REPUBLIC OF BULGARIA
MINISTRY OF ENVIRONMENT AND WATER

EXECUTIVE ENVIRONMENT AGENCY

# NATIONAL INVENTORY REPORT 2013

## for Greenhouse Gas Emissions

## Submission under the UNFCCC and the Kyoto Protocol

May, 2013

Reporting Entity

Executive Environment Agency at the Ministry of Environment and Water

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# EXECUTIVE SUMMARY

ES 1 Background information on climate change

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

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

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

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

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

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

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

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

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

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

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

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

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

## ES 2 Background information on greenhouse gas inventories

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

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

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

This National Inventory Report (NIR) of Bulgaria for the 2013 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 2011. Full time series of the emissions and removals (with exception of F-gases) from 1988 to 2011 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

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

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

the guidance contained therein, developed by the UNFCCC secretariat in 2009, has been followed. Chapter 1 provides an introduction to the background of greenhouse gas inventories and the inventory preparation process and Chapter 2 presents the overall emission trend in Bulgaria from the year 1988 to the year 2011. 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 2011. The following are described as well:

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

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

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

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

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

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

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

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

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

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

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

The 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 Intergovernmental Panel of Climate Change (IPCC 2007), the atmospheric concentrations of $CO_2$ have increased by 35%, $CH_4$ concentrations have more than doubled and $N_2O$ concentration has risen by 18%, compared with the pre-industrial era.

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

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

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

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

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

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

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

### 1.1.2 BACKGROUND INFORMATION ON GREENHOUSE GAS INVENTORIES

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

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

The 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 2013 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 2011. Full time series of the emissions and removals (with exception of F-gases) from 1988 to 2011 are included in the submission.

The structure of this NIR was reelaborated in order to follow the UNFCCC reporting guidelines on annual inventories (UNFCCC 2006). The annotated outline of the NIR, and the guidance contained therein, developed by the UNFCCC secretariat in 2009, has been followed. Chapter 1 provides an introduction to the background of greenhouse gas inventories and the inventory preparation process and Chapter 2 presents the overall emission trend in Bulgaria from the year 1988 to the year 2011. 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 2011. 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 1988-2011 in the Common Reporting Format (CRF) for annual GHG inventories are submitted together with the Report and are uploaded on:

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

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

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

### 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 transparency, accuracy, consistency, comparability and completeness of the inventories:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1996 IPCC GL)
- IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories 2000 (GPG 2000)
- IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry 2003 (GPG LULUCF 2003)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC GL)
- EMEP/EEA air pollutant emission inventory guidebook – 2009.[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 2013 update of the Action Plan is presented in Chapter 1.4. The activities for improvement of quality of GHGs inventory are planned in order to implement the recommendations of the Expert Review Team set out in the annual review report FCCC/ARR/2011/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 2008-2013) | Prospected BGNIS |
|---|---|---|
| ← | Centralized inventory | → |
| Single institute | Single agency | → |
| Out-sourced inventory | In-sourced inventory | → |
| **Private consultants** | **Public/Governmental** (submission with cooperation of consultants) | → |
| National Inventory Focal Point: Private consultants | National Inventory Focal Point: ExEA | → |
| ← | National Focal Point: MoEW | → |

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

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

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

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

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

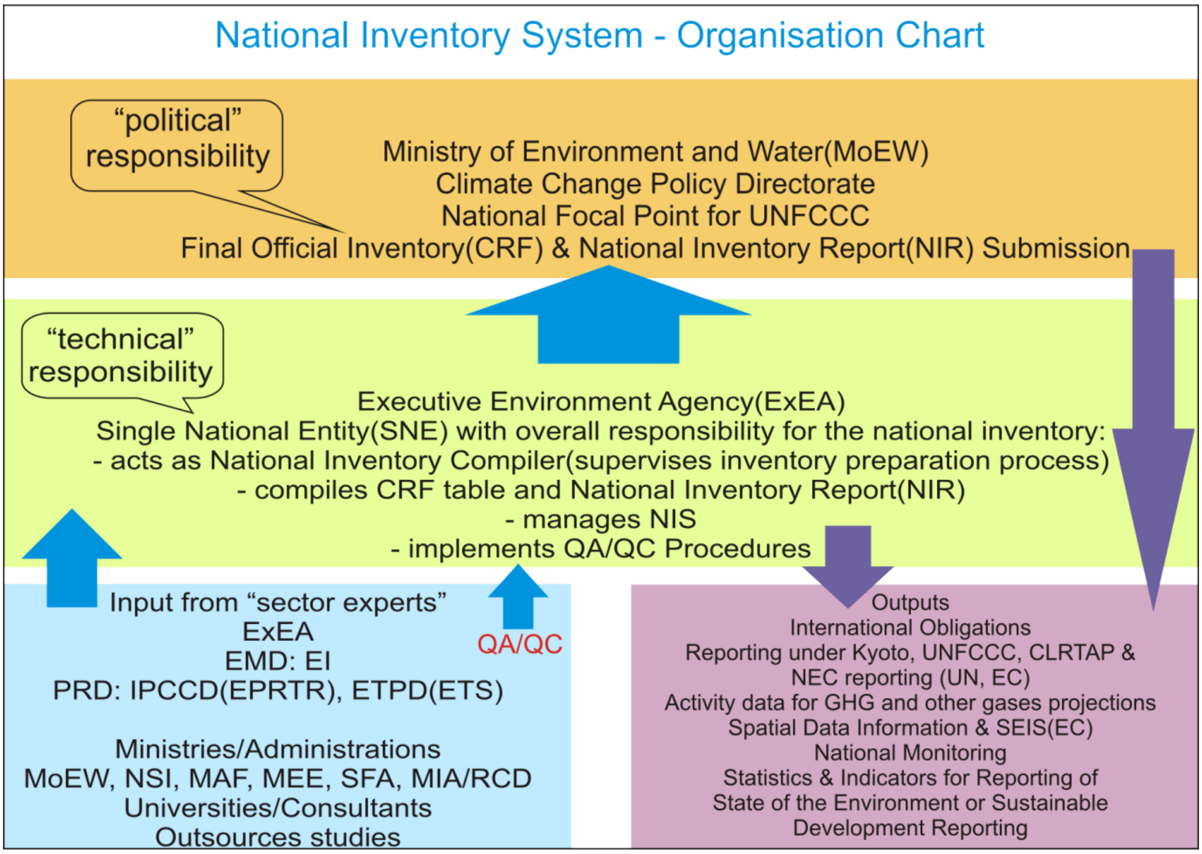


Figure 1 Organizational Chart of the Bulgarian National Inventory System

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

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

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

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

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

Amendment of the Environmental Protection 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

In 2011 two JI projects were approved according to the national JI Guidance and procedures.

Development of the Third National Action Plan on Climate Change

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

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

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

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

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

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

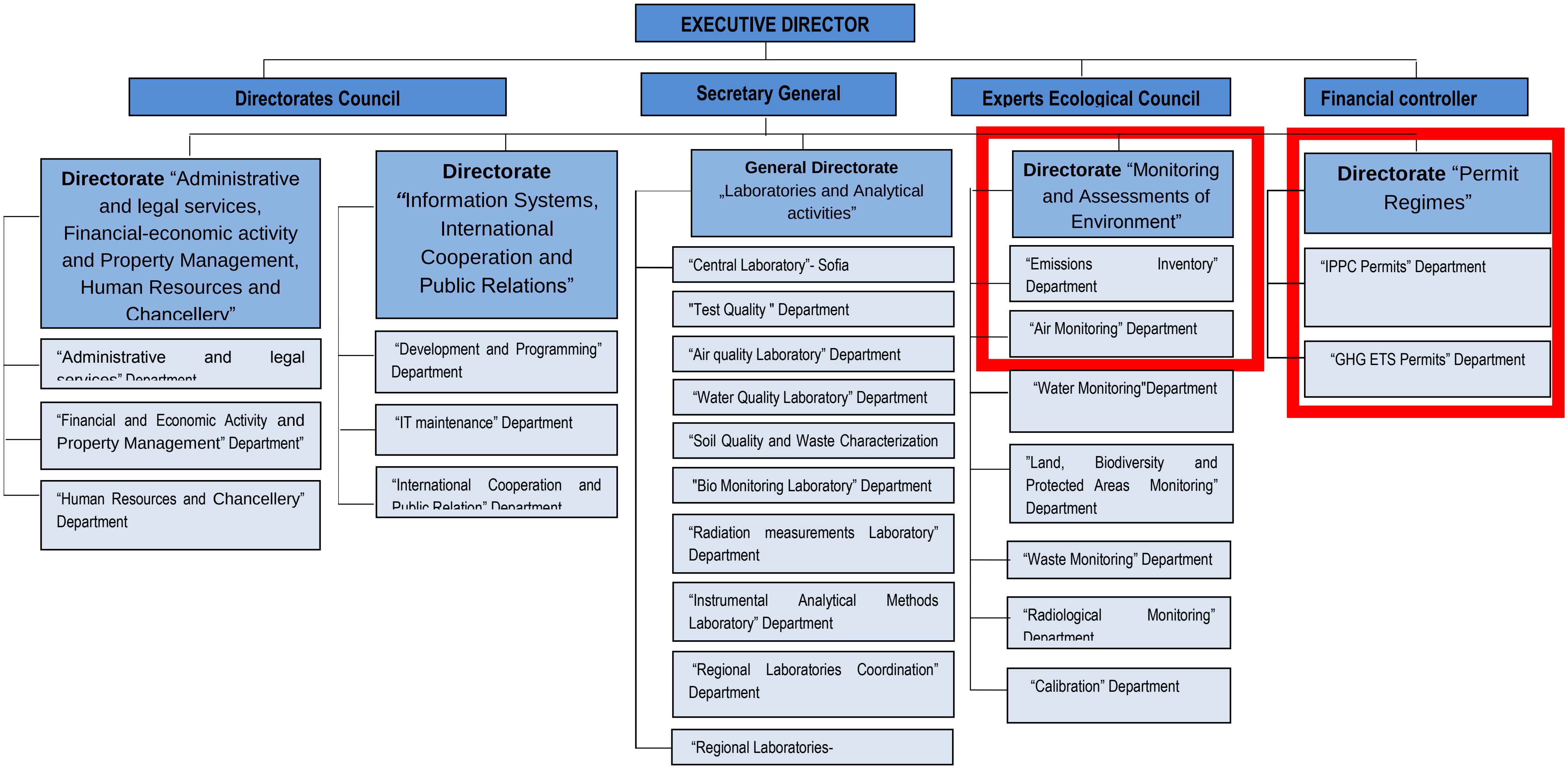


Figure 2 Organizational Chart of the Executive Environmental Agency (ExEA)

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

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

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

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

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

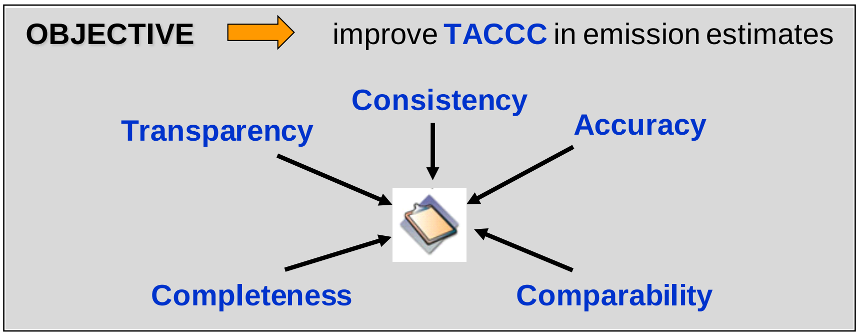


Figure 3 Objectives of the Bulgarian National Inventory System

### 1.2.3 LEGAL BASIS OF THE BGNIS - GENERAL FUNCTIONS

**Fulfillment of paragraph 10(a)**

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

**Legal basis of the BGNIS**

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

National Focal Point;

QA experts from Climate Change Policy Directorate;

Approval of inventory;

Submission of CRF / NIR / Kyoto Tables / SEF.

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

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

The bases for BGNIS are:

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

Statute on the organization and structure of ExEA (Decision of Council of ministers 162/03.08.2012 – final update 16.03.2012);

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 November 2012), which establishes the National Environmental Monitoring System, make clear the responsibility for preparation inventories under both conventions and lists of its tasks:

Chapter One: GENERAL DISPOSITIONS

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

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

**Article 13:**

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

The Executive Environment Agency shall be a legal person.

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

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

Chapter Eight: NATIONAL ENVIRONMENTAL MONITORING SYSTEM

Article 144:

The National Environmental Monitoring System shall comprehend:

1. the national networks for:

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

**Add 2.**

EPA establishes the national Executive Environment Agency (ExEA) according to **Regulation on the organization and structure of ExEA** (Decision of Council of ministers 162/03.08.2012 - final update16.03.2012), 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 Forest 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 – official letters (questionnaire)
- Branch Business Associations – official letters (questionnaire)

and aggregates on a national level the data relevant for GHG emissions

### 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<br>National VOC register | NSI<br>ExEA | National statistical Institute<br>Executive Environment Agency |
| 4. Agriculture | National agriculture statistics | MAF | Ministry of Agriculture and Food/Statistics Department |
| 5. LULUCF | National Forest Inventory | EFA | Executive Forest Agency |
| 6. Waste | National statistics | NSI | National Statistical Institute |
| | National studies | ExEA | Executive Environment Agency/ Waste Department |

### 1.2.7 PROCEDURAL ARRANGEMENTS

The inventory preparation process covers:

- Identification key source categories[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

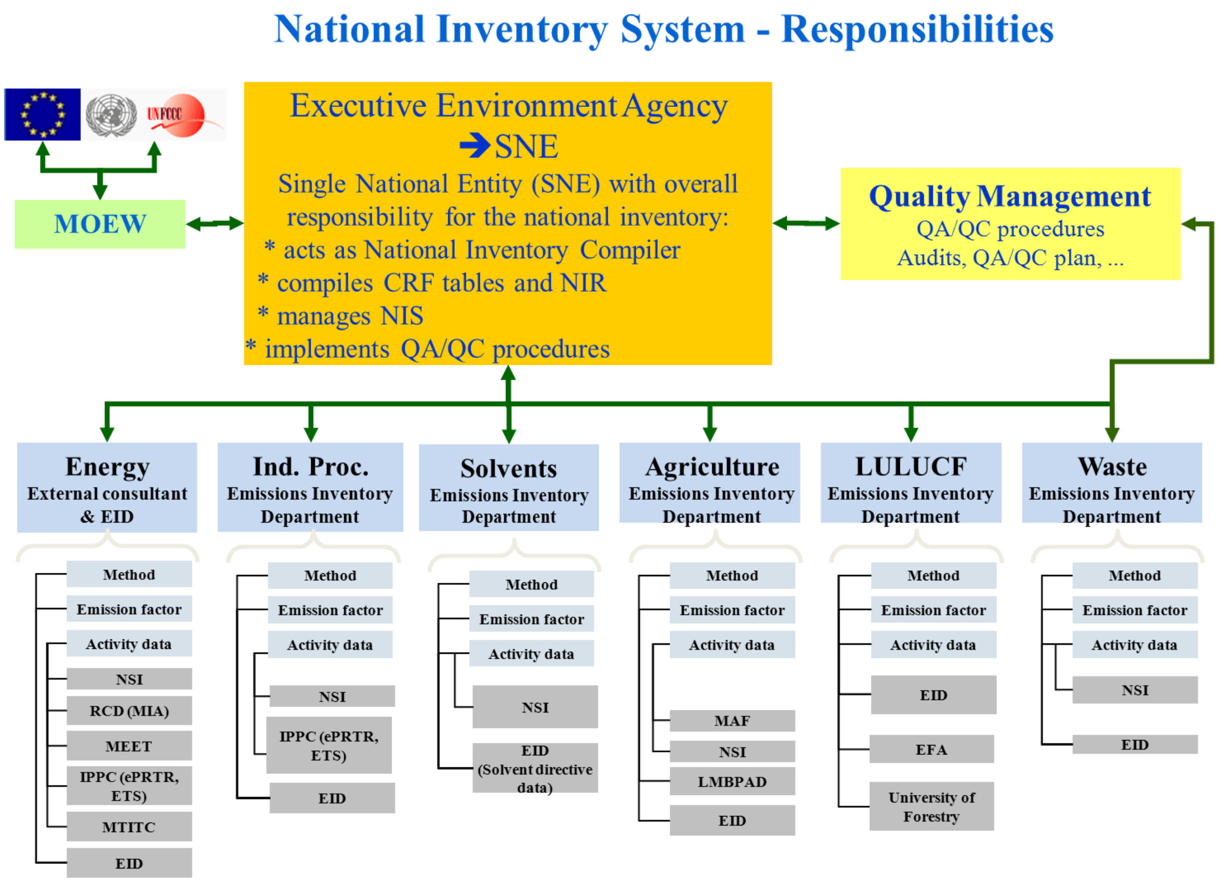


Figure 4 Bulgarian National Inventory System – Responsibilities

The following table presents the responsibilities of all engaged institutions for preparation of GHGs emission inventory for 2013 submission.

Table 2 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 consultants |
| Energy/Transport CRF1A3 | NSI<br>MI<br>MTITC | ExEA, NSI MI, MTITC | External consultants |
| Energy CRF1B | NSI<br>MEET | ExEA, NSI, MEET | External consultants |
| Industry processes CRF2 | NSI<br>ExEA<br>MOEW | ExEA, NSI, Branch chambers, Installations operators | Sector expert ExEA |
| Solvents use CRF3 | NSI<br>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<br>ExEA | ExEA, NSI | Sector expert ExEA |

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

### 1.2.8 EXPERT CAPACITY IN EXEA

**Expert capacity in ExEA - Emission Inventory Department**

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

The responsibilities of the Sector experts

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

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

Engaged departments within ExEA

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

Additionally to the existing experts in Emissions Inventory Department, there are one expert from Air Monitoring Department and two sector experts for 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.

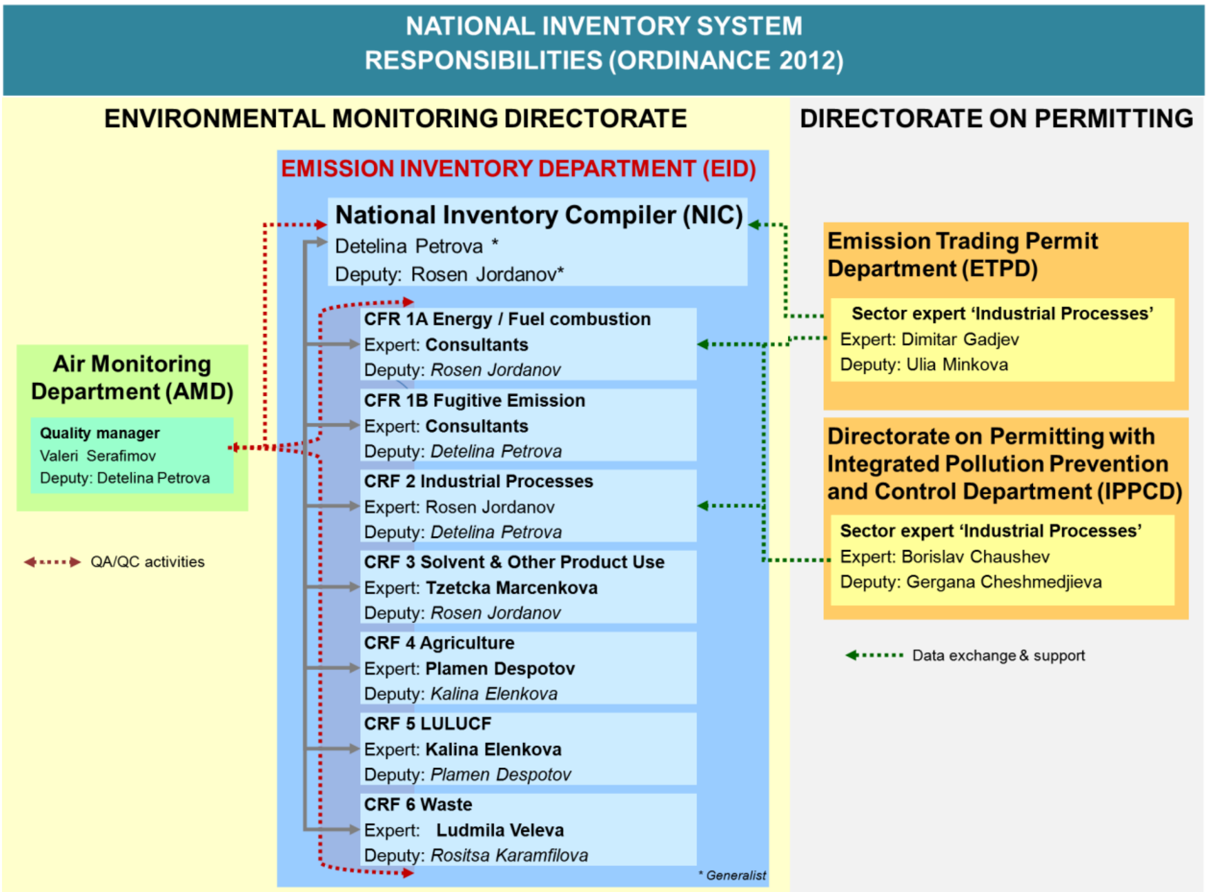


Figure 5 ExEA capacity for ensuring the function of BGNIS

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 2013 submission

In order to support ExEA staff in preparation of 2013 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 2013 submission

| Consultant | Cooperation agreements | Responsibilities and outputs |
|---|---|---|
| **Denkstatt** | Preparation of 2013 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<br>Training of ExEA's staff |
| **External consultant In collabouration with Executive Forest Agency** | Revision of KP-LULUCF activity data. The contract № 2446 was signed on 04.02.2013 | Support of ExEA staff in preparation of 2013 submission (KP-LULUCF tables) |

### 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.

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

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

[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

### 1.2.10 UNFCCC REPORTING GUIDELINES AND SUPPLEMENTARY INFORMATION

**Fulfilment of paragraph 10(d);**

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

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

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

**Fulfilment of paragraph 10(c)**

See below

### 1.2.11 LEGAL BASIS OF THE BGNIS - SPECIFIC FUNCTIONS

**SINGLE NATIONAL ENTITY**

**Fulfilment of paragraph 12(a)**

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

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

The Executive Environment Agency (ExEA) has been identified as the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and

the Kyoto Protocol and designated as single national entity. ExEA has the technical responsibility for the national inventory:

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

**Fulfilment of paragraph 12(b)**

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

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Sofia 1618, Bulgaria

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E-Mail: vgrigorova@eea.government.bg

E-mail: ncesd@eea.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

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**Name of Quality Manager: Valeri Serafimov**

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Tel.: +359 2 940 64 87

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**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.

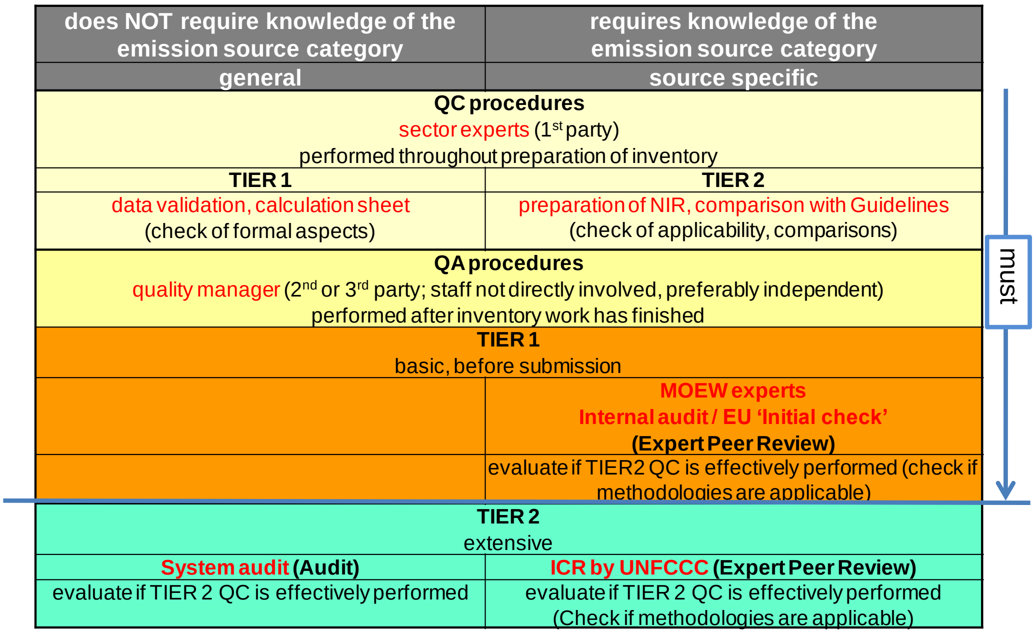


Figure 6 National quality assurance and quality control program

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 4 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 2013 submission the QA procedures are implemented by sector experts within the MoEW and experts from the ExEA, who are not directly involved in the preparation of inventory (Order № RD-218/05.03.2010 by the minister) or external reviewers.

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

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

#### 1.2.12.1 Information of the QA/QC activities

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

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

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

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

Table 5 Comparison of IPCC GPG and ISO 9001

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

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

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

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

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

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

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

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

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

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

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

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

**Documentation and data archiving**

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

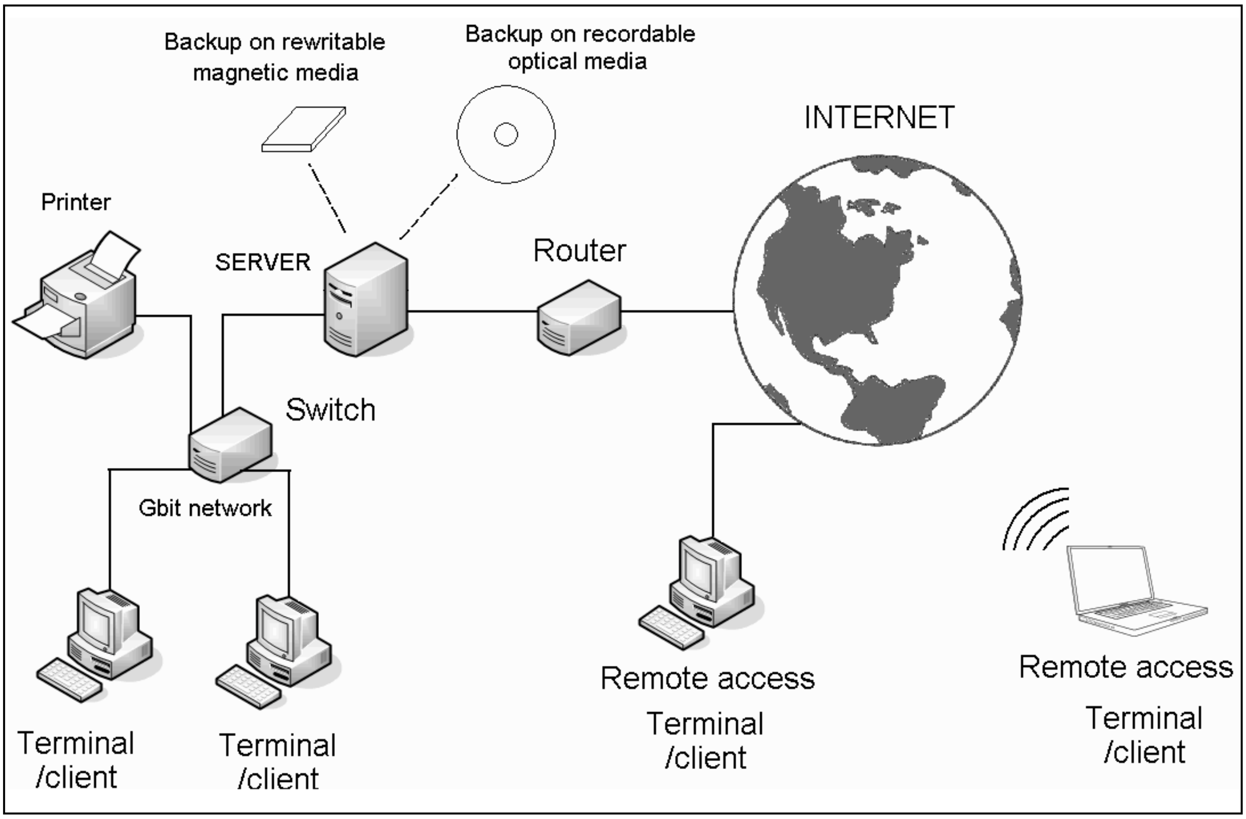


Figure 7 Documentation and data archiving in ExEA

#### 1.2.12.1.1 QA/QC activities of data provider

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

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

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

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

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

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

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

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

Table 6 Responsibilities in the exchange of check lists between QC experts for 2013 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 |
| 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 2013 submission the QA procedures are implemented by sector experts within the MoEW and experts from the ExEA, who are not directly involved in the preparation of inventory (Order № RD-218/05.03.2010 by the minister) or external reviewers

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

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

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

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

Table 7 Responsibilities in exchange of the check lists between QA experts and sector experts for 2013 submission

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

#### 1.2.12.1.2 Quality Management of the Sources of Initial Data

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

#### 1.2.12.1.3 Official consideration and approval of the inventory

**Fulfilment of paragraph 12(e)**

**Official consideration and approval of the inventory**

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

#### 1.2.12.1.4 Quality improvement

**Fulfilment of paragraph 13**

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

The objectives of the project are:

Third-party audit[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 outcomes are partly implemented in Submission 2013 and are to be completed in Submission 2014.

### 1.2.13 INVENTORY PREPARATION

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

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

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

### 1.2.14 KEY CATEGORY ANALYSIS

**Fulfilment of paragraph 14(a)**

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

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

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

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

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

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

### 1.2.15 NATIONAL INVENTORY METHODOLOGY

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

The most recent greenhouse gas inventory for the period 1988 to 2011 (NIR 2013) 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 2011, submission 2013 v1.3.

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

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

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

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

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

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

## 1.2.16 UNCERTAINTY

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

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

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

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

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

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

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

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

### 1.2.17 QC PROCEDURES

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

**QC procedures**

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

### 1.2.18 WORK PLAN FOR SUBMISSION 2014

**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 2014 submission.

Table 10 Preparation of GHGs emission inventory for 2014 submission

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

The Work plan for preparation and submission of National GHGs inventory in 2014 is presented in the next table.

Table 11 Work plan for GHGs inventory preparation and submission 2014

| Action | Responsible organization | Initial Deadline | Final Deadline | Comment |
|---|---|---|---|---|
| Sending of statistic questionnaire to all enterprises in the country | NSI with its regional inspectorates | 31.03.13 | 15.06.13 | 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 | 31.03.13 | 15.06.13 | |
| QA/QC Procedures - Implementation of the requirements of National QA/QC Plan. | NSI MAF, MEE, MEW, SFA, RCD | 15.06.13 | 30.09.13 | 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 | 30.09.13 | 30.10.13 | |
| QA/QC Procedures - Implementation of the requirements of National QA/QC Plan | ExEA | 30.10.13 | 15.11.13 | 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 | | 30.11.13 | |
| Preliminary estimation of emissions | ExEA, external consultants | | 15.12.13 | |
| Provision of corrected activity data as a result of QA/QC procedures to ExEA | NSI MAF, MEET, MEW, EFA, MIA | | 20.12.13 | |
| Recalculation of emissions, based on the corrected activity data of inventory in the required format for reporting | ExEA and external consultant | | 31.12.13 | |
| Preparation of Preliminary national inventory report (NIR) to the UNFCCC and EU decisions. | ExEA | | 10.01.14 | |
| Submission of national GHG inventory under the MM with the draft NIR. | ExEA | | 15.01.14 | Delivered to Eionet Central Data Repository |
| Submission of final | ExEA | | 15.03.14 | Delivered to Eionet |

| Action | Responsible organization | Initial Deadline | Final Deadline | Comment |
|---|---|---|---|---|
| national GHG inventory and NIR. | | | | Central Data Repository |
| Submission of the final GHG inventory and NIR after the European Commission comments | MEW ExEA | | 15.04.14 | Official submission to UNFCCC Delivered to Eionet Central Data Repository |
| Documentation and archiving of inventory. Preparation of inventory management report | ExEA | | 15.05.14 | |
| Preparation of QA/QC plan for the next inventory. | ExEA | | 15.06.14 | |

### 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). For the uncertainties of the national total emissions, estimated by Tier 2 analysis (the Monte Carlo approach) in Submission

2012, Bulgaria decided to perform the Monte Carlo analysis every two-years instead of every year. The next Tier 2 analysis will be provided in submission 2014.

### 1.3.1 GHG INVENTORY

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

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

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

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

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

Two rules are applied in this process:

Rule A - combination of the uncertainty by summing;

Rule B - combination of the uncertainty by multiplying.

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

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

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

Combined uncertainty as a part of overall emissions for 2011 for every source has been calculated as following equation:

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

where MCUi – measured combined uncertainty,

$EM_i$ - source emissions for 2011,

$EM_{total}$ – total country emissions for 2011,

$CN_i$ – combined uncertainty of the i-th source.

Uncertainty of the overall emissions trend for 2011 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 2011 (row 7, column H in Table 6.1 of the GPG), and the overall emission trend related to the base

inventory year until 2011 (row 7, column M in Table 6.1.) are given in Table 12. The relevant data for the previous inventory for 2010 are given for comparison (NIR 2012 and NIR 2013).

Table 12 Uncertainty in total GHG emissions, %

| Uncertainty | Uncertainty NIR 2012 | Uncertainty NIR 2013 |
|---|---|---|
| Uncertainty in total GHG emissions | 14.60 % | 13.35 % |
| Overall uncertainty into the trend in total GHG emissions | 3.05 % | 4.23 % |

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

### 1.3.2 KP-LULUCF INVENTORY

An assessment of the uncertainties of emissions/removals of the ARD units based on Tier 2 method will be presented for submission 2014..

## 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 2013:

Table 13 Completeness of national inventory

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

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

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

### 1.4.2 KP-LULUCF INVENTORY

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

# 2 TRENDS IN GREENHOUSE GAS EMISSIONS

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

In 2011 Bulgaria's greenhouse gas emissions totalled 66 133,28 Gg CO2 without reporting of sequestration from LULUCF sector. The emissions decreased by 45,8% compared with the base year and on 45.8% below the level of 122000 Gg CO2 to which Bulgaria should limit its emissions during the Kyoto Protocol's first commitment period between 2008 and 2012. Emissions in 2011 were 9.6 % increase in comparison with the emissions of the previous year.

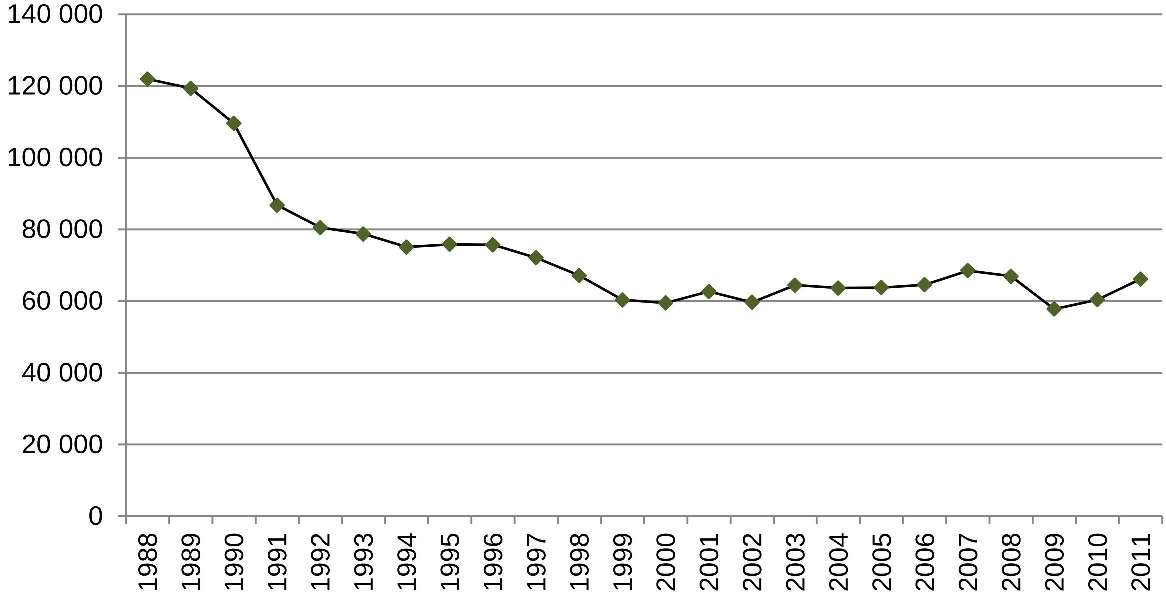



Figure 8 Total GHG emissions (without LULUCF) for 1988 – 2011, Gg $CO_2$ eq.

The net emissions including reporting of sequestration from LULUCF sector were 57 747.13 Gg CO2 eq. The emissions decreased by 46.4% compared with the base year.

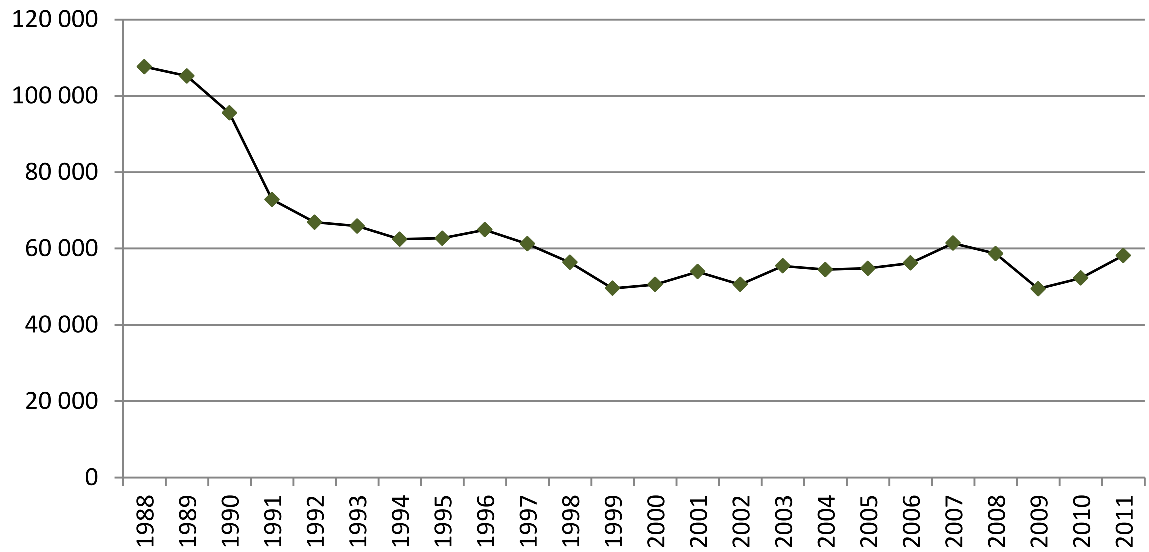



Figure 9 Total GHG emissions (with LULUCF) for 1988 – 2011, Gg $CO_2$ eq.

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

Bulgaria experienced a steady declining population trend during the period 1990-2011, which resulted in the reduction of population by 13%.

## 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 varies around 80% excluding LULUCF and 77% including LULUCF. In absolute terms $CO_2$ emissions have decreased 40,9% since 1988. Around 75% 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 55,4% 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 67% which has been occasioned mostly by the reduced nitrogen fertilisation of agricultural fields, the biggest decline was in the beginning of time series.

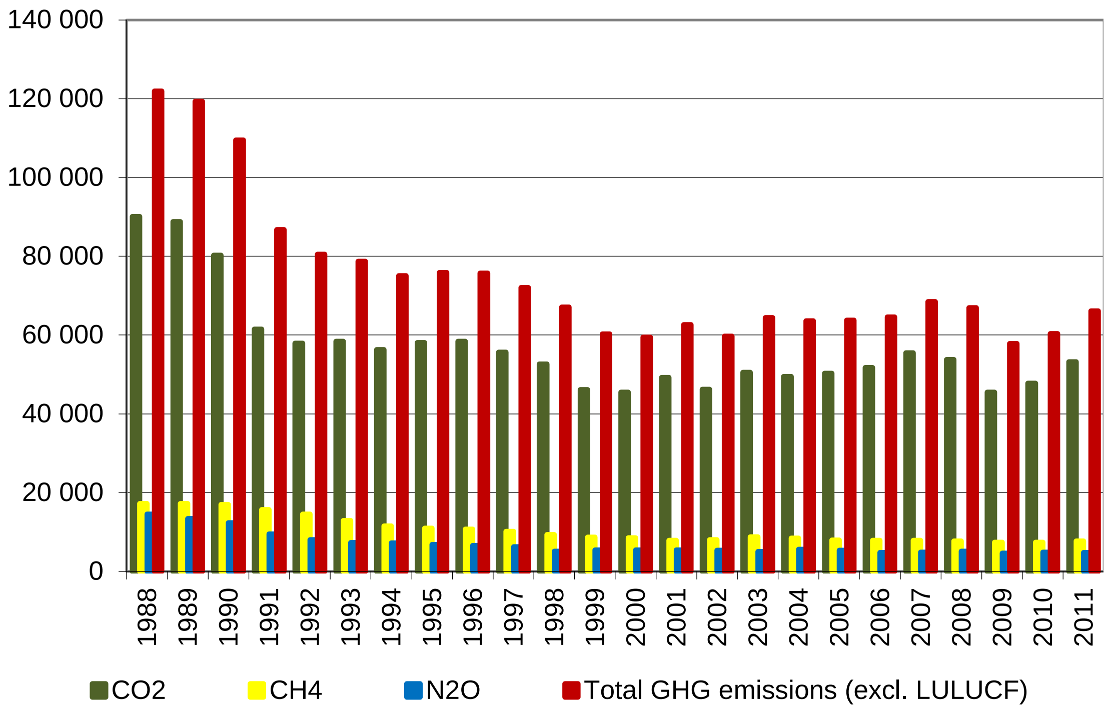



Figure 10 Total GHG emissions in Gg $CO_2$ eq. for 1988 – 2011.

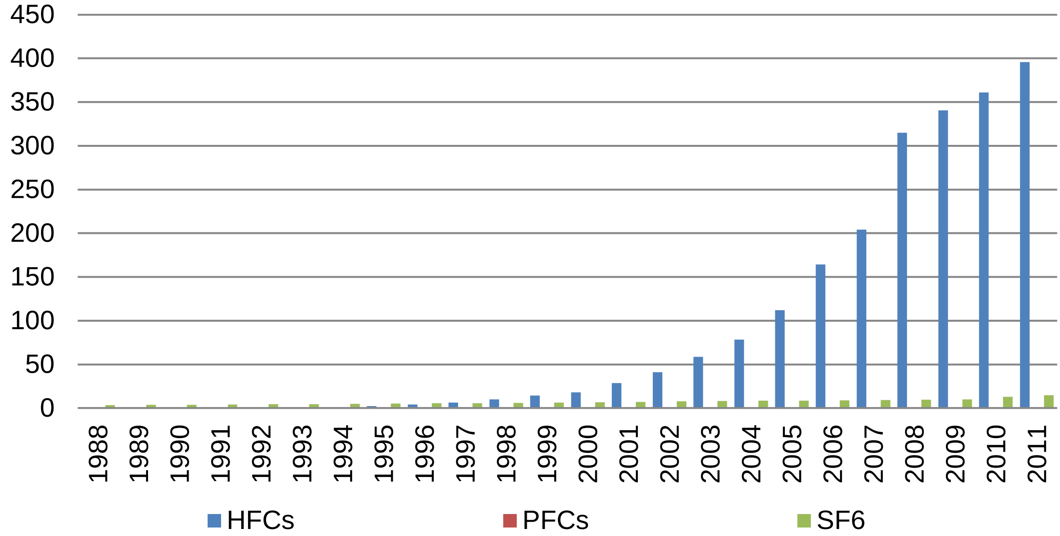



Figure 11 Actual emissins of HFCs, PFCs and SF6 for 1988 – 2011, Gg $CO_2$ eq.

The emissions of F-gases have increased over tenfold during 1995-2011. 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

Figure 12 below shows the GHG aggregated emission trends by IPCC sectors. The Energy sector, where GHG emissions come from fuel combustion, headed the list in 2011 with the biggest share – 79%. Sector Agriculture ranked the second place with 9% and sectors IP/Waste ranked the third place with 6%.

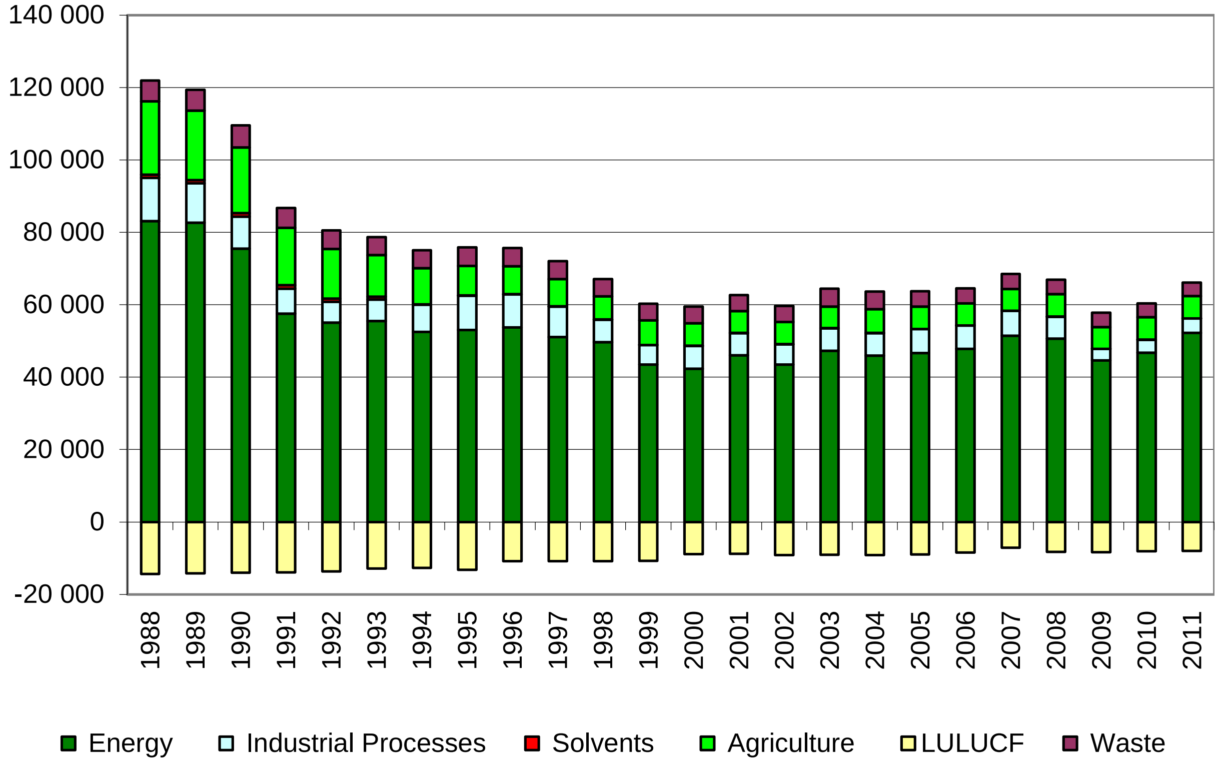



Figure 12 Total greenhouse gas emissions in $CO_2$-eq. per IPCC sector 1988-2011

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

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Change from base to latest reported year |
|---|---|
| 1. Energy | -37,17 |
| 2. Industrial Processes | -66,74 |
| 3. Solvent and Other Product Use | -95,41 |
| 4. Agriculture | -69,57 |
| 5. Land Use, Land-Use Change and Forestry(5) | -40,63 |
| 6. Waste | -34,67 |
| 7. Other | 0,00 |
| Total (including LULUCF) | -46,42 |

### Energy

Emissions from the energy sector in 2011 decreased by 37.17% compared to the base year (51 072 Gg CO2e in 2011 compared to 83 081 Gg CO2e in 1988), although there is an increase of 12% compared to last year. Main source of emissions in the Energy sector is Fuel combustion of solid fuels, which is responsible for 65.8% of the emissions.

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

The trend of GHG emissions between 1988 and 2011 was defined by a substancial decrease of emissions from fuel combustion in energy industries (13.7%) and energy use in manufacturing industry and construction (79.1%) and in other sectors (64.9%), as well as a clear increase in GHG emissions from transport (10.1%).

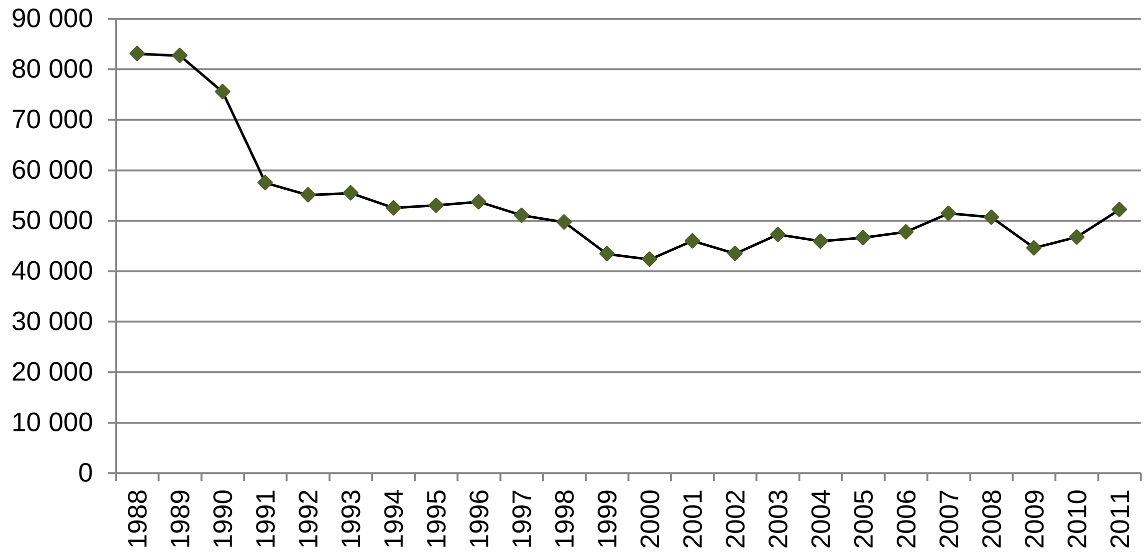



Figure 13 GHG emissions from Energy sector for 1988 – 2011, Gg $CO_2$ eq.

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

**Industrial Processes**

A steady trend towards emission reduction in this sector is observed since 1988. The emissions in 2011 decreased with 67% compared to the base year.

In the year 2011, 6.01% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes, compared to 9.81% in the base year 1988. In 2011, greenhouse gas emissions from Industrial Processes are 3 977.93 Gg CO2 equivalent compared to 11 959.94 Gg in the base year.

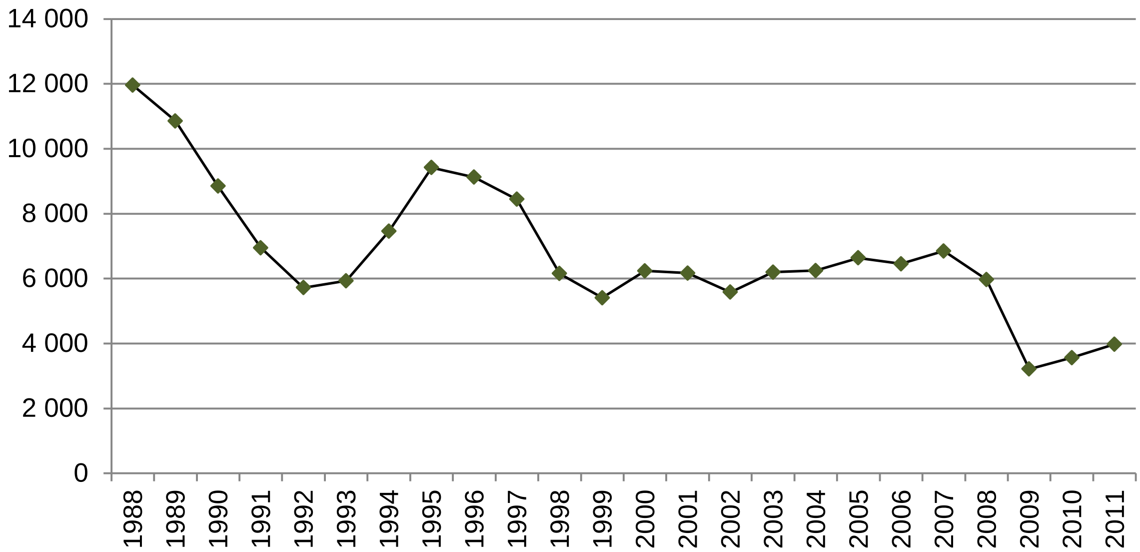



Figure 14 GHG emissions from Industrial processes sector for 1988 – 2011, Gg $CO_2$ eq.

In 2011 the most important emitting category is Mineral products (mainly clinker production), which share in the total Industrial processes emissions is 68.4%. The second category by share is Chemical Industry (ammonia and nitric acid production) with 19.6%, followed by Consumption of Halocarbons and SF6 with 10.3% share and finally Metal Production (steel) with 1.7%.

Greenhouse gas emissions from the Industrial Processes sector fluctuate during the period and reach a minimum in 2009. The reduction in 2011 for the whole sector is 66.7% while the biggest reduction (compared to the base year) can be seen in Metal Production category – 98.2%.

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 2010 – 2011 the market was 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

### Solvent and Other Product Use

The emissions in 2011 decreased with 95,41% compared to the base year.

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

### Agriculture

The overall emission reduction in the sector has amounted to 69.6% since 1988. In the year 2011 the sector agriculture contributed 9.3% to the total of Bulgaria's greenhouse gas emissions (without LULUCF).

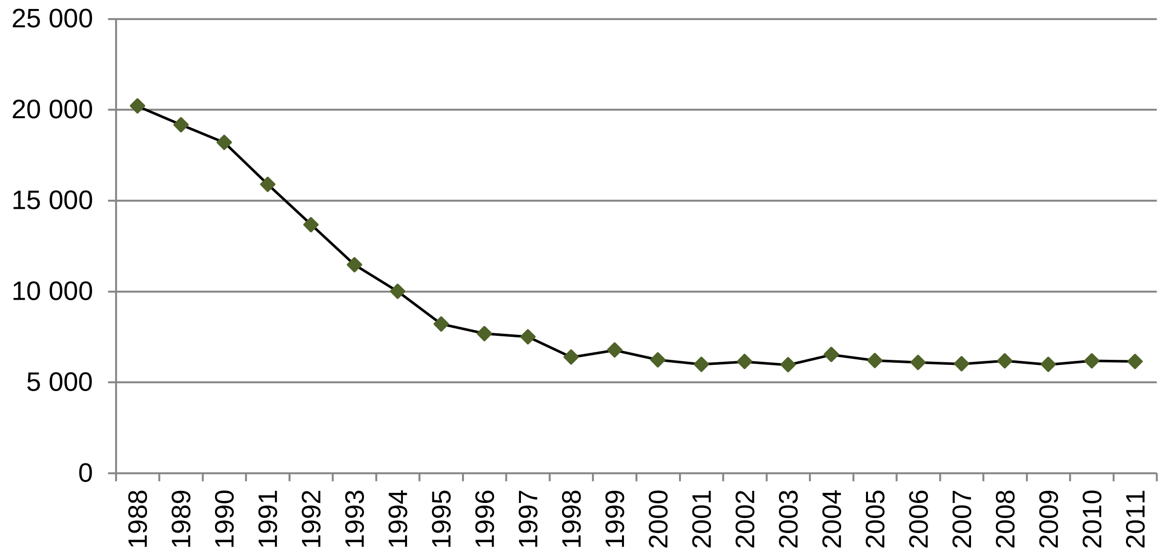



Figure 15 GHG emissions from Agriculture sector for 1988 – 2011, Gg $CO_2$ eq.

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

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

**Land-Use Change and Forestry**

The trend of net CO2 removals (CO2 eq) from LULUCF decreases by 40.63% 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 1990-2011 a permanent trend is observed for increasing the tree biomass stock (by 47% for the coniferous species and by 23% for the deciduous).

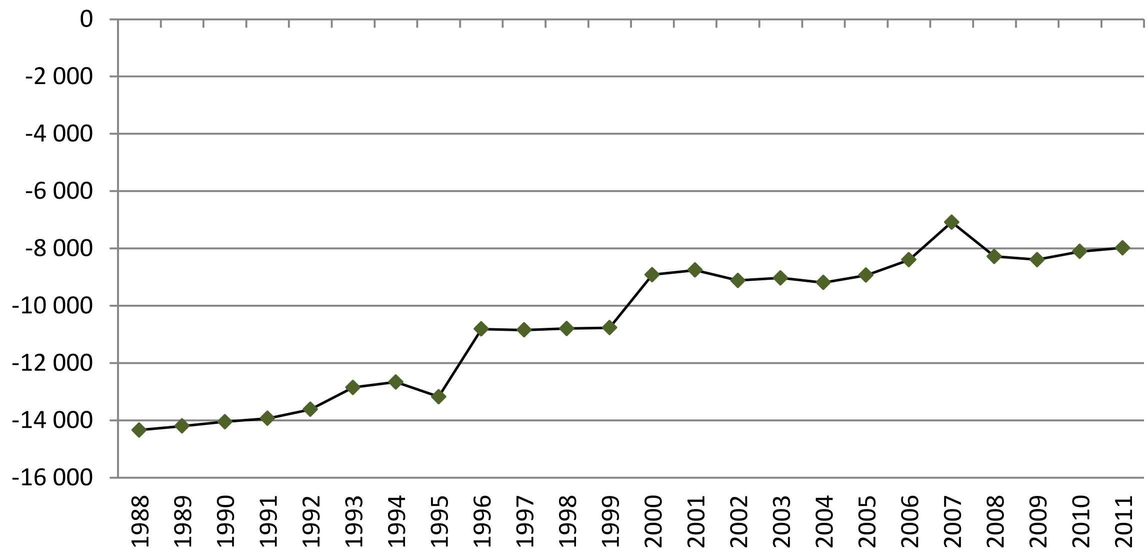



Figure 16 LULUCF emissions and removals for 1988 – 2011 $CO_2$ eq.

In spite of the decrease observed, the share of the removals from the total GHG emissions (in CO2 eq) 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 -11.8% from the total GHG emissions in $CO_2$ eq, while in the inventoried year the share is -12.1%.

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.

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 34,67 %. The decline was mainly driven by a steady population decline over the past 10 years.

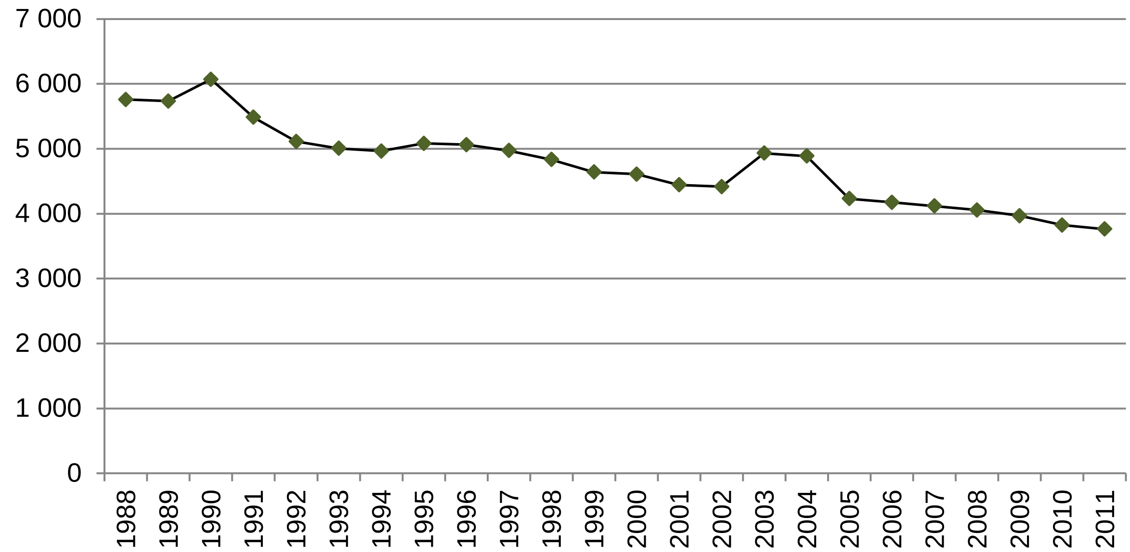



Figure 17 GHG emissions from Waste sector for 1988 – 2011, Gg $CO_2$ eq.

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

## 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 third time, thus trends are not available. Net removals from AR in 2011 are 1 544,28 Gg CO2 eq and net emissions from D activities are 174,8 Gg CO2 eq. More information about activities under Article 3.3 of Kyoto Protocol is described in Chapter 11.

# 3 ENERGY (CRF CATEGORY 1)

## 3.1 OVERVIEW OF SECTOR

This chapter provides information about the GHG emission estimates from the energy sector. Following the IPCC guidelines, Energy sector consists of these categories:

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

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

Emissions from the energy sector are the main source of GHGs in Bulgaria: in 2011 the sector is responsible for 78.9% of national total GHGs emissions (52 204 Gg $CO_2$e from sector 1A of the total 66 133 Gg $CO_2$e excl. LULUCF).

## 3.2 EMISSION TREND

Emissions from the energy sector in 2011 decreased by 37.2% compared to the base year (52 204 Gg $CO_2$e in 2011 compared to 83 081 Gg $CO_2$e in 1988). The increasing trend of the emissions continues in 2011, reaching an increase of 11.7% compared to previous year.

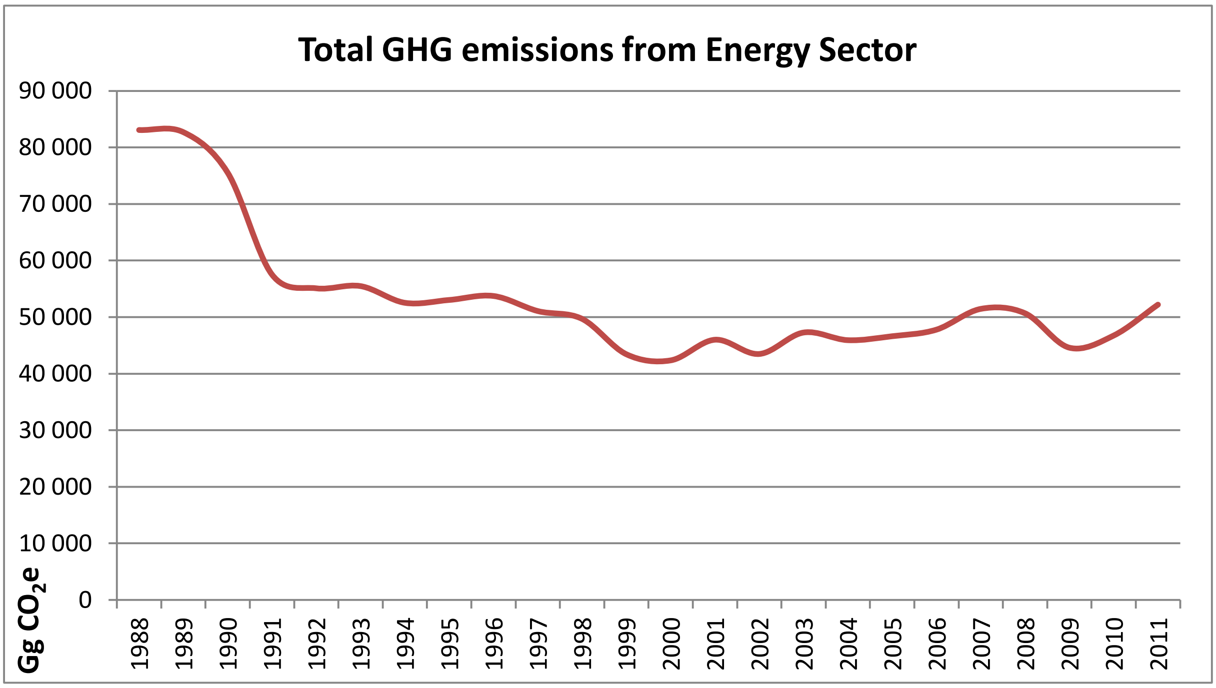



Figure 18 Total GHG emissions from Energy Sector

Main source of emissions in the energy sector is fuel combustion of solid fuels, which is responsible for 68.5% of the emissions from fuel combustion in 2011, followed by liquid fuels with 20.2% and gaseous fuels with 10.7%.

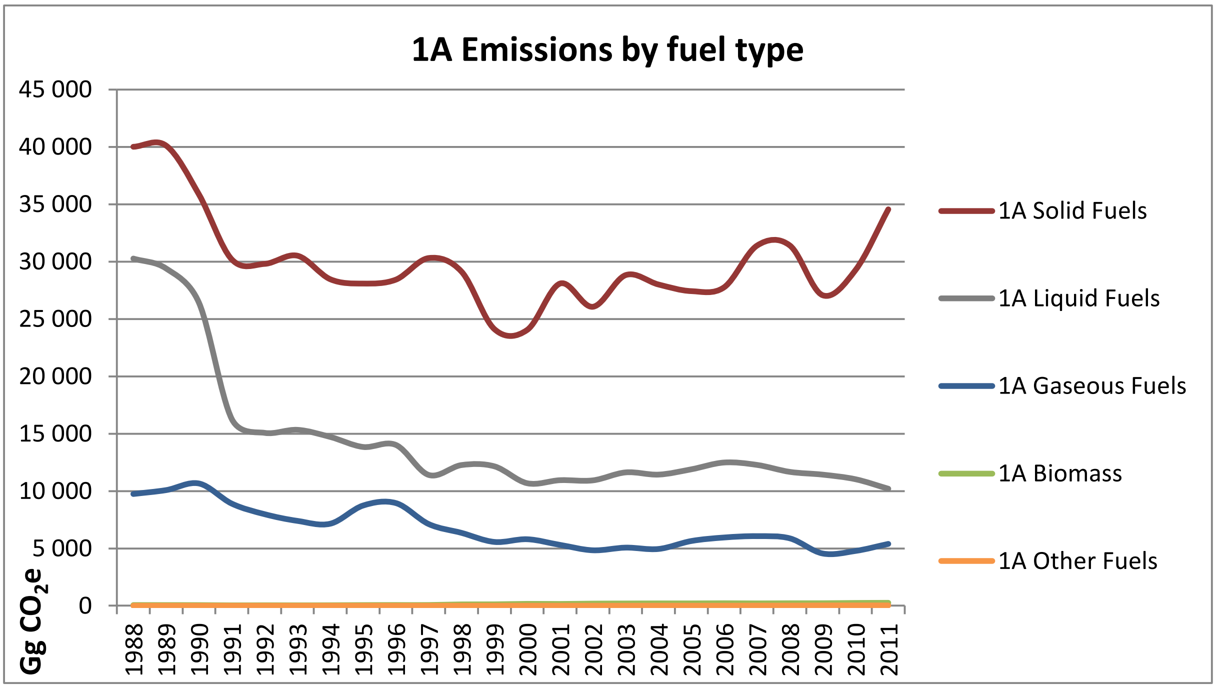



Figure 19 GHG emissions from fuel combustions by fuel type

On a subcategory level, energy industries is the major source of emissions, responsible for 72.1% of the emissions from fuel combustion, followed by transport with 16.1% and manufacturing industries and construction with 7.3%.

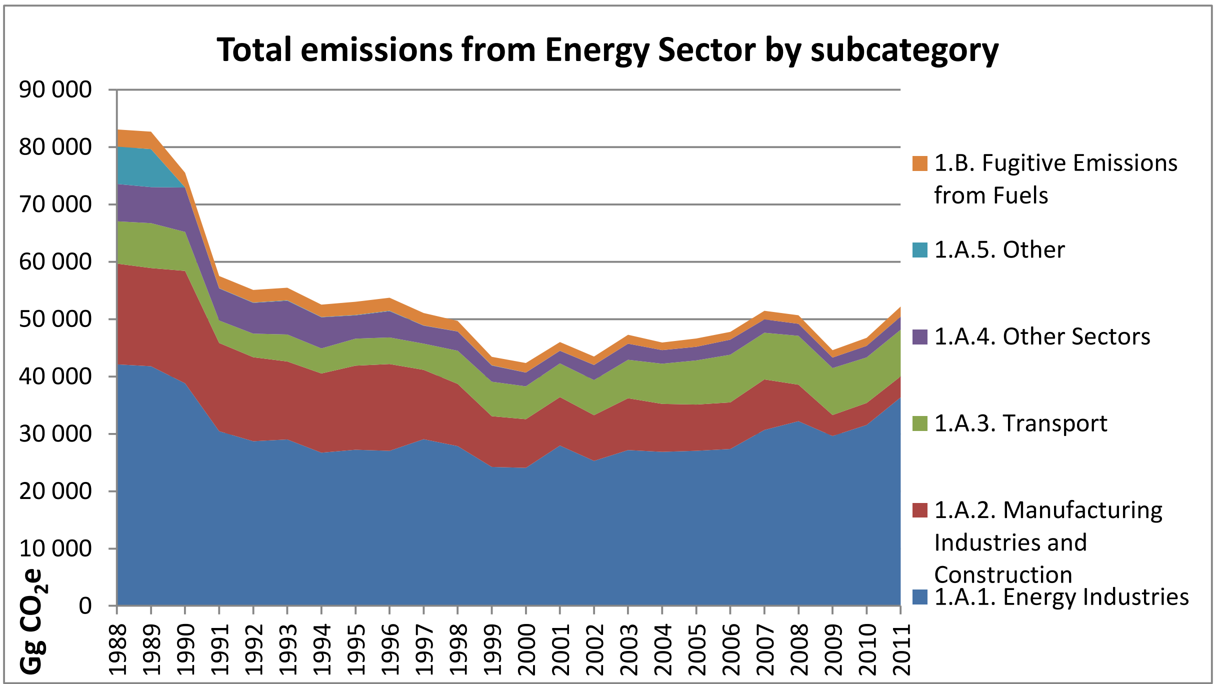



Figure 20 Total GHG emissions from Energy Sector by subcategory

Total emissions from energy sector mainly consist of $CO_2$; with total amount of 49 878.66 Gg for 2011, followed by $CH_4$ and $N_2O$, which only make up about 97.26 Gg and 0.91 Gg, respectively.

Table 15 Emissions of GHG and their trends for the years 1988 – 2011

| Year | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | Total GHG [Gg $CO_2$e] |
|---|---|---|---|---|
| **1988** | 79 349.99 | 162.06 | 1.06 | 83 081.19 |
| **1989** | 78 911.89 | 164.34 | 1.07 | 82 693.62 |
| **1990** | 72 288.33 | 138.01 | 1.11 | 75 529.23 |
| **1991** | 54 892.97 | 113.86 | 0.77 | 57 523.16 |
| **1992** | 52 345.45 | 119.24 | 0.79 | 55 092.99 |
| **1993** | 52 636.61 | 119.73 | 1.07 | 55 481.56 |
| **1994** | 49 743.92 | 115.19 | 1.19 | 52 530.51 |
| **1995** | 50 031.38 | 121.41 | 1.45 | 53 029.69 |
| **1996** | 50 725.09 | 121.55 | 1.48 | 53 737.18 |
| **1997** | 48 293.60 | 114.42 | 1.21 | 51 071.54 |
| **1998** | 47 153.62 | 100.35 | 1.39 | 49 691.24 |
| **1999** | 41 317.14 | 81.50 | 1.30 | 43 432.39 |
| **2000** | 40 089.77 | 90.36 | 1.17 | 42 350.74 |
| **2001** | 43 938.11 | 81.65 | 1.13 | 46 003.93 |
| **2002** | 41 392.85 | 82.52 | 1.15 | 43 482.29 |
| **2003** | 45 063.59 | 88.02 | 1.18 | 47 276.42 |
| **2004** | 44 076.91 | 75.53 | 0.85 | 45 925.29 |
| **2005** | 44 669.01 | 80.45 | 0.86 | 46 624.35 |
| **2006** | 45 891.46 | 77.13 | 0.88 | 47 785.38 |
| **2007** | 49 427.63 | 83.17 | 0.91 | 51 455.98 |
| **2008** | 48 646.26 | 83.26 | 0.91 | 50 677.34 |
| **2009** | 42 809.55 | 73.19 | 0.80 | 44 593.44 |
| **2010** | 44 809.14 | 79.62 | 0.84 | 46 741.61 |
| **2011** | 49 878.66 | 97.26 | 0.91 | 52 203.73 |

## 3.3 FUEL COMBUSTION (CRF 1.A)

### 3.3.1 COMPARISON OF THE SECTORAL APPROACH WITH THE REFERENCE APPROACH

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

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

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

- Energy Industries, including Public Electricity and Heat Production, Petroleum Refining and Manufacture of Solid Fuels and Other Energy Industries;
- Manufacturing Industries and Construction, including Iron and Steel, Non-Ferrous Metals, Chemicals, Pulp, Paper and Print, Food Processing, Beverages and Tobacco and Other

- Transport, including Civil Aviation, Road Transportation, Railways, Navigation and Other Transportation
- Other Sectors, including Commercial / Institutional, Residential, Agriculture / Forestry / Fisheries
- Other Stationary and Mobile sources

#### 3.3.1.1 Methodology

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

#### 3.3.1.2 Results of the reference approach

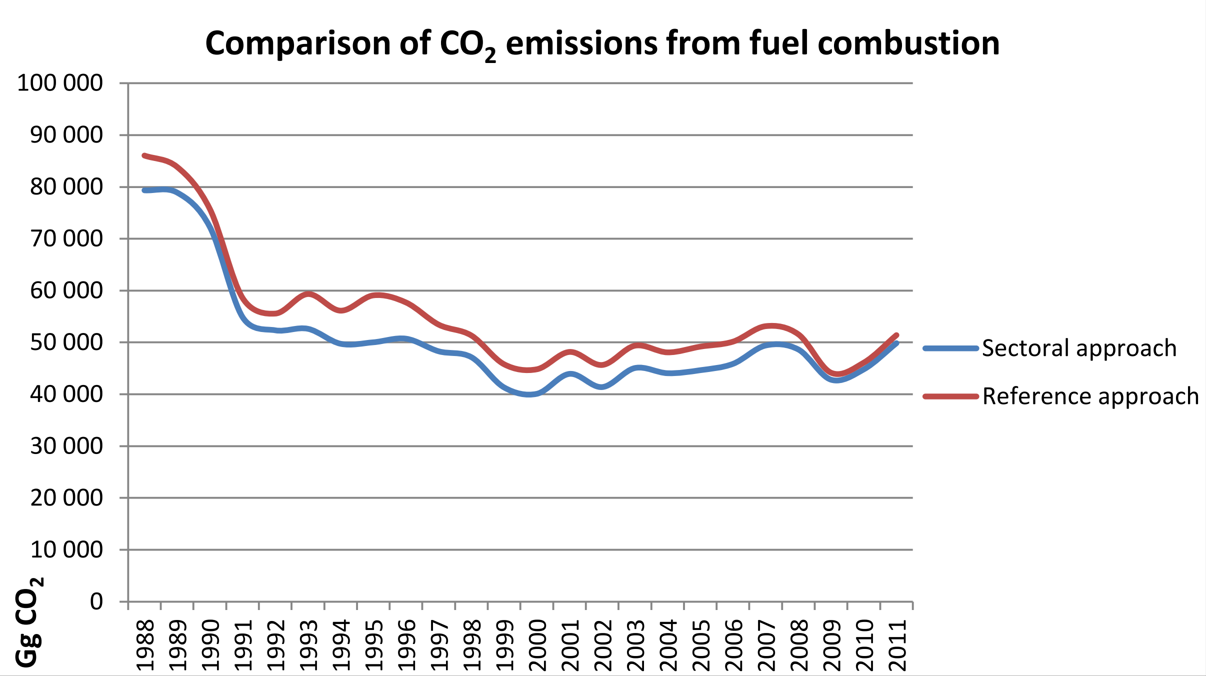



Figure 21 Comparison of the sectoral approach with the reference approach

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

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

| Year | Energy consumption, PJ | | Difference | $CO_2$ Emissions, Gg | | Difference |
|---|---|---|---|---|---|---|
| | Reference approach | Sectoral approach | | Reference approach | Sectoral approach | |
| **1988** | 1104.66 | 972.04 | 13.64% | 86051.76 | 79344.98 | 8.45% |
| **1989** | 1081.75 | 967.71 | 11.78% | 83851.73 | 78906.97 | 6.27% |
| **1990** | 984.42 | 898.37 | 9.58% | 75746.72 | 72284.19 | 4.79% |
| **1991** | 756.88 | 677.93 | 11.65% | 58587.68 | 54889.16 | 6.74% |
| **1992** | 706.76 | 639.35 | 10.54% | 55563.86 | 52340.75 | 6.16% |
| **1993** | 752.73 | 640.74 | 17.48% | 59338.29 | 52631.10 | 12.74% |
| **1994** | 711.74 | 606.38 | 17.37% | 56127.52 | 49739.30 | 12.84% |
| **1995** | 761.93 | 618.69 | 23.15% | 59077.92 | 50026.61 | 18.09% |
| **1996** | 745.34 | 627.76 | 18.73% | 57707.56 | 50721.24 | 13.77% |
| **1997** | 669.91 | 576.32 | 16.24% | 53427.23 | 48290.32 | 10.64% |
| **1998** | 643.57 | 561.81 | 14.55% | 51333.42 | 47150.38 | 8.87% |
| **1999** | 573.39 | 499.23 | 14.85% | 45783.48 | 41313.64 | 10.82% |

| Year | Energy consumption, PJ | | Difference | $CO_2$ Emissions, Gg | | Difference |
|---|---|---|---|---|---|---|
| | Reference approach | Sectoral approach | | Reference approach | Sectoral approach | |
| **2000** | 563.54 | 483.78 | 16.49% | 44819.69 | 40086.68 | 11.81% |
| **2001** | 592.86 | 517.83 | 14.49% | 48164.88 | 43935.10 | 9.63% |
| **2002** | 557.01 | 488.27 | 14.08% | 45649.58 | 41389.84 | 10.29% |
| **2003** | 599.84 | 529.35 | 13.32% | 49371.85 | 45061.12 | 9.57% |
| **2004** | 582.81 | 519.25 | 12.24% | 48085.78 | 44060.68 | 9.14% |
| **2005** | 608.24 | 532.74 | 14.17% | 49192.22 | 44644.19 | 10.19% |
| **2006** | 622.60 | 549.41 | 13.32% | 50150.49 | 45867.44 | 9.34% |
| **2007** | 651.27 | 584.40 | 11.44% | 53136.25 | 49413.34 | 7.53% |
| **2008** | 630.02 | 569.61 | 10.60% | 51562.11 | 48635.40 | 6.02% |
| **2009** | 533.12 | 501.30 | 6.35% | 44153.75 | 42807.31 | 3.15% |
| **2010** | 544.86 | 519.39 | 4.90% | 46100.43 | 44804.55 | 2.89% |
| **2011** | 601.88 | 571.15 | 5.38% | 51409.50 | 49858.21 | 3.11% |

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

| Year | Energy consumption, PJ | | Difference | $CO_2$ Emissions, Gg | | Difference |
|---|---|---|---|---|---|---|
| | Reference approach | Sectoral approach | | Reference approach | Sectoral approach | |
| **1988** | 490.37 | 402.67 | 21.78% | 33938.12 | 30019.13 | 13.05% |
| **1989** | 475.20 | 391.24 | 21.46% | 32802.72 | 29139.37 | 12.57% |
| **1990** | 395.24 | 352.93 | 11.99% | 27118.88 | 26133.80 | 3.77% |
| **1991** | 244.48 | 217.54 | 12.38% | 16446.90 | 16121.38 | 2.02% |
| **1992** | 220.05 | 200.50 | 9.75% | 14797.14 | 14912.62 | -0.77% |
| **1993** | 250.55 | 203.87 | 22.90% | 16686.74 | 15087.47 | 10.60% |
| **1994** | 232.94 | 194.97 | 19.48% | 15662.08 | 14425.11 | 8.58% |
| **1995** | 251.79 | 182.75 | 37.78% | 16773.53 | 13473.23 | 24.50% |
| **1996** | 227.35 | 185.10 | 22.83% | 14796.47 | 13647.37 | 8.42% |
| **1997** | 185.57 | 150.91 | 22.97% | 11873.74 | 11136.17 | 6.62% |
| **1998** | 198.14 | 162.61 | 21.85% | 12480.02 | 11944.03 | 4.49% |
| **1999** | 186.09 | 162.15 | 14.77% | 11955.02 | 11839.00 | 0.98% |
| **2000** | 172.92 | 142.66 | 21.21% | 11020.10 | 10417.60 | 5.78% |
| **2001** | 174.04 | 147.26 | 18.18% | 11011.07 | 10713.65 | 2.78% |
| **2002** | 180.52 | 145.64 | 23.95% | 12225.45 | 10691.94 | 14.34% |
| **2003** | 186.56 | 155.80 | 19.74% | 12377.61 | 11395.15 | 8.62% |
| **2004** | 177.58 | 154.65 | 14.83% | 11769.60 | 11306.68 | 4.09% |
| **2005** | 201.32 | 160.24 | 25.64% | 13353.38 | 11765.11 | 13.50% |
| **2006** | 208.93 | 168.44 | 24.04% | 13778.93 | 12352.99 | 11.54% |
| **2007** | 199.31 | 165.49 | 20.43% | 13140.73 | 12151.92 | 8.14% |
| **2008** | 194.93 | 158.30 | 23.14% | 12573.38 | 11546.73 | 8.89% |
| **2009** | 176.09 | 155.13 | 13.51% | 11835.98 | 11324.06 | 4.52% |
| **2010** | 159.97 | 147.67 | 8.33% | 11273.69 | 10929.48 | 3.15% |
| **2011** | 152.34 | 138.35 | 10.11% | 10475.29 | 10105.42 | 3.66% |

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

| Year | Energy consumption, PJ | | Difference | $CO_2$ Emissions, Gg | | Difference |
|---|---|---|---|---|---|---|
| | Reference approach | Sectoral approach | | Reference approach | Sectoral approach | |
| **1988** | 406.48 | 392.24 | 3.63% | 41255.08 | 39596.16 | 4.19% |
| **1989** | 392.62 | 393.17 | -0.14% | 39853.85 | 39699.92 | 0.39% |
| **1990** | 363.29 | 351.69 | 3.30% | 36776.27 | 35508.01 | 3.57% |

| Year | Energy consumption, PJ | | Difference | $CO_2$ Emissions, Gg | | Difference |
|---|---|---|---|---|---|---|
| | Reference approach | Sectoral approach | | Reference approach | Sectoral approach | |
| **1991** | 319.10 | 298.59 | 6.87% | 32078.08 | 29880.51 | 7.35% |
| **1992** | 316.44 | 293.81 | 7.70% | 31962.99 | 29460.95 | 8.49% |
| **1993** | 342.98 | 302.43 | 13.41% | 34416.23 | 30159.49 | 14.11% |
| **1994** | 318.86 | 281.45 | 13.29% | 32075.99 | 28175.31 | 13.84% |
| **1995** | 318.20 | 277.17 | 14.80% | 32121.49 | 27832.36 | 15.41% |
| **1996** | 322.21 | 280.05 | 15.05% | 32575.01 | 28142.06 | 15.75% |
| **1997** | 329.43 | 296.05 | 11.28% | 33542.09 | 30048.69 | 11.63% |
| **1998** | 314.43 | 283.78 | 10.80% | 32150.90 | 28866.34 | 11.38% |
| **1999** | 274.83 | 235.99 | 16.46% | 28072.65 | 23921.65 | 17.35% |
| **2000** | 267.89 | 235.75 | 13.63% | 27289.20 | 23881.16 | 14.27% |
| **2001** | 304.18 | 274.16 | 10.95% | 31015.88 | 27925.87 | 11.07% |
| **2002** | 275.91 | 254.75 | 8.30% | 28168.06 | 25871.30 | 8.88% |
| **2003** | 308.62 | 281.45 | 9.65% | 31482.54 | 28607.33 | 10.05% |
| **2004** | 300.87 | 274.62 | 9.56% | 30733.87 | 27809.28 | 10.52% |
| **2005** | 289.51 | 269.92 | 7.26% | 29534.14 | 27242.42 | 8.41% |
| **2006** | 292.22 | 272.88 | 7.09% | 29888.37 | 27574.24 | 8.39% |
| **2007** | 325.92 | 308.55 | 5.63% | 33278.65 | 31196.25 | 6.68% |
| **2008** | 313.08 | 304.44 | 2.84% | 32447.24 | 31216.54 | 3.94% |
| **2009** | 266.57 | 263.23 | 1.27% | 27514.16 | 26913.84 | 2.23% |
| **2010** | 288.58 | 284.68 | 1.37% | 29708.08 | 29081.21 | 2.16% |
| **2011** | 339.37 | 334.70 | 1.39% | 34969.82 | 34345.65 | 1.82% |

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

| Year | Energy consumption, PJ | | Difference | $CO_2$ Emissions, Gg | | Difference |
|---|---|---|---|---|---|---|
| | Reference approach | Sectoral approach | | Reference approach | Sectoral approach | |
| **1988** | 207.81 | 177.13 | 17.32% | 10858.56 | 9729.69 | 11.60% |
| **1989** | 213.92 | 183.29 | 16.71% | 11195.16 | 10067.68 | 11.20% |
| **1990** | 225.89 | 193.75 | 16.59% | 11851.57 | 10642.38 | 11.36% |
| **1991** | 193.31 | 161.80 | 19.47% | 10062.69 | 8887.27 | 13.23% |
| **1992** | 170.27 | 145.05 | 17.39% | 8803.74 | 7967.18 | 10.50% |
| **1993** | 159.19 | 134.43 | 18.42% | 8235.32 | 7384.14 | 11.53% |
| **1994** | 159.94 | 129.97 | 23.06% | 8389.45 | 7138.89 | 17.52% |
| **1995** | 191.94 | 158.77 | 20.89% | 10182.89 | 8721.02 | 16.76% |
| **1996** | 195.78 | 162.61 | 20.40% | 10336.08 | 8931.82 | 15.72% |
| **1997** | 154.90 | 129.36 | 19.75% | 8011.40 | 7105.47 | 12.75% |
| **1998** | 131.01 | 115.42 | 13.50% | 6702.51 | 6340.01 | 5.72% |
| **1999** | 112.46 | 101.10 | 11.25% | 5755.80 | 5553.00 | 3.65% |
| **2000** | 122.73 | 105.37 | 16.48% | 6510.39 | 5787.91 | 12.48% |
| **2001** | 114.64 | 96.41 | 18.91% | 6137.92 | 5295.58 | 15.91% |
| **2002** | 100.58 | 87.87 | 14.47% | 5256.06 | 4826.59 | 8.90% |
| **2003** | 104.65 | 92.10 | 13.64% | 5511.70 | 5058.64 | 8.96% |
| **2004** | 104.36 | 89.95 | 16.02% | 5582.31 | 4941.27 | 12.97% |
| **2005** | 117.40 | 102.54 | 14.50% | 6304.70 | 5633.86 | 11.91% |
| **2006** | 121.44 | 108.07 | 12.37% | 6483.19 | 5938.57 | 9.17% |
| **2007** | 126.04 | 110.25 | 14.33% | 6716.88 | 6055.45 | 10.92% |
| **2008** | 122.01 | 106.77 | 14.27% | 6541.48 | 5864.39 | 11.55% |
| **2009** | 90.47 | 82.68 | 9.41% | 4803.61 | 4546.99 | 5.64% |
| **2010** | 96.31 | 86.70 | 11.09% | 5118.66 | 4768.75 | 7.34% |

| Year | Energy consumption, PJ | | Difference | $CO_2$ Emissions, Gg | | Difference |
|---|---|---|---|---|---|---|
| | Reference approach | Sectoral approach | | Reference approach | Sectoral approach | |
| **2011** | 110.17 | 97.80 | 12.65% | 5964.40 | 5380.73 | 10.85% |

#### 3.3.1.3 Explanation of differences

A comparison between the Reference Approach (RA) and the Sectoral Approach (RA) indicates a difference of 5.38% in terms of energy consumption and 3.11% in terms of $CO_2$ emissions for 2011.

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. While this is generally true in the long term, the resulting emissions are excluded from the Sectoral approach and instead reported mostly in the IP sector. This could lead to a consistent difference between the two approaches, especially for gaseous fuels, where the default fraction of carbon stored from natural gas used as feedstock is rather low.

Additional reasons for differences between the two approaches are the significant statistical differences and losses reported for some of the years in the national energy balances.

The highest differences are observed in the period 1993-1996, and most notably 1995. The analysis showed that the main reason for this are the differences in liquid fuels consumption resulting from the significant amounts of refinery loses reported (9.52% of total refinery intake in 1995 was reported as refinery losses, with an average of 3.9% for the period 1990-2011).

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

### 3.3.2 INTERNATIONAL BUNKER FUELS

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

Table 20 GHG Emissions from International bunker fuels

| Year | Total [Gg $CO_2e$] | Aviation [Gg $CO_2e$] | Marine [Gg $CO_2e$] |
|---|---|---|---|
| **1988** | 1 668 | 589 | 1 080 |
| **1989** | 1 555 | 441 | 1 114 |
| **1990** | 965 | 720 | 245.95 |
| **1991** | 1 634 | 472 | 1 162 |
| **1992** | 1 917 | 847 | 1 070 |
| **1993** | 2 176 | 1 136 | 1 040 |
| **1994** | 1 973 | 921 | 1 052 |
| **1995** | 1 998 | 914 | 1 083 |
| **1996** | 1 541 | 600 | 941 |

| Year | Total [Gg $CO_2e$] | Aviation [Gg $CO_2e$] | Marine [Gg $CO_2e$] |
|---|---|---|---|
| **1997** | 472 | 444 | 29 |
| **1998** | 615 | 393 | 222 |
| **1999** | 240 | 213 | 26 |
| **2000** | 448 | 245 | 203 |
| **2001** | 622 | 317 | 305 |
| **2002** | 712 | 379 | 333 |
| **2003** | 919 | 485 | 434 |
| **2004** | 832 | 468 | 364 |
| **2005** | 922 | 574 | 348 |
| **2006** | 881 | 549 | 332 |
| **2007** | 719 | 554 | 165 |
| **2008** | 1 047 | 644 | 402 |
| **2009** | 1 177 | 464 | 713 |
| **2010** | 867 | 511 | 356 |
| **2011** | 787 | 517 | 270 |

### 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 due to unstable trends in the exports, imports or production. The non-energy use of fuels is on average 6.2% of the total apparent energy consumption during the period 1988-2011 and 2.3% for 2011. The apparent consumption is calculated according to Table 1-1 p. 1.12 from the 1996 IPCC Guidelines.

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

| Year | Non-energy use, PJ | Apparent energy consumption incl. non-energy use, PJ | % |
|---|---|---|---|
| **1988** | 61.64 | 1105.03 | 5.58% |
| **1989** | 60.46 | 1082.16 | 5.59% |
| **1990** | 63.06 | 983.76 | 6.41% |
| **1991** | 55.03 | 756.87 | 7.27% |
| **1992** | 56.39 | 706.76 | 7.98% |
| **1993** | 58.07 | 752.71 | 7.71% |
| **1994** | 46.39 | 711.71 | 6.52% |
| **1995** | 48.79 | 761.95 | 6.40% |
| **1996** | 56.33 | 745.21 | 7.56% |
| **1997** | 58.23 | 669.73 | 8.69% |
| **1998** | 61.37 | 643.31 | 9.54% |
| **1999** | 51.39 | 573.26 | 8.96% |
| **2000** | 40.10 | 563.31 | 7.12% |
| **2001** | 36.92 | 592.55 | 6.23% |

| Year | Non-energy use, PJ | Apparent energy consumption incl. non-energy use, PJ | % |
|---|---|---|---|
| **2002** | 31.08 | 556.54 | 5.59% |
| **2003** | 34.78 | 599.40 | 5.80% |
| **2004** | 28.80 | 582.17 | 4.95% |
| **2005** | 30.48 | 607.80 | 5.01% |
| **2006** | 34.28 | 622.09 | 5.51% |
| **2007** | 35.07 | 650.63 | 5.39% |
| **2008** | 36.21 | 629.55 | 5.75% |
| **2009** | 24.84 | 532.64 | 4.66% |
| **2010** | 16.92 | 544.51 | 3.11% |
| **2011** | 13.59 | 601.48 | 2.26% |

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

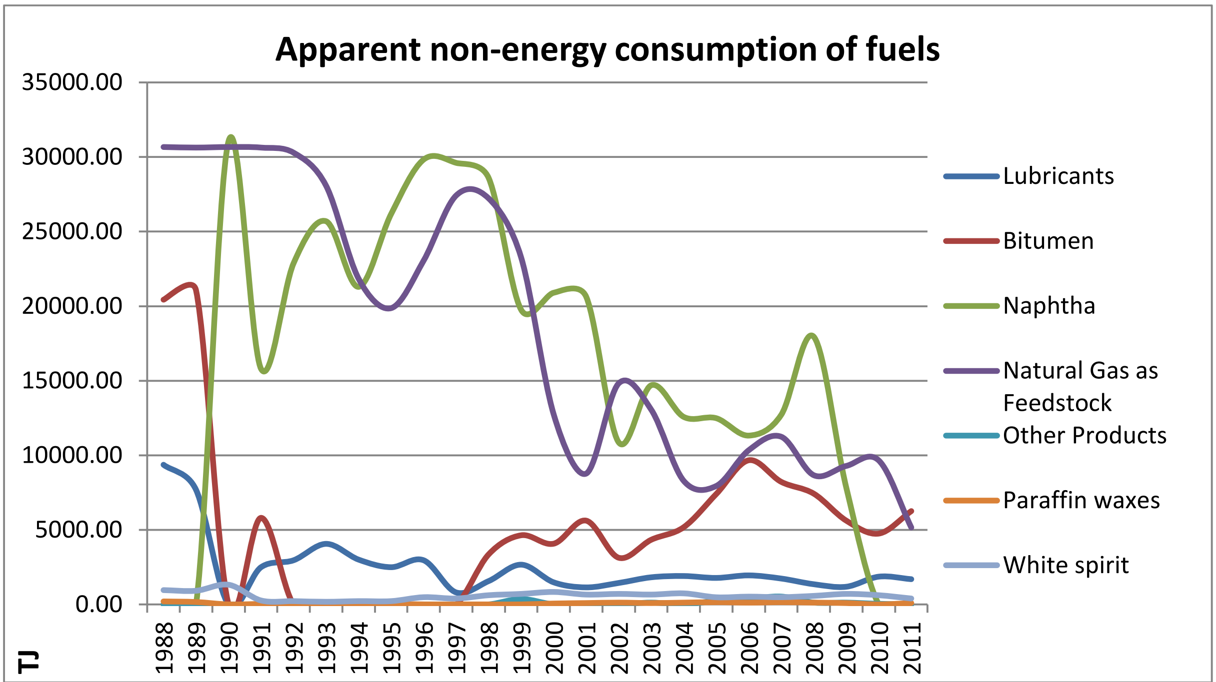



Figure 4 Apparent non-energy consumption of fuels

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

Table 22 Apparent consumption of non-energy fuels

| TJ | Lubricants | Bitumen | Naphtha | Natural Gas as Feedstock | Other Products | Paraffin waxes | White spirit |
|---|---|---|---|---|---|---|---|
| **1988** | 9366.00 | 20436.00 | NO | 30674.04 | NO | 200.00 | 959.20 |
| **1989** | 7686.00 | 21060.00 | NO | 30636.22 | NO | 160.00 | 915.60 |
| **1990** | NO | NO | 31064.00 | 30673.80 | NO | NO | 1320.00 |
| **1991** | 2495.70 | 5805.80 | 15796.00 | 30636.00 | NO | 30.00 | 264.00 |
| **1992** | 2961.00 | NO | 22880.00 | 30294.00 | NO | 30.00 | 220.00 |

| TJ | Lubricants | Bitumen | Naphtha | Natural Gas as Feedstock | Other Products | Paraffin waxes | White spirit |
|---|---|---|---|---|---|---|---|
| **1993** | 4060.80 | NO | 25696.00 | 28077.30 | NO | 60.00 | 176.00 |
| **1994** | 3003.30 | NO | 21296.00 | 21843.00 | NO | 30.00 | 220.00 |
| **1995** | 2495.70 | NO | 26180.00 | 19867.50 | NO | 30.00 | 220.00 |
| **1996** | 2961.00 | NO | 29832.00 | 23053.50 | NO | NO | 484.00 |
| **1997** | 803.70 | NO | 29612.00 | 27421.20 | NO | NO | 396.00 |
| **1998** | 1565.10 | 3355.30 | 28600.00 | 27229.50 | NO | NO | 616.00 |
| **1999** | 2664.90 | 4637.10 | 19756.00 | 23262.30 | 364.02 | NO | 704.00 |
| **2000** | 1480.50 | 4071.60 | 20900.00 | 12748.50 | NO | 60.00 | 836.00 |
| **2001** | 1142.10 | 5617.30 | 20636.00 | 8773.20 | NO | 90.00 | 660.00 |
| **2002** | 1438.20 | 3129.10 | 10868.00 | 14823.90 | NO | 120.00 | 704.00 |
| **2003** | 1818.90 | 4335.50 | 14696.00 | 13061.70 | 121.34 | 90.00 | 660.00 |
| **2004** | 1903.50 | 5177.47 | 12574.11 | 8285.40 | NO | 120.00 | 740.23 |
| **2005** | 1776.60 | 7402.17 | 12487.69 | 7942.50 | 242.68 | 150.00 | 478.97 |
| **2006** | 1945.80 | 9667.31 | 11321.02 | 10341.00 | 364.02 | 120.00 | 522.52 |
| **2007** | 1734.30 | 8218.60 | 12716.00 | 11244.60 | 525.81 | 150.00 | 484.00 |
| **2008** | 1353.60 | 7426.90 | 17952.00 | 8664.30 | 121.34 | 120.00 | 572.00 |
| **2009** | 1184.40 | 5617.30 | 7832.00 | 9287.10 | 121.34 | 90.00 | 704.00 |
| **2010** | 1861.20 | 4750.20 | NO | 9654.30 | 40.45 | NO | 616.00 |
| **2011** | 1692.00 | 6258.20 | NO | 5156.10 | NO | 90.00 | 396.00 |

### 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 1990-2011. The National statistics have not prepared official balances in the Eurostat format for the years before 1990, so the IEA Energy balances were used for the years 1988 and 1989.

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

### 3.3.6 KEY CATEGORIES

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

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

| IPCC Category | Source Categories | Key Category | |
|---|---|---|---|
| | | GHG | KCA |
| 1A1a – Liquid Fuels | Public Electricity and Heat Production | $CO_2$ | LA, TA |
| 1A1a – Solid Fuels | Public Electricity and Heat Production | $CO_2$ | LA, TA |
| 1A1a – Gaseous Fuels | Public Electricity and Heat Production | $CO_2$ | LA, TA |

| IPCC Category | Source Categories | Key Category | |
|---|---|---|---|
| | | GHG | KCA |
| 1A1b – Liquid Fuels | Petroleum Refining | $CO_2$ | LA |
| 1A2a – Solid Fuels | Iron and Steel | $CO_2$ | TA |
| 1A2c – Solid Fuels | Chemicals | $CO_2$ | LA |
| 1A2c – Gaseous Fuels | Chemicals | $CO_2$ | LA |
| 1A2d – Liquid Fuels | Pulp, Paper and Print | $CO_2$ | TA |
| 1A2e – Liquid Fuels | Food Processing, Beverages and Tobacco | $CO_2$ | TA |
| 1A2e – Gaseous Fuels | Food Processing, Beverages and Tobacco | $CO_2$ | LA |
| 1A2f – Liquid Fuels | Other | $CO_2$ | LA, TA |
| 1A2f – Solid Fuels | Other | $CO_2$ | LA, TA |
| 1A2f – Gaseous Fuels | Other | $CO_2$ | LA |
| 1A3b – Liquid Fuels | Road Transportation | $CO_2$ | LA, TA |
| 1A3e – Gaseous Fuels | Other Transportation | $CO_2$ | LA |
| 1A4b – Liquid Fuels | Residential | $CO_2$ | TA |
| 1A4b – Solid Fuels | Residential | $CO_2$ | LA, TA |
| 1A4c – Liquid Fuels | Agriculture/Forestry/Fisheries | $CO_2$ | LA, TA |

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

## 3.3.7 COMPLETENESS

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

## 3.3.8 METHODOLOGICAL ISSUES

### 3.3.8.1 Choice of Method

**Tier 1 Methodology**

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

*$CH_4$ and $N_2O$:* $$E = F * EF_{(default)}$$

*where* *F = fuel consumption*

*EF(fuel) = default (IPCC)*

**Tier 2 Methodology**

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

*$CO_2$:* $$E = F * EF_{(CS/default)}$$

*where* *F = fuel consumption*

*EF(fuel) = CS (country specific)*

*EF(fuel) = default (IPCC)*

### 3.3.8.2 Choice of Emission factor

#### 3.3.8.2.1 Choice of emission factors for stationary sources

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

*EF for $CO_2$:*

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

*where: C – carbon content in t/TJ*

*$O_x$ - oxidation factor*

Table 24 Oxidation factors

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

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

Table 25 Default Emission factors for $CO_2$ for different fuels

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

| 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 in Table 27 and Table 28.

#### 3.3.8.2.2 Country specific emission factors for $CO_2$ for solid fuels

**Emission data reported under the European Emission Trading Scheme**

A total of 158 operators have provided their verified $CO_2$ emission reports required under the EU ETS for the years 2007-2011. These emissions have been incorporated in the inventory to the extent possible (see respective subchapters for more information). Furthermore the background data for the emission calculations under the EU ETS were used for further QA/QC checks.

Data from the verified ETS reports was analysed in order to use a Tier 2 methodology for emission calculations. From all the operators, in 2011 only the largest 30 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 2011 are applied the respective annual emission factors and for the years 1988 to 2006 is applied an EF calculated as a weighted average.

The following country-specific carbon contents were calculated:

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

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

The following emission factors excluding oxidation factor were calculated:

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

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

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

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

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

#### 3.3.8.2.3 Country specific emission factors for $CO_2$ for gaseous fuels

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

- "Bulgargaz" EAD, the sole public supplier of natural gas for the territory of the Republic of Bulgaria for the period 2007-2011
- "Melrose Resources" OOD and "Oil and Gas Exploration and Production" AD - the companies licensed for oil and gas extraction for the period 2004-2011 and 1999-2011

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

- the percentages of methane, ethane, propane, i-butane, n-butane, i-pentane, n-pentane, neo-pentane, i-hexane, $N_2$ and $CO_2$ as molar percentage;
- density, NCV/GCV and quantities supplied or extracted at a temperature of 20°C (293.15 K) and an absolute pressure of 101.325 kPa (760 mm Hg)

- Using stoichiometric calculations and the above data it was possible to calculate a country specific emission factor for natural gas for each year and as a weighted average for the period 2007-2011.

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

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

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 considering those conditions.

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

Table 30 Emission factors for $CH_4$ for different fuels

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

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

Table 31 Emission factors for $N_2O$ for different fuels

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

#### 3.3.8.2.4 Choice of emission factors for mobile sources

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

### 3.3.8.3 Choice of activity data for stationary sources

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

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

Following the recommendations, the energy balances prepared by the National Statistics Institute in the Eurostat format were used for estimating the emissions for the years 1990-2011. The National statistics have not prepared balances in the Eurostat format for the years before 1990, so the IEA Energy balances were used for the years 1988 and 1989.

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

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

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

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

#### 3.3.8.3.1 Choice of NCV

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

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

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

- Main Activity Producer Heat Plants
- Own Use in Electricity, CHP and Heat Plants
- NCV for fuels used in industry - applied to:
- Autoproducer Electricity Plants
- Autoproducer CHP Plants
- Autoproducer Heat Plants
- Iron and Steel
- Chemical (including Petrochemical)
- Non-Ferrous Metals
- Non-Metallic Minerals
- Transport Equipment
- Machinery
- Mining and Quarrying
- Food, Beverages and Tobacco
- Paper, Pulp and Printing
- Wood and Wood Products
- Construction
- Textiles and Leather
- Non-specified (Industry)
- NCV for fuels used for other uses - applied to:
- Commercial and Public Services
- Residential
- Agriculture/Forestry
- Fishing
- Non-specified (Other)

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

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

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

Table 32 Selected Net Calorific Values for 2011

| 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 | 23 851 | 28 628 |
| Coking Coal | - | - |
| Other Bituminous Coal | 25 666 | 26 612 |
| Lignite and Sub-bituminous Coal | 6 920 | 16 041 |
| BKB & Patent Fuel | 12 219 | 17 361 |
| Coke Oven / Gas Coke | - | 28 500 |
| **Gaseous fuels** | | |
| Natural Gas [TJ/1000 m3] | 0.033653 | |

For all NCVs please consult Annex III.

#### 3.3.8.4 Uncertainties in CRF 1.A

**STATIONARY COMBUSTION**

##### 3.3.8.4.1 Uncertainty of AD

**Solid fuels**

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

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

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

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

**Natural gas**

The supply, transmission and storage of natural gas are licensed to 'Bulgargaz' and 'Bulgartransgaz' according to the energy act. The gas transmission network consists of gas pipelines with high-pressure branches (1700 km), three compressor stations (total capacity of 49 MW), 68 gas pressure-reduction stations and 8 gas measuring stations. The gas transmission network for natural gas transit is not connected to the national gas transmission network. Furthermore, underground gas storage and a related compressor stations exist.

Losses are mainly due to leakages, maintenance, old pipes, and varying pressure. Whereas the uncertainty of natural gas supplied to the industry can be assed as low, the uncertainty for natural gas consumed by households is higher due to the large number of licensed providers and network complexity. Further reason for uncertainty is related to GCV and conversion factor 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 subcategories is not clear. Therefore a higher uncertainty is estimated for small combustion plants and engines.

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

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

#### 3.3.8.4.2 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 VII.

### 3.3.8.5 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.

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

#### 3.3.8.5.1 Activity data checks

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

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

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

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

#### 3.3.8.5.2 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.

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

#### 3.3.8.6.1 Country-specific emission factors

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

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 26.

#### 3.3.8.6.2 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.

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

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

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

### 3.3.9 EMISSION TREND

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

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

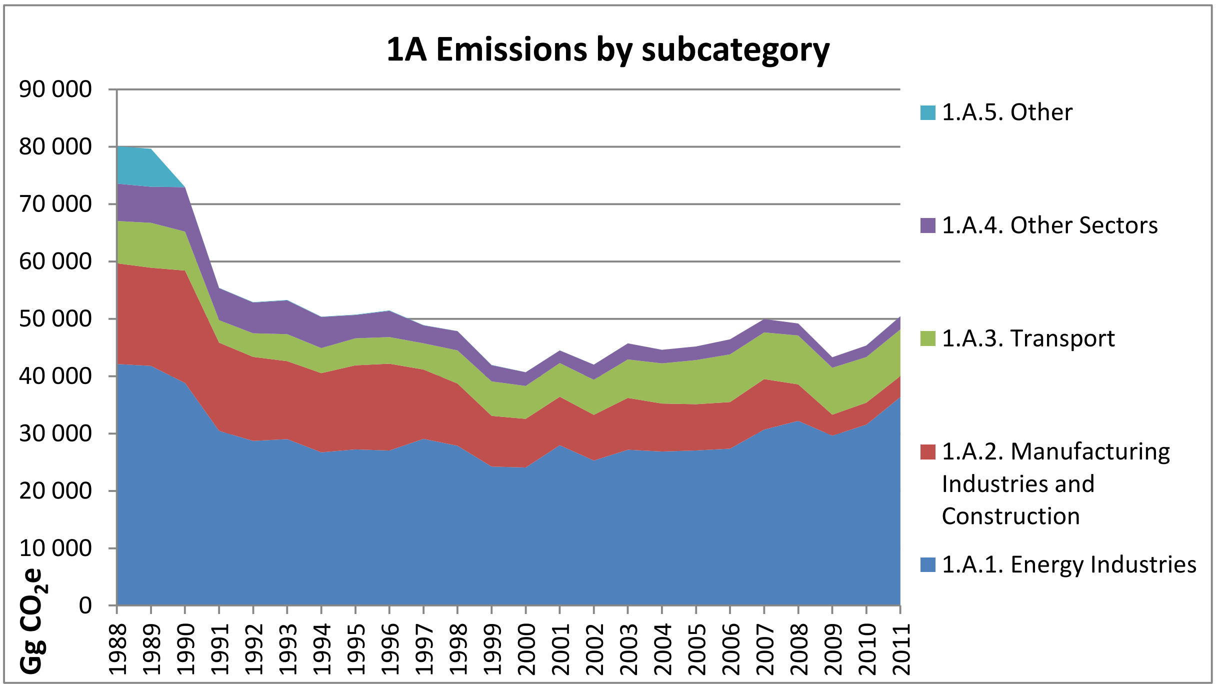



Figure 22 Total GHG emissions from Fuel combustion by subcategory

Energy Industries are the main source of GHG emissions from fuel combustion with 72.1% of the sector emissions for 2011. Transport is the second most important source with 16.1% of the sector emissions, followed by Manufacturing industries and construction with 7.3%.

The general trend shows a notable drop in the country emissions after 1990-1991 due to the transition from planned economy to market economy, which happened in the country. The decrease of the GHG emissions continued up to 1999, followed by a slow increase after 2000, after the national economy started to grow. In the recent years (2008-2009) due to the economic crisis the emissions decreased again, approaching the 2000 levels. In 2010 and

2011 there is an increasing trend of the emissions, which is mostly due to the increase in energy industries of 15.3% in the last year. Compared to 2010, there is an increase of the emissions from fuel combustion of 11.2% in 2011.

Manufacturing industry and construction is the sector, which changed drastically – compared to 1988 the emissions decreased by 79.1% in 2011. The significant decrease of the emissions after 2008 is mostly due to the restructuring of the Iron and steel industry in Bulgaria. The closure of Bulgaria's biggest I&S plant, which was the only plant in the country operating coke ovens and blast furnaces, decreased significantly the emissions from solid fuels and the emissions from the industry subcategory in general. The trend for solid fuels was reversed in 2011 mostly due to the opening of a new coal power plant and the general increase of electricity production from lignite coal in the country.

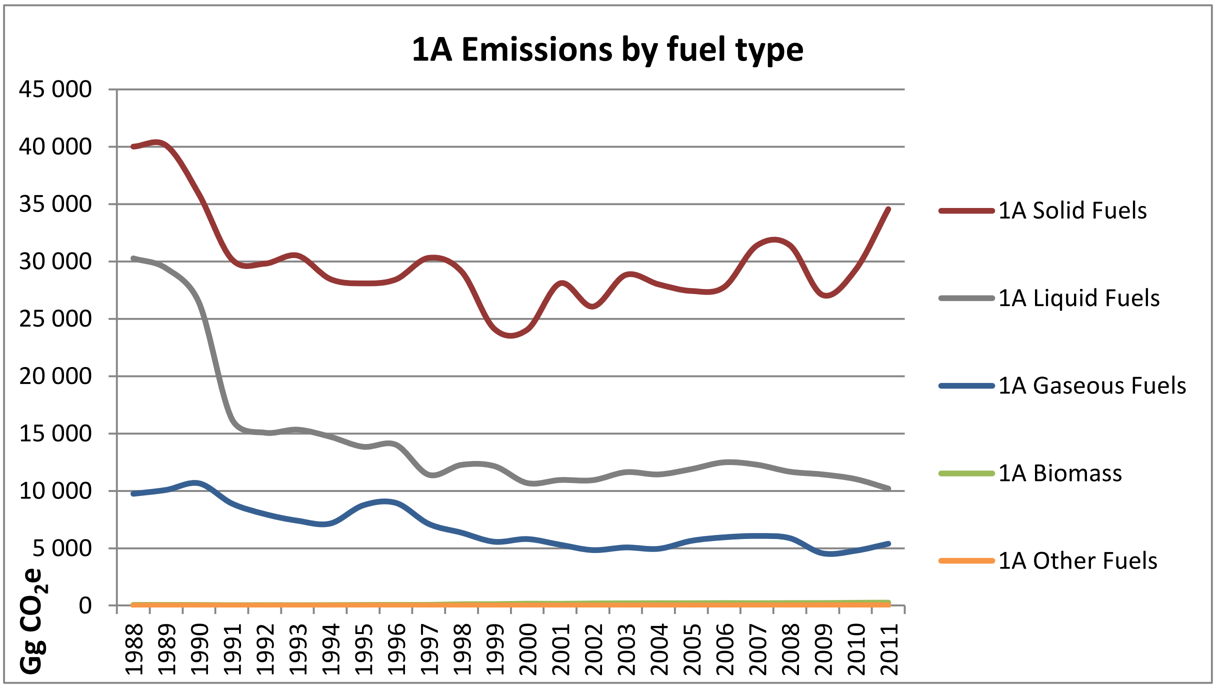



Figure 23 Total GHG emissions from Fuel combustion by fuel type

In 2011, 68.5% of the emissions from fuel combustion were from solid fuels, 20.2% were from liquid fuels, and 10.7% were from gaseous fuels.

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

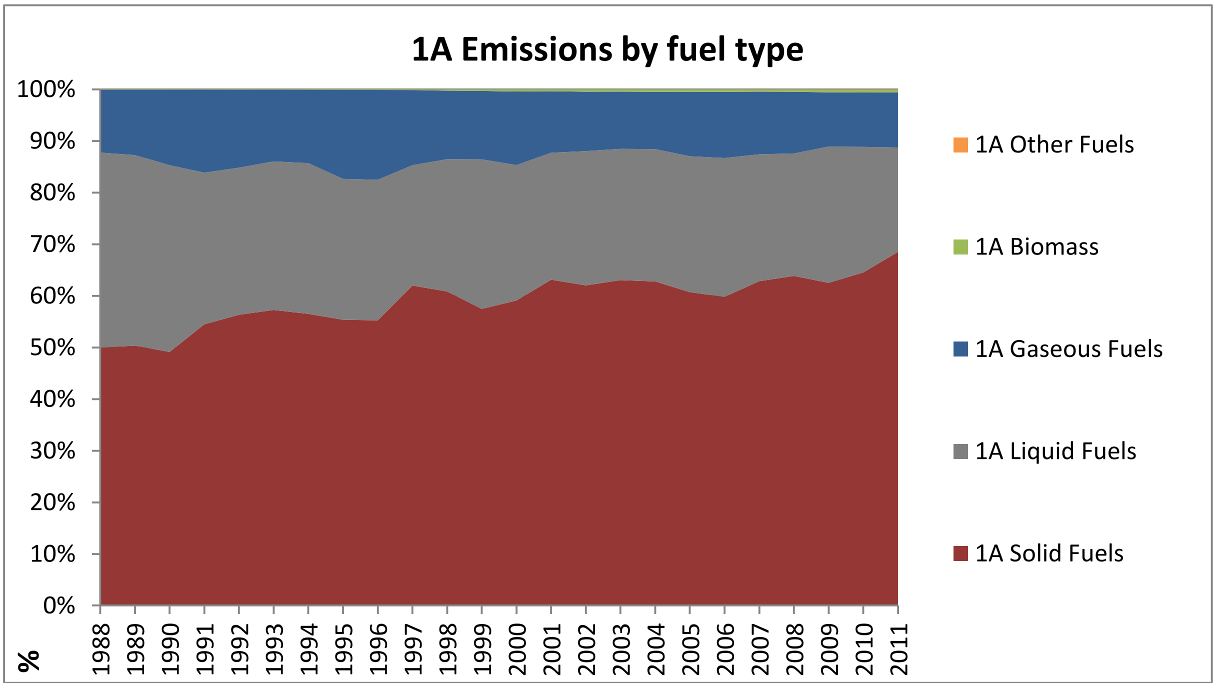



Figure 24 Total GHG emissions from Fuel combustion by fuel type

Table 33 $CO_2$ emissions in 1.A. Fuel Combustion

| $CO_2$ (Gg) | 1.A. Fuel Combustion | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 79 344.98 | 30 019.13 | 39 596.16 | 9 729.69 | NO | NA,NO |
| **1989** | 78 906.97 | 29 139.37 | 39 699.92 | 10 067.68 | NO | NA,NO |
| **1990** | 72 284.19 | 26 133.80 | 35 508.01 | 10 642.38 | NO | NA,NO |
| **1991** | 54 889.16 | 16 121.38 | 29 880.51 | 8 887.27 | NO | NA,NO |
| **1992** | 52 340.75 | 14 912.62 | 29 460.95 | 7 967.18 | NO | NA,NO |
| **1993** | 52 631.10 | 15 087.47 | 30 159.49 | 7 384.14 | NO | NA,NO |
| **1994** | 49 739.30 | 14 425.11 | 28 175.31 | 7 138.89 | NO | NA,NO |
| **1995** | 50 026.61 | 13 473.23 | 27 832.36 | 8 721.02 | NO | NA,NO |
| **1996** | 50 721.24 | 13 647.37 | 28 142.06 | 8 931.82 | NO | NA,NO |
| **1997** | 48 290.32 | 11 136.17 | 30 048.69 | 7 105.47 | NO | NA,NO |
| **1998** | 47 150.38 | 11 944.03 | 28 866.34 | 6 340.01 | NO | NA,NO |
| **1999** | 41 313.64 | 11 839.00 | 23 921.65 | 5 553.00 | NO | NA,NO |
| **2000** | 40 086.68 | 10 417.60 | 23 881.16 | 5 787.91 | NO | NA,NO |
| **2001** | 43 935.10 | 10 713.65 | 27 925.87 | 5 295.58 | NO | NA,NO |
| **2002** | 41 389.84 | 10 691.94 | 25 871.30 | 4 826.59 | NO | NA,NO |
| **2003** | 45 061.12 | 11 395.15 | 28 607.33 | 5 058.64 | NO | NA,NO |
| **2004** | 44 060.68 | 11 306.68 | 27 809.28 | 4 941.27 | NO | 3.4595 |
| **2005** | 44 644.19 | 11 765.11 | 27 242.42 | 5 633.86 | NO | 2.8073 |
| **2006** | 45 867.44 | 12 352.99 | 27 574.24 | 5 938.57 | NO | 1.6434 |
| **2007** | 49 413.34 | 12 151.92 | 31 196.25 | 6 055.45 | NO | 9.7319 |
| **2008** | 48 635.40 | 11 546.73 | 31 216.54 | 5 864.39 | NO | 7.7358 |
| **2009** | 42 807.31 | 11 324.06 | 26 913.84 | 4 546.99 | NO | 22.4192 |
| **2010** | 44 804.55 | 10 929.48 | 29 081.21 | 4 768.75 | NO | 25.1073 |
| **2011** | 49 858.21 | 10 105.42 | 34 345.65 | 5 380.73 | NO | 26.4157 |
| **Decrease 1988-2011** | 37.2% | 66.3% | 13.3% | 44.7% | - | - |
| **Decrease 1990-2011** | 31.0% | 61.3% | 3.3% | 49.4% | - | - |

| $CO_2$ (Gg) | 1.A. Fuel Combustion | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| Decrease 2010-2011 | -11.3% | 7.5% | -18.1% | -12.8% | - | -5.2% |

Table 34 $CH_4$ emissions in 1.A. Fuel Combustion

| $CH_4$ (Gg) | 1.A. Fuel Combustion | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988 | 19.9205 | 5.0392 | 12.0849 | 0.4141 | 2.3823 | NA,NO |
| 1989 | 19.8700 | 5.3501 | 11.8071 | 0.4340 | 2.2788 | NA,NO |
| 1990 | 16.8200 | 4.6747 | 9.4714 | 0.5076 | 2.1663 | NA,NO |
| 1991 | 13.0678 | 2.4694 | 8.7751 | 0.4583 | 1.3650 | NA,NO |
| 1992 | 15.1679 | 2.6343 | 10.4671 | 0.4648 | 1.6017 | NA,NO |
| 1993 | 15.6118 | 2.8308 | 10.8671 | 0.4770 | 1.4370 | NA,NO |
| 1994 | 12.9568 | 2.6220 | 8.2000 | 0.4692 | 1.6657 | NA,NO |
| 1995 | 12.0172 | 2.5685 | 6.6886 | 0.5667 | 2.1933 | NA,NO |
| 1996 | 13.6093 | 2.1996 | 8.3880 | 0.5785 | 2.4431 | NA,NO |
| 1997 | 11.2167 | 1.5646 | 6.7966 | 0.4276 | 2.4278 | NA,NO |
| 1998 | 13.4707 | 1.8098 | 6.6481 | 0.3855 | 4.6273 | NA,NO |
| 1999 | 11.4606 | 1.7434 | 4.5364 | 0.3133 | 4.8676 | NA,NO |
| 2000 | 11.7883 | 1.5012 | 3.4283 | 0.3571 | 6.5017 | NA,NO |
| 2001 | 10.2899 | 1.4092 | 2.4343 | 0.3157 | 6.1307 | NA,NO |
| 2002 | 13.0732 | 1.3473 | 4.0834 | 0.2827 | 7.3597 | NA,NO |
| 2003 | 14.1716 | 1.3157 | 4.8510 | 0.2960 | 7.7089 | NA,NO |
| 2004 | 13.2485 | 1.1308 | 3.7967 | 0.3052 | 8.0140 | 0.0019 |
| 2005 | 12.8827 | 1.0970 | 3.4742 | 0.3747 | 7.9354 | 0.0015 |
| 2006 | 13.6105 | 1.0906 | 3.6889 | 0.4108 | 8.4195 | 0.0006 |
| 2007 | 12.7377 | 0.9811 | 3.3218 | 0.4285 | 7.9971 | 0.0092 |
| 2008 | 12.8064 | 0.8803 | 3.0037 | 0.4086 | 8.4883 | 0.0255 |
| 2009 | 11.8431 | 0.8393 | 2.1079 | 0.2929 | 8.5701 | 0.0329 |
| 2010 | 13.2310 | 0.7507 | 2.8132 | 0.3193 | 9.3188 | 0.0291 |
| 2011 | 14.3184 | 0.6697 | 3.4588 | 0.3604 | 9.8056 | 0.0238 |
| Decrease 1988-2011 | 28.1% | 86.7% | 71.4% | 13.0% | -311.6% | - |
| Decrease 1990-2011 | 14.9% | 85.7% | 63.5% | 29.0% | -352.6% | - |
| Decrease 2010-2011 | -8.2% | 10.8% | -23.0% | -12.9% | -5.2% | 18.3% |

Table 35 $N_2O$ emissions in 1.A. Fuel Combustion

| $N_2O$ (Gg) | 1.A. Fuel Combustion | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988 | 1.0580 | 0.4722 | 0.5364 | 0.0177 | 0.0318 | NA,NO |
| 1989 | 1.0662 | 0.4798 | 0.5377 | 0.0183 | 0.0304 | NA,NO |
| 1990 | 1.1051 | 0.5776 | 0.4792 | 0.0194 | 0.0289 | NA,NO |
| 1991 | 0.7713 | 0.3202 | 0.4113 | 0.0162 | 0.0236 | NA,NO |
| 1992 | 0.7852 | 0.3413 | 0.4032 | 0.0145 | 0.0262 | NA,NO |
| 1993 | 1.0664 | 0.6147 | 0.4145 | 0.0134 | 0.0237 | NA,NO |
| 1994 | 1.1861 | 0.7628 | 0.3833 | 0.0130 | 0.0270 | NA,NO |
| 1995 | 1.4473 | 1.0218 | 0.3758 | 0.0159 | 0.0338 | NA,NO |
| 1996 | 1.4827 | 1.0483 | 0.3814 | 0.0163 | 0.0367 | NA,NO |
| 1997 | 1.2101 | 0.7513 | 0.4032 | 0.0129 | 0.0427 | NA,NO |

| $N_2O$ (Gg) | 1.A. Fuel Combustion | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1998** | 1.3877 | 0.9187 | 0.3884 | 0.0115 | 0.0690 | NA,NO |
| **1999** | 1.3021 | 0.8978 | 0.3222 | 0.0101 | 0.0720 | NA,NO |
| **2000** | 1.1720 | 0.7479 | 0.3200 | 0.0105 | 0.0935 | NA,NO |
| **2001** | 1.1328 | 0.6562 | 0.3764 | 0.0096 | 0.0906 | NA,NO |
| **2002** | 1.1503 | 0.6838 | 0.3494 | 0.0088 | 0.1083 | NA,NO |
| **2003** | 1.1752 | 0.6612 | 0.3861 | 0.0092 | 0.1188 | NA,NO |
| **2004** | 0.8461 | 0.3359 | 0.3769 | 0.0091 | 0.1240 | 0.0003 |
| **2005** | 0.8575 | 0.3498 | 0.3712 | 0.0106 | 0.1256 | 0.0002 |
| **2006** | 0.8842 | 0.3618 | 0.3763 | 0.0113 | 0.1346 | 0.0001 |
| **2007** | 0.9088 | 0.3426 | 0.4274 | 0.0118 | 0.1258 | 0.0012 |
| **2008** | 0.9114 | 0.3430 | 0.4236 | 0.0114 | 0.1299 | 0.0034 |
| **2009** | 0.7962 | 0.2861 | 0.3685 | 0.0092 | 0.1280 | 0.0044 |
| **2010** | 0.8402 | 0.2739 | 0.3986 | 0.0100 | 0.1539 | 0.0039 |
| **2011** | 0.9119 | 0.2659 | 0.4686 | 0.0110 | 0.1633 | 0.0032 |
| **Decrease 1988-2011** | 13.8% | 43.7% | 12.6% | 38.0% | -414.0% | - |
| **Decrease 1990-2011** | 17.5% | 54.0% | 2.2% | 43.3% | -465.3% | - |
| **Decrease 2010-2011** | -8.5% | 2.9% | -17.6% | -10.1% | -6.1% | 18.3% |

Table 36 GHG emissions in 1.A. Fuel Combustion

| GHG (Gg) | TJ | 1.A. Fuel Combustion | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **1988** | 979 983.81 | 80 091.31 | 30 271.32 | 40 016.23 | 9 743.88 | 59.8751 | NO |
| **1989** | 975 301.67 | 79 654.77 | 29 400.46 | 40 114.56 | 10 082.48 | 57.2738 | NO |
| **1990** | 905 587.83 | 72 980.00 | 26 411.03 | 35 855.47 | 10 659.05 | 54.4463 | NO |
| **1991** | 683 825.88 | 55 402.68 | 16 272.50 | 30 192.28 | 8 901.91 | 35.9810 | NO |
| **1992** | 645 903.96 | 52 902.69 | 15 073.73 | 29 805.76 | 7 981.44 | 41.7608 | NO |
| **1993** | 646 652.97 | 53 289.52 | 15 337.48 | 30 516.21 | 7 398.32 | 37.5097 | NO |
| **1994** | 613 125.30 | 50 379.09 | 14 716.65 | 28 466.33 | 7 152.77 | 43.3408 | NO |
| **1995** | 627 138.20 | 50 727.64 | 13 843.94 | 28 089.33 | 8 737.85 | 56.5330 | NO |
| **1996** | 636 942.80 | 51 466.67 | 14 018.55 | 28 436.42 | 8 949.00 | 62.6966 | NO |
| **1997** | 586 981.13 | 48 901.02 | 11 401.94 | 30 316.41 | 7 118.46 | 64.2092 | NO |
| **1998** | 579 069.26 | 47 863.44 | 12 266.82 | 29 126.36 | 6 351.68 | 118.5773 | NO |
| **1999** | 517 241.00 | 41 957.96 | 12 153.91 | 24 116.79 | 5 562.71 | 124.5499 | NO |
| **2000** | 507 167.27 | 40 697.56 | 10 680.98 | 24 052.37 | 5 798.68 | 165.5310 | NO |
| **2001** | 540 473.59 | 44 502.37 | 10 946.66 | 28 093.68 | 5 305.20 | 156.8235 | NO |
| **2002** | 515 351.79 | 42 020.97 | 10 932.22 | 26 065.36 | 4 835.25 | 188.1370 | NO |
| **2003** | 559 044.74 | 45 723.05 | 11 627.74 | 28 828.89 | 5 067.71 | 198.7104 | NO |
| **2004** | 550 252.93 | 44 601.20 | 11 434.55 | 28 005.84 | 4 950.50 | 206.7317 | 3.5788 |
| **2005** | 564 147.58 | 45 180.56 | 11 896.59 | 27 430.45 | 5 645.03 | 205.5933 | 2.9021 |
| **2006** | 583 066.19 | 46 427.35 | 12 488.06 | 27 768.36 | 5 950.71 | 218.5445 | 1.6819 |
| **2007** | 615 853.64 | 49 962.57 | 12 278.74 | 31 398.50 | 6 068.09 | 206.9367 | 10.3028 |
| **2008** | 602 253.90 | 49 186.87 | 11 671.56 | 31 410.95 | 5 876.50 | 218.5321 | 9.3250 |
| **2009** | 533 438.27 | 43 302.85 | 11 430.37 | 27 072.35 | 4 556.01 | 219.6518 | 24.4693 |
| **2010** | 557 976.45 | 45 342.87 | 11 030.15 | 29 263.84 | 4 778.55 | 243.4063 | 26.9209 |
| **2011** | 612 068.49 | 50 441.60 | 10 201.92 | 34 563.55 | 5 391.70 | 256.5351 | 27.8966 |
| **Decrease 1988-2011** | 37.5% | 37.0% | 66.3% | 13.6% | 44.7% | -328.5% | - |
| **Decrease** | 32.4% | 30.9% | 61.4% | 3.6% | 49.4% | -371.2% | - |

| GHG (Gg) | TJ | 1.A. Fuel Combustion | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| 1990-2011 | | | | | | | |
| Decrease 2010-2011 | -9.7% | -11.2% | 7.5% | -18.1% | -12.8% | -5.4% | -3.6% |

### 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.

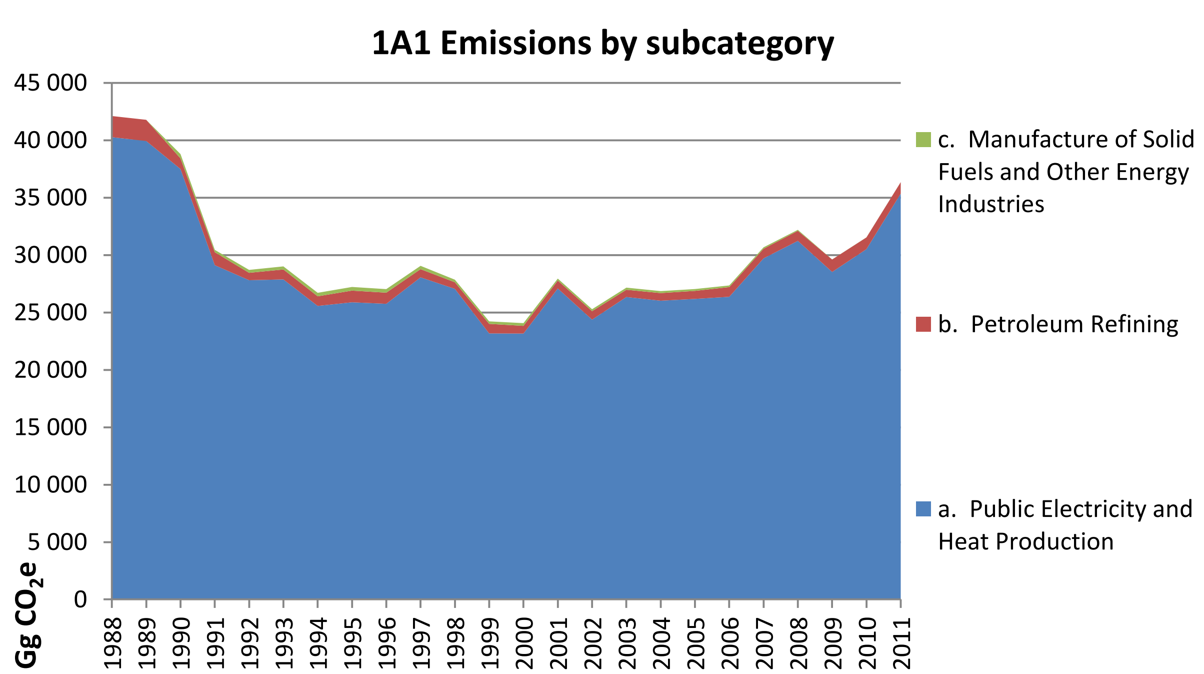



Figure 25 Total GHG emissions from 1.A.1 Energy industries by subcategory

For 2011 the general trend in CRF category 1.A.1 is a decrease in the emissions of 13.7% compared to base year and an increase of 15.3% compared to last year.

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

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

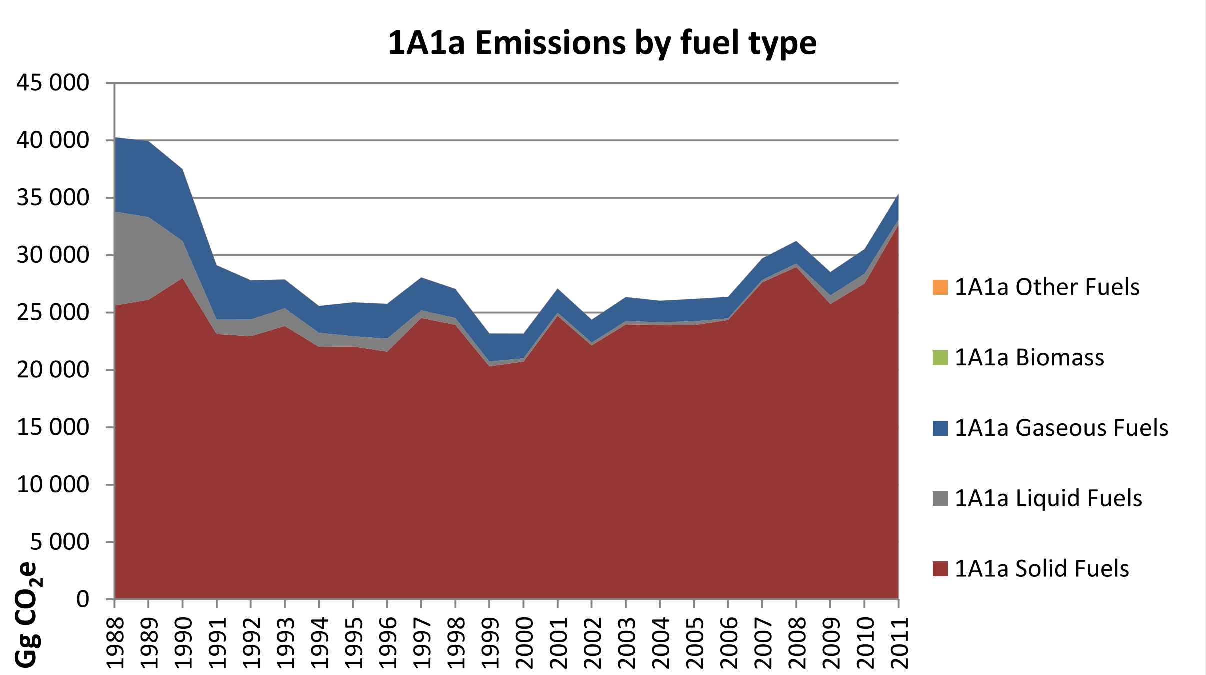



Figure 26 GHG emissions from 1.A.1.a Public Electricity and Heat Production

The share of CRF category 1.A.1.a from the total GHG emissions is 53.5% for the year 2011. The share of this subcategory from CRF category 1.A Fuel combustion is 70.1% for the year 2011.

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

| $CO_2$ (Gg) | CRF 1.A.1.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 40 129.01 | 8 155.62 | 25 497.33 | 6 476.06 | NO | NO |
| **1989** | 39 800.03 | 7 181.36 | 25 994.31 | 6 624.36 | NO | NO |
| **1990** | 37 359.64 | 3 211.50 | 27 884.16 | 6 263.98 | NO | NO |
| **1991** | 29 010.52 | 1 253.44 | 23 016.65 | 4 740.42 | NO | NO |
| **1992** | 27 703.73 | 1 443.73 | 22 833.37 | 3 426.62 | 0.1120 | NO |
| **1993** | 27 768.10 | 1 538.44 | 23 720.90 | 2 508.75 | 0.1120 | NO |
| **1994** | 25 467.24 | 1 213.64 | 21 910.45 | 2 343.15 | 0.1120 | NO |
| **1995** | 25 785.90 | 891.88 | 21 938.02 | 2 956.00 | 0.1120 | NO |
| **1996** | 25 655.06 | 1 124.69 | 21 493.00 | 3 037.37 | NO | NO |
| **1997** | 27 948.16 | 671.15 | 24 414.10 | 2 862.91 | 0.1120 | NO |
| **1998** | 26 951.20 | 594.50 | 23 817.00 | 2 539.70 | 0.1120 | NO |
| **1999** | 23 083.59 | 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 | 4.1440 | NO |
| **2010** | 30 393.82 | 843.07 | 27 404.06 | 2 146.69 | 9.0720 | NO |
| **2011** | 35 214.45 | 424.91 | 32 516.16 | 2 273.37 | 30.4640 | NO |
| **Decrease 1988-2011** | 12.2% | 94.8% | -27.5% | 64.9% | - | - |

| $CO_2$ (Gg) | CRF 1.A.1.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **Decrease 1990-2011** | 5.7% | 86.8% | -16.6% | 63.7% | - | - |
| **Decrease 2010-2011** | -15.9% | 49.6% | -18.7% | -5.9% | -235.8% | - |

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

| $CH_4$ (Gg) | CRF 1.A.1.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.6820 | 0.3194 | 0.2446 | 0.1179 | NO | NO |
| **1989** | 0.6512 | 0.2813 | 0.2493 | 0.1206 | NO | NO |
| **1990** | 0.5102 | 0.1259 | 0.2702 | 0.1140 | NO | NO |
| **1991** | 0.3612 | 0.0491 | 0.2258 | 0.0863 | NO | NO |
| **1992** | 0.3417 | 0.0567 | 0.2226 | 0.0624 | 0.0000 | NO |
| **1993** | 0.3386 | 0.0603 | 0.2326 | 0.0457 | 0.0000 | NO |
| **1994** | 0.3035 | 0.0476 | 0.2133 | 0.0427 | 0.0000 | NO |
| **1995** | 0.3013 | 0.0350 | 0.2125 | 0.0538 | 0.0000 | NO |
| **1996** | 0.3073 | 0.0441 | 0.2079 | 0.0553 | NO | NO |
| **1997** | 0.3129 | 0.0263 | 0.2344 | 0.0521 | 0.0000 | NO |
| **1998** | 0.2982 | 0.0233 | 0.2286 | 0.0462 | 0.0000 | NO |
| **1999** | 0.2555 | 0.0161 | 0.1948 | 0.0446 | NO | NO |
| **2000** | 0.2491 | 0.0113 | 0.1985 | 0.0392 | NO | NO |
| **2001** | 0.2866 | 0.0106 | 0.2377 | 0.0384 | NO | NO |
| **2002** | 0.2588 | 0.0094 | 0.2129 | 0.0365 | NO | NO |
| **2003** | 0.2791 | 0.0108 | 0.2301 | 0.0382 | NO | NO |
| **2004** | 0.2739 | 0.0091 | 0.2307 | 0.0340 | 0.0000 | NO |
| **2005** | 0.2794 | 0.0121 | 0.2319 | 0.0354 | NO | NO |
| **2006** | 0.2762 | 0.0058 | 0.2363 | 0.0341 | NO | NO |
| **2007** | 0.3114 | 0.0079 | 0.2693 | 0.0342 | NO | NO |
| **2008** | 0.3269 | 0.0107 | 0.2792 | 0.0359 | 0.0010 | NO |
| **2009** | 0.3148 | 0.0265 | 0.2500 | 0.0371 | 0.0011 | NO |
| **2010** | 0.3365 | 0.0278 | 0.2671 | 0.0391 | 0.0024 | NO |
| **2011** | 0.3792 | 0.0141 | 0.3156 | 0.0413 | 0.0082 | NO |
| **Decrease 1988-2011** | 44.4% | 95.6% | -29.0% | 64.9% | - | - |
| **Decrease 1990-2011** | 25.7% | 88.8% | -16.8% | 63.7% | - | - |
| **Decrease 2010-2011** | -12.7% | 49.5% | -18.2% | -5.9% | -235.8% | - |

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

| $N_2O$ (Gg) | CRF 1.A.1.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.4181 | 0.0639 | 0.3425 | 0.0118 | NO | NO |
| **1989** | 0.4174 | 0.0563 | 0.3491 | 0.0121 | NO | NO |
| **1990** | 0.4149 | 0.0252 | 0.3783 | 0.0114 | NO | NO |
| **1991** | 0.3345 | 0.0098 | 0.3161 | 0.0086 | NO | NO |
| **1992** | 0.3292 | 0.0113 | 0.3117 | 0.0062 | 0.0000 | NO |
| **1993** | 0.3423 | 0.0121 | 0.3256 | 0.0046 | 0.0000 | NO |
| **1994** | 0.3123 | 0.0095 | 0.2986 | 0.0043 | 0.0000 | NO |
| **1995** | 0.3098 | 0.0070 | 0.2975 | 0.0054 | 0.0000 | NO |

| $N_2O$ (Gg) | CRF 1.A.1.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1996 | 0.3054 | 0.0088 | 0.2911 | 0.0055 | NO | NO |
| 1997 | 0.3386 | 0.0053 | 0.3281 | 0.0052 | 0.0000 | NO |
| 1998 | 0.3294 | 0.0047 | 0.3201 | 0.0046 | 0.0000 | NO |
| 1999 | 0.2804 | 0.0032 | 0.2727 | 0.0045 | NO | NO |
| 2000 | 0.2842 | 0.0023 | 0.2780 | 0.0039 | NO | NO |
| 2001 | 0.3387 | 0.0021 | 0.3327 | 0.0038 | NO | NO |
| 2002 | 0.3036 | 0.0019 | 0.2981 | 0.0036 | NO | NO |
| 2003 | 0.3281 | 0.0022 | 0.3221 | 0.0038 | NO | NO |
| 2004 | 0.3283 | 0.0018 | 0.3230 | 0.0034 | 0.0000 | NO |
| 2005 | 0.3307 | 0.0024 | 0.3247 | 0.0035 | NO | NO |
| 2006 | 0.3354 | 0.0012 | 0.3308 | 0.0034 | NO | NO |
| 2007 | 0.3820 | 0.0016 | 0.3770 | 0.0034 | NO | NO |
| 2008 | 0.3967 | 0.0021 | 0.3909 | 0.0036 | 0.0001 | NO |
| 2009 | 0.3591 | 0.0052 | 0.3500 | 0.0037 | 0.0001 | NO |
| 2010 | 0.3837 | 0.0055 | 0.3740 | 0.0039 | 0.0003 | NO |
| 2011 | 0.4499 | 0.0028 | 0.4419 | 0.0041 | 0.0011 | NO |
| Decrease 1988-2011 | -7.6% | 95.6% | -29.0% | 64.9% | - | - |
| Decrease 1990-2011 | -8.4% | 88.9% | -16.8% | 63.7% | - | - |
| Decrease 2010-2011 | -17.2% | 49.4% | -18.2% | -5.9% | -235.8% | - |

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

| GHG (Gg) | TJ | CRF 1.A.1.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| 1988 | 469 001.13 | 40 272.96 | 8 182.14 | 25 608.64 | 6 482.19 | NO | NO |
| 1989 | 463 709.64 | 39 943.10 | 7 204.71 | 26 107.76 | 6 630.63 | NO | NO |
| 1990 | 426 234.80 | 37 498.97 | 3 221.95 | 28 007.12 | 6 269.91 | NO | NO |
| 1991 | 328 458.47 | 29 121.81 | 1 257.52 | 23 119.38 | 4 744.91 | NO | NO |
| 1992 | 303 886.86 | 27 812.97 | 1 448.44 | 22 934.67 | 3 429.87 | 0.0019 | NO |
| 1993 | 298 381.32 | 27 881.32 | 1 543.45 | 23 826.74 | 2 511.13 | 0.0019 | NO |
| 1994 | 271 779.96 | 25 570.44 | 1 217.59 | 22 007.49 | 2 345.36 | 0.0019 | NO |
| 1995 | 277 954.32 | 25 888.28 | 894.79 | 22 034.70 | 2 958.80 | 0.0019 | NO |
| 1996 | 277 920.40 | 25 756.20 | 1 128.35 | 21 587.60 | 3 040.24 | NO | NO |
| 1997 | 295 277.67 | 28 059.71 | 673.34 | 24 520.74 | 2 865.62 | 0.0019 | NO |
| 1998 | 282 637.44 | 27 059.57 | 596.44 | 23 921.03 | 2 542.11 | 0.0019 | NO |
| 1999 | 244 787.15 | 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 | 271 362.80 | 26 184.51 | 333.90 | 23 903.98 | 1 946.64 | NO | NO |
| 2006 | 272 358.76 | 26 367.39 | 149.60 | 24 341.03 | 1 876.77 | NO | NO |
| 2007 | 306 165.24 | 29 715.37 | 211.22 | 27 622.74 | 1 881.41 | NO | NO |
| 2008 | 319 212.67 | 31 238.75 | 301.20 | 28 963.42 | 1 974.06 | 0.0598 | NO |
| 2009 | 296 786.32 | 28 529.25 | 746.46 | 25 740.91 | 2 041.81 | 0.0692 | NO |
| 2010 | 315 983.41 | 30 519.84 | 845.36 | 27 525.61 | 2 148.72 | 0.1515 | NO |
| 2011 | 362 151.34 | 35 361.89 | 426.07 | 32 659.78 | 2 275.52 | 0.5086 | NO |
| Decrease | 22.8% | 12.2% | 94.8% | -27.5% | 64.9% | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1988-2011 | | | | | | | |
| Decrease 1990-2011 | 15.0% | 5.7% | 86.8% | -16.6% | 63.7% | - | - |
| Decrease 2010-2011 | -14.6% | -15.9% | 49.6% | -18.7% | -5.9% | -235.8% | - |

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

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

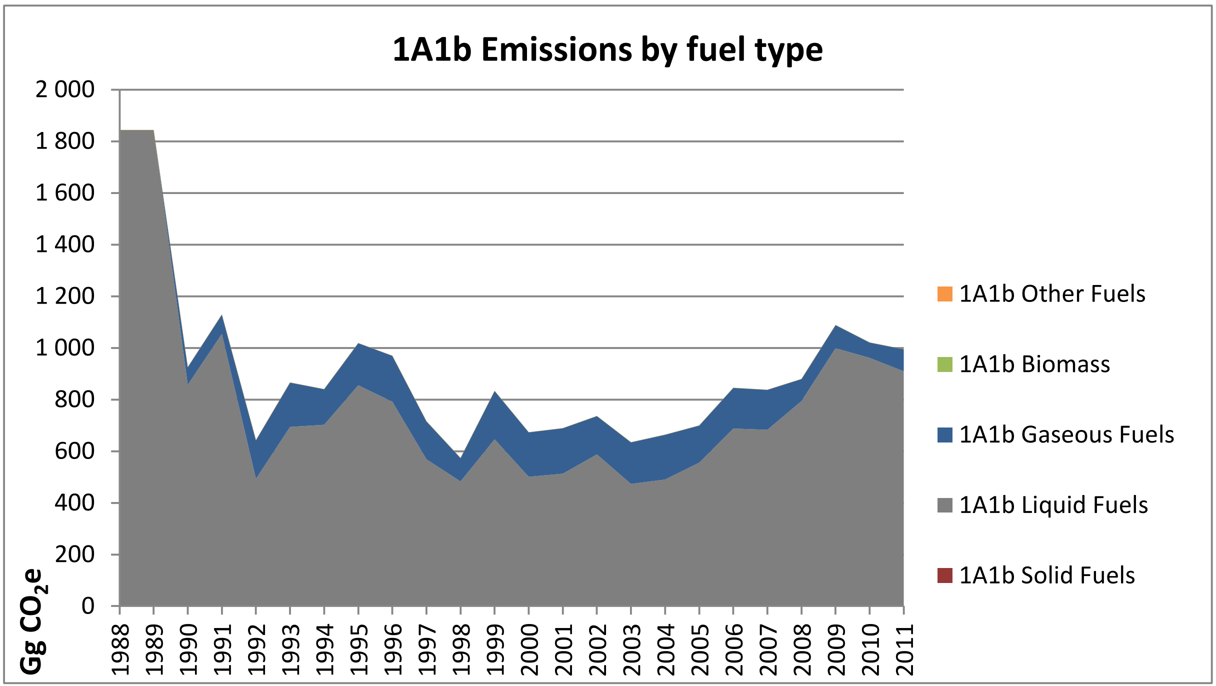



Figure 27 GHG emissions from CRF 1.A.1.b Petroleum refining

For the year 2011 the share of this subcategory from sector 1A Fuel Combustion is 2.0% while from the total GHGs emissions it is 1.5%.

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

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

| $CO_2$ (Gg) | CRF 1.A.1.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 2004 | 662.85 | 489.43 | NO | 173.42 | NO | NO |
| 2005 | 698.36 | 554.55 | NO | 143.81 | NO | NO |
| 2006 | 844.19 | 686.68 | NO | 157.50 | NO | NO |
| 2007 | 836.58 | 681.85 | NO | 154.73 | NO | NO |
| 2008 | 878.39 | 793.06 | NO | 85.33 | NO | NO |
| 2009 | 1 087.03 | 997.40 | NO | 89.63 | NO | NO |
| 2010 | 1 019.53 | 959.97 | NO | 59.56 | NO | NO |
| 2011 | 993.44 | 908.18 | NO | 85.27 | NO | NO |
| Decrease 1988-2011 | 46.0% | 50.6% | - | - | - | - |
| Decrease 1990-2011 | -7.5% | -6.1% | - | -24.8% | - | - |
| Decrease 2010-2011 | 2.6% | 5.4% | - | -43.2% | - | - |

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

| $CH_4$ (Gg) | CRF 1.A.1.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988 | 0.0720 | 0.0720 | NO | NO | NO | NO |
| 1989 | 0.0720 | 0.0720 | NO | NO | NO | NO |
| 1990 | 0.0223 | 0.0211 | NO | 0.0012 | NO | NO |
| 1991 | 0.0320 | 0.0307 | NO | 0.0014 | NO | NO |
| 1992 | 0.0163 | 0.0136 | NO | 0.0027 | NO | NO |
| 1993 | 0.0199 | 0.0168 | NO | 0.0031 | NO | NO |
| 1994 | 0.0200 | 0.0175 | NO | 0.0025 | NO | NO |
| 1995 | 0.0256 | 0.0226 | NO | 0.0030 | NO | NO |
| 1996 | 0.0262 | 0.0229 | NO | 0.0032 | NO | NO |
| 1997 | 0.0175 | 0.0148 | NO | 0.0027 | NO | NO |
| 1998 | 0.0141 | 0.0125 | NO | 0.0016 | NO | NO |
| 1999 | 0.0221 | 0.0187 | NO | 0.0034 | NO | NO |
| 2000 | 0.0164 | 0.0133 | NO | 0.0031 | NO | NO |
| 2001 | 0.0160 | 0.0128 | NO | 0.0032 | NO | NO |
| 2002 | 0.0160 | 0.0133 | NO | 0.0027 | NO | NO |
| 2003 | 0.0149 | 0.0120 | NO | 0.0029 | NO | NO |
| 2004 | 0.0160 | 0.0129 | NO | 0.0032 | NO | NO |
| 2005 | 0.0174 | 0.0148 | NO | 0.0026 | NO | NO |
| 2006 | 0.0189 | 0.0160 | NO | 0.0029 | NO | NO |
| 2007 | 0.0191 | 0.0163 | NO | 0.0028 | NO | NO |
| 2008 | 0.0198 | 0.0182 | NO | 0.0016 | NO | NO |
| 2009 | 0.0244 | 0.0227 | NO | 0.0016 | NO | NO |
| 2010 | 0.0224 | 0.0213 | NO | 0.0011 | NO | NO |
| 2011 | 0.0216 | 0.0200 | NO | 0.0016 | NO | NO |
| Decrease 1988-2011 | 70.0% | 72.2% | - | - | - | - |
| Decrease 1990-2011 | 3.1% | 4.8% | - | -24.7% | - | - |
| Decrease 2010-2011 | 3.5% | 5.8% | - | -43.1% | - | - |

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

| $N_2O$ (Gg) | CRF 1.A.1.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.0144 | 0.0144 | NO | NO | NO | NO |
| **1989** | 0.0144 | 0.0144 | NO | NO | NO | NO |
| **1990** | 0.0035 | 0.0034 | NO | 0.0001 | NO | NO |
| **1991** | 0.0056 | 0.0055 | NO | 0.0001 | NO | NO |
| **1992** | 0.0026 | 0.0024 | NO | 0.0003 | NO | NO |
| **1993** | 0.0030 | 0.0027 | NO | 0.0003 | NO | NO |
| **1994** | 0.0031 | 0.0029 | NO | 0.0003 | NO | NO |
| **1995** | 0.0041 | 0.0038 | NO | 0.0003 | NO | NO |
| **1996** | 0.0044 | 0.0041 | NO | 0.0003 | NO | NO |
| **1997** | 0.0028 | 0.0025 | NO | 0.0003 | NO | NO |
| **1998** | 0.0022 | 0.0021 | NO | 0.0002 | NO | NO |
| **1999** | 0.0037 | 0.0033 | NO | 0.0003 | NO | NO |
| **2000** | 0.0026 | 0.0023 | NO | 0.0003 | NO | NO |
| **2001** | 0.0024 | 0.0021 | NO | 0.0003 | NO | NO |
| **2002** | 0.0023 | 0.0021 | NO | 0.0003 | NO | NO |
| **2003** | 0.0023 | 0.0020 | NO | 0.0003 | NO | NO |
| **2004** | 0.0025 | 0.0021 | NO | 0.0003 | NO | NO |
| **2005** | 0.0027 | 0.0025 | NO | 0.0003 | NO | NO |
| **2006** | 0.0028 | 0.0025 | NO | 0.0003 | NO | NO |
| **2007** | 0.0029 | 0.0026 | NO | 0.0003 | NO | NO |
| **2008** | 0.0030 | 0.0028 | NO | 0.0002 | NO | NO |
| **2009** | 0.0037 | 0.0036 | NO | 0.0002 | NO | NO |
| **2010** | 0.0034 | 0.0033 | NO | 0.0001 | NO | NO |
| **2011** | 0.0033 | 0.0031 | NO | 0.0002 | NO | NO |
| **Decrease 1988-2011** | 77.3% | 78.3% | - | - | - | - |
| **Decrease 1990-2011** | 7.7% | 8.9% | - | -24.7% | - | - |
| **Decrease 2010-2011** | 4.4% | 6.0% | - | -43.1% | - | - |

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

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

| GHG (Gg) | TJ | CRF 1.A.1.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **2004** | 10 281.31 | 663.95 | 490.36 | NO | 173.58 | NO | NO |
| **2005** | 10 679.95 | 699.57 | 555.63 | NO | 143.94 | NO | NO |
| **2006** | 12 966.96 | 845.44 | 687.79 | NO | 157.65 | NO | NO |
| **2007** | 12 821.87 | 837.86 | 682.99 | NO | 154.87 | NO | NO |
| **2008** | 13 229.61 | 879.73 | 794.31 | NO | 85.41 | NO | NO |
| **2009** | 15 603.89 | 1 088.70 | 998.98 | NO | 89.72 | NO | NO |
| **2010** | 14 447.43 | 1 021.07 | 961.45 | NO | 59.62 | NO | NO |
| **2011** | 14 166.62 | 994.91 | 909.56 | NO | 85.35 | NO | NO |
| **Decrease 1988-2011** | 41.0% | 46.1% | 50.7% | - | - | - | - |
| **Decrease 1990-2011** | -5.0% | -7.5% | -6.1% | - | -24.8% | - | - |
| **Decrease 2010-2011** | 1.9% | 2.6% | 5.4% | - | -43.2% | - | - |

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

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

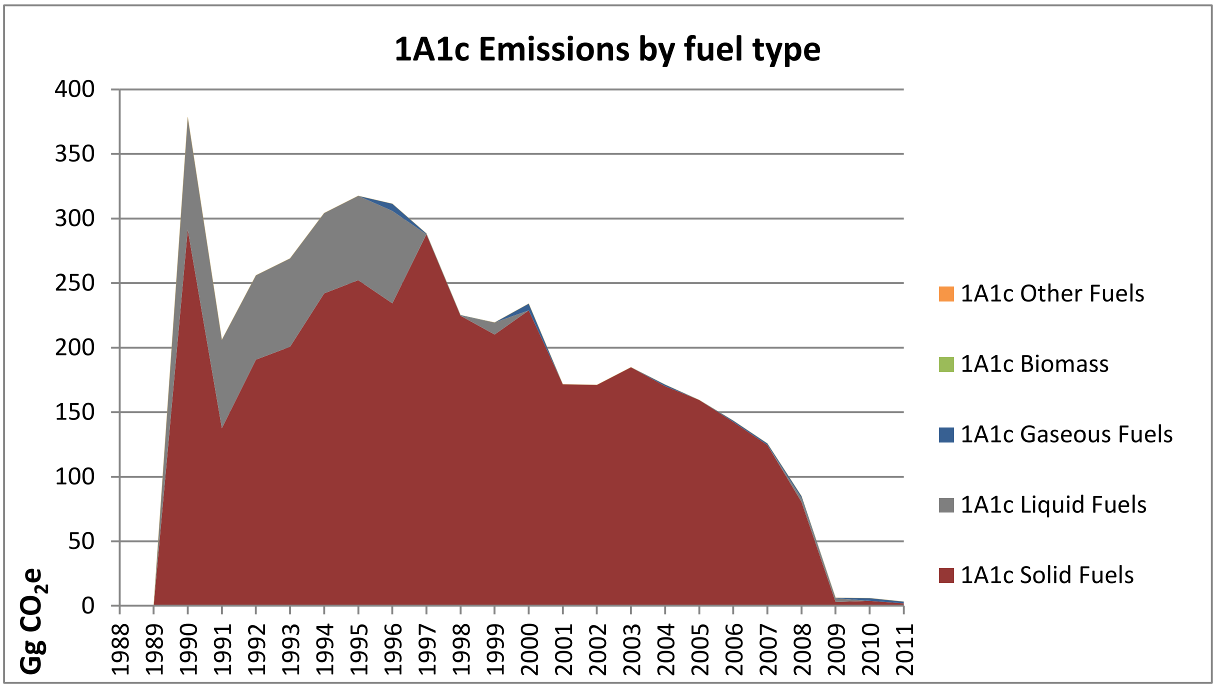



Figure 28 GHG emissions from 1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries

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

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

| $CO_2$ (Gg) | CRF 1.A.1.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988 | NO | NO | NO | NO | NO | NO |
| 1989 | NO | NO | NO | NO | NO | NO |
| 1990 | 377.88 | 86.85 | 291.03 | NO | NO | NO |
| 1991 | 205.68 | 68.24 | 137.45 | NO | NO | NO |
| 1992 | 255.53 | 65.14 | 190.39 | NO | NO | NO |
| 1993 | 268.58 | 68.24 | 200.34 | NO | 0.1120 | NO |
| 1994 | 303.69 | 62.03 | 241.66 | NO | 0.1120 | NO |
| 1995 | 317.03 | 65.14 | 251.90 | NO | NO | NO |
| 1996 | 310.90 | 71.34 | 233.97 | 5.59 | 0.1120 | NO |
| 1997 | 287.92 | NO | 287.28 | 0.64 | NO | NO |
| 1998 | 224.81 | NO | 224.32 | 0.49 | 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 |
| 2009 | 6.22 | 2.87 | 3.00 | 0.35 | NO | NO |
| 2010 | 5.98 | NO | 3.85 | 2.13 | NO | NO |
| 2011 | 3.28 | NO | 1.95 | 1.34 | NO | NO |
| Decrease 1988-2011 | - | - | - | - | - | - |
| Decrease 1990-2011 | 99.1% | - | 99.3% | - | - | - |
| Decrease 2010-2011 | 45.1% | - | 49.5% | 37.2% | - | - |

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

| $CH_4$ (Gg) | CRF 1.A.1.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988 | NO | NO | NO | NO | NO | NO |
| 1989 | NO | NO | NO | NO | NO | NO |
| 1990 | 0.0094 | 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 |

| $CH_4$ (Gg) | CRF 1.A.1.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 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 |
| 2011 | 0.0000 | NO | 0.0000 | 0.0000 | NO | NO |
| Decrease 1988-2011 | - | - | - | - | - | - |
| Decrease 1990-2011 | 99.5% | - | 99.7% | - | - | - |
| Decrease 2010-2011 | 43.3% | - | 49.3% | 37.2% | - | - |

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

| $N_2O$ (Gg) | CRF 1.A.1.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988 | NO | NO | NO | NO | NO | NO |
| 1989 | NO | NO | NO | NO | NO | NO |
| 1990 | 0.0017 | 0.0007 | 0.0010 | NO | NO | NO |
| 1991 | 0.0008 | 0.0006 | 0.0003 | NO | NO | NO |
| 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 |
| 2011 | 0.0000 | NO | 0.0000 | 0.0000 | NO | NO |
| Decrease 1988-2011 | - | - | - | - | - | - |
| Decrease 1990-2011 | 98.2% | - | 97.0% | - | - | - |
| Decrease | 48.5% | - | 49.3% | 37.2% | - | - |

| $N_2O$ (Gg) | CRF 1.A.1.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **2010-2011** | | | | | | |

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

| GHG (Gg) | TJ | CRF 1.A.1.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **1988** | NO | NO | NO | NO | NO | NO | NO |
| **1989** | NO | NO | NO | NO | NO | NO | NO |
| **1990** | 6 985.19 | 378.59 | 87.14 | 291.45 | NO | NO | NO |
| **1991** | 3 828.60 | 206.07 | 68.47 | 137.60 | NO | NO | NO |
| **1992** | 4 586.81 | 256.07 | 65.36 | 190.71 | NO | NO | NO |
| **1993** | 4 844.79 | 269.13 | 68.47 | 200.66 | NO | 0.0019 | NO |
| **1994** | 5 631.36 | 304.28 | 62.24 | 242.03 | NO | 0.0019 | NO |
| **1995** | 5 928.39 | 317.62 | 65.36 | 252.27 | NO | NO | NO |
| **1996** | 5 667.93 | 311.52 | 71.58 | 234.34 | 5.59 | 0.0019 | NO |
| **1997** | 5 353.00 | 288.44 | NO | 287.80 | 0.64 | NO | NO |
| **1998** | 4 172.80 | 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 |
| **2010** | 78.26 | 6.00 | NO | 3.87 | 2.13 | NO | NO |
| **2011** | 44.36 | 3.29 | NO | 1.96 | 1.34 | NO | NO |
| **Decrease 1988-2011** | - | - | - | - | - | - | - |
| **Decrease 1990-2011** | 99.4% | 99.1% | - | 99.3% | - | - | - |
| **Decrease 2010-2011** | 43.3% | 45.1% | - | 49.5% | 37.2% | - | - |

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

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

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

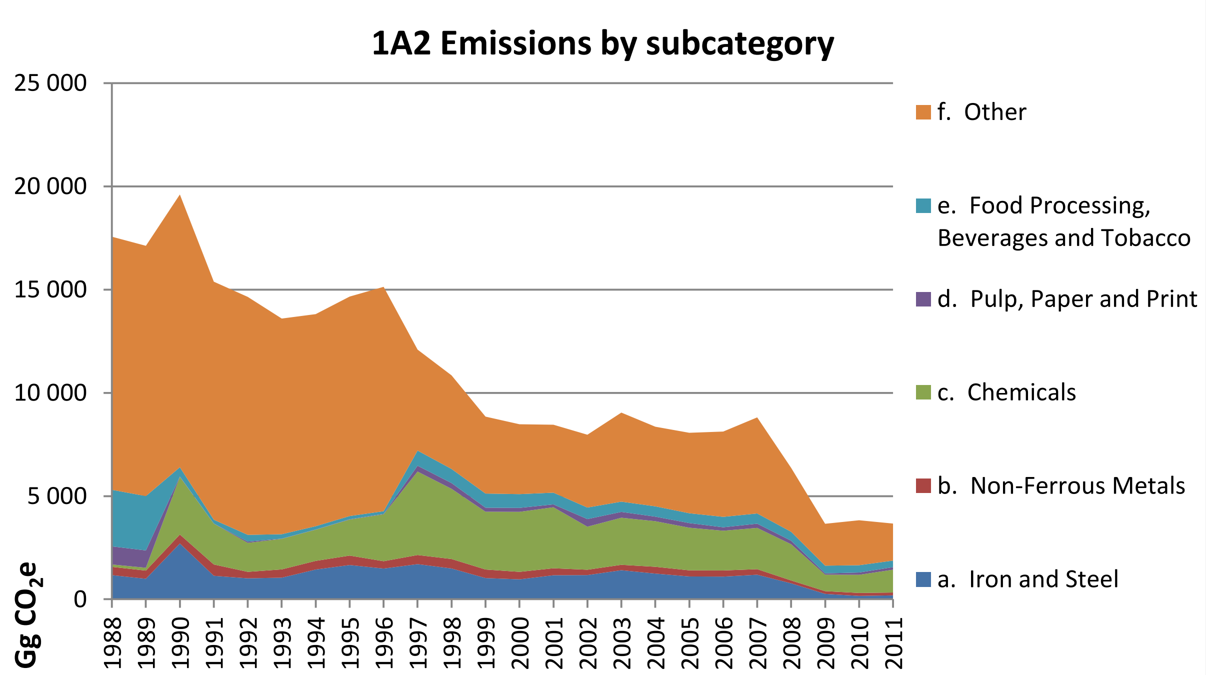



Figure 29 Total GHG emissions from 1.A.2 Manufacturing Industries and Construction by subcategory

Following the restructuring of the industry sector on the country, the general trend in CRF category 1.A.2 shows a decrease of 79.1% compared to base year and an decrease of 4.2% 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.

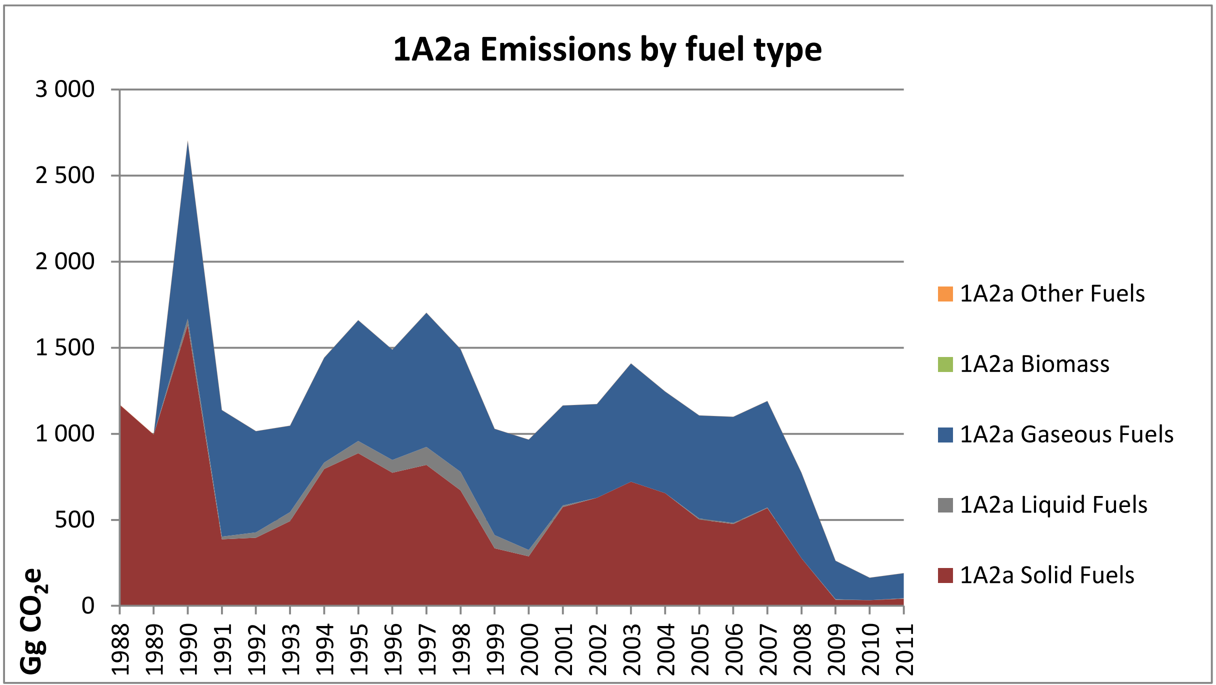



Figure 30 GHG emissions from 1.A.2.a. Iron and Steel

For the year 2011 the share of this subcategory from sector 1A Fuel Combustion is 0.4% while from the total GHGs emissions it is 0.3%. The drastic decrease in the emissions since

2009 in this subcategory is due to the closure of the biggest iron and steel plant in Bulgaria at the end of 2008.

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

| $CO_2$ (Gg) | CRF 1.A.2.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 1 164.20 | NO | 1 164.20 | NO | NO | NO |
| **1989** | 990.91 | NO | 990.91 | NO | NO | NO |
| **1990** | 2 690.92 | 36.95 | 1 622.14 | 1 031.82 | NO | NO |
| **1991** | 1 133.98 | 15.43 | 384.88 | 733.67 | NO | NO |
| **1992** | 1 011.70 | 30.90 | 394.05 | 586.75 | 0.1120 | NO |
| **1993** | 1 042.90 | 52.35 | 489.57 | 500.98 | 0.1120 | NO |
| **1994** | 1 435.71 | 37.03 | 790.72 | 607.96 | 0.2240 | NO |
| **1995** | 1 653.13 | 70.81 | 882.02 | 700.30 | 0.3360 | NO |
| **1996** | 1 482.96 | 73.95 | 769.27 | 639.75 | 0.2240 | NO |
| **1997** | 1 696.39 | 104.17 | 814.41 | 777.82 | 0.2240 | NO |
| **1998** | 1 487.03 | 107.27 | 667.35 | 712.42 | NO | NO |
| **1999** | 1 025.28 | 76.43 | 332.79 | 616.07 | 0.2240 | NO |
| **2000** | 963.05 | 36.80 | 286.50 | 639.75 | 0.3360 | NO |
| **2001** | 1 159.62 | 9.19 | 570.79 | 579.63 | 0.7840 | NO |
| **2002** | 1 167.84 | NO | 624.50 | 543.35 | 0.5600 | NO |
| **2003** | 1 402.97 | NO | 717.25 | 685.72 | 0.6720 | NO |
| **2004** | 1 240.52 | NO | 651.44 | 589.07 | 0.5600 | NO |
| **2005** | 1 102.20 | 6.17 | 499.00 | 597.03 | 0.5600 | NO |
| **2006** | 1 094.43 | 6.14 | 473.11 | 615.18 | 0.3360 | NO |
| **2007** | 1 185.50 | 3.10 | 565.13 | 617.27 | 0.4480 | NO |
| **2008** | 770.62 | NO | 275.04 | 495.58 | 0.4480 | NO |
| **2009** | 261.54 | 2.91 | 35.50 | 223.14 | 0.3360 | NO |
| **2010** | 163.33 | NO | 33.03 | 130.30 | 0.2240 | NO |
| **2011** | 189.71 | 2.88 | 41.48 | 145.35 | 0.2240 | NO |
| **Decrease 1988-2011** | 83.7% | - | 96.4% | - | - | - |
| **Decrease 1990-2011** | 93.0% | 92.2% | 97.4% | 85.9% | - | - |
| **Decrease 2010-2011** | -16.1% | - | -25.6% | -11.5% | 0.0% | - |

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

| $CH_4$ (Gg) | CRF 1.A.2.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.1150 | NO | 0.1150 | NO | NO | NO |
| **1989** | 0.0986 | NO | 0.0986 | NO | NO | NO |
| **1990** | 0.2490 | 0.0010 | 0.1540 | 0.0939 | NO | NO |
| **1991** | 0.1042 | 0.0004 | 0.0370 | 0.0668 | NO | NO |
| **1992** | 0.0922 | 0.0008 | 0.0379 | 0.0534 | 0.0000 | NO |
| **1993** | 0.0937 | 0.0014 | 0.0467 | 0.0456 | 0.0000 | NO |
| **1994** | 0.1322 | 0.0010 | 0.0758 | 0.0553 | 0.0001 | NO |
| **1995** | 0.1504 | 0.0019 | 0.0847 | 0.0637 | 0.0001 | NO |
| **1996** | 0.1340 | 0.0020 | 0.0737 | 0.0582 | 0.0001 | NO |
| **1997** | 0.1560 | 0.0027 | 0.0824 | 0.0708 | 0.0001 | NO |
| **1998** | 0.1352 | 0.0028 | 0.0676 | 0.0648 | NO | NO |
| **1999** | 0.0940 | 0.0020 | 0.0359 | 0.0561 | 0.0001 | NO |

| $CH_4$ (Gg) | CRF 1.A.2.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **2000** | 0.0900 | 0.0010 | 0.0307 | 0.0582 | 0.0001 | NO |
| **2001** | 0.1110 | 0.0002 | 0.0578 | 0.0528 | 0.0002 | NO |
| **2002** | 0.1118 | NO | 0.0622 | 0.0495 | 0.0002 | NO |
| **2003** | 0.1338 | NO | 0.0712 | 0.0624 | 0.0002 | NO |
| **2004** | 0.1183 | NO | 0.0645 | 0.0536 | 0.0002 | NO |
| **2005** | 0.1049 | 0.0002 | 0.0502 | 0.0543 | 0.0002 | NO |
| **2006** | 0.1038 | 0.0002 | 0.0475 | 0.0560 | 0.0001 | NO |
| **2007** | 0.1118 | 0.0001 | 0.0553 | 0.0562 | 0.0001 | NO |
| **2008** | 0.0725 | NO | 0.0272 | 0.0451 | 0.0001 | NO |
| **2009** | 0.0240 | 0.0001 | 0.0036 | 0.0203 | 0.0001 | NO |
| **2010** | 0.0153 | NO | 0.0034 | 0.0119 | 0.0001 | NO |
| **2011** | 0.0176 | 0.0001 | 0.0043 | 0.0132 | 0.0001 | NO |
| **Decrease 1988-2011** | 84.7% | - | 96.3% | - | - | - |
| **Decrease 1990-2011** | 92.9% | 93.7% | 97.2% | 85.9% | - | - |
| **Decrease 2010-2011** | -15.2% | - | -26.6% | -11.5% | 0.0% | - |

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

| $N_2O$ (Gg) | CRF 1.A.2.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.0102 | NO | 0.0102 | NO | NO | NO |
| **1989** | 0.0079 | NO | 0.0079 | NO | NO | NO |
| **1990** | 0.0228 | 0.0003 | 0.0206 | 0.0019 | NO | NO |
| **1991** | 0.0059 | 0.0001 | 0.0044 | 0.0013 | NO | NO |
| **1992** | 0.0058 | 0.0002 | 0.0045 | 0.0011 | 0.0000 | NO |
| **1993** | 0.0073 | 0.0004 | 0.0060 | 0.0009 | 0.0000 | NO |
| **1994** | 0.0112 | 0.0003 | 0.0098 | 0.0011 | 0.0000 | NO |
| **1995** | 0.0124 | 0.0006 | 0.0106 | 0.0013 | 0.0000 | NO |
| **1996** | 0.0112 | 0.0006 | 0.0094 | 0.0012 | 0.0000 | NO |
| **1997** | 0.0120 | 0.0008 | 0.0098 | 0.0014 | 0.0000 | NO |
| **1998** | 0.0102 | 0.0008 | 0.0081 | 0.0013 | NO | NO |
| **1999** | 0.0055 | 0.0006 | 0.0038 | 0.0011 | 0.0000 | NO |
| **2000** | 0.0042 | 0.0003 | 0.0027 | 0.0012 | 0.0000 | NO |
| **2001** | 0.0081 | 0.0001 | 0.0070 | 0.0011 | 0.0000 | NO |
| **2002** | 0.0086 | NO | 0.0076 | 0.0010 | 0.0000 | NO |
| **2003** | 0.0101 | NO | 0.0088 | 0.0012 | 0.0000 | NO |
| **2004** | 0.0090 | NO | 0.0079 | 0.0011 | 0.0000 | NO |
| **2005** | 0.0073 | 0.0001 | 0.0061 | 0.0011 | 0.0000 | NO |
| **2006** | 0.0070 | 0.0001 | 0.0058 | 0.0011 | 0.0000 | NO |
| **2007** | 0.0083 | 0.0000 | 0.0072 | 0.0011 | 0.0000 | NO |
| **2008** | 0.0045 | NO | 0.0036 | 0.0009 | 0.0000 | NO |
| **2009** | 0.0009 | 0.0000 | 0.0005 | 0.0004 | 0.0000 | NO |
| **2010** | 0.0007 | NO | 0.0005 | 0.0002 | 0.0000 | NO |
| **2011** | 0.0009 | 0.0000 | 0.0006 | 0.0003 | 0.0000 | NO |
| **Decrease 1988-2011** | 91.3% | - | 94.1% | - | - | - |
| **Decrease 1990-2011** | 96.1% | 93.7% | 97.1% | 85.9% | - | - |

| $N_2O$ (Gg) | CRF 1.A.2.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **Decrease 2010-2011** | -23.9% | - | -26.6% | -11.5% | 0.0% | - |

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

| GHG (Gg) | TJ | CRF 1.A.2.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **1988** | 16 396.80 | 1 169.78 | NO | 1 169.78 | NO | NO | NO |
| **1989** | 14 763.20 | 995.44 | NO | 995.44 | NO | NO | NO |
| **1990** | 35 474.30 | 2 703.21 | 37.07 | 1 631.77 | 1 034.37 | NO | NO |
| **1991** | 17 874.74 | 1 138.00 | 15.48 | 387.03 | 735.49 | NO | NO |
| **1992** | 15 595.66 | 1 015.43 | 31.00 | 396.23 | 588.20 | 0.0019 | NO |
| **1993** | 14 961.67 | 1 047.13 | 52.51 | 492.40 | 502.22 | 0.0019 | NO |
| **1994** | 19 863.32 | 1 441.95 | 37.14 | 795.34 | 609.46 | 0.0037 | NO |
| **1995** | 23 228.68 | 1 660.15 | 71.02 | 887.08 | 702.04 | 0.0056 | NO |
| **1996** | 20 772.27 | 1 489.23 | 74.17 | 773.73 | 641.33 | 0.0037 | NO |
| **1997** | 25 199.82 | 1 703.40 | 104.48 | 819.17 | 779.74 | 0.0037 | NO |
| **1998** | 22 262.85 | 1 493.04 | 107.59 | 671.28 | 714.18 | NO | NO |
| **1999** | 16 814.31 | 1 028.97 | 76.66 | 334.72 | 617.59 | 0.0037 | NO |
| **2000** | 16 535.12 | 966.23 | 36.91 | 287.98 | 641.33 | 0.0056 | NO |
| **2001** | 17 404.29 | 1 164.46 | 9.22 | 574.17 | 581.07 | 0.0131 | NO |
| **2002** | 17 050.10 | 1 172.86 | NO | 628.16 | 544.69 | 0.0094 | NO |
| **2003** | 20 596.93 | 1 408.90 | NO | 721.47 | 687.42 | 0.0112 | NO |
| **2004** | 18 109.01 | 1 245.79 | NO | 655.25 | 590.53 | 0.0094 | NO |
| **2005** | 16 753.11 | 1 106.65 | 6.19 | 501.94 | 598.51 | 0.0094 | NO |
| **2006** | 16 707.38 | 1 098.78 | 6.16 | 475.92 | 616.70 | 0.0056 | NO |
| **2007** | 17 293.10 | 1 190.43 | 3.11 | 568.52 | 618.80 | 0.0075 | NO |
| **2008** | 11 920.39 | 773.54 | NO | 276.73 | 496.81 | 0.0075 | NO |
| **2009** | 4 450.35 | 262.34 | 2.92 | 35.73 | 223.69 | 0.0056 | NO |
| **2010** | 2 711.76 | 163.88 | NO | 33.25 | 130.62 | 0.0037 | NO |
| **2011** | 3 105.87 | 190.35 | 2.88 | 41.76 | 145.71 | 0.0037 | NO |
| **Decrease 1988-2011** | 81.1% | 83.7% | - | 96.4% | - | - | - |
| **Decrease 1990-2011** | 91.2% | 93.0% | 92.2% | 97.4% | 85.9% | - | - |
| **Decrease 2010-2011** | -14.5% | -16.2% | - | -25.6% | -11.5% | 0.0% | - |

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

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

In addition, following the recommendation of the Technical review of GHG inventories under the EU Effort Sharing Decision (ESD) in 2012, we revised the methodology concerning Iron & Steel sector in order to remove the double counting with the IP sector. The quantities of

coke oven gas reported under blast furnaces; blast furnace gas reported under blast furnaces, autoproducers and Iron and Steel; coke oven coke in blast furnaces were disregarded from the Energy sector.

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

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

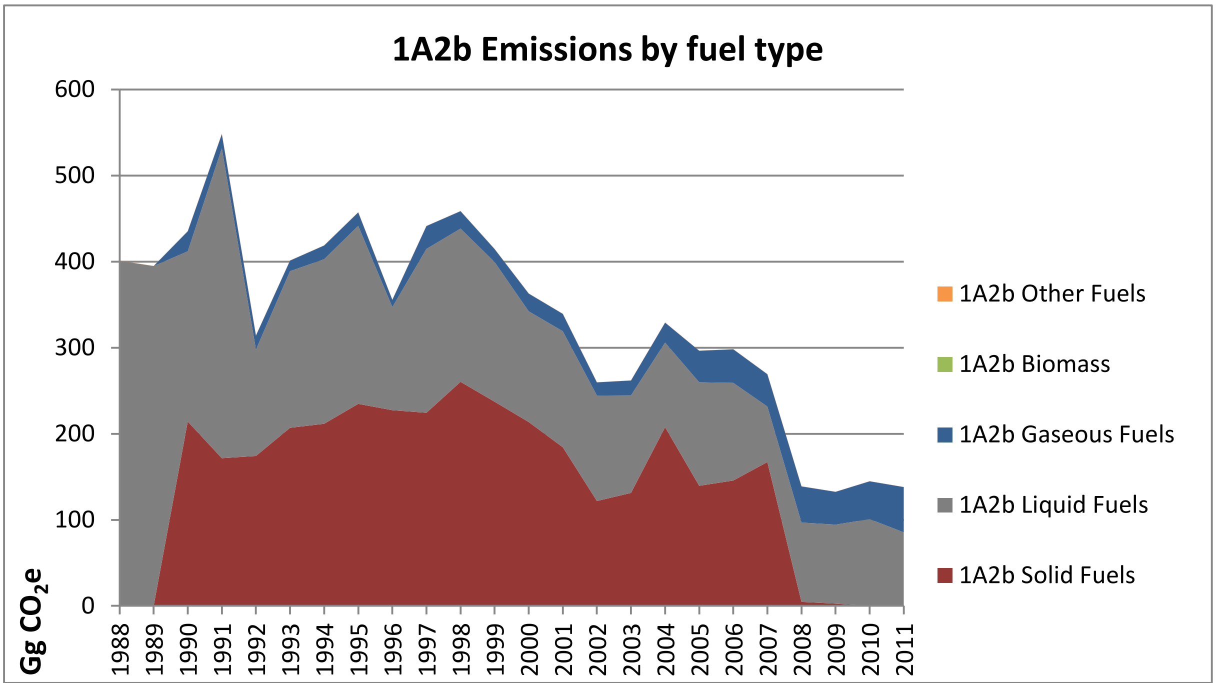



Figure 31 GHG emissions from CRF 1.A.2.b. Non-Ferrous Metals

The share of this subcategory from sector 1.A is 0.3% for the year 2011, while the share from the total GHG emissions is 0.2%.

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

| $CO_2$ (Gg) | CRF 1.A.2.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 399.84 | 399.84 | NO | NO | NO | NO |
| **1989** | 393.78 | 393.78 | NO | NO | NO | NO |
| **1990** | 433.41 | 197.22 | 212.91 | 23.28 | NO | NO |
| **1991** | 546.18 | 359.14 | 170.58 | 16.46 | NO | NO |
| **1992** | 312.72 | 123.27 | 173.18 | 16.26 | 2.5760 | NO |
| **1993** | 399.48 | 181.48 | 205.70 | 12.31 | 2.3520 | NO |
| **1994** | 416.94 | 190.67 | 210.35 | 15.92 | 1.5680 | NO |
| **1995** | 455.23 | 206.25 | 233.35 | 15.62 | 1.9040 | NO |
| **1996** | 353.95 | 119.41 | 226.04 | 8.50 | 0.3360 | NO |
| **1997** | 439.44 | 189.83 | 223.06 | 26.55 | 0.4480 | NO |
| **1998** | 456.61 | 177.54 | 258.80 | 20.27 | 0.5600 | NO |
| **1999** | 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 |
| **2003** | 260.80 | 113.05 | 130.49 | 17.25 | NO | NO |

| $CO_2$ (Gg) | CRF 1.A.2.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **2004** | 327.62 | 98.04 | 206.39 | 23.19 | 0.6720 | NO |
| **2005** | 295.27 | 119.88 | 138.75 | 36.63 | NO | NO |
| **2006** | 296.91 | 113.13 | 144.82 | 38.96 | NO | NO |
| **2007** | 267.96 | 64.34 | 166.16 | 37.46 | 0.1120 | NO |
| **2008** | 138.50 | 91.91 | 4.64 | 41.95 | NO | NO |
| **2009** | 132.21 | 91.57 | 2.60 | 38.04 | NO | NO |
| **2010** | 144.44 | 100.57 | NO | 43.88 | 0.1120 | NO |
| **2011** | 137.75 | 85.25 | NO | 52.51 | NO | NO |
| **Decrease 1988-2011** | 65.5% | 78.7% | - | - | - | - |
| **Decrease 1990-2011** | 68.2% | 56.8% | - | -125.5% | - | - |
| **Decrease 2010-2011** | 4.6% | 15.2% | - | -19.7% | - | - |

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

| $CH_4$ (Gg) | CRF 1.A.2.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.0105 | 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** | 0.0067 | 0.0024 | 0.0005 | 0.0038 | NO | NO |
| **2009** | 0.0064 | 0.0027 | 0.0003 | 0.0035 | NO | NO |
| **2010** | 0.0071 | 0.0031 | NO | 0.0040 | 0.0000 | NO |
| **2011** | 0.0075 | 0.0027 | NO | 0.0048 | NO | NO |
| **Decrease 1988-2011** | 29.1% | 74.4% | - | - | - | - |
| **Decrease 1990-2011** | 72.9% | 48.8% | - | -125.3% | - | - |
| **Decrease 2010-2011** | -5.0% | 12.9% | - | -19.6% | - | - |

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

| $N_2O$ (Gg) | CRF 1.A.2.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.0032 | 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** | 0.0009 | 0.0007 | 0.0001 | 0.0001 | NO | NO |
| **2009** | 0.0008 | 0.0007 | 0.0000 | 0.0001 | NO | NO |
| **2010** | 0.0008 | 0.0007 | NO | 0.0001 | 0.0000 | NO |
| **2011** | 0.0007 | 0.0006 | NO | 0.0001 | NO | NO |
| **Decrease 1988-2011** | 77.5% | 80.5% | - | - | - | - |
| **Decrease 1990-2011** | 84.0% | 61.0% | - | -125.3% | - | - |
| **Decrease 2010-2011** | 13.2% | 16.3% | - | -19.6% | - | - |

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

| GHG (Gg) | TJ | CRF 1.A.2.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **1988** | 5 267.60 | 401.04 | 401.04 | NO | NO | NO | NO |
| **1989** | 5 190.20 | 394.96 | 394.96 | NO | NO | NO | NO |
| **1990** | 5 066.91 | 435.36 | 197.82 | 214.20 | 23.34 | NO | NO |
| **1991** | 6 647.78 | 548.33 | 360.21 | 171.61 | 16.50 | NO | NO |
| **1992** | 3 615.94 | 314.23 | 123.64 | 174.24 | 16.30 | 0.0430 | NO |
| **1993** | 4 608.63 | 401.35 | 182.03 | 206.95 | 12.34 | 0.0393 | NO |
| **1994** | 4 836.30 | 418.87 | 191.25 | 211.64 | 15.96 | 0.0262 | NO |
| **1995** | 5 264.94 | 457.34 | 206.88 | 234.77 | 15.66 | 0.0318 | NO |
| **1996** | 3 863.12 | 355.71 | 119.76 | 227.42 | 8.52 | 0.0056 | NO |
| **1997** | 5 082.17 | 441.43 | 190.40 | 224.41 | 26.61 | 0.0075 | NO |
| **1998** | 5 143.72 | 458.77 | 178.07 | 260.37 | 20.32 | 0.0094 | NO |
| **1999** | 4 633.67 | 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 |

| GHG (Gg) | TJ | CRF 1.A.2.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **2003** | 3 041.72 | 261.96 | 113.38 | 131.29 | 17.30 | NO | NO |
| **2004** | 3 655.13 | 329.23 | 98.33 | 207.65 | 23.24 | 0.0112 | NO |
| **2005** | 3 560.36 | 296.55 | 120.23 | 139.60 | 36.72 | NO | NO |
| **2006** | 3 571.75 | 298.21 | 113.46 | 145.70 | 39.05 | NO | NO |
| **2007** | 3 090.70 | 269.25 | 64.53 | 167.17 | 37.55 | 0.0019 | NO |
| **2008** | 2 012.27 | 138.91 | 92.19 | 4.67 | 42.05 | NO | NO |
| **2009** | 1 933.74 | 132.59 | 91.83 | 2.62 | 38.13 | NO | NO |
| **2010** | 2 139.60 | 144.85 | 100.86 | NO | 43.99 | 0.0019 | NO |
| **2011** | 2 095.20 | 138.13 | 85.49 | NO | 52.64 | NO | NO |
| **Decrease 1988-2011** | 60.2% | 65.6% | 78.7% | - | - | - | - |
| **Decrease 1990-2011** | 58.6% | 68.3% | 56.8% | - | -125.5% | - | - |
| **Decrease 2010-2011** | 2.1% | 4.6% | 15.2% | - | -19.7% | - | - |

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

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

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

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

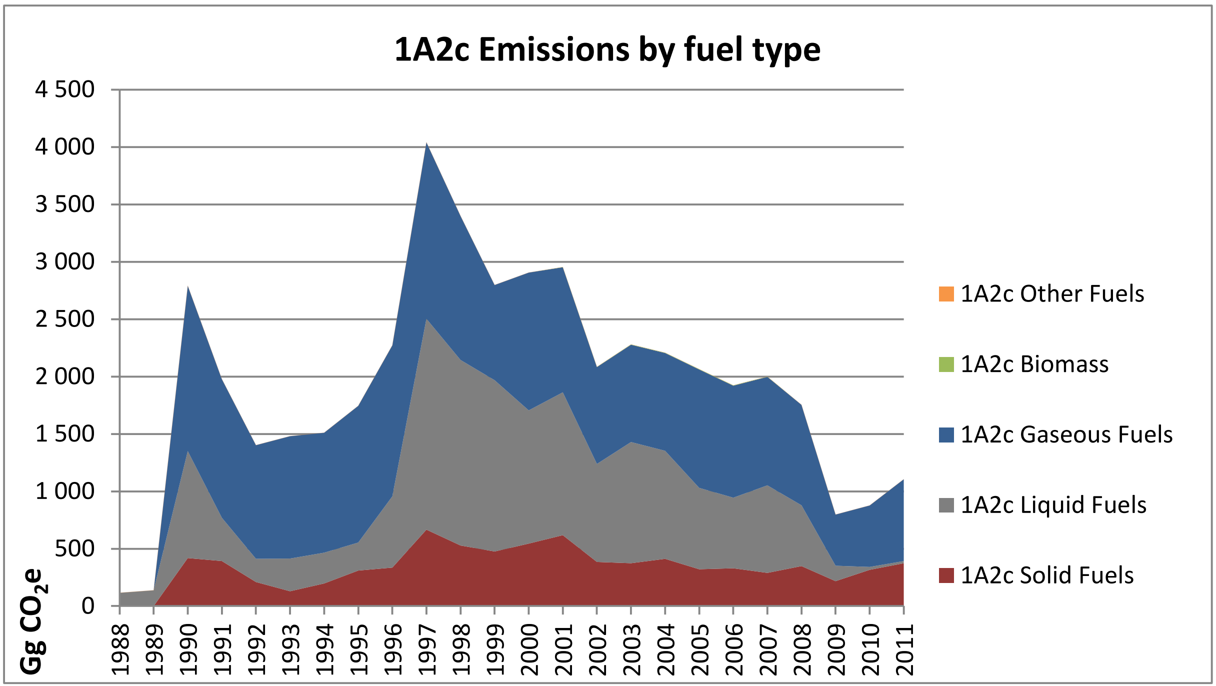



Figure 32 GHG emissions from CRF 1.A.2.c. Chemicals

The share of this subcategory from sector 1.A is 2.2% for the year 2011, while from the total GHG emissions it is 1.7%.

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

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

| $CO_2$ (Gg) | CRF 1.A.2.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 115.58 | 115.58 | NO | NO | NO | NO |
| **1989** | 137.44 | 137.44 | NO | NO | NO | NO |
| **1990** | 2 783.49 | 930.31 | 415.79 | 1 437.39 | NO | NO |
| **1991** | 1 972.21 | 376.35 | 390.18 | 1 205.68 | NO | NO |
| **1992** | 1 398.32 | 202.03 | 208.33 | 987.97 | 0.5600 | NO |
| **1993** | 1 476.71 | 284.22 | 128.44 | 1 064.05 | 0.1120 | NO |
| **1994** | 1 506.46 | 267.74 | 195.88 | 1 042.84 | 0.2240 | NO |
| **1995** | 1 739.82 | 243.57 | 307.62 | 1 188.63 | 0.2240 | NO |
| **1996** | 2 265.55 | 619.34 | 333.30 | 1 312.91 | 0.7840 | NO |
| **1997** | 4 028.59 | 1 832.51 | 661.85 | 1 534.23 | 6.2720 | NO |
| **1998** | 3 389.24 | 1 612.53 | 524.60 | 1 252.10 | 2.8000 | NO |
| **1999** | 2 789.51 | 1 488.91 | 472.75 | 827.85 | 3.2480 | NO |
| **2000** | 2 897.19 | 1 158.24 | 541.13 | 1 197.82 | 7.9520 | NO |
| **2001** | 2 943.27 | 1 241.80 | 614.04 | 1 087.43 | 104.6080 | NO |
| **2002** | 2 076.40 | 851.79 | 382.17 | 842.43 | 100.8000 | NO |
| **2003** | 2 270.44 | 1 053.23 | 371.17 | 846.04 | 155.2320 | NO |
| **2004** | 2 198.05 | 939.12 | 409.03 | 849.90 | 170.2400 | NO |
| **2005** | 2 055.35 | 707.55 | 318.80 | 1 029.00 | 189.3920 | NO |
| **2006** | 1 914.47 | 613.76 | 327.33 | 973.39 | 194.6560 | NO |
| **2007** | 1 991.58 | 761.24 | 287.31 | 943.03 | 128.9120 | NO |
| **2008** | 1 748.40 | 528.97 | 346.21 | 873.22 | 0.1120 | NO |
| **2009** | 795.12 | 134.28 | 215.71 | 445.13 | 0.1120 | NO |
| **2010** | 873.68 | 25.27 | 313.81 | 534.61 | 0.2240 | NO |
| **2011** | 1 101.27 | 19.14 | 370.59 | 711.54 | 0.1120 | NO |
| **Decrease 1988-2011** | -852.8% | 83.4% | - | - | - | - |
| **Decrease 1990-2011** | 60.4% | 97.9% | 10.9% | 50.5% | - | - |
| **Decrease 2010-2011** | -26.0% | 24.3% | -18.1% | -33.1% | 50.0% | - |

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

| $CH_4$ (Gg) | CRF 1.A.2.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.0032 | 0.0032 | NO | NO | NO | NO |
| **1989** | 0.0037 | 0.0037 | NO | NO | NO | NO |

| $CH_4$ (Gg) | CRF 1.A.2.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1990** | 0.2249 | 0.0544 | 0.0397 | 0.1308 | NO | NO |
| **1991** | 0.1667 | 0.0200 | 0.0370 | 0.1098 | NO | NO |
| **1992** | 0.1190 | 0.0089 | 0.0199 | 0.0899 | 0.0002 | NO |
| **1993** | 0.1223 | 0.0132 | 0.0123 | 0.0969 | 0.0000 | NO |
| **1994** | 0.1257 | 0.0120 | 0.0187 | 0.0949 | 0.0001 | NO |
| **1995** | 0.1467 | 0.0092 | 0.0293 | 0.1082 | 0.0001 | NO |
| **1996** | 0.1716 | 0.0202 | 0.0317 | 0.1195 | 0.0002 | NO |
| **1997** | 0.2640 | 0.0574 | 0.0652 | 0.1397 | 0.0017 | NO |
| **1998** | 0.2225 | 0.0564 | 0.0514 | 0.1140 | 0.0008 | NO |
| **1999** | 0.1914 | 0.0687 | 0.0464 | 0.0754 | 0.0009 | NO |
| **2000** | 0.2227 | 0.0587 | 0.0528 | 0.1090 | 0.0021 | NO |
| **2001** | 0.2484 | 0.0616 | 0.0598 | 0.0990 | 0.0280 | NO |
| **2002** | 0.1736 | 0.0333 | 0.0366 | 0.0767 | 0.0270 | NO |
| **2003** | 0.1995 | 0.0452 | 0.0358 | 0.0770 | 0.0416 | NO |
| **2004** | 0.2059 | 0.0419 | 0.0410 | 0.0774 | 0.0456 | NO |
| **2005** | 0.2122 | 0.0355 | 0.0322 | 0.0937 | 0.0507 | NO |
| **2006** | 0.2075 | 0.0336 | 0.0332 | 0.0886 | 0.0521 | NO |
| **2007** | 0.1935 | 0.0437 | 0.0295 | 0.0859 | 0.0345 | NO |
| **2008** | 0.1482 | 0.0343 | 0.0344 | 0.0795 | 0.0000 | NO |
| **2009** | 0.0716 | 0.0094 | 0.0216 | 0.0405 | 0.0000 | NO |
| **2010** | 0.0821 | 0.0012 | 0.0322 | 0.0486 | 0.0001 | NO |
| **2011** | 0.1041 | 0.0010 | 0.0384 | 0.0647 | 0.0000 | NO |
| **Decrease 1988-2011** | -3201.8% | 68.4% | - | - | - | - |
| **Decrease 1990-2011** | 53.7% | 98.2% | 3.3% | 50.6% | - | - |
| **Decrease 2010-2011** | -26.8% | 13.9% | -19.1% | -33.0% | 50.0% | - |

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

| $N_2O$ (Gg) | CRF 1.A.2.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.0009 | 0.0009 | NO | NO | NO | NO |
| **1989** | 0.0011 | 0.0011 | NO | NO | NO | NO |
| **1990** | 0.0117 | 0.0035 | 0.0056 | 0.0026 | NO | NO |
| **1991** | 0.0090 | 0.0017 | 0.0052 | 0.0022 | NO | NO |
| **1992** | 0.0058 | 0.0011 | 0.0028 | 0.0018 | 0.0000 | NO |
| **1993** | 0.0052 | 0.0015 | 0.0017 | 0.0019 | 0.0000 | NO |
| **1994** | 0.0060 | 0.0015 | 0.0026 | 0.0019 | 0.0000 | NO |
| **1995** | 0.0078 | 0.0016 | 0.0041 | 0.0022 | 0.0000 | NO |
| **1996** | 0.0115 | 0.0046 | 0.0044 | 0.0024 | 0.0000 | NO |
| **1997** | 0.0256 | 0.0134 | 0.0091 | 0.0028 | 0.0002 | NO |
| **1998** | 0.0208 | 0.0112 | 0.0072 | 0.0023 | 0.0001 | NO |
| **1999** | 0.0161 | 0.0080 | 0.0065 | 0.0015 | 0.0001 | NO |
| **2000** | 0.0154 | 0.0056 | 0.0074 | 0.0022 | 0.0003 | NO |
| **2001** | 0.0202 | 0.0062 | 0.0084 | 0.0020 | 0.0037 | NO |
| **2002** | 0.0156 | 0.0054 | 0.0051 | 0.0015 | 0.0036 | NO |
| **2003** | 0.0185 | 0.0064 | 0.0050 | 0.0015 | 0.0055 | NO |
| **2004** | 0.0189 | 0.0055 | 0.0057 | 0.0015 | 0.0061 | NO |
| **2005** | 0.0167 | 0.0036 | 0.0045 | 0.0019 | 0.0068 | NO |

| $N_2O$ (Gg) | CRF 1.A.2.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 2006 | 0.0161 | 0.0027 | 0.0047 | 0.0018 | 0.0070 | NO |
| 2007 | 0.0135 | 0.0031 | 0.0041 | 0.0017 | 0.0046 | NO |
| 2008 | 0.0080 | 0.0016 | 0.0048 | 0.0016 | 0.0000 | NO |
| 2009 | 0.0041 | 0.0003 | 0.0030 | 0.0008 | 0.0000 | NO |
| 2010 | 0.0056 | 0.0001 | 0.0045 | 0.0010 | 0.0000 | NO |
| 2011 | 0.0068 | 0.0001 | 0.0054 | 0.0013 | 0.0000 | NO |
| Decrease 1988-2011 | -614.5% | 90.7% | - | - | - | - |
| Decrease 1990-2011 | 42.2% | 97.5% | 3.3% | 50.6% | - | - |
| Decrease 2010-2011 | -20.1% | 35.2% | -19.1% | -33.0% | 50.0% | - |

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

| GHG (Gg) | TJ | CRF 1.A.2.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| 1988 | 1 576.20 | 115.94 | 115.94 | NO | NO | NO | NO |
| 1989 | 1 874.40 | 137.87 | 137.87 | NO | NO | NO | NO |
| 1990 | 43 612.47 | 2 791.83 | 932.54 | 418.35 | 1 440.95 | NO | NO |
| 1991 | 31 006.86 | 1 978.52 | 377.28 | 392.56 | 1 208.67 | NO | NO |
| 1992 | 22 808.99 | 1 402.61 | 202.57 | 209.61 | 990.42 | 0.0094 | NO |
| 1993 | 24 579.72 | 1 480.88 | 284.96 | 129.23 | 1 066.69 | 0.0019 | NO |
| 1994 | 24 592.26 | 1 510.96 | 268.45 | 197.08 | 1 045.42 | 0.0037 | NO |
| 1995 | 27 893.19 | 1 745.33 | 244.25 | 309.51 | 1 191.57 | 0.0037 | NO |
| 1996 | 35 617.14 | 2 272.71 | 621.19 | 335.34 | 1 316.16 | 0.0131 | NO |
| 1997 | 59 165.91 | 4 042.06 | 1 837.88 | 666.05 | 1 538.03 | 0.1047 | NO |
| 1998 | 50 002.79 | 3 400.34 | 1 617.18 | 527.91 | 1 255.20 | 0.0468 | NO |
| 1999 | 40 599.30 | 2 798.53 | 1 492.84 | 475.74 | 829.90 | 0.0542 | NO |
| 2000 | 43 597.71 | 2 906.65 | 1 161.19 | 544.53 | 1 200.79 | 0.1328 | NO |
| 2001 | 44 315.76 | 2 954.76 | 1 245.00 | 617.89 | 1 090.13 | 1.7466 | NO |
| 2002 | 31 583.80 | 2 084.88 | 854.15 | 384.53 | 844.52 | 1.6830 | NO |
| 2003 | 35 293.10 | 2 280.36 | 1 056.17 | 373.47 | 848.13 | 2.5918 | NO |
| 2004 | 34 454.76 | 2 208.22 | 941.70 | 411.67 | 852.00 | 2.8424 | NO |
| 2005 | 33 821.90 | 2 064.98 | 709.40 | 320.87 | 1 031.55 | 3.1622 | NO |
| 2006 | 31 687.85 | 1 923.82 | 615.30 | 329.47 | 975.80 | 3.2501 | NO |
| 2007 | 32 388.87 | 1 999.84 | 763.12 | 289.21 | 945.36 | 2.1524 | NO |
| 2008 | 27 177.52 | 1 754.00 | 530.19 | 348.42 | 875.38 | 0.0019 | NO |
| 2009 | 12 267.00 | 797.91 | 134.57 | 217.11 | 446.24 | 0.0019 | NO |
| 2010 | 13 302.58 | 877.15 | 25.33 | 315.88 | 535.93 | 0.0037 | NO |
| 2011 | 17 049.65 | 1 105.55 | 19.19 | 373.06 | 713.30 | 0.0019 | NO |
| Decrease 1988-2011 | -981.7% | -853.6% | 83.5% | - | - | - | - |
| Decrease 1990-2011 | 60.9% | 60.4% | 97.9% | 10.8% | 50.5% | - | - |
| Decrease 2010-2011 | -28.2% | -26.0% | 24.3% | -18.1% | -33.1% | 50.0% | - |

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

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

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

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

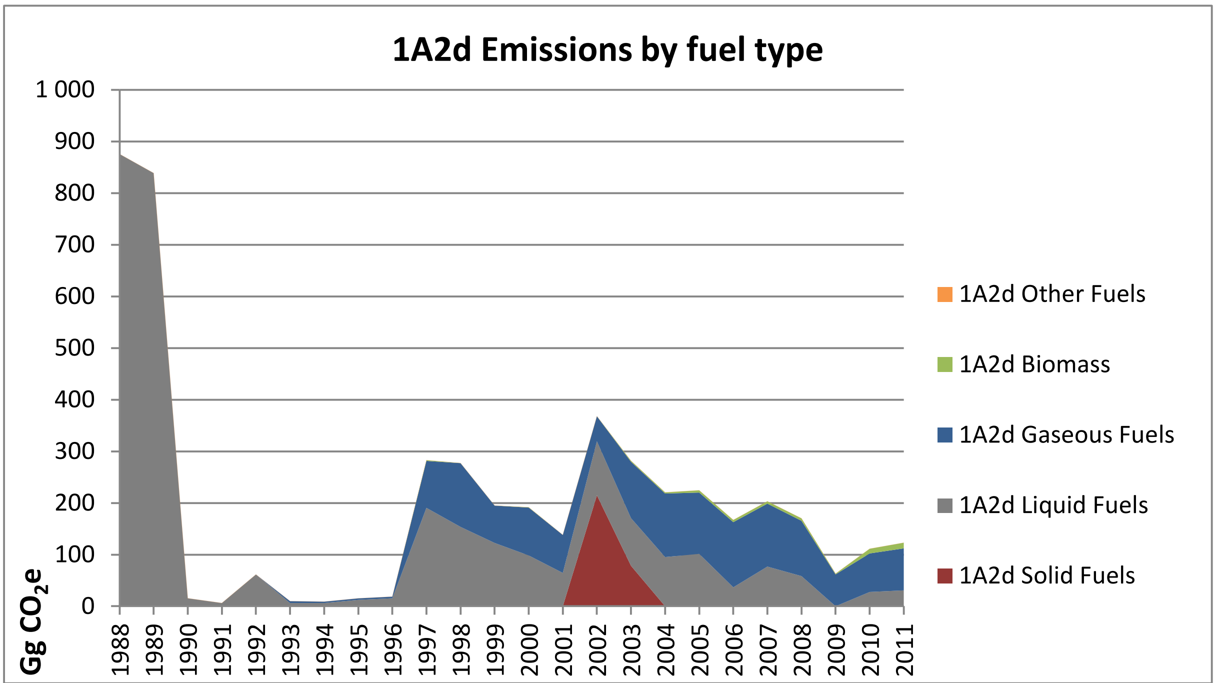



Figure 33 GHG emissions from CRF 1.A.2.d. Pulp, Paper and Print

The share of this subcategory from sector 1.A is 0.2% for 2011, as well as the share from total GHGs emissions.

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

| $CO_2$ (Gg) | CRF 1.A.2.d. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 873.16 | 873.16 | NO | NO | NO | NO |
| **1989** | 836.40 | 836.40 | NO | NO | NO | NO |
| **1990** | 15.39 | 15.39 | NO | NO | NO | NO |
| **1991** | 6.20 | 6.20 | NO | NO | NO | NO |
| **1992** | 61.35 | 61.35 | NO | NO | NO | NO |
| **1993** | 9.86 | 6.20 | NO | 3.66 | NO | NO |
| **1994** | 8.87 | 6.20 | NO | 2.67 | 0.1120 | NO |
| **1995** | 15.25 | 12.33 | NO | 2.92 | 0.2240 | NO |

| $CO_2$ (Gg) | CRF 1.A.2.d. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 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 |
| 2011 | 111.75 | 30.64 | NO | 81.11 | 660.2400 | NO |
| Decrease 1988-2011 | 87.2% | 96.5% | - | - | - | - |
| Decrease 1990-2011 | -625.9% | -99.0% | - | - | - | - |
| Decrease 2010-2011 | -9.5% | -11.1% | - | -8.9% | -22.1% | - |

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

| $CH_4$ (Gg) | CRF 1.A.2.d. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988 | 0.0228 | 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 |
| 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 |
| 2011 | 0.1850 | 0.0008 | NO | 0.0074 | 0.1769 | NO |

| $CH_4$ (Gg) | CRF 1.A.2.d. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **Decrease 1988-2011** | -711.5% | 96.5% | - | - | - | - |
| **Decrease 1990-2011** | -45116.4% | -95.5% | - | - | - | - |
| **Decrease 2010-2011** | -21.4% | -11.1% | - | -8.9% | -22.1% | - |

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

| $N_2O$ (Gg) | CRF 1.A.2.d. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.0068 | 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 |
| **2011** | 0.0240 | 0.0002 | NO | 0.0001 | 0.0236 | NO |
| **Decrease 1988-2011** | -250.4% | 96.5% | - | - | - | - |
| **Decrease 1990-2011** | -19423.9% | -95.5% | - | - | - | - |
| **Decrease 2010-2011** | -21.9% | -11.1% | - | -8.9% | -22.1% | - |

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

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

| GHG (Gg) | TJ | CRF 1.A.2.d. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| 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 | 2 979.10 | 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 | 4 662.57 | 220.53 | 95.26 | NO | 123.05 | 2.2178 | NO |
| 2005 | 5 829.27 | 224.55 | 101.41 | NO | 118.74 | 4.3964 | NO |
| 2006 | 5 035.71 | 167.09 | 36.68 | NO | 126.17 | 4.2356 | NO |
| 2007 | 5 633.00 | 203.21 | 76.82 | NO | 121.87 | 4.5235 | NO |
| 2008 | 5 297.90 | 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 |
| 2011 | 7 770.10 | 123.06 | 30.73 | NO | 81.31 | 11.0237 | NO |
| Decrease 1988-2011 | 31.8% | 85.9% | 96.5% | - | - | - | - |
| Decrease 1990-2011 | -3697.7% | -697.0% | -99.0% | - | - | - | - |
| Decrease 2010-2011 | -18.7% | -10.5% | -11.1% | - | -8.9% | -22.1% | - |

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

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

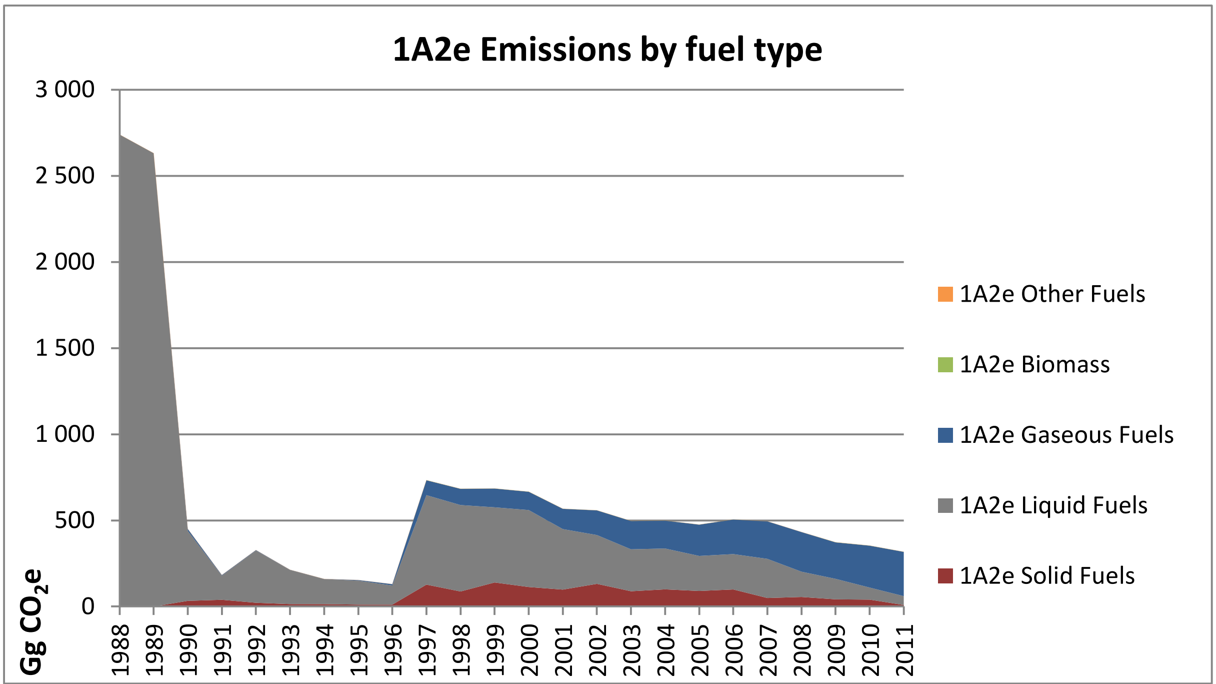



Figure 34 GHG emissions from 1.A.2.e. Food Processing, Beverages and Tobacco

The share of this subcategory from sector 1.A is 0.6% for 2011 and the share from total GHGs emissions is 0.5%.

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

| $CO_2$ (Gg) | CRF 1.A.2.e. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 2 731.92 | 2 731.92 | NO | NO | NO | NO |
| **1989** | 2 624.15 | 2 624.15 | NO | NO | NO | NO |
| **1990** | 449.09 | 404.99 | 32.72 | 11.37 | NO | NO |
| **1991** | 181.94 | 139.58 | 38.85 | 3.51 | NO | NO |
| **1992** | 326.59 | 302.03 | 21.74 | 2.82 | 3.2480 | NO |
| **1993** | 212.64 | 197.48 | 14.07 | 1.09 | 0.7840 | NO |
| **1994** | 159.58 | 145.13 | 13.80 | 0.64 | 0.8960 | NO |
| **1995** | 153.26 | 138.85 | 10.99 | 3.41 | 1.9040 | NO |
| **1996** | 129.40 | 110.98 | 10.91 | 7.51 | 3.0240 | NO |
| **1997** | 730.44 | 517.88 | 126.39 | 86.17 | 44.2400 | NO |
| **1998** | 680.91 | 500.26 | 86.82 | 93.83 | 30.5760 | NO |
| **1999** | 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 |
| **2011** | 316.47 | 51.28 | 8.85 | 256.35 | 24.7520 | NO |
| **Decrease 1988-2011** | 88.4% | 98.1% | - | - | - | - |
| **Decrease 1990-2011** | 29.5% | 87.3% | 73.0% | -2154.6% | - | - |
| **Decrease 2010-2011** | 10.2% | 26.6% | 77.7% | -5.6% | 25.1% | - |

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

| $CH_4$ (Gg) | CRF 1.A.2.e. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.0720 | 0.0720 | NO | NO | NO | NO |
| **1989** | 0.0692 | 0.0692 | NO | NO | NO | NO |
| **1990** | 0.0151 | 0.0109 | 0.0032 | 0.0010 | NO | NO |
| **1991** | 0.0079 | 0.0038 | 0.0038 | 0.0003 | NO | NO |
| **1992** | 0.0113 | 0.0081 | 0.0021 | 0.0003 | 0.0009 | NO |
| **1993** | 0.0069 | 0.0053 | 0.0013 | 0.0001 | 0.0002 | NO |
| **1994** | 0.0056 | 0.0039 | 0.0014 | 0.0001 | 0.0002 | NO |
| **1995** | 0.0056 | 0.0037 | 0.0011 | 0.0003 | 0.0005 | NO |
| **1996** | 0.0057 | 0.0031 | 0.0011 | 0.0007 | 0.0008 | NO |
| **1997** | 0.0461 | 0.0137 | 0.0127 | 0.0078 | 0.0119 | NO |
| **1998** | 0.0390 | 0.0135 | 0.0087 | 0.0085 | 0.0082 | NO |
| **1999** | 0.0429 | 0.0118 | 0.0140 | 0.0099 | 0.0072 | NO |

| $CH_4$ (Gg) | CRF 1.A.2.e. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **2000** | 0.0428 | 0.0119 | 0.0114 | 0.0096 | 0.0099 | NO |
| **2001** | 0.0359 | 0.0094 | 0.0099 | 0.0107 | 0.0059 | NO |
| **2002** | 0.0407 | 0.0078 | 0.0132 | 0.0130 | 0.0066 | NO |
| **2003** | 0.0365 | 0.0066 | 0.0089 | 0.0149 | 0.0061 | NO |
| **2004** | 0.0384 | 0.0066 | 0.0102 | 0.0147 | 0.0069 | NO |
| **2005** | 0.0367 | 0.0057 | 0.0093 | 0.0165 | 0.0052 | NO |
| **2006** | 0.0408 | 0.0057 | 0.0102 | 0.0182 | 0.0067 | NO |
| **2007** | 0.0327 | 0.0063 | 0.0049 | 0.0198 | 0.0017 | NO |
| **2008** | 0.0336 | 0.0045 | 0.0056 | 0.0209 | 0.0026 | NO |
| **2009** | 0.0395 | 0.0039 | 0.0043 | 0.0192 | 0.0121 | NO |
| **2010** | 0.0376 | 0.0025 | 0.0042 | 0.0221 | 0.0089 | NO |
| **2011** | 0.0330 | 0.0021 | 0.0009 | 0.0233 | 0.0066 | NO |
| **Decrease 1988-2011** | 54.2% | 97.0% | - | - | - | - |
| **Decrease 1990-2011** | -117.9% | 80.5% | 72.0% | -2152.2% | - | - |
| **Decrease 2010-2011** | 12.3% | 13.4% | 78.9% | -5.6% | 25.1% | - |

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

| $N_2O$ (Gg) | CRF 1.A.2.d. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 0.0216 | 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 |
| **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 |
| **2011** | 0.0018 | 0.0003 | 0.0001 | 0.0005 | 0.0009 | NO |
| **Decrease 1988-2011** | 91.7% | 98.5% | - | - | - | - |
| **Decrease 1990-2011** | 52.1% | 90.3% | 72.0% | -2152.2% | - | - |

| $N_2O$ (Gg) | CRF 1.A.2.d. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| Decrease 2010-2011 | 33.4% | 34.0% | 78.9% | -5.6% | 25.1% | - |

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

| GHG (Gg) | TJ | CRF 1.A.2.e. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| 1988 | 36 011.40 | 2 740.13 | 2 740.13 | NO | NO | NO | NO |
| 1989 | 34 588.00 | 2 632.03 | 2 632.03 | NO | NO | NO | NO |
| 1990 | 5 984.34 | 450.56 | 406.24 | 32.93 | 11.40 | NO | NO |
| 1991 | 2 344.95 | 182.62 | 140.01 | 39.09 | 3.52 | NO | NO |
| 1992 | 4 319.24 | 327.71 | 302.95 | 21.88 | 2.82 | 0.0542 | NO |
| 1993 | 2 806.06 | 213.34 | 198.09 | 14.15 | 1.09 | 0.0131 | NO |
| 1994 | 2 104.79 | 160.12 | 145.58 | 13.89 | 0.64 | 0.0150 | NO |
| 1995 | 2 045.98 | 153.79 | 139.28 | 11.06 | 3.42 | 0.0318 | NO |
| 1996 | 1 772.86 | 129.88 | 111.31 | 10.98 | 7.53 | 0.0505 | NO |
| 1997 | 10 022.26 | 733.75 | 519.42 | 127.21 | 86.38 | 0.7387 | NO |
| 1998 | 9 463.30 | 683.71 | 501.75 | 87.38 | 94.06 | 0.5105 | NO |
| 1999 | 9 379.56 | 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 |
| 2011 | 5 690.71 | 317.72 | 51.42 | 8.91 | 256.98 | 0.4133 | NO |
| Decrease 1988-2011 | 84.2% | 88.4% | 98.1% | - | - | - | - |
| Decrease 1990-2011 | 4.9% | 29.5% | 87.3% | 73.0% | -2154.6% | - | - |
| Decrease 2010-2011 | 6.4% | 10.2% | 26.6% | 77.7% | -5.6% | 25.1% | - |

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

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

Most notably these are:

- Autoproducer Electricity Plants
- Autoproducer CHP Plants
- Autoproducer Heat Plants
- Non-Metallic Minerals
- Transport Equipment
- Machinery

- Mining and Quarrying
- Wood and Wood Products
- Construction
- Textiles and Leather
- Non-specified (Industry)

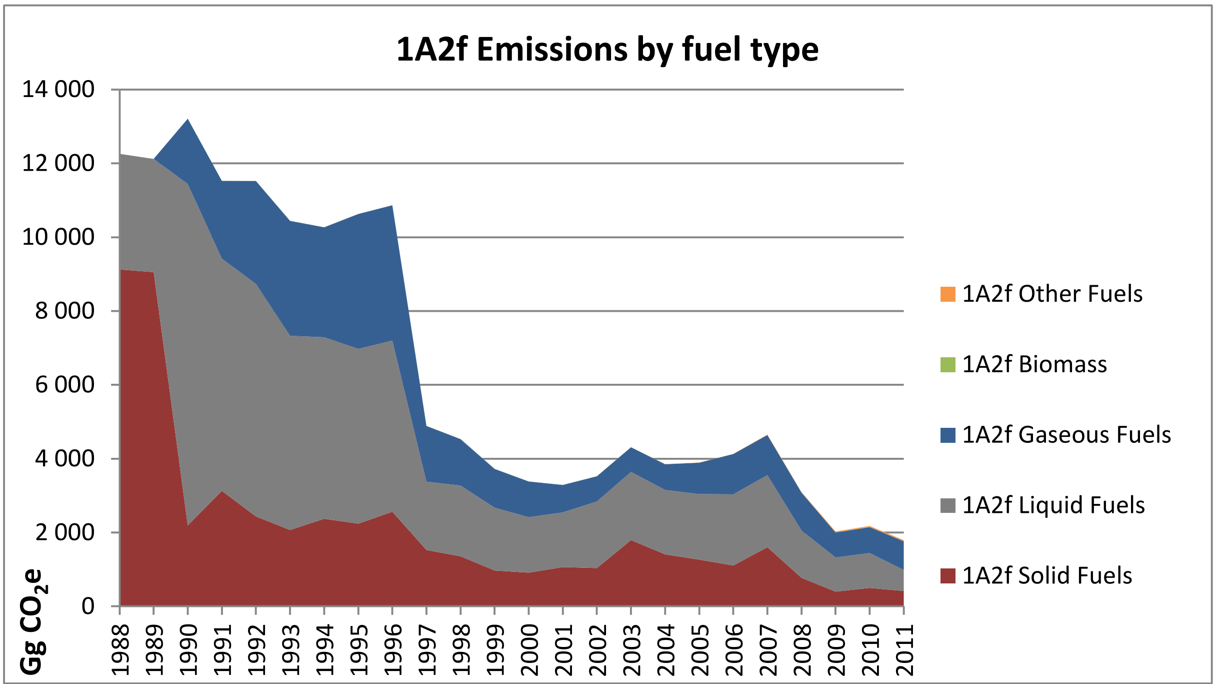



Figure 35 GHG emissions from 1.A.2.f. Other industries

The share of this subcategory from sector 1.A is 3.6% for 2011, while the share from total GHGs emissions is 2.7%.

Up to 1997 there was a significantly higher consumption in this sector, due to the fact that the total amount of fuels used by autoproducers CHP and heat plants was reported under autoproducers instead of reporting only the quantities sold to third parties. The National statistics changed their methodologies after 1997 and reallocated fuels used for the production of electricity and heat for own use to the respective subcategories from category 1.A.2.

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

| $CO_2$ (Gg) | CRF 1.A.2.f. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 12 192.34 | 3 122.90 | 9 069.45 | NO | NO | NO |
| **1989** | 12 055.81 | 3 058.02 | 8 997.78 | NO | NO | NO |
| **1990** | 13 166.47 | 9 223.84 | 2 178.43 | 1 764.21 | NO | NO |
| **1991** | 11 483.98 | 6 273.56 | 3 109.26 | 2 101.16 | 168.0000 | 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** | 4 868.98 | 1 844.74 | 1 517.98 | 1 506.25 | 178.5280 | NO |
| **1998** | 4 513.61 | 1 912.64 | 1 347.33 | 1 253.64 | 181.5520 | NO |
| **1999** | 3 709.31 | 1 697.15 | 965.26 | 1 046.90 | 183.6800 | NO |
| **2000** | 3 369.76 | 1 499.04 | 907.17 | 963.55 | 128.8000 | NO |

| $CO_2$ (Gg) | CRF 1.A.2.f. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 2001 | 3 276.05 | 1 476.99 | 1 057.63 | 741.43 | 143.8080 | NO |
| 2002 | 3 511.14 | 1 800.72 | 1 029.90 | 680.53 | 179.0880 | NO |
| 2003 | 4 291.94 | 1 840.97 | 1 784.23 | 666.74 | 200.1440 | NO |
| 2004 | 3 837.44 | 1 741.26 | 1 399.34 | 693.38 | 205.3403 | 3.4595 |
| 2005 | 3 879.32 | 1 771.79 | 1 257.70 | 847.03 | 146.2755 | 2.8073 |
| 2006 | 4 113.45 | 1 922.93 | 1 100.06 | 1 088.82 | 179.8774 | 1.6434 |
| 2007 | 4 632.77 | 1 948.66 | 1 591.90 | 1 082.48 | 190.3833 | 9.7319 |
| 2008 | 3 080.51 | 1 279.24 | 767.64 | 1 025.90 | 301.6536 | 7.7358 |
| 2009 | 2 015.53 | 924.31 | 396.18 | 672.62 | 369.7121 | 22.4192 |
| 2010 | 2 164.44 | 943.14 | 495.32 | 700.87 | 302.1727 | 25.1073 |
| 2011 | 1 782.59 | 568.07 | 413.92 | 774.19 | 260.6411 | 26.4157 |
| Decrease 1988-2011 | 85.4% | 81.8% | 95.4% | - | - | - |
| Decrease 1990-2011 | 86.5% | 93.8% | 81.0% | 56.1% | - | - |
| Decrease 2010-2011 | 17.6% | 39.8% | 16.4% | -10.5% | 13.7% | -5.2% |

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

| $CH_4$ (Gg) | CRF 1.A.2.f. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988 | 0.9897 | 0.0835 | 0.9062 | NO | NO | NO |
| 1989 | 0.9808 | 0.0815 | 0.8992 | NO | NO | NO |
| 1990 | 0.6296 | 0.2531 | 0.2160 | 0.1606 | NO | NO |
| 1991 | 0.7214 | 0.1721 | 0.3131 | 0.1913 | 0.0450 | NO |
| 1992 | 0.7057 | 0.1706 | 0.2433 | 0.2532 | 0.0387 | NO |
| 1993 | 0.6682 | 0.1418 | 0.2071 | 0.2827 | 0.0365 | NO |
| 1994 | 0.6807 | 0.1337 | 0.2377 | 0.2704 | 0.0388 | NO |
| 1995 | 0.7227 | 0.1300 | 0.2244 | 0.3318 | 0.0366 | NO |
| 1996 | 0.7499 | 0.1258 | 0.2576 | 0.3330 | 0.0335 | NO |
| 1997 | 0.3861 | 0.0503 | 0.1509 | 0.1371 | 0.0478 | NO |
| 1998 | 0.3510 | 0.0522 | 0.1361 | 0.1141 | 0.0486 | NO |
| 1999 | 0.2903 | 0.0474 | 0.0984 | 0.0953 | 0.0492 | NO |
| 2000 | 0.2540 | 0.0387 | 0.0930 | 0.0877 | 0.0345 | NO |
| 2001 | 0.2527 | 0.0387 | 0.1080 | 0.0675 | 0.0385 | NO |
| 2002 | 0.2598 | 0.0451 | 0.1048 | 0.0619 | 0.0480 | NO |
| 2003 | 0.3425 | 0.0465 | 0.1817 | 0.0607 | 0.0536 | NO |
| 2004 | 0.3097 | 0.0453 | 0.1450 | 0.0631 | 0.0544 | 0.0019 |
| 2005 | 0.2927 | 0.0452 | 0.1301 | 0.0771 | 0.0387 | 0.0015 |
| 2006 | 0.3099 | 0.0480 | 0.1141 | 0.0991 | 0.0481 | 0.0006 |
| 2007 | 0.3649 | 0.0488 | 0.1625 | 0.0986 | 0.0459 | 0.0092 |
| 2008 | 0.2890 | 0.0319 | 0.0778 | 0.0934 | 0.0605 | 0.0255 |
| 2009 | 0.2339 | 0.0228 | 0.0405 | 0.0612 | 0.0766 | 0.0329 |
| 2010 | 0.2308 | 0.0220 | 0.0518 | 0.0638 | 0.0642 | 0.0291 |
| 2011 | 0.2080 | 0.0141 | 0.0430 | 0.0704 | 0.0567 | 0.0238 |
| Decrease 1988-2011 | 79.0% | 83.1% | 95.3% | - | - | - |
| Decrease 1990-2011 | 67.0% | 94.4% | 80.1% | 56.2% | - | - |
| Decrease | 9.9% | 36.0% | 16.9% | -10.4% | 11.6% | 18.3% |

| $CH_4$ (Gg) | CRF 1.A.2.f. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 2010-2011 | | | | | | |

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

| $N_2O$ (Gg) | CRF 1.A.2.f. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988 | 0.1519 | 0.0250 | 0.1269 | NO | NO | NO |
| 1989 | 0.1504 | 0.0245 | 0.1259 | NO | NO | NO |
| 1990 | 0.1034 | 0.0718 | 0.0284 | 0.0032 | NO | NO |
| 1991 | 0.1015 | 0.0484 | 0.0432 | 0.0038 | 0.0060 | NO |
| 1992 | 0.0923 | 0.0488 | 0.0332 | 0.0051 | 0.0052 | NO |
| 1993 | 0.0790 | 0.0408 | 0.0276 | 0.0057 | 0.0049 | NO |
| 1994 | 0.0805 | 0.0381 | 0.0319 | 0.0054 | 0.0052 | NO |
| 1995 | 0.0779 | 0.0364 | 0.0299 | 0.0066 | 0.0049 | NO |
| 1996 | 0.0819 | 0.0362 | 0.0346 | 0.0067 | 0.0045 | NO |
| 1997 | 0.0439 | 0.0143 | 0.0205 | 0.0027 | 0.0064 | NO |
| 1998 | 0.0422 | 0.0149 | 0.0185 | 0.0023 | 0.0065 | NO |
| 1999 | 0.0350 | 0.0131 | 0.0134 | 0.0019 | 0.0066 | NO |
| 2000 | 0.0301 | 0.0112 | 0.0125 | 0.0018 | 0.0046 | NO |
| 2001 | 0.0323 | 0.0110 | 0.0148 | 0.0013 | 0.0051 | NO |
| 2002 | 0.0350 | 0.0129 | 0.0144 | 0.0012 | 0.0064 | NO |
| 2003 | 0.0469 | 0.0134 | 0.0252 | 0.0012 | 0.0071 | NO |
| 2004 | 0.0412 | 0.0125 | 0.0200 | 0.0013 | 0.0073 | 0.0003 |
| 2005 | 0.0372 | 0.0123 | 0.0180 | 0.0015 | 0.0052 | 0.0002 |
| 2006 | 0.0374 | 0.0132 | 0.0158 | 0.0020 | 0.0064 | 0.0001 |
| 2007 | 0.0451 | 0.0132 | 0.0226 | 0.0020 | 0.0061 | 0.0012 |
| 2008 | 0.0326 | 0.0084 | 0.0108 | 0.0019 | 0.0081 | 0.0034 |
| 2009 | 0.0278 | 0.0063 | 0.0057 | 0.0012 | 0.0102 | 0.0044 |
| 2010 | 0.0272 | 0.0062 | 0.0072 | 0.0013 | 0.0086 | 0.0039 |
| 2011 | 0.0221 | 0.0039 | 0.0060 | 0.0014 | 0.0076 | 0.0032 |
| Decrease 1988-2011 | 85.5% | 84.4% | 95.3% | - | - | - |
| Decrease 1990-2011 | 78.7% | 94.6% | 78.8% | 56.2% | - | - |
| Decrease 2010-2011 | 18.8% | 37.2% | 16.9% | -10.4% | 11.6% | 18.3% |

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

| GHG (Gg) | TJ | CRF 1.A.2.f. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| 1988 | 132 354.36 | 12 260.22 | 3 132.41 | 9 127.81 | NO | NO | NO |
| 1989 | 130 696.10 | 12 123.01 | 3 067.32 | 9 055.69 | NO | NO | NO |
| 1990 | 177 324.69 | 13 211.76 | 9 251.41 | 2 191.78 | 1 768.57 | NO | NO |
| 1991 | 154 228.05 | 11 530.58 | 6 292.19 | 3 129.22 | 2 106.36 | 2.8050 | NO |
| 1992 | 159 741.11 | 11 525.98 | 6 300.09 | 2 435.15 | 2 788.33 | 2.4123 | NO |
| 1993 | 148 694.61 | 10 446.13 | 5 260.45 | 2 069.57 | 3 113.82 | 2.2758 | NO |
| 1994 | 144 990.70 | 10 272.32 | 4 919.21 | 2 372.46 | 2 978.23 | 2.4198 | NO |
| 1995 | 153 503.52 | 10 632.10 | 4 735.62 | 2 240.49 | 3 653.71 | 2.2795 | NO |
| 1996 | 155 937.70 | 10 869.34 | 4 636.86 | 2 563.01 | 3 667.39 | 2.0888 | NO |
| 1997 | 68 938.13 | 4 890.70 | 1 850.23 | 1 527.50 | 1 509.98 | 2.9808 | NO |

| GHG (Gg) | TJ | CRF 1.A.2.f. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **1998** | 63 761.72 | 4 534.06 | 1 918.36 | 1 355.93 | 1 256.74 | 3.0313 | NO |
| **1999** | 53 360.10 | 3 726.26 | 1 702.22 | 971.49 | 1 049.49 | 3.0668 | NO |
| **2000** | 47 380.12 | 3 384.41 | 1 503.33 | 913.00 | 965.93 | 2.1505 | NO |
| **2001** | 44 575.21 | 3 291.36 | 1 481.21 | 1 064.48 | 743.27 | 2.4011 | NO |
| **2002** | 46 623.80 | 3 527.43 | 1 805.67 | 1 036.56 | 682.21 | 2.9901 | NO |
| **2003** | 54 949.18 | 4 313.67 | 1 846.09 | 1 795.85 | 668.39 | 3.3417 | NO |
| **2004** | 50 712.01 | 3 856.73 | 1 746.08 | 1 408.58 | 695.10 | 3.3919 | 3.5788 |
| **2005** | 51 237.89 | 3 897.00 | 1 776.56 | 1 266.00 | 849.13 | 2.4140 | 2.9021 |
| **2006** | 55 712.14 | 4 131.57 | 1 928.02 | 1 107.35 | 1 091.51 | 2.9980 | 1.6819 |
| **2007** | 60 568.58 | 4 654.43 | 1 953.78 | 1 602.32 | 1 085.16 | 2.8622 | 10.3028 |
| **2008** | 43 306.33 | 3 096.69 | 1 282.52 | 772.63 | 1 028.44 | 3.7705 | 9.3250 |
| **2009** | 29 932.65 | 2 029.06 | 926.75 | 398.78 | 674.29 | 4.7730 | 24.4693 |
| **2010** | 31 020.02 | 2 177.72 | 945.54 | 498.66 | 702.60 | 4.0000 | 26.9209 |
| **2011** | 27 286.81 | 1 793.80 | 569.58 | 416.69 | 776.10 | 3.5366 | 27.8966 |
| **Decrease 1988-2011** | 79.4% | 85.4% | 81.8% | 95.4% | - | - | - |
| **Decrease 1990-2011** | 84.6% | 86.4% | 93.8% | 81.0% | 56.1% | - | - |
| **Decrease 2010-2011** | 12.0% | 17.6% | 39.8% | 16.4% | -10.5% | 11.6% | -3.6% |

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

There is a specific case for other fuels used in the cement industry, for which a separate calculation model was developed. Due to the fact that all cement 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, IPCC 2006 and IPCC-GPG guidelines.

### 3.3.12.1 Source category description

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

Table 73 Transport sector categories

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

The main emissions from transport discussed are carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$), as for the calculation of each the most appropriate method has been chosen based on the type of emission, transport category, data availability. The uncertainty of the main inputs regarding the emission type is considered and evaluated. Further, for the GHG inventory compilation, the recommendations of ERT set out in FCCC/ARR/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 – 2011 are shown below.

Table 74 Fuels for CRF 1.A.3 Transport in TJ 1988 - 2011

| CRF 1A3 Transport | a. Civil Aviation | b. Road Transportation | c. Railways | d. Navigation | e. Other Transport |
|---|---|---|---|---|---|
| | TJ | | | | |
| 1988 | 2937 | 96190 | NA,NO | NA,NO | NO |
| 1989 | 3134 | 102072 | NA,NO | NA,NO | NO |
| 1990 | 1899 | 81854 | 4357 | 761 | 1777 |
| 1991 | 1511 | 47136 | 3574 | 42 | NO |
| 1992 | 1519 | 48714 | 4600 | 85 | NO |
| 1993 | 1395 | 55320 | 5129 | 129 | 40 |
| 1994 | 1404 | 51485 | 3805 | 171 | 40 |
| 1995 | 1280 | 55904 | 3146 | 171 | 40 |
| 1996 | 1156 | 55826 | 2170 | 254 | 40 |
| 1997 | 1076 | 56587 | 1819 | 85 | 472 |
| 1998 | 904 | 70214 | 1734 | 129 | 3719 |
| 1999 | 2239 | 72595 | 1607 | 217 | 3296 |
| 2000 | 860 | 68846 | 1607 | 85 | 6887 |
| 2001 | 1893 | 71427 | 1396 | 77 | 5777 |
| 2002 | 1119 | 75685 | 1311 | 114 | 5821 |
| 2003 | 990 | 85646 | 1184 | 141 | 3665 |
| 2004 | 820 | 89695 | 1200 | 132 | 5631 |
| 2005 | 561 | 97046 | 1227 | 153 | 9042 |
| 2006 | 1035 | 105211 | 1214 | 161 | 9538 |
| 2007 | 1720 | 101118 | 1058 | 179 | 10974 |
| 2008 | 560 | 107136 | 1354 | 207 | 10808 |
| 2009 | 990 | 106960 | 846 | 152 | 5846 |
| 2010 | 646 | 104899 | 846 | 117 | 5896 |
| 2011 | 904 | 104772 | 761 | 127 | 8528 |

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

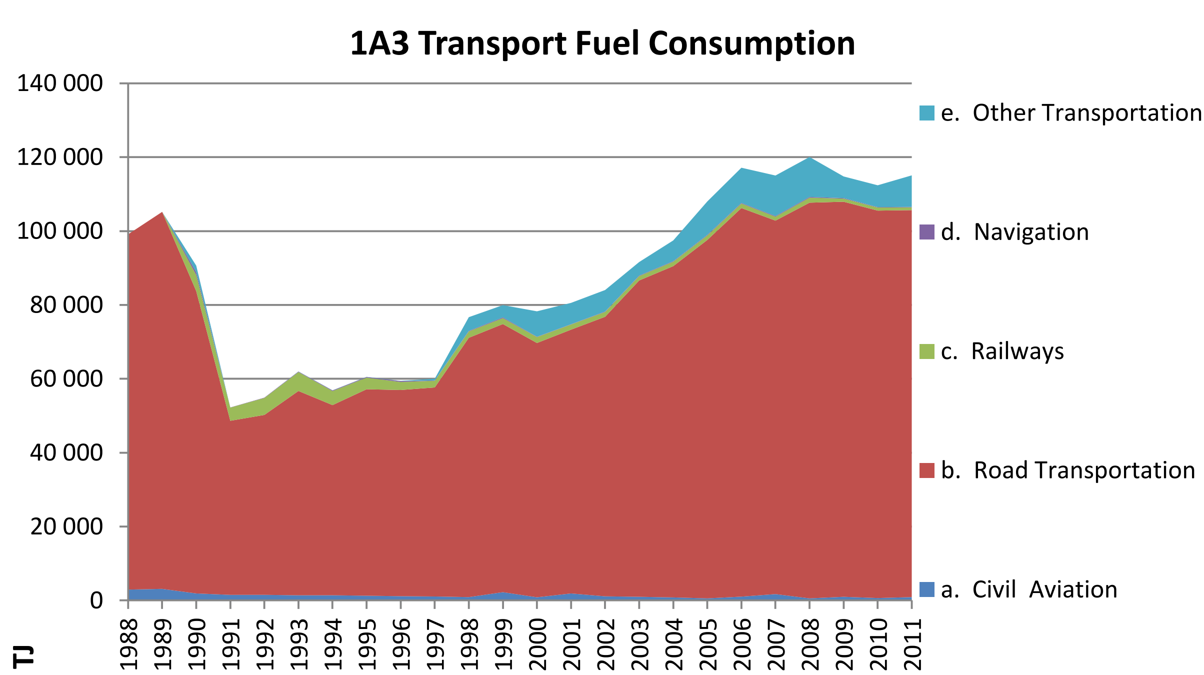



Figure 36 Fuels for CRF 1.A.3 transport for 1988 - 2011

In period 1988 to 1991 the fuel consumption decreased by 47%. But since 1991 the fuel consumption increased by 110% mainly due to road transport. The share of the transport categories is for the period of the inventory is the following:

Table 75 Share of fuel consumption in 1A3 Transport fuel

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

### 3.3.12.2 CRF 1.A.3.a Civil Aviation

#### 3.3.12.2.1 Source description

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

### 3.3.12.2.2 Emission trend

For 2011 there is a decrease of 69.0% in the emissions from civil aviation compared to the base year, but there is an increase of 39.9% compared to last year. The sector is responsible for 0.1% from the emissions from fuel combustion and 0.1% from the total GHG emissions in 2011.

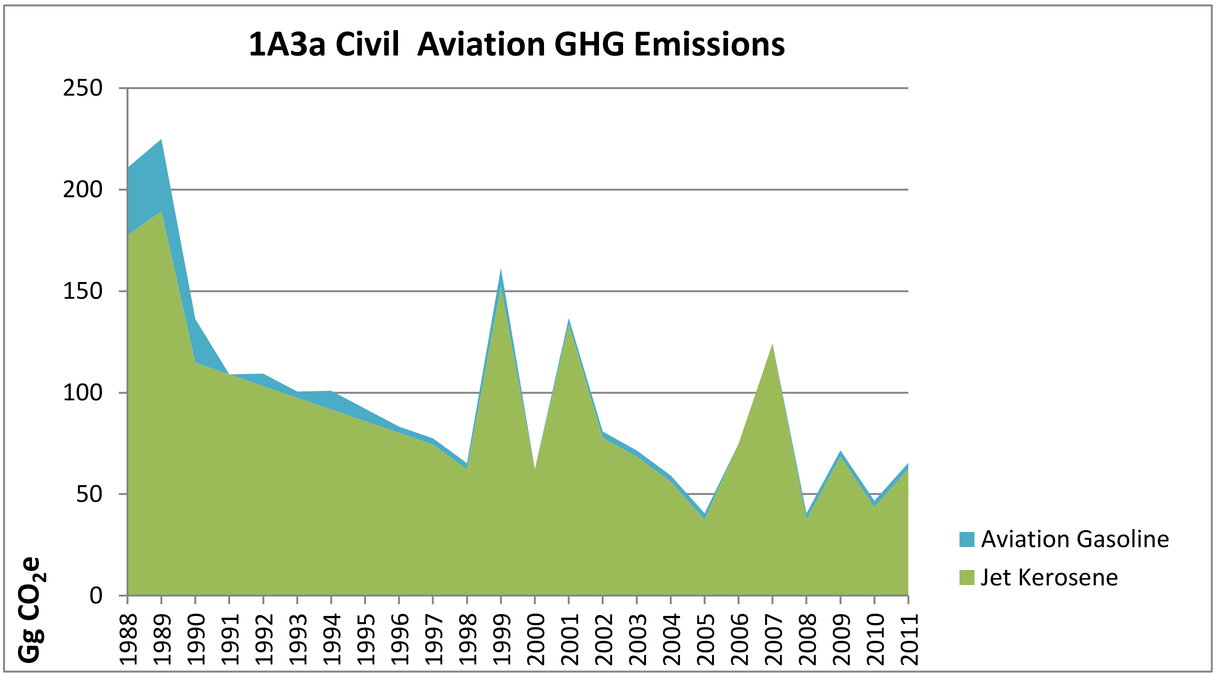



Figure 37 GHG emission in CRF 1.A.3.a Civil aviation – domestic (1988 - 2011)

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

| Year | TJ | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | Total GHG [Gg $CO_2$e] |
|---|---|---|---|---|---|
| **1988** | 2 936.74 | 208.93 | 0.0015 | 0.0059 | 210.78 |
| **1989** | 3 134.41 | 222.99 | 0.0016 | 0.0063 | 224.97 |
| **1990** | 1 899.00 | 135.10 | 0.0009 | 0.0038 | 136.30 |
| **1991** | 1 511.14 | 108.05 | 0.0008 | 0.0030 | 109.00 |
| **1992** | 1 519.29 | 108.44 | 0.0008 | 0.0030 | 109.39 |
| **1993** | 1 395.43 | 99.68 | 0.0007 | 0.0028 | 100.56 |
| **1994** | 1 403.57 | 100.06 | 0.0007 | 0.0028 | 100.95 |
| **1995** | 1 279.71 | 91.31 | 0.0006 | 0.0026 | 92.11 |
| **1996** | 1 155.86 | 82.55 | 0.0006 | 0.0023 | 83.28 |
| **1997** | 1 076.00 | 76.84 | 0.0005 | 0.0022 | 77.52 |
| **1998** | 904.00 | 64.67 | 0.0009 | 0.0019 | 65.26 |
| **1999** | 2 239.00 | 160.01 | 0.0018 | 0.0045 | 161.45 |
| **2000** | 860.00 | 61.73 | 0.0018 | 0.0018 | 62.32 |
| **2001** | 1 893.00 | 135.49 | 0.0029 | 0.0039 | 136.74 |
| **2002** | 1 119.00 | 80.10 | 0.0019 | 0.0023 | 80.85 |
| **2003** | 990.00 | 70.89 | 0.0018 | 0.0020 | 71.55 |
| **2004** | 820.12 | 58.69 | 0.0015 | 0.0017 | 59.25 |
| **2005** | 561.40 | 40.20 | 0.0011 | 0.0012 | 40.59 |
| **2006** | 1 034.88 | 74.14 | 0.0009 | 0.0022 | 74.82 |
| **2007** | 1 720.00 | 123.14 | 0.0013 | 0.0035 | 124.26 |
| **2008** | 560.00 | 40.15 | 0.0011 | 0.0013 | 40.56 |
| **2009** | 990.00 | 70.92 | 0.0010 | 0.0021 | 71.60 |
| **2010** | 646.00 | 46.30 | 0.0008 | 0.0014 | 46.76 |

| Year | TJ | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | Total GHG [Gg $CO_2$e] |
|---|---|---|---|---|---|
| 2011 | 904.00 | 64.77 | 0.0012 | 0.0020 | 65.42 |

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

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

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

| Year | TJ | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | Total GHG [Gg $CO_2$e] |
|---|---|---|---|---|---|
| 1988 | 476.31 | 33.01 | 0.0002 | 0.0010 | 33.31 |
| 1989 | 508.37 | 35.23 | 0.0003 | 0.0010 | 35.55 |
| 1990 | 308.00 | 21.34 | 0.0002 | 0.0006 | 21.54 |
| 1991 | NO | NO | NO | NO | 0.00 |
| 1992 | 88.00 | 6.10 | 0.0000 | 0.0002 | 6.15 |
| 1993 | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |
| 1994 | 132.00 | 9.15 | 0.0001 | 0.0003 | 9.23 |
| 1995 | 88.00 | 6.10 | 0.0000 | 0.0002 | 6.15 |
| 1996 | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |
| 1997 | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |
| 1998 | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |
| 1999 | 132.00 | 9.15 | 0.0001 | 0.0003 | 9.23 |
| 2000 | NO | NO | NO | NO | 0.00 |
| 2001 | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |
| 2002 | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |
| 2003 | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |
| 2004 | 43.96 | 3.05 | 0.0000 | 0.0001 | 3.07 |
| 2005 | 43.96 | 3.05 | 0.0000 | 0.0001 | 3.07 |
| 2006 | NO | NO | NO | NO | 0.00 |
| 2007 | NO | NO | NO | NO | 0.00 |
| 2008 | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |

| Year | TJ | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | Total GHG [Gg $CO_2$e] |
|---|---|---|---|---|---|
| **2009** | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |
| **2010** | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |
| **2011** | 44.00 | 3.05 | 0.0000 | 0.0001 | 3.08 |

#### 3.3.12.2.3 Methods

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

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

*LTO Emissions = Number of LTOs • Emission Factor LTO*

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

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

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

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

*Total Emissions = LTO Emissions + Cruise Emissions*

#### 3.3.12.2.4 Activity data

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

The LTOs per aircraft type per year were obtained from Eurocontrol for the period 1996-2012 with the note that data for 1996 and 1997 is incomplete, since Bulgaria became a Eurocontrol member on 1st June 1997. The primary data for all years consists of 469 airplane types classified by ICAO code. The data was matched with the information from ICAO DOC 8643 Aircraft Type Designators document, which currently consists of 9463 type designators in order to identify the manufacturer, model, engine type, engine count and wake turbulence category. About 91 of the ICAO type designators, which were reported by Eurocontrol were not present in the ICAO DOC 8643. For those airplanes was performed a manual search in order to identify the exact type of airplane.

As a second step all 469 aircraft type designators were manually matched to the appropriate aircraft types from 2006 IPCC GL, Vol.2, Ch. 3, Table 3.6.9. The choice of the 2006 IPCC GL was mandated by the fact that they provide information about much greater number of

aircraft types, while the 1996 IPCC GL do not provide emission factors for almost none of the modern aircrafts currently in operation.

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

Table 79 Correspondence between aircraft characteristics and generic aircraft types

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

The outcome of the updated Tier 2 methodology results in increase of the GHG emissions from jet kerosene by 0.2% for the base year and 0.5% for 2011.

#### 3.3.12.2.5 Emission factors

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

#### 3.3.12.2.6 Uncertainties

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

AD: 5 %

EF $CO_2$: ±5 %

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

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

#### 3.3.12.2.7 Source-specific QA/QC and verification

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

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

- Check of methodology, $CO_2$ emissions, emission factors and IEF (time series);
- Time series consistency;

- Plausibility checks of dips and jumps;
- Documentation and archiving of all information required in NIR, background documentation and archive;
- Comparison of Tier 1 and Tier 2 approach.

#### 3.3.12.2.8 Source-specific recalculations

Recalculations have been done of the entire time series for 2013 submission.

The emissions for the whole period are calculated using Tier 2 approach based on:

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

#### 3.3.12.2.9 Source-specific planned improvements

At this stage no improvements are planned for next submission.

### 3.3.12.3 CRF 1.A.3.b Road transport

#### 3.3.12.3.1 Source description

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

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

Special feature of Bulgarian vehicle fleet is its age structure. In 2011 more than 50% from the vehicles are above 15 years and about 29% are more than 20 years old.

The total number of registered vehicles in Bulgaria for the period 1988 – 2011 is presented in the next table.

Table 80 Number of vehicles, 1988 - 2011

| Vehicle type | Trucks | Special cars | Trucks Trailer | Busses | Passenger cars | Motor-cycles | Mopeds |
|---|---|---|---|---|---|---|---|
| **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 |
| **2011** | 315505 | 31779 | 32056 | 23101 | 2694821 | 73799 | 58019 |

*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 2011 the road transport consumed 91% from the total energy in the sector.

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

### 3.3.12.3.2 Emission trend

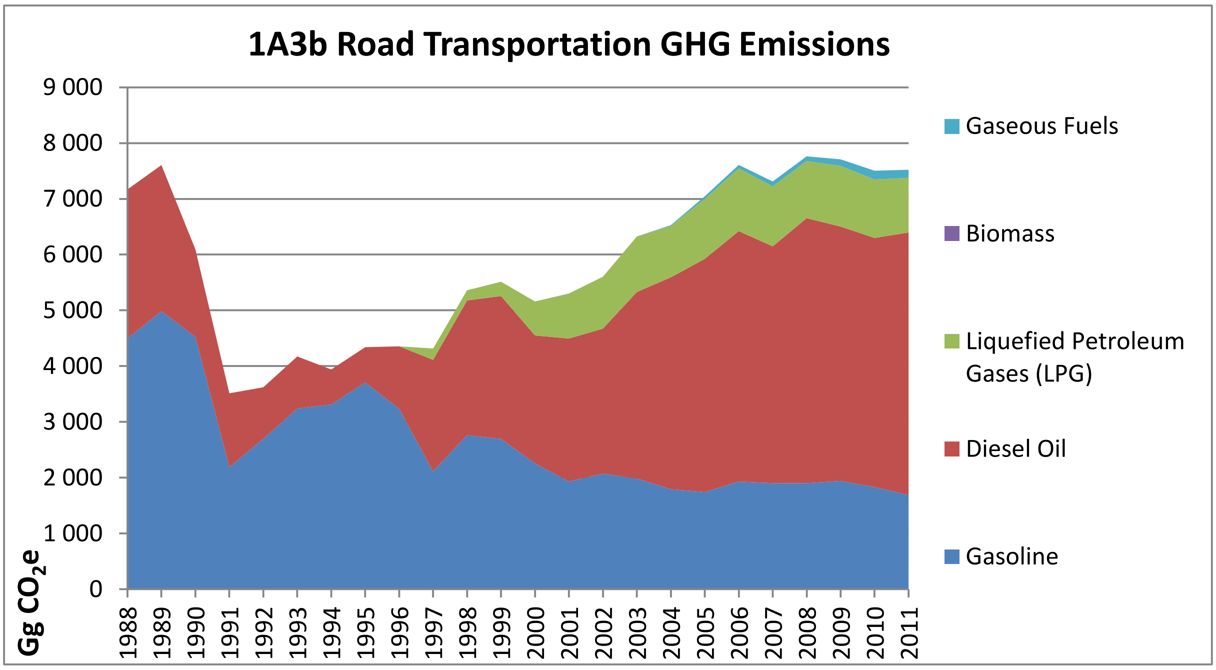



Figure 38 GHG emissions in CRF 1.A.3.b Road transport 1988 - 2011

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 4,9% compared to base year levels being 7 169,5 Gg $CO_2$e in 1988 and reached levels of 7 521,3 Gg $CO_2$e in 2011. However, that growth in 2011 compared to 1991 is calculated at 114,1%. This sudden change was brought with the economic recovery, preceded by the introduction of a currency board regime in 1997 and rigorous economic and political reforms.

The most significant contributor to GHG emissions is passenger cars, followed by heavy-duty vehicles, light-duty vehicles and motorcycles and mopeds. As it can be noticed from the following figure, in 2011, passenger cars and heavy duty vehicles account for 61,7% and 19,9% of total GHG $CO_2$e emissions respectively, dependent on the intensification of passenger and goods transportation. The remaining 18,4% were shared among light-duty vehicles, buses and mopeds and motorcycles.

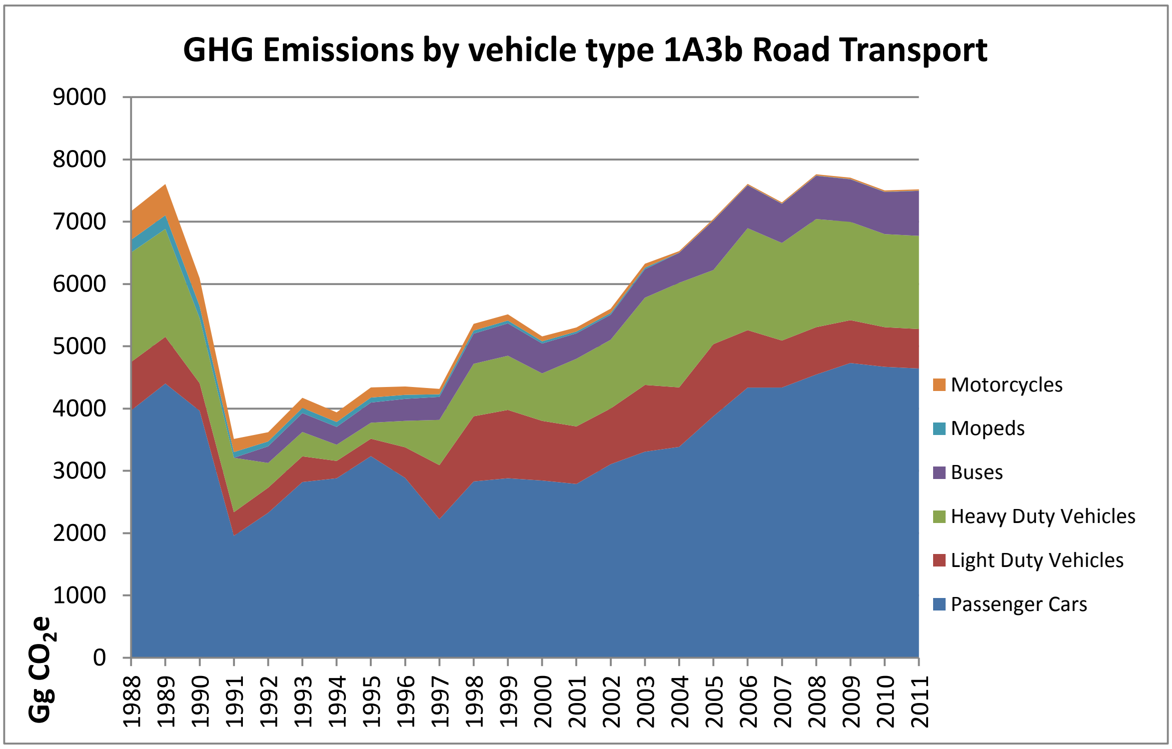



Figure 39 Emissions allocated to vehicle categories for the period 1988-2011

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.

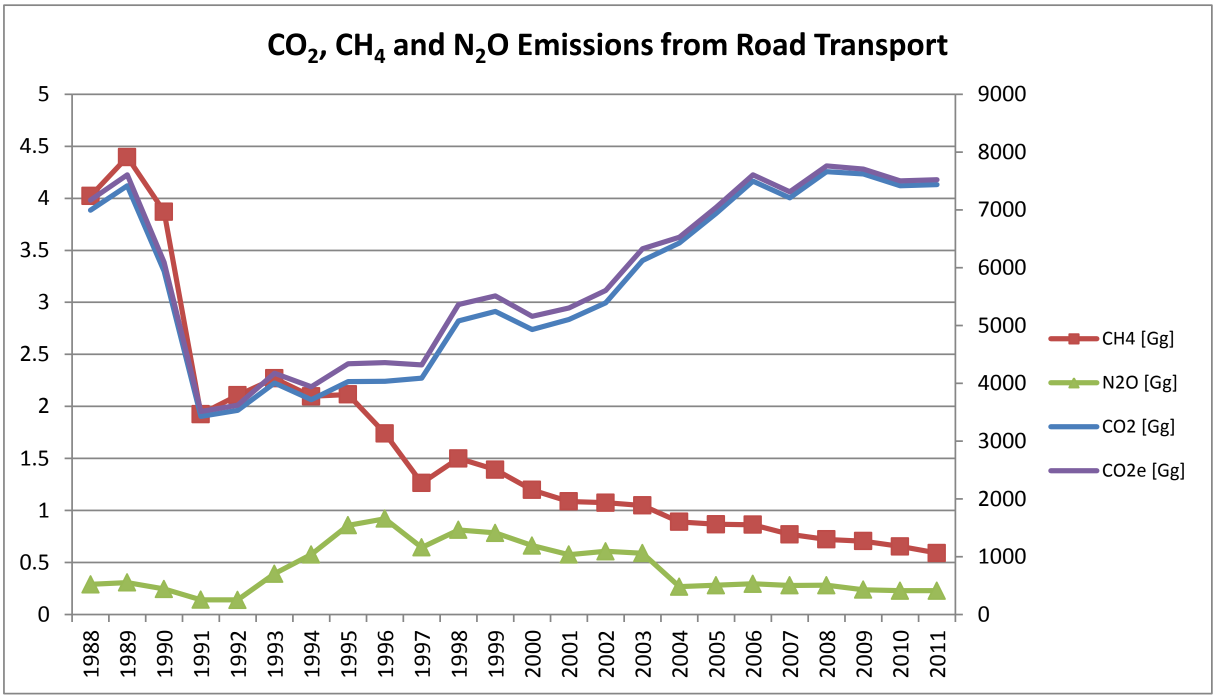



Figure 40 $CO_2$, $CO_2$-eq, $CH_4$ and $N_2O$ emissions trends for the period 1998-2011

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

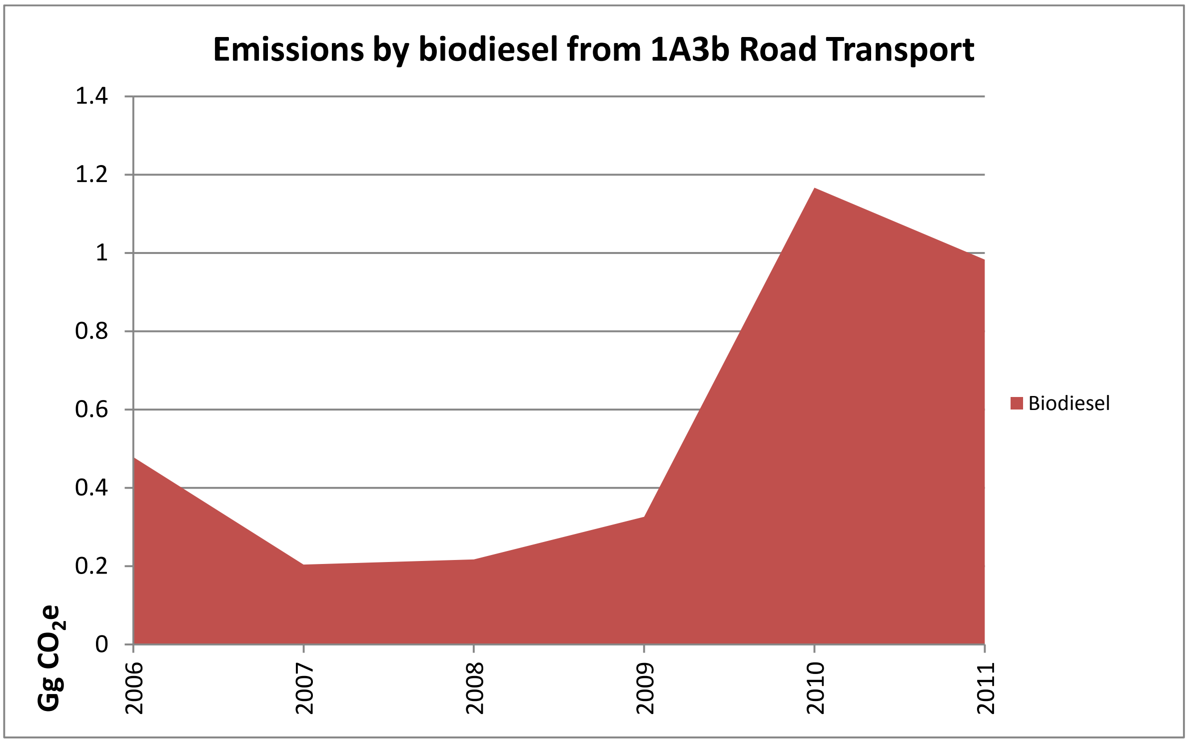



Figure 41 Emissions by biodiesel from Road Transport for the period 2004-2011

Tier 1 is applied to calculate the emissions from biodiesel, as there was insufficient data to use the COPERT model for this fuel. 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. The $CO_2$e emissions for 2011 are declining, though biodiesel for blending has increased with 1000 tonnes from 2010 to 2011, zero quantity for other liquid biofuels have been reported for 2011.

#### 3.3.12.3.3 Methods

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

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

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

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

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

Table 81 Gasoline $CH_4$ hot emissions (g/km)

| COPERT Version | Urban | Rural | Highway |
|---|---|---|---|
| Version 9 | 0.00196 | 0.00200 | 0.00000 |
| Version 10<br>EURO 4/5/6 | 0.00287 | 0.00269 | 0.00508 |

In the model emissions were calculated through the input of detailed data on average daily trip distance and time, fuel Reid Vapour Pressure (RVP), monthly minimum and maximum

temperatures, consumption and fuel specifications, vehicle fleet categorized in sectors, subsectors and technology (standard), vehicle stock and annual mileage, speed and driving shares. Comparison of Tier 2 with Tier 1 is performed as a verification cross-check.

### 3.3.12.3.4 Activity data

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

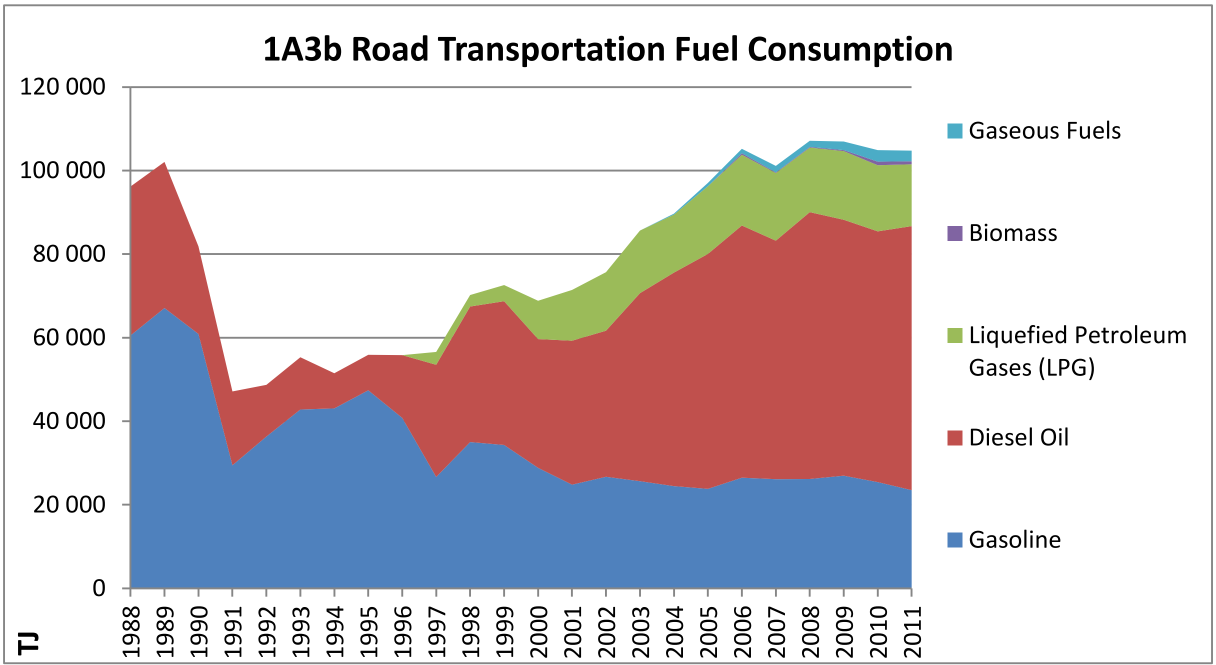



Figure 42 Fuel consumption in CRF 1.A.3.b Road transport (1988 - 2011)

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 2011 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 2005-2011 by Lukoil Neftohim – Burgas and the State Agency For Metrological And Technical Surveillance (SAMTS). Data on LPG, biodiesel and CNG was not obtained. Hence, literature information and regulatory technical requirements were used instead. Whereas appropriate, default values provided by COPERT 4, version 10 and extrapolation of the existing numbers were applied to fill the gaps in the available data (Samaras 2000). It is important to be noted that there has been only unleaded gasoline in Bulgaria (National Program to phase out lead in petrol) since 2004. The years before, the percentage of leaded and unleaded gasoline varies as in 2003 the leaded gasoline share was only 0,2% (National Statistical Institute).

Values for fuel volatility (RVP – Reid Vapour Pressure) are available for the period 2006-2011 provided by Lukoil Neftohim – Burgas. For the previous periods a summer and winter range is specified according to the technical requirements. Therefore, RVP data for the years 2000-2005 is estimated based on the available values and the legal requirements. RVP of 62 kPa (summer) and 67 kPa (winter) for the period 1988 -1999 is applied, based on the market average for 1996 (Samaras et al. et al. 2000) and the ratio legal requirements to measured data, submitted for the recent years.

**Speed**

Infrastructure and vehicle stock differ significantly from city to city. Vehicle speed varies from big and small cities during the day, being quite low in the rush hours, especially in the densely populated areas. However, detailed data for speed variations is not available for the whole period. Krzywkowska et al. (2004) report approximate value of 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 shows (Breshkov, 2005).

Table 82 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 83 Average free flow speed (km/h) per type of road class

| Road Class | Average free flow speed (km/h) |
|---|---|
| Class I | 79 |
| Class II | 70 |
| Class III | 55 |
| Motorway (Highway) | 110 |

Given these data, for the emission calculations average speed was estimated to be 68km/h for rural areas for all types of vehicles (except for mopeds) and 110km/h for motorway, except for coaches. Whereas inappropriate and/or data was missing, the legal requirement speed limit was applied instead the above mentioned numbers. Moreover, a comparison of road classes for the years 2010-2002 revealed a negligible change in relation to rural speed variation. Therefore, identical value of 68km/h was used for all years.

**Driving share**

The density of the Bulgarian road network is similar to the average density for the other EU member states, excluding highways. In terms of high speed roads and motorways the

country lags far behind – 3,8 km/1000 sq km compared to Austria - 19 km/1000 sq km in Slovenia - 14 km/1000 sq km, and in Lithuania - 6 km/1000 sq km (MRDPW 2010).

Due to lack of data for Bulgaria on mileage split between urban, rural and highway driving, literature survey of driving cycles (André, 2006) based on information from 80 representative European private cars in  France, the UK, Germany and Greece was performed. Additionally, comparison of road statistics for Slovakia and Bulgaria shows a number of similarities related to road classes' ratio, length of network, geography and GDP trends. Taking into account the mentioned surveys, the driving share split for Slovakia was adopted. Where necessary data gaps for some years and categories were filled in by extrapolating the existing values.

**Vehicle fleet**

Corresponding to the COPERT methodology, detailed knowledge of the structure of the vehicle fleet is required. Main sources of data on vehicle stock and classifications are National Statistical Institute and Ministry of Internal affairs. However, apart from the total numbers for the main vehicle categories, only partial data considering distribution into fuel, weight 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.

Regarding the new passenger cars subsectors of COPERT 4, version 10, no changes have been introduced. The reason for this is that a car fleet research showed a limited number of vehicles that could be allocated to these two new subsectors, still without a technology break. Therefore, in the current technology mix, these two categories have been neglected and all passenger cars are distributed in the upper class categories.

Mopeds classification to 2-sroke and 4-stroke engines is another area of change in COPERT 4, version 10. It is assumed, based on expert judgement, that 4-stroke mopeds are very rare and applicable for the matrix of some countries (e.g. Italy). Thus, this subsector is considered irrelevant in the current matrix.

The Slovenian vehicle distribution does not include LPG driven passenger cars for the period before 2008 and CNG driven passenger cars. In Bulgaria, the LPG consumption for road transport started in 1997. The ratio LPG/Gasoline for the period 1997-2011, as reported by the Ministry of inferior, for each year in the period 2006-2011, was applied to each technology category of the passenger cars on gasoline with the purpose to shift a number of those vehicles to the respective LPG category. The same approach is applied for passenger cars (Euro 4 and 5) running on CNG for the period 2004-2011. As a result emissions from CNG are calculated following a Tier 2 method.

**Mileage**

As only basic information on mileage per urban buses and coaches, heavy duty vehicles (>6t) was obtained from the National Statistics Institute, mileage for 2005 was estimated from the average for 16 European countries that provided such data (Ntziachristos et al. 2008). However, the average EU15 mileage data may lead to overestimations of emissions. A recommendation by Ntziachristos et al. (2008) to tune the mileage values in order to better match the statistical fuel consumption (actual fuel sold) was followed. This was performed in relation to the fact that $CO_2$ emissions are calculated on the basis of fuel consumption (Ntziachristos et al., 2008) and that $CO_2$ emissions from road transport are indicated as a key category. The calibration procedure aimed to exactly match the statistical with the calculated fuel consumption. The calibration procedure ensures that $CO_2$ emission estimates are prepared based on the quantities of fuel sold, according to the IPCC guidelines.

All the other required data (Fuel Injection, Evaporation Control, Evaporation distribution, Slope factor, Load factor) used for calculation of emissions using COPERT 4, version 10 program are input as default according to the COPERT.

#### 3.3.12.3.5 Emission factors

According to the Revised 1996 IPCC GL, an emission factor is defined as the average emission rate of a given GHG for a given source, relative to units of activity. Whereas, an implied emission factor (IEF) is defined as emissions divided by the relevant measure of activity:

*IEF = Emissions / Activity data*

IEF are not equivalent to the emissions factors for emissions calculations. IEF are more as of results providing average values for complex categories, such as the vehicle fleet distribution.

Emission factors used for the calculations of GHG emissions form road transport subsector are based on the algorithms of COPERT 4, version 10. The emission factors are internal parameters that depend both on the input data (average trip distance, driving and climatic conditions, etc.) and COPERT algorithms. However, COPERT model uses different emission factors for each vehicle category and technology. Thus, it is only possible to provide the implied emission factors which take into account the calculated emissions of greenhouse gases per fuel by the model related to the reported fuel consumption.

Table 84 Implied emission factors of $CO_2$, $N_2O$ and $CH_4$ by fuel types

| Fuel type | Gasoline | | | Diesel | | |
|---|---|---|---|---|---|---|
| Emissions | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| Year | t/TJ | kg/TJ | kg/TJ | t/TJ | kg/TJ | kg/TJ |
| 1988 | 72.09 | 61.05 | 2.941 | 73.81 | 9.156 | 3.085 |
| 1989 | 72.09 | 60.75 | 2.949 | 73.81 | 9.163 | 3.087 |
| 1990 | 72.09 | 60.43 | 2.952 | 73.81 | 9.169 | 3.091 |
| 1991 | 72.09 | 59.89 | 2.937 | 73.81 | 9.114 | 3.043 |
| 1992 | 72.09 | 55.22 | 3.049 | 73.81 | 8.09 | 2.254 |
| 1993 | 71.97 | 50.66 | 8.48 | 73.81 | 8.04 | 2.189 |
| 1994 | 71.87 | 47.1 | 12.97 | 73.81 | 7.997 | 2.106 |
| 1995 | 71.77 | 43.17 | 17.71 | 73.81 | 7.961 | 2.032 |
| 1996 | 71.67 | 39.74 | 21.82 | 73.81 | 7.853 | 1.946 |
| 1997 | 71.59 | 37.31 | 21.92 | 73.81 | 7.693 | 1.868 |
| 1998 | 71.5 | 34.35 | 21.28 | 73.81 | 7.47 | 1.771 |
| 1999 | 71.41 | 31.23 | 20.72 | 73.81 | 7.223 | 1.682 |
| 2000 | 71.34 | 28.47 | 20.05 | 73.81 | 6.942 | 1.593 |
| 2001 | 71.29 | 26.26 | 19.16 | 73.81 | 6.647 | 1.524 |
| 2002 | 71.24 | 23.74 | 18.81 | 73.81 | 6.124 | 1.456 |
| 2003 | 71.19 | 21.88 | 18.16 | 73.81 | 5.657 | 1.426 |
| 2004 | 71.12 | 17.05 | 5.637 | 73.81 | 5.101 | 1.448 |
| 2005 | 71.08 | 15.69 | 5.433 | 73.81 | 4.334 | 1.56 |
| 2006 | 71.05 | 14.24 | 4.906 | 73.81 | 3.823 | 1.622 |
| 2007 | 71.03 | 13.18 | 4.551 | 73.81 | 3.206 | 1.716 |
| 2008 | 71.01 | 12.39 | 4.165 | 73.81 | 2.732 | 1.798 |
| 2009 | 71 | 11.78 | 2.369 | 73.81 | 2.451 | 1.907 |
| 2010 | 70.99 | 11.25 | 2.156 | 73.81 | 2.167 | 2.01 |
| 2011 | 70.99 | 10.83 | 1.969 | 73.81 | 1.934 | 2.131 |

Table 85 Implied emission factors of $CO_2$, $N_2O$ and $CH_4$ by fuel types

| Fuel type | LPG | | | CNG | | |
|---|---|---|---|---|---|---|
| Emissions | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| Year | t/TJ | kg/TJ | | t/TJ | kg/TJ | |
| 1988 | NO | NO | NO | NO | NO | NO |
| 1989 | NO | NO | NO | NO | NO | NO |
| 1990 | NO | NO | NO | NO | NO | NO |
| 1991 | NO | NO | NO | NO | NO | NO |
| 1992 | NO | NO | NO | NO | NO | NO |
| 1993 | NO | NO | NO | NO | NO | NO |
| 1994 | NO | NO | NO | NO | NO | NO |
| 1995 | NO | NO | NO | NO | NO | NO |
| 1996 | NO | NO | NO | NO | NO | NO |
| 1997 | 64.93 | 20.24 | 3.045 | NO | NO | NO |
| 1998 | 64.93 | 19.42 | 3.28 | NO | NO | NO |
| 1999 | 64.93 | 18.52 | 3.549 | NO | NO | NO |
| 2000 | 64.93 | 17.62 | 3.735 | NO | NO | NO |
| 2001 | 64.93 | 16.87 | 3.803 | NO | NO | NO |
| 2002 | 64.93 | 16.13 | 3.845 | NO | NO | NO |
| 2003 | 64.93 | 15.49 | 3.875 | NO | NO | NO |
| 2004 | 64.93 | 14.87 | 3.914 | 56.92 | 22.47 | 0.583 |
| 2005 | 64.93 | 14.23 | 3.901 | 57.14 | 22.65 | 0.587 |
| 2006 | 64.93 | 13.56 | 3.838 | 57.11 | 22.52 | 0.585 |
| 2007 | 64.93 | 12.91 | 3.726 | 56.26 | 21.53 | 0.573 |
| 2008 | 64.93 | 12.3 | 3.569 | 56.6 | 21.89 | 0.578 |

| Fuel type | LPG | | | CNG | | |
|---|---|---|---|---|---|---|
| Emissions | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| Year | t/TJ | kg/TJ | | t/TJ | kg/TJ | |
| **2009** | 64.93 | 11.7 | 3.393 | 56.23 | 21.79 | 0.575 |
| **2010** | 64.93 | 11.13 | 3.193 | 56.23 | 21.85 | 0.575 |
| **2011** | 64.93 | 10.65 | 3.012 | 56.22 | 21.94 | 0.575 |

#### 3.3.12.3.6 Uncertainties

The following default uncertainties are assumed (IPCC 2006 GLs, Ch. 3.2.2 Uncertainty Assessment, page 3.29 – 3.30):

| AD | +/-5 % | | EF $CO_2$ | EF $N_2O$ | EF $CH_4$ | |
|---|---|---|---|---|---|---|
| | | Motor Gasoline | 5% / -3% | 244% / -70% | 233% / | -71% |
| | | Gas / Diesel Oil | 1% / -2% | 208% / -67% | 144% / | -59% |
| | | LPG | 4% / -2% | 200% / -68% | 238% / | -70% |

Except for the above mentioned uncertainty values, the inherited uncertainty of COPERT is associated with model formulation and input data. The main internal parameter is the emission factors, whose uncertainty comes from the experimental data. Information on the vehicle fleet and related data on vehicle movements are the most probable source of uncertainties with respect to inputs. Monte Carlo simulations reveal that 16 and 17 items of total 51 internal parameters and inputs variables are responsible for more than 90% of the total uncertainty in countries with good and poor statistics, respectively. In our case, as a country with relatively poor transport statistics, the most probable factors, according to this research, could be hot and cold-start emission factors, technology distribution, mileage, mean trip distance. Further, coefficient of variation for the following was estimated (Kioutsioukisa et al., 2010):

| Parameter | Uncertainty for countries with poor transport statistics (%) |
|---|---|
| Fuel consumption and $CO_2$ | <10 |
| $CH_4$ | >20 |
| $N_2O$ | >20 |

#### 3.3.12.3.7 Source-specific QA/QC and verification

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

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

- Check of methodology, $CO_2$ emissions, emission factors and IEF (time series)
- Time series consistency
- Plausibility checks of dips and jumps (this is due to the Energy balance)
- Documentation and archiving of all information required in NIR, background documentation and archive.

#### 3.3.12.3.8 Source-specific recalculations

Following a recommendation from FCCC/ARR/2010/BGR §79, a recalculation of the entire time series is undertaken due to implementation of higher tier method and incorporation of model COPERT, version 10 into the national road transport inventory.

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

Regarding recommendation from FCCC/ARR/2011/BGR §70, a detailed review of the activity data and parameters used in the COPERT model was undertaken. We believe that the main cause for the decrease of the implied emission factor fog gasoline is the significant increase of EURO-standard vehicles (mostly EURO 2 and EURO 3), introduced in the country, which replaced the older Pre-ECE and ECE vehicles. As the $CH_4$ EF of the Pre-ECE and ECE vehicles is 5 times higher than the EURO vehicles, a significant drop in the IEF is observed. This is also the reason the generally stable downwards trend in the IEF.

#### 3.3.12.3.9 Source-specific planned improvements

Investigation of the country specific parameters used in the COPERT IV model concerning the car fleet and vehicle split.

### 3.3.12.4 Railways (CRF 1.A.3.c)

#### 3.3.12.4.1 Source category description

Railways transport, $CO_2$ emissions, is defined as a key category and represents the third contributor to the Transport sector emissions in 2011.

#### 3.3.12.4.2 Emission trend

Railways related GHG emissions are quite low in Bulgaria, due to the decreased transport of passengers and freight. A clear downwards trend of the GHG emissions in recent years is shown in following figures.

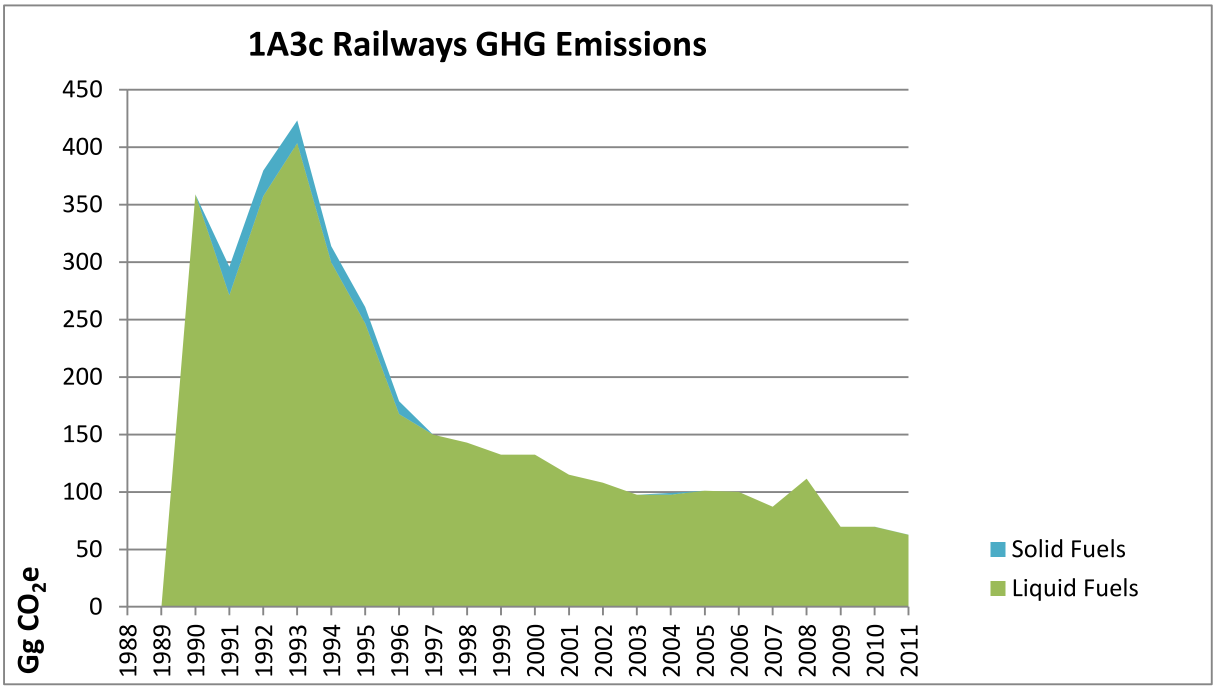



Figure 43 GHG emissions in CRF 1.A.3.d Railway transport (1988 - 2011)

As it can be observed from the figure above, emissions from Railway transport decreased steeply since 1993 with 85% to 2011. The emissions are mainly due to the consumption of liquid fuels (Gas-Diesel Oil). As for the years 1988-1989, there are no quantities for fuels consumed in the Railways category reported, the data entries are marked as NO. However, it is assumed that the relevant quantities are reported under CRF 1.A.5 Other.

#### 3.3.12.4.3 Methods

Following the recommendations of ERT set out in FCCC/ARR/2010/BGR §75 the emissions from Railway are calculated based on Revised 1996 IPCC GL and IPCC GPG 2000. Where there are no emission factors in the Revised 1996 IPCC GL, the 2006 IPCC GL is used.

The Tier 1 approach has been applied.

GENERAL METHOD FOR EMISSIONS FROM LOCOMOTIVES

$$Emissions = \sum_j \left(Fuel_j \bullet EF_j\right)$$

*Where:*

*Emissions = emissions (kg)*

*Fuel j = fuel type j consumed (as represented by fuel sold) in (TJ)*

*EF j = emission factor for fuel type j, (kg/TJ)*

*j = fuel type*

For Tier 1, emissions are estimated using fuel-specific default emission factors, assuming that for each fuel type the total fuel is consumed by a single locomotive type.

#### 3.3.12.4.4 Activity data

Fuel consumption 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.

Fuel consumption (liquid and solid) is obtained from Eurostat Energy balance and converted into energy units using the CS NCV. The energy balance provides activity data for consumption of residual fuel oil in road transport in the period 1991 – 1996. This is an improbable allocation and following the recommendations of ERT set out in FCCC/ARR/2010/BGR §76, quantities of this fuel reported under road transport is allocated in 1A3c Railway.

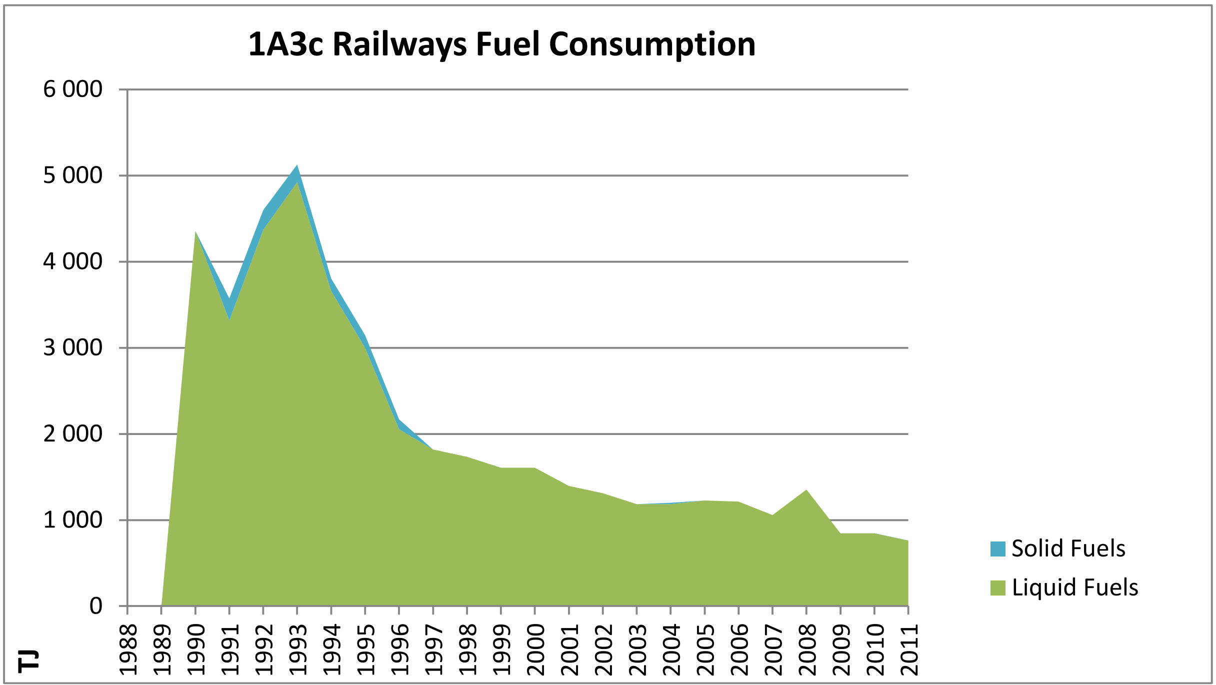



Figure 44 Fuel consumption in CRF 1.A.3.d Railway transport (1988 - 2011)

Table 86 Activity data of Gas-Diesel Oil, emissions and emission factors for IPCC Sub-category 1A3c – Railways

| | Gas-Diesel Oil | | | | EF* $CO_2$ | $CO_2$ emission | EF* $N_2O$ | $N_2O$ emission | EF* $CH_4$ | $CH_4$ emission |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gg | t | TJ | NCV GJ/t | (t/TJ) | Gg | (t/TJ) | Gg | (t/TJ) | Gg |
| **1988** | 0 | 0 | NO | 42.3 | 73 | NO | 0.03 | NO | 0.004 | NO |
| **1989** | 0 | 0 | NO | 42.3 | 73 | NO | 0.03 | NO | 0.004 | NO |
| **1990** | 103 | 103000 | 10609 | 42.3 | 73 | 318.054 | 0.03 | 0.131 | 0.004 | 0.018 |
| **1991** | 68 | 68000 | 4624 | 42.3 | 73 | 209.977 | 0.03 | 0.086 | 0.004 | 0.012 |
| **1992** | 91 | 91000 | 8281 | 42.3 | 73 | 280.999 | 0.03 | 0.115 | 0.004 | 0.016 |
| **1993** | 106 | 106000 | 11236 | 42.3 | 73 | 327.317 | 0.03 | 0.135 | 0.004 | 0.019 |
| **1994** | 78 | 78000 | 6084 | 42.3 | 73 | 240.856 | 0.03 | 0.099 | 0.004 | 0.014 |
| **1995** | 69 | 69000 | 4761 | 42.3 | 73 | 213.065 | 0.03 | 0.088 | 0.004 | 0.012 |
| **1996** | 41 | 41000 | 1681 | 42.3 | 73 | 126.604 | 0.03 | 0.052 | 0.004 | 0.007 |
| **1997** | 43 | 43000 | 1849 | 42.3 | 73 | 132.78 | 0.03 | 0.055 | 0.004 | 0.008 |
| **1998** | 41 | 41000 | 1681 | 42.3 | 73 | 126.604 | 0.03 | 0.052 | 0.004 | 0.007 |
| **1999** | 38 | 38000 | 1444 | 42.3 | 73 | 117.34 | 0.03 | 0.048 | 0.004 | 0.007 |
| **2000** | 38 | 38000 | 1444 | 42.3 | 73 | 117.34 | 0.03 | 0.048 | 0.004 | 0.007 |
| **2001** | 33 | 33000 | 1089 | 42.3 | 73 | 101.901 | 0.03 | 0.042 | 0.004 | 0.006 |
| **2002** | 31 | 31000 | 961 | 42.3 | 73 | 95.725 | 0.03 | 0.039 | 0.004 | 0.005 |
| **2003** | 28 | 28000 | 784 | 42.3 | 73 | 86.461 | 0.03 | 0.036 | 0.004 | 0.005 |
| **2004** | 28 | 28000 | 784 | 42.3 | 73 | 86.461 | 0.03 | 0.036 | 0.004 | 0.005 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **2005** | 29 | 29000 | 841 | 42.3 | 73 | 89.549 | 0.03 | 0.037 | 0.004 | 0.005 |
| **2006** | 29 | 29000 | 841 | 41.87 | 73 | 88.635 | 0.03 | 0.036 | 0.004 | 0.005 |
| **2007** | 25 | 25000 | 625 | 42.3 | 73 | 77.198 | 0.03 | 0.032 | 0.004 | 0.004 |
| **2008** | 32 | 32000 | 1024 | 42.3 | 73 | 98.813 | 0.03 | 0.041 | 0.004 | 0.006 |
| **2009** | 20 | 20000 | 400 | 42.3 | 73 | 61.76 | 0.03 | 0.03 | 0.004 | 0.004 |
| **2010** | 20 | 20000 | 400 | 42.3 | 73 | 61.76 | 0.03 | 0.03 | 0.004 | 0.004 |
| **2011** | 18 | 18000 | 324 | 42.3 | 73 | 55.58 | 0.03 | 0.02 | 0.004 | 0.003 |

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

Table 87 Activity data of Residual Fuel Oil, emissions and emission factors for IPCC Sub-category 1A3c – Railways

| | 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 |
| **2011** | 0.00 | 0.00 | NO | 40.00 | 77.400 | NO | 0.0003 | NO | 0.003 | NO |

**For $CO_2$ 2006 IPCC stationary 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).*

#### 3.3.12.4.5 Emission factors

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

#### 3.3.12.4.6 Uncertainties

The following default uncertainties are assumed (2006 IPCC GL, Ch. 3.4.1.6 Uncertainty Assessment, page 3.45 – 3.46):

| | EF $CO_2$ | EF $N_2O$ | EF $CH_4$ |
|---|---|---|---|
| Diesel | 1.5% | 58% | 60% |
| AD | +/-5 % | | |

#### 3.3.12.4.7 Source-specific QA/QC and verification

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

- Check of methodology, $CO_2$ emissions, emission factors and IEF (time series)
- Time series consistency
- Plausibility checks of dips and jumps (due to the Energy balance)
- Documentation and archiving of all information required in NIR, Background documentation and archive.

### 3.3.12.5 Navigation (CRF 1.A.3.d)

GHG emissions from navigation are not defined as key source.

#### 3.3.12.5.1 Source category description

In Bulgaria the navigation is used mostly for transportation of freights. However, the consumption patterns are limited since 2000, as it can be observed from the figures below.

The previous assumption regarding residual fuel oil and gas/diesel oil consumed by navigation and marine transport was that it was reported in the industry sector, since there were some discussions regarding erroneously allocated quantities. In addition, in the earlier years NSI reported in the energy balances all amounts of fuels loaded on Bulgarian ships regardless on the port the fuel was loaded on. This explains the large quantities reported for the years before 1997. Recently, it was clarified by the NSI that the marine vessels do not load at our ports because of the low fuel quality and higher prices.

It is said that predominantly the cargo is transported on international cruises. Very limited amount is believed to be transported within Bulgaria and this usually happens as part of an international route. Still, there is high uncertainty how the loading of fuel is accounted in this particular scenario – it is assumed that the logistic companies mainly prefer to load outside BG – either in RO or on their way in another country.

#### 3.3.12.5.2 Emission trend

Navigation is a very minor source of emissions for Bulgaria.

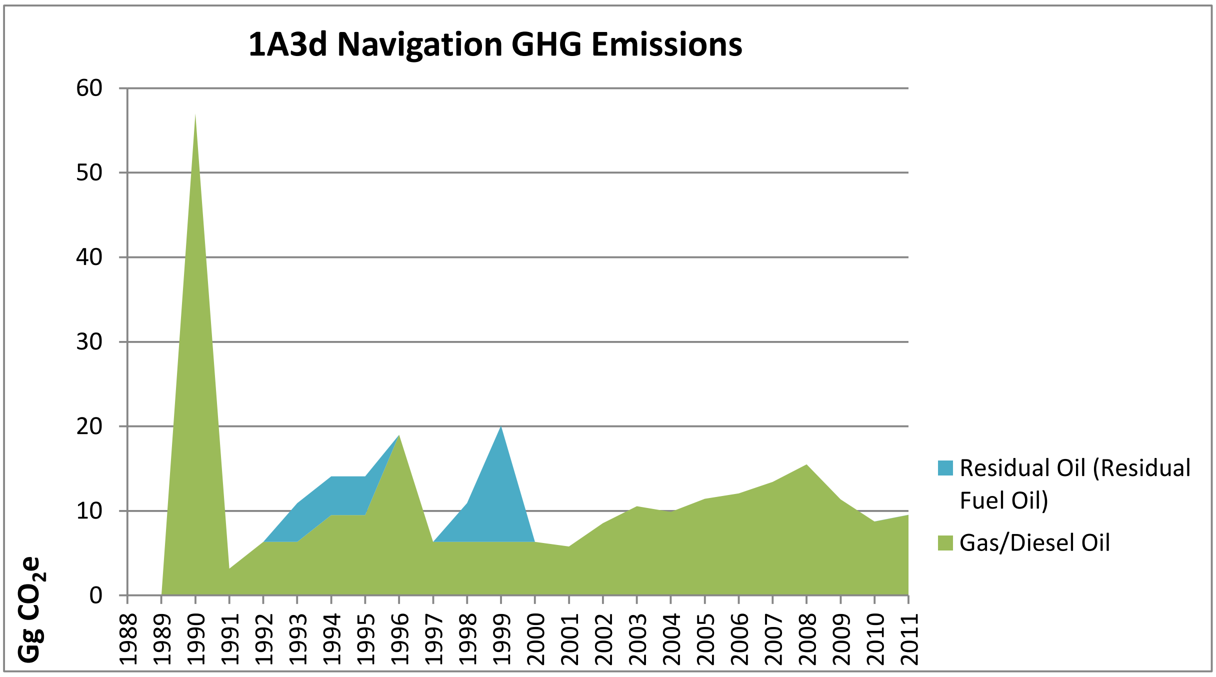



Figure 45 GHG emissions in CRF 1.A.3.d Navigation (1988 - 2011)

### 3.3.12.5.3 Methods

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

$$Emissions = \Sigma(Fuel\ Consumed_{ab} \bullet Emission\ Factor_{ab})$$

*Where:*

*a = fuel type (diesel, gasoline, LPG, bunker, etc.)*

*b = water-borne navigation type (i.e., ship or boat, and possibly engine type.) (Only at Tier 2 is the fuel used differentiated by type of vessel so b can be ignored at Tier 1)*

### 3.3.12.5.4 Activity data

Considering the fuel consumption fluctuations described above, in order to avoid underestimation of the emissions from navigation, the amount of fuel consumed is calculated based on the cargo transported inland (domestic transport of goods) for the period 2001-2011. Data on transported cargo inland is obtained from the National Statistics Institute (NSI) and Danube Commission (DC). Data on transported goods for previous years (1988 – 2000) is not available, thus the reported quantities of fuel sold are used for the emission estimates.

Average distance is calculated based on 410 km distance between western and eastern Bulgaria ports. Further, distance in tonne kilometres travelled goods (tkm) is derived from the average distance and domestic goods transported.

Fuel economy for barge operation (kg/tkm) estimated as average European data from Ecoinvent 2.2 database is applied to calculate the tonnes of fuel consumed.

Table 88 Data on transported goods and fuel consumed for transportation

| Year | Transported goods (DC) | Transported goods (NSI) | Transported goods (domestic) | Average distance | Distance | Fuel economy | Fuel consumed |
|---|---|---|---|---|---|---|---|
| Unit | 1000t | | | km | tkm | kg diesel/tkm | t |
| **2001** | 950 | - | 950 | 205 | 194647500 | 0.0094 | 1828 |
| **2002** | 1402 | - | 1402 | 205 | 287410000 | 0.0094 | 2699 |
| **2003** | 1731 | - | 1731 | 205 | 354855000 | 0.0094 | 3332 |
| **2004** | 1621 | - | 1621 | 205 | 332202500 | 0.0094 | 3119 |
| **2005** | 1741 | 1875 | 1875 | 205 | 384375000 | 0.0094 | 3609 |
| **2006** | 1001 | 2000 | 2000 | 205 | 410000000 | 0.0094 | 3850 |
| **2007** | 1130 | 2203 | 2203 | 205 | 451615000 | 0.0094 | 4241 |
| **2008** | 1392 | 2543 | 2543 | 205 | 521315000 | 0.0094 | 4895 |
| **2009** | 842 | 1864 | 1864 | 205 | 382120000 | 0.0094 | 3588 |
| **2010** | 390 | 1434 | 1434 | 205 | 293970000 | 0.0094 | 2760 |
| **2011** | - | 1563 | 1563 | 205 | 320415000 | 0.0094 | 3009 |

### 3.3.12.5.5 Emission factors

The 1996 IPCC Guidelines default GHG EFs for Gas-Diesel Oil and Residual Fuel Oil have been applied (assuming an oxidation factor of 1). The emission factors are provided in the following tables:

Table 89 Activity data, emissions and emission factors for IPCC Sub-category 1A3d – Navigation: 1988-2011

| | 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 | 74.1 | NO | 0.002 | NO | 0.007 | NO |
| **1989** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.002 | NO | 0.007 | NO |
| **1990** | 18.00 | 18,000.00 | 761.40 | 42.30 | 74.1 | 56.420 | 0.002 | 0.00011 | 0.007 | 0.000 |
| **1991** | 1.00 | 1,000.00 | 42.30 | 42.30 | 74.1 | 3.134 | 0.002 | 0.00001 | 0.007 | 0.000 |
| **1992** | 2.00 | 2,000.00 | 84.60 | 42.30 | 74.1 | 6.269 | 0.002 | 0.00001 | 0.007 | 0.000 |
| **1993** | 2.00 | 2,000.00 | 84.60 | 42.30 | 74.1 | 6.269 | 0.002 | 0.00001 | 0.007 | 0.000 |
| **1994** | 3.00 | 3,000.00 | 126.90 | 42.30 | 74.1 | 9.403 | 0.002 | 0.00002 | 0.007 | 0.000 |
| **1995** | 3.00 | 3,000.00 | 126.90 | 42.30 | 74.1 | 9.403 | 0.002 | 0.00002 | 0.007 | 0.000 |
| **1996** | 6.00 | 6,000.00 | 253.80 | 42.30 | 74.1 | 18.807 | 0.002 | 0.00004 | 0.007 | 0.000 |
| **1997** | 2.00 | 2,000.00 | 84.60 | 42.30 | 74.1 | 6.269 | 0.002 | 0.00001 | 0.007 | 0.000 |
| **1998** | 2.00 | 2,000.00 | 84.60 | 42.30 | 74.1 | 6.269 | 0.002 | 0.00001 | 0.007 | 0.000 |
| **1999** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.002 | NO | 0.007 | NO |
| **2000** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.002 | NO | 0.007 | NO |
| **2001** | 1.8 | 1827.74 | 77.3 | 42.3 | 74.1 | 5.73 | 0.002 | 0.0002 | 0.007 | 0.001 |
| **2002** | 2.7 | 2698.78 | 114.2 | 42.3 | 74.1 | 8.46 | 0.002 | 0.0002 | 0.007 | 0.001 |
| **2003** | 3.3 | 3332.09 | 140.9 | 42.3 | 74.1 | 10.44 | 0.002 | 0.0003 | 0.007 | 0.001 |
| **2004** | 3.1 | 3119.38 | 131.9 | 42.3 | 74.1 | 9.78 | 0.002 | 0.0003 | 0.007 | 0.001 |

| | 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 |
| **2005** | 3.6 | 3609.28 | 152.7 | 42.3 | 74.1 | 11.31 | 0.002 | 0.0003 | 0.007 | 0.001 |
| **2006** | 3.8 | 3849.90 | 161.2 | 41.87 | 74.1 | 11.94 | 0.002 | 0.0003 | 0.007 | 0.001 |
| **2007** | 4.2 | 4240.66 | 179.4 | 42.3 | 74.1 | 13.29 | 0.002 | 0.0004 | 0.007 | 0.001 |
| **2008** | 4.9 | 4895.15 | 207.1 | 42.3 | 74.1 | 15.34 | 0.002 | 0.0004 | 0.007 | 0.001 |
| **2009** | 3.6 | 3588.11 | 151.8 | 42.3 | 74.1 | 11.25 | 0.002 | 0.0003 | 0.007 | 0.001 |
| **2010** | 2.8 | 2760.38 | 116.8 | 42.3 | 74.1 | 8.65 | 0.002 | 0.0002 | 0.007 | 0.001 |
| **2011** | 3.0 | 3008.70 | 127.3 | 42.3 | 74.1 | 9.43 | 1.002 | 0.0003 | 1.007 | 0.001 |

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

| | Residual Fuel Oil | | | | EF* $CO_2$ | $CO_2$ emission | EF* $N_2O$ | $N_2O$ emission | EF* $CH_4$ | $CH_4$ emission |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gg | t | TJ | NCV GJ/t | (t/TJ) | Gg | (t/TJ) | t | Gg | t |
| **1988** | NO | NO | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1989** | NO | NO | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1990** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1991** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1992** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1993** | 1.00 | 1,000.00 | 40.00 | 44.00 | 77.4 | 3.406 | 0.086 | 0.004 | 0.010 | 0.0005 |
| **1994** | 1.00 | 1,000.00 | 40.00 | 44.00 | 77.4 | 3.406 | 0.086 | 0.004 | 0.010 | 0.0005 |
| **1995** | 1.00 | 1,000.00 | 40.00 | 44.00 | 77.4 | 3.406 | 0.086 | 0.004 | 0.010 | 0.0005 |
| **1996** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1997** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1998** | 1.00 | 1,000.00 | 40.00 | 44.00 | 77.4 | 3.406 | 0.086 | 0.004 | 0.010 | 0.000 |
| **1999** | 3.00 | 3,000.00 | 132.00 | 44.00 | 77.4 | 10.217 | 0.086 | 0.011 | 0.010 | 0.001 |
| **2000** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2001** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2002** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2003** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2004** | 0.00 | 0.00 | NO | 43.96 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2005** | 0.00 | 0.00 | NO | 43.96 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2006** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2007** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2008** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2009** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2010** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2011** | 0.00 | 0.00 | NO | 44.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |

*For* $N_2O$ *and* $CH_4$ *an upper values from table 3.4.1 IPCC 2006 GL are used.*

### 3.3.12.5.6 Uncertainties

The following default uncertainties are assumed (2006 IPCC GL, Ch. 3.5.1.7 Uncertainty Assessment, page 3.54):

| | EF $CO_2$ | EF $N_2O$ | EF $CH_4$ |
|---|---|---|---|
| Diesel | ± -1.5 % | -40%/+140% | ±50% |
| Residual Fuel Oil | ± -3 % | | |
| AD | +/-50 % | | |

#### 3.3.12.5.7 Source-specific QA/QC and verification

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

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

- Check of methodology, $CO_2$ emissions, emission factors and IEF (time series)
- Time series consistency
- Plausibility checks of dips and jumps (this is due to the Energy balance at this stage not possible / see trend description)
- Documentation and archiving of all information required in NIR, Background documentation and archive.

#### 3.3.12.5.8 Source-specific planned improvements

No specific improvements for this subcategory are planned.

### 3.3.12.6 Other (CRF 1.A.3.e)

#### 3.3.12.6.1 Source category description

The category (1.A.3.e) includes emissions from all remaining transport activities including pipeline transportation, related to the operation of pump stations and maintenance of pipelines. This is a key category for 2011, mainly because of the significant volume of natural gas consumed for pipeline transport.

#### 3.3.12.6.2 Emission trend

Quantities of liquid fuels are reported at the beginning of the timeseries, but in general natural gas remains the main source of emissions from this category. Data regarding the consumption is provided in the energy balance.

Table 91 Activity data, emissions and emission factors for gas-diesel oil

| | Gas-Diesel Oil | | | | EF $CO_2$ | $CO_2$ emission | EF $N_2O$ | $N_2O$ emission | EF $CH_4$ | $CH_4$ emission |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gg | t | TJ | NCV GJ/t | (t/TJ) | Gg | (t/TJ) | Gg | (t/TJ) | Gg |
| **1988** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **1989** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **1990** | 42.00 | 42 000.00 | 1 776.60 | 42.30 | 74.1 | 131.646 | 0.029 | 0.051 | 0.004 | 0.007 |
| **1991** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **1992** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **1993** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **1994** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **1995** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **1996** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **1997** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **1998** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **1999** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2000** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2001** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2002** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2003** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2004** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2005** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2006** | 0.00 | 0.00 | NO | 41.87 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2007** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2008** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2009** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2010** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |
| **2011** | 0.00 | 0.00 | NO | 42.30 | 74.1 | NO | 0.029 | NO | 0.004 | NO |

Table 92 Activity data, emissions and emission factors for residual fuel oil

| | Residual fuel oil | | | | EF $CO_2$ | $CO_2$ emission | EF $N_2O$ | $N_2O$ emission | EF $CH_4$ | $CH_4$ emission |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gg | t | TJ | NCV GJ/t | (t/TJ) | Gg | (t/TJ) | Gg | (t/TJ) | Gg |
| **1988** | 0.00 | 0.00 | 0.000 | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1989** | 0.00 | 0.00 | 0.000 | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1990** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1991** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1992** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1993** | 1.00 | 1 000.00 | 40.000 | 40.00 | 77.4 | 3.096 | 0.086 | 0.003 | 0.010 | 0.000 |
| **1994** | 1.00 | 1 000.00 | 40.000 | 40.00 | 77.4 | 3.096 | 0.086 | 0.003 | 0.010 | 0.000 |
| **1995** | 1.00 | 1 000.00 | 40.000 | 40.00 | 77.4 | 3.096 | 0.086 | 0.003 | 0.010 | 0.000 |
| **1996** | 1.00 | 1 000.00 | 40.000 | 40.00 | 77.4 | 3.096 | 0.086 | 0.003 | 0.010 | 0.000 |
| **1997** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1998** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **1999** | 2.00 | 2 000.00 | 80.000 | 40.00 | 77.4 | 6.192 | 0.086 | 0.007 | 0.010 | 0.001 |
| **2000** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2001** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2002** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2003** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2004** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2005** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2006** | 0.00 | 0.00 | NO | 39.77 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2007** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2008** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2009** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |
| **2010** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **2011** | 0.00 | 0.00 | NO | 40.00 | 77.4 | NO | 0.086 | NO | 0.010 | NO |

Table 93 Activity data, emissions and emission factors for natural gas

| | Natural gas | EF $CO_2$ | $CO_2$ emission | EF $N_2O$ | $N_2O$ emission | EF $CH_4$ | $CH_4$ emission |
|---|---|---|---|---|---|---|---|
| | TJ | (t/TJ) | Gg | (t/TJ) | Gg | (t/TJ) | Gg |
| **1988** | NO | NO | NO | NO | NO | NO | NO |
| **1989** | NO | NO | NO | NO | NO | NO | NO |
| **1990** | NO | NO | NO | NO | NO | NO | NO |
| **1991** | NO | NO | NO | NO | NO | NO | NO |
| **1992** | NO | NO | NO | NO | NO | NO | NO |
| **1993** | NO | NO | NO | NO | NO | NO | NO |
| **1994** | NO | NO | NO | NO | NO | NO | NO |
| **1995** | NO | NO | NO | NO | NO | NO | NO |
| **1996** | NO | NO | NO | NO | NO | NO | NO |
| **1997** | 471.60 | 54.93 | 25.90 | 0.10 | 0.0000 | 5.00 | 0.0024 |
| **1998** | 3 718.80 | 54.93 | 204.27 | 0.10 | 0.0004 | 5.00 | 0.0186 |
| **1999** | 3 215.70 | 54.93 | 176.63 | 0.10 | 0.0003 | 5.00 | 0.0161 |
| **2000** | 6 886.80 | 54.93 | 378.28 | 0.10 | 0.0007 | 5.00 | 0.0344 |
| **2001** | 5 777.10 | 54.93 | 317.33 | 0.10 | 0.0006 | 5.00 | 0.0289 |
| **2002** | 5 821.20 | 54.93 | 319.75 | 0.10 | 0.0006 | 5.00 | 0.0291 |
| **2003** | 3 664.80 | 54.93 | 201.30 | 0.10 | 0.0004 | 5.00 | 0.0183 |
| **2004** | 5 631.30 | 54.93 | 309.32 | 0.10 | 0.0006 | 5.00 | 0.0282 |
| **2005** | 9 042.30 | 54.93 | 496.68 | 0.10 | 0.0009 | 5.00 | 0.0452 |
| **2006** | 9 538.20 | 54.93 | 523.92 | 0.10 | 0.0010 | 5.00 | 0.0477 |
| **2007** | 10 973.70 | 54.91 | 602.54 | 0.10 | 0.0011 | 5.00 | 0.0549 |
| **2008** | 10 808.10 | 54.90 | 593.36 | 0.10 | 0.0011 | 5.00 | 0.0540 |
| **2009** | 5 845.50 | 54.96 | 321.27 | 0.10 | 0.0006 | 5.00 | 0.0292 |
| **2010** | 5 895.90 | 54.97 | 324.07 | 0.10 | 0.0006 | 5.00 | 0.0295 |
| **2011** | 8 527.50 | 54.99 | 468.90 | 0.10 | 0.0009 | 5.00 | 0.0426 |

### 3.3.12.6.3 Methods

The 1996 IPCC Guidelines Tier 1 approach has been applied.

### 3.3.12.6.4 Activity data

The National energy balances have been used to obtain the fuel consumption and net calorific values.

### 3.3.12.6.5 Emission factors

The default EFs from the 1996 IPCC Guidelines for Gas-Diesel Oil and Residual Fuel Oil has been applied. For the calculation of pipeline transport emissions are used the country-specific emission factors.

#### 3.3.12.6.6 Uncertainties

Greenhouse gas emissions from other transport sources are typically much smaller than those from road transportation, but activities in this category are diverse and are thus typically associated with higher uncertainties because of the additional uncertainty in activity data.

The types of equipment and their operating conditions are typically more diverse than that for road transportation, and this may give rise to a larger variation in emission factors and thus to larger uncertainties. However, the uncertainty estimate is likely to be dominated by the activity data for natural gas, and so it is reasonable to assume as a default that the values for gaseous fuels apply.

Uncertainty in activity data is determined by the accuracy of the surveys or bottom-up models on which the estimates of fuel usage by off-road source and fuel type are based. This will be very case-specific, but factor of 2 uncertainties are certainly possible, unless if there is evidence to the contrary from the survey design.

The following default uncertainties are assumed based on the lower and higher values of the EFs (2006 IPCC GL, Ch. 3, Table 3.2.2 Uncertainty Assessment):

| AD | +/-5 % | | EF $CO_2$ | EF $N_2O$ | EF $CH_4$ |
|---|---|---|---|---|---|
| | | Natural gas | 1% / -2% | 208% / -67% | 144% /-59% |

#### 3.3.12.6.7 Source specific QA/QC and verification

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

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

- Check of methodology, $CO_2$ emissions, emission factors and IEF (time series)
- Time series consistency
- Plausibility checks of dips and jumps (this is due to the Energy balance at this stage not possible / see trend description)
- Documentation and archiving of all information required in NIR, background documentation and archive.

### 3.3.13 OTHER SECTORS (CRF 1.A.4)

Other sectors include the following subcategories:

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

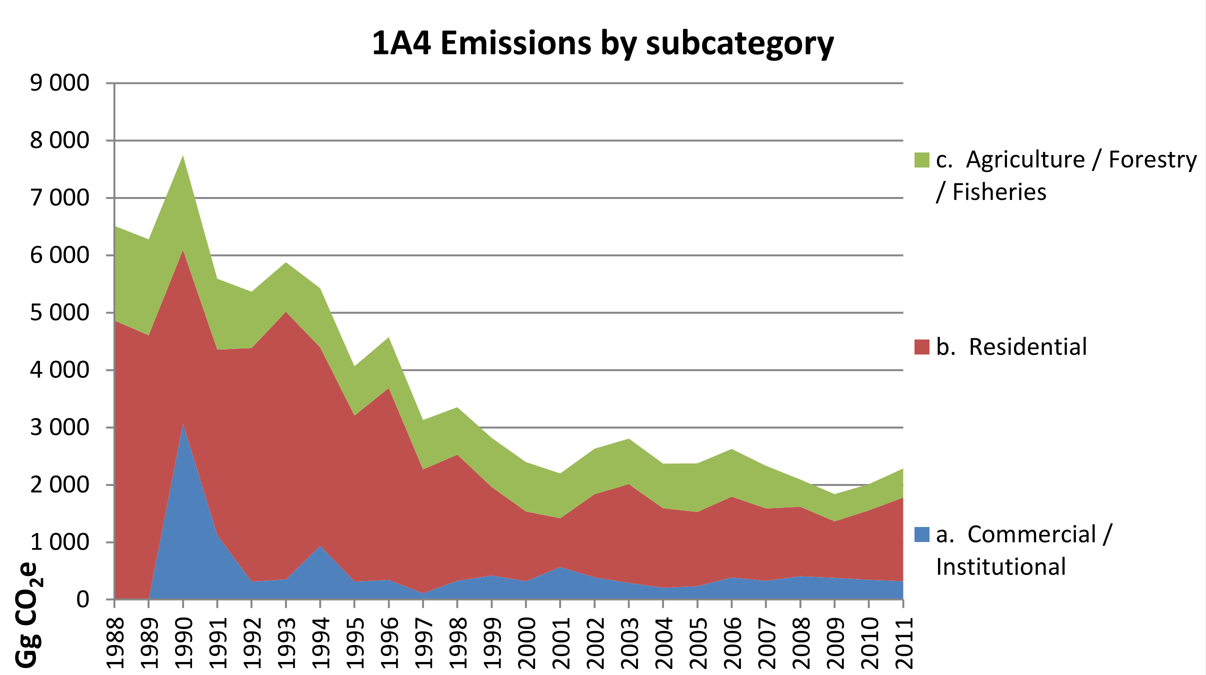



Figure 46 Total GHG emissions from 1.A.4 Other Sectors

The general trend in CRF category 1.A.4 is a decrease of 64.9% compared to base year and an increase of 13.5% compared to last year.

### 3.3.13.1 Commercial/Institutional (CRF 1.A.4.a.)

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

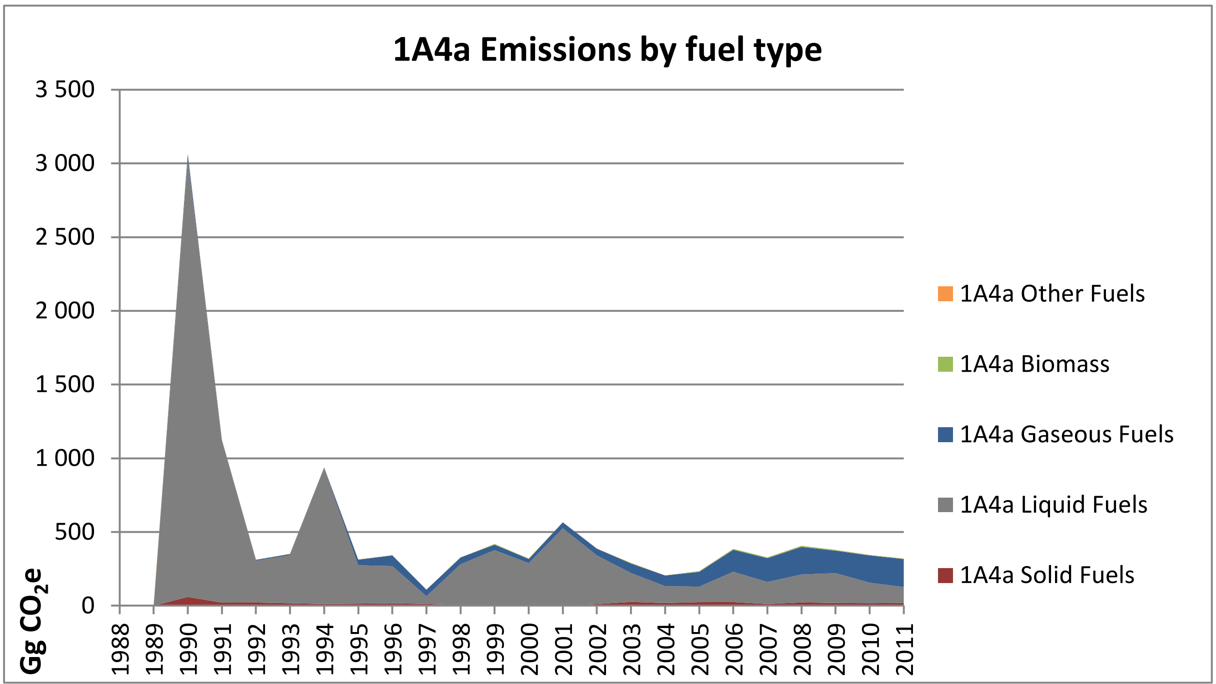



Figure 47 GHG emissions from CRF 1.A.4.a. Commercial/Institutional

The share of this subcategory from sector 1.A is 0.6% for 2011, while the share from the total GHG emissions is 0.5%.

For the years before 1990 no consumption is reported in this subcategory, instead it is reported under category 1.A.5.

Table 94 $CO_2$ 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** | 385.23 | 327.98 | 11.42 | 45.83 | NO | NO |
| **2003** | 285.17 | 194.65 | 26.06 | 64.46 | 60.7040 | NO |
| **2004** | 204.38 | 113.89 | 18.51 | 71.98 | NO | NO |
| **2005** | 229.04 | 104.30 | 24.54 | 100.21 | 63.5040 | NO |
| **2006** | 378.01 | 204.58 | 25.08 | 148.36 | 85.3440 | NO |
| **2007** | 321.48 | 148.31 | 11.83 | 161.35 | 70.0000 | NO |
| **2008** | 397.73 | 188.56 | 22.50 | 186.67 | 99.5680 | NO |
| **2009** | 371.94 | 201.19 | 18.79 | 151.96 | 70.5516 | NO |
| **2010** | 339.90 | 138.16 | 17.32 | 184.42 | 50.7290 | NO |
| **2011** | 315.57 | 106.88 | 19.35 | 189.34 | 51.7860 | NO |
| **Decrease 1988-2011** | - | - | - | - | - | - |
| **Decrease 1990-2011** | 89.7% | 96.4% | 67.6% | -388.5% | - | - |
| **Decrease 2010-2011** | 7.2% | 22.6% | -11.7% | -2.7% | -2.1% | - |

Table 95 $CH_4$ 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 |

| $CH_4$ (Gg) | CRF 1.A.4.a. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **2003** | 0.1973 | 0.0261 | 0.0027 | 0.0059 | 0.1626 | NO |
| **2004** | 0.0234 | 0.0149 | 0.0019 | 0.0066 | NO | NO |
| **2005** | 0.1957 | 0.0140 | 0.0025 | 0.0091 | 0.1701 | NO |
| **2006** | 0.2718 | 0.0271 | 0.0026 | 0.0135 | 0.2286 | NO |
| **2007** | 0.2234 | 0.0200 | 0.0012 | 0.0147 | 0.1875 | NO |
| **2008** | 0.3324 | 0.0254 | 0.0023 | 0.0170 | 0.2877 | NO |
| **2009** | 0.2491 | 0.0272 | 0.0019 | 0.0138 | 0.2061 | NO |
| **2010** | 0.1570 | 0.0179 | 0.0018 | 0.0168 | 0.1205 | NO |
| **2011** | 0.1583 | 0.0135 | 0.0020 | 0.0172 | 0.1257 | NO |
| **Decrease 1988-2011** | - | - | - | - | - | - |
| **Decrease 1990-2011** | -77.1% | 83.2% | 66.3% | -388.0% | - | - |
| **Decrease 2010-2011** | -0.9% | 24.8% | -12.3% | -2.6% | -4.3% | - |

Table 96 $N_2O$ 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 |
| **1998** | 0.0024 | 0.0022 | 0.0001 | 0.0001 | NO | NO |
| **1999** | 0.0054 | 0.0030 | 0.0001 | 0.0001 | 0.0023 | NO |
| **2000** | 0.0040 | 0.0023 | NO | 0.0001 | 0.0016 | NO |
| **2001** | 0.0043 | 0.0042 | NO | 0.0001 | NO | NO |
| **2002** | 0.0029 | 0.0026 | 0.0002 | 0.0001 | NO | NO |
| **2003** | 0.0042 | 0.0016 | 0.0004 | 0.0001 | 0.0022 | NO |
| **2004** | 0.0013 | 0.0009 | 0.0003 | 0.0001 | NO | NO |
| **2005** | 0.0036 | 0.0008 | 0.0004 | 0.0002 | 0.0023 | NO |
| **2006** | 0.0053 | 0.0016 | 0.0004 | 0.0003 | 0.0030 | NO |
| **2007** | 0.0042 | 0.0012 | 0.0002 | 0.0003 | 0.0025 | NO |
| **2008** | 0.0051 | 0.0015 | 0.0003 | 0.0003 | 0.0029 | NO |
| **2009** | 0.0041 | 0.0016 | 0.0003 | 0.0003 | 0.0020 | NO |
| **2010** | 0.0031 | 0.0010 | 0.0003 | 0.0003 | 0.0015 | NO |
| **2011** | 0.0030 | 0.0008 | 0.0003 | 0.0003 | 0.0016 | NO |
| **Decrease 1988-2011** | - | - | - | - | - | - |
| **Decrease 1990-2011** | 88.1% | 96.8% | 66.3% | -388.0% | - | - |
| **Decrease 2010-2011** | 3.8% | 26.8% | -12.3% | -2.6% | -8.1% | - |

Table 97 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** | 5 400.48 | 387.16 | 329.73 | 11.49 | 45.94 | NO | NO |
| **2003** | 4 620.54 | 290.62 | 195.68 | 26.23 | 64.62 | 4.0867 | NO |
| **2004** | 3 046.52 | 205.27 | 114.48 | 18.63 | 72.16 | NO | NO |
| **2005** | 4 042.48 | 234.28 | 104.85 | 24.70 | 100.45 | 4.2752 | NO |
| **2006** | 6 430.04 | 385.37 | 205.65 | 25.24 | 148.72 | 5.7455 | NO |
| **2007** | 5 681.36 | 327.46 | 149.10 | 11.90 | 161.75 | 4.7125 | NO |
| **2008** | 7 061.22 | 406.29 | 189.56 | 22.65 | 187.13 | 6.9488 | NO |
| **2009** | 6 313.79 | 378.46 | 202.27 | 18.92 | 152.33 | 4.9384 | NO |
| **2010** | 5 916.11 | 344.15 | 138.86 | 17.43 | 184.88 | 2.9832 | NO |
| **2011** | 5 616.64 | 319.81 | 107.39 | 19.48 | 189.81 | 3.1275 | NO |
| **Decrease 1988-2011** | - | - | - | - | - | - | - |
| **Decrease 1990-2011** | 86.3% | 89.6% | 96.4% | 67.6% | -388.5% | - | - |
| **Decrease 2010-2011** | 5.1% | 7.1% | 22.7% | -11.7% | -2.7% | -4.8% | - |

### 3.3.13.2 Residential (CRF 1.A.4.b.)

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

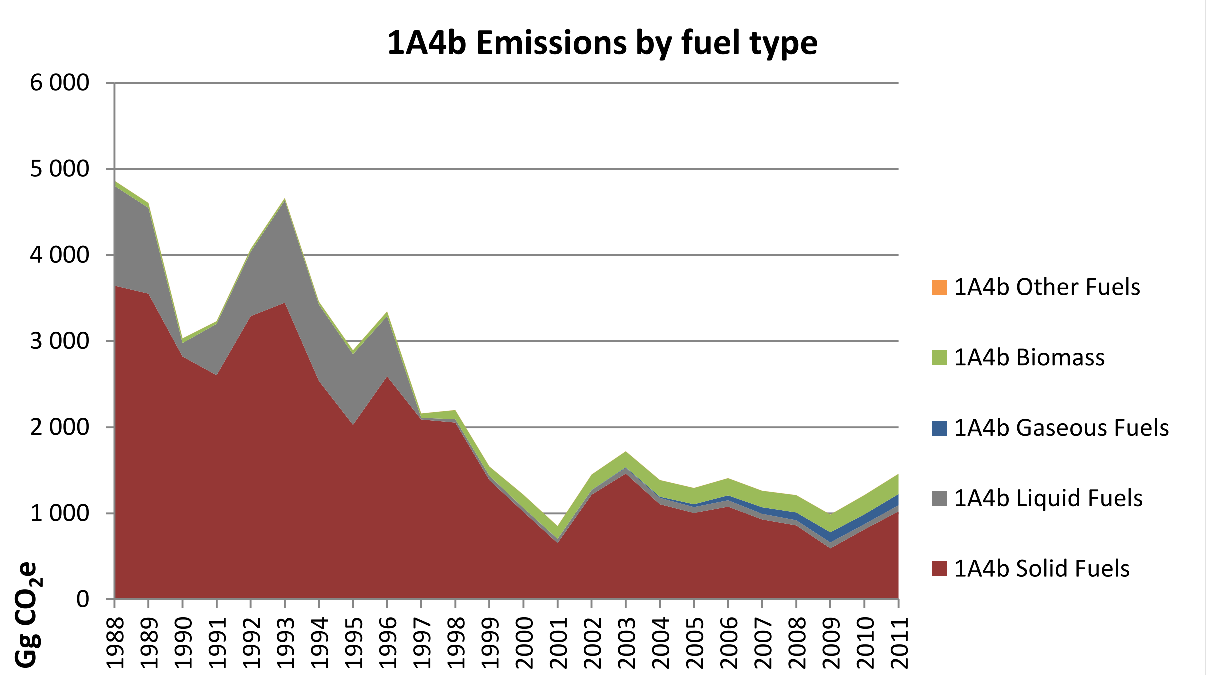



Figure 48 GHG emissions from CRF 1.A.4.b. Residential

The share of this subcategory from sector 1.A is 2.9% for 2011, while the share from the total GHG emissions is 2.2%. The emissions from this category decreased by 70% compared to base year, which is mostly due to the drastically decreased consumption of liquid and solid fuels, which were substituted mostly by biomass.

Table 98 $CO_2$ emissions in CRF 1.A.4.b. Residential

| $CO_2$ (Gg) | CRF 1.A.4.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1988** | 4 558.54 | 1 155.57 | 3 402.98 | NO | 889.3920 | NO |
| **1989** | 4 308.57 | 993.04 | 3 315.52 | NO | 850.7520 | NO |
| **1990** | 2 790.84 | 156.03 | 2 634.81 | NO | 808.7520 | NO |
| **1991** | 3 023.36 | 594.20 | 2 429.16 | NO | 469.2800 | NO |
| **1992** | 3 816.52 | 745.06 | 3 071.47 | NO | 480.1440 | NO |
| **1993** | 4 397.35 | 1 181.59 | 3 215.76 | NO | 440.4960 | NO |
| **1994** | 3 250.59 | 883.49 | 2 367.11 | NO | 506.5760 | NO |
| **1995** | 2 707.83 | 817.25 | 1 890.58 | NO | 674.9120 | NO |
| **1996** | 3 113.61 | 697.20 | 2 416.41 | NO | 805.3920 | NO |
| **1997** | 1 970.79 | 20.10 | 1 950.68 | NO | 741.6640 | NO |
| **1998** | 1 955.13 | 38.71 | 1 916.41 | NO | 1 581.6640 | NO |
| **1999** | 1 343.45 | 49.97 | 1 293.47 | NO | 1 604.4000 | NO |
| **2000** | 993.07 | 44.00 | 948.62 | 0.44 | 2 292.0800 | NO |
| **2001** | 658.80 | 46.64 | 610.33 | 1.83 | 2 212.7840 | NO |
| **2002** | 1 190.06 | 52.39 | 1 134.75 | 2.92 | 2 667.1680 | NO |
| **2003** | 1 438.29 | 66.75 | 1 364.43 | 7.12 | 2 752.7360 | NO |
| **2004** | 1 118.77 | 74.46 | 1 031.07 | 13.25 | 2 880.6400 | NO |
| **2005** | 1 037.99 | 68.32 | 937.30 | 32.38 | 2 812.4320 | NO |
| **2006** | 1 136.35 | 74.65 | 1 005.44 | 56.26 | 2 977.7440 | NO |
| **2007** | 1 008.91 | 66.29 | 867.31 | 75.31 | 2 846.4800 | NO |
| **2008** | 952.51 | 60.54 | 802.54 | 89.43 | 2 998.1280 | NO |
| **2009** | 739.46 | 69.39 | 553.19 | 116.89 | 3 062.6400 | NO |
| **2010** | 932.64 | 60.77 | 758.33 | 113.53 | 3 334.1280 | NO |
| **2011** | 1 155.06 | 72.03 | 954.21 | 128.82 | 3 502.6880 | NO |

| $CO_2$ (Gg) | CRF 1.A.4.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **Decrease 1988-2011** | 74.7% | 93.8% | 72.0% | - | -293.8% | - |
| **Decrease 1990-2011** | 58.6% | 53.8% | 63.8% | - | -333.1% | - |
| **Decrease 2010-2011** | -23.8% | -18.5% | -25.8% | -13.5% | -5.1% | - |

Table 99 $CH_4$ 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** | 10.7387 | 0.0047 | 3.5895 | 0.0003 | 7.1442 | NO |
| **2003** | 11.6622 | 0.0059 | 4.2822 | 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 |
| **2011** | 12.3939 | 0.0059 | 2.9941 | 0.0117 | 9.3822 | NO |
| **Decrease 1988-2011** | 6.7% | 95.5% | 72.2% | - | -293.8% | - |
| **Decrease 1990-2011** | -18.3% | 55.7% | 63.9% | - | -333.1% | - |
| **Decrease 2010-2011** | -9.2% | -13.9% | -24.6% | -13.4% | -5.1% | - |

Table 100 $N_2O$ 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 |

| $N_2O$ (Gg) | CRF 1.A.4.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **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 |
| **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** | 0.1185 | 0.0002 | 0.0200 | 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 |
| **2011** | 0.1394 | 0.0001 | 0.0140 | 0.0002 | 0.1251 | NO |
| **Decrease 1988-2011** | -57.6% | 97.9% | 72.2% | - | -293.8% | - |
| **Decrease 1990-2011** | -105.2% | 61.7% | 63.9% | - | -333.1% | - |
| **Decrease 2010-2011** | -6.7% | 1.7% | -24.6% | -13.4% | -5.1% | - |

Table 101 GHG emissions in CRF 1.A.4.b. Residential

| GHG (Gg) | TJ | CRF 1.A.4.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **1988** | 61 036.20 | 4 865.01 | 1 160.36 | 3 644.78 | NO | 59.8751 | NO |
| **1989** | 57 574.80 | 4 605.84 | 996.92 | 3 551.64 | NO | 57.2738 | NO |
| **1990** | 37 335.50 | 3 031.84 | 156.42 | 2 820.97 | NO | 54.4463 | NO |
| **1991** | 39 201.46 | 3 231.74 | 596.28 | 2 603.87 | NO | 31.5926 | NO |
| **1992** | 47 162.73 | 4 071.84 | 748.86 | 3 290.65 | NO | 32.3240 | NO |
| **1993** | 54 614.84 | 4 663.89 | 1 187.59 | 3 446.64 | NO | 29.6548 | NO |
| **1994** | 42 196.30 | 3 458.92 | 887.74 | 2 537.08 | NO | 34.1034 | NO |
| **1995** | 37 833.80 | 2 893.45 | 821.09 | 2 026.92 | NO | 45.4360 | NO |
| **1996** | 42 918.43 | 3 345.01 | 700.44 | 2 590.35 | NO | 54.2201 | NO |
| **1997** | 27 558.82 | 2 159.58 | 20.15 | 2 089.50 | NO | 49.9299 | NO |
| **1998** | 35 051.27 | 2 198.81 | 38.86 | 2 053.47 | NO | 106.4799 | NO |
| **1999** | 28 760.27 | 1 543.68 | 50.13 | 1 385.54 | NO | 108.0105 | NO |
| **2000** | 31 163.18 | 1 214.95 | 44.14 | 1 016.06 | 0.45 | 154.3061 | NO |
| **2001** | 26 947.85 | 851.22 | 46.77 | 653.65 | 1.83 | 148.9678 | NO |
| **2002** | 36 649.13 | 1 450.34 | 52.53 | 1 215.33 | 2.92 | 179.5576 | NO |
| **2003** | 40 028.66 | 1 719.93 | 66.92 | 1 460.55 | 7.14 | 185.3181 | NO |
| **2004** | 37 954.10 | 1 385.80 | 74.65 | 1 103.94 | 13.28 | 193.9288 | NO |
| **2005** | 36 595.41 | 1 293.62 | 68.47 | 1 003.34 | 32.46 | 189.3369 | NO |
| **2006** | 39 298.38 | 1 407.89 | 74.83 | 1 076.19 | 56.40 | 200.4660 | NO |
| **2007** | 36 773.38 | 1 261.03 | 66.44 | 927.46 | 75.50 | 191.6291 | NO |
| **2008** | 37 671.27 | 1 210.68 | 60.68 | 858.50 | 89.65 | 201.8383 | NO |

| GHG (Gg) | TJ | CRF 1.A.4.b. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **2009** | 36 307.24 | 984.75 | 69.56 | 591.83 | 117.17 | 206.1813 | NO |
| **2010** | 40 801.64 | 1 211.46 | 60.92 | 812.26 | 113.81 | 224.4583 | NO |
| **2011** | 44 743.19 | 1 458.56 | 72.20 | 1 021.42 | 129.14 | 235.8060 | NO |
| **Decrease 1988-2011** | 26.7% | 70.0% | 93.8% | 72.0% | - | -293.8% | - |
| **Decrease 1990-2011** | -19.8% | 51.9% | 53.8% | 63.8% | - | -333.1% | - |
| **Decrease 2010-2011** | -9.7% | -20.4% | -18.5% | -25.7% | -13.5% | -5.1% | - |

### 3.3.13.3 Agriculture/Forestry/Fisheries (CRF 1.A.4.c.)

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

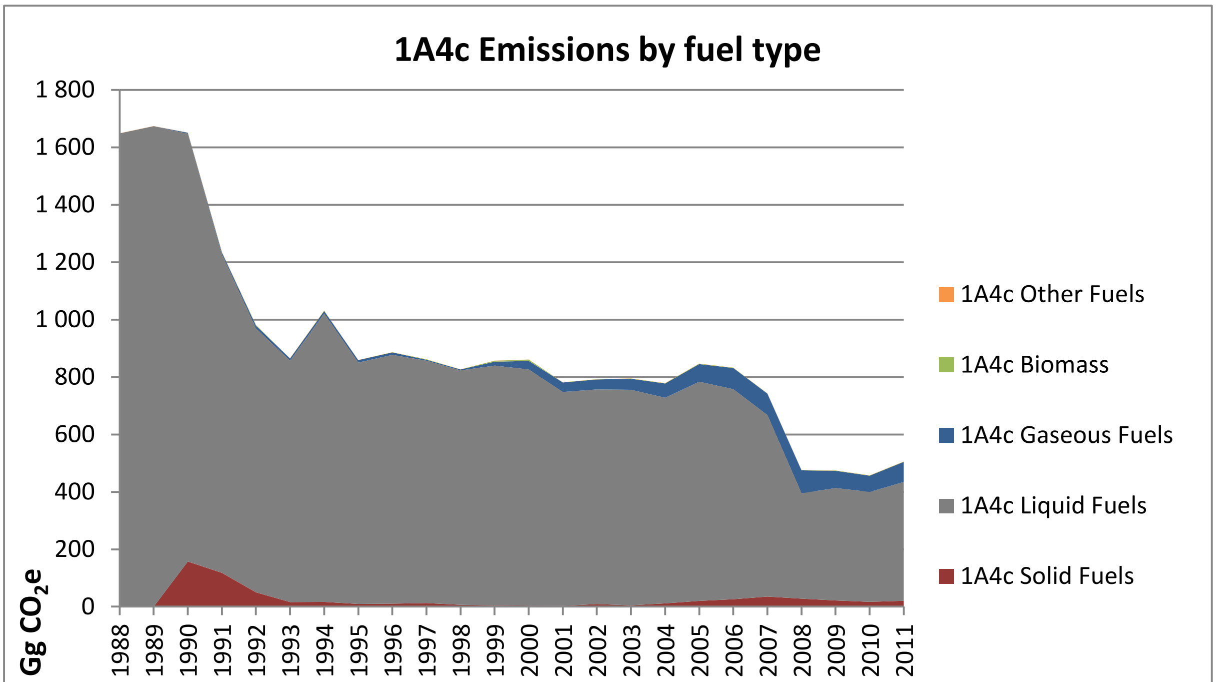



Figure 49 GHG emissions from CRF 1.A.4.c. Agriculture/Forestry/Fisheries

The share of this subcategory from sector 1.A is 1.0% for 2011, while the share from the total GHG emissions is 0.8%.

Table 102 $CO_2$ 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 |

| $CO_2$ (Gg) | CRF 1.A.4.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| **1997** | 854.67 | 839.68 | 11.73 | 3.26 | 25.0880 | NO |
| **1998** | 821.50 | 812.07 | 6.17 | 3.26 | 4.7040 | NO |
| **1999** | 848.42 | 830.42 | 4.65 | 13.35 | 52.8640 | NO |
| **2000** | 851.30 | 817.93 | 3.71 | 29.66 | 68.4320 | NO |
| **2001** | 776.71 | 740.58 | 3.11 | 33.02 | 7.2800 | NO |
| **2002** | 786.89 | 743.83 | 8.55 | 34.51 | 11.3120 | NO |
| **2003** | 789.50 | 746.63 | 4.65 | 38.21 | 14.7840 | NO |
| **2004** | 772.69 | 712.53 | 10.73 | 49.44 | 15.9040 | NO |
| **2005** | 839.35 | 759.48 | 18.82 | 61.05 | 24.8640 | NO |
| **2006** | 825.63 | 727.78 | 24.24 | 73.61 | 14.1120 | NO |
| **2007** | 736.38 | 628.92 | 32.89 | 74.57 | 10.9760 | NO |
| **2008** | 471.08 | 365.08 | 26.15 | 79.85 | 10.0800 | NO |
| **2009** | 469.61 | 389.63 | 20.23 | 59.75 | 17.1360 | NO |
| **2010** | 452.95 | 380.82 | 15.74 | 56.39 | 15.6800 | NO |
| **2011** | 500.65 | 411.84 | 19.13 | 69.68 | 16.8000 | NO |
| **Decrease 1988-2011** | 69.5% | 74.9% | - | - | - | - |
| **Decrease 1990-2011** | 69.3% | 72.2% | 87.0% | -2035.6% | - | - |
| **Decrease 2010-2011** | -10.5% | -8.1% | -21.6% | -23.6% | -7.1% | - |

Table 103 $CH_4$ 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** | 0.1426 | 0.1105 | 0.0193 | 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 |
| **2011** | 0.1675 | 0.0557 | 0.0605 | 0.0063 | 0.0450 | NO |
| **Decrease** | 25.1% | 75.1% | - | - | - | - |

| $CH_4$ (Gg) | CRF 1.A.4.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|
| 1988-2011 | | | | | | |
| Decrease 1990-2011 | 74.7% | 72.5% | 86.8% | -2033.3% | - | - |
| Decrease 2010-2011 | -12.7% | -8.2% | -20.9% | -23.5% | -7.1% | - |

Table 104 $N_2O$ 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 |
| 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 |
| 2011 | 0.0043 | 0.0033 | 0.0003 | 0.0001 | 0.0006 | NO |
| Decrease 1988-2011 | 67.8% | 75.3% | - | - | - | - |
| Decrease 1990-2011 | 69.7% | 72.7% | 86.8% | -2033.3% | - | - |
| Decrease 2010-2011 | -9.3% | -8.3% | -20.9% | -23.5% | -7.1% | - |

Table 105 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 |

| GHG (Gg) | TJ | CRF 1.A.4.c. | Liquid Fuels | Solid Fuels | Gaseous Fuels | Biomass | Other Fuels |
|---|---|---|---|---|---|---|---|
| **1994** | 13 978.14 | 1 030.89 | 1 004.57 | 16.64 | 8.52 | 1.1612 | NO |
| **1995** | 11 641.80 | 859.19 | 840.89 | 9.55 | 8.47 | 0.2790 | NO |
| **1996** | 12 091.92 | 886.36 | 866.62 | 10.53 | 8.52 | 0.6937 | NO |
| **1997** | 11 814.54 | 861.70 | 844.20 | 12.54 | 3.27 | 1.6890 | NO |
| **1998** | 11 213.70 | 826.64 | 816.45 | 6.60 | 3.27 | 0.3167 | NO |
| **1999** | 12 049.00 | 856.80 | 834.89 | 4.98 | 13.38 | 3.5589 | NO |
| **2000** | 12 319.45 | 860.64 | 822.33 | 3.97 | 29.73 | 4.6069 | NO |
| **2001** | 10 781.05 | 781.48 | 744.56 | 3.32 | 33.10 | 0.4901 | NO |
| **2002** | 10 949.05 | 792.31 | 747.84 | 9.12 | 34.59 | 0.7615 | NO |
| **2003** | 11 052.14 | 794.92 | 750.64 | 4.98 | 38.31 | 0.9953 | NO |
| **2004** | 10 843.06 | 778.48 | 716.36 | 11.48 | 49.56 | 1.0707 | NO |
| **2005** | 11 875.71 | 846.56 | 763.53 | 20.15 | 61.20 | 1.6739 | NO |
| **2006** | 11 648.14 | 832.39 | 731.69 | 25.96 | 73.79 | 0.9500 | NO |
| **2007** | 10 371.47 | 742.95 | 632.29 | 35.16 | 74.76 | 0.7389 | NO |
| **2008** | 6 805.72 | 475.73 | 367.02 | 27.99 | 80.04 | 0.6786 | NO |
| **2009** | 6 799.60 | 474.40 | 391.68 | 21.66 | 59.90 | 1.1536 | NO |
| **2010** | 6 546.86 | 457.30 | 382.85 | 16.87 | 56.53 | 1.0556 | NO |
| **2011** | 7 255.94 | 505.51 | 414.03 | 20.49 | 69.85 | 1.1310 | NO |
| **Decrease 1988-2011** | 67.6% | 69.3% | 74.9% | - | - | - | - |
| **Decrease 1990-2011** | 66.7% | 69.4% | 72.2% | 87.0% | -2035.6% | - | - |
| **Decrease 2010-2011** | -10.8% | -10.5% | -8.1% | -21.5% | -23.6% | -7.1% | - |

## 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 2.7% of total GHG emissions for 2011. The fugitive emissions from gas and oil are also key source and have a share of approx. 1.0% of total GHG emissions, while the fugitive emissions from solid fuels are approx. 1.6% of total GHG emissions.

### 3.4.1 COAL MINING (CRF 1.B.1)

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 37.1 million tons in 2011. Local lignite has low calorific value – about 7000 MJ/kg, and high content of humidity and sulphur which makes them high energy consuming and low quality coals.

### 3.4.2 EXTRACTION, REFINING, TRANSPORTATION AND DISTRIBUTION OF OIL AND NATURAL GAS (CRF 1.B.2)

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 107 and Table 108. 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 was reduced more than twice in 2011, compared to 1988, due to the collapse of fertilizer production industry, which 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.

Natural gas production in Bulgaria peaked in the interval 2004-2008, following the development of the new field (Galata), which was expended in 2009. Since 2010 there is a new field developed (Kaliakra), which has again increased the domestic production of natural gas and is expected to be developed until 2017. As a requirement from the National Statistics Institute, due to the limited number of oil and natural gas production companies in the country, the indigenous production data is notated as confidential.

Table 106 Activity data and $CH_4$ emissions from CRF 1.B.1 Coal mining and Handling

| Year | 1.B.1.a Coal Mining and Handling | | | | | | 1.B.1.b Solid Fuel Transformation | |
|---|---|---|---|---|---|---|---|---|
| | i. Underground Mines | | | ii. Surface Mines | | | | |
| | 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 | 30.20 | 1400.00 | 0.07 |
| **1989** | 4115.76 | 6.89 | 49.64 | 30182 | 2.02 | 30.33 | 1208.00 | 0.06 |
| **1990** | 3848.00 | 6.45 | 46.41 | 27827 | 1.86 | 27.97 | 1854.00 | 0.09 |
| **1991** | 3159.00 | 5.29 | 38.10 | 25231 | 1.69 | 25.36 | 1004.00 | 0.05 |
| **1992** | 3589.00 | 6.01 | 43.28 | 26735 | 1.79 | 26.87 | 1161.00 | 0.06 |
| **1993** | 3682.00 | 6.17 | 44.40 | 25350 | 1.70 | 25.48 | 1295.00 | 0.06 |
| **1994** | 3328.00 | 5.57 | 40.14 | 25429 | 1.70 | 25.56 | 1519.00 | 0.07 |
| **1995** | 3381.00 | 5.66 | 40.77 | 27449 | 1.84 | 27.59 | 1693.00 | 0.08 |
| **1996** | 3198.00 | 5.36 | 38.57 | 28104 | 1.88 | 28.24 | 1491.00 | 0.07 |
| **1997** | 2779.00 | 4.65 | 33.51 | 26929 | 1.80 | 27.06 | 1656.00 | 0.08 |
| **1998** | 1970.00 | 3.30 | 23.76 | 28141 | 1.89 | 28.28 | 1189.00 | 0.06 |
| **1999** | 1458.00 | 2.44 | 17.58 | 23840 | 1.60 | 23.96 | 1090.00 | 0.05 |
| **2000** | 1621.00 | 2.72 | 19.55 | 24811 | 1.66 | 24.94 | 1325.00 | 0.06 |
| **2001** | 1248.00 | 2.09 | 15.05 | 25363 | 1.70 | 25.49 | 1148.00 | 0.06 |
| **2002** | 1354.00 | 2.27 | 16.33 | 24664 | 1.65 | 24.79 | 1072.00 | 0.05 |
| **2003** | 1560.00 | 2.61 | 18.81 | 25739 | 1.72 | 25.87 | 1188.00 | 0.06 |
| **2004** | 383.00 | 0.64 | 4.62 | 26102 | 1.75 | 26.23 | 1174.00 | 0.06 |
| **2005** | 585.00 | 0.98 | 7.06 | 24110 | 1.62 | 24.23 | 1051.00 | 0.05 |
| **2006** | 161.00 | 0.27 | 1.94 | 25517 | 1.71 | 25.64 | 947.00 | 0.05 |
| **2007** | 475.00 | 0.80 | 5.73 | 27978 | 1.87 | 28.12 | 751.00 | 0.04 |
| **2008** | 556.00 | 0.93 | 6.71 | 28233 | 1.89 | 28.37 | 434.00 | 0.02 |
| **2009** | 698.00 | 1.17 | 8.42 | 26488 | 1.77 | 26.62 | NO | NO |
| **2010** | 756.00 | 1.27 | 9.12 | 28649 | 1.92 | 28.79 | NO | NO |
| **2011** | 878.00 | 1.47 | 10.59 | 36250 | 2.43 | 36.43 | NO | NO |

Table 107 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 | C | C | 559.1 | C | 1234.0 | 6152.7 | 50.0 | 175.2 | 0.4 | C | C | C | C |
| 1989 | C | C | 559.1 | C | 1350.0 | 6333.8 | 50.0 | 181.2 | 0.5 | C | C | C | C |
| 1990 | C | C | 352.8 | C | 1469.0 | 6717.0 | 50.0 | 120.4 | 0.9 | C | C | C | C |
| 1991 | C | C | 191.6 | C | 1619.0 | 5661.0 | 50.0 | 93.5 | 0.2 | C | C | C | C |
| 1992 | C | C | 107.2 | C | 1644.0 | 5012.0 | 50.0 | 84.2 | 0.3 | C | C | C | C |
| 1993 | C | C | 242.3 | C | 1769.0 | 4670.0 | 50.0 | 82.7 | 0.3 | C | C | C | C |
| 1994 | C | C | 296.0 | C | 1919.0 | 4674.0 | 50.0 | 81.6 | 0.3 | C | C | C | C |
| 1995 | C | C | 340.0 | C | 2044.0 | 5638.0 | 50.0 | 88.2 | 0.9 | C | C | C | C |
| 1996 | C | C | 295.8 | C | 2205.0 | 5761.0 | 50.0 | 92.3 | 1.6 | C | C | C | C |
| 1997 | C | C | 253.7 | C | 2370.0 | 4599.0 | 60.0 | 109.0 | 1.0 | C | C | C | C |
| 1998 | C | C | 236.3 | C | 2410.0 | 3848.0 | 100.0 | 96.8 | 1.0 | C | C | C | C |
| 1999 | C | C | 240.4 | C | 2540.0 | 3322.0 | 200.0 | 76.6 | 1.0 | C | C | C | C |
| 2000 | C | C | 226.0 | C | 2645.0 | 3616.0 | 300.0 | 76.0 | 1.2 | C | C | C | C |
| 2001 | C | C | 227.6 | C | 2540.0 | 3361.0 | 500.0 | 64.4 | 1.5 | C | C | C | C |
| 2002 | C | C | 222.1 | C | 2645.0 | 2935.0 | 700.0 | 65.5 | 1.7 | C | C | C | C |
| 2003 | C | C | 214.3 | C | 2645.0 | 3058.0 | 911.0 | 65.1 | 2.2 | C | C | C | C |
| 2004 | C | C | 224.7 | C | 2645.0 | 3092.0 | 1268.0 | 61.2 | 2.7 | C | C | C | C |
| 2005 | C | C | 263.1 | C | 2645.0 | 3466.0 | 1577.0 | 70.5 | 3.9 | C | C | C | C |
| 2006 | C | C | 302.4 | C | 2645.0 | 3539.0 | 1870.0 | 75.8 | 5.6 | C | C | C | C |
| 2007 | C | C | 301.8 | C | 2645.0 | 3582.0 | 2290.0 | 80.1 | 6.3 | C | C | C | C |
| 2008 | C | C | 304.0 | C | 2645.0 | 3508.0 | 2710.0 | 73.6 | 7.2 | C | C | C | C |
| 2009 | C | C | 265.7 | C | 2645.0 | 2609.0 | 3164.0 | 51.4 | 6.6 | C | C | C | C |
| 2010 | C | C | 232.9 | C | 2645.0 | 2795.0 | 3493.0 | 54.1 | 7.2 | C | C | C | C |
| 2011 | C | C | 216.2 | C | 2645.0 | 3188.0 | 3656.0 | 58.3 | 7.8 | C | C | C | C |

Table 108 $CH_4$ 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. Expolarati on | ii. Productio n | iv. Refining / Storage | ii. Productio n / Processin g | iii. Transmiss ion | iv. Distributio n | 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 | 3.0850 | 0.0335 | 48.9703 | 0.0619 | 0.8112 | 0.0019 | 0.0020 | 0.0000 |
| 1989 | 0.0181 | 0.0090 | 0.4920 | 0.0708 | 3.3750 | 0.0335 | 50.6504 | 0.0637 | 0.8112 | 0.0015 | 0.0020 | 0.0000 |
| 1990 | 0.0136 | 0.0068 | 0.3105 | 0.1142 | 3.6725 | 0.0335 | 33.6568 | 0.1186 | 0.6084 | 0.0025 | 0.0015 | 0.0000 |
| 1991 | 0.0131 | 0.0065 | 0.1686 | 0.0856 | 4.0475 | 0.0335 | 26.1237 | 0.0324 | 0.5881 | 0.0018 | 0.0014 | 0.0000 |
| 1992 | 0.0120 | 0.0060 | 0.0943 | 0.3189 | 4.1100 | 0.0335 | 23.5238 | 0.0449 | 0.5374 | 0.0067 | 0.0013 | 0.0001 |
| 1993 | 0.0097 | 0.0048 | 0.2132 | 0.5759 | 4.4225 | 0.0335 | 23.1060 | 0.0434 | 0.4360 | 0.0124 | 0.0011 | 0.0001 |
| 1994 | 0.0081 | 0.0041 | 0.2605 | 0.4797 | 4.7975 | 0.0335 | 22.8011 | 0.0477 | 0.3650 | 0.0102 | 0.0009 | 0.0001 |
| 1995 | 0.0097 | 0.0048 | 0.2992 | 0.4179 | 5.1100 | 0.0335 | 24.6497 | 0.1304 | 0.4360 | 0.0091 | 0.0011 | 0.0001 |
| 1996 | 0.0072 | 0.0036 | 0.2603 | 0.3482 | 5.5125 | 0.0335 | 25.7869 | 0.2285 | 0.3245 | 0.0076 | 0.0008 | 0.0001 |
| 1997 | 0.0063 | 0.0032 | 0.2233 | 0.2967 | 5.9250 | 0.0402 | 30.4552 | 0.1338 | 0.2839 | 0.0064 | 0.0007 | 0.0001 |
| 1998 | 0.0075 | 0.0037 | 0.2079 | 0.2470 | 6.0250 | 0.0670 | 27.0584 | 0.1398 | 0.3346 | 0.0053 | 0.0008 | 0.0001 |
| 1999 | 0.0090 | 0.0045 | 0.2115 | 0.2247 | 6.3500 | 0.1340 | 21.4209 | 0.1417 | 0.4056 | 0.0049 | 0.0010 | 0.0001 |
| 2000 | 0.0095 | 0.0047 | 0.1989 | 0.1301 | 6.6125 | 0.2010 | 21.2526 | 0.1645 | 0.4259 | 0.0027 | 0.0010 | 0.0000 |
| 2001 | 0.0077 | 0.0038 | 0.2003 | 0.1936 | 6.3500 | 0.3350 | 17.9883 | 0.2122 | 0.3448 | 0.0042 | 0.0008 | 0.0000 |
| 2002 | 0.0084 | 0.0042 | 0.1954 | 0.1707 | 6.6125 | 0.4690 | 18.3092 | 0.2349 | 0.3752 | 0.0036 | 0.0009 | 0.0000 |
| 2003 | 0.0068 | 0.0034 | 0.1886 | 0.1355 | 6.6125 | 0.6104 | 18.1896 | 0.3098 | 0.3042 | 0.0029 | 0.0007 | 0.0000 |
| 2004 | 0.0068 | 0.0034 | 0.1978 | 2.8221 | 6.6125 | 0.8496 | 17.1032 | 0.3800 | 0.3042 | 0.0601 | 0.0007 | 0.0007 |
| 2005 | 0.0068 | 0.0034 | 0.2315 | 4.0597 | 6.6125 | 1.0566 | 19.6933 | 0.5464 | 0.3042 | 0.0957 | 0.0007 | 0.0011 |
| 2006 | 0.0063 | 0.0032 | 0.2662 | 3.9478 | 6.6125 | 1.2529 | 21.1802 | 0.7851 | 0.2839 | 0.0928 | 0.0007 | 0.0010 |
| 2007 | 0.0059 | 0.0029 | 0.2656 | 2.4893 | 6.6125 | 1.5343 | 22.3821 | 0.8786 | 0.2636 | 0.0528 | 0.0006 | 0.0006 |
| 2008 | 0.0054 | 0.0027 | 0.2675 | 1.6510 | 6.6125 | 1.8157 | 20.5838 | 1.0050 | 0.2434 | 0.0389 | 0.0006 | 0.0004 |
| 2009 | 0.0057 | 0.0028 | 0.2338 | 0.1382 | 6.6125 | 2.1199 | 14.3537 | 0.9267 | 0.2535 | 0.0031 | 0.0006 | 0.0000 |
| 2010 | 0.0052 | 0.0026 | 0.2049 | 0.6240 | 6.6125 | 2.3403 | 15.1165 | 0.9992 | 0.2332 | 0.0133 | 0.0006 | 0.0001 |
| 2011 | 0.0050 | 0.0025 | 0.1903 | 3.7033 | 6.6125 | 2.4495 | 16.3004 | 1.0933 | 0.2231 | 0.0794 | 0.0005 | 0.0009 |

### 3.4.3 METHODOLOGICAL ISSUES

Fugitive emissions from coal mining were estimated by IPCC Tier 1 method.

Relevant values between emission factors from IPCC Guidelines are chosen considering that the underground mines have average depth not more than 400 m, and the surface mines for lignite coals have depth more than 25 m.

Emissions = Coal Production (Surface or Underground) • Emission Factor

EQUATION 2.12 (IPCC GPG 2000, Chapter Energy, p.2.74)

Calculation of $CO_2$, $CH_4$ and $N_2O$ fugitive emissions from gas and oil systems was estimated by methods and emission factors in IPCC – Tier 1.

Emissions = gas/oil network • Emission Factor

| 1. B. 2. a. Oil | | | |
|---|---|---|---|
| i. Exploration | | | iv. Refining / Storage |
| AD | National Energy Balance | AD | National Energy Balance |
| EF | 2006 IPCC Guidelines | EF | Revised 1996 IPCC Guidelines |
| Em = EF x AD | | | Em = EF x AD |
| ii. 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 IPCC Guidelines | AD | National Energy Balance |
| Em = EF x AD | | EF | Revised 1996 IPCC 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 IPCC 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 IPCC Guidelines |
| Em = EF x AD | | | Em = EF x AD |
| ii. Gas | | | ii. Gas |

| | | | |
|---|---|---|---|
| AD | National Energy Balance | AD | National Energy Balance |
| EF | Revised 1996 IPCC Guidelines | EF | 2006 IPCC Guidelines |
| Em = EF x AD | | | Em = EF x AD |

| 1.B.1.a Coal Mining and Handling | |
|---|---|
| i. Underground Mines | |
| AD | National Energy Balance |
| EF | 2006 IPCC Guidelines |
| Em = EF x Conv. Factor x AD | |
| ii. Surface Mines | |
| AD | National Energy Balance |
| EF | 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.

### 3.4.4 UNCERTAINTIES

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

200 % for coal mining;

50 % for oil and natural gas systems.

### 3.4.5 SOURCE-SPECIFIC QA/QC AND VERIFICATION

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

### 3.4.6 SOURCE-SPECIFIC RECALCULATIONS, INCLUDING CHANGES MADE IN RESPONSE TO THE REVIEW PROCESS

For category 1.B.1.a.2.1 Fugitive emissions from surface mines, the previous emission factor of 1.2 $m^3/t$ was changed to 1.5 $m^3/t$ (IPCC GPG 2000, p.2.75), following a recommendation of the ERT during the Centralised review in 2012.

For category 1.B.2.b.3 Fugitive emissions from gas transmission, the previous emission factor of 1340 kg$CH_4$/km was changed to 2500 kg$CH_4$/km (IPCC GPG 2000, Table 2.16, p.2.86), following a recommendation of the ERT during the Centralised review in 2012.

### 3.4.7 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

No specific improvements are planned.

# 4 INDUSTRIAL PROCESSES (CRF SECTOR 2)

## 4.1 OVERVIEW OF SECTOR

This chapter includes information on and descriptions of methodologies used for estimating greenhouse gas emissions as well as references for activity data and emission factors reported under IPCC Category 2 Industrial Processes for the period from 1988 to 2011.

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 2011 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 2011 the most important emitting category is Mineral products (mainly clinker production) which share in the total Industrial processes emissions is 68,4%. The second category by share is Chemical Industry (ammonia and nitric acid production) with 19,56%, followed by Consumption of Halocarbons and $SF_6$ with 10,32% share and finally Metal Production (steel) with 1,72%.

These results are presented in the following table:

Table 109 GHG Emission trends in CRF 2 Industrial processes, 1988 - 2011

| IPCC category | Emissions [Gg $CO_2$ eq] | | Share [%] | | Trend |
|---|---|---|---|---|---|
| | Base year* | 2011 | Base year* | 2011 | 1988 – 2011 [%] |
| 2 Industrial processes | 11959,94 | 3977,93 | 100,00 | 100,00 | -66,74 |
| 2.A Mineral products | 4373,68 | 2720,81 | 36,57 | 68,40 | -37,79 |
| 2.B Chemical Industry | 3801,62 | 778,04 | 31,79 | 19,56 | -79,53 |
| 2.C Metal Production | 3773,56 | 68,42 | 31,55 | 1,72 | -98,19 |
| 2.F Consumption of Halocarbons and $SF_6$ | 3,46 | 410,66 | 0,03 | 10,32 | 11771,59 |

* Base year 1988

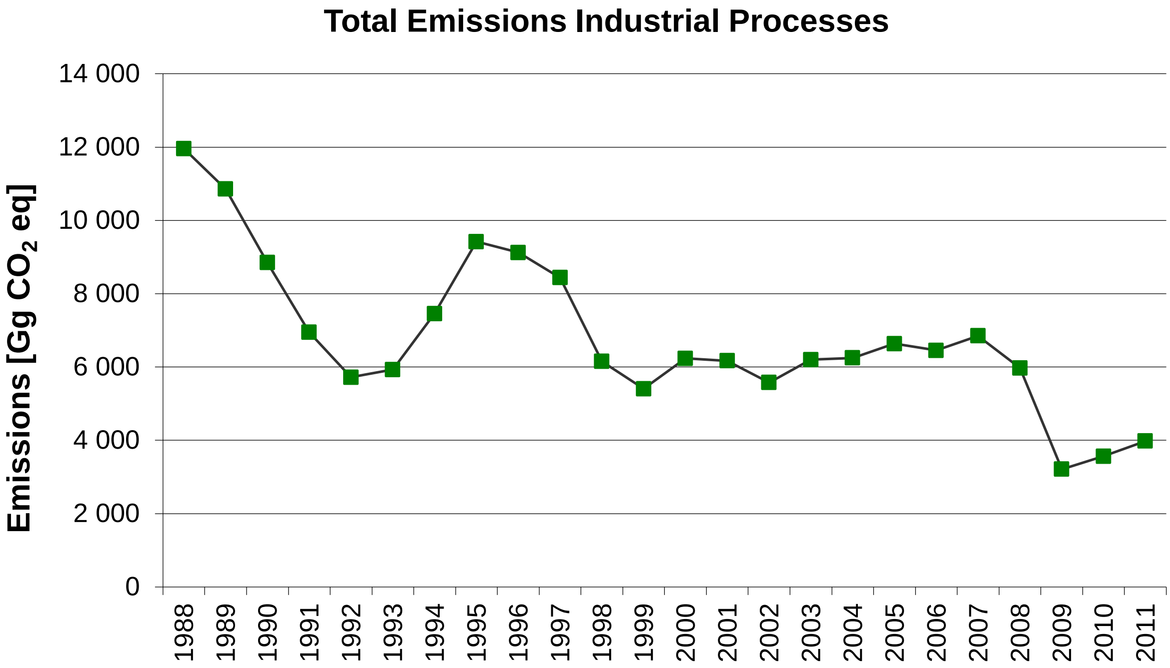



Figure 50 $CO_2$ Emission trends for CRF Sector 2 Industrial Processes for 1988-2011

In the year 2011, 6,02% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes, compared to 9,81% in the base year 1988. In 2011, greenhouse gas emissions from Category 2 Industrial Processes are 3 977.93 Gg $CO_2$ equivalent compared to 11 959.94 Gg in the base year.

Greenhouse gas emissions from the Industrial Processes sector fluctuate during the period and reach a minimum in 2009. The reduction for the whole sector is 66.74% in 2011 while the biggest reduction (compared to the base year) is in Metal Production category – 98.19%.

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 – 2011 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 2011.

Table 110 GHG emissions from CRF 2 Industrial Processes by gas in 1988 and 2011

| GHG | Base year* | 2011 | Base year* | 2011 |
|---|---|---|---|---|
| | $CO_2$ equivalent [Gg $CO_2$ eq] | | [%] | |
| Total | 11959,94 | 3977,93 | 100,00 | 100,00 |
| $CO_2$ | 9856,62 | 3332,83 | 82,41 | 83,78 |
| $CH_4$ | 90,04 | 0,00 | 0,75 | 0,00 |
| $N_2O$ | 2009,83 | 234,44 | 16,80 | 5,89 |
| HFCs | 0,00 | 395,74 | 0,00 | 9,95 |
| PFCs | 0,00 | 0,05 | 0,00 | 0,001 |
| $SF_6$ | 3,46 | 14,87 | 0,03 | 0,37 |

*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 83.78% of the total emissions from this category in 2011, followed by HFCs with 9.95%, $N_2O$ with 5.89 %, $SF_6$ with 0, 0.37%, PFCs with <0,001% and finally $CH_4$ with 0.00%

Table 111 GHG Emissions from CRF 2 Industrial Processes by gases 1988 - 2011

| GHG emissions [Gg $CO_2$ eq] | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year** | **Total** | **$CO_2$** | **$CH_4$** | **$N_2O$** | **HFCs** | **PFCs** | **$SF_6$** |
| **1988** | 11 178,91 | 9 075,59 | 90,04 | 2 009,83 | 0,00 | 0,00 | 3,46 |
| **1989** | 10 811,96 | 8 931,29 | 89,60 | 1 787,41 | 0,00 | 0,00 | 3,66 |
| **1990** | 9 536,73 | 7 748,63 | 70,47 | 1 713,76 | 0,00 | 0,00 | 3,87 |
| **1991** | 7 045,71 | 5 811,29 | 51,64 | 1 177,96 | 0,72 | 0,00 | 4,10 |
| **1992** | 5 714,56 | 4 668,51 | 48,92 | 992,79 | 0,00 | 0,00 | 4,33 |
| **1993** | 5 750,87 | 4 814,73 | 56,80 | 874,75 | 0,01 | 0,00 | 4,59 |
| **1994** | 7 239,57 | 6 218,18 | 73,86 | 942,67 | 0,02 | 0,00 | 4,85 |
| **1995** | 8 963,16 | 7 467,57 | 81,21 | 1 406,85 | 2,39 | 0,00 | 5,13 |
| **1996** | 8 843,87 | 7 311,90 | 76,08 | 1 446,26 | 4,20 | 0,00 | 5,43 |
| **1997** | 7 942,45 | 6 768,68 | 81,26 | 1 080,40 | 6,38 | 0,00 | 5,75 |
| **1998** | 5 830,73 | 5 101,09 | 65,43 | 647,99 | 10,14 | 0,00 | 6,08 |
| **1999** | 5 076,73 | 4 462,86 | 55,87 | 537,23 | 14,34 | 0,00 | 6,43 |
| **2000** | 5 978,53 | 5 082,57 | 56,81 | 814,39 | 17,95 | 0,00 | 6,80 |
| **2001** | 5 818,24 | 4 910,78 | 55,27 | 816,37 | 28,62 | 0,00 | 7,20 |
| **2002** | 5 345,47 | 4 578,15 | 48,36 | 670,14 | 41,20 | 0,00 | 7,62 |
| **2003** | 5 907,29 | 5 080,72 | 59,26 | 700,52 | 58,73 | 0,00 | 8,06 |
| **2004** | 6 130,36 | 5 151,06 | 49,63 | 842,78 | 78,35 | 0,00 | 8,53 |
| **2005** | 6 356,00 | 5 274,74 | 46,98 | 913,86 | 111,86 | 0,00 | 8,56 |
| **2006** | 5 942,01 | 5 233,84 | 45,01 | 489,98 | 164,29 | 0,00 | 8,89 |
| **2007** | 6 453,93 | 5 594,40 | 40,47 | 605,61 | 204,20 | 0,00 | 9,24 |
| **2008** | 5 652,14 | 4 725,29 | 21,54 | 580,65 | 315,05 | 0,00 | 9,60 |
| **2009** | 3 209,05 | 2 584,78 | 1,35 | 272,58 | 340,36 | 0,01 | 9,97 |
| **2010** | 3 561,84 | 2 920,35 | 0,00 | 267,51 | 360,88 | 0,04 | 13,07 |
| **2011** | 3 977,93 | 3 332,83 | 0,00 | 234,44 | 395,74 | 0,05 | 14,87 |

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

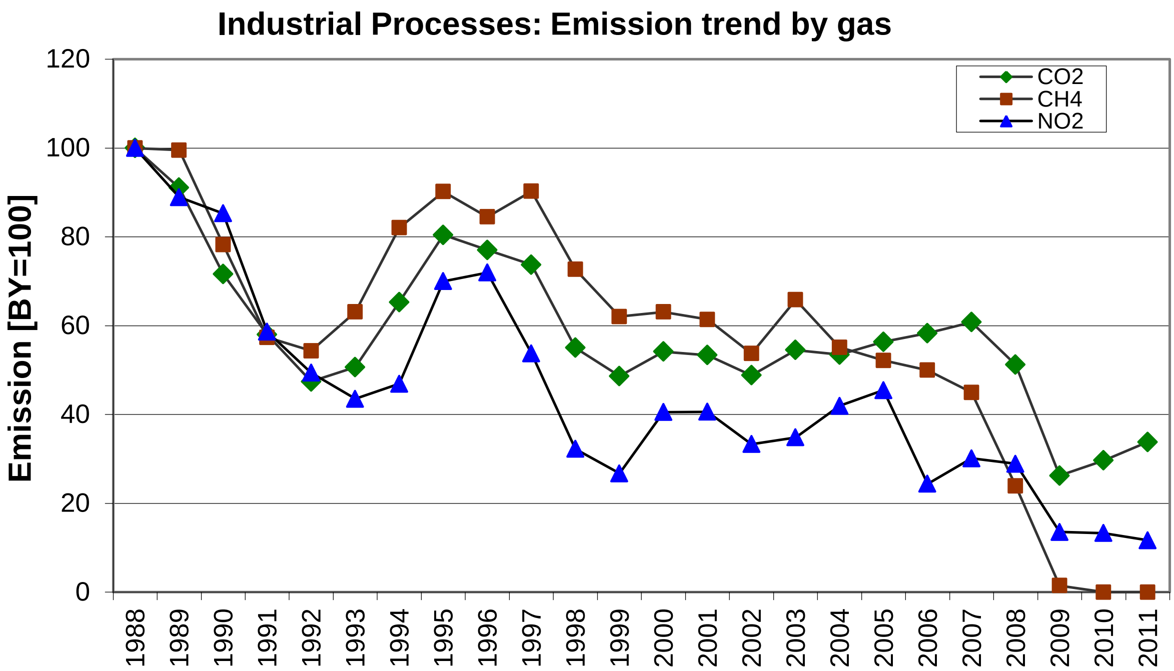



Figure 51 Industrial Processes: Emission trend by gas – $CO_2$, $N_2O$, $CH_4$

**Emission trends by sources**

The main sources of greenhouse gas emissions in the industrial processes sector are Mineral Products and Chemical Industry, which cause about 68.4% and 19.56%, respectively, of the emissions from this sector in 2011.

Table 112 GHG Emissions from CRF 2 Industrial Processes by sector 1988 to 2011

| GHG emissions [Gg $CO_2$ eq] | | | | |
|---|---|---|---|---|
| **Year** | **Mineral Products** | **Chemical Industry** | **Metal Production** | **Consumption of Halocarbons and $SF_6$** |
| **1988** | 4373,68 | 3801,62 | 3773,56 | 3,46 |
| **1989** | 4256,89 | 3596,73 | 2989,78 | 3,66 |
| **1990** | 3906,81 | 3490,00 | 1440,62 | 3,87 |
| **1991** | 2586,34 | 2794,87 | 1558,59 | 4,10 |
| **1992** | 2008,83 | 2246,83 | 1457,05 | 4,33 |
| **1993** | 1962,88 | 2007,55 | 1951,22 | 4,59 |
| **1994** | 2408,68 | 2252,36 | 2787,10 | 4,85 |
| **1995** | 3239,55 | 2962,79 | 3207,60 | 5,13 |
| **1996** | 3238,07 | 2990,23 | 2881,76 | 5,43 |
| **1997** | 2621,89 | 2403,45 | 3398,84 | 5,75 |
| **1998** | 1991,95 | 1378,32 | 2760,84 | 6,08 |
| **1999** | 1816,01 | 1039,19 | 2529,52 | 6,43 |
| **2000** | 2120,11 | 1650,29 | 2439,43 | 6,80 |
| **2001** | 2256,93 | 1549,89 | 2325,25 | 7,20 |
| **2002** | 2272,35 | 1140,20 | 2116,91 | 7,62 |
| **2003** | 2343,27 | 1153,00 | 2636,36 | 8,06 |
| **2004** | 2594,58 | 1442,27 | 2124,38 | 8,53 |
| **2005** | 2808,80 | 1564,67 | 2142,95 | 8,56 |
| **2006** | 2939,66 | 994,10 | 2348,10 | 8,89 |
| **2007** | 3460,41 | 1140,84 | 2035,19 | 9,24 |
| **2008** | 3474,00 | 1136,69 | 1037,12 | 9,60 |
| **2009** | 2205,85 | 573,41 | 80,46 | 9,97 |
| **2010** | 2468,47 | 665,59 | 55,03 | 13,07 |
| **2011** | 2720,81 | 778,04 | 68,42 | 14,87 |

Figure 52 presents greenhouse gas emissions from IPCC Category 2 Industrial Processes by sub category for the years 1988 to 2011.

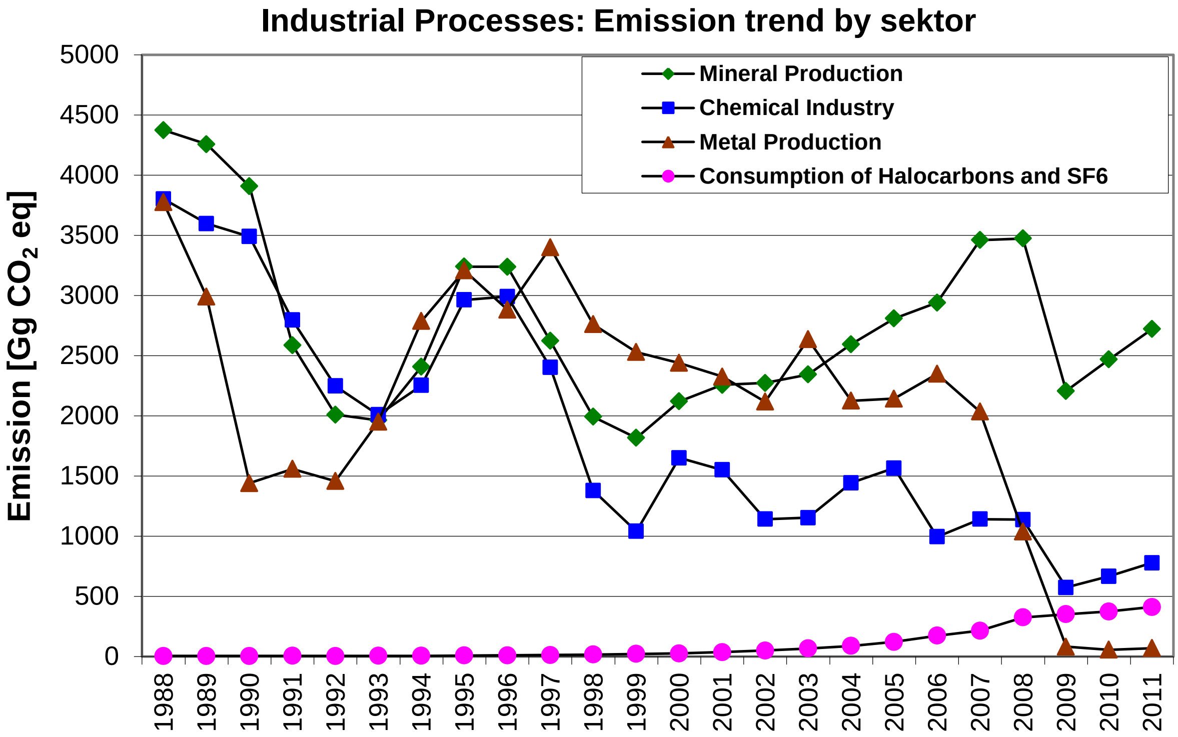



Figure 52 CRF 2 Industrial Processes: Emission trend by sector – [Gg $CO_2$ eq]

There is general reduction of the total emission in the Industrial Processes sector in 2011 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 2011 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 66.74% in 2011 while the biggest reduction (compared to the base year) is in Metal Production category – 98.19%, followed by Chemical Industry with 79.53% and Mineral Products with 37.79%.

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 2011 is about 35%.

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 2011 the market was recovered.

In 2011 a slight increase in emissions is observed for the entire IP sector. This is mainly due to the increae in minerals products category. There is a slight increase in the Chemical products category, which indicates that the chemical plants start to recover from the effects of the world economic crisis in 2008. In 2011 the increase of the sector production varies from 10% to 20% for the different categories compared to 2010. There is some increase observed in one sectors while there is a decrease in others.

**Methodology**

The general method for estimating emissions for the industrial processes sector, as recommended by the IPCC, involves multiplying production data for each process by an emission factor per unit of production. For some sub-sectors (for example ammonia production, nitric acid production, etc.) higher tier, i.e. tier 2 or tier 3, are used.

In some categories emission and production data were reported directly by industry or ETS, IPPC and/or E-PRTR reports thus represent plant and country specific data. Methodologies are described for all IPCC categories.

Detailed information on the methodology can be found in the corresponding subchapters.

**Emission data reported under the European Emission Trading Scheme - EU ETS**

Verified $CO_2$ emissions reported under the EU ETS were available for the years 2007-2011. These emissions have been incorporated in the inventory as far as possible (see respective subchapters for more information). Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

**Uncertainty Assessment**

For the sector Industrial processes uncertainties are estimated taking into account the recommendations of 1996 IPCC guidelines and Good Practice Guidance as well as some specific recommendations from 2006 IPCC Guidelines.

For all the sub-sectors uncertainties for the emission factors and activity data as well as combined uncertainty are estimated. When doing so the methods for obtaining the activity data and estimating the emission factors (plant specific, country specific, national statistics) were considered.

**Quality Assurance and Quality Control (QA/ QC)**

Emission estimations as well as activity data and emission factors are compared with EU ETS verified emission reports, IPPC reports as well as E-PRTR reports where available.

The availability of quality management systems, such as ISO 9001, ISO 14001 and EMAS, are available for is also taken into account that.

Monitoring data are used in some emissions estimation.

**Planned Improvements**

All planned improvements (described in the following sub-chapters) have been implemented in this sector.

## 4.2 MINERAL PRODUCTS (CRF 2.A)

## 4.2.1 CEMENT PRODUCTION (CRF 2.A.1)

### 4.2.1.1 Source category description

Since 1997 until present there are only 5 existing/operational cement plants in Bulgaria (respectively, 2 within HOLCIM Group, 2 within ITALCEMENTI Group and 1 within TITAN CEMENT Group. All 5 plants are covered by the EU ETS and the IPPC Directive and have been modernized accordingly during the last 10 years. In addition all plant sites are certified at present according to ISO 9001 and 14 001 standards. One more (6th) installation was operational from 1988 till 1996 and decommissioned finally during that last year. One from the 5th existing/operational installation was the decrease substantially its production during 2010. In 2011 this factory completely ceases operation and all equipment is decommissioned. At present there are only 4 operating plants.

During 2011 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 2011 compared to 2010. This is mainly due to that one from the 5th existing/operational installation was the decrease substantially its production with 96% during 2010. In 2011 this factory completely ceases operation and all equipment is decommissioned.

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

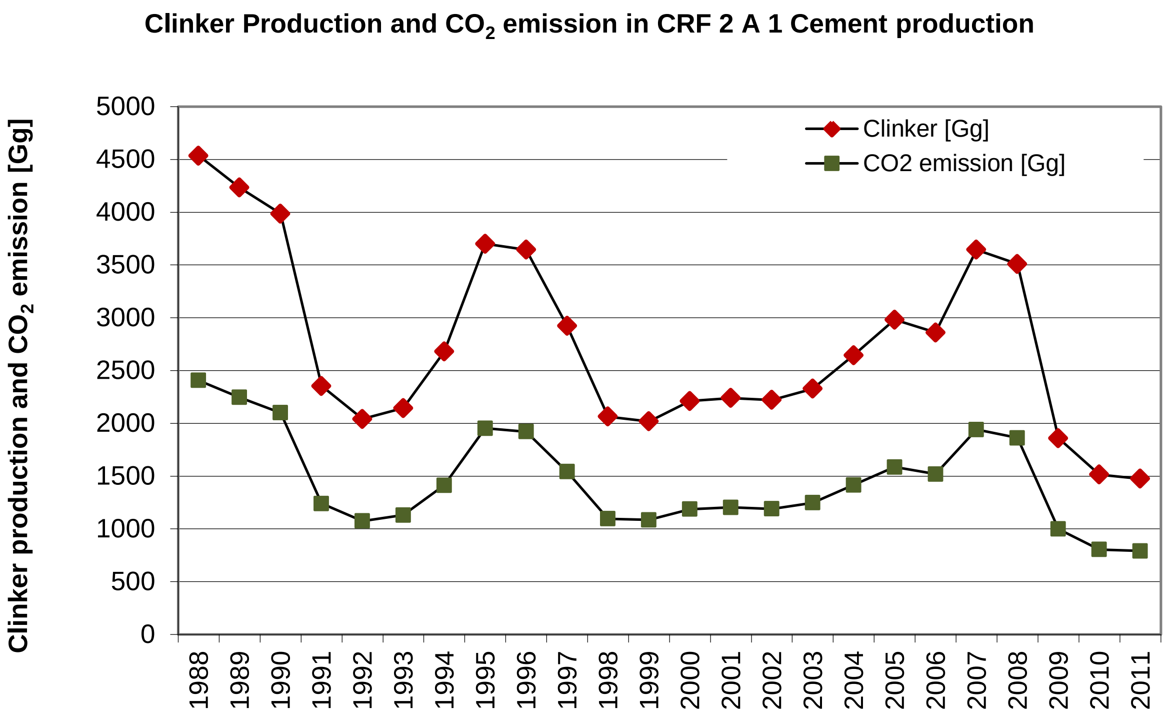



Figure 53 Clinker Production and $CO_2$ emission in CRF 2 A 1 Cement production

#### 4.2.1.3 Methodological issues

The GHG emissions from the sector are calculated by using a clinker production data and a country specific method, similar to a Tier 2 Method according to item 3.1.1 from the IPCC GPG 2000. The aggregated national clinker production (CP) data in t/y are provided by the NSI.

The emission calculations and the applied emission factor are respectively according to equations 3.1 and 3.3 on pages 3.10 and 3.12 from item 3.1.1 (IPCC GPG 2000):

$$\textbf{Emissions} = \textbf{EF}_{\textbf{clinker}} \bullet \textbf{CP} \bullet \textbf{CKD Correction Factor}$$

$$\textbf{EF}_{\textbf{clinker}} = \sum \textbf{M} \bullet \textbf{C}_{\textbf{(MeO)}}$$

$$\textbf{C}_{\textbf{(MeO)}} = ((\sum \textbf{Cn}_{\textbf{(MeO)}}) \bullet \textbf{CPn}) / \textbf{CP})/100$$

Where:

CKD Correction Factor = 1.00

M - Molecular Weight $CO_2$/ Molecular Weight Me-oxide

$C_{(MeO)}$ – Content (Weight Fraction) in Clinker [%]

CP – clinker production [Gg]

Me – Ca, Mg, other

n – Cement plants (1-5)

The above assumption for the CKD Correction Factor is based on the modern status of all 5 operational cement plants and the total (100%) recycling of their CKD as a raw material. Respectively, the approach is according to paragraph 1 on p.3.12 from item 3.1.1 (IPCC GPG 2000 - van Oss, 1988).

In addition, the above calculations are based on the conservative assumption that all of the lime (MeO) comes from a carbonate sources (e.g. limestone/MeCO3) in the lack of reliable data on the use of non-carbonate sources, i.e. assuming 100% calcinations of the carbonate sources present in the raw materials mixture.

Taking into account the above, the final equation is as follows:

**Emissions = 0,536 • CP • 1.0 = 0,536 • CP** **(for 2011)**

The 2011 $CO_2$ 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 2011. They are presented in the table below together with the relevant coefficients and the calculated $CO_2$ emissions:

Table 113 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 |

| 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] | | | | | | |
| **2010** | 1514,55 | 0,785 | 0,660 | 1,092 | 0,012 | 0,532 | 805,21 |
| **2011** | 1475,70 | 0,785 | 0,659 | 1,092 | 0,012 | 0,536 | 790,75 |
| Plant specific data | | Statistical data | | | | | |

#### 4.2.1.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

AD = 2 %

CKD = 10 %

CaO Weight Fraction = 1-2%

MgO Weight Fraction = 1-2%

Quantitative uncertainty estimates are provided in Annex 7.

#### 4.2.1.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

As a part from the QA activities the aggregated national clinker production data provided by the NSI were compared with the production data reported by the cement plants in the annual reports for compliance with their IPPC permits (EPRTR data), as well as in their verified emission reports within the EU ETS.

The last were also used to check the overall $CO_2$ emissions from the category.

The verified (process) $CO_2$ emissions from all 5 cement plants for 2008 were 1862.44 kt or with 11.39 kt (0.61%) higher compared to the 1 873.83 kt calculated following the applied national inventory approach and reported within NIR 2010.

The verified (process) $CO_2$ emissions from all 5 cement plants for 2009 were 999.70 kt or with 16.73 kt (1.7%) higher compared to the 982.96 kt calculated following the applied national inventory approach and reported within NIR 2011.

The verified (process) $CO_2$ emissions from all 5 cement plants for 2010 were 805.21 kt or with 0.8 kt (0.1%) higher compared to the 804.41 kt calculated following the applied national inventory approach and reported within NIR 2012.

The verified (process) $CO_2$ emissions from all 4 cement plants for 2011 were 790,75 kt or with 7,14 kt (0.91%) higher compared to the 783,61 kt calculated following the applied national inventory approach and reported within NIR 2013.

All 15 verification reports (for 2008, 2009, 2010 and 2011) 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.

#### 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):

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

Currently there are 4 lime producing plants in Bulgaria which fall under IPPC and EU ETS. They produce high calcium quicklime. After the largest metallurgic plants ceases operation in 2008 there is virtually no production of dolomitic lime. In 2012 letters were sent to all quicklime producing plants (including the ones producing quicklimes for their own needs) and all of them declared that they do not procude 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 2011 compared to 2010. This is mainly due to that the biggest producer increases the lime production with 15% in 2010. This lead to increase of the quicklime production which for the whole sector is about 15%.

The reduction in 2009 are ceased operation (in November 2008) of one of the lime producers (integrated steel making plant), reduction in the construction works and other quicklime consuming production processes and world economical crises.

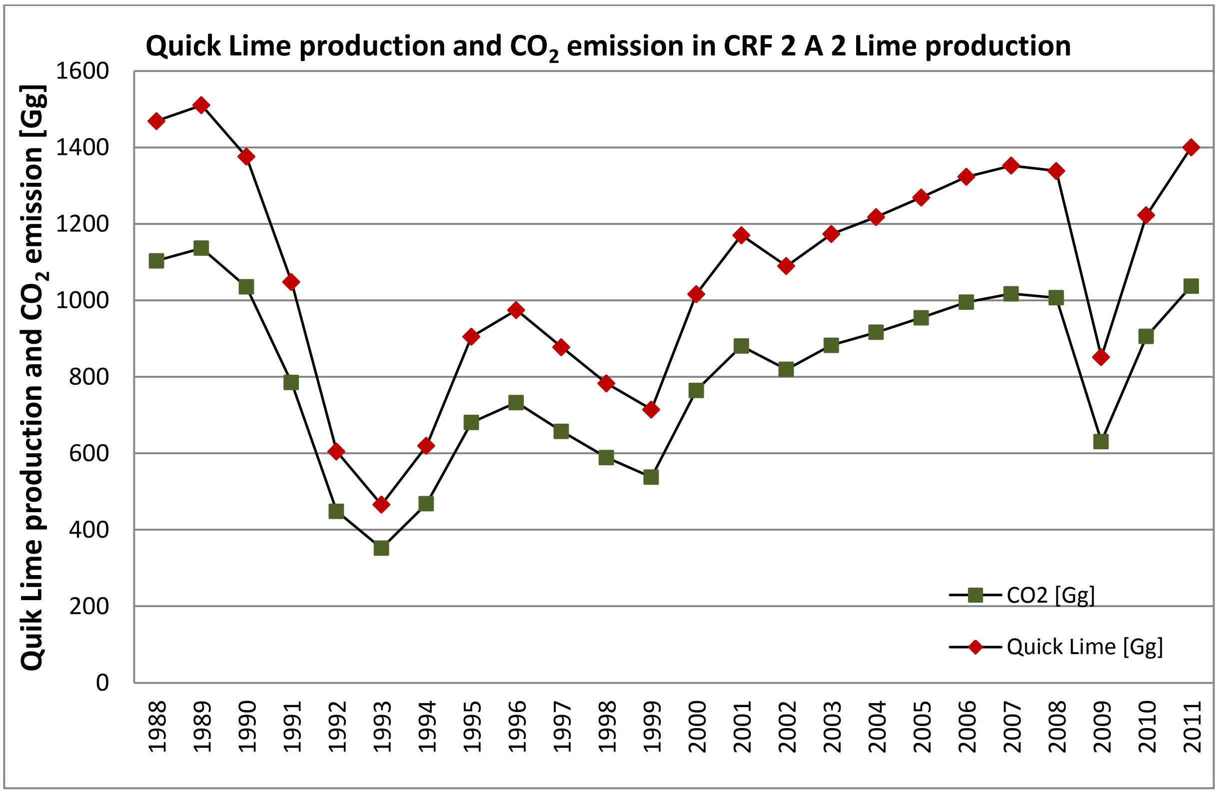



Figure 54 Lime Production and $CO_2$ emission in CRF 2.A.2 Lime production

#### 4.2.2.3 Methodological issues

##### 4.2.2.3.1 Method

The emissions from the sector are calculated using country specific data on the total amount of lime produced provided by NSI. Default emission factor is applied.

The emissions are estimated following the general approach recommended in 1996 IPCC Guidelines and using the following equation from IPCC GPG 2000 (p.3.19):

**EQUATION 3.4**

**$CO_2$ Emissions = Emission Factor (EF) • Lime Production**

The following is taken into account:

1996 IPCC Guidelines (Table 2-1p. 2.5) recommend a default emission factor of 0.79 tonnes $CO_2$/tonne quicklime produced and 0.91 tonnes $CO_2$/tonne dolomitic lime produced.

According to IPCC GPG 2000 The default emission factors in the IPCC Guidelines mentioned under Equation 3.4 correspond to 100% of CaO (or CaO·MgO) in lime (stoichiometric ratio) and can lead to an overestimation of emissions since the CaO and (if present) MgO content may be less than 100%. It is good practice to apply Equation

3.5A or Equation 3.5B, or both, to adjust the emission factors and to account for the CaO or the CaO·MgO content (see Table 3.4, Basic Parameters for Calculation of Emission Factors):

**EQUATION 3.5A**

$$EF_1 = \text{Stoichiometric ratio } (CO_2 / CaO) \bullet \text{CaO content}$$

Where: $EF_1$ = emission factor for quicklime

**EQUATION 3.5B**

$$EF_2 = \text{Stoichiometric ratio } (CO_2 / CaO \cdot MgO) \bullet (CaO \cdot MgO) \text{ content}$$

Where: $EF_2$ = emission factor for dolomitic quicklime

The above equations are used to estimate the emission factor, taking into account CaO Gnd MgO content in the lime produced. The metal oxides content is taken as default from Table 3.4, p. 3.21, GPG, as lower values due to it being closer to the available data.

Thus an approach in line with Tier 2 method (2006 IPCC Guidelines, p.2.19) is used to estimate $CO_2$ emissions from lime production.

#### 4.2.2.3.2 Emission factor

According to 2000 GPG it is good practice to apply Equation 3.5A or Equation 3.5B, or both, to adjust the emission factors and to account for the CaO or the CaO·MgO content (see Table 3.4, Basic Parameters for Calculation of Emission Factors):

**EQUATION 3.5A**

$$EF1 = \text{Stoichiometric ratio } (CO_2 / CaO) \bullet \text{CaO content}$$

Where: EF1 = emission factor for quicklime

**EQUATION 3.5B**

$$EF2 = \text{Stoichiometric ratio } (CO_2 / CaO \cdot MgO) \bullet (CaO \cdot MgO) \text{ content}$$

Where: EF2 = emission factor for dolomitic quicklime

The above equations are used to estimate the emission factor.

#### 4.2.2.3.3 Activity data

Country specific data on the total lime production (quicklime) are provided by NSI.

The following is taken into consideration: It is good practice to assess the available national statistics for completeness, and for the ratio of limestone to dolomite used in lime production (2006 IPCC Guidelines).

Thus statistical data on total amount of lime produced are used to estimate the emissions of $CO_2$ from lime production.

**Issues of double counting:**

$CO_2$ emissions from Lime production are reported in this chapter and are not included in Limestone and dolomite use chapter.

Table 114 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 | 0,741 | 630,85 |
| **2010** | 1222,43 | 0,741 | 905,55 |
| **2011** | 1400,20 | 0,741 | 1037,24 |

### 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

In general the TACCC is improved.

$CO_2$ emissions for 2009 and 2010 are recalculated to be only from quicklime production as all 14 lime production plans declare that they do not produce dolomitic lime.

#### 4.2.2.6 Source specific planned improvements

No source specific improvements are planned.

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

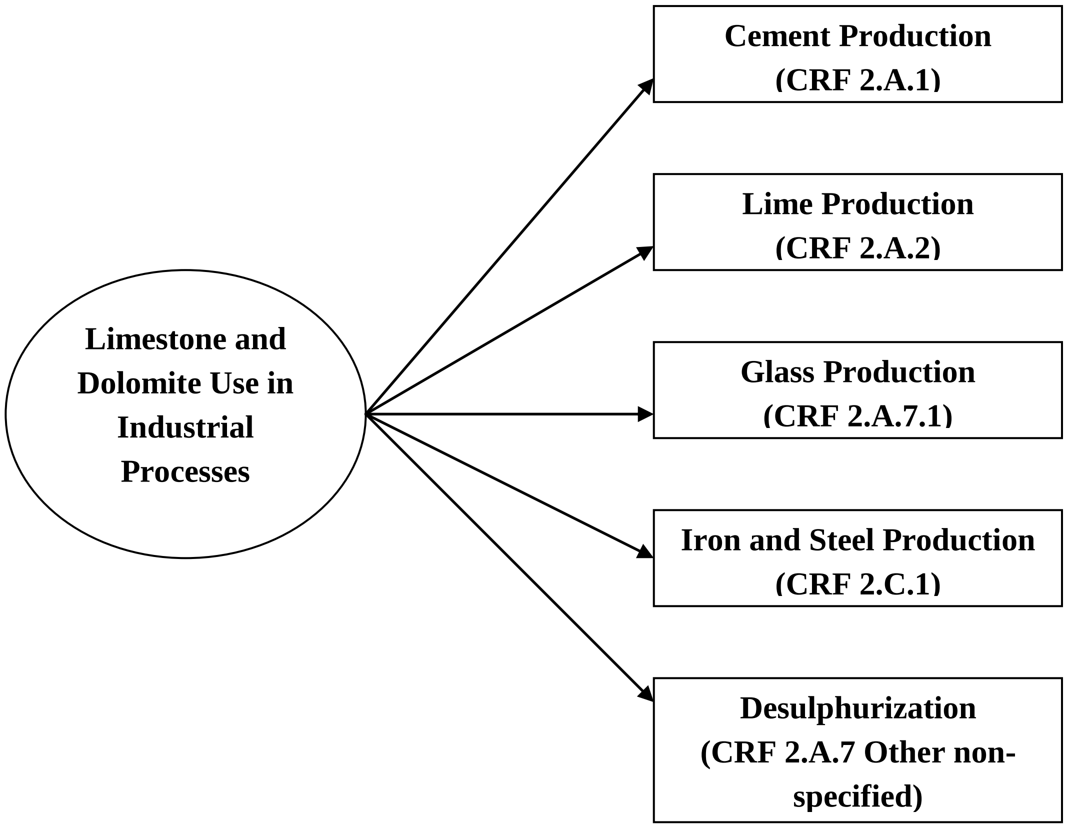
#### 4.2.3.1 Source category description

Limestone ($CaCO_3$), dolomite ($CaMg.(CO_3)_2$) and other carbonates (e.g., $MgCO_3$ and $FeCO_3$) are basic raw materials having commercial applications in a number of industries. In addition to those industries already discussed individually (cement production, lime production and glass production), carbonates also are consumed in metallurgy (e.g. iron and steel), agriculture, construction and environmental pollution control (e.g. flue gas desulphurisation.). (2006 IPCC GL, p.2.32.)

Limestone or dolomite used for producing cement, lime and magnesium, agricultural activities and processes where $CO_2$ is not generated should be excluded from this calculation (1996 IPCC GL, p. 2.6).

$CO_2$ from liming of agricultural soils should be reported in the Land-use Change and Forestry Chapter. Limestone and dolomite used in cement and lime production should be reported under that industry sector. This section covers all other uses of limestone and dolomite which produce $CO_2$ emissions (1996 IPCC GL, p. 2.6).

The above is taken into account and the emissions from the limestone and dolomite usage are reported under the specific production industries, e.i. Cement Production, Lime Production, Glass Production, Desulphurisation, etc. The following diagram shows these categories to which emissions are attributed:




Issue of double accounting

Taking the above into account the $CO_2$ emissions from Cement, Glass, Lime (quicklime) production, metallurgy and desulphurization are presented in the respective chapters.

#### 4.2.3.2 Source specific planned improvements

No source specific improvements are planned.

### 4.2.4 SODA ASH PRODUCTION AND USE (CRF 2.A.4)

#### 4.2.4.1 Source category description

**Soda ash production**

There is one soda ash producing plant in Bulgaria. It applies Solvay process which is $CO_2$-neutral except for coke used for calcination of limestone. This coke used in soda ash production was considered as fuel in the energy sector (subcategory 1.A.2.C).

### Soda ash use

In this category $CO_2$ emissions from soda ash use in non-ferrous metal processing and glass production are considered and other industries.

### Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production

There is decrease of the total emission in the sector in 2011 compared to 2010.

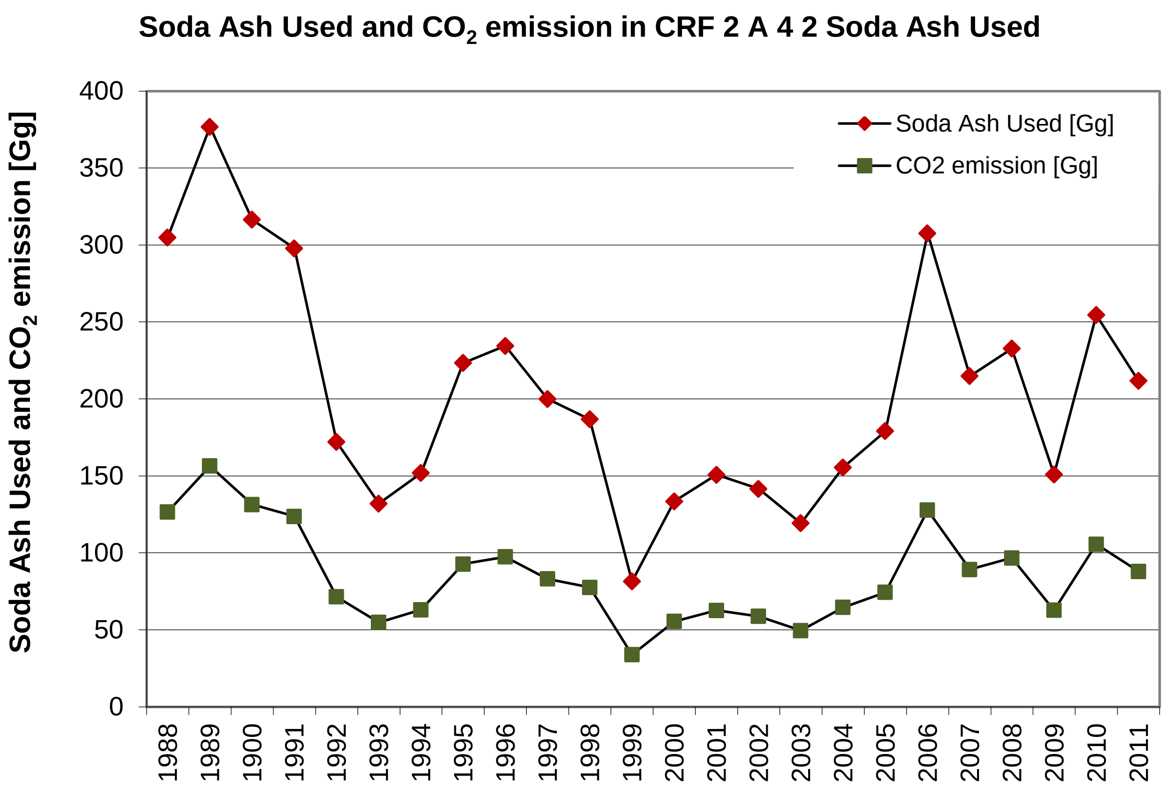



Figure 55 Soda ash used and $CO_2$ emission in CRF 2.A.4.2

### 4.2.4.2 Methodological issues

For the period 1988 - 2009 a recalculation of the emissions from soda ash use is made. The following is taken into account: Statistics on soda ash production, imports and exports are obtained from NSI. Based on that a balance is made to obtain the quantity of soda ash used. This quantity is further used as AD for the calculations of the emissions from category 2.A.4. The EF for these recalculations is estimated stoichiometrically from $Na_2CO_3$. The emissions are estimated following the recommendations of the Revised 1996 IPCC Guidelines.

In order to avoid double counting emissions from soda ash used in Glass productions are reported only here under 2.A.4 and are not considered under Glass production (2.A.7).

#### 4.2.4.2.1 Method

Emissions of $CO_2$ from Soda ash use are estimated using the methodology described in 1996 IPCC Guidelines (and in lines with recommendations of 2006 IPCC Guidelines) and a default emission factor from the same guidelines (415 kg $CO_2$/t soda). Plant specific and country specific data were used to estimate $CO_2$ emissions from Soda ash use.

In emissions estimations the general approach described in 1996 IPCC Guidelines is applied using the following equation:

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

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 2011.

**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 115 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 |

| Year | Soda ash used [kt/y] | $CO_2$ EF [t $CO_2$/kt soda] | $CO_2$ Emissions [Gg $CO_2$] |
|---|---|---|---|
| 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 |
| 2011 | 211,72 | 415 | 87,91 |

#### 4.2.4.3 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

| | |
|---|---|
| Combined uncertainty | 3.6 % |
| AD | 2 % |
| EF | +/-3 % |

*Uncertainty for AD:*

The two following aspects are relevant (2006 IPCC GL, Chapter 2.5.2)

Assuming that carbonate consumption is allocated to the appropriate consuming sectors/industries, the uncertainty associated with weighing or proportioning the carbonates for any given industry is 1-3 percent.
The uncertainty of the overall chemical analysis pertaining to carbonate content and identity also is 1-3 percent.
Taking the above into account as well as that for the part of the time series statistical (and not plant specific) data were used an uncertainty of 2 % for activity data is assumed.

***Uncertainty for EF:***

The following is taken into account:

In theory the uncertainty associated with the emission factor for this source category should be relatively low, as the emission factor is the stoichiometric ratio reflecting the amount of $CO_2$ released upon calcination of the carbonate. In practice, there are uncertainties due, in part, to variations in the chemical composition of the limestone and other carbonates. For example, in addition to calcium carbonate, limestone may contain smaller amounts of magnesia, silica and sulphur. Assuming that the activity data are collected correctly, and thus the correct emission factor is applied, there is negligible uncertainty associated with the emission factor. There may be some uncertainty associated with assuming a fractional purity of limestone and dolomite in cases where only carbonate rock data are available (+/- 1-5 percent) (2006 IPCC GL, Chapter 2.5.2).

On the basis of the above as well as taking into account that for the part of the time series statistical (and not plant specific) data were used the emission factor uncertainty is assumed as ± 3 %.

Quantitative uncertainty estimates are provided in Annex 7.

#### 4.2.4.4 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

Revised the emission estimation method, by using soda ash mass balance
ISO 9001 and 14 001 standards.
EU ETS reports - emission from soda ash used in glass production (calculated by plants in the reports) and using the mass balance approach are compared.

#### 4.2.4.5 Source specific recalculations

There are no source specific recalculations for this category

#### 4.2.4.6 Source specific planned improvements

No source specific improvements are planned

### 4.2.5 GLASS PRODUCTION (CRF 2.A.7.1)

#### 4.2.5.1 Source category description

Currently there are six glass plants in Bulgaria mainly producing flat, container and domestic glass. All of them fall under IPPC and EU ETS.

According to the information given in the Reference Document on Best Available Techniques in the Glass Manufacturing Industry, December 2001, the general description of the main types of glass produced in the country are:

*Container glass*

The forming process is carried out in two stages, the initial forming of the blank either by pressing with a plunger, or by blowing with compressed air, and the final moulding operation by blowing to obtain the finished hollow shape. These two processes are thus respectively termed "press and blow" and "blow and blow". Container production is almost exclusively by IS (Individual Section) machines.

*Flat glass*

Flat glass is produced almost exclusively with cross-fired regenerative furnaces. The basic principle of the float process is to pour the molten glass onto a bath of molten tin, and to form a ribbon with the upper and lower surfaces becoming parallel under the influence of gravity and surface tension. From the exit of the float bath the glass ribbon is passed through the annealing lehr, gradually cooling the glass to reduce residual stresses. On-line coatings can be applied to improve the performance of the product (e.g. low emissivity glazing).

*Domestic glass*

Domestic glass is a diverse sector involving a wide range of products and processes. Ranging from intricate handmade lead crystal, to high volume, mechanised methods used for mass produced tableware.

The forming processes are automatic processing, hand made or semi-automatic processing, and following production the basic items can be subjected to cold finishing operations (e.g. lead crystal is often cut and polished).

### 4.2.5.2 Trend description

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

There is increase of the total emission in the sector in 2011 compared to 2010. This is mainly due to the slightly increase in production after the economical crisis.

One of the glass producing plants is new and has started working in the period 2005/2006. Another one had reduced capacity, operational time, during 2008 – 2009 and had stopped in 2010.

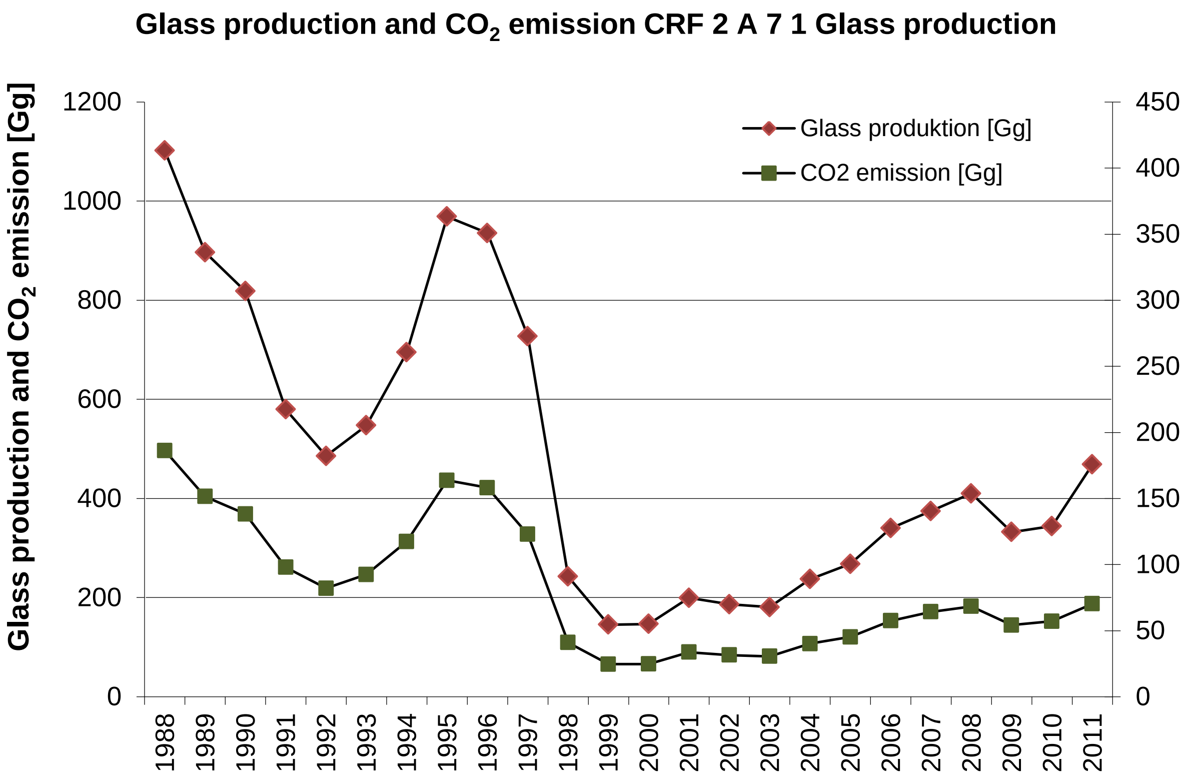



Figure 56 Glass Production and $CO_2$ emission in CRF 2.A.7.1. Glass production

### 4.2.5.3 Methodological issues

#### 4.2.5.3.1 Method

Taking into account that no specific information about $CO_2$ emissions, estimation from glass production is given in 1996 Revised IPCC GL. Since a good practice guidance has not yet been developed for glass production (IPCC GPG 2000, p. 3.8) an approach in line with the general methodology described in 1996 IPCC GL is used:

The emissions were estimated using the following equation:

**Emissions $CO_2$ = Emission factor • Glass production**

For the period 2007 - 2011 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 - 2011 plant specific (for five plants) emission factors were calculated on the basis of data from IPPC and ETS reports (see Table 116). These emission factors were used to calculate an implied emission factor which was further used to recalculate the emissions for the rest of the time series.

#### 4.2.5.3.3 Activity data

Plant specific data from IPPC and ETS reports are available for the years 2007 - 2011. For the time series 1988 – 2011 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 this category are etimated only the emissions from the use of lime in the glass production process. The quantities of soda ash and fuel used are reported under Soda ash use and Energy Chapter respectively.

Table 116 Glass production and $CO_2$ emission in CRF 2.A.3 Glass production

| Year | Glass Production (GP) [kt/y] | Emission Factor (EF $CO_2$) [kt $CO_2$/kt GP] | $CO_2$ Emissions [kt $CO_2$] |
|---|---|---|---|
| **1988** | 1102,09 | 0,169 | 186,24 |
| **1989** | 896,74 | 0,169 | 151,54 |
| **1990** | 818,04 | 0,169 | 138,24 |
| **1991** | 579,65 | 0,169 | 97,96 |
| **1992** | 485,66 | 0,169 | 82,07 |
| **1993** | 547,33 | 0,169 | 92,49 |
| **1994** | 694,82 | 0,169 | 117,42 |
| **1995** | 968,79 | 0,169 | 163,72 |
| **1996** | 935,62 | 0,169 | 158,11 |

| Year | Glass Production (GP) [kt/y] | Emission Factor (EF $CO_2$) [kt $CO_2$/kt GP] | $CO_2$ Emissions [kt $CO_2$] |
|---|---|---|---|
| **1997** | 727,54 | 0,169 | 122,95 |
| **1998** | 242,41 | 0,169 | 40,97 |
| **1999** | 145,54 | 0,169 | 24,60 |
| **2000** | 146,66 | 0,169 | 24,78 |
| **2001** | 199,59 | 0,169 | 33,73 |
| **2002** | 186,58 | 0,169 | 31,53 |
| **2003** | 180,62 | 0,169 | 30,52 |
| **2004** | 237,31 | 0,169 | 40,10 |
| **2005** | 267,94 | 0,169 | 45,28 |
| **2006** | 340,01 | 0,169 | 57,46 |
| **2007** | 374,65 | 0,171 | 64,21 |
| **2008** | 410,19 | 0,167 | 68,33 |
| **2009** | 332,20 | 0,163 | 54,21 |
| **2010** | 344,16 | 0,166 | 57,11 |
| **2011** | 468,50 | 0,150 | 70,35 |

#### 4.2.5.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

| | |
|---|---|
| Combined uncertainty | 60.3 % |
| AD | ±6 % |
| EF | 60% |

***Uncertainty for AD:***

"Glass production data are typically measured fairly accurately (+/-5 percent) for Tier 1 and Tier 2. As mentioned above, inventory compilers should be cautious where activity data are not originally available in mass, but rather as a unit (e.g., bottle) or area (e.g., m2). If activity data have to be converted to mass, this may result in additional uncertainty." (2006 IPCC GL, p. 2.31)

Taking the above into account the uncertainty of the emission factor was assumed as ±6 %.

***Uncertainty for EF:***

Uncertainty associated with use of the Tier 1 emission factor and cullet ratio is significantly higher, and may be on the order of +/- 60 percent.

Quantitative uncertainty estimates are provided in Annex 7.

#### 4.2.5.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.
Revision of the activity data by using IPPC and EU ETS reports as well as statistical data.
Development of country specific emission factor for glass production based on IPPC and ETS data.

ISO 9001 and 14 001 standards.

#### 4.2.5.6 Source specific recalculations

There are no source specific recalculations for this category.

#### 4.2.5.7 Source specific planned improvements

No source specific improvements are planned

### 4.2.6 CERAMICS PRODUCTION (CRF 2.A.7)

#### 4.2.6.1 Source category description

According to the Reference Document on Best Available Techniques in the Ceramic Manufacturing Industry, August 2007, the fundamental methods and steps in the production processes hardly differ in the manufacture of the various ceramic products, besides the fact that, for the manufacture of, e.g. wall and floor tiles, table- and ornamentalware (household ceramics), sanitaryware and also technical ceramics, often a multiple stage firing process is used.

The manufacture of ceramic products takes place in different types of kilns, with a wide range of raw materials and in numerous shapes, sizes and colours. The general process of manufacturing ceramic products, however, is rather uniform, besides the fact that, for the manufacture of wall and floor tiles, table- and ornamentalware (household ceramics), sanitaryware and also technical ceramics, often a multiple stage firing process is used. In general, raw materials are mixed and cast, pressed or extruded into shape. Water is regularly used for a thorough mixing and shaping. This water is evaporated in dryers and the products are either placed by hand in the kiln (especially in the case of periodically operated kilns) or placed onto carriages that are transferred through continuously operated kilns. In most cases, the kilns are heated with natural gas, but liquefied petroleum gas, fuel oil, coal, petroleum coke, biogas/biomass or electricity are also used.

The currently operating ceramic plants in Bulgaria are producing mostly bricks, roof and wall tiles and other ceramic products. Those of them which cover the capacity criteria according to the IPPC Directive have IPPC permits as well as ETS permits.

#### 4.2.6.2 Trend description

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

There is general reduction of the total emission in the sector in 2011 compared to 2010. 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 6%.

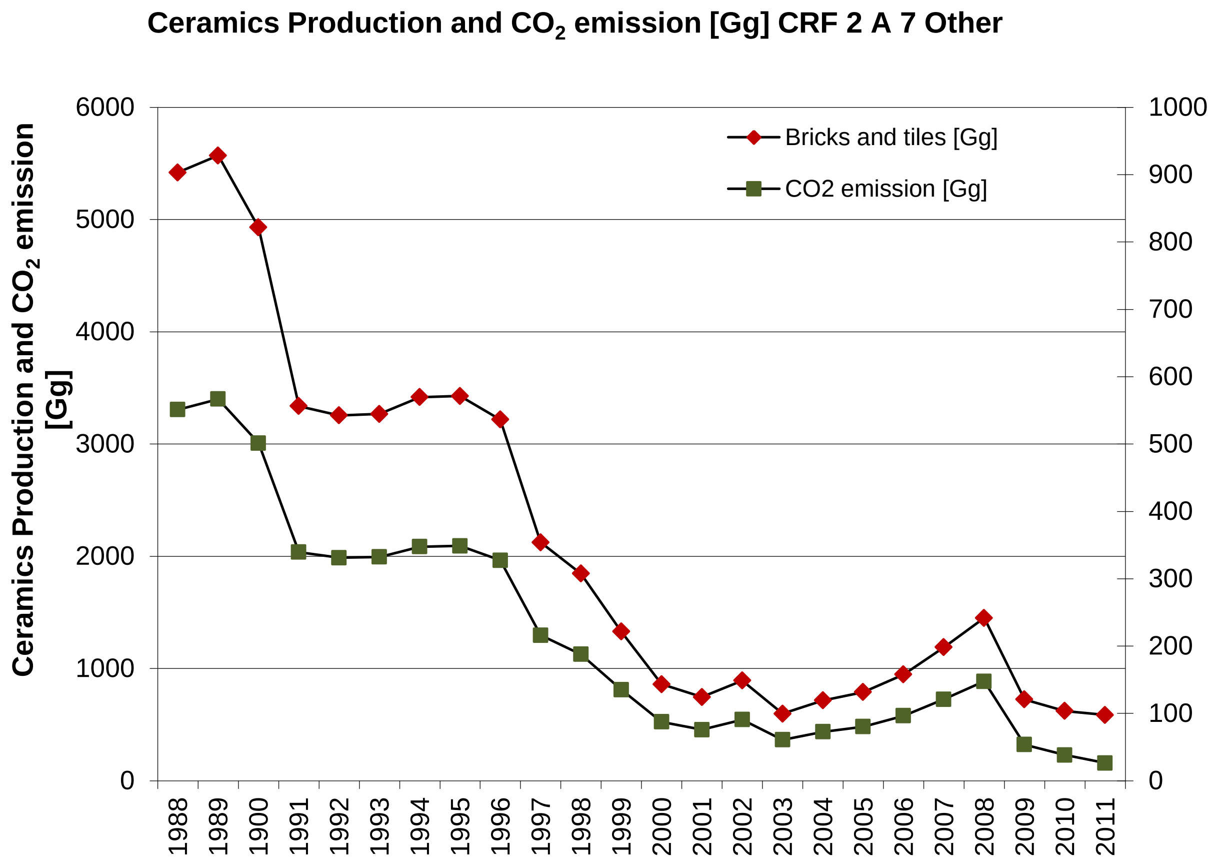



Figure 57 Ceramics Production and $CO_2$ emission in 2 A 7 "Other (mineral products)"

### 4.2.6.3 Methodological issues

#### 4.2.6.3.1 Method

The $CO_2$ emissions from the verified ETS reports are used. These emissions are estimated taking into account the CaO and MgO content in the products. The $CO_2$ emissions in the ETS reports are calculated using the following equation:

**Emissions** $CO_2$ **= ∑ (Activity data • Emission factor MeO • Conversion coefficient)**

Where:

Activity data = Ceramics production, tones

MeO = CaO, MgO

Emission factor $_{MeO}$:

Emission factor $_{CaO}$ = 0.785,

Emission factor $_{MgO}$ = 1.092

Conversion coefficient = 1.

The emissions estimated by the above equation are used together with the respective EU ETS production data for 2008 to obtain country specific emission factor.

For the rest of the time series NSI data were used. Since these data were expressed in different measurement units (for example: $m^3$, units) a conversion factor was applied in order to obtain the production in tones. To convert the production from units to tones a local conversion factor was obtained.

#### 4.2.6.3.2 $CO_2$ Emission factor

Country specific emission factor was calculated on the basis of data from ETS and IPPC reports of the operators (see Table 117). The ETS data used to estimate the EF take into account the $CaCO_3$, $MgCO_3$ in the used in the raw materials (clay).

#### 4.2.6.3.3 Activity data

Statistical data on production are used for the whole time series. Conversion of the production data (from $m^3$ and units) was performed in order to obtain them in tones.

Issue of double counting:

In order to avoid double counting, the quantity fuel used are reported under Energy Chapter respectively.

Table 117 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 |
| **2011** | 585,70 | 0,045 | 26,39 |

* Ceramic Production = Bricks and Tiles

#### 4.2.6.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

| | |
|---|---|
| Combined uncertainty | 5.8 % |
| AD | 3 % |
| EF | 5% |

*Uncertainty for AD:*

The following is relevant (2006 IPCC GL, p. 2.39)

Assuming that carbonate consumption is allocated to the appropriate consuming sectors/industries, the uncertainty associated with weighing or proportioning the carbonates for any given industry is 1-3 percent. The uncertainty of the overall chemical analysis pertaining to carbonate content and identity also is 1-3 percent.

*Uncertainty for EF:*

The following is relevant (2006 IPCC GL, p. 2.39)

Assuming that the activity data are collected correctly, and thus the correct emission factor is applied, there is negligible uncertainty associated with the emission factor. There may be some uncertainty associated with assuming a fractional purity of limestone and dolomite in cases where only carbonate rock data are available (+/- 1-5 percent).

Quantitative uncertainty estimates are provided in Annex 7.

#### 4.2.6.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

Check with IPPC reports on the activity data used.
ETS $CO_2$ emissions used for the emission factor estimation and recalculations.

#### 4.2.6.6 Source specific recalculations

There are no source specific recalculations for this category.

#### 4.2.6.7 Source specific planned improvements

No source specific improvements are planned

### 4.2.7 DESULPHURISATION (CRF 2.A.7 OTHER NON-SPECIFIED)

#### 4.2.7.1 Source category description

Flue gas desulphurization (FGD) is a technology used to remove sulphur dioxide ($SO_2$) from the exhaust flue gas if fossil fuels power plants. Fossil fuels such as coal, peat and oil contain varying amounts of sulphur. To avoid high emissions of sulphur dioxide to the atmosphere, large combustion plants (in particular plants over 100 MWth) are usually equipped with FGD.

Nowadays there are many different ways of reducing the $SO_2$ emissions generated by the combustion of fossil fuels. In Bulgaria two following desulphurization techniques are applied:

Use of adsorbents in fluidised bed combustion systems

This is a primary measure to reduce the sulphur oxide emissions. The use of adsorbents in fluidised bed combustion systems are integrated desulphurisation systems. This limits the combustion temperature to about 850°C. The adsorbent utilised is typically CaO, $Ca(OH)_2$ or $CaCO_3$. The reaction needs a surplus of adsorbent with a stoichiometric ratio (fuel/adsorbent) of 1.5 to 7 depending on the fuel. Due to chlorine corrosion effects, the desulphurisation rate is limited by 75%. This technique is mainly utilised in coalfired LCPs and is described in Chapter 4. (LCP BREF, p. 65).

Wet scrubbers

This is a secondary measure to reduce sulphur oxide emissions. Wet scrubbers, especially the limestone-gypsum processes, are the leading FGD technologies. They are used in large utility boilers. This is due to their high $SO_2$ removal efficiency and their high reliability. Limestone is used in most cases as the sorbent, as it is available in large amounts in many countries and is cheaper to process than other sorbents. By-products are either gypsum or a mixture of calcium sulphate/sulphite, depending on the oxidation mode. (LCP BREF, p. 66 - 67).

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, 2009 and 2011.

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

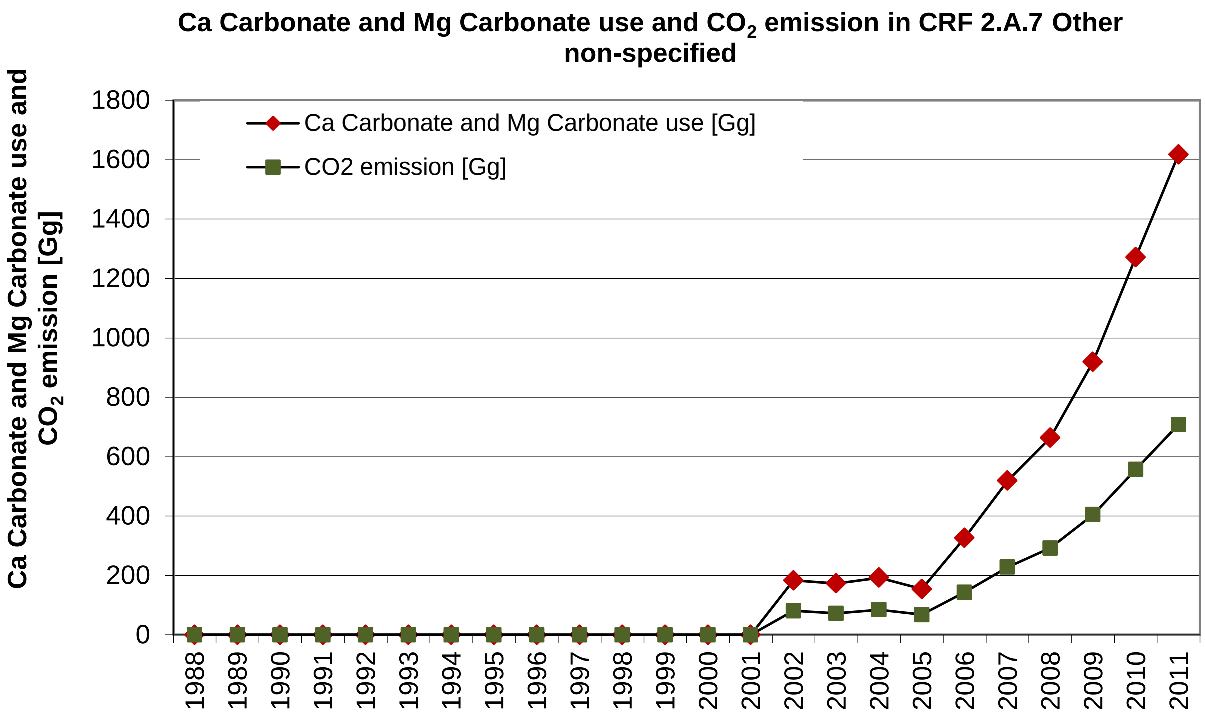



Figure 58 $CaCO_3$, $MgCO_3$ use and $CO_2$ emission in CRF 2.A.7 "Other non-specified"

### 4.2.7.3 Methodological issues

Tier 2 method for the $CO_2$ emissions estimation is used. The $CO_2$ emissions estimated using the above equation are taken from the LCP operators EU ETS reports. The quantities of calcium carbonate ($CaCO_3$) and magnesium carbonate ($MgCO_3$) used for the estimations are also taken form the EU ETS reports thus allowing to take into account the pure carbonates used in the process.

#### 4.2.7.3.1 Method

Tier 2 method for the $CO_2$ emissions estimation is used. Under Tier 2, the amount of $CO_2$ emitted from the use of limestone and dolomite is estimated from a consideration of consumption and the stoichiometry of the chemical processes.

The equation used to estimate the emissions is as follows:

$$CO_2\ Emissions = (MCa \cdot EFCa) + (MMg \cdot EFMg)$$

Where:

$CO_2$ Emissions = emissions of $CO_2$ from other process uses of carbonates - desulphurisation, tonnes

$M_{Ca}$ or $M_{Mg}$ = mass of Ca Carbonate and Mg Carbonate (consumption), tonnes.

$EF_{Ca}$ or $EF_{Mg}$ = emission factor for Ca Carbonate and Mg Carbonate calcination respectively, tonnes $CO_2$/tonne carbonate

The $CO_2$ emissions estimated using the above equation are taken from the operators EU ETS reports.

#### 4.2.7.3.2 $CO_2$ Emission factor

The emission factor is based on the mass of $CO_2$ released per mass of carbonate consumed (2006 IPCC GL, p. 2.7).

The EFs used to estimate $CO_2$ emissions from desulphurization processes are the following:

$EF_{CaCO3}$ = 0.44,

$EF_{MgCO3}$ = 0.522.

#### 4.2.7.3.3 Activity data

Plant specific activity data on the amount of carbonates use are obtained from EU ETS reports.

*Issue of double counting:*

The quantity of carbonates used in desulphurization are not considered in CRF 2.A.3 Limestone and dolomite use.

Table 118 $CaCO_3$ and $MgCO_3$ use and $CO_2$ emission in CRF 2.A.7 Other non-specified

| Year | Ca Carbonate and Mg Carbonate use [kt/y] | $CO_2$ EF [kt $CO_2$/kt $CaC_2$] | CO2 Emissions [Gg $CO_2$] |
|---|---|---|---|
| 1988 | 0,0 | - | 0,0 |
| 1989 | 0,0 | - | 0,0 |
| 1990 | 0,0 | - | 0,0 |
| 1991 | 0,0 | - | 0,0 |
| 1992 | 0,0 | - | 0,0 |
| 1993 | 0,0 | - | 0,0 |
| 1994 | 0,0 | - | 0,0 |
| 1995 | 0,0 | - | 0,0 |
| 1996 | 0,0 | - | 0,0 |
| 1997 | 0,0 | - | 0,0 |
| 1998 | 0,0 | - | 0,0 |
| 1999 | 0,0 | - | 0,0 |
| 2000 | 0,0 | - | 0,0 |
| 2001 | 0,0 | - | 0,0 |
| 2002 | 183,58 | 0,440 | 80,77 |
| 2003 | 173,28 | 0,416 | 72,10 |
| 2004 | 192,61 | 0,440 | 84,75 |
| 2005 | 154,26 | 0,440 | 67,87 |
| 2006 | 326,62 | 0,440 | 143,71 |
| 2007 | 518,91 | 0,440 | 228,32 |
| 2008 | 663,61 | 0,440 | 292,19 |
| 2009 | 919,70 | 0,440 | 404,66 |
| 2010 | 1271,65 | 0,438 | 556,68 |
| 2011 | 1618,22 | 0,438 | 708,16 |

### 4.2.7.4 Uncertainties and time series consistency

Taking into account the economic crises of 1989/1990 and 1997/1998 all data and time series shall be regarded as consistent.

| | |
|---|---|
| Combined uncertainty | 2.9 % |
| AD | ±1.5 % |
| EF | ±2.5 % |

*Uncertainty for AD:*

Activity data uncertainties are greater than the uncertainties associated with emission factors. Assuming that carbonate consumption is allocated to the appropriate consuming sectors/industries, the uncertainty associated with weighing or proportioning the carbonates for any given industry is 1-3 percent. The uncertainty of the overall chemical analysis pertaining to carbonate content and identity also is 1-3 percent (2006 IPCC GL, p. 2.39).

*Uncertainty for EF:*

In theory the uncertainty associated with the emission factor for this source category should be relatively low, as the emission factor is the stoichiometric ratio reflecting the amount of $CO_2$ released upon calcination of the carbonate. In practice, there are uncertainties due, in part, to variations in the chemical composition of the limestone and other carbonates. For example, in addition to calcium carbonate, limestone may contain smaller amounts of magnesia, silica and sulphur. Assuming that the activity data are collected correctly, and thus the correct emission factor is applied, there is negligible uncertainty associated with the emission factor. There may be some uncertainty associated with assuming a fractional purity of limestone and dolomite in cases where only carbonate rock data are available (+/- 1-5 percent) (2006 IPCC GL, p. 2.39).

#### 4.2.7.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

AD compared with the annual reports under IPPC.
ISO 9001 and 14 001 standards.
EU ETS reports

#### 4.2.7.6 Source specific recalculations

There are no source specific recalculations for this category.

#### 4.2.7.7 Source specific planned improvements

No source specific improvements are planned.

## 4.3 CHEMICAL INDUSTRY (CRF 2.B)

### 4.3.1 AMMONIA PRODUCTION (CRF 2.B.1)

#### 4.3.1.1 Source category description

Ammonia is synthesised from nitrogen and hydrogen by the following reaction:

$$N_2 + 3H_2 = 2NH_3.$$

The technological process for Ammonia production in both of the currently operating plants is similar. Ammonia ($NH_3$) is produced by catalytic steam reforming of natural gas. The feedstock is reformed with steam in a heated primary reformer and subsequently with air in a second reformer in order to produce the synthesis gas.

The reaction taking place during primary reforming is:

$$CH_4 + H_2O = CO + 3H_2$$

The main objective of secondary reforming is to add the nitrogen required for the synthesis and to complete the conversion of the hydrocarbon feed.

The synthesis gas then undergoes processes of heat and $CO_2$ removal and reaction of methanation due to the fact that small amounts of CO and $CO_2$, remaining in the synthesis gas, are poisonous for the ammonia synthesis catalyst. The synthesis gas is then compressed in a compressor to the required pressure for Ammonia synthesis.

Currently ammonia is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and EU ETS. Until the year of 2002 there were four plants operating.

#### 4.3.1.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation, which is the case in 1999/2000 and 2002 when two of the ammonia producing plants stopped working.

There is increase by 28% of the total emission in the sector in 2011 compared to 2010. 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.

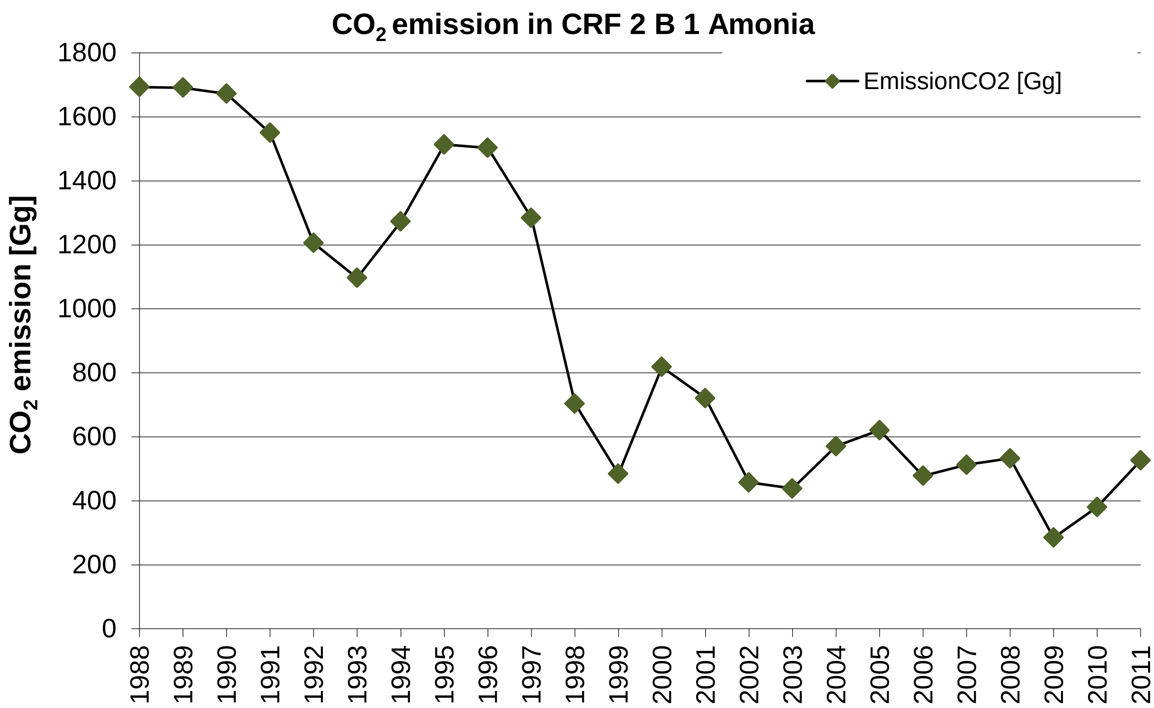



Figure 59 Ammonia Production and $CO_2$ emission in CRF 2 B 1 Ammonia production

#### 4.3.1.3 Methodological issues

##### 4.3.1.3.1 Method

As recommended in revised 1996 IPCC Guidelines plant specific data were used to estimate $CO_2$ emissions from ammonia production. Taking into account that good practice guidance has not yet been developed for the ammonia production (IPCC GPG 2000, p. 3.8) a higher tier method – Tier 2, is applied using the following equations from 2006 IPCC Guidelines (Chapter 3: Chemical Industry Emissions, equation 3.2).

**TOTAL FUEL REQUIREMENT FOR AMMONIA PRODUCTION – TIER 2**

$$TFR_i = \sum_j (AP_{ij} \times FR_{ij})$$

Where:

$TFR_i$ = total fuel requirement for fuel type i, GJ

$AP_{ij}$ = ammonia production using fuel type i in process type j, tonnes

$FR_{ij}$ = fuel requirement per unit of output for fuel type i in process type j, GJ/tonne ammonia produced

**$CO_2$ EMISSIONS FROM AMMONIA PRODUCTION – TIER 2**

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

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 119 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 120 Ammonia production and $CO_2$ emission in CRF 2.B.1 Ammonia production

| Year | Ammonia Production ($NH_3$) [kt/y] | Ammonia Production ($NH_3$) [kt/y] | $CO_2$ IEF [kt $CO_2$/kt $NH_3$] | $CO_2$ Emissions [Gg $CO_2$] |
|---|---|---|---|---|
| 1988 | PS data / NSI | C | C | 1693,34 |
| 1989 | PS data / NSI | C | C | 1691,25 |
| 1990 | PS data / NSI | C | C | 1672,38 |
| 1991 | PS data / NSI | C | C | 1549,98 |
| 1992 | PS data / NSI | C | C | 1205,85 |
| 1993 | PS data / NSI | C | C | 1096,76 |
| 1994 | PS data / NSI | C | C | 1272,67 |
| 1995 | PS data / NSI | C | C | 1513,78 |
| 1996 | PS data / NSI | C | C | 1503,19 |
| 1997 | PS data / NSI | C | C | 1284,18 |
| 1998 | PS data / NSI | C | C | 703,77 |
| 1999 | PS data / NSI | C | C | 484,33 |
| 2000 | PS data / NSI | C | C | 818,32 |
| 2001 | PS data / NSI | C | C | 721,07 |
| 2002 | PS data / NSI | C | C | 457,40 |
| 2003 | PS data | C | C | 438,48 |
| 2004 | PS data | C | C | 570,86 |
| 2005 | PS data | C | C | 620,74 |
| 2006 | PS data | C | C | 478,33 |
| 2007 | PS data | C | C | 512,51 |
| 2008 | PS data | C | C | 532,70 |
| 2009 | PS data | C | C | 284,79 |
| 2010 | PS data | C | C | 380,32 |
| 2011 | PS data | C | C | 526,05 |

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

A complete recalculation of $CO_2$ emissions from ammonia production has been made, with only the quantity of natural gas for conversion process is used. In the past calculations were based on the entire quantity of natural gas which led to double counting of emissions. $CO_2$ emissions for energy and non-energy use in chemical industry are calculated separately in order to avoid double counting and underestimation of emissions from this process. From the resulting total emissions, the emissions from ammonia production were subtracted and the difference is reported in sector Energy – 1A2c – GF.

#### 4.3.1.7 Source specific planned improvements

No source specific improvements are planned.

### 4.3.2 NITRIC ACID PRODUCTION (CRF 2.B.2)

#### 4.3.2.1 Source category description

Currently nitric acid is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and ETS. Until 1999/2000 there were three plants operating.

The nitric acid is produced by following general technological steps:

Oxidation of $NH_3$

$NH_3$ is reacted with air on a catalyst in the oxidation section. Nitric oxide and water are formed in this process according to the main equation:

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

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 $HNO_3$ formation) depend on pressure and temperature and are favoured by higher pressure and lower temperature.

The most common treatment techniques for tail gases from nitric acid plants are:

SCR (Selective Catalytic Reduction, for NOx abatement)
NSCR (Selective Non-Catalytic Reduction, for NOx and $N_2O$ abatement)
One of the currently operating plants conducts both reactions of oxidation and absorption at normal pressure and the other plant – at high pressure. Both of the plants are using NSCR as emissions abatement technology.

#### 4.3.2.2 Trend description

The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation, which is the case around 1999/2000 with one of the nitric acid producing plants.

There is 14% reduction of the total emission in the sector in 2011 compared to 2010 although the increase of the production with 30%. This is mainly due to the improvement of the technology by installing new catalytic convertor columns as follows:

- Catalytic converter for $N_2O$ reduction since September 2005 – average efficiency 75%
- Since November 2011 catalyst $DN_2O$(BASF) – 85% efficiency for $N_2O$

This is connected with the increase of the Ammonia production which is performed by the same plants.

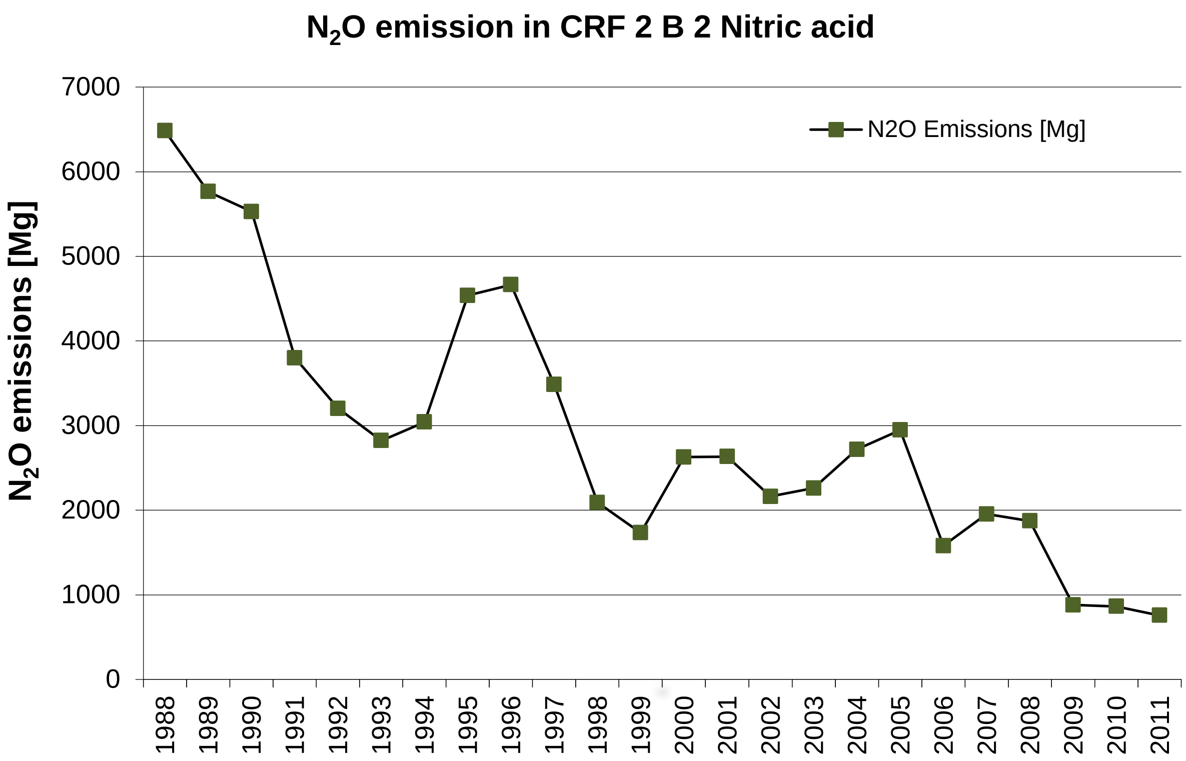



Figure 60 Nitric acid production and $N_2O$ emission in CRF 2 B 2 Nitric acid production

### 4.3.2.3 Methodological issues

#### 4.3.2.3.1 Method

Taking into account the recommendations of the ERT for $N_2O$ emissions from the nitric production, plant specific data are used and a country specific emission factor was developed. Following the Decision tree for $N_2O$ emissions from nitric acid production (IPCC GPG 2000, p. 3.32) plant specific data on $N_2O$ emissions and destruction were obtained. A higher tier method (referred as Tier 3 in 2006 IPCC Guidelines, Chapter 3, p. 3.21) is applied, which means that the $N_2O$ emissions are based on real measurement data.

For completing the time series additional data from NSI were also used. The emissions were recalculated using the following equation:

$$\textbf{Emission } N_2O = IEF * NAP$$

Where:

IEF – Implied emission factor,

NAP – Nitric acid production.

#### 4.3.2.3.2 $N_2O$ Implied Emission factor

For the years 2000 to 2011 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 2011 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 121 Questionnaire to plant operator of Ammonia production

| | | |
|---|---|---|
| 1 | Nitric acid production (100%) | t |
| 2 | $N_2O$ emissions | t/y |

Table 122 Nitric acid production and $N_2O$ emission

| Year | Nitric acid Production ($HNO_3$) [kt/y] | Nitric acid Production ($HNO_3$) [kt/y] | Emission Factor [kt $N_2O$/kt $HNO_3$] | $N_2O$ Emissions [kt $N_2O$] |
|---|---|---|---|---|
| 1988 | PS data / NSI | C | C | 6,48 |
| 1989 | PS data / NSI | C | C | 5,77 |
| 1990 | PS data / NSI | C | C | 5,53 |
| 1991 | PS data / NSI | C | C | 3,80 |
| 1992 | PS data / NSI | C | C | 3,20 |
| 1993 | PS data / NSI | C | C | 2,82 |
| 1994 | PS data / NSI | C | C | 3,04 |
| 1995 | PS data / NSI | C | C | 4,54 |
| 1996 | PS data / NSI | C | C | 4,67 |
| 1997 | PS data / NSI | C | C | 3,49 |
| 1998 | PS data / NSI | C | C | 2,09 |
| 1999 | PS data / NSI | C | C | 1,73 |
| 2000 | PS data | C | C | 2,63 |
| 2001 | PS data | C | C | 2,63 |
| 2002 | PS data | C | C | 2,16 |
| 2003 | PS data | C | C | 2,26 |
| 2004 | PS data | C | C | 2,72 |
| 2005 | PS data | C | C | 2,95 |
| 2006 | PS data | C | C | 1,58 |
| 2007 | PS data | C | C | 1,95 |
| 2008 | PS data | C | C | 1,87 |
| 2009 | PS data | C | C | 0,88 |

| 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 $N_2O$] |
|---|---|---|---|---|
| 2010 | PS data | C | C | 0,86 |
| 2011 | PS data | C | C | 0,76 |

*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.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

The entire time series has been recalculated with revised activity data for 2005-2010 from the plants.

### Source specific planned improvements

No source specific improvements are planned.

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

#### 4.3.3.1 Source category description

**Carbide production**

There is one carbide producing plant in Bulgaria. It reports under EU ETS and has IPPC permit. The process which is used to produce carbide in it is as follows:

Calcium carbide ($CaC_2$) is made by reducing calcium oxide CaO with carbon e.g., anthracite coal, in electric arc furnaces. The reaction is:

$CaO + 3C \rightarrow CaC_2 + CO\ (+ \frac{1}{2} O_2 \rightarrow CO_2)$

The CaO used for carbide production is produced by the same plant from limestone. This limestone usage is included in CRF 2.A.2 Lime production in order to avoid double counting with the quicklime production.

#### 4.3.3.2 Trend description

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

There is and insignificant decrease in calcium carbide production in 2011, which leads to decrease in emissions with aproximately 3%.

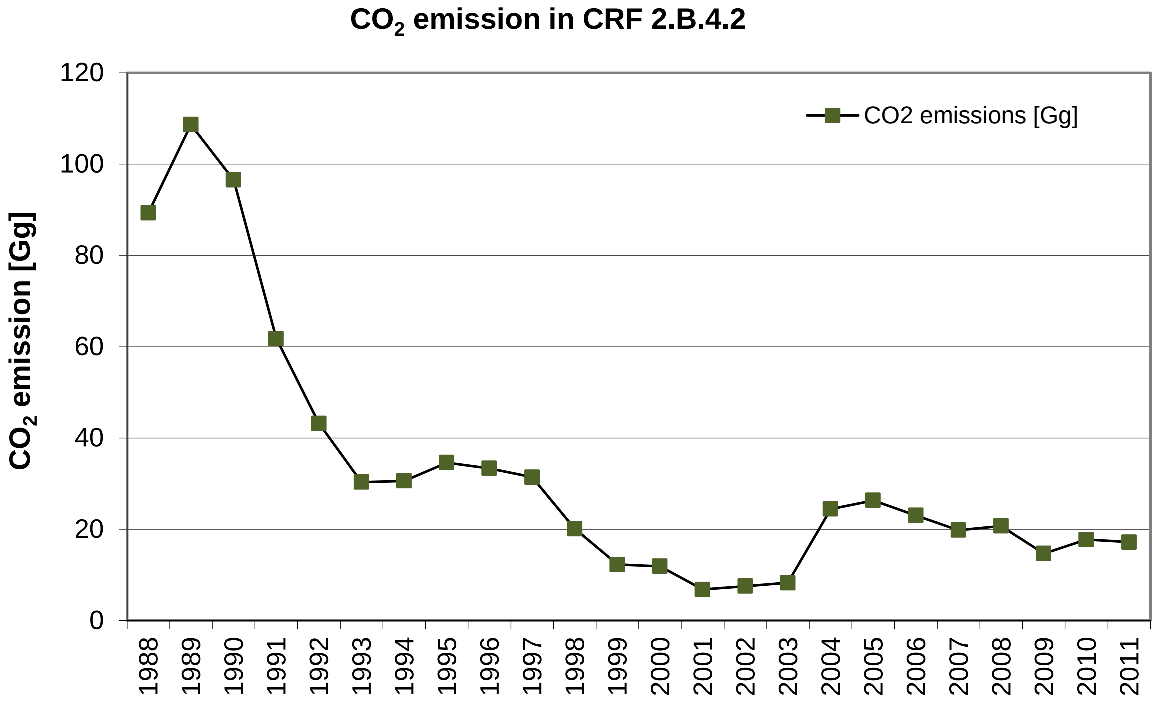



Figure 61 Carbide production and use and $CO_2$ emission in CRF 2.B.4.2

### 4.3.3.3 Methodological issues

The Tier 1 method based on default values and national statistics is used.

The carbide production is taken from NSI. This quantity is used as AD for the calculations of the emissions from category 2.B.4.

The EF for these calculations are taken as default (table 2-8, p. 2.19, 1996 IPCC GL) for the reduction process (1.09 tonnes $CO_2$/tonne carbide) and for the use of product (1.1 tonnes $CO_2$/tonne carbide).

The emissions are estimated following the recommendations of the Revised 1996 IPCC guidelines.

In order to ensure that there is no double counting with the energy sector further investigation will be made on the quantity of the anthracite used as reducing agent.

#### 4.3.3.3.1 Method

Emissions of $CO_2$ from Carbide production and use are estimated using the methodology described in 1996 IPCC Guidelines and a default emission factor from the same guidelines (table 2-8, p. 2.19). Plant specific and country specific data were used to estimate $CO_2$ emissions from Carbide production and use.

In emissions estimations the general approach described in 1996 IPCC Guidelines is applied using the following equation:

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

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 123 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 |

| Year | Carbide production [kt/y] | $CO_2$ EF [kt $CO_2$/kt $CaC_2$] | $CO_2$ Emissions [Gg $CO_2$] |
|---|---|---|---|
| 2007 | C | C | 19,81 |
| 2008 | C | C | 20,72 |
| 2009 | C | C | 14,69 |
| 2010 | C | C | 17,76 |
| 2011 | C | C | 17,21 |

*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

There are no source specific recalculations for this category.

#### 4.3.3.7 Source specific planned improvements

No source specific improvements are planned.

## 4.4 METAL PRODUCTION (CRF 2.C)

### 4.4.1 IRON AND STEEL PRODUCTION (CRF 2.C.1)

#### 4.4.1.1 Source category description

According to the information given in Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001, p. 16, four routes are currently used for the production of steel: the classic blast furnace/basic-oxygen furnace route, direct melting of scrap (electric arc furnace), smelting reduction and direct reduction. At present (1998), EU (15) steel production is based on the blast furnace/ basic-oxygen route (approximately 65%) and the electric arc furnace (EAF) route (approximately 35%).[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

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

to remove undesirable impurities to the greatest possible extent

The production of steel by the basic oxygen furnace (BOF) process is a discontinuous process which involves the following steps:

transfer and storage of hot metal
pre-treatment of hot metal (desulphurisation)
oxidation in the BOF (decarburisation and oxidation of impurities)
secondary metallurgical treatment
casting (continuous or/and ingot)

*Electric steelmaking*

The direct smelting of iron-containing materials, such as scrap is usually performed in electric arc furnaces (EAF). The major feed stock for the EAF is ferrous scrap, which may comprise of scrap from inside the steelworks (e.g. offcuts), cut-offs from steel product manufacturers (e.g. vehicle builders) and capital or post-consumer scrap (e.g. end of life products).

With respect to the end-products distinction has to be made between production of ordinary, so called carbon steel as well as low alloyed steel and high alloyed steels/stainless steels. In the EU about 85% of steel production is carbon or low alloyed steel [EC Study, 1996].For the production of carbon steel and low alloyed steels, following main operations are performed:

raw material handling and storage
furnace charging with/without scrap preheating
EAF scrap melting
steel and slag tapping
ladle furnace treatments for quality adjustment
slag handling
continuous casting

For high alloyed and special steels, the operation sequence is more complex and tailor-made for the end-products. In addition to the mentioned operations for carbon steels various ladle treatments (secondary metallurgy) are carried out like

desulphurisation
degassing for the elimination of dissolved gases like nitrogen and hydrogen
decarburisation (AOD=Argon-Oxygen-Decarburisation or VOD=Vacuum-Oxygen-Decarburi-sation)

The steel making plant which produced sinter, pig iron and steel (BOF) ceased operation in November 2008.

Currently in Bulgaria steel is produced only in EAF.

#### 4.4.1.2 Trend description

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

There is general reduction of the total emission in the sector in 2009 compared to 2008. This is mainly due to the world economic crisis in 2009 which lead to a reduction of the production processes rates. The total reduction in the sector production is about 45%.

Another factor leading to this reduction is that the biggest plant from this sector (which share in the steel production before 2008 was more than 50%) ceased operation of its pig iron and the following steel making in BOF in November 2008.

There is general reduction of the total emission in the sector in 2011 compared to 2010. This is mainly due to the stable fluctuation on the production of the second biggest steel plant.

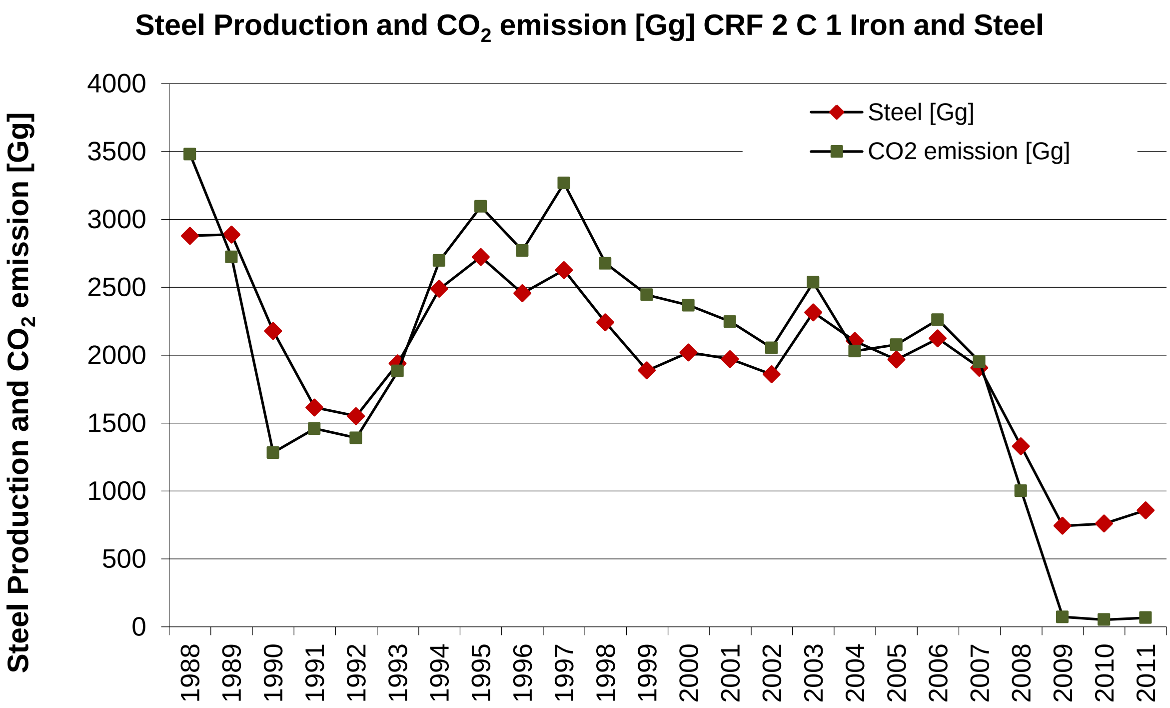



Figure 62 Iron and Steel Production and $CO_2$ emission in CRF 2 C 1 Iron and Steel production

#### 4.4.1.3 Methodological issues

##### 4.4.1.3.1 Method

The $CO_2$ emissions from the sector are calculated using country specific data from EU ETS reports. Data for 2011 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 - 2011. In the calculation of ETS emissions the operators performed a mass balance of the Carbon content in the raw materials used and the produced end product. Thus $CO_2$ emissions are estimated by an approach similar to the following equation (IPCC GPG 2000, p. 3.25):

**EQUATION 3.6B**

**Emissions crude steel = (Mass of Carbon in the Crude Iron used for Crude Steel Production – Mass of Carbon in the Crude Steel) • 44/12 + Emission FactorEAF • Mass of Steel produced in EAF**

#### 4.4.1.3.3 Activity data

Country specific data from EU ETS reports as well as from BAMI and WSA on total crude steel production were received.

*Issue of double accounting:*

In order to avoid double counting, the quantity the fuel used is subtracted from the quantity reported under energy and non-energy use in the Energy Chapter.

Table 124 Iron and Steel production and $CO_2$ emission

| Year | Steel Production | Steel Production [kt/y] | Emission Factor [kt $CO_2$/kt Steel] | $CO_2$ Emissions [kt $CO_2$] |
|---|---|---|---|---|
| 1988 | BAMI / WSA | 2880,00 | 1,209 | 3481,44 |
| 1989 | BAMI / WSA | 2890,00 | 0,943 | 2724,87 |
| 1990 | BAMI / WSA | 2180,00 | 0,589 | 1283,24 |
| 1991 | BAMI / WSA | 1616,00 | 0,904 | 1460,58 |
| 1992 | BAMI / WSA | 1552,00 | 0,897 | 1392,13 |
| 1993 | BAMI / WSA | 1942,00 | 0,970 | 1883,71 |
| 1994 | BAMI / WSA | 2490,00 | 1,083 | 2697,12 |
| 1995 | BAMI / WSA | 2724,00 | 1,136 | 3095,68 |
| 1996 | BAMI / WSA | 2457,00 | 1,128 | 2771,76 |
| 1997 | BAMI / WSA | 2628,00 | 1,244 | 3268,68 |
| 1998 | BAMI / WSA | 2242,00 | 1,194 | 2676,82 |
| 1999 | BAMI / WSA | 1889,00 | 1,294 | 2444,83 |
| 2000 | BAMI / WSA | 2022,00 | 1,171 | 2368,01 |
| 2001 | BAMI / WSA | 1972,00 | 1,140 | 2247,66 |
| 2002 | BAMI / WSA | 1860,00 | 1,105 | 2055,21 |
| 2003 | BAMI / WSA | 2316,00 | 1,096 | 2537,47 |
| 2004 | BAMI / WSA | 2106,00 | 0,965 | 2031,37 |
| 2005 | BAMI / WSA | 1969,00 | 1,055 | 2078,16 |

| Year | Steel Production | Steel Production [kt/y] | Emission Factor [kt $CO_2$/kt Steel] | $CO_2$ Emissions [kt $CO_2$] |
|---|---|---|---|---|
| 2006 | BAMI / WSA | 2124,00 | 1,065 | 2261,72 |
| 2007 | BAMI / WSA / ETS | 1909,00 | 1,023 | 1953,25 |
| 2008 | BAMI / WSA / ETS | 1330,00 | 0,754 | 1003,16 |
| 2009 | BAMI / WSA / ETS | 744,53 | 0,100 | 74,17 |
| 2010 | BAMI / WSA / ETS | 761,41 | 0,070 | 53,47 |
| 2011 | BAMI / WSA / ETS | 858,92 | 0,079 | 67,96 |

As can be seen in Table 124 the emission factor for 2008 is lower than the ones for the previous years. This is mainly due to the fact that in 2008 the biggest steel making plant (which is also the only one producing steel in BOF) significantly decreased and subsequently stopped BOF steel production. This leads to a decrease in the production as well as in the $CO_2$ emissions.

For the period 2009-2011, 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, 2010 and 2011 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 IPCC GPG 2000 (Chapter 3, p 3.28):
For both Tier 1 and 2 the most important type of activity data is the amount of reducing agent used for iron production. According to Chapter 2, Energy, energy data have a typical uncertainty of about 5% (about 10% for countries with less developed energy statistics). For calculating the carbon storage term Tier 2 requires additional activity data on amounts of pig iron and net crude steel production that have a typical uncertainty of a few percent. In addition, Tier 2 requires information on the carbon content of pig iron, crude steel, and of iron ore that may have an uncertainty of 5% when plant-specific data are available. Otherwise the uncertainty in the carbon content could be of the order of 25 to 50%. Finally, the uncertainty in the emission factors for the reducing agent (e.g. coke) are generally within 5% (see Section 2.1.1.6, $CO_2$ Emissions from Stationary Combustion, Uncertainty Assessment).

Taking into account that plant specific data from EU ETS reports were used to estimate emissions an uncertainty of 5% is considered.

*Uncertainty for EF:*

According to Table 4.4 (2006 IPCC GL, Chapter 4.2.3) applying Tier 2 material-specific carbon contents would be expected to have an uncertainty of 10 percent. This uncertainty is considered due to using EU ETS data.

Quantitative uncertainty estimates are provided in Annex 7.

#### 4.4.1.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

$CO_2$ emissions were taken from ETS reports.
Aggregated national steel production data provided by BAMI and reported by World Steel Association are used for crosscheck.

#### 4.4.1.6 Source specific recalculations

Emissions form BOF steel production were recalculated due to doubts for double counting of the eissions from coke used in blast furnaces whish are reported in the energy sector. The used EF of 1,46, according to literature sources accounts all emissions from the entire process or BOF steel production i.e. the coke quantities used for pig iron production in blast furnaces. Therefore emissions from coke quantities used in blast furnaces are excluded from the energy sector.

#### 4.4.1.7 Source specific planned improvements

No source specific improvements are planned.

### 4.4.2 PIG IRON PRODUCTION (CRF 2.C.1.2)

#### 4.4.2.1 Source category description

There is one pig iron production plant in Bulgaria. Currently it has ceased operation (since November 2008).

#### 4.4.2.2 Trend description

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

In particular in pig iron production case the only plant ceased operation in November 2008 (see also "Iron and steel production" chapter).

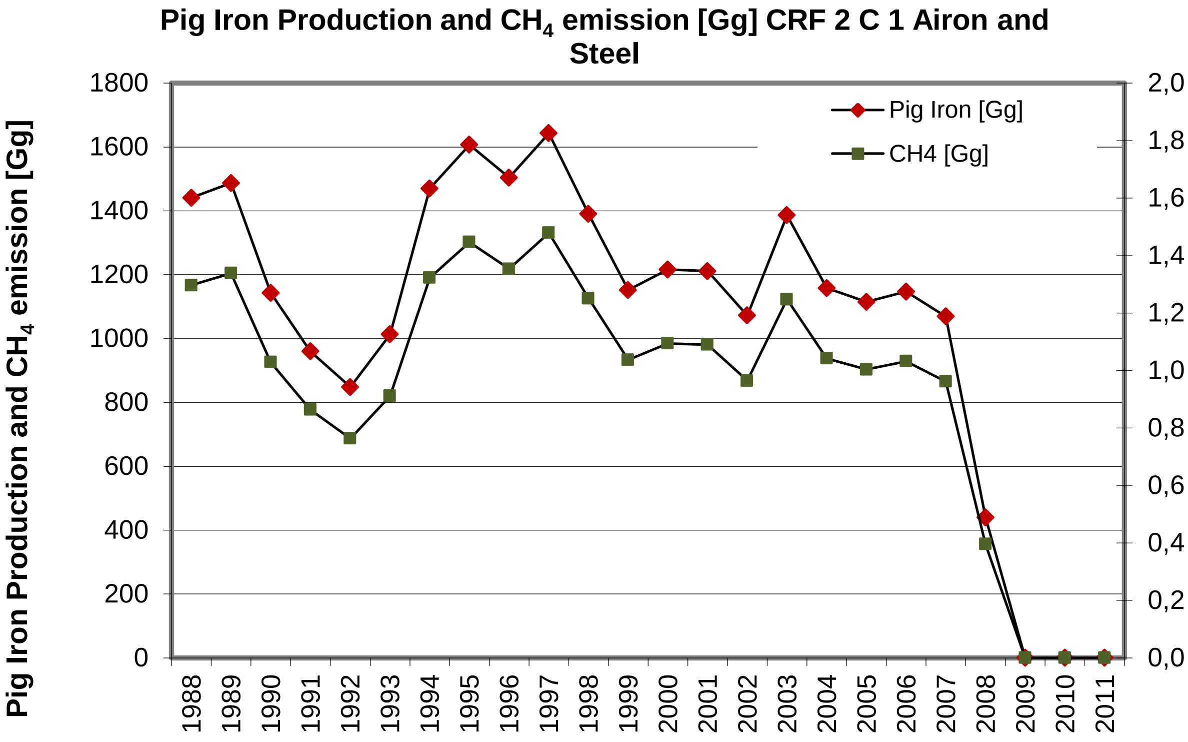



Figure 63 Pig iron Production and $CH_4$ emission in CRF 2.C.1.2 Pig iron production

#### 4.4.2.3 Methodological issues

##### 4.4.2.3.1 Method

Tier 1 methodology for $CH_4$ based on emission factors and national production statistics is applied (2006 IPCC GL, p. 4.24).The emissions from the sector are calculated using country specific data on the total amount of pig iron produced taken from WSA Yearbooks. Default emission factor is applied.

The emissions are estimated using the following equation (2006 IPCC GL, p. 4.24, equation 4.13).

**EQUATION 4.13**

**$CH_4$ EMISSIONS FROM BLAST FURNACE PRODUCTION OF PIG IRON (TIER 1)**

$$E_{CH4,non-energy} = PI \cdot EF_{PI}$$

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 125 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 |
| 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 |

| Year | Pig Iron Production [kt/y] | Emission Factor [t $CH_4$/ kt production] | $CH_4$ Emissions [kt $CH_4$] |
|---|---|---|---|
| 2008 | 440,00 | 0,900 | 0,40 |
| 2009 | 0,00 | 0,900 | 0,00 |
| 2010 | 0,00 | 0,900 | 0,00 |
| 2011 | 0,00 | 0,900 | 0,00 |

#### 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).

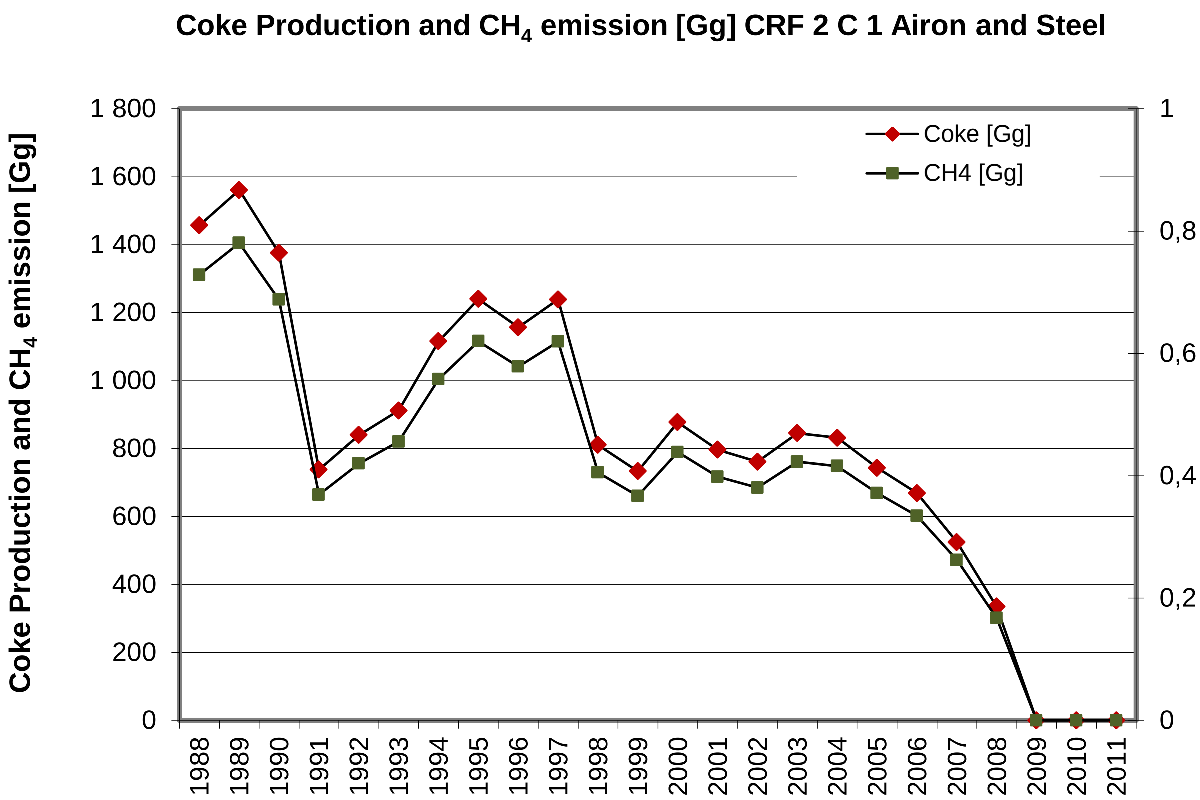



Figure 64 Coke Production and $CH_4$ emission in CRF 2.C.1.4 Coke production

### 4.4.3.3 Methodological issues

#### 4.4.3.3.1 Method

The emissions from the sector are calculated using country specific data on the total amount of coke produced provided by NSI. Default emission factor is applied.

The emissions are estimated following the general approach recommended in 1996 IPCC Guidelines using the following equation:

**Emissions $CH_4$ = Emission factor • Coke production**

#### 4.4.3.3.2 Emission factor

Default emission factor of 0.5 kg $CH_4$/ ton production is used (1996 IPCC GL, p. 2.21, Table 2-9).

#### 4.4.3.3.3 Activity data

Country specific data on the total coke production are provided by NSI.

*Issue of double counting:*

The following is considered: Metallurgical coke production is considered to be an energy use of fossil fuel, and as a result emissions should be reported in Category 1A of the Energy Sector (2006 IPCC Guidelines, p. 4.9).

In order to avoid double counting, the $CO_2$ emissions from coke production are reported in the Energy Chapter.

Table 126 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 |
| 2011 | 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.

### 4.4.4 FERROALLOYS PRODUCTION (CRF 2.C.2)

#### 4.4.4.1 Source category description

Ferroalloys production is a non-key category.

Ferroalloys production involves a metallurgical reduction process that results in $CO_2$ emissions.

This is only a minor source of $CO_2$ emissions in Bulgaria: in 2010, emissions account for the 0.04% of total emissions from Industrial Processes sector.

There is one ferroalloys producer in Bulgaria. Recovered $CO_2$ emissions in ferroalloys production are not included.

#### 4.4.4.2 Trend description

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

There is a significant decrease of the total emission in the sector in 2011 compared to 2010. This is due to the fact that a steel making plant which produced sinter, pig iron and steel ceased operation in November 2008.

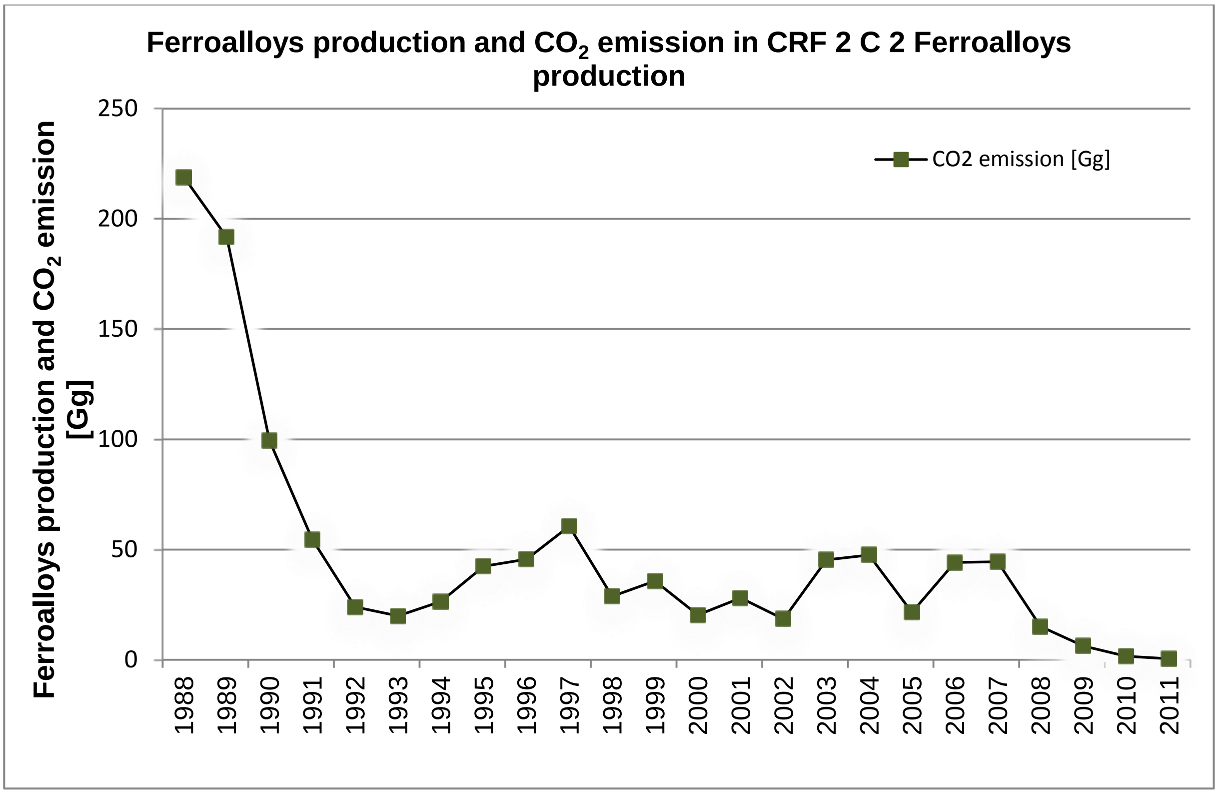



Figure 65 Ferroalloys production and $CO_2$ emission in CRF 2.C.2

#### 4.4.4.3 Methodological issues

The Tier 1 method based on default values and national statistics is used.

The ferroalloys production is taken from NSI. This quantity is used as AD for the calculations of the emissions from category 2.C.2.

The EF for these calculations is taken as an average default factor 2.4 tonnes $CO_2$/tonne ferroalloys.

##### 4.4.4.3.1 Method

Emissions of $CO_2$ from ferroalloys production is estimated using the methodology described in 1996 IPCC Guidelines and an average default emission factor from the same guidelines (table 2.15, p. 2.31).

In emissions estimations the general approach described in 1996 IPCC Guidelines is applied using the following equation:

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

where:

TOTAL $CO_2$ = the process emission (tonnes) of $CO_2$

$AD_p$ = ferroalloys produced (tonnes/yr)

$EF_p$ = the emission factor for $CO_2$ for ferroalloys produced (EF = 2.4 tonnes $CO_2$/tonne ferroalloys)

#### 4.4.4.3.2 CO2 Emission factor

The EF for these calculations is taken as an average default (table 2.15, p. 2.31, 1996 IPCC GL) for the reduction process (2.4 tonnes $CO_2$/tonne ferroalloys).

#### 4.4.4.3.3 Activity data

Country-specific activity data on the amount of ferroalloys produced and use are obtained from NSI for the whole time period.

Table 127 Ferroalloys production and $CO_2$ emission in CRF 2.C.2

| Year | Ferroalloys production [kt/y] | $CO_2$ EF [kt $CO_2$/kt] | $CO_2$ Emissions [Gg $CO_2$] |
|---|---|---|---|
| 1988 | C | C | 218,84 |
| 1989 | C | C | 191,62 |
| 1990 | C | C | 99,47 |
| 1991 | C | C | 54,55 |
| 1992 | C | C | 23,95 |
| 1993 | C | C | 19,87 |
| 1994 | C | C | 26,37 |
| 1995 | C | C | 42,37 |
| 1996 | C | C | 45,62 |
| 1997 | C | C | 60,54 |
| 1998 | C | C | 28,81 |
| 1999 | C | C | 35,68 |
| 2000 | C | C | 20,28 |
| 2001 | C | C | 27,97 |
| 2002 | C | C | 18,44 |
| 2003 | C | C | 45,37 |
| 2004 | C | C | 47,56 |
| 2005 | C | C | 21,54 |
| 2006 | C | C | 44,11 |
| 2007 | C | C | 44,38 |
| 2008 | C | C | 15,04 |
| 2009 | C | C | 6,29 |
| 2010 | C | C | 1,56 |
| 2011 | C | C | 0,45 |

In CRF 2.C.2 Ferroalloys production the production data and the EF as well as IEF is marked as confidential "C", because these information could lead to the disclosure of confidential information provided by the plant operator.

### 4.4.4.4 Uncertainties and time series consistency

| | |
|---|---|
| Combined uncertainty | 25.5 % |
| AD | ± 5 % |
| EF | ± 25 % |

### 4.4.4.5 Source specific QA/QC and verification

The quality objectives and the QA/QC plan are presented in Section 1.6.

#### 4.4.4.6 Source specific recalculations

No recalculations have been performed in the current submission.

#### 4.4.4.7 Source specific planned improvements

There are no source-specific planned improvements.

## 4.5 CONSUMPTION OF HALOCARBONS AND $SF_6$ – SECTOR OVERVIEW (CRF 2.F)

The following table and figure summarize the results for CRF Sector 2.F for 2011:

Table 128 Summary of the results for 2011

| Sector | Actual emission 2011 | Potential emission 2011 | Actual share | Potential share |
|---|---|---|---|---|
| | Gg $CO_2$-eq. | | % | |
| Solvents | 0,00 | 0,00 | 0,00% | 0,00% |
| Aerosols | 9,33 | 4,81 | 2,27% | 0,04% |
| Foams | 32,36 | 317,19 | 7,88% | 2,96% |
| Domestic refrigeration | 6,06 | 79,93 | 1,47% | 0,75% |
| Commercial and industrial refrigeration | 45,04 | 565,10 | 10,97% | 5,28% |
| Transport refrigeration | 3,59 | 9,97 | 0,87% | 0,09% |
| Domestic AC | 169,22 | 7978,41 | 41,21% | 74,55% |
| Stationary AC | 15,05 | 178,68 | 3,67% | 1,67% |
| Mobile AC | 110,82 | 924,75 | 26,99% | 8,64% |
| Fire protection | 4,27 | 85,40 | 1,04% | 0,80% |
| Electrical equipment | 14,87 | 558,36 | 3,62% | 5,22% |
| Total | 410,62 | 10702,61 | 100,00% | 100,00% |

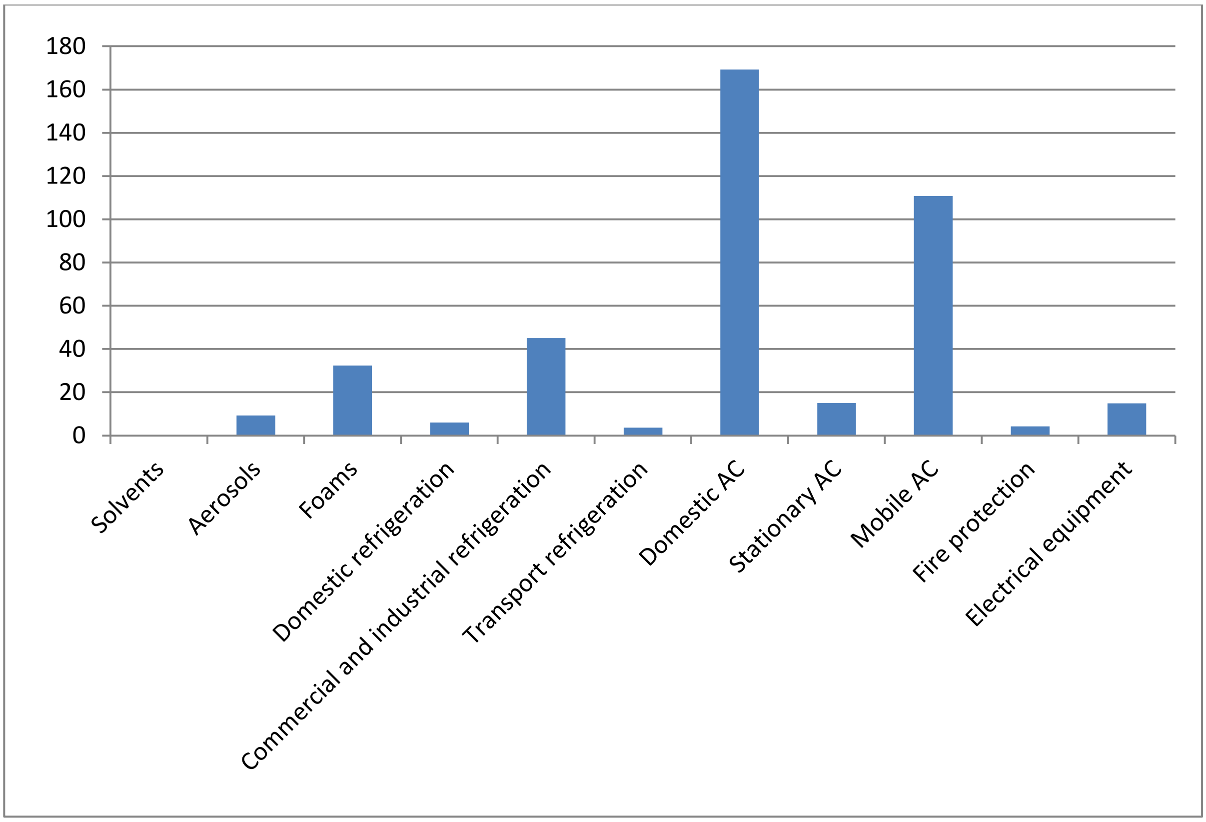



Figure 66 Actual emissions for 2011 [Gg $CO_2$-eq.]

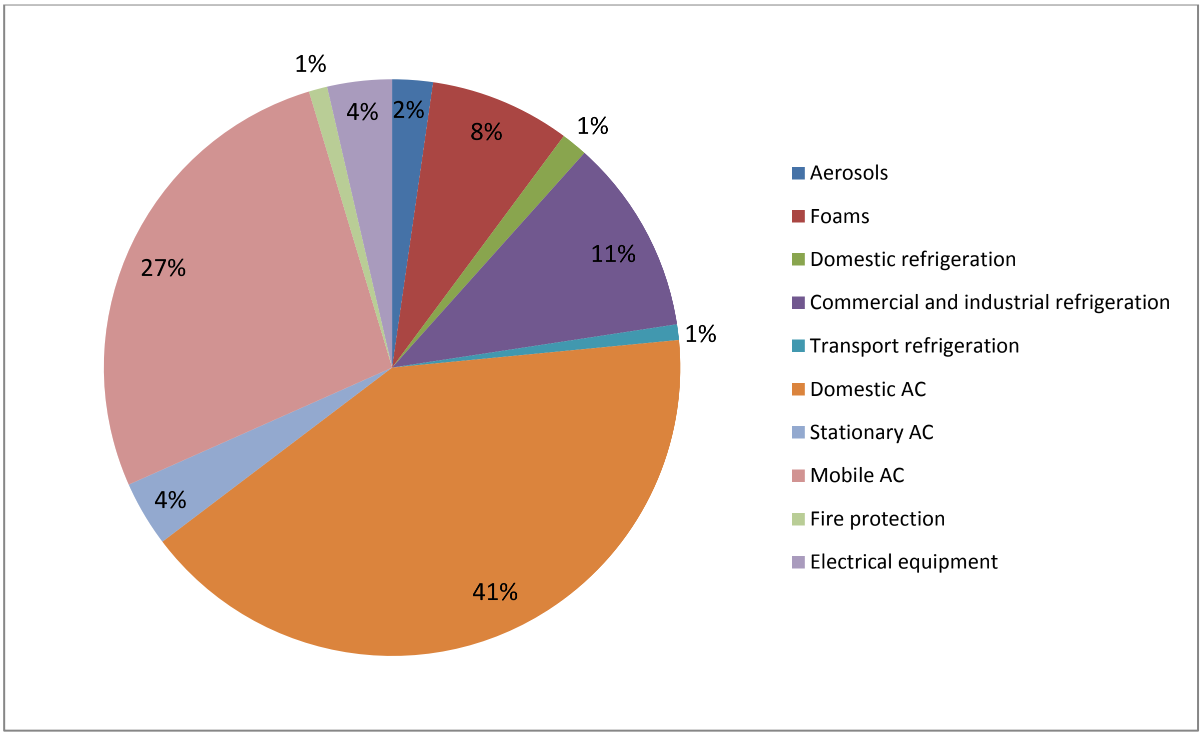



Figure 67 Actual emissions for 2011 [Gg $CO_2$-eq.]

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

Table 129 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 | 0,55 | 7,20 |
| 2002 | NO | 0,74 | NO | 0,20 | 8,38 | 0,49 | 1,98 | 2,81 | 25,90 | 0,69 | 7,62 |
| 2003 | NO | 1,18 | NO | 0,22 | 12,24 | 0,69 | 3,92 | 4,15 | 35,48 | 0,86 | 8,06 |
| 2004 | NO | 1,71 | NO | 0,24 | 16,09 | 1,02 | 8,33 | 5,49 | 44,40 | 1,07 | 8,53 |

| Year | Solvents | Aerosols | Foams | Domestic Ref | Industrial and Commercial Ref | Transport Ref | Domestic AC | Stationary AC | Mobil AC | Fire protecion | Electrical equipment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2005** | NO | 2,36 | 10,78 | 0,26 | 19,95 | 1,45 | 12,64 | 6,83 | 56,26 | 1,33 | 8,56 |
| **2006** | NO | 6,52 | 31,43 | 0,99 | 23,80 | 2,37 | 17,38 | 8,16 | 71,97 | 1,66 | 8,89 |
| **2007** | NO | 8,79 | 42,57 | 2,02 | 27,66 | 2,90 | 25,37 | 9,50 | 83,33 | 2,07 | 9,24 |
| **2008** | NO | 8,76 | 117,36 | 3,14 | 31,51 | 3,45 | 40,73 | 10,84 | 96,69 | 2,59 | 9,60 |
| **2009** | NO | 10,30 | 58,91 | 3,59 | 35,36 | 3,80 | 109,09 | 12,18 | 104,09 | 3,05 | 9,97 |
| **2010** | NO | 9,63 | 38,40 | 5,47 | 39,22 | 3,66 | 140,35 | 13,52 | 107,59 | 3,05 | 13,07 |
| **2011** | NO | 9,33 | 32,36 | 6,06 | 45,04 | 3,59 | 169,22 | 15,05 | 110,82 | 4,27 | 14,87 |

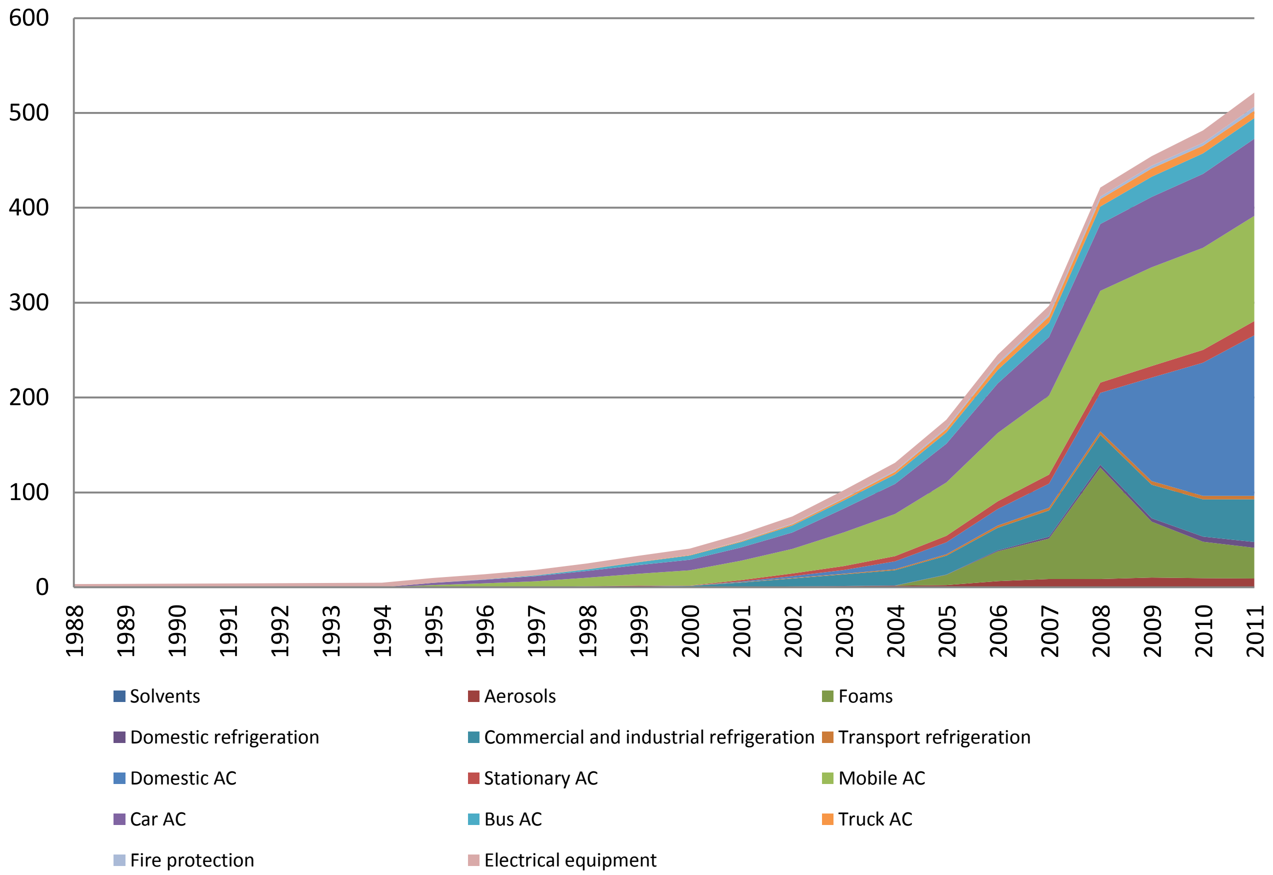



Figure 68 Actual emissions [Gg $CO_2$-eq.]

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

Table 130 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 |
| 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 | 11,05 | 296,31 |
| 2002 | NO | 0,53 | NO | 73,96 | 113,61 | 3,45 | 156,91 | 39,75 | 210,44 | 13,77 | 313,50 |
| 2003 | NO | 0,65 | NO | 80,27 | 151,48 | 4,80 | 333,07 | 53,00 | 301,43 | 17,17 | 331,68 |
| 2004 | NO | 1,07 | NO | 85,19 | 189,35 | 6,31 | 505,70 | 66,25 | 378,98 | 21,41 | 350,92 |
| 2005 | NO | 1,29 | 10,78 | 87,90 | 227,22 | 10,92 | 695,29 | 79,49 | 492,93 | 26,70 | 364,61 |
| 2006 | NO | 5,23 | 36,83 | 90,11 | 265,09 | 12,73 | 1014,87 | 92,74 | 615,79 | 33,28 | 378,83 |
| 2007 | NO | 3,57 | 60,98 | 91,49 | 302,96 | 13,53 | 1629,02 | 105,99 | 741,86 | 41,50 | 393,60 |
| 2008 | NO | 5,19 | 304,30 | 91,03 | 340,83 | 16,02 | 4363,70 | 119,24 | 859,58 | 51,74 | 408,95 |
| 2009 | NO | 5,11 | 336,71 | 88,83 | 378,70 | 14,13 | 5614,05 | 132,49 | 883,19 | 60,91 | 424,90 |
| 2010 | NO | 4,52 | 328,33 | 84,69 | 416,57 | 11,94 | 6768,71 | 145,74 | 907,71 | 60,91 | 484,93 |
| 2011 | 1,00 | 4,81 | 317,19 | 79,93 | 565,10 | 9,97 | 7978,41 | 178,68 | 924,75 | 85,40 | 558,36 |

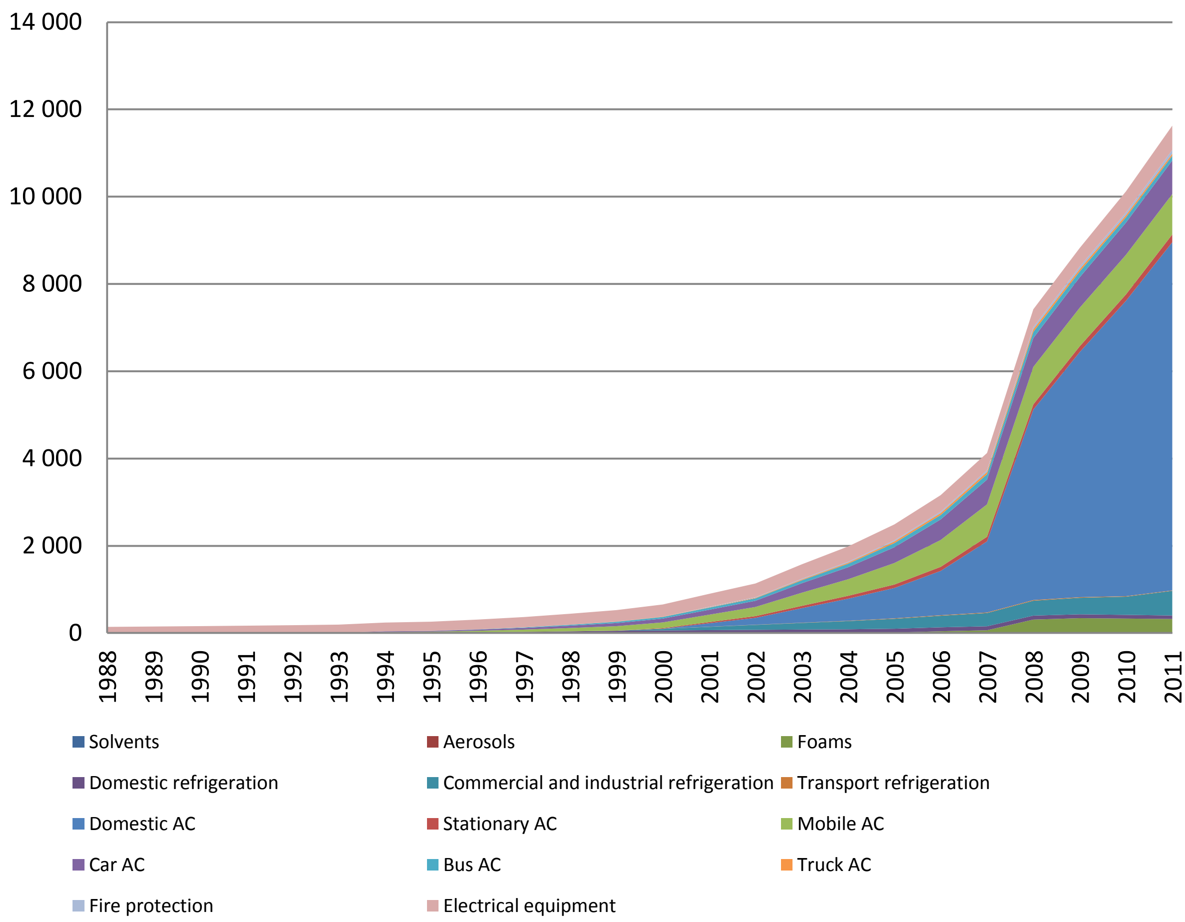



Figure 69 Potential emissions [Gg $CO_2$-eq.]

## 4.5.1 REFRIGERATION AND AIR CONDITIONING

### 4.5.1.1 Source Category Description

Depending on the purpose and specifics of the country, the refrigeration and air conditioning equipment can be divided into six major subcategories listed below. It should be noted that according to a recent study (Lambrev, 2010), subsector Refrigeration and Air Conditioning employs over 1000 certified technicians and over 70 licensed service companies in the country.

#### 4.5.1.1.1 Domestic refrigeration (2.IIA.F.1.1)

There is no production of domestic refrigeration using HFCs in Bulgaria. The producers have switched from CFCs, HFCs, HCFCs and ammonia to other alternatives as i-butane, for example. Therefore, the calculations on this subsector are based on data for imports. The following table represents the activity date for the subsector:

Table 131 Activity data for Domestic refrigeration – HFC-134a [kg]

| Activity Data | Filled in new manufactured products | In operating systems | Remained in products at decommissioning | Actual emissions from manufacturing | Actual emissions from stocks | Actual emissions from disposal |
|---|---|---|---|---|---|---|
| **1988** | NO | NO | NO | NO | NO | NO |
| **1989** | NO | NO | NO | NO | NO | NO |
| **1990** | NO | NO | NO | NO | NO | NO |
| **1991** | 558 | 558 | NO | NO | NO | NO |
| **1992** | 1344 | 1899 | NO | NO | 2 | NO |
| **1993** | 2203 | 4096 | NO | NO | 6 | NO |
| **1994** | 2551 | 6636 | NO | NO | 12 | NO |
| **1995** | 4000 | 10615 | NO | NO | 20 | NO |
| **1996** | 4463 | 15047 | NO | NO | 32 | NO |
| **1997** | 5503 | 20504 | NO | NO | 45 | NO |
| **1998** | 9341 | 29784 | NO | NO | 62 | NO |
| **1999** | 11111 | 40805 | NO | NO | 89 | NO |
| **2000** | 6010 | 46692 | NO | NO | 122 | NO |
| **2001** | 5460 | 52012 | NO | NO | 140 | NO |
| **2002** | 5035 | 56891 | NO | NO | 156 | NO |
| **2003** | 5027 | 61747 | NO | NO | 171 | NO |
| **2004** | 3969 | 65531 | NO | NO | 185 | NO |
| **2005** | 2280 | 67615 | NO | NO | 197 | NO |
| **2006** | 2458 | 69312 | NO | NO | 203 | 558 |
| **2007** | 2614 | 70375 | NO | NO | 208 | 1344 |
| **2008** | 2061 | 70022 | NO | NO | 211 | 2203 |
| **2009** | 1071 | 68332 | NO | NO | 210 | 2551 |
| **2010** | 1019 | 65146 | NO | NO | 205 | 4000 |
| **2011** | 998 | 61485 | NO | NO | 195 | 4463 |

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

In this subsector emissions from the production of refrigerators, emissions from refrigeration of goods in a supermarket for example, as in other retail outlets are included. The task to determine emissions from this sector is complex because it is more heterogeneous in terms of equipment characteristics: design, size, type of refrigerant, the amount of losses and more. In addition to supermarkets, there is also a wide range of equipment for other types of applications - slaughterhouses, gastronomy, agriculture and others. In contrast to household refrigeration equipment or automotive air conditioning systems, systems that are manufactured in batch production are in smaller quantities than those produced on demand.

Today the most commonly used blend of HFC is R-404A, which becomes even more important than HFC-134a. R-407C also plays an important role. Currently, there are still banked amounts of HCFC-22.

Since the available data does not permit a separate calculation of the banked quantities used in commercial and industrial refrigeration equipment and since the emission factors as recommended by the IPCC Guidelines, are in similar margins, it was decided the two subcategories - commercial and industrial refrigeration - to be grouped and evaluated together.

Even before the entry into force of the Montreal Protocol bans for the use of CFCs and HCFCs (which were subsequently implemented in the European and national legislation), industrial refrigeration equipment was the only sector using alternative cooling agents in significant quantities (mainly ammonia). However, after the ban on the CFC-12 use, imposed by the Montreal Protocol, the main substitute on the market became different types of HFCs. It is also difficult to determine the annual inflow of new refrigerant for this sector due to the its heterogeneity. The following four tables represent the activity date for the subsector:

Table 132 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 |
| 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 |
| 2011 | 5811 | 26923 | NO | 102 | 2357 | NO |

Table 133 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 |
| 2011 | 622 | 4949 | NO | 11 | 482 | NO |

Table 134 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 |

| Activity Data | Filled in new manufactured products | In operating systems | Remained in products at decommissioning | Actual emissions from manufacturing | Actual emissions from stocks | Actual emissions from disposal |
|---|---|---|---|---|---|---|
| 2005 | 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 |
| 2011 | 29179 | 81145 | NO | 511 | 5831 | NO |

Table 135 Activity data for Commercial refrigeration – HFC-143a [kg]

| Activity Data | Filled in new manufactured products | In operating systems | Remained in products at decommissioning | Actual emissions from manufacturing | Actual emissions from stocks | Actual emissions from disposal |
|---|---|---|---|---|---|---|
| 1988 | NO | NO | NO | NO | NO | NO |
| 1989 | NO | NO | NO | NO | NO | NO |
| 1990 | NO | NO | NO | NO | NO | NO |
| 1991 | NO | NO | NO | NO | NO | NO |
| 1992 | NO | NO | NO | NO | NO | NO |
| 1993 | NO | NO | NO | NO | NO | NO |
| 1994 | NO | NO | NO | NO | NO | NO |
| 1995 | NO | NO | NO | NO | NO | NO |
| 1996 | NO | NO | NO | NO | NO | NO |
| 1997 | NO | NO | NO | NO | NO | NO |
| 1998 | NO | NO | NO | NO | NO | NO |
| 1999 | NO | NO | NO | NO | NO | NO |
| 2000 | 5346 | 5252 | NO | 94 | NO | NO |
| 2001 | 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 |
| 2011 | 27348 | 78864 | NO | 479 | 5777 | NO |

#### 4.5.1.1.3 Transport refrigeration (2.IIA.F.1.3)

Since the reporting of refrigeration vehicles is not obligated by the legislation, as it is for stationary equipment above 3 kg, there are not many companies, which have submited any data in their annual reports to the RIEW. It is observed that the reports are missing data for years before 2007, and the available for 2007, 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 136 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 |
| 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 |
| 2011 | 551 | 5208 | NO | 5 | 1096 | 633 |

Table 137 Activity data for Transport refrigeration – HFC-152a [kg]

| Activity Data | NO | NO | NO | NO | NO | NO |
|---|---|---|---|---|---|---|
| **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 |

| Activity Data | 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 | 14 | 14 | NO | 0,08 | NO | NO |
| 2002 | 9 | 21 | NO | 0,05 | 2 | NO |
| 2003 | 14 | 32 | NO | 0,08 | 3 | NO |
| 2004 | 5 | 32 | NO | 0,03 | 5 | NO |
| 2005 | NO | 27 | NO | NO | 5 | NO |
| 2006 | NO | 23 | NO | NO | 4 | NO |
| 2007 | NO | 20 | NO | NO | 3 | NO |
| 2008 | NO | 17 | NO | NO | 3 | NO |
| 2009 | NO | 14 | NO | NO | 3 | NO |
| 2010 | NO | 12 | NO | NO | 2 | NO |
| 2011 | NO | NO | NO | NO | NO | NO |

Table 138 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 |
| 2011 | NO | 41 | NO | NO | 7 | NO |

Table 139 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 | 0,53 | 27 | NO |
| 2003 | 125 | 281 | NO | 0,75 | 39 | NO |
| 2004 | 165 | 385 | NO | 0,99 | 56 | 4 |
| 2005 | 251 | 547 | NO | 1,50 | 77 | 11 |
| 2006 | 319 | 741 | NO | 1,92 | 109 | 14 |
| 2007 | 254 | 827 | NO | 1,52 | 148 | 18 |
| 2008 | 212 | 850 | NO | 1,27 | 165 | 23 |
| 2009 | 49 | 682 | NO | 0,30 | 170 | 47 |
| 2010 | 53 | 535 | NO | 0,32 | 136 | 63 |
| 2011 | 90 | 428 | NO | 0,54 | 107 | 89 |

Table 140 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 | 0,5 | 0,5 | NO | 0,00 | NO | NO |
| 1996 | 1,4 | 1,8 | NO | 0,01 | 0,1 | NO |
| 1997 | 1,8 | 3,2 | NO | 0,01 | 0,4 | NO |
| 1998 | 2,3 | 4,8 | NO | 0,01 | 0,6 | NO |
| 1999 | 3,0 | 6,9 | NO | 0,02 | 1,0 | NO |
| 2000 | 6,0 | 11,5 | NO | 0,04 | 1,4 | NO |
| 2001 | 8,0 | 17,1 | NO | 0,05 | 2,3 | NO |
| 2002 | 11,5 | 25,1 | NO | 0,07 | 3,4 | 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 |
|---|---|---|---|---|---|---|
| **2003** | 16,0 | 36,0 | NO | 0,10 | 5,0 | NO |
| **2004** | 21,5 | 49,7 | NO | 0,13 | 7,2 | 0,5 |
| **2005** | 33,2 | 71,3 | NO | 0,20 | 9,9 | 1,4 |
| **2006** | 42,9 | 98,0 | NO | 0,26 | 14,3 | 1,8 |
| **2007** | 32,3 | 108,1 | NO | 0,19 | 19,6 | 2,3 |
| **2008** | 27,3 | 110,6 | NO | 0,16 | 21,6 | 3,0 |
| **2009** | 6,1 | 88,5 | NO | 0,04 | 22,1 | 6,0 |
| **2010** | 6,5 | 69,3 | NO | 0,04 | 17,7 | 8,0 |
| **2011** | 10,9 | 54,7 | NO | 0,07 | 13,9 | 11,5 |

Table 141 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 | 1 | NO |
| **1997** | 14 | 25 | NO | 0,08 | 3 | 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 | 0,55 | 28 | NO |
| **2003** | 129 | 289 | NO | 0,77 | 40 | NO |
| **2004** | 170 | 396 | NO | 1,02 | 58 | 4 |
| **2005** | 257 | 562 | NO | 1,54 | 79 | 11 |
| **2006** | 327 | 760 | NO | 1,96 | 112 | 14 |
| **2007** | 262 | 850 | NO | 1,57 | 152 | 18 |
| **2008** | 219 | 873 | NO | 1,31 | 170 | 24 |
| **2009** | 51 | 701 | NO | 0,31 | 175 | 49 |
| **2010** | 55 | 550 | NO | 0,33 | 140 | 66 |
| **2011** | 93 | 441 | NO | 0,56 | 110 | 91 |

#### 4.5.1.1.4 Stationary air conditioning (2.IIA.F.1.5)

Stationary air conditioning is divided on domestic and commercial air conditioning systems, respectively divided into more than 20 kW and 20 kW of power. Commercial systems have capacity that is able to provide a comfortable temperature in the whole buildings (central air conditioning systems) or large rooms. In both types of systems, a wide range of HFC is used. Emissions may occur during installation, charging and

disposal. Emissions from domestic and commercial air conditioning systems are calculated separately. The following four tables represent the activity date for the subsector, divided by HFC types:

Table 142 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 | 82196 | 250076 | NO | 19 | 4850 | NO |
| 2007 | 154406 | 397590 | NO | 20 | 6872 | NO |
| 2008 | 663439 | 1050359 | NO | 21 | 10648 | NO |
| 2009 | 326180 | 1349460 | NO | 23 | 27056 | NO |
| 2010 | 310947 | 1625761 | NO | 24 | 34622 | NO |
| 2011 | 337515 | 1921568 | NO | 90 | 41618 | NO |

Table 143 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 |

| 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** | 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** | 85357 | 261608 | NO | 34 | 5500 | NO |
| **2007** | 159134 | 413050 | NO | 36 | 7655 | NO |
| **2008** | 678648 | 1080059 | NO | 39 | 11600 | NO |
| **2009** | 334599 | 1386183 | NO | 41 | 28435 | NO |
| **2010** | 319147 | 1669040 | NO | 43 | 36247 | NO |
| **2011** | 344554 | 1970024 | NO | 93 | 43477 | NO |

Table 144 Activity data for Stationary air conditioning – HFC-143a [kg]

| Activity Data | Filled in new manufactured products | In operating systems | Remained in products at decommissioning | Actual emissions from manufacturing | Actual emissions from stocks | Actual emissions from disposal |
|---|---|---|---|---|---|---|
| **1988** | NO | NO | NO | NO | NO | NO |
| **1989** | NO | NO | NO | NO | NO | NO |
| **1990** | NO | NO | NO | NO | NO | NO |
| **1991** | NO | NO | NO | NO | NO | NO |
| **1992** | NO | NO | NO | NO | NO | NO |
| **1993** | NO | NO | NO | NO | NO | NO |
| **1994** | NO | NO | NO | NO | NO | NO |
| **1995** | NO | NO | NO | NO | NO | NO |
| **1996** | NO | NO | NO | NO | NO | NO |
| **1997** | NO | NO | NO | NO | NO | NO |
| **1998** | NO | NO | NO | NO | NO | NO |
| **1999** | NO | NO | NO | NO | NO | NO |
| **2000** | 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 |
| **2011** | 1363 | 10858 | NO | 14 | 1057 | NO |

Table 145 Activity data for Stationary air conditioning – HFC-134a [kg]

| Activity Data | Filled in new manufactured products | In operating systems | Remained in products at decommissioning | Actual emissions from manufacturing | Actual emissions from stocks | Actual emissions from disposal |
|---|---|---|---|---|---|---|
| 1988 | NO | NO | NO | NO | NO | NO |
| 1989 | NO | NO | NO | NO | NO | NO |
| 1990 | NO | NO | NO | NO | NO | NO |
| 1991 | NO | NO | NO | NO | NO | NO |
| 1992 | NO | NO | NO | NO | NO | NO |
| 1993 | NO | NO | NO | NO | NO | NO |
| 1994 | NO | NO | NO | NO | NO | NO |
| 1995 | NO | NO | NO | NO | NO | NO |
| 1996 | NO | NO | NO | NO | NO | NO |
| 1997 | NO | NO | NO | NO | NO | NO |
| 1998 | NO | NO | NO | NO | NO | NO |
| 1999 | NO | NO | NO | NO | NO | NO |
| 2000 | 6171 | 6149 | NO | 22 | NO | NO |
| 2001 | 8649 | 14453 | NO | 25 | 320 | NO |
| 2002 | 12769 | 26500 | NO | 27 | 694 | NO |
| 2003 | 25684 | 50992 | NO | 29 | 1162 | NO |
| 2004 | 26019 | 75039 | NO | 31 | 1941 | NO |
| 2005 | 28933 | 101229 | NO | 34 | 2709 | NO |
| 2006 | 46191 | 143854 | NO | 36 | 3530 | NO |
| 2007 | 84668 | 223721 | NO | 38 | 4762 | NO |
| 2008 | 354928 | 571683 | NO | 40 | 6926 | NO |
| 2009 | 176135 | 731984 | NO | 43 | 15791 | NO |
| 2010 | 168213 | 880187 | NO | 45 | 19965 | NO |
| 2011 | 182771 | 1039036 | NO | 84 | 23837 | NO |

#### 4.5.1.1.5 Mobile air conditioning (2.IIA.F.1.6)

Emissions from mobile air conditioners are summarized in the IPCC manual under the chapter "3.7.5. Mobile air-conditioning sub-source category". There are no special comments, guidelines and methodologies for the separation of air conditioners into different subcategories. However, in this report, mobile air conditioners are divided into three subcategories - for cars, trucks 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 146 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 |

| 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** | 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 |
| **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 |
| **2011** | 95612 | 711349 | NO | NO | 82166 | 3083 |

### 4.5.1.2 Methodological Issues

#### 4.5.1.2.1 Domestic refrigeration (2.IIA.F.1.1)

A default emission factor of 0.3% per year and average amount of refrigerant in a number of equipment - 0,1 kg was used (IPCC, 2006). The results, obtained according Tier 2a show an annual emission of 6.06 Gg $CO_2$-eq. for 2011 and potential emissions of 79.93 Gg $CO_2$-eq. for the observed period (1988-2011). In this subsector, emissions from disposal are estimated with lifetime of the equipment set to 15 years (which falls within the boundaries set by IPCC Guidelines, 1996 and 2006).

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

Emission factor of 1.75% was used for the first year and 10% emission factor for emissions from operation (IPCC, 2006). Emissions from disposal 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.

#### 4.5.1.2.3 Transport refrigeration (2.IIA.F.1.3)

The only data that was obtained is used for the amount of refrigerant in the railways from 1998 to 2011. 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.

#### 4.5.1.2.4 Stationary air conditioning (2.IIA.F.1.5)

Data about domestic AC was received from NSI. The most commonly used refrigerants are R-407C and R-410A (in ratio of approximately 2:3). The calculation of emissions from domestic systems was made after the following assumptions: default EF of 2,5% (IPCC, 2006) was used and the average quantity of agent is 2,92 kg per unit equipment (F-gases Germany, 2005). Emission lifetime is set to 15 years. The results are calculated based on Tier 2a.

Data on F-gas quantities used in the commercial air conditioning equipment were obtained from RIEW reports that importers, operators and service companies are required to report each year. Emissions from disposal are included as well with average lifetime of 15 years. The results are based on Tier 2a.

#### 4.5.1.2.5 Mobile air conditioning (2.IIA.F.1.6)

The Guidelines does not take into account the quantities of refrigerant over 1.5 kg and therefore offers no default emission factors for such systems. Only quantities over 1.5 kg for bus air-conditioners are used for the calculations.

Due to the specifics of the Bulgarian car market, a detailed model for the emissions calculation from Car AC subsector had to be created. As regards the fact that in Bulgaria there is no production of cars, trucks or buses, data about import from NSI was used (data from the Association of Automobile manufacturers and their authorized representatives in Bulgaria, which have data from 1991 to today is used for verification),. For the proper assessment of the Bulgarian fleet, a detailed statistics of the largest website in the country for trade of new and used cars, including the year of manufacture of the vehicle, the presence of air-conditioning system and year of import in Bulgaria was obtained. The results obtained are based on Tier 2a method.

For the selection of appropriate EF, a number of foreign researches have been reviewed. The most detailed information was found in a British study (AEAT, 2003), in which values are set for an average amount of agent 1,2 kg in 1993, declining to 0,8 kg in 2000. Expectations of this study is the amount to decrease up to 0,6 kg in 2010 on the annual level of losses (which include losses from normal use and losses in accidents), the data show that losses in 1995 is amounted to 15%, reducing to 10% in 2000 and projections are for about 6% in 2010. Disposal emissions are not calculated as average lifetime for the country is very high (over 20 years). Overall emissions are overestimated due to the fact that it is assumed that after the refrigerant has been leaked, it has been recharged in 100% of the cases.

According to various international studies (F-gases Germany, 2005; AEAT, 2003), the average quantity of refrigerant in air conditioning systems in the cabins of trucks varies around 1,00-1,20 kg. Similar studies are an appropriate source of information for this report, since Bulgaria does not produce trucks, as well as studies in this field.

According to the classification of NSI (NSI, 2011) whose data were used, mainly trucks are divided by weight - less than 5 t, 5-20 t and over 20 t. In the lowest grade trend over the years is the amount of refrigerant to decrease from 1 to 0,85 kg, while in the other two classes, it remains constant - 1,20 kg. However, for the purposes of this project, a constant quantity of 1 kg for the lower class was chosen, because of lack of accurate data on truck fleet in Bulgaria and the assumption that the car park is older than the average age for Western Europe. The amount of coolant in the three classes vary in small range, since it considers that the magnitude of the cabin and the corresponding volume to be cooled remain almost identical regardless of the increasing weight of the vehicle.

The refrigerant used is mainly HFC-134a. It enters mass market after 1993-1995, as a substitute of CFC-12. At the end of 1993 in Germany, half of all new trucks used cooling agent based on HFCs. Admittedly, in Bulgaria this share was lower. Studies show that from 1994 to 2002, the percentage of trucks with air conditioners has increased from 5 to 32% and this share continues to grow today, especially for heavy trucks (Schwarz, 2007a).

Operating losses of coolant here are much higher than in vehicle AC for number of reasons such as long time driving, larger loads, the greater length of piping and more. No evidence of studies on the loss of agent in trucks over 1,5 t was observed. Additional 5% on 10% emissions during operation are considered acceptable because of the

possibility of higher losses in trucks compared to cars and light trucks. The results obtained are based on Tier 2a.

It is assumed that all coaches manufactured after 1999 are equipped with air-conditioning system, and since 1995 their percentage is growing slowly from 20% (AEAT, 2003). As with other mobile air conditioning systems, here the most used cooling agent is HFC-134a. Its average quantity contained in one air conditioner is assumed to be 12 kg. The length of piping may exceed 30 m in order to reach the cooled air to all passengers. Due to this great length, emissions from leakage are increased. Emissions of refrigerant in use are accepted as 15% annually. Here, as in trucks, to 10% emission factor adopted for passenger cars a further 5% were added due to longer pipelines and more frequent bus exploitation. Equipment lifetime is assumed to be 15 years. Emissions from disposal are also included. Calculations were conducted according to Tier 2a methodology.

#### 4.5.1.3 Uncertainties and time-series consistency

##### 4.5.1.3.1 Domestic refrigeration (2.IIA.F.1.1)

The share of domestic refrigeration equipment using HFCs in Bulgaria has been allocated approximately from 0% in 1990 to a maximum of 90% in 1998. A drop follows to 40% in 2002 and 5% in 2005. These numbers show the change of Bulgarian producers and importers to use a hydrocarbon refrigerant, replacing HFCs. It is believed that the level of equipment containing HFCs after 2005 remains within 5%. According to a relevant British study (AEAT, 2003) the only agent to be used in this sector is HFC-134a, which has GWP of 1300. Data about the calculation of emission was extracted from the import of refrigeration and air conditioning of the NSI from 2000 to 2010. Data for the years 1988-1999 was extrapolated as a function of data about the total amount of imports of goods and services in Bulgaria (NSI, 2011). An uncertainty in the rage of 20-100% is applied.

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

Since the beginning of 2009 in Bulgaria a new legal instrument (Ordinance establishing measures for the implementation of Regulation (EC) № 842/2006 on certain fluorinated greenhouse gases, called The Ordinance for short) is in effect, that fulfils the Regulation (EC) № 842/2006 requirements. According to the Ordinance, operators of equipment containing more than 3 kg refrigerant must report annually their relevant quantities to RIEWs, which then send a summary report of all reported to MOEW. Prior to 2008, the reports have been prepared under the legislation for the control and management of ODS. In order to assess emissions from this sector, reports from all 16 RIEW in Bulgaria for the period 1996-2010 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%.

#### 4.5.1.3.3 Transport refrigeration (2.IIA.F.1.3)

It is a high uncertainty (80%) that emissions from this subsector are calculated based on many assumptions extracted from foreign studies and do not reflect in the best way the Bulgarian case.

#### 4.5.1.3.4 Stationary air conditioning (2.IIA.F.1.5)

Data for actual numbers of AC units is available for the period 2000-2005. For the period after 2006 the NSI provides data only for the total money spent on AC equipment. To estimate the number of units after 2006, first the average price of an AC unit calculated for 2005 and the the total numbers for the next period were divided into in. The average price for 2005 was taken insted of average price for 2000-2005 because throught the period the price of a single AC unit drops with a stready trend. Admission was made that before 1999 the majority of equipment was using CFCs and therefore, the calculations do not include the years before 2000. After 2007, legislative modifications have forced the import of equipment with HFCs. Despite that 35% of the refrigerant used in this sector is assumed still to be a CFC (AEAT, 2003).

It is believed that the data concerning commercial AC and reported for the years before 2009 from RIEW reports are not reliable enough. Therefore, to calculate the emissions, data for 2011 were used by 1% emission factor for the first year and 10% in operating emission factor (IPCC, 2006) and then linearly extrapolated back to 1999. Uncertainty is assumed to be around 15%.

#### 4.5.1.3.5 Mobile air conditioning (2.IIA.F.1.6)

Data on annual imports of new and second hand cars from NSI was received for the period 2000-2011. 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 2000-2011 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 2011. For the years before 2000, data were based on extrapolation of the imports of goods and services for the period 1988-1999 (World Bank, 2011).

The subsector is assumed to have approx. 80% uncertainty.

### 4.5.1.4 Source-Specific QA/QA and Verification

In general, the whole Refrigeration and air conditioning subsector (CRF 2.F.1) is verified by an external expert from the MOEW. The expert was introduced with all activity data collection and assumptions, methodological issues and calculation approaches. After a discussion, some measures and improvements, concerning assumptions of the overall subsector were decided to be implemented.

#### 4.5.1.5 Source-Specific recalculations

##### 4.5.1.5.1 Domestic refrigeration (2.IIA.F.1.1)

There are no recalculations in this category.

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

There are no recalculations in this category..

##### 4.5.1.5.3 Transport refrigeration (2.IIA.F.1.3)

There are no recalculations in this category.

##### 4.5.1.5.4 Stationary air conditioning (2.IIA.F.1.5)

A recalculation was made due to that in the previous submission, activity data is based on extrapolation for the number of goods and services. For the current submission activity data is based on market prices for single AC unit.

##### 4.5.1.5.5 Mobile air conditioning (2.IIA.F.1.6)

There are no recalculations in this category.

#### 4.5.1.6 Source-Specific planned improvements

In the next years, it s planned to make a step by step revison of data and models about each category. The firs step will be the revision of data concerning railway transport reported under "Transport refrigeration" - divison of data between mabile air conditioning equipment and mobile refrigeration equipment.

### 4.5.2 FOAM BLOWING(CRF 2.F.2)

#### 4.5.2.1 Source category description

Onl two types of HFCs are used in the manufacture of extruded polystyrene insulation foams (XPS), solid polyurethane foams and one component foams (OCF). In Bulgaria, there are several larger companies in the production of foams. The largest of them, using as a blowing agent HFCs, imports raw materials from abroad. Others are using $CO_2$ and/or water as a substitute for HCFCs.

A large manufacturers of XPS, using HFCs is on the Bulgarian market since 2005. Quantity of imported and used HFCs is reported annually. These quantities (reported to RIEW/MoEW) are used to calculate emissions in this category, by assuming the entire quantity of produced foams stays in the country (although more than 50% is exported). There is no data available for the quantities of foams containing HFCs that were imported in the country.

#### 4.5.2.2 Methodological issues

The data about quantities of HFCs were obtained from questionnaires and annual reports of RIEWs. Market research in Bulgaria showed that only HFC-134a and HFC-152a are used, where foam blowing is carried out with HFCs. For the purposes of the calculations, default emission factors were used as follows - for HFC-134a 25% loss in the first year and 0.75% annual loss, for HFC-152a - 50% EF for the first year and 25% per annum thereafter ( IPCC, 2006). Global warming potential of the two gases are respectively 1300 and 140 for HFC-134a and HFC-152a. The results, calculated based on Tier 2a, represent 32,36 Gg $CO_2$-eq. actual emissions in 2011 and 317,19 Gg $CO_2$-eq. potential emissions.

Activity data for Foam blowing – HFC-152a, HFC-134a could not be reported, because there is only one producer and data is confidential.

#### 4.5.2.3 Uncertainties and time-series consistency

It is assumed that import and export balance each other, but could also be 40/60 or 60/40 (20% uncertainty).

#### 4.5.2.4 Source-Specific QA/QA and Verification

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

#### 4.5.2.5 Source-Specific recalculations

A revision of activity data about used quantities of HFC-152A and HFC-134A is made for the period 2005-2010.

#### 4.5.2.6 Source-Specific planned improvements

There are no planned improvements in this category.

### 4.5.3 FIRE EXTINGIUSHERS(CRF 2.F.3)

#### 4.5.3.1 Source category description

According to experts from the industry, who have been asked, fire protections activities with the use of HFC in Bulgaria are implemented in very rare cases - mainly in fire protection systems installed in the server and computer rooms. At the same time in Bulgaria filling of fire fighting equipment is not practiced. It is all imported, as there are no Bulgarian manufacturers of fire protection equipment, using HFC. The following two tables represent the activity date for the subsector:

Table 147 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 |

| Activity Data | Filled in new manufactured products | In operating systems | Remained in products at decommissioning | Actual emissions from manufacturing | Actual emissions from stocks | Actual emissions from disposal |
|---|---|---|---|---|---|---|
| 1990 | NO | NO | NO | NO | NO | NO |
| 1991 | NO | NO | NO | NO | NO | NO |
| 1992 | NO | NO | NO | NO | NO | NO |
| 1993 | NO | NO | NO | NO | NO | NO |
| 1994 | NO | NO | NO | NO | NO | NO |
| 1995 | 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 | 879 | 837 | NO | NO | 42 | NO |
| 2002 | 259 | 1043 | NO | NO | 52 | NO |
| 2003 | 323 | 1301 | NO | NO | 65 | NO |
| 2004 | 402 | 1622 | NO | NO | 81 | NO |
| 2005 | 501 | 2022 | NO | NO | 101 | NO |
| 2006 | 625 | 2521 | NO | NO | 126 | NO |
| 2007 | 779 | 3143 | NO | NO | 157 | NO |
| 2008 | 972 | 3919 | NO | NO | 196 | NO |
| 2009 | 196 | 3919 | NO | NO | 196 | NO |
| 2010 | 196 | 3919 | NO | NO | 196 | NO |
| 2011 | 196 | 3919 | NO | NO | 196 | NO |

Table 148 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 | 3152 | 3002 | NO | NO | 150 | NO |
| 2002 | 928 | 3742 | NO | NO | 187 | NO |
| 2003 | 1157 | 4666 | NO | NO | 233 | NO |
| 2004 | 1442 | 5817 | NO | NO | 291 | NO |
| 2005 | 1798 | 7253 | NO | NO | 363 | NO |
| 2006 | 2242 | 9043 | NO | NO | 452 | NO |
| 2007 | 2795 | 11274 | NO | NO | 564 | NO |
| 2008 | 3485 | 14056 | NO | NO | 703 | 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** | 4023 | 17218 | NO | NO | 861 | NO |
| **2010** | 861 | 17218 | NO | NO | 861 | NO |
| **2011** | 9731 | 25666 | NO | NO | 1283 | NO |

#### 4.5.3.2 Methodological Issues

Data about banked HFC quantities in firefighting equipment were used(mainly FM-200 type), according to which the mainly used HFC is HFC-227ea (80%) and to a lesser extent - HFC-125. This data is provided by "National Fire Safety and Protection of Population Service" in Ministry of Interior. Using default EF of 5% of the IPCC Guidelines, 1996, the results obtained based on Tier 2a show actual emissions of 4,27 Gg $CO_2$-eq. and 85,40 Gg $CO_2$-eq. potential emission for both gases in 2011.

#### 4.5.3.3 Uncertainties and time-series consistency

Analysis of data obtained by the questionnaires from operators and importers determined that there is no use of F-gases in fire protection equipment before 2005, while reports of RIEW have reported small amounts of HFC-227ea imports since 2001. Therefore, it is assumed that the starting year of HFC usage in fire protection equipment is 2001. To calculate emissions for the years before 2008, an assumption for linear growth of about 25% in fire fighting equipment was made. Uncertainty is considered to be in range of 60-100% of the original value.

#### 4.5.3.4 Source-Specific QA/QA and Verification

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

#### 4.5.3.5 Source-Specific recalculations

Revision of data from the "National Fire Safety and Protection of Population Service" for the period 2008-2010.

#### 4.5.3.6 Source-Specific planned improvements

No source-specific planned improvements are to be performed.

### 4.5.4 AEROSOLS (CRF 2.F.4)

#### 4.5.4.1 Source category description

The used HFCs as propellants currently are HFC-134a, HFC-227ea and HFC-152a. Data on their use as medical and technical aerosols were obtained directly from industry by telephone calls and questionnaires. After direct contact with experts from the industry, the researched showed that in Bulgaria there is only one producer, which uses HFC-134a in the production of aerosols. There are several companies working in this field, but they do not use any F-gases.

Concerning the import and usage of meter dose inhalers (MDIs) in the medicine, according to an official letter of the Executive Drug Agency in Bulgaria HFC-134a is the only F-gas used in MDIs. The Agency provided a full list of operators and importers of MDIs, containing HFC-134a. A profound research on those companies and contacting them helped in collecting data for the use of such equipment since 2005. Therefore, the results are based on real numbers, reported by the companies. The following table represents the activity date for the subsector:

Table 149 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 | 779,30 | NO | NO |
| 1999 | 925 | 462 | NO | 462,46 | 779 | NO |
| 2000 | 134 | 67 | NO | 67 | 462 | NO |
| 2001 | 323 | 162 | NO | 162 | 67 | NO |
| 2002 | 816 | 408 | NO | 408 | 162 | NO |
| 2003 | 996 | 498 | NO | 498 | 408 | NO |
| 2004 | 1640 | 820 | NO | 820 | 498 | NO |
| 2005 | 1990 | 995 | NO | 995 | 820 | NO |
| 2006 | 8039 | 4020 | NO | 4020 | 995 | NO |
| 2007 | 5485 | 2743 | NO | 2743 | 4020 | NO |
| 2008 | 7984 | 3992 | NO | 3992 | 2743 | NO |
| 2009 | 7855 | 3928 | NO | 3928 | 3992 | NO |
| 2010 | 6953 | 3477 | NO | 3477 | 3928 | NO |
| 2011 | 7400 | 3700 | NO | 3700 | 3477 | NO |

### 4.5.4.2 Methodological Issues

According to the 2006 IPCC Guidelines, aerosol emissions are considered to be immediate, occurring during the first year of production. Using data on quantities of HFC-134a consumed by the company for the period 1988-2011, the default EF of 50% for the first year and 100% for the next year (IPCC, 2006), emissions were calculated as 4,81 Gg $CO_2$-eq. potential emissions in 2011 and 9.33 Gg $CO_2$-eq. real emissions in 2011. The EFs selected are default because of the absence of specific empirical data on the territory of Bulgaria. Results are obtained according to Tier 2a method.

### 4.5.4.3 Uncertainties and time-series consistency

Uncertainty is assumed to be around 30% for the whole subsector.

### 4.5.4.4 Source-Specific QA/QA and Verification

Data is verified by MOEW expert.

#### 4.5.4.5 Source-Specific recalculations

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.

#### 4.5.4.6 Source-Specific planned improvements

No source-specific planned improvements are to be performed.

# 5 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

## 5.1 OVERVIEW OF SECTOR

This chapter describes the methodology used for calculating greenhouse gas emissions from solvent use in Bulgaria. Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber and plastic. They are used also in production of chemicals, in printing industry or for cleaning purposes (degreasing of metals and dry cleaning). Most of the solvents are released into air after application of these substances or other processing. Solvents consist mainly of NMVOC, it is the cause their use is a major source for anthropogenic NMVOC emissions. Once released into the atmosphere NMVOCs react with air molecules (mainly HO-radicals) or high energetic light and generated emission of $CO_2$.

$N_2O$ emissions are caused by medical uses of $N_2O$ (for anaesthesia) and other possible sources emissions (aerosol cans).

$CO_2$ emissions from CRF sector 3D5.1, 3D5.2 and 3D5.3 are estimated, based on conversion factor, provided by 2006 IPCC Guidelines.
Calculation of $N_2O$ emission from CRF sector 3 D.1 are based on emission factor in accordance with 2006 IPCC Guidelines.

### 5.1.1 EMISSION TRENDS

Greenhouse gas emissions in this sector decrease by 95.41 % between 1988 and 2011. 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 - 2011. 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.

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

The trend of NMVOC and $CO_2$ emissions is presented in Figure 70 and Table 150 and also in Table 151.

The drop from 1993 to 1995 is mainly due to economic crisis. The production of many plants in Bulgaria is decreased in the same period; thus the metal degreasing activities decreased.

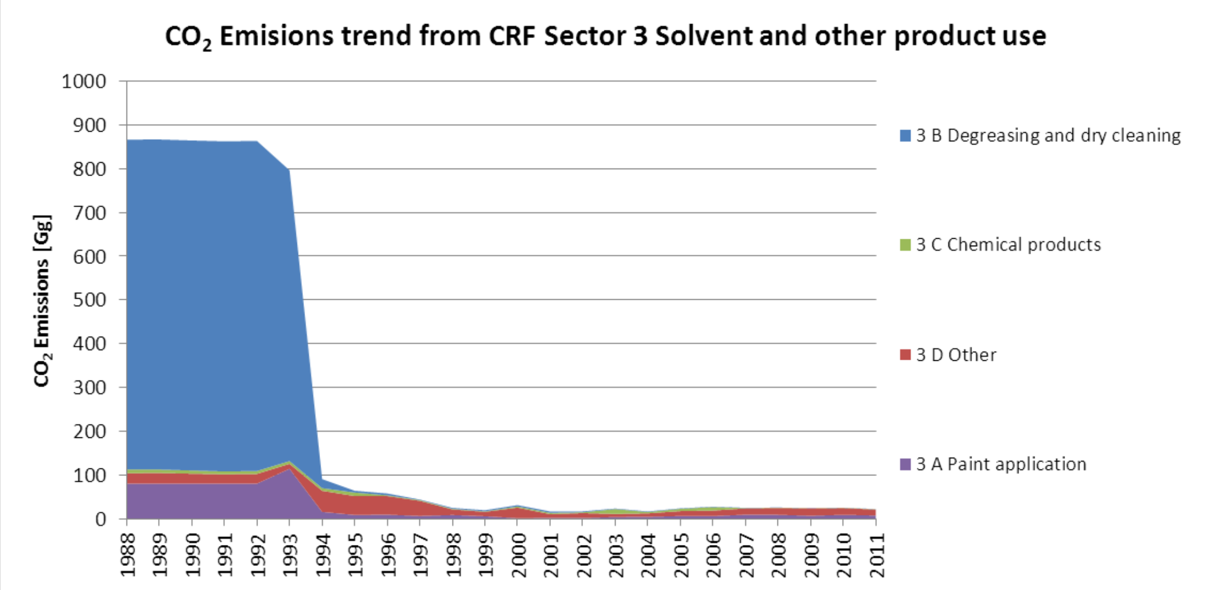



Figure 70 Trend of $CO_2$ emissions from CRF sector 3 Solvent and other product use

Table 150 Trend of NMVOC emissions from Solvent and other product use, Gg

| | 3 A | 3 B | 3 C | 3 D | | | |
|---|---|---|---|---|---|---|---|
| Sub-categories | Paint Application | Degreasing and Dry Cleaning | Chemical Products, Manufacturing and Processing | Pharmacy | Use of lacquers and solvents | Vegetable Oil Production | Total |
| **1988** | 36.517 | 342.76 | 3.652 | 0.126 | 7.716 | 3.115 | 393.88 |
| **1989** | 36.517 | 342.76 | 3.673 | 0.123 | 7.716 | 3.198 | 393.98 |
| **1990** | 36.517 | 342.76 | 3.33 | 0.121 | 7.716 | 2.512 | 392.95 |
| **1991** | 36.517 | 342.76 | 3 | 0.12 | 7.716 | 1.917 | 392.03 |
| **1992** | 36.517 | 342.76 | 3.004 | 0.119 | 7.716 | 2.323 | 392.43 |
| **1993** | 51.914 | 301.96 | 2.861 | 0.118 | 2.337 | 2.721 | 361.91 |
| **1994** | 7.203 | 9.38 | 2.732 | 0.118 | 19.295 | 2.543 | 41.27 |
| **1995** | 3.998 | 1.92 | 3.608 | 0.117 | 16.155 | 3.428 | 29.22 |
| **1996** | 4.289 | 1.84 | 0.799 | 0.117 | 16.389 | 2.878 | 26.31 |
| **1997** | 2.971 | 0.58 | 0.754 | 0.116 | 12.886 | 2.798 | 20.11 |
| **1998** | 3.964 | 1.03 | 0.606 | 0.115 | 3.838 | 1.876 | 11.43 |
| **1999** | 2.73 | 1.14 | 0.493 | 0.115 | 2.643 | 1.83 | 8.95 |
| **2000** | 0.667 | 1.38 | 1.23 | 0.114 | 9.032 | 1.845 | 14.27 |
| **2001** | 0.975 | 1.42 | 1.328 | 0.11 | 2.273 | 1.607 | 7.71 |
| **2002** | 0.81 | 0.99 | 0.867 | 0.11 | 3.817 | 1.222 | 7.82 |
| **2003** | 1.893 | 0.59 | 5.008 | 0.109 | 1.751 | 1.393 | 10.74 |
| **2004** | 2.116 | 0.62 | 1.378 | 0.109 | 2.249 | 1.236 | 7.7 |
| **2005** | 2.911 | 0.45 | 2.372 | 0.108 | 3.548 | 1.487 | 10.88 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2006** | 2.853 | 0.45 | 3.601 | 0.108 | 4.159 | 1.491 | 12.66 |
| **2007** | 4.33 | 0.34 | 0.284 | 0.107 | 4.945 | 1.48 | 11.49 |
| **2008** | 4.183 | 0.1 | 0.294 | 0.106 | 5.63 | 1.442 | 11.76 |
| **2009** | 3.183 | 0.12 | 0.232 | 0.106 | 4.703 | 2.84 | 11.19 |
| **2010** | 4.647 | 0.16 | 0.276 | 0.105 | 5.144 | 1.77 | 12.102 |
| **2011** | 3.507 | 0.18 | 0.262 | 0.103 | 4.451 | 1.62 | 10.123 |

Table 151 Trend of $CO_2$ emissions from Solvent and other product use, 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 | 0.367 | 0.61 | 0.231 | 11.326 | 3.898 | 25.632 |
| **2011** | 7.724 | 0.405 | 0.58 | 0.226 | 9.792 | 3.550 | 22.277 |

**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 – 2011. The activity data are provided by the only Bulgarian Plant operator – NEOHIM AD.
The trend of $N_2O$ emissions is presented in Table 152.

Table 152 Trend of $N_2O$ emissions from Solvent and other product use, Mg

| Sub-categories | 3D1.Use of $N_2O$ for Anaesthesia | 3D3.$N_2O$ from Aerosol Cans | Population, 1000 number |
|---|---|---|---|
| **1988** | 106.95 | 0.09 | 8986.6 |
| **1989** | 106.95 | 0.088 | 8767.3 |
| **1990** | 106.95 | 0.087 | 8669.27 |
| **1991** | 106.95 | 0.086 | 8595.47 |
| **1992** | 106.95 | 0.085 | 8484.86 |
| **1993** | 107.38 | 0.085 | 8459.76 |
| **1994** | 115.87 | 0.084 | 8427.42 |
| **1995** | 100.95 | 0.084 | 8384.72 |
| **1996** | 108.32 | 0.083 | 8340.94 |
| **1997** | 113.44 | 0.083 | 8283.2 |
| **1998** | 125.73 | 0.082 | 8230.37 |
| **1999** | 118.84 | 0.082 | 8190.88 |
| **2000** | 119.3 | 0.081 | 8149.47 |
| **2001** | 121.82 | 0.079 | 7891.1 |
| **2002** | 129.62 | 0.078 | 7845.84 |
| **2003** | 118.53 | 0.078 | 7801.27 |
| **2004** | 103.01 | 0.078 | 7761.05 |
| **2005** | 86.17 | 0.077 | 7718.75 |
| **2006** | 83.39 | 0.077 | 7679.29 |
| **2007** | 80.08 | 0.076 | 7640.24 |
| **2008** | 81.31 | 0.076 | 7606.55 |
| **2009** | 74.83 | 0.076 | 7563.71 |
| **2010** | 65,00 | 0,075 | 7679.29 |
| **2011** | 61.26 | 0.073 | 7327.224 |

## 5.2 SOURCE CATEGORY DESCRIPTION

NMVOC emissions from Paint application, Degreasing and Dry cleaning, Chemical products and other product use are calculated, based on the emission factors, set in the EMEP/EEA Guidebooks (2006 and 2009) and activity data, provided by the NSI. For some categories as 060307 Paints manufacturing, the activity data are taken from the National Register under the European Solvents Directive 1999/13/EC.

The Solvent Inventory is based on the SNAP[30] systematic and has current reporting format under the LRTAP Convention – the NFR[31] format.

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

[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

**3. A Paint application**

This sector deals with the use of paints within the industrial and domestic sectors.

**Decorative coating application (3.A.1), which includes:**

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

**Industrial coating application (3.A.2), which includes:**

- Paint application: manufacture of automobiles (SNAP 060101)
- Paint application: car repairing (SNAP 060102)
- Paint application: coil coating (SNAP 060105)
- Paint application: boat building (SNAP 060106)
- Paint application: wood (SNAP 060107)
- Other industrial paint application (SNAP 060108)

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

- Other non-industrial paint application (SNAP 060109)

**3. B. Degreasing and Dry cleaning**

This category deals with the following activities:

**3. B.1 Degreasing** - process for cleaning products from water-insoluble substances such as grease, fats, oils, waxes, carbon deposits, fluxes and tars. In most cases the process is applied to metal products, but also plastic, fibreglass, printed circuit boards and other products are treated by the same process.

**3. B.2 Dry cleaning** - refers to any process to remove contamination from furs, leather, down leathers, textiles or other objects made of fibres using organic solvents.

**3. C Chemical products**

This sector covers the emissions from the use of chemical products, manufacture and processing.

**3. D 5 Other product use**

- Use of lacquers and solvents
- Printing industry (SNAP 060403)
- Fat, edible and non-edible oil extraction (SNAP 060404)
- Application of glues and adhesives (SNAP 060405)
- Preservation of wood (SNAP 060406)
- Vegetable Oil Production
- Pharmacy

## 5.3 METHODOLOGICAL ISSUES

### 5.3.1 METHODS

The Tier 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.

#### 5.3.1.1 $CO_2$ and $N_2O$ emissions from solvent and other product use

Converting of NMVOC into $CO_2$ with conversion factor is provided in 2006 IPCC Guidelines, Volume 1, Chapter 7.2.1.5 Carbon Emitted in Gases Other than $CO_2$.

From NMVOC:

$$Inputs_{CO_2} = Emissions_{NMVOC} \times C \times \frac{44}{12}$$

Where C is the fraction carbon in NMVOC by mass (default = 0.6)

Due to lack of data and the fact it is not a key category the default value is used.

Reference for default: conversion- factor NMVOC – $CO_2$, 2006 IPCC Guidelines , Volume 3, Chapter 5: Industrial Processes and Product Use, page 5.17, 2006 IPCC Guidelines s, Volume 1, Chapter 7: Precursors and Indirect Emissions, page 7.6

The $N_2O$ emissions from CRF sector 3 D.1 Use of $N_2O$ for Anaesthesia are estimated based on methodological issues set in the 2006 IPCC Guideline (Volume 3: Industrial Processes and Product Use, Chapter 8). Equation 8.24 for estimation of $N_2O$ emissions from other product use is implemented. It is assumed that none of the administered $N_2O$ is chemically changed by the body, and all is returned to the atmosphere. It is reasonable to assume an emission factor of 1.0. The activity data are provided by the only Bulgarian Plant operator – NEOHIM AD.

The estimation of emissions in CRF sector 3 D 3 $N_2O$ from Aerosol Cans is based on an assumption, that the intensity of using aerosols is the same as in Switzerland (10 grams per person per year of $N_2O$ emissions). There is no activity data available by manufacturers and distributors of $N_2O$ products for total quantity of $N_2O$ supplied by application type. Thus the $N_2O$ emissions from aerosol cans sub-category are estimated based on the assumption.

#### 5.3.1.2 Emission Factors

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

The default emission factors used for assessment of emissions of NMVOC from 3.A, 3.B, 3.C and 3D are presented in Table 153.

Table 153 Emission factors used for estimation of NMVOC emissions from Solvent and Other product use

| SNAP activity | Name of activity | Emission factor | Unit | Reference |
|---|---|---|---|---|
| **3.A Paint application** | | | | |
| 060101 | Manufacture of automobiles | 500 | g/kg of paint | EMEP/EEA guidebook – 2006 |
| 060102 | Car repairing | 720 | g/kg of paint | EMEP/EEA guidebook – 2009 |
| 060103 | Construction and buildings (except 060107) | 230 | g/kg of paint | EMEP/EEA guidebook – 2009 |
| 060104 | Domestic use (except 060107) | 230 | g/kg of paint | EMEP/EEA guidebook – 2009 |
| 060105 | Coil coating | 480 | g/kg of paint | EMEP/EEA guidebook – 2009 |
| 060106 | Boat building | 750 | g/kg of paint | EMEP/EEA guidebook – 2006 |
| 060107 | Wood | 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 processing | 60 | g/kg foam processed | |
| 060305 | Rubber processing | 8 | g/kg rubber produced | |
| 060306 | Pharmaceutical products manufacturing | 300 | g/kg solvents used | |

| SNAP activity | Name of activity | Emission factor | Unit | Reference |
|---|---|---|---|---|
| 060307 | Paints manufacturing | 11 | g/kg product | |
| 060308 | Inks manufacturing | 11 | g/kg product | |
| 060309 | Glues manufacturing | 11 | g/kg product | |
| 060310 | Asphalt blowing | 1710 | g/Mg asphalt | |
| 3.D Other product use | | | | |
| 060403 | Printing industry | 730 | g/kg ink | EMEP/EEA guidebook – 2009 |
| 060404 | Fat, edible and non-edible oil extraction | 3 | g/kg seed | EMEP/EEA guidebook – 2009 |
| 060405 | Application of glues and adhesives | 780 | g/kg adhesives | EMEP/EEA guidebook – 2009 |
| 060406 | Preservation of wood | 900 | g/kg preservative | EMEP/EEA guidebook – 2009 |
| 3D5.3 | Vegetable Oil Production | 18 | kg/t | CORINAIR |
| 3D5.2 | Pharmacy | 14 | kg/t | CORINAIR |

#### 5.3.1.3 Activity Data

The activity data for estimation of emissions in sector 3A.Paint application, 3B.Degreasing and Dry cleaning, 3C.Chemical products and 3D.Other product use are provided by the NSI. For the most SNAP activities under 3A, 3B, 3C and 3D the NSI has provided activity data just for the period 1992 – 2011.

For some categories as Paints manufacturing (SNAP 060307), the activity data for the last five years are taken from the National Register. NSI give us new data for 2010 of activity 3B2.Dry cleaning.

Due to lack of data, the activity data for the period 1988 – 1991 are taken the same as first available year.

### 5.3.2 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of the GHG emissions is presented in Table 154.

Table 154 Uncertainty of sector Solvents and Other product use, %

| CRF categories | Key Category | GHG | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty |
|---|---|---|---|---|---|
| 3 | No | $CO_2$ | 10 | 30 | 31.62 |
| 3 | No | $N_2O$ | 10 | 100 | 100,5 |

### 5.3.3 SOURCE-SPECIFIC QA/QC AND VERIFICATION, IF APPLICABLE

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

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

- Check of methodology, emissions, emission factors and IEF (time series);
- Time series consistency;
- Plausibility checks of the results (due to the national statistic and national VOC register);
- Documentation and archiving of all information required in NIR, background documentation and archive;
- QA procedures have been performed by the Sector expert in the MOEW (Order № RD-218/05.03.2010 by the Minister of Environment and Water).

### 5.3.4 SOURCE-SPECIFIC RECALCULATIONS

There are recalculation of activity 3. B.2 Dry cleaning because NSI give us new data for 2010.

### 5.3.5 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Obtaining additional data and comparing data for some sources using the National VOC Register.

Check if it is possible to provide the necessary activity data for $N_2O$ of aerosol cans from Bulgarian customs or other institution. At this moment there are no activity data for manufacturers and distributors or import and export of these $N_2O$ products.

# 6 AGRICULTURE (CRF SECTOR 4)

## 6.1 OVERVIEW OF SECTOR

This chapter gives information about the estimation of greenhouse gas emissions from Sector Agriculture in correspondence to the data reported under the Sector 4 in the Common Reporting Format. The following sources exist in Bulgaria:

- domestic livestock activities with enteric fermentation and manure management,
- rice cultivation,
- agricultural soils, and
- agricultural residue burning.

The agricultural holdings surveyed during the census in 2010 were 371 100, which is a decrease of 44% compared to the number of holdings surveyed during the census in 2003. A trend of decrease has been maintained over the recent years. Conducted sample surveys of the structure of agricultural holdings in 2005 and 2007 show that the number of holdings decreased by 19.7% in 2005 compared to 2003, by 7.8% in 2007 compared to 2005 and by 24.7% in 2010 compared to 2007.

The holdings owned by individuals are 363 700 or 98% of all agricultural holdings; followed by those owned by commercial companies – 1%, sole traders – 0.6%, cooperatives – about 0.3% and other holdings – about 0.1%.

357 900 agricultural holdings use agricultural area to the amount of 3 620 900 ha. An agricultural holding manages the average of 10.1 ha of utilized agricultural area (UAA), this indicator being the highest in the Northeast region (17.6 ha) and lowest in the Southwest region (3.6 ha).

Natural persons manage 33.8% of the UAA. The commercial companies manage 31.6% of the UAA of the country, the cooperatives – 17.7%, sole traders – 14.9%, and the remaining holdings – 2%.

In the UAA of 3 620 900 ha of the agricultural holdings, the share of arable land of 86.5% is the highest, followed by permanent grassland – 10.4% of the UAA. Permanent crops occupy 2.8% of the UAA.

The arable land is 3 133 000 hectares and is divided into 250 900 agricultural holdings. Cereals are grown on 47.8% of the holdings, representing 58.1% of the arable land. Industrial crops occupy 33.9% of the arable land and are grown on 23.1% of the holdings possessing arable land. Most industrial plants are grown in the Northwest region – 250 300 ha or 23.6%. Vegetables occupy 1.2% of the arable land and are grown mainly in the South Central region - 44.6% of the land under vegetables. Fodder crops are grown in 30% of the holdings on an area of 106,300 ha. This area is only 3.4% of the arable land.

The agricultural holdings with UAA from 0.00 to 1.99 ha in 2010 were 83.2% of all holdings. Over 78.2% of the UAA is located in holdings with an area of 100.00 ha or more, the average UAA of these holdings was 534 ha.

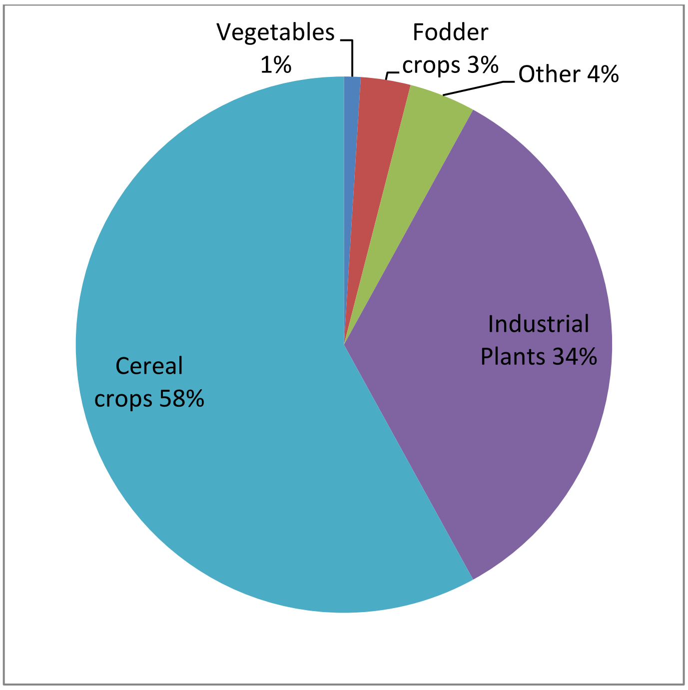
Around 280 300 were the holdings that kept livestock, poultry and bees as of 31 August 2010. Of these 91.5% used agricultural area from 0.01 ha to 10 ha (the analysis of the UAA of the holdings does not include collectively used common land for grazing animals). In the holdings with UAA from 0.01 ha to 10 ha 86.6% of equidae species, 82.5% of goats and 65.8% of sheep were raised. Cattle were raised in 34.1% of the holdings. Of these 4.4% did not have UAA and raised 7.7% of cattle, and the holdings with UAA from 0.01 ha to 10 ha were 89.1% and they raised 51.0% of the cattle. In the holdings without UAA 45.1% of the pigs and 47.6% of the birds were raised. 66.2% of the livestock holdings raised poultry. Over 10 ha of UAA were owned by 3.8% of the livestock breeding holdings. 5% of the holdings that raised pigs farmed more than 10 ha of the UAA and they raised 23.9% of the pigs.

About 100 of the surveyed agricultural holdings were engaged in activities for the production of mushrooms, growing of silkworms, hatcheries and others.

**Labour force in agriculture**

371 100 agricultural holdings employed 751 700 persons in 2010, the proportion of family labour force was 92.8% or 697 400 employed persons. 54 300 persons were employed in agriculture as paid workers. The total reduction of the persons employed in agriculture compared to those in 2007 was 20.8%. The annual work units (AWU) of all employed were 394 100, of these 343 100 were family labour force and 51 000 were paid labour force.

The proportion of men employed in agricultural holdings in 2010 was 55.7%. Employed men were by 22.1% less compared to 2007. Total of 61.0% of employed persons were aged 35 to 64 years. In the agricultural holdings 9.8% of the persons employed were aged between 15 and 34 years, and 29.2% were persons over 65 years of age.




*Source: Ministry of Agriculture and Food, Agrostatistics Department*

Figure 71 Arable land, used agricultural area and area of agricultural designation in the period in 2008 (ha)

## 6.2 EMISSION TRENDS

In the year 2011 the sector agriculture contributed 9,3% to the total of Bulgaria's greenhouse gas emissions (without LULUCF). The trend of GHG emissions from 1988 to 2011 shows a decrease of 69,57% for this sector due to decrease in activity data. (**Figure 72**)

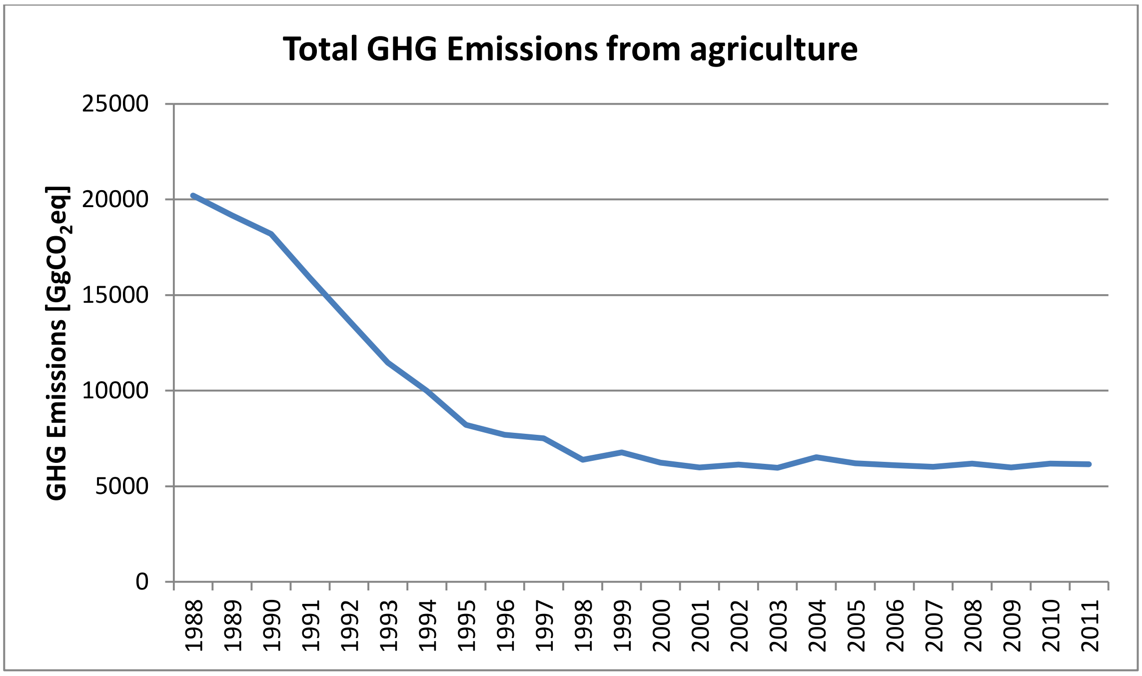



Figure 72 Trend of GHG Emissions from agriculture

### 6.2.1 EMISSION TRENDS PER GAS

$CH_4$ emissions form 33,5% of the total emissions in the sector in $CO_2$-eq in 2011. 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 66,5% for the year 2011. The biggest share in these emissions have the Agricultural soils category with 86,6%. $N_2O$ emissions from manure management and field burning of agricultural residues are of an order of magnitude smaller and in total are about 13,1% from the aggregated $N_2O$ emissions of the sector.

Since 1988 $CH_4$ emissions from agriculture decreased by 75% and $N_2O$ emissions by 65,85%. The trend is presented in Table 155.

Table 155 Emissions of greenhouse gases from agriculture 1988 – 2011.

| Year | GHG emissions [Gg] | |
|---|---|---|
| | $CH_4$ | $N_2O$ |
| 1988 | 385,14 | 38,57 |
| 1989 | 381,86 | 35,40 |
| 1990 | 383,82 | 32,25 |
| 1991 | 377,76 | 25,27 |
| 1992 | 337,55 | 20,99 |
| 1993 | 264,88 | 18,87 |
| 1994 | 204,30 | 18,29 |
| 1995 | 165,70 | 15,11 |
| 1996 | 153,63 | 14,25 |
| 1997 | 136,28 | 14,80 |
| 1998 | 119,39 | 12,32 |
| 1999 | 118,35 | 13,72 |
| 2000 | 105,13 | 12,83 |
| 2001 | 88,81 | 13,12 |
| 2002 | 94,86 | 13,15 |
| 2003 | 102,89 | 12,06 |
| 2004 | 103,48 | 13,78 |
| 2005 | 102,51 | 12,86 |
| 2006 | 104,05 | 12,39 |
| 2007 | 101,33 | 12,31 |
| 2008 | 98,39 | 13,05 |
| 2009 | 94,10 | 12,60 |
| 2010 | 91,96 | 13,28 |
| 2011 | 92,22 | 13,15 |

## 6.2.2 EMISSION TRENDS PER SUB CATEGORY

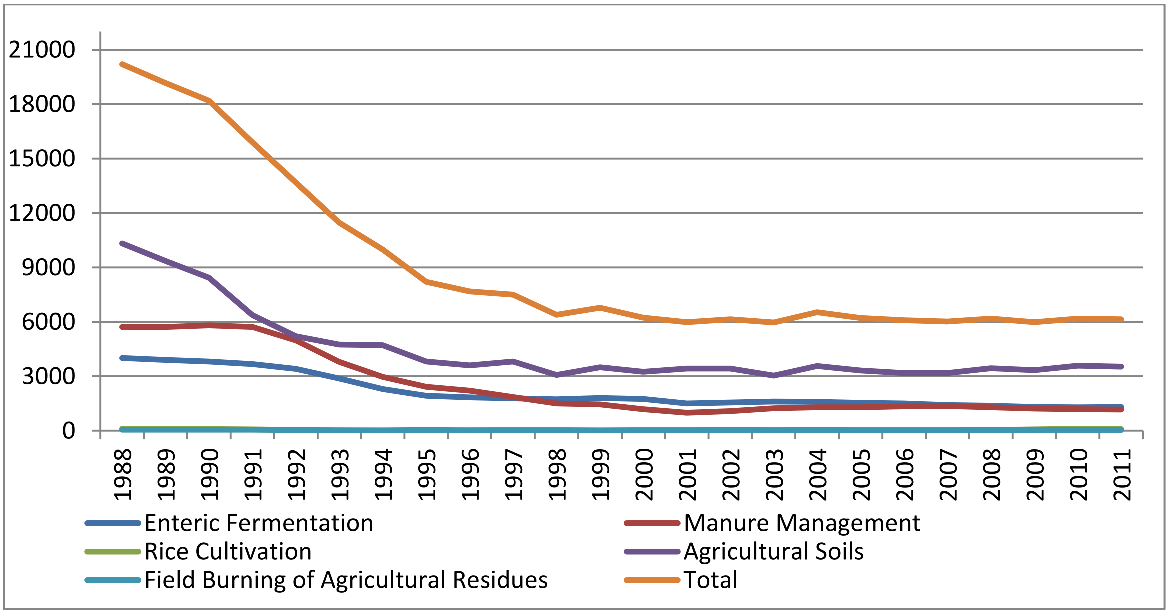



Figure 73 GHG emission trends 1988–2011 of agriculture by categories (Gg $CO_2$-eq)

Table 156 and Figure 73 present total GHG emissions and trend 1988–2011 from agriculture by sub-categories as well as the contribution to the overall inventory emissions. Important categories are 4.D Agricultural soils (57,6%) and 4.A Enteric Fermentation (21,3%) followed by 4.B Manure management (18,9%).

Table 156 GHG emissions 1988–2011 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 | 20206,36 | 4008,12 | 5717,17 | 114,24 | 10318,14 | 48,69 |
| 1989 | 19169,54 | 3906,62 | 5725,18 | 114,6 | 9361,85 | 61,29 |
| 1990 | 18198,35 | 3810,57 | 5808,08 | 88,96 | 8439,95 | 50,80 |
| 1991 | 15892,74 | 3665,2 | 5720,44 | 68,91 | 6380,25 | 57,95 |
| 1992 | 13672,09 | 3412,97 | 4977,43 | 38,01 | 5204,02 | 39,66 |
| 1993 | 11468,14 | 2874,99 | 3795,57 | 26,2 | 4742,71 | 28,67 |
| 1994 | 9997,05 | 2288,75 | 2965,85 | 6,95 | 4705,78 | 29,72 |
| 1995 | 8209,03 | 1930,46 | 2415,45 | 11,59 | 3817,9 | 33,63 |
| 1996 | 7686,08 | 1835,34 | 2201,67 | 21,89 | 3607,29 | 19,89 |
| 1997 | 7510,28 | 1780,55 | 1861,82 | 31,87 | 3807 | 48,69 |
| 1998 | 6386,96 | 1736,75 | 1510,04 | 33,63 | 3080,58 | 61,29 |
| 1999 | 6777,7 | 1798,2 | 1447,86 | 11,9 | 3492,84 | 50,8 |
| 2000 | 6237,32 | 1747,92 | 1186,52 | 30 | 3251,47 | 57,95 |
| 2001 | 5990,38 | 1505,52 | 999,68 | 32,73 | 3427,29 | 39,66 |
| 2002 | 6142,62 | 1554,3 | 1088,2 | 43,95 | 3425,02 | 28,67 |
| 2003 | 5967,79 | 1612,24 | 1246,68 | 47,41 | 3039,23 | 29,72 |
| 2004 | 6527,83 | 1586,45 | 1284,4 | 45,33 | 3575,4 | 33,63 |
| 2005 | 6206,78 | 1540,62 | 1285,1 | 39,34 | 3313,06 | 19,89 |
| 2006 | 6098,03 | 1499 | 1342,5 | 42,69 | 3185,24 | 29,04 |
| 2007 | 6014,93 | 1413,23 | 1354,07 | 54,21 | 3177,98 | 25,96 |
| 2008 | 6186,88 | 1386,92 | 1283,06 | 42,35 | 3441,07 | 26,91 |
| *2009* | 5985,08 | 1317,53 | 1226,33 | 69,82 | 3339,65 | 21,42 |
| *2010* | 6185,58 | 1286,4 | 1185,91 | 100,61 | 3576,21 | 25,15 |
| *2011* | 6148,50 | 1309,57 | 1163,32 | 99,38 | 3540,09 | 31,16 |
| *Share in Total 2011* | - | 21,3% | 18,9% | 1,6% | 57,6% | 0,5% |

As can be seen in Figure 73 and Table 156 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 157 Key sources of agriculture.

| IPCC Category | Source Categories | Key Sources | |
|---|---|---|---|
| | | GHG | KS-Assessment* |
| 4D1 | Direct $N_2O$ emissions from Agricultural soils | $N_2O$ | Yes |
| 4A1 | Enteric Fermentation - cattle | $CH_4$ | Yes |
| 4A3 | Enteric Fermentation - sheep | $CH_4$ | Yes |
| 4B1 | Manure Management - cattle | $CH_4$ | Yes |
| 4B8 | Manure Management - swine | $CH_4$ | Yes |
| 4D3 | Indirect N2O from Nitrogen used in Agriculture | $N_2O$ | Yes |
| 4B9 | Manure Management - swine | $CH_4$ | Yes |
| 4D2 | Pasture, Range and Paddock Manure | $N_2O$ | Yes |

### 6.2.4 COMPLETENESS

Table 158 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 158 Overview of sub-categories of agriculture.

| IPCC Category | | $CH_4$ | | $N_2O$ |
|---|---|---|---|---|
| **4.A** | **ENTERIC FERMENTATION** | **ENTERIC FERMENTATION** | ✓ | **NA** |
| 4.A.1 | Cattle | – | ✓ | NA |
| 4.A.1.a | Dairy Cattle | Dairy cows | ✓ | NA |
| 4.A.1.b | Non-Dairy Cattle | Other cattle | ✓ | NA |
| 4.A.1.C | Young cattle | Calves and heifers | ✓ | NA |
| 4.A.2 | Buffalo | Buffalos | ✓ | NO |
| 4.A.3 | Sheep | Sheep | ✓ | NA |
| 4.A.4 | Goats | Goats | ✓ | NA |
| 4.A.5 | Camels and Lamas | Camels | NO | NO |
| 4.A.6 | Horses | Horses | ✓ | NA |
| 4.A.7 | Mules and Asses | Mules and asses | ✓ | NA |
| 4.A.8 | Swine | Swine | ✓ | NA |
| 4.A.9 | Poultry | Laying hens, broilers, other poultry | NA | NA |
| 4.A.10 | Other | - | NO | NO |
| **4.B.** | **MANURE MANAGEMENT** | **MANURE MANAGEMENT REGARDING ORGANIC COMPOUNDS MANURE MANAGEMENT** | ✓ | **NO** |

| IPCC Category | | $CH_4$ | | $N_2O$ |
|---|---|---|---|---|
| | | **REGARDING NITROGEN COMPOUNDS** | **NO** | **✓** |
| 4.B.1 | Cattle | – | ✓ | ✓ |
| 4.B.1.a | Dairy Cattle | Dairy cows | ✓ | ✓ |
| 4.B.1.b | Non-Dairy Cattle | Other cattle | ✓ | ✓ |
| 4.A.1.C | Young cattle | Calves and heifers | ✓ | ✓ |
| 4.B.2 | Buffalo | Buffalos | ✓ | ✓ |
| 4.B.3 | Sheep | Sheep | ✓ | ✓ |
| 4.B.4 | Goats | Goats | ✓ | ✓ |
| 4.B.5 | Camels and Llamas | Camels | NO | NO |
| 4.B.6 | Horses | Horses | ✓ | ✓ |
| 4.B.7 | Mules and Asses | Mules and asses | ✓ | ✓ |
| 4.B.8 | Swine | Swine | ✓ | ✓ |
| 4.B.9 | Poultry | Laying hens, broilers, Other poultry (ducks, gooses,…) | ✓ | ✓ |
| 4.A.10 | Other | - | NO | NO |
| 4.B.11 | Anaerobic | Anaerobic | - | ✓ |
| 4.B.12 | Liquid Systems | Liquid Systems | - | ✓ |
| 4.B.13 | Solid Storage | Solid Storage and Dry Lot | - | ✓ |
| 4.B.14 | Other | Other management/ manure without bedding<br>Pit storage of swine manure included here | - | ✓ |
| **4.C** | **RICE CULTIVATION** | **Rice Field (with fertilizers) Rice Field (without fertilizers)** | ✓ | **NO** |
| **4.D** | **AGRICULTURAL SOILS** | **CULTURES WITH FERTILIZERS CULTURES WITHOUT FERTILIZERS** | **NO** | **✓** |
| 4.D.1 | Direct Soil Emissions | Cultures with and without fertilizers | NO | ✓ |
| 4.D.2 | Pasture, Range and Paddock Manure | Cultures without fertilizers | NO | ✓ |
| 4.D.3 | Indirect Emissions | Cultures with and without fertilizers | NO | ✓ |
| **4.E** | **PRESCRIBED BURNING OF SAVANNAS** | **–** | **NO** | **NO** |
| **4.F** | **FIELD BURNING OF AGRICULTURAL RESIDUES** | **ON-FIELD BURNING OF STUBBLE, STRAW, …** | **✓** | **✓** |
| 4.F.1 | Cereals | Cereals | ✓ | ✓ |
| 4.F.2 | Pulses | Pulse | ✓ | ✓ |
| 4.F.3 | Tubers and Roots | Tuber and Root | ✓ | ✓ |
| 4.F.4 | Sugar Cane | Sugar Cane | ✓ | ✓ |

**QA/QC activities**

- Sector specific QA/QC procedures are to be intensified;
- Comparison of emissions using alternative approaches;
- Food and Agriculture Organization of the United Nations (FAO);
- Documentation and archiving of all information required in NIR, background documentation and archive.

**Recalculations and time-series consistency**

- Emissions from young cattle have been recalculated for the entire time series due to finding by the ESD Technical review in 2012 for the way animal weight is calculated.
- Emissions from poultry manure have been recalculated for the entire time series due to acquisition of country specific data for the amount of nitrogen excreted and AWMS distribution.

## 6.3 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 1309,6 Gg in the year 2011. The inecrease for the year 2011 is 1,77% compared to 2010. Compared to base year a decrease of 67,3% is observed.

$CH_4$ emissions from the enteric fermentation of domestic livestock are given in Table 159.

Table 159 Greenhouse gas emissions from enteric fermentation 1988–2011.

| Year | $CH_4$ emissions [Gg] per Livestock Category | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 4.A | 4.A.1 a | 4.A.1.b | 4.A.1.c | 4.A.2 | 4.A.3 | 4.A.4 | 4.A.6& A7 | 4.A.8 |
| | Total | Mature Dairy | Mature Non-Dairy | Young | Buffalo | Sheep | Goats | Horses, Mules & asses | Swine |
| 1988 | 190,86 | 68,94 | 9,79 | 33,12 | 1,39 | 63,63 | 2,17 | 5,75 | 6,06 |
| 1989 | 186,03 | 68,95 | 9,48 | 32,07 | 1,31 | 60,21 | 2,16 | 5,72 | 6,11 |
| 1990 | 181,46 | 67,89 | 9,23 | 31,21 | 1,28 | 57,68 | 2,17 | 5,66 | 6,34 |
| 1991 | 174,53 | 65,93 | 8,66 | 29,28 | 1,34 | 55,03 | 2,33 | 5,58 | 6,39 |
| 1992 | 162,52 | 64,18 | 7,56 | 25,55 | 1,39 | 50,29 | 2,63 | 5,42 | 5,5 |
| 1993 | 136,9 | 58,16 | 5,79 | 19,58 | 1,3 | 39,53 | 2,91 | 5,27 | 4,37 |
| 1994 | 108,99 | 49,65 | 3,87 | 13,1 | 1,08 | 29,4 | 3,22 | 5,1 | 3,56 |
| 1995 | 91,93 | 42,12 | 2,94 | 9,93 | 0,85 | 24,21 | 3,68 | 5,16 | 3,04 |
| 1996 | 87,4 | 39,42 | 2,61 | 8,82 | 0,75 | 23,07 | 4,07 | 5,56 | 3,09 |
| 1997 | 84,79 | 39,83 | 2,31 | 7,8 | 0,69 | 21,61 | 4,21 | 5,62 | 2,73 |
| 1998 | 82,7 | 40,78 | 2,13 | 7,2 | 0,6 | 20,15 | 4,54 | 5,06 | 2,24 |
| 1999 | 85,63 | 44,33 | 2,25 | 7,6 | 0,58 | 19,22 | 5,03 | 4,23 | 2,4 |
| 2000 | 83,23 | 44,2 | 2,32 | 10,17 | 0,53 | 15,75 | 4,47 | 3,88 | 1,91 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2001 | 71,69 | 38,54 | 2,12 | 10,31 | 0,43 | 11,56 | 3,54 | 3,99 | 1,21 |
| 2002 | 74,01 | 39,43 | 2,55 | 11,27 | 0,39 | 11,38 | 3,57 | 4,09 | 1,34 |
| 2003 | 76,77 | 39,46 | 3,12 | 13,18 | 0,42 | 11,53 | 3,7 | 3,84 | 1,52 |
| 2004 | 75,55 | 40,18 | 2,85 | 12,13 | 0,44 | 11,31 | 3,61 | 3,54 | 1,47 |
| 2005 | 73,36 | 39,55 | 2,61 | 11,14 | 0,44 | 11,36 | 3,32 | 3,53 | 1,41 |
| 2006 | 71,38 | 38,64 | 2,64 | 10,71 | 0,45 | 11,09 | 2,89 | 3,49 | 1,47 |
| 2007 | 67,3 | 36,64 | 2,74 | 9,35 | 0,47 | 10,59 | 2,61 | 3,46 | 1,43 |
| 2008 | 66,04 | 35,72 | 2,84 | 9,35 | 0,5 | 10,18 | 2,31 | 3,9 | 1,25 |
| 2009 | 62,74 | 33,56 | 2,86 | 8,62 | 0,48 | 9,62 | 1,98 | 4,49 | 1,14 |
| 2010 | 61,26 | 33,28 | 2,84 | 8,68 | 0,48 | 9,22 | 1,79 | 3,91 | 1,05 |
| 2011 | 62,36 | 33,88 | 3,1 | 8,79 | 0,53 | 9,39 | 1,74 | 3,97 | 0,95 |
| *Share 2011* | | 54,33% | 4,98% | 14,10% | 0,84% | 15,06% | 2,80% | 6,36% | 1,53% |
| *Trend 1988–2011* | 67,33% | 50,85% | 68,30% | 73,46% | 62,22% | 85,24% | 19,76% | 31,00% | 84,26% |

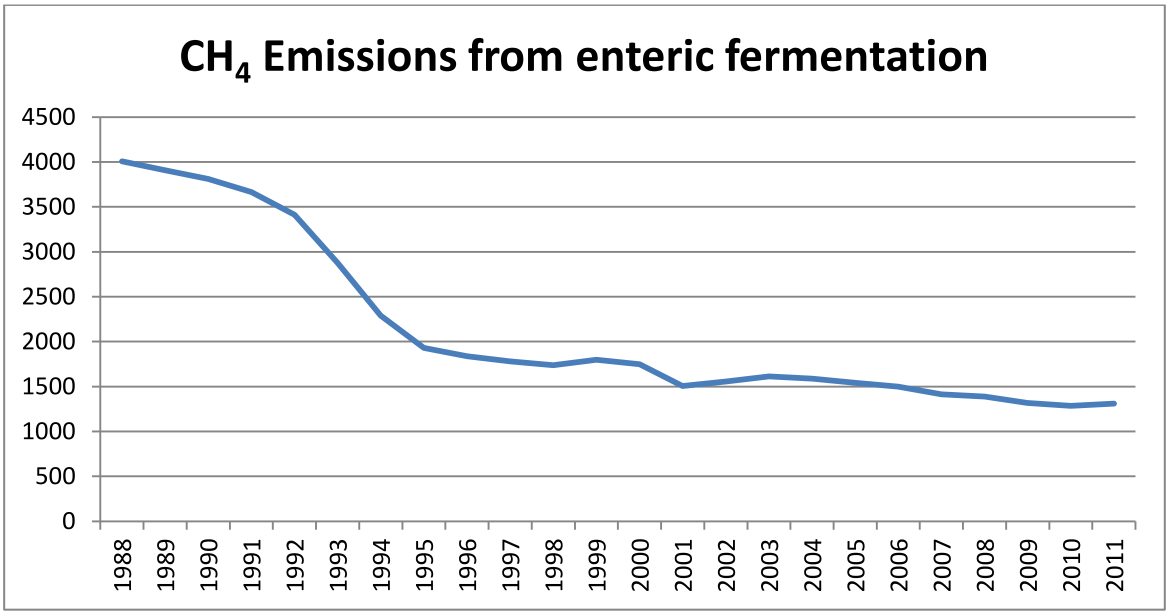



Figure 74 $CH_4$ emission from enteric fermentation

Figure 74 shows steady decrease in $CH_4$ emissions after 2002. The rapid decrease in the period 1991-1995 is consequence of a reform in agricultural holdings during this period. The overall reduction is caused by a decrease in total numbers of animals.

## 6.3.2 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.

$EF_i = [GE_i \bullet Ym_i \bullet 365] / 55.65$

*With* *i = each livestock category*

*$EF_i$ expressed in kg $CH_4$/head/year*

*$Y_m$ Methane conversion rate*
*Ge =Gross energy intake*

*The factor 55.65 expressed in MJ/kg of $CH_4$*

➔ See equation 4.14 in the IPCC-GPG 2000.

For the Tier 1 method, default GE is usually provided in the IPCC Guidelines. For the Tier 2 method, GE is the combination of various feed intake – or net energy – estimates relating to maintenance, activity, growth, etc. of the animals.

The methane conversion rate ($Y_m$) is taken from the IPCC guidelines.

**Tier 2 method – cattle**

For dairy cattle, the EF has been calculated by combining activity data, coefficients and parameters sown in Table 160. Bulgarian specific values for dairy cows were derived from feed intake data and energy content of food in dependency of annual milk yields.

Table 160 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 |

| Parameter | Unit | Source |
|---|---|---|
| Net Energy for Pregnancy | MJ/day | Eq. 4.8 & Table 4.7 - GPG_2000 |
| Ratio of Net Energy in a Diet for Maintenance to Digestible Energy Consumed | | Eq. 4.9 - GPG_2000 |
| Ratio of Net Energy Available for Growth in a Diet to Digestible Energy Consumed | | Eq. 4.10 - GPG_2000 |
| Gross Energy Intake (average) | MJ/day | Eq. 4.11 - GPG_2000 |
| CH4 conversion rate (average) | % | Table 4.8 - GPG_2000 |
| Implied Emission Factor - CH4 | kg $CH_4$/head/ year | Eq. 4.14 - GPG_2000 |

For the other cattle categories, IEF's are obtained by combining slightly different parameters which are listed in Table 161.

Table 161 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<br>- young cattle: Default |
| Digestible energy | % | - mature non-dairy cattle: 60%<br>- young cattle: Table A2 IPCC Reference manual |
| Net energy for maintenance | MJ/day | equation 4.1 & table 4.4 – 2000 IPCC-GPG |
| Net energy for activity | MJ/day | equation 4.2a & table 4.5 – 2000 IPCC-GPG |
| Net energy for growth | MJ/day | equation 4.3a – 2000 IPCC-GPG |
| Net energy due to weight loss | MJ/day | equation 4.4b – 2000 IPCC-GPG |
| Net energy for lactation | MJ/day | equation 4.5a – 2000 IPCC-GPG |
| Net energy for work | MJ/day | equation 4.6 – 2000 IPCC-GPG |
| Net energy for pregnancy | MJ/day | equation 4.8 & table 4.7 – 2000 IPCC-GPG |
| Ratio of Net Energy in a Diet for Maintenance to Digestible Energy Consumed | # | equation 4.9 – 2000 IPCC-GPG |
| Ratio of Net Energy Available for Growth in a Diet to Digestible Energy Consumed | # | equation 4.10 – 2000 IPCC-GPG |
| Gross Energy Intake (average) | MJ/day | equation 4.11 – 2000 IPCC-GPG |
| CH4 Conversion Rate (average) | % | table 4.8 – 2000 IPCC-GPG |

**Tier 1 method – all farm animal categories except cattle and sheep**

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

Table 162.

Table 162 Activity data, coefficients and parameters used for IPCC Sub-categories

| Parameter name | Unit | Parameter source |
|---|---|---|
| Livestock | # | Ministry of Agriculture and Food – Agrostatistics department (see Table 140- Table 142) |
| Live Weight | kg | - Ministry of Agriculture and Food – Agrostatistics department (see Table 144)<br>- 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

The average number of animals per year is shown in Table 163.

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 1990-2011.

Table 163 Domestic livestock populations 1988–2011 (I).

| | Dairy cattle | Non-dairy cattle-females | Non-dairy cattle - bulls | Young cattle - <1yr | Young cattle 1-2yrs | Goats | Buffalo |
|---|---|---|---|---|---|---|---|
| **1988** | 628,64 | 134,37 | 18,97 | 688,06 | 193,45 | 434,78 | 25,31 |
| **1989** | 628,78 | 130,11 | 18,37 | 666,28 | 187,32 | 431,98 | 23,89 |
| **1990** | 619,14 | 126,59 | 17,87 | 648,25 | 182,25 | 434,28 | 23,27 |
| **1991** | 601,25 | 118,77 | 16,77 | 608,21 | 171,00 | 465,51 | 24,28 |
| **1992** | 585,30 | 103,66 | 14,64 | 530,84 | 149,24 | 525,41 | 25,34 |
| **1993** | 530,33 | 79,43 | 11,21 | 406,75 | 114,36 | 581,98 | 23,64 |
| **1994** | 452,79 | 53,14 | 7,50 | 272,12 | 76,51 | 643,83 | 19,68 |
| **1995** | 384,11 | 40,28 | 5,69 | 206,25 | 57,99 | 735,93 | 15,46 |
| **1996** | 359,52 | 35,77 | 5,05 | 183,15 | 51,49 | 814,38 | 13,69 |
| **1997** | 363,21 | 31,64 | 4,47 | 162,03 | 45,55 | 841,03 | 12,57 |
| **1998** | 371,85 | 29,22 | 4,13 | 149,63 | 42,07 | 907,43 | 11,00 |
| **1999** | 404,24 | 30,81 | 4,35 | 157,78 | 44,36 | 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 |
| **2011** | 307,50 | 44,41 | 4,49 | 139,76 | 58,88 | 348,85 | 9,56 |

The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data. In the case of Bulgaria, this data comes from the national statistical system. FAOSTAT data are seemingly based on the official data but there is an annual attribution error. The rapid decline in cattle numbers in the period 1992-1994 is due to reforms in agricultural holdings in this period.

Table 164 Domestic livestock populations 1988–2011 (II).

| | Mature sheep | | | Young sheep | Horses | Swine | Mules & Asses | Poultry | |
|---|---|---|---|---|---|---|---|---|---|
| | For meat or wool production or both | commercial milk production | Other (males) | Intact males, castrates & Females | | | | Chicken(1) | ducks, geese, etc.(2) |
| 1988 | 590,22 | 6.838,09 | 217,21 | 1.579,05 | 122,13 | 4042,2 | 355,27 | 35856,16 | 4723,47 |
| 1989 | 559,69 | 6.484,38 | 205,97 | 1.497,37 | 122,41 | 4076,5 | 351,51 | 36770,38 | 4843,90 |
| 1990 | 535,52 | 6.204,34 | 197,08 | 1.432,71 | 120,45 | 4225,2 | 349,19 | 34523,45 | 4547,91 |
| 1991 | 514,06 | 5.955,66 | 189,18 | 1.375,28 | 117,16 | 4259,1 | 347,42 | 28423,85 | 3744,39 |
| 1992 | 468,41 | 5.426,78 | 172,38 | 1.253,15 | 114,85 | 3664,0 | 335,32 | 21959,95 | 2892,87 |
| 1993 | 368,47 | 4.268,97 | 135,60 | 985,79 | 113,99 | 2910,6 | 322,03 | 18369,90 | 2419,94 |
| 1994 | 274,41 | 3.179,21 | 100,99 | 734,14 | 113,41 | 2375,5 | 305,86 | 21149,37 | 2786,09 |
| 1995 | 229,09 | 2.654,12 | 84,31 | 612,89 | 123,08 | 2028,8 | 294,69 | 20819,73 | 2742,67 |
| 1996 | 216,93 | 2.513,21 | 79,83 | 580,35 | 141,78 | 2063,1 | 301,10 | 16671,62 | 2196,22 |
| 1997 | 204,83 | 2.373,11 | 75,38 | 548,00 | 160,50 | 1820,2 | 273,06 | 15390,86 | 2027,5 |
| 1998 | 187,70 | 2.174,62 | 69,08 | 502,16 | 148,34 | 1490,1 | 239,41 | 13692,69 | 1803,8 |
| 1999 | 179,04 | 2.074,24 | 65,89 | 478,98 | 129,79 | 1600,6 | 189,01 | 13453,35 | 1772,26 |
| 2000 | 142,63 | 1.652,50 | 52,49 | 381,60 | 137,20 | 1276,4 | 140,67 | 15528,73 | 2045,66 |
| 2001 | 106,45 | 1.233,33 | 36,37 | 264,40 | 140,67 | 809,9 | 145,50 | 15221,82 | 2005,23 |
| 2002 | 106,54 | 1.234,38 | 37,36 | 271,60 | 145,50 | 892,5 | 147,17 | 14636,46 | 1928,12 |
| 2003 | 105,59 | 1.223,32 | 42,21 | 292,34 | 138,51 | 1014,4 | 134,99 | 17673,16 | 1849,55 |
| 2004 | 104,48 | 1.210,50 | 39,47 | 291,08 | 125,66 | 981,9 | 128,28 | 18239,4 | 1970,25 |
| 2005 | 99,63 | 1.233,17 | 36,14 | 278,44 | 124,00 | 937,2 | 130,23 | 17182,2 | 2331,35 |
| 2006 | 97,55 | 1.207,74 | 36,87 | 276,68 | 121,50 | 977,8 | 130,23 | 17582 | 2254 |
| 2007 | 106,91 | 1.157,90 | 36,48 | 279,61 | 120,00 | 950,6 | 130,23 | 17192,5 | 2235 |
| 2008 | 102,40 | 1.113,38 | 35,54 | 249,31 | 144,14 | 836,1 | 130,23 | 16095,5 | 2028 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2009 | 79,07 | 1.087,72 | 33,64 | 237,11 | 171,68 | 756,7 | 139,80 | 15883,5 | 1 591 |
| 2010 | 72,49 | 1.041,76 | 27,21 | 242,67 | 142,15 | 696,9 | 135,6 | 14063 | 1 871 |
| 2011 | 78,62 | 1.054,48 | 27,19 | 251,01 | 143,95 | 636,13 | 143,95 | 13606,5 | 1688,5 |

(1) broiler and layer chickens, roosters, chicks
(2) ducks, geese, turkeys, guinea-fowls, wild poultry

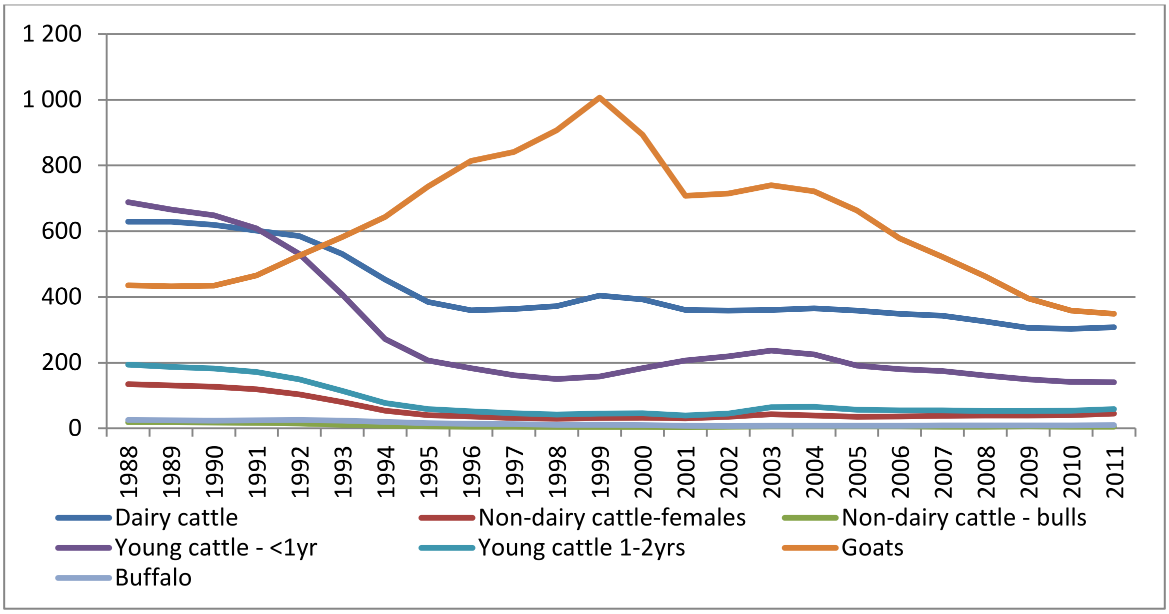



Figure 75 Domestic livestock populations (I)

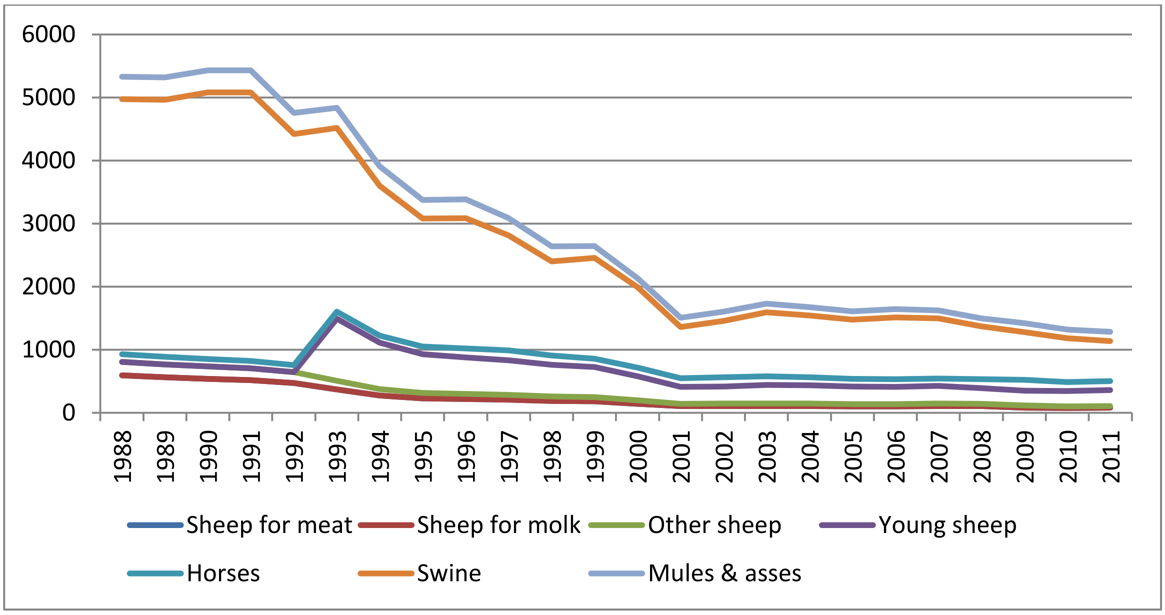



Figure 76 Domestic livestock populations (II)

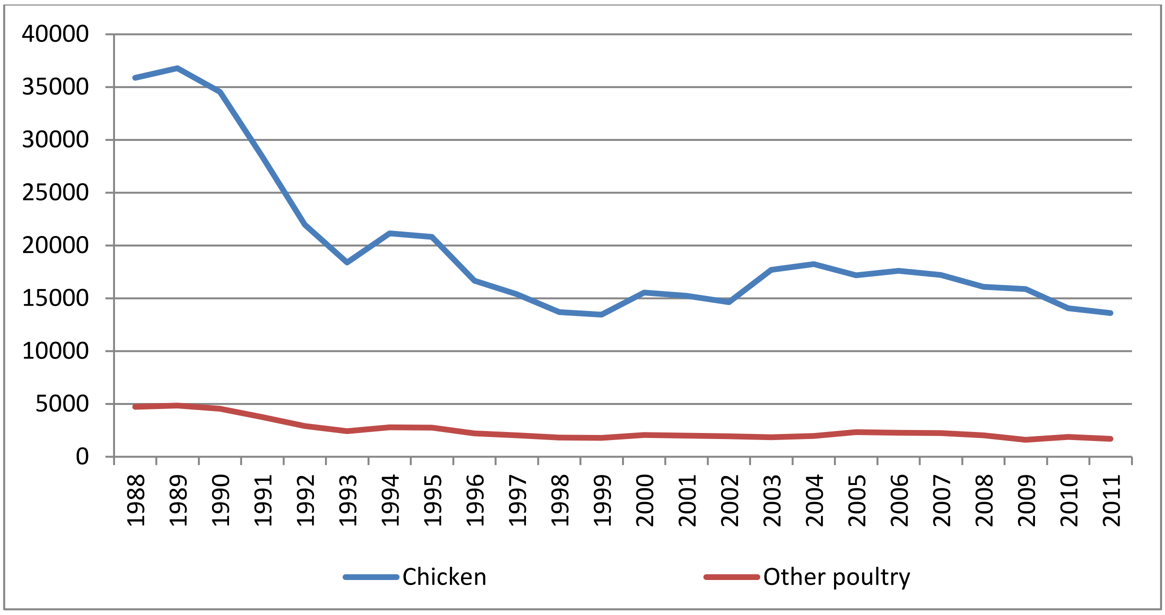



Figure 77 Domestic livestock populations (III)

#### 6.3.2.3.1 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 2000-2011, the milk yield has increased by 0,7%. At the same time the dairy cattle population declined by 51%. As these two parameters are the main drivers for the calculation of the EF under the Tier 2 method, it is no surprise to have slight fluctuations in the EF expressed in $CH_4$/head/year.

The average fat content of milk for 2011 is 3.76%

Table 165 Milk yield, gross energy intake and EFs for dairy cattle: 2000 – 2011

| Year | Milk Yield [kg/cow*yr] | Gross Energy Intake [MJ/head*day] | Emission Factor [kg CH4/head*yr] |
|---|---|---|---|
| 2000 | 4639 | 286,53 | 112,76 |
| 2001 | 4091 | 271,55 | 106,86 |
| 2002 | 4383 | 279,54 | 110,01 |
| 2003 | 4346 | 278,54 | 109,61 |
| 2004 | 4383 | 279,54 | 110,01 |
| 2005 | 4420 | 280,54 | 110,4 |
| 2006 | 4456 | 281,37 | 110,73 |
| 2007 | 4091 | 271,4 | 106,8 |
| 2008 | 4346 | 279,02 | 109,8 |
| 2009 | 4344 | 278,94 | 109,77 |
| 2010 | 4366 | 279,57 | 110,02 |
| 2011 | 4381 | 279,98 | 110,18 |

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 166.

Table 166  Live-weight for farm animals reported in the inventory

| Livestock category | Live-weight in kg used for estimating enteric fermentation emissions | |
|---|---|---|
| 4A1 – Cattle – Mature Dairy Cattle | 588 | |
| 4A1 – Cattle – Mature Non-Dairy Cattle – Females | 613 | |
| 4A1 – Cattle – Mature Non-Dairy Cattle – Males | 880 | |
| 4A1 – Cattle – Young Cattle – Calves | 203 | |
| 4A1 – Cattle – Young Cattle – Growing Heifers | 391,2 | |
| 4A3 - Sheep-Mature ewes where either meat or wool production or both is the primary purpose | 61 | |
| 4A3 - Sheep-Mature ewes where commercial milk production is the primary purpose | 45.2 | |
| 4A3 - Mature Sheep-Other(males) | 65 | |
| 4A3 - Young sheep - Intact males, castrates & Females | Slaughter body weight | 16.1 |
| | Weight at weaning | 12.9 |
| 4A8 – Swine | 105,80 | |
| 4A9 – Poultry – Chickens | 2.1 | |
| 4A10 – Other – Other Poultry | 5.3 | |

*Source: Ministry of agriculture and food, Agrostatistiscs department*

### 6.3.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

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

Table 167 Uncertainty of sub-sector Enteric Fermentation for 2011, %

| CRF categories | Key Category | GHG | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty |
|---|---|---|---|---|---|
| 4.A.1 | Cattle | $CH_4$ | 2 | 20 | 20 |
| 4.A.2 | Buffalo | $CH_4$ | 2 | 20 | 20 |
| 4.A.3 | Sheep | $CH_4$ | 2 | 20 | 20 |
| 4.A.4 | Goats | $CH_4$ | 2 | 20 | 20 |
| 4.A.6 | Horses | $CH_4$ | 2 | 20 | 20 |
| 4.A.7 | Mules and Asses | $CH_4$ | 2 | 20 | 20 |
| 4.A.8 | Swine | $CH_4$ | 2 | 20 | 20 |
| 4.A.9 | Poultry | $CH_4$ | 2 | 20 | 20 |

Uncertainty values are the default ones from the IPCC Guidelines

### 6.3.4 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

There are no planned improvements for this category.

## 6.4 MANURE MANAGEMENT

### 6.4.1 SOURCE CATEGORY DESCRIPTION

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

Table 169.

Table 168 $CH_4$ emissions from Manure management 1988 –2011, 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** | 194,27 | 2,05 | 0,21 | 0,7 | 0,23 | 1,14 | 0,08 | 0,26 | 186,04 | 3,18 |
| **1989** | 195,83 | 2,05 | 0,2 | 0,68 | 0,22 | 1,08 | 0,08 | 0,26 | 187,61 | 3,26 |
| **1990** | 202,36 | 2,02 | 0,19 | 0,66 | 0,21 | 1,03 | 0,08 | 0,25 | 194,46 | 3,06 |
| **1991** | 203,23 | 1,96 | 0,18 | 0,62 | 0,22 | 0,99 | 0,08 | 0,25 | 196,02 | 2,52 |
| **1992** | 175,03 | 1,91 | 0,16 | 0,54 | 0,23 | 0,9 | 0,09 | 0,24 | 168,63 | 1,94 |
| **1993** | 127,97 | 1,73 | 0,12 | 0,41 | 0,21 | 0,71 | 0,1 | 0,24 | 122,45 | 1,63 |
| **1994** | 95,31 | 1,48 | 0,08 | 0,28 | 0,18 | 0,53 | 0,12 | 0,24 | 90,19 | 1,87 |
| **1995** | 73,77 | 1,25 | 0,06 | 0,21 | 0,14 | 0,43 | 0,13 | 0,26 | 69,11 | 1,84 |
| **1996** | 66,23 | 1,17 | 0,05 | 0,19 | 0,12 | 0,41 | 0,15 | 0,3 | 62,02 | 1,48 |
| **1997** | 51,49 | 1,18 | 0,05 | 0,16 | 0,11 | 0,39 | 0,15 | 0,34 | 47,43 | 1,36 |
| **1998** | 36,69 | 1,21 | 0,04 | 0,15 | 0,1 | 0,36 | 0,16 | 0,31 | 32,86 | 1,21 |
| **1999** | 32,72 | 1,32 | 0,05 | 0,16 | 0,09 | 0,34 | 0,18 | 0,27 | 28,89 | 1,19 |
| **2000** | 21,89 | 1,31 | 0,05 | 0,21 | 0,09 | 0,28 | 0,16 | 0,29 | 17,96 | 1,38 |
| **2001** | 17,12 | 1,15 | 0,04 | 0,22 | 0,07 | 0,21 | 0,13 | 0,3 | 13,5 | 1,35 |
| **2002** | 20,84 | 1,17 | 0,05 | 0,24 | 0,06 | 0,2 | 0,13 | 0,31 | 17,21 | 1,3 |
| **2003** | 26,12 | 1,17 | 0,07 | 0,28 | 0,07 | 0,21 | 0,13 | 0,29 | 22,22 | 1,53 |
| **2004** | 27,94 | 1,2 | 0,06 | 0,26 | 0,07 | 0,2 | 0,13 | 0,26 | 24,03 | 1,58 |
| **2005** | 29,15 | 1,18 | 0,06 | 0,23 | 0,07 | 0,2 | 0,12 | 0,26 | 25,35 | 1,53 |
| **2006** | 32,67 | 1,15 | 0,06 | 0,23 | 0,07 | 0,2 | 0,1 | 0,26 | 28,91 | 1,55 |
| **2007** | 34,03 | 1,09 | 0,06 | 0,2 | 0,08 | 0,19 | 0,09 | 0,25 | 30,41 | 1,52 |
| **2008** | 32,35 | 1,06 | 0,06 | 0,2 | 0,08 | 0,18 | 0,08 | 0,3 | 28,81 | 1,42 |
| **2009** | 31,36 | 1 | 0,06 | 0,18 | 0,08 | 0,17 | 0,07 | 0,36 | 27,91 | 1,37 |
| **2010** | 30,7 | 0,99 | 0,06 | 0,18 | 0,08 | 0,16 | 0,06 | 0,3 | 27,46 | 1,25 |
| **2011** | 29,86 | 1,01 | 0,07 | 0,19 | 0,09 | 0,17 | 0,06 | 0,3 | 26,63 | 1,2 |
| ***Share 2011*** | - | 3,38% | 0,22% | 0,62% | 0,29% | 0,56% | 0,21% | 1,01% | 89,18% | 4,01% |
| ***Trend 1988–*** | -84,6% | -50,9% | -68,3% | -73,5% | -62,2% | -85,3% | -19,8% | 17,9% | -85,7% | -62,3% |

| $CH_4$ 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 |
| ***2011*** | | | | | | | | | | |

Table 169 $N_2O$ emissions from Manure management 1988 –2011, 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 | 5,28 | 1,14 | 0,21 | 0,80 | 0,0014 | 1,48 | 0,09 | 0,04 | 0,14 | 0,73 |
| 1989 | 5,20 | 1,14 | 0,20 | 0,77 | 0,0013 | 1,41 | 0,09 | 0,04 | 0,14 | 0,75 |
| 1990 | 5,03 | 1,12 | 0,20 | 0,75 | 0,0013 | 1,35 | 0,09 | 0,04 | 0,15 | 0,71 |
| 1991 | 4,69 | 1,09 | 0,18 | 0,70 | 0,0014 | 1,29 | 0,10 | 0,04 | 0,15 | 0,58 |
| 1992 | 4,20 | 1,06 | 0,16 | 0,61 | 0,0014 | 1,18 | 0,11 | 0,04 | 0,13 | 0,45 |
| 1993 | 3,57 | 0,95 | 0,12 | 0,47 | 0,0013 | 0,93 | 0,12 | 0,04 | 0,16 | 0,38 |
| 1994 | 3,11 | 0,80 | 0,08 | 0,31 | 0,0011 | 0,69 | 0,14 | 0,04 | 0,19 | 0,43 |
| 1995 | 2,79 | 0,68 | 0,06 | 0,23 | 0,0009 | 0,58 | 0,16 | 0,04 | 0,20 | 0,43 |
| 1996 | 2,62 | 0,63 | 0,05 | 0,20 | 0,0008 | 0,55 | 0,17 | 0,04 | 0,25 | 0,34 |
| 1997 | 2,52 | 0,63 | 0,05 | 0,18 | 0,0007 | 0,52 | 0,18 | 0,05 | 0,26 | 0,32 |
| 1998 | 2,39 | 0,64 | 0,04 | 0,16 | 0,0006 | 0,47 | 0,19 | 0,05 | 0,25 | 0,28 |
| 1999 | 2,45 | 0,69 | 0,04 | 0,17 | 0,0006 | 0,45 | 0,22 | 0,04 | 0,30 | 0,28 |
| 2000 | 2,34 | 0,66 | 0,05 | 0,19 | 0,0005 | 0,36 | 0,19 | 0,04 | 0,26 | 0,32 |
| 2001 | 2,07 | 0,62 | 0,04 | 0,20 | 0,0004 | 0,27 | 0,15 | 0,04 | 0,16 | 0,31 |
| 2002 | 2,10 | 0,63 | 0,05 | 0,23 | 0,0004 | 0,27 | 0,15 | 0,05 | 0,16 | 0,30 |
| 2003 | 2,25 | 0,65 | 0,07 | 0,27 | 0,0004 | 0,27 | 0,16 | 0,04 | 0,17 | 0,34 |
| 2004 | 2,25 | 0,67 | 0,06 | 0,26 | 0,0004 | 0,26 | 0,15 | 0,04 | 0,15 | 0,35 |
| 2005 | 2,17 | 0,67 | 0,06 | 0,23 | 0,0005 | 0,27 | 0,14 | 0,04 | 0,13 | 0,35 |
| 2006 | 2,12 | 0,65 | 0,06 | 0,22 | 0,0005 | 0,26 | 0,12 | 0,04 | 0,12 | 0,36 |
| 2007 | 2,06 | 0,64 | 0,06 | 0,22 | 0,0005 | 0,25 | 0,11 | 0,04 | 0,11 | 0,35 |
| 2008 | 1,95 | 0,61 | 0,06 | 0,20 | 0,0005 | 0,24 | 0,10 | 0,05 | 0,08 | 0,32 |
| 2009 | 1,83 | 0,57 | 0,06 | 0,19 | 0,0005 | 0,23 | 0,08 | 0,05 | 0,06 | 0,30 |
| 2010 | 1,75 | 0,56 | 0,06 | 0,19 | 0,0005 | 0,22 | 0,08 | 0,04 | 0,05 | 0,29 |
| 2011 | 1,73 | 0,57 | 0,07 | 0,19 | 0,0005 | 0,23 | 0,07 | 0,05 | 0,04 | 0,27 |
| *Share 2011* | - | 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 2,74% in $CH_4$ emission for the present inventory, compared to the emissions from the preceding year and maintaining the low level compared to the base 1988 year – i.e. 84,6%% reduction. $N_2O$ Emissions have decreased by 1,1% compared to the previous year and 67,2% compared to the base year

## 6.4.2 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 (IPCC GPG 2000, Equation 4.17):

$$EF_i = VS_i * 365 \text{ [days yr}^{-1}\text{]} * B_{0i} * 0.67 \text{ [kg m}^{-3}\text{]} * \Sigma_{jK} MCF_{jK} * MS\%_{ijK}$$

$EF_i$ = annual emission factor (kg) for animal type i (e.g. dairy cows)

$VS_i$ = Average daily volatile solids excreted (kg) for animal type i

$B_{0i}$ = maximum methane producing capacity ($m^3$ 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 170 Methane conversion factors

| AWMS | Allocation by climate | MCF |
|---|---|---|
| Anaerobic lagoon | Temperate | 90% |
| Liquid system | Cool | 39% |
| Daily spread | Cool | 0.1% |
| Solid storage | Cool | 1 |
| Pasture range and paddock | Cool | 1% |
| Pit storage <30days< | Cool | 22.5% |
| Other | Cool | 1% |

A survey conducted with the Agricultural University of Plovdiv, provided data about the distribution of AWMS. The survey provided data for 4 pillar years – 1995, 2000, 2005 and 2010. This data as well as interpolated data is provided in Table 171.

Table 171 AWMS distribution for cattle, swine, and poultry

| | Cattle | | | Swine | | | Poultry | |
|---|---|---|---|---|---|---|---|---|
| | Solid storage | Dry lot | Pasture range paddock | Anaerobic lagoon | Solid storage | Dry lot | Solid storage | Dry lot |
| 1988 | 33,5% | 47,0% | 19,5% | 92,0% | 8,0% | 0,0% | 50% | 50% |
| 1989 | 33,5% | 47,0% | 19,5% | 92,0% | 8,0% | 0,0% | 50% | 50% |
| 1990 | 33,5% | 47,0% | 19,5% | 92,0% | 8,0% | 0,0% | 50% | 50% |
| 1991 | 33,5% | 47,0% | 19,5% | 92,0% | 8,0% | 0,0% | 50% | 50% |
| 1992 | 33,5% | 47,0% | 19,5% | 92,0% | 8,0% | 0,0% | 50% | 50% |
| 1993 | 35,2% | 44,6% | 20,2% | 84,0% | 12,5% | 3,5% | 50% | 50% |
| 1994 | 36,7% | 42,3% | 21,0% | 75,7% | 17,3% | 7,0% | 50% | 50% |
| 1995 | 38,4% | 40,0% | 21,6% | 67,8% | 22,0% | 10,2% | 50% | 50% |
| 1996 | 40,0% | 37,7% | 22,3% | 59,7% | 26,6% | 13,7% | 50% | 50% |
| 1997 | 41,6% | 35,4% | 23,0% | 51,6% | 31,3% | 17,1% | 50% | 50% |
| 1998 | 43,2% | 33,1% | 23,7% | 43,5% | 36,0% | 20,5% | 50% | 50% |
| 1999 | 44,8% | 30,7% | 24,5% | 35,4% | 40,6% | 24,0% | 50% | 50% |
| 2000 | 46,4% | 28,4% | 25,2% | 27,4% | 45,3% | 27,4% | 50% | 50% |
| 2001 | 45,0% | 31,5% | 23,5% | 32,6% | 42,8% | 24,6% | 50% | 50% |
| 2002 | 43,6% | 34,3% | 22,1% | 37,9% | 40,3% | 21,8% | 50% | 50% |
| 2003 | 42,2% | 37,5% | 20,3% | 43,2% | 37,8% | 19,0% | 50% | 50% |
| 2004 | 40,7% | 40,6% | 18,7% | 48,4% | 35,3% | 16,3% | 50% | 50% |
| 2005 | 39,3% | 43,6% | 17,1% | 53,6% | 32,9% | 13,5% | 50% | 50% |
| 2006 | 36,8% | 46,1% | 17,1% | 58,7% | 29,3% | 12,0% | 50% | 50% |
| 2007 | 34,3% | 48,7% | 17,0% | 63,6% | 25,7% | 10,7% | 50% | 50% |
| 2008 | 32,8% | 51,1% | 16,1% | 68,6% | 22,1% | 9,3% | 50% | 50% |
| 2009 | 29,2% | 53,7% | 17,1% | 73,5% | 18,6% | 7,9% | 50% | 50% |
| 2010 | 26,7% | 56,1% | 17,2% | 78,6% | 15,0% | 6,4% | 50% | 50% |
| 2011 | 26,5% | 56,3% | 17,3% | 83,6% | 11,5% | 5,0% | 50% | 50% |

### 6.4.2.2 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).

N excretion per animal waste management system:

$$Nex_{(AWMS)} = \sum_{(T)}[N_{(T)} \times Nex_{(T)} \times AWMS_{(T)}]$$

*$Nex_{(AWMS)}$* = *N excretion per animal waste management system [kg $yr^{-1}$]*

*$N_{(T)}$* = *number of animals of type T in the country*

*$Nex_{(T)}$* = *N excretion of animals of type T in the country [kg N $animal^{-1}$ $yr^{-1}$]*

*$AWMS_{(T)}$* = *fraction of $Nex_{(T)}$ that is managed in one of the different distinguished animal waste management systems for animals of type T in the country*

*T* = *type of animal category*

$N_2O$ emission per animal waste management system:

$$N_2O_{(AWMS)} = \sum[Nex_{(AWMS)} \times EF_{3(AWMS)}]$$

*$N_2O_{(AWMS)}$* = *$N_2O$ emissions from all animal waste management systems in the country [kg N $yr^{-1}$]*

*$Nex_{(AWMS)}$* = *N excretion per animal waste management system [kg $yr^{-1}$]*

*$EF_{3(AWMS)}$* = *$N_2O$ emissions factor for an AWMS [kg $N_2O$-N per kg of Nex in AWMS]*

### AWMS

The animal waste management systems distribution data applied to estimate $N_2O$ emissions from *Manure Management* is the same as used for the estimation of $CH_4$ emissions from *Manure Management* (see **Table 171**).

### 6.4.2.3 Nitrogen excretion

Table 172 Nitrogen excretion rates of animal livestock categories.

| Livestock category | Nitrogen excretion [kg/animal*yr.] |
|---|---|
| Mature Dairy Cattle | 71,54 |
| Mature Non Dairy Cattle Females | 53,66 |
| Mature Non Dairy Cattle Males | 53,66 |
| Young Cattle - Calves | 30,7 |
| Young Cattle - Growing Heifers | 53,66 |
| Buffalo | 50 |
| Mature Sheep | 16 |
| Young Sheep | 8 |
| Goats | 17 |
| Horses | 25 |
| Mules & Asses | 42,5 |
| Swine(average)<br>- Pigs <20kg<br>- Pigs20-50 kg<br>- Pigs 50-80kg<br>- Pigs 80-110kg<br>- Breeding pigs<br>- boars | 8,53<br>2,46<br>5,09<br>8,71<br>12,65<br>13,47<br>13,47<br>13,47 |
| Poultry avergage<br>Poultry Chickens<br>Other Poultry | 0,93<br>0,82<br>1,87 |

### 6.4.2.4 Emission factors

$N_2O$ emission factors of the IPCC GPG 2000 have been used for all AWMS.

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

Table 173 Emission factors for $N_2O$ from manure management

| Animal Waste Management System | Emission factor [kg $N_2O$-N per kg N excreted] | Reference |
|---|---|---|
| Anaerobic lagoon | 0.001 | IPCC GPG 2000, Table 4.12 |
| Liquid system | 0.001 | IPCC GPG 2000, Table 4.12 |
| Daily spread | 0.00 | IPCC GPG 2000, Table 4.12 |
| Solid storage | 0.020 | IPCC GPG 2000, Table 4.12 |
| Pasture range, paddock | 0.020 | IPCC GPG 2000, Table 4.12 |
| Pit storage <30days< | 0.001 | IPCC GPG 2000, Table 4.12 |
| Other | 0.001 | IPCC GPG 2000, Table 4.12 |

### 6.4.2.5 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 1990-2011.

Animal numbers are the same as the ones used for calculating emissions from enteric fermentation and are presented in Table 163 and Table 164, except pigs are divided into sub-categories in order to estimate more accurately the nitrogen excretion. Division of pigs is presented in Table 174. Data for estimating nitrogen excretion from cattle is shown in Table 175.

Table 174 Activity data for estimating nitrogen excretion from swine

| | | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Pigs < 20 kg | Population size | 146496 | 135654 | 127246 | 129926 |
| | Kg Manure/day | 1,5 | 1,5 | 1,5 | 1,5 |
| Pigs 20-50 kg | Population size | 163994 | 162787 | 141764 | 131418 |
| | Kg Manure/day | 3,1 | 3,1 | 3,1 | 3,1 |
| Pigs 50 -80 kg | Population size | 126151 | 117215 | 107584 | 106988 |
| | Kg Manure/day | 5,3 | 5,3 | 5,3 | 5,3 |
| Pigs 80 -110 kg | Population size | 198574 | 161380 | 142807 | 124380 |
| | Kg Manure/day | 7,7 | 7,7 | 7,7 | 7,7 |
| Pigs > 110 kg, breeding | Population size | 200915 | 179689 | 177499 | 143422 |

| | | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| pigs and boars | 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 | | 8,98 | 8,78 | 8,85 | 8,53 |

Table 175 Activity data for estimating nitrogen excretion from cattle

| | | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Mature dairy cattle | Population size | 325277 | 305713 | 302461 | 307504 |
| | Kg Manure/day | 40,0 | 40,0 | 40,0 | 40,0 |
| Mature non-dairy cattle | Population size | 44506 | 44635 | 44607 | 48911 |
| | Kg Manure/day | 30,0 | 30,0 | 30,0 | 30,0 |
| Fattering claves under 1 year | Population size | 67799 | 62464 | 58238 | 61842 |
| | Kg Manure/day | 15,0 | 15,0 | 15,0 | 15,0 |
| Other calves under 1 year | Population size | 93101 | 86432 | 83124 | 77913 |
| | Kg Manure/day | 15,0 | 15,0 | 15,0 | 15,0 |
| Bovine 1-2 years | Population size | 13826 | 13463 | 13210 | 12316 |
| | Kg Manure/day | 30,0 | 30,0 | 30,0 | 30,0 |
| Heifers | Population size | 38972 | 39525 | 40005 | 42564 |
| | 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 176 Uncertainty of sub-sector Manure Management for 2011, %

| 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 |

| CRF categories | Key Category | GHG | Activity data uncertainty, % | Emission factor uncertainty, % | Combined uncertainty, % |
|---|---|---|---|---|---|
| 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.

### 6.4.5 SOURCE-SPECIFIC RECALCULATIONS

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

| Animal type | Reason for recalculation | Recalculated period |
|---|---|---|
| 4A1c & 4B1c – Young Cattle | Change in animal weights due to recommendations from the ESD review | 1988-2010 |
| 4B9 - Poultry | Change in awms distribution and nitrogen excretion | 1988-2010 |

### 6.4.6 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

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

Collection of data for dividing swine into sub-categories and data regarding each sub-category AWMS distribution in order to imply Tier 2 method since the $N_2O$ emissions from swine manures are a key category.

Analyse if its time/resources effective to develop specific parameter values for 4A9-Poultry since agrostatistics department provide breakdown of Poultry in various sub-categories.

## 6.5 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 11 831 ha in 2011.

99,38 Gg $CH_4$ $CO_2$-eq. has been emitted in 2011. Emission decrease by 1,22% compared to the year 2010 is due to the decrease 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 | Table 4.20 IPCC GPG 2000 |
| **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.

### 6.5.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of methane emissions from this source is 20%

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

### 6.5.4 SOURCE-SPECIFIC QA/QC AND VERIFICATION

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

### 6.5.5 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

There are no planned improvements for this category.

## 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 2011.

Direct emissions result from:

- Soil fertilization with synthetic nitrogenous fertilizers;
- Nitrogen input from manure applied to soils (excluding manure from pasture animals);
- Decomposition of waste from N-fixing crops;
- Decomposition of vegetable waste from other cultures;
- Cultivation of histosols.

The emissions of **pasture animals** include emissions from the excretion on pasture range and paddock.

**Indirect emissions** include:

- ammonia and nitrous oxides release in the ambient air after nitrogen fertilization;
- Emissions from drawing of water.

Activities described above are differentiated according to the IPCC classification. One has to take into consideration that the existing emissions of methane from soil are considered natural (non-anthropogenic) and is not subject of the inventory.

Direct $N_2O$ emissions are 2057 Gg $CO_2$-eq. in 2011. The emission decrease by 0,55% in 2011 compared to 2010

Indirect $N_2O$ emissions were 1206,3 Gg $CO_2$-eq. in 2011. The emissions from this decrease by 2,37% compared to 2010.

The emissions from pasture animals decrease by 1,28% compared to 2010.

## 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 177 $N_2O$ emissions factors for agricultural soils.

| Category | Emission Factor [t N2O-N/t N] | Source |
|---|---|---|
| **4.D.1 Direct Soil Emissions** | | |
| Synthetic fertilizers (mineral fert.) | 0.0125 | IPCC GPG 2000 (Table 4.17) |
| Animal waste applied to soils | | |
| N-fixing crops | | |
| Crop residue | | |
| Sewage sludge spreading | | |
| **4.D.2 Pasture, range and paddock manure** | | |
| Grazing animals | 0.02/ t $N_{exGRAZ}$ | 1996 IPCC GL (Table 4.22) |
| **4.D.3 Indirect soil emissions** | | |
| Atmospheric deposition | 0.01/ t of volatized nitrogen | IPCC GPG 2000 (Table 4.18) |
| Nitrogen leaching (and run-off) | 0.025/ t N-loss by leaching | IPCC GPG 2000 (Table 4.18) |

### 6.6.2.2 Emission factors

Emission factors are the default ones from the 1996 IPCC Guidelines. So far, there are no assessments of these emission factors, which result from measurements in the country.

### 6.6.2.3 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.

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 178 Uncertainty of sub-sector Manure Management for 2009, %

| 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.

36,19 Gg $CO_2$-eq. aggregated GHGs were emitted in 2011. The increase is 0,5%, compared to 2010, on the expert judgement that 3% of the vegetal residues, left on the fields after yielding crop, are burned.

### 6.7.2 METHODOLOGICAL ISSUES

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

Table 179 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 180 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 |

### 6.7.3 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of methane emissions from this source is 50% and of $N_2O$ emissions – 200%, with very high uncertainty of the activity data.

### 6.7.4 SOURCE-SPECIFIC QA/QC

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

Activity data has been cross-checked with FAO's statistical database.

### 6.7.5 SOURCE-SPECIFIC RECALCULATIONS

There are no recalculations for this category

# 7 LAND-USE, LAND-USE CHANGES AND FORESTRY (CRF SECTOR 5)

## 7.1 GENERAL OVERVIEW LULUCF

Land Use, Land-Use Change and Forestry (LULUCF) sector includes emissions and greenhouse gas removals from different land-use types, changes in the land-use and forestry. The greenhouse gas inventory of LULUCF sector comprises emissions and removals of $CO_2$ due to overall carbon gains or losses in the relevant carbon pools of the predefined six land-use categories. These pools are above-ground biomass, below-ground biomass, dead organic matter (litter and dead wood) and soils. The methodology used to calculate emissions and removals in LULUCF follows that of the IPCC Good Practice Guidance for LULUCF 2003 (IPCC GPG 2003). The predefined land-use types under IPCC GPG are Forest land (FL), Cropland (CL), Grassland (GL), Wetland (WL), Settlements (S), Other land (OL). In accordance with the IPCC GPG 2003 emissions and removals should be reported into two sub-categories – land remaining in the same category and land converted to another land-use category. All the land-use changes were traced down and reported for a transition period of 20 years (as require in IPCC GPG 2003) after which they are reported in the respective categories.

Table 181 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 | 13 688.8 | 9.9% | 28.4% |

Table 182 Level assessment of the key category including LULUCF - 2011

| Source | Gas | Fuel/Cat. | GHG emission [Gg $CO_2$ eq] | % incl. | cumul. % |
|---|---|---|---|---|---|
| 5A1 Forests remaining Forests | $CO_2$ | 0 | 9622.0 | 12,00% | 52,5% |
| 5A2 Land use change to Forests | $CO_2$ | 0 | 654.9 | 0.8% | 88,9% |
| 5B1 Cropland remaining Cropland | $CO_2$ | 0 | 1304.4 | 1.6% | 71,0% |
| 5B2 Land use change to Cropland | $CO_2$ | 0 | 855.4 | 1.1% | 80.9% |
| 5C2 Land use change to Grassland | $CO_2$ | 0 | -786,6 | 1,00% | 84,0% |
| 5E2 Land use change to Settlements | $CO_2$ | 0 | 523.2 | 0.7% | 91.6% |

### 7.1.1 SECTOR COVERAGE

In the 2013 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 183.

Table 183 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 183

Table 184 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** | -14340,02 | -14343,51 | 706,95 | -786,64 | NE, NO | 83,17 | NO |
| **1989** | -14198,09 | -14363,25 | 868,62 | -786,64 | NE, NO | 83,17 | NO |
| **1990** | -14048,81 | -14370,70 | 1025,35 | -786,64 | NE, NO | 83,17 | NO |
| **1991** | -13931,71 | -14406,90 | 1178,65 | -786,64 | NE, NO | 83,17 | NO |
| **1992** | -13619,01 | -14269,08 | 1353,54 | -786,64 | NE, NO | 83,17 | NO |
| **1993** | -12852,79 | -13785,46 | 1636,14 | -786,64 | NE, NO | 83,17 | NO |
| **1994** | -12661,84 | -13821,21 | 1862,84 | -786,64 | NE, NO | 83,17 | NO |
| **1995** | -13177,57 | -14449,51 | 1975,41 | -786,64 | NE, NO | 83,17 | NO |
| **1996** | -10809,13 | -12184,45 | 2078,78 | -786,64 | NE, NO | 83,17 | NO |
| **1997** | -10843,25 | -12201,25 | 2061,47 | -786,64 | NE, NO | 83,17 | NO |
| **1998** | -10793,24 | -11946,80 | 1857,02 | -786,64 | NE, NO | 83,17 | NO |
| **1999** | -10765,99 | -11863,69 | 1801,16 | -786,64 | NE, NO | 83,17 | NO |
| **2000** | -8918,24 | -10132,95 | 1918,17 | -786,64 | NE, NO | 83,17 | NO |
| **2001** | -8755,57 | -10107,55 | 1949,66 | -786,64 | 90,83 | 98,13 | NO |
| **2002** | -9117,54 | -10580,89 | 2016,93 | -786,64 | 103,11 | 129,95 | NO |
| **2003** | -9025,79 | -10677,34 | 2188,55 | -786,64 | 115,14 | 134,50 | NO |
| **2004** | -9191,85 | -10807,10 | 2133,13 | -786,64 | 127,12 | 141,64 | NO |
| **2005** | -8934,39 | -10813,90 | 2270,66 | -786,64 | 139,59 | 255,91 | 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 |
|---|---|---|---|---|---|---|---|
| **2006** | -8398,15 | -10284,09 | 2224,81 | -786,64 | 151,64 | 296,13 | NO |
| **2007** | -7086,33 | -8929,65 | 2075,97 | -786,64 | 163,97 | 390,01 | NO |
| **2008** | -8281,14 | -10241,76 | 2061,55 | -786,64 | 176,04 | 509,67 | NO |
| **2009** | -8388,63 | -10391,77 | 2189,79 | -786,64 | 188,87 | 411,11 | NO |
| **2010** | -8109,04 | -10261,36 | 2162,86 | -786,64 | 200,68 | 575,40 | NO |
| **2011** | -7979,42 | -10250,84 | 2322,47 | -786,64 | 212,42 | 523,16 | NO |

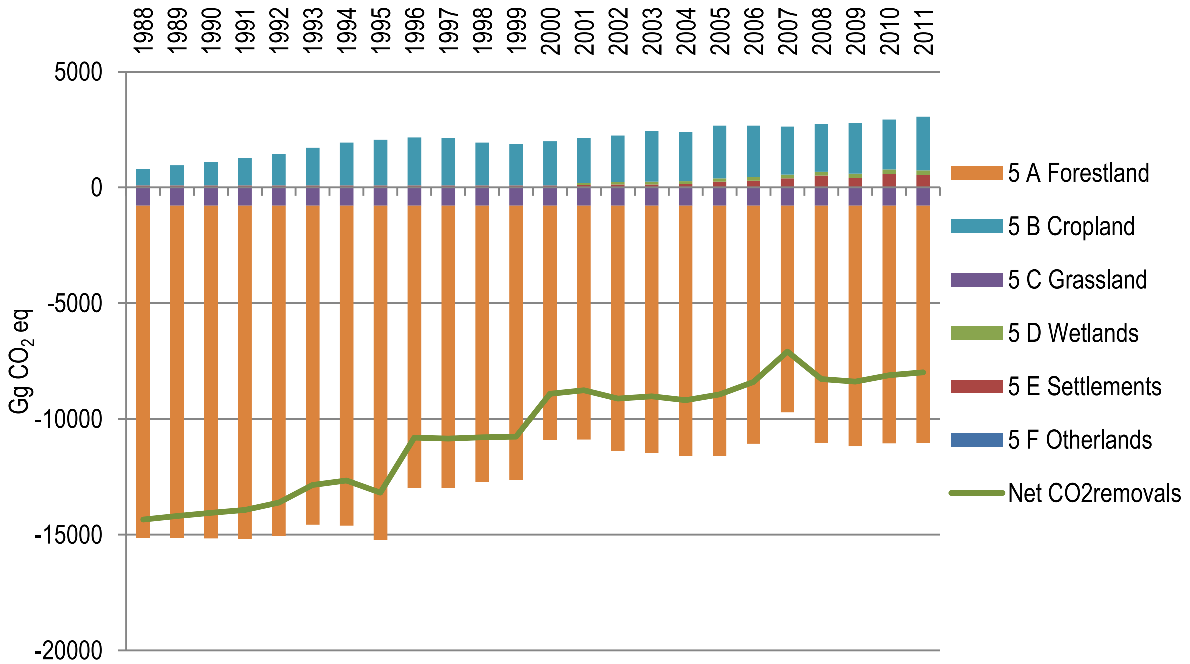



Figure 78 LULUCF emissions and removals 1988 – 2011 $CO_2$ eq.

The figure shows that the land use, land use changes and forestry are serving as a sink of greenhouse gases for Bulgaria. The two categories – "Forest land" and "Grassland" are removals of $CO_2$. All other categories are sources of $CO_2$ emissions. The trend of net $CO_2$ removals ($CO_2$ eq) from LULUCF decreases by 44% compared to the base year, reaching its lowest point in 2007. The reason for the decrease of the uptakes of $CO_2$ 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 increase in net removals from Forest land and a slight decrease in croplands' emissions. The net changes of the carbon stock in the biomass causes biggest effect on the final results, obtained for the whole sector. Over the period 1990-2011 a permanent trend is observed for increasing the tree biomass stock (by 30% for the coniferous species and by 26% for the deciduous).

In spite of the decrease observed, the share of the removals from the total GHG emissions (in $CO_2$eq) 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 -11,8% from the total GHG emissions in $CO_2$eq, while in the inventoried year the share is -12.07%.

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 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 185 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 1988-2011 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 2011 - 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 2009-2011 are extrapolated.

Concerning the total area of the grasslands for the single years for the period 1988-2011 statistical information is used (Executive Forest 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 Forest 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.

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

| area in kha | 1988 | 2011 | 2011-1988 |
|---|---|---|---|
| 5.A Forest Land - Total | 3604 | 3831 | 227 |
| 5A1. Forest land remaining forest land | 3408 | 3626 | 218 |
| 5A1a. Forest land remaining forest land - coniferous | 1158 | 1058 | -100 |
| 5A1b. Forest land remaining forest land - deciduous | 2168 | 2493 | 325 |
| 5A1c. Forest land remaining forest land - out of yield | 21 | 23 | 1 |
| 5A1d .Forest land remaining forest land – other vegetation | 61 | 53 | -8 |
| 5A2. LUC in forest land | 196 | 205 | 9 |
| 5A2.1.a Annual Cropland in forest land | 25 | 23 | -2 |
| 5A2.1.b Perennial Cropland in forest land | 1 | 1 | 0 |
| 5A2.2 Grassland in forest land | 167 | 179 | 12 |
| 5A2.3 Wetland in forest land | 0 | 0 | 0 |
| 5A2.4 Settlement in forest land | 0 | 0 | 0 |
| 5A2.5 Other land in forest land | 2 | 1 | -1 |
| 5.B Cropland - Total | 3922 | 3813 | -110 |
| Cropland annual | 3547 | 3590 | 42 |
| Cropland perennial | 375 | 223 | -152 |
| 5B1. Cropland remaining cropland | 3771 | 3565 | -206 |
| 5B1a annual cropland remaining annual cropland | 3348 | 3307 | -40 |
| 5B1b perennial cropland remaining perennial cropland | 321 | 155 | -166 |
| 5B1c LUC perennial cropland in annual cropland | 63 | 63 | 0 |
| 5B1d LUC annual cropland in perennial cropland | 39 | 39 | 0 |
| 5B2. LUC in cropland | 152 | 248 | 96 |
| 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 | 136 | 219 | 83 |
| 5B2.2b Grassland in perennial cropland | 15 | 29 | 14 |
| 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 | 2008 | 1792 | -217 |
| 5C1. Grassland remaining grassland | 1759 | 1542 | -217 |
| 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 |

| area in kha | 1988 | 2011 | 2011-1988 |
|---|---|---|---|
| 5C2.5 Other land in grassland | 0 | 0 | 0 |
| 5 D Wetlands | 202 | 213 | 11 |
| 5D1. Wetlands remaining wetlands | 202 | 202 | 0 |
| 5D2. LