euro II - 91/542/EEC Stage II	133	228	1192	1304	1427	1501	318	295	313	314	264	212
Articulated 50 - 60 t	HD Euro III - 2000 Standards	0	0	131	312	572	989	322	302	345	377	369	308
Articulated 50 - 60 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	153	359	524	536	710
Articulated 50 - 60 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	35	401
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

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
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
Urban Buses Midi <=15 t	Conventional	4559	4001	3363	3039	2525	1629	1298	675	504	359	263	161
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	470	486	503	510	517	422	427	444	435	390	324	314
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	1447	1926	2107	2196	2307	1998	2087	1321	1384	1416	1345	1120
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	0	0	406	686	1153	1281	1693	1051	1137	1201	1204	1009
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	202	415	729	728	1067
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	212	384
Urban Buses Standard 15 - 18 t	Conventional	4559	4001	3363	3039	2525	1629	1298	675	504	359	263	161
Urban Buses Standard 15 - 18 t	HD Euro I - 91/542/EEC Stage I	470	486	503	510	517	422	427	444	435	390	324	314
Urban Buses Standard 15 - 18 t	HD Euro II - 91/542/EEC Stage II	1447	1926	2107	2196	2307	1998	2087	1321	1384	1416	1345	1120
Urban Buses Standard 15 - 18 t	HD Euro III - 2000 Standards	0	0	406	686	1153	1281	1693	1051	1137	1201	1204	1009
Urban Buses Standard 15 - 18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	202	415	729	728	1067
Urban Buses Standard 15 - 18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	212	384
Urban Buses Articulated >18 t	Conventional	4559	4001	3363	3039	2525	1629	1298	675	504	359	263	161
Urban Buses Articulated >18 t	HD Euro I - 91/542/EEC Stage I	470	486	503	510	517	422	427	444	435	390	324	314
Urban Buses Articulated >18 t	HD Euro II - 91/542/EEC Stage II	1447	1926	2107	2196	2307	1998	2087	1321	1384	1416	1345	1120
Urban Buses Articulated >18 t	HD Euro III - 2000 Standards	0	0	406	686	1153	1281	1693	1051	1137	1201	1204	1009
Urban Buses Articulated >18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	202	415	729	728	1067
Urban Buses Articulated >18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	212	384
Coaches Standard <=18 t	Conventional	6947	6506	5953	5196	4574	3084	2416	1003	761	544	384	219
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	2135	2225	2319	2313	2346	1835	1824	665	652	595	486	312
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	2189	2804	3170	3411	3619	3124	3550	1986	2075	2114	2023	1597
Coaches Standard <=18 t	HD Euro III - 2000 Standards	0	0	425	1020	1551	1961	2531	1572	1710	1806	1800	1516
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	299	623	1108	1092	1624
Coaches Standard <=18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	324	577
Coaches Articulated >18 t	Conventional	6947	6506	5953	5196	4574	3084	2416	1003	761	544	384	219
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	2135	2225	2319	2313	2346	1835	1824	665	652	595	486	312
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	2189	2804	3170	3411	3619	3124	3550	1986	2075	2114	2023	1597
Coaches Articulated >18 t	HD Euro III - 2000 Standards	0	0	425	1020	1551	1961	2531	1572	1710	1806	1800	1516
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	0	0	0	0	0	0	0	299	623	1108	1092	1624
Coaches Articulated >18 t	HD Euro V - 2008 Standards	0	0	0	0	0	0	0	0	0	0	324	577
<50 cm³	Conventional	284031	286047	288290	195658	166876	22107	23047	14081	14898	16063	16554	14710
<50 cm³	Mop - Euro I	0	0	0	82018	92950	13303	12331	7325	7515	7805	7741	6674
<50 cm³	Mop - Euro II	0	0	0	12955	33402	9276	13468	11969	16987	22933	26971	33599
<50 cm³	Mop - Euro III	0	0	0	0	0	0	0	0	0	0	0	0
2-stroke >50 cm³	Conventional	20953	17105	14318	13181	10392	3668	3506	1247	970	1060	1159	826
2-stroke >50 cm³	Mot - Euro I	227	263	358	578	594	216	209	151	192	265	310	396

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
2-stroke >50 cm^3	Mot - Euro II	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
4-stroke <250 cm^3	Conventional	75255	64862	59044	55055	56326	18963	18074	5897	4142	4189	4065	2660
4-stroke <250 cm^3	Mot - Euro I	14289	25295	33212	37439	45277	17982	19167	8049	7572	9465	10772	9317
4-stroke <250 cm^3	Mot - Euro II	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
4-stroke 250 - 750 cm^3	Conventional	73513	68968	63894	56355	47971	16801	16314	6960	7315	7528	7496	6682
4-stroke 250 - 750 cm^3	Mot - Euro I	13153	19652	25304	32138	37770	17474	21066	10900	16752	20483	23182	27707
4-stroke 250 - 750 cm^3	Mot - Euro II	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
4-stroke >750 cm^3	Conventional	30597	28237	25810	23557	19617	7053	6846	3070	3438	3576	3618	3396
4-stroke >750 cm^3	Mot - Euro I	7195	11945	15815	21329	24494	11112	12669	6606	10539	13545	15729	19403
4-stroke >750 cm^3	Mot - Euro II	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

Table 274 Mileage data for Road transport (average km/ year/vehicle) 1988-1998

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gasoline <1,4 l	PRE ECE	15053	16132	14159	6635	5697	6088	5665	5799	4672	2960	3640
Gasoline <1,4 l	ECE 15/00-01	18131	19431	17055	7992	6861	7333	6824	6985	5627	3566	4384
Gasoline <1,4 l	ECE 15/02	18361	19676	17271	8093	6948	7425	6910	7073	5699	3611	4440
Gasoline <1,4 l	ECE 15/03	21637	23188	20353	9537	8188	8751	8143	8336	6716	4255	5232
Gasoline <1,4 l	ECE 15/04	29068	31150	27342	12812	11000	11755	10940	11198	9022	5716	7029
Gasoline <1,4 l	Improved Conventional	23877	25588	22459	10524	9036	9656	8986	9198	7411	4696	5774
Gasoline <1,4 l	Open Loop	25901	27757	24363	11416	9802	10475	9748	9978	8039	5094	6263
Gasoline <1,4 l	PC Euro 1 - 91/441/EEC	34992	37500	32914	15423	13242	14151	13169	13481	10860	6882	8461
Gasoline <1,4 l	PC Euro 2 - 94/12/EEC	40546	43451	38138	17871	15344	16397	15259	15620	12584	7974	9804
Gasoline <1,4 l	PC Euro 3 - 98/69/EC Stage2000	46783	50135	44005	20620	17704	18920	17607	18023	14520	9200	11312
Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	49560	53112	46618	21845	18755	20043	18652	19093	15382	9747	11984
Gasoline <1,4 l	PC Euro 5 - EC 715/2007	55456	59429	52163	24443	20986	22427	20871	21364	17212	10906	13410
Gasoline 1,4 - 2,0 l	PRE ECE	16133	17289	15175	7111	6105	6524	6072	6215	5007	3173	3901
Gasoline 1,4 - 2,0 l	ECE 15/00-01	19315	20699	18168	8513	7309	7811	7269	7441	5995	3799	4671
Gasoline 1,4 - 2,0 l	ECE 15/02	20264	21716	19061	8932	7669	8195	7626	7807	6289	3985	4900
Gasoline 1,4 - 2,0 l	ECE 15/03	23227	24891	21847	10238	8790	9393	8741	8948	7209	4568	5616
Gasoline 1,4 - 2,0 l	ECE 15/04	31237	33475	29382	13768	11821	12633	11756	12034	9695	6143	7553
Gasoline 1,4 - 2,0 l	Improved Conventional	23877	25588	22459	10524	9036	9656	8986	9198	7411	4696	5774
Gasoline 1,4 - 2,0 l	Open Loop	29401	31507	27655	12959	11126	11890	11065	11326	9125	5782	7109
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	38655	41425	36360	17038	14628	15633	14548	14892	11997	7602	9347
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	43591	46714	41003	19213	16496	17629	16405	16793	13529	8573	10541
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	50300	53904	47313	22170	19035	20342	18930	19378	15611	9892	12163
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	55826	59827	52511	24606	21126	22577	21010	21507	17327	10979	13499
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	61649	66066	57988	27173	23330	24932	23201	23750	19134	12124	14907
Gasoline >2,0 l	PRE ECE	16967	18182	15959	7478	6421	6862	6385	6536	5266	3337	4103
Gasoline >2,0 l	ECE 15/00-01	20297	21751	19091	8946	7681	8208	7639	7819	6299	3992	4908
Gasoline >2,0 l	ECE 15/02	20651	22130	19424	9102	7815	8351	7772	7956	6409	4061	4993
Gasoline >2,0 l	ECE 15/03	24493	26248	23039	10796	9269	9906	9218	9436	7602	4817	5923
Gasoline >2,0 l	ECE 15/04	32495	34824	30566	14323	12297	13142	12230	12519	10086	6391	7858
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	39603	42440	37251	17456	14987	16016	14904	15257	12291	7788	9576
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	46525	49859	43763	20507	17607	18816	17510	17924	14440	9150	11250
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	51798	55509	48722	22831	19602	20948	19494	19955	16076	10187	12525
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	58230	62403	54773	25666	22036	23549	21915	22433	18073	11452	14080
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	64328	68937	60508	28354	24343	26015	24210	24782	19965	12651	15555
Diesel <2,0 l	Conventional	9304	8766	5050	3974	3680	3533	2298	2293	4039	7151	8372
Diesel <2,0 l	PC Euro 1 - 91/441/EEC	10482	9875	5689	4477	4146	3980	2588	2584	4550	8056	9432
Diesel <2,0 l	PC Euro 2 - 94/12/EEC	12346	11631	6700	5273	4883	4688	3049	3043	5359	9489	11110
Diesel <2,0 l	PC Euro 3 - 98/69/EC Stage2000	14009	13198	7603	5984	5541	5319	3460	3453	6081	10767	12606
Diesel <2,0 l	PC Euro 4 - 98/69/EC Stage2005	14132	13314	7670	6036	5589	5366	3490	3483	6135	10862	12717

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Diesel <2,0 l	PC Euro 5 - EC 715/2007	15896	14976	8627	6790	6287	6035	3926	3918	6900	12217	14304
Diesel >2,0 l	Conventional	10275	9680	5576	4389	4064	3901	2537	2533	4460	7897	9246
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	11641	10967	6318	4972	4604	4420	2875	2869	5053	8947	10475
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	13087	12329	7102	5590	5176	4969	3232	3226	5681	10058	11776
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	15298	14413	8303	6534	6051	5809	3778	3771	6641	11758	13766
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	15829	14912	8591	6761	6260	6010	3909	3902	6871	12166	14244
Diesel >2,0 l	PC Euro 5 - EC 715/2007	17658	16635	9583	7542	6984	6704	4361	4352	7665	13571	15890
LPG	Conventional	0	0	0	0	0	0	0	0	0	103726	44215
LPG	PC Euro 1 - 91/441/EEC	0	0	0	0	0	0	0	0	0	117735	50187
LPG	PC Euro 2 - 94/12/EEC	0	0	0	0	0	0	0	0	0	125002	53284
LPG	PC Euro 3 - 98/69/EC Stage2000	0	0	0	0	0	0	0	0	0	131032	55854
LPG	PC Euro 4 - 98/69/EC Stage2005	0	0	0	0	0	0	0	0	0	128094	54602
LPG	PC Euro 5 - EC 715/2007	0	0	0	0	0	0	0	0	0	134742	57436
2-Stroke	Conventional	12572	13473	11826	5541	4758	5084	4732	4843	3902	2472	3040
Hybrid Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	60802	65159	57192	26800	23009	24590	22883	23424	18871	11957	14702
Hybrid Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	61903	66338	58227	27285	23426	25034	23297	23848	19213	12174	14968
Hybrid Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	72149	77319	67865	31801	27303	29178	27153	27795	22393	14189	17446
Gasoline <3,5t	Conventional	41301	44260	38848	18204	15629	16703	15544	15911	12818	8122	9987
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	47536	50942	44713	20952	17989	19224	17890	18313	14754	9348	11494
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	53174	56984	50017	23437	20123	21505	20012	20485	16504	10457	12858
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	60322	64645	56740	26588	22828	24395	22702	23239	18722	11863	14586
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	68208	73096	64158	30064	25812	27585	25670	26277	21170	13414	16493
Gasoline <3,5t	LD Euro 5 - 2008 Standards	74602	79947	70172	32882	28231	30170	28076	28740	23154	14671	18039
Diesel <3,5 t	Conventional	9582	9027	5200	4093	3790	3638	2366	2362	4159	7365	8622
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	11116	10473	6033	4748	4396	4221	2745	2740	4825	8544	10003
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	12228	11520	6636	5223	4836	4643	3020	3014	5308	9398	11004
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	13342	12569	7241	5699	5277	5066	3295	3289	5791	10254	12006
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	15384	14493	8349	6571	6084	5841	3799	3792	6678	11824	13843
Diesel <3,5 t	LD Euro 5 - 2008 Standards	16497	15542	8953	7046	6524	6263	4074	4066	7161	12679	14845
Gasoline >3,5 t	Conventional	54337	58230	51110	23950	20563	21975	20449	20933	16864	10686	13139
Rigid <=7,5 t	Conventional	13872	13069	7528	5925	5486	5267	3426	3419	6021	10662	12483
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	16265	15323	8827	6947	6433	6175	4017	4009	7060	12501	14636
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	19162	18053	10400	8185	7579	7276	4732	4723	8318	14728	17243
Rigid <=7,5 t	HD Euro III - 2000 Standards	22423	21125	12169	9578	8868	8514	5537	5527	9734	17234	20178
Rigid <=7,5 t	HD Euro IV - 2005 Standards	24248	22844	13159	10357	9590	9206	5988	5977	10525	18636	21819
Rigid <=7,5 t	HD Euro V - 2008 Standards	7536	7100	4090	3219	2981	2861	1861	1857	3271	5792	6781
Rigid 7,5 - 12 t	Conventional	14270	13444	7745	6095	5644	5418	3524	3517	6194	10968	12841
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	17920	16883	9725	7654	7087	6804	4425	4417	7779	13773	16126
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	21047	19828	11422	8990	8324	7991	5197	5188	9136	16176	18939
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	24890	23449	13508	10631	9844	9450	6147	6135	10804	19130	22398

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	27172	25598	14746	11606	10746	10317	6710	6697	11795	20884	24451
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	7536	7100	4090	3219	2981	2861	1861	1857	3271	5792	6781
Rigid 12 - 14 t	Conventional	12444	11724	6754	5315	4922	4725	3073	3067	5402	9564	11198
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	16254	15313	8821	6943	6428	6171	4014	4006	7056	12493	14626
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	19431	18306	10546	8300	7685	7378	4799	4789	8435	14934	17485
Rigid 12 - 14 t	HD Euro III - 2000 Standards	24243	22839	13157	10355	9588	9205	5987	5975	10523	18633	21815
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	25002	23554	13569	10679	9888	9493	6174	6162	10853	19216	22498
Rigid 12 - 14 t	HD Euro V - 2008 Standards	7536	7100	4090	3219	2981	2861	1861	1857	3271	5792	6781
Rigid 14 - 20 t	Conventional	15662	14755	8500	6690	6194	5947	3868	3860	6799	12037	14094
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	19639	18502	10658	8388	7767	7457	4850	4841	8525	15094	17673
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	22632	21322	12283	9667	8951	8593	5589	5578	9824	17395	20366
Rigid 14 - 20 t	HD Euro III - 2000 Standards	26240	24721	14241	11208	10378	9963	6480	6468	11390	20168	23613
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	26815	25263	14553	11454	10605	10181	6622	6609	11640	20610	24130
Rigid 14 - 20 t	HD Euro V - 2008 Standards	7536	7100	4090	3219	2981	2861	1861	1857	3271	5792	6781
Rigid 20 - 26 t	Conventional	15685	14777	8513	6700	6203	5955	3873	3866	6809	12055	14114
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	19901	18749	10800	8500	7871	7556	4915	4905	8639	15295	17908
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	22821	21499	12385	9747	9025	8664	5636	5625	9906	17539	20535
Rigid 20 - 26 t	HD Euro III - 2000 Standards	27103	25534	14709	11577	10719	10291	6693	6680	11765	20831	24389
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	24692	23263	13401	10547	9766	9375	6098	6086	10718	18978	22220
Rigid 20 - 26 t	HD Euro V - 2008 Standards	7536	7100	4090	3219	2981	2861	1861	1857	3271	5792	6781
Rigid 26 - 28 t	Conventional	15623	14718	8479	6673	6179	5932	3858	3851	6782	12007	14058
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	19229	18116	10436	8213	7605	7301	4749	4740	8347	14779	17304
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	22106	20826	11997	9442	8743	8393	5459	5449	9596	16990	19892
Rigid 26 - 28 t	HD Euro III - 2000 Standards	25976	24472	14097	11095	10273	9862	6415	6403	11276	19964	23375
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	26679	25135	14479	11395	10552	10130	6588	6576	11581	20505	24008
Rigid 26 - 28 t	HD Euro V - 2008 Standards	7536	7100	4090	3219	2981	2861	1861	1857	3271	5792	6781
Rigid 28 - 32 t	Conventional	15658	14752	8498	6688	6193	5945	3867	3859	6797	12035	14090
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	19481	18353	10572	8321	7705	7396	4811	4802	8456	14972	17530
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	22414	21117	12165	9574	8865	8510	5535	5525	9730	17227	20170
Rigid 28 - 32 t	HD Euro III - 2000 Standards	26615	25074	14444	11368	10526	10105	6573	6560	11553	20456	23950
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	25088	23635	13615	10716	9922	9525	6195	6184	10890	19282	22575
Rigid 28 - 32 t	HD Euro V - 2008 Standards	7536	7100	4090	3219	2981	2861	1861	1857	3271	5792	6781
Rigid >32 t	Conventional	19292	18175	10470	8240	7630	7325	4764	4755	8374	14828	17360
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	21287	20055	11553	9092	8419	8082	5257	5247	9240	16361	19155
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	26121	24608	14176	11157	10331	9917	6450	6438	11338	20076	23505
Rigid >32 t	HD Euro III - 2000 Standards	30085	28343	16328	12850	11899	11423	7430	7415	13059	23123	27072
Rigid >32 t	HD Euro IV - 2005 Standards	27560	25964	14957	11771	10900	10464	6806	6793	11963	21182	24800
Rigid >32 t	HD Euro V - 2008 Standards	7536	7100	4090	3219	2981	2861	1861	1857	3271	5792	6781
Articulated 14 - 20 t	Conventional	20400	19219	11071	8713	8068	7745	5038	5028	8855	15679	18357
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	24652	23224	13379	10529	9750	9360	6088	6076	10701	18947	22183

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	29495	27787	16007	12598	11665	11198	7284	7270	12803	22669	26541
Articulated 14 - 20 t	HD Euro III - 2000 Standards	36774	34645	19958	15707	14544	13962	9081	9064	15963	28264	33092
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	39036	36776	21185	16673	15439	14821	9640	9622	16945	30002	35127
Articulated 14 - 20 t	HD Euro V - 2008 Standards	35277	33234	19145	15068	13952	13394	8712	8695	15313	27113	31744
Articulated 20 - 28 t	Conventional	22619	21310	12276	9661	8946	8588	5586	5575	9819	17385	20354
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	26871	25315	14583	11477	10627	10202	6636	6623	11664	20653	24180
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	32176	30313	17462	13743	12726	12217	7946	7931	13967	24730	28954
Articulated 20 - 28 t	HD Euro III - 2000 Standards	38994	36736	21162	16655	15422	14805	9630	9611	16926	29970	35089
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	39036	36776	21185	16673	15439	14821	9640	9622	16945	30002	35127
Articulated 20 - 28 t	HD Euro V - 2008 Standards	35277	33234	19145	15068	13952	13394	8712	8695	15313	27113	31744
Articulated 28 - 34 t	Conventional	24284	22878	13179	10372	9604	9220	5997	5986	10541	18664	21852
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	28495	26845	15465	12171	11270	10819	7037	7024	12369	21901	25642
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	34081	32108	18496	14557	13479	12940	8416	8400	14794	26194	30668
Articulated 28 - 34 t	HD Euro III - 2000 Standards	41103	38723	22307	17556	16256	15606	10150	10131	17842	31591	36987
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	44751	42160	24287	19114	17699	16991	11051	11030	19425	34394	40269
Articulated 28 - 34 t	HD Euro V - 2008 Standards	35277	33234	19145	15068	13952	13394	8712	8695	15313	27113	31744
Articulated 34 - 40 t	Conventional	23158	21817	12568	9891	9159	8792	5719	5708	10052	17798	20839
Articulated 34 - 40 t	HD Euro I - 91/542/EEC Stage I	29771	28047	16157	12716	11774	11304	7352	7338	12923	22882	26790
Articulated 34 - 40 t	HD Euro II - 91/542/EEC Stage II	35311	33267	19164	15082	13966	13407	8720	8704	15328	27139	31775
Articulated 34 - 40 t	HD Euro III - 2000 Standards	42633	40164	23137	18210	16861	16187	10528	10508	18506	32767	38364
Articulated 34 - 40 t	HD Euro IV - 2005 Standards	45194	42577	24527	19304	17874	17159	11161	11139	19618	34735	40668
Articulated 34 - 40 t	HD Euro V - 2008 Standards	35277	33234	19145	15068	13952	13394	8712	8695	15313	27113	31744
Articulated 40 - 50 t	Conventional	26735	25187	14509	11419	10574	10151	6602	6590	11605	20548	24058
Articulated 40 - 50 t	HD Euro I - 91/542/EEC Stage I	32794	30896	17798	14007	12970	12451	8099	8083	14235	25205	29510
Articulated 40 - 50 t	HD Euro II - 91/542/EEC Stage II	40352	38016	21900	17236	15959	15321	9965	9946	17516	31014	36311
Articulated 40 - 50 t	HD Euro III - 2000 Standards	48189	45399	26153	20583	19059	18296	11900	11878	20918	37037	43363
Articulated 40 - 50 t	HD Euro IV - 2005 Standards	45194	42577	24527	19304	17874	17159	11161	11139	19618	34735	40668
Articulated 40 - 50 t	HD Euro V - 2008 Standards	35277	33234	19145	15068	13952	13394	8712	8695	15313	27113	31744
Articulated 50 - 60 t	Conventional	24586	23163	13343	10502	9724	9335	6072	6060	10673	18897	22124
Articulated 50 - 60 t	HD Euro I - 91/542/EEC Stage I	29201	27510	15848	12473	11549	11087	7211	7197	12676	22443	26277
Articulated 50 - 60 t	HD Euro II - 91/542/EEC Stage II	35357	33309	19188	15102	13983	13424	8731	8715	15348	27174	31816
Articulated 50 - 60 t	HD Euro III - 2000 Standards	43080	40586	23380	18401	17038	16357	10639	10618	18700	33111	38766
Articulated 50 - 60 t	HD Euro IV - 2005 Standards	45194	42577	24527	19304	17874	17159	11161	11139	19618	34735	40668
Articulated 50 - 60 t	HD Euro V - 2008 Standards	35277	33234	19145	15068	13952	13394	8712	8695	15313	27113	31744
Urban CNG Buses	HD Euro I - 91/542/EEC Stage I	180983	193951	170236	79771	68489	73193	68113	69723	56171	35592	43763
Urban CNG Buses	HD Euro II - 91/542/EEC Stage II	201729	216184	189751	88916	76340	81583	75921	77715	62610	39672	48779
Urban CNG Buses	HD Euro III - 2000 Standards	215122	230536	202348	94819	81408	86999	80961	82875	66767	42306	52018
Urban CNG Buses	EEV	215122	230536	202348	94819	81408	86999	80961	82875	66767	42306	52018
Urban Biodiesel Buses	Conventional	26260	24740	14252	11216	10386	9970	6485	6473	11399	20183	23630
Urban Biodiesel Buses	HD Euro I - 91/542/EEC Stage I	31916	30068	17321	13632	12623	12118	7882	7867	13854	24530	28719

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Urban Biodiesel Buses	HD Euro II - 91/542/EEC Stage II	35574	33514	19306	15195	14069	13507	8785	8768	15442	27341	32012
Urban Biodiesel Buses	HD Euro III - 2000 Standards	37936	35739	20588	16203	15004	14403	9368	9350	16467	29157	34137
Urban Biodiesel Buses	HD Euro IV - 2005 Standards	36730	34603	19934	15688	14527	13946	9070	9053	15944	28230	33052
Urban Biodiesel Buses	HD Euro V - 2008 Standards	49884	46996	27072	21307	19729	18940	12319	12295	21654	38340	44888
Urban Buses Midi <=15 t	Conventional	24800	23364	13459	10593	9808	9416	6124	6113	10765	19061	22317
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	30534	28767	16571	13042	12076	11593	7540	7526	13254	23468	27477
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	32591	30704	17687	13921	12890	12374	8048	8033	14147	25049	29327
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	34765	32752	18867	14849	13750	13200	8585	8569	15091	26720	31284
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	32842	30941	17824	14028	12989	12469	8110	8095	14256	25242	29553
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	33256	31330	18048	14205	13153	12627	8213	8197	14436	25560	29926
Urban Buses Standard 15 - 18 t	Conventional	26260	24740	14252	11216	10386	9970	6485	6473	11399	20183	23630
Urban Buses Standard 15 - 18 t	HD Euro I - 91/542/EEC Stage I	31916	30068	17321	13632	12623	12118	7882	7867	13854	24530	28719
Urban Buses Standard 15 - 18 t	HD Euro II - 91/542/EEC Stage II	35574	33514	19306	15195	14069	13507	8785	8768	15442	27341	32012
Urban Buses Standard 15 - 18 t	HD Euro III - 2000 Standards	37936	35739	20588	16203	15004	14403	9368	9350	16467	29157	34137
Urban Buses Standard 15 - 18 t	HD Euro IV - 2005 Standards	36730	34603	19934	15688	14527	13946	9070	9053	15944	28230	33052
Urban Buses Standard 15 - 18 t	HD Euro V - 2008 Standards	49884	46996	27072	21307	19729	18940	12319	12295	21654	38340	44888
Urban Buses Articulated >18 t	Conventional	25157	23700	13653	10745	9949	9552	6212	6201	10920	19335	22638
Urban Buses Articulated >18 t	HD Euro I - 91/542/EEC Stage I	32094	30236	17418	13708	12693	12186	7926	7911	13932	24667	28880
Urban Buses Articulated >18 t	HD Euro II - 91/542/EEC Stage II	36150	34057	19619	15441	14297	13726	8927	8910	15692	27784	32530
Urban Buses Articulated >18 t	HD Euro III - 2000 Standards	38368	36146	20823	16388	15174	14567	9475	9457	16655	29489	34525
Urban Buses Articulated >18 t	HD Euro IV - 2005 Standards	36427	34318	19769	15559	14407	13831	8996	8979	15812	27997	32779
Urban Buses Articulated >18 t	HD Euro V - 2008 Standards	49884	46996	27072	21307	19729	18940	12319	12295	21654	38340	44888
Coaches Standard <=18 t	Conventional	25304	23839	13733	10808	10008	9607	6249	6237	10984	19448	22770
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	29587	27874	16057	12637	11701	11233	7306	7293	12843	22740	26624
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	32618	30730	17702	13932	12900	12384	8055	8040	14159	25070	29352
Coaches Standard <=18 t	HD Euro III - 2000 Standards	35308	33264	19162	15081	13964	13406	8719	8703	15326	27137	31772
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	36935	34797	20045	15776	14608	14024	9121	9104	16033	28388	33237
Coaches Standard <=18 t	HD Euro V - 2008 Standards	49884	46996	27072	21307	19729	18940	12319	12295	21654	38340	44888
Coaches Articulated >18 t	Conventional	25043	23593	13591	10697	9905	9508	6184	6173	10871	19248	22535
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	30191	28443	16385	12896	11941	11463	7456	7442	13105	23204	27168
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	34487	32490	18716	14730	13639	13094	8516	8500	14970	26506	31033
Coaches Articulated >18 t	HD Euro III - 2000 Standards	36554	34437	19838	15613	14457	13879	9027	9010	15867	28094	32893
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	36517	34403	19818	15597	14442	13865	9018	9001	15851	28066	32860
Coaches Articulated >18 t	HD Euro V - 2008 Standards	49884	46996	27072	21307	19729	18940	12319	12295	21654	38340	44888
<50 cm^3	Conventional	8756	9384	8236	3859	3314	3541	3295	3373	2718	1722	2117
<50 cm^3	Mop - Euro I	9230	9891	8682	4068	3493	3733	3474	3556	2865	1815	2232
<50 cm^3	Mop - Euro II	6848	7339	6442	3019	2592	2770	2577	2638	2126	1347	1656
<50 cm^3	Mop - Euro III	5729	6139	5388	2525	2168	2317	2156	2207	1778	1127	1385
2-stroke >50 cm^3	Conventional	13022	13956	12249	5740	4928	5266	4901	5017	4042	2561	3149
2-stroke >50 cm^3	Mot - Euro I	13582	14555	12775	5986	5140	5493	5111	5232	4215	2671	3284

Subsector	Technology	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2-stroke >50 cm³	Mot - Euro II	15385	16488	14472	6781	5822	6222	5790	5927	4775	3026	3720
2-stroke >50 cm³	Mot - Euro III	15769	16899	14833	6951	5968	6377	5935	6075	4894	3101	3813
4-stroke <250 cm³	Conventional	16869	18078	15867	7435	6384	6822	6349	6499	5236	3317	4079
4-stroke <250 cm³	Mot - Euro I	18761	20105	17647	8269	7100	7587	7061	7228	5823	3689	4536
4-stroke <250 cm³	Mot - Euro II	16616	17807	15630	7324	6288	6720	6254	6401	5157	3268	4018
4-stroke <250 cm³	Mot - Euro III	17747	19019	16693	7822	6716	7177	6679	6837	5508	3490	4291
4-stroke 250 - 750 cm³	Conventional	17358	18602	16327	7651	6569	7020	6533	6687	5387	3414	4197
4-stroke 250 - 750 cm³	Mot - Euro I	19528	20927	18368	8607	7390	7897	7349	7523	6061	3840	4722
4-stroke 250 - 750 cm³	Mot - Euro II	17499	18753	16460	7713	6622	7077	6586	6741	5431	3441	4231
4-stroke 250 - 750 cm³	Mot - Euro III	17747	19019	16693	7822	6716	7177	6679	6837	5508	3490	4291
4-stroke >750 cm³	Conventional	17621	18883	16575	7767	6668	7126	6632	6788	5469	3465	4261
4-stroke >750 cm³	Mot - Euro I	20082	21521	18890	8852	7600	8122	7558	7737	6233	3949	4856
4-stroke >750 cm³	Mot - Euro II	17956	19242	16889	7914	6795	7262	6758	6917	5573	3531	4342
4-stroke >750 cm³	Mot - Euro III	17747	19019	16693	7822	6716	7177	6679	6837	5508	3490	4291

Table 275 Mileage data for Road transport (average km/year/vehicle) 1999-2010

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gasoline <1,4 l	PRE ECE	3300	2574	2086	2166	1988	1909	1804	3105	2659	2361	2337	2112
Gasoline <1,4 l	ECE 15/00-01	3975	3100	2513	2609	2395	2300	2173	3739	3203	2844	2815	2544
Gasoline <1,4 l	ECE 15/02	4025	3139	2545	2642	2425	2329	2200	3787	3243	2880	2850	2576
Gasoline <1,4 l	ECE 15/03	4744	3699	2999	3113	2858	2745	2593	4462	3822	3394	3359	3036
Gasoline <1,4 l	ECE 15/04	6373	4970	4028	4182	3839	3687	3484	5995	5135	4559	4512	4078
Gasoline <1,4 l	Improved Conventional	5235	4082	3309	3435	3153	3029	2861	4924	4218	3745	3707	3350
Gasoline <1,4 l	Open Loop	5678	4428	3590	3727	3421	3285	3104	5342	4575	4062	4021	3634
Gasoline <1,4 l	PC Euro 1 - 91/441/EEC	7671	5983	4849	5035	4622	4439	4194	7217	6181	5488	5432	4909
Gasoline <1,4 l	PC Euro 2 - 94/12/EEC	8889	6932	5619	5834	5355	5143	4859	8362	7162	6359	6294	5689
Gasoline <1,4 l	PC Euro 3 - 98/69/EC Stage2000	10256	7999	6483	6731	6179	5934	5607	9648	8264	7338	7262	6564
Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	10865	8474	6868	7131	6546	6287	5940	10221	8755	7773	7694	6953
Gasoline <1,4 l	PC Euro 5 - EC 715/2007	12158	9482	7685	7979	7324	7034	6646	11437	9796	8698	8609	7781
Gasoline 1,4 - 2,0 l	PRE ECE	3537	2758	2236	2321	2131	2046	1933	3327	2850	2530	2504	2263
Gasoline 1,4 - 2,0 l	ECE 15/00-01	4234	3302	2677	2779	2551	2450	2315	3984	3412	3029	2998	2710
Gasoline 1,4 - 2,0 l	ECE 15/02	4443	3465	2808	2916	2676	2570	2429	4179	3580	3178	3146	2843
Gasoline 1,4 - 2,0 l	ECE 15/03	5092	3971	3219	3342	3068	2946	2784	4790	4103	3643	3606	3259
Gasoline 1,4 - 2,0 l	ECE 15/04	6848	5341	4329	4494	4126	3962	3744	6442	5518	4899	4849	4383
Gasoline 1,4 - 2,0 l	Improved Conventional	5235	4082	3309	3435	3153	3029	2861	4924	4218	3745	3707	3350
Gasoline 1,4 - 2,0 l	Open Loop	6445	5027	4074	4230	3883	3729	3523	6064	5193	4611	4564	4125
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	8474	6609	5357	5562	5105	4903	4633	7972	6828	6063	6001	5423
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	9556	7453	6041	6272	5757	5529	5224	8990	7700	6837	6767	6116
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	11027	8600	6971	7237	6643	6380	6028	10374	8885	7889	7808	7057
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	12239	9545	7737	8032	7373	7081	6690	11514	9861	8756	8666	7833
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	13515	10540	8544	8870	8142	7820	7388	12714	10890	9669	9570	8649
Gasoline >2,0 l	PRE ECE	3720	2901	2351	2441	2241	2152	2033	3499	2997	2661	2634	2380
Gasoline >2,0 l	ECE 15/00-01	4450	3470	2813	2920	2681	2575	2432	4186	3585	3183	3151	2848
Gasoline >2,0 l	ECE 15/02	4527	3531	2862	2971	2727	2619	2475	4259	3648	3239	3206	2897
Gasoline >2,0 l	ECE 15/03	5370	4188	3394	3524	3235	3107	2935	5052	4327	3842	3802	3436
Gasoline >2,0 l	ECE 15/04	7124	5556	4503	4675	4292	4122	3894	6702	5740	5097	5045	4559
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	8682	6771	5488	5698	5230	5024	4746	8168	6996	6211	6148	5556
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	10200	7955	6448	6694	6145	5902	5576	9595	8218	7297	7222	6528
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	11356	8856	7178	7453	6841	6570	6208	10683	9150	8124	8041	7267
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	12766	9956	8070	8378	7691	7386	6979	12009	10286	9133	9040	8170
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	14103	10998	8915	9256	8496	8160	7709	13267	11363	10089	9986	9025
Diesel <2,0 l	Conventional	8624	7434	6975	6572	7719	8330	9619	12654	9693	9143	8142	6989
Diesel <2,0 l	PC Euro 1 - 91/441/EEC	9715	8375	7858	7404	8696	9385	10836	14255	10919	10301	9172	7873
Diesel <2,0 l	PC Euro 2 - 94/12/EEC	11443	9865	9256	8721	10242	11054	12763	16791	12861	12133	10803	9274
Diesel <2,0 l	PC Euro 3 - 98/69/EC Stage2000	12984	11193	10502	9895	11622	12543	14483	19052	14594	13767	12258	10523
Diesel <2,0 l	PC Euro 4 - 98/69/EC Stage2005	13099	11292	10595	9983	11724	12653	14610	19220	14722	13888	12367	10616

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Diesel <2,0 l	PC Euro 5 - EC 715/2007	14734	12701	11917	11228	13187	14232	16434	21619	16559	15621	13910	11940
Diesel >2,0 l	Conventional	9523	8210	7703	7258	8524	9199	10622	13974	10704	10097	8991	7718
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	10790	9301	8727	8223	9657	10422	12034	15832	12127	11440	10186	8744
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	12130	10456	9811	9244	10856	11717	13529	17798	13633	12860	11451	9830
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	14180	12224	11469	10806	12691	13697	15816	20806	15937	15034	13387	11491
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	14671	12648	11867	11181	13131	14172	16364	21528	16490	15555	13851	11890
Diesel >2,0 l	PC Euro 5 - EC 715/2007	16367	14109	13238	12473	14649	15809	18255	24015	18395	17353	15451	13264
LPG	Conventional	39185	65859	66629	62277	54760	43408	44494	62945	53938	48477	49864	53604
LPG	PC Euro 1 - 91/441/EEC	44478	74754	75628	70688	62156	49271	50504	71446	61223	55024	56598	60844
LPG	PC Euro 2 - 94/12/EEC	47223	79368	80295	75051	65992	52312	53621	75856	65001	58420	60092	64599
LPG	PC Euro 3 - 98/69/EC Stage2000	49501	83197	84169	78671	69175	54836	56207	79515	68137	61238	62990	67715
LPG	PC Euro 4 - 98/69/EC Stage2005	48391	81331	82281	76907	67624	53606	54947	77732	66609	59865	61578	66197
LPG	PC Euro 5 - EC 715/2007	50902	85552	86552	80898	71134	56388	57799	81766	70066	62972	64774	69633
2-Stroke	Conventional	2756	2150	1742	1809	1660	1595	1507	2593	2221	1972	1952	1764
Hybrid Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	13330	10396	8426	8748	8030	7713	7287	12540	10740	9537	9439	8531
Hybrid Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	13571	10584	8579	8907	8176	7852	7419	12767	10935	9709	9610	8685
Hybrid Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	15817	12336	9999	10381	9529	9152	8647	14880	12745	11316	11200	10123
Gasoline <3,5t	Conventional	9054	7061	5724	5942	5455	5239	4950	8518	7296	6478	6411	5795
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	10421	8127	6588	6839	6278	6030	5697	9804	8397	7456	7379	6669
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	11657	9091	7369	7651	7023	6745	6373	10967	9393	8340	8255	7460
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	13224	10314	8360	8679	7967	7652	7229	12441	10656	9461	9364	8463
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	14953	11662	9453	9814	9008	8652	8174	14067	12049	10698	10589	9570
Gasoline <3,5t	LD Euro 5 - 2008 Standards	16355	12755	10339	10734	9853	9463	8941	15386	13178	11701	11581	10467
Diesel <3,5 t	Conventional	8881	7656	7183	6768	7949	8579	9906	13032	9982	9416	8385	7198
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	10303	8882	8333	7852	9222	9953	11492	15118	11580	10924	9727	8350
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	11334	9771	9167	8638	10144	10948	12642	16631	12739	12017	10700	9185
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	12366	10660	10002	9424	11068	11945	13793	18145	13899	13111	11675	10022
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	14259	12292	11533	10866	12762	13773	15904	20922	16026	15118	13461	11555
Diesel <3,5 t	LD Euro 5 - 2008 Standards	15290	13181	12367	11653	13685	14770	17054	22436	17185	16211	14435	12391
Gasoline >3,5 t	Conventional	11912	9290	7530	7818	7176	6892	6512	11206	9598	8522	8435	7624
Rigid <=7,5 t	Conventional	12857	11084	10399	9798	11508	12420	14341	18866	14451	13632	12138	10420
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	15075	12996	12193	11489	13493	14562	16814	22120	16943	15983	14232	12217
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	17761	15311	14366	13536	15897	17156	19810	26061	19962	18831	16768	14394
Rigid <=7,5 t	HD Euro III - 2000 Standards	20784	17917	16810	15839	18602	20076	23182	30496	23359	22036	19621	16843
Rigid <=7,5 t	HD Euro IV - 2005 Standards	22474	19374	18178	17128	20115	21709	25068	32977	25260	23828	21218	18214
Rigid <=7,5 t	HD Euro V - 2008 Standards	6985	6021	5650	5323	6252	6747	7791	10249	7851	7406	6594	5661
Rigid 7,5 - 12 t	Conventional	13227	11402	10698	10080	11838	12776	14753	19408	14866	14023	12487	10719
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	16610	14318	13434	12658	14866	16044	18526	24372	18668	17610	15681	13461
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	19507	16817	15778	14866	17460	18843	21758	28624	21925	20683	18417	15809
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	23070	19888	18660	17581	20648	22285	25732	33851	25929	24460	21780	18696

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	25185	21711	20370	19193	22541	24327	28090	36954	28306	26702	23776	20410
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	6985	6021	5650	5323	6252	6747	7791	10249	7851	7406	6594	5661
Rigid 12 - 14 t	Conventional	11534	9943	9329	8790	10324	11142	12865	16925	12964	12229	10889	9348
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	15065	12987	12185	11481	13484	14553	16804	22106	16932	15973	14223	12209
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	18010	15526	14567	13725	16120	17397	20088	26427	20242	19095	17003	14596
Rigid 12 - 14 t	HD Euro III - 2000 Standards	22470	19371	18174	17124	20112	21705	25063	32971	25255	23824	21214	18210
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	23174	19977	18743	17660	20741	22385	25847	34003	26045	24570	21878	18780
Rigid 12 - 14 t	HD Euro V - 2008 Standards	6985	6021	5650	5323	6252	6747	7791	10249	7851	7406	6594	5661
Rigid 14 - 20 t	Conventional	14517	12514	11741	11063	12993	14023	16192	21301	16316	15391	13705	11764
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	18203	15692	14723	13872	16292	17583	20303	26710	20459	19300	17185	14752
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	20977	18084	16967	15987	18775	20263	23398	30780	23577	22241	19804	17000
Rigid 14 - 20 t	HD Euro III - 2000 Standards	24321	20966	19672	18535	21768	23493	27128	35687	27335	25787	22961	19710
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	24854	21426	20103	18941	22245	24008	27722	36469	27934	26352	23465	20142
Rigid 14 - 20 t	HD Euro V - 2008 Standards	6985	6021	5650	5323	6252	6747	7791	10249	7851	7406	6594	5661
Rigid 20 - 26 t	Conventional	14538	12533	11759	11079	13012	14043	16216	21332	16340	15414	13725	11782
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	18446	15901	14919	14057	16509	17818	20574	27066	20731	19557	17414	14949
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	21152	18234	17108	16120	18931	20432	23592	31036	23773	22426	19969	17142
Rigid 20 - 26 t	HD Euro III - 2000 Standards	25121	21656	20319	19145	22484	24266	28020	36861	28234	26635	23717	20359
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	22887	19730	18511	17442	20484	22108	25527	33582	25723	24266	21607	18548
Rigid 20 - 26 t	HD Euro V - 2008 Standards	6985	6021	5650	5323	6252	6747	7791	10249	7851	7406	6594	5661
Rigid 26 - 28 t	Conventional	14480	12483	11712	11035	12960	13987	16151	21247	16275	15353	13671	11735
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	17823	15364	14416	13583	15952	17216	19879	26152	20032	18897	16826	14444
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	20489	17663	16572	15615	18339	19792	22853	30064	23028	21724	19344	16605
Rigid 26 - 28 t	HD Euro III - 2000 Standards	24076	20755	19473	18348	21549	23257	26854	35328	27060	25527	22730	19512
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	24728	21317	20001	18845	22133	23887	27581	36284	27793	26218	23346	20040
Rigid 26 - 28 t	HD Euro V - 2008 Standards	6985	6021	5650	5323	6252	6747	7791	10249	7851	7406	6594	5661
Rigid 28 - 32 t	Conventional	14513	12511	11739	11060	12990	14019	16188	21296	16312	15388	13702	11762
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	18056	15565	14604	13760	16161	17441	20139	26494	20294	19144	17046	14633
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	20775	17910	16804	15833	18595	20068	23172	30484	23350	22027	19614	16837
Rigid 28 - 32 t	HD Euro III - 2000 Standards	24669	21266	19953	18800	22079	23829	27515	36197	27726	26155	23289	19992
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	23253	20045	18808	17721	20812	22462	25936	34120	26135	24654	21953	18845
Rigid 28 - 32 t	HD Euro V - 2008 Standards	6985	6021	5650	5323	6252	6747	7791	10249	7851	7406	6594	5661
Rigid >32 t	Conventional	17881	15415	14463	13627	16004	17273	19944	26238	20097	18959	16881	14491
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	19730	17009	15958	15036	17659	19059	22007	28951	22176	20919	18627	15990
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	24210	20871	19582	18451	21669	23386	27004	35525	27211	25669	22857	19620
Rigid >32 t	HD Euro III - 2000 Standards	27885	24038	22554	21251	24958	26936	31102	40916	31341	29565	26326	22598
Rigid >32 t	HD Euro IV - 2005 Standards	25544	22021	20661	19467	22863	24675	28492	37482	28710	27083	24116	20701
Rigid >32 t	HD Euro V - 2008 Standards	6985	6021	5650	5323	6252	6747	7791	10249	7851	7406	6594	5661
Articulated 14 - 20 t	Conventional	18908	16300	15293	14410	16923	18264	21090	27744	21251	20047	17851	15323
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	22849	19697	18481	17413	20450	22071	25485	33527	25680	24225	21571	18517

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	27338	23567	22111	20834	24468	26407	30492	40113	30725	28985	25809	22155
Articulated 14 - 20 t	HD Euro III - 2000 Standards	34085	29383	27569	25976	30507	32925	38018	50014	38309	36139	32179	27623
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	36181	31190	29264	27573	32383	34950	40356	53089	40665	38361	34158	29322
Articulated 14 - 20 t	HD Euro V - 2008 Standards	32697	28187	26446	24918	29265	31584	36470	47977	36749	34667	30869	26498
Articulated 20 - 28 t	Conventional	20965	18073	16957	15977	18765	20252	23384	30763	23563	22228	19793	16991
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	24906	21470	20145	18981	22292	24058	27780	36545	27993	26407	23513	20184
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	29823	25709	24122	22728	26693	28808	33264	43760	33519	31620	28155	24169
Articulated 20 - 28 t	HD Euro III - 2000 Standards	36142	31157	29233	27544	32349	34912	40312	53032	40621	38320	34121	29290
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	36181	31190	29264	27573	32383	34950	40356	53089	40665	38361	34158	29322
Articulated 20 - 28 t	HD Euro V - 2008 Standards	32697	28187	26446	24918	29265	31584	36470	47977	36749	34667	30869	26498
Articulated 28 - 34 t	Conventional	22508	19403	18205	17153	20146	21742	25105	33027	25297	23864	21250	18241
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	26412	22768	21362	20128	23639	25512	29459	38754	29685	28003	24935	21404
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	31589	27231	25550	24074	28273	30514	35234	46351	35503	33492	29823	25600
Articulated 28 - 34 t	HD Euro III - 2000 Standards	38097	32842	30814	29033	34098	36800	42493	55900	42818	40392	35967	30874
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	41478	35756	33548	31610	37124	40066	46264	60862	46618	43977	39159	33614
Articulated 28 - 34 t	HD Euro V - 2008 Standards	32697	28187	26446	24918	29265	31584	36470	47977	36749	34667	30869	26498
Articulated 34 - 40 t	Conventional	21464	18503	17361	16358	19211	20733	23941	31495	24124	22757	20264	17395
Articulated 34 - 40 t	HD Euro I - 91/542/EEC Stage I	27594	23788	22319	21029	24698	26655	30778	40489	31014	29257	26051	22363
Articulated 34 - 40 t	HD Euro II - 91/542/EEC Stage II	32729	28214	26472	24942	29293	31615	36505	48024	36785	34701	30899	26524
Articulated 34 - 40 t	HD Euro III - 2000 Standards	39515	34064	31961	30114	35367	38170	44074	57981	44412	41896	37306	32024
Articulated 34 - 40 t	HD Euro IV - 2005 Standards	41889	36111	33881	31923	37492	40463	46722	61464	47080	44413	39547	33947
Articulated 34 - 40 t	HD Euro V - 2008 Standards	32697	28187	26446	24918	29265	31584	36470	47977	36749	34667	30869	26498
Articulated 40 - 50 t	Conventional	24780	21362	20043	18885	22179	23937	27639	36360	27851	26273	23394	20082
Articulated 40 - 50 t	HD Euro I - 91/542/EEC Stage I	30396	26203	24585	23165	27206	29362	33903	44601	34163	32228	28697	24634
Articulated 40 - 50 t	HD Euro II - 91/542/EEC Stage II	37401	32242	30251	28503	33476	36128	41717	54880	42036	39655	35310	30311
Articulated 40 - 50 t	HD Euro III - 2000 Standards	44665	38504	36126	34039	39977	43145	49818	65538	50200	47356	42167	36197
Articulated 40 - 50 t	HD Euro IV - 2005 Standards	41889	36111	33881	31923	37492	40463	46722	61464	47080	44413	39547	33947
Articulated 40 - 50 t	HD Euro V - 2008 Standards	32697	28187	26446	24918	29265	31584	36470	47977	36749	34667	30869	26498
Articulated 50 - 60 t	Conventional	22789	19645	18432	17367	20396	22013	25418	33438	25613	24161	21514	18468
Articulated 50 - 60 t	HD Euro I - 91/542/EEC Stage I	27066	23332	21891	20626	24225	26144	30188	39714	30420	28696	25552	21934
Articulated 50 - 60 t	HD Euro II - 91/542/EEC Stage II	32771	28250	26506	24975	29331	31656	36552	48086	36832	34745	30939	26558
Articulated 50 - 60 t	HD Euro III - 2000 Standards	39930	34422	32296	30430	35739	38571	44537	58590	44878	42336	37697	32360
Articulated 50 - 60 t	HD Euro IV - 2005 Standards	41889	36111	33881	31923	37492	40463	46722	61464	47080	44413	39547	33947
Articulated 50 - 60 t	HD Euro V - 2008 Standards	32697	28187	26446	24918	29265	31584	36470	47977	36749	34667	30869	26498
Urban CNG Buses	HD Euro I - 91/542/EEC Stage I	39677	30943	25082	26040	23903	22957	21690	37326	31970	28386	28095	25392
Urban CNG Buses	HD Euro II - 91/542/EEC Stage II	44225	34491	27957	29025	26643	25589	24176	41605	35634	31640	31316	28303
Urban CNG Buses	HD Euro III - 2000 Standards	47161	36780	29813	30952	28412	27288	25781	44367	38000	33741	33395	30182
Urban CNG Buses	EEV	47161	36780	29813	30952	28412	27288	25781	44367	38000	33741	33395	30182
Urban Biodiesel Buses	Conventional	24340	20982	19687	18549	21785	23511	27148	35714	27356	25806	22979	19725
Urban Biodiesel Buses	HD Euro I - 91/542/EEC Stage I	29582	25501	23926	22544	26477	28575	32995	43406	33247	31364	27928	23973

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Urban Biodiesel Buses	HD Euro II - 91/542/EEC Stage II	32973	28424	26669	25128	29512	31850	36777	48381	37059	34959	31129	26721
Urban Biodiesel Buses	HD Euro III - 2000 Standards	35162	30311	28440	26796	31471	33965	39219	51593	39519	37280	33196	28495
Urban Biodiesel Buses	HD Euro IV - 2005 Standards	34044	29348	27536	25945	30470	32885	37972	49953	38263	36095	32140	27590
Urban Biodiesel Buses	HD Euro V - 2008 Standards	46236	39858	37397	35236	41383	44662	51571	67843	51966	49022	43651	37470
Urban Buses Midi <=15 t	Conventional	22987	19816	18592	17518	20574	22204	25639	33729	25835	24371	21701	18629
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	28301	24398	22891	21568	25331	27338	31567	41527	31809	30007	26719	22936
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	30208	26041	24433	23021	27037	29179	33693	44324	33951	32028	28519	24481
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	32223	27778	26063	24557	28841	31126	35941	47281	36216	34164	30421	26114
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	30440	26241	24621	23198	27245	29404	33953	44666	34213	32274	28738	24669
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	30824	26572	24931	23491	27588	29775	34380	45229	34644	32681	29100	24980
Urban Buses Standard 15 - 18 t	Conventional	24340	20982	19687	18549	21785	23511	27148	35714	27356	25806	22979	19725
Urban Buses Standard 15 - 18 t	HD Euro I - 91/542/EEC Stage I	29582	25501	23926	22544	26477	28575	32995	43406	33247	31364	27928	23973
Urban Buses Standard 15 - 18 t	HD Euro II - 91/542/EEC Stage II	32973	28424	26669	25128	29512	31850	36777	48381	37059	34959	31129	26721
Urban Buses Standard 15 - 18 t	HD Euro III - 2000 Standards	35162	30311	28440	26796	31471	33965	39219	51593	39519	37280	33196	28495
Urban Buses Standard 15 - 18 t	HD Euro IV - 2005 Standards	34044	29348	27536	25945	30470	32885	37972	49953	38263	36095	32140	27590
Urban Buses Standard 15 - 18 t	HD Euro V - 2008 Standards	46236	39858	37397	35236	41383	44662	51571	67843	51966	49022	43651	37470
Urban Buses Articulated >18 t	Conventional	23317	20101	18859	17770	20870	22523	26007	34214	26207	24722	22013	18897
Urban Buses Articulated >18 t	HD Euro I - 91/542/EEC Stage I	29747	25644	24060	22670	26625	28735	33180	43649	33434	31540	28084	24108
Urban Buses Articulated >18 t	HD Euro II - 91/542/EEC Stage II	33507	28885	27101	25535	29990	32366	37373	49165	37659	35525	31633	27154
Urban Buses Articulated >18 t	HD Euro III - 2000 Standards	35562	30656	28763	27101	31829	34351	39665	52181	39969	37704	33573	28820
Urban Buses Articulated >18 t	HD Euro IV - 2005 Standards	33763	29106	27308	25731	30219	32614	37659	49541	37947	35797	31875	27362
Urban Buses Articulated >18 t	HD Euro V - 2008 Standards	46236	39858	37397	35236	41383	44662	51571	67843	51966	49022	43651	37470
Coaches Standard <=18 t	Conventional	23454	20218	18970	17874	20992	22655	26160	34414	26360	24867	22142	19007
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	27423	23640	22180	20899	24545	26490	30587	40238	30821	29075	25890	22224
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	30233	26062	24453	23040	27059	29204	33721	44361	33979	32054	28542	24501
Coaches Standard <=18 t	HD Euro III - 2000 Standards	32726	28212	26469	24940	29291	31612	36502	48019	36781	34698	30896	26521
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	34234	29512	27690	26090	30641	33069	38184	50233	38477	36297	32320	27744
Coaches Standard <=18 t	HD Euro V - 2008 Standards	46236	39858	37397	35236	41383	44662	51571	67843	51966	49022	43651	37470
Coaches Articulated >18 t	Conventional	23212	20010	18774	17689	20775	22422	25890	34059	26088	24610	21914	18811
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	27983	24123	22634	21326	25046	27031	31212	41061	31451	29669	26419	22678
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	31965	27555	25854	24360	28609	30877	35653	46902	35926	33890	30177	25905
Coaches Articulated >18 t	HD Euro III - 2000 Standards	33881	29207	27403	25820	30324	32727	37790	49714	38079	35922	31986	27457
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	33847	29178	27376	25794	30294	32694	37752	49664	38041	35886	31954	27430
Coaches Articulated >18 t	HD Euro V - 2008 Standards	46236	39858	37397	35236	41383	44662	51571	67843	51966	49022	43651	37470
<50 cm^3	Conventional	1920	1497	1213	1260	1156	1111	1049	1806	1547	1373	1359	1229
<50 cm^3	Mop - Euro I	2024	1578	1279	1328	1219	1171	1106	1904	1630	1448	1433	1295
<50 cm^3	Mop - Euro II	1501	1171	949	985	904	869	821	1412	1210	1074	1063	961
<50 cm^3	Mop - Euro III	1256	979	794	824	757	727	687	1181	1012	898	889	804
2-stroke >50 cm^3	Conventional	2855	2226	1805	1874	1720	1652	1561	2686	2300	2042	2022	1827
2-stroke >50 cm^3	Mot - Euro I	2978	2322	1882	1954	1794	1723	1628	2801	2399	2130	2108	1906

Subsector	Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
2-stroke >50 cm³	Mot - Euro II	3373	2630	2132	2214	2032	1952	1844	3173	2718	2413	2388	2159
2-stroke >50 cm³	Mot - Euro III	3457	2696	2185	2269	2083	2000	1890	3252	2786	2473	2448	2212
4-stroke <250 cm³	Conventional	3698	2884	2338	2427	2228	2140	2022	3479	2980	2646	2619	2367
4-stroke <250 cm³	Mot - Euro I	4113	3208	2600	2699	2478	2380	2248	3869	3314	2943	2912	2632
4-stroke <250 cm³	Mot - Euro II	3643	2841	2303	2391	2195	2108	1991	3427	2935	2606	2580	2331
4-stroke <250 cm³	Mot - Euro III	3891	3034	2459	2553	2344	2251	2127	3660	3135	2784	2755	2490
4-stroke 250 - 750 cm³	Conventional	3805	2968	2406	2497	2292	2202	2080	3580	3066	2722	2695	2435
4-stroke 250 - 750 cm³	Mot - Euro I	4281	3339	2706	2810	2579	2477	2340	4027	3449	3063	3031	2740
4-stroke 250 - 750 cm³	Mot - Euro II	3836	2992	2425	2518	2311	2220	2097	3609	3091	2745	2716	2455
4-stroke 250 - 750 cm³	Mot - Euro III	3891	3034	2459	2553	2344	2251	2127	3660	3135	2784	2755	2490
4-stroke >750 cm³	Conventional	3863	3013	2442	2535	2327	2235	2112	3634	3113	2764	2735	2472
4-stroke >750 cm³	Mot - Euro I	4403	3434	2783	2889	2652	2547	2407	4142	3547	3150	3118	2818
4-stroke >750 cm³	Mot - Euro II	3936	3070	2488	2583	2371	2278	2152	3703	3172	2816	2787	2519
4-stroke >750 cm³	Mot - Euro III	3891	3034	2459	2553	2344	2251	2127	3660	3135	2784	2755	2490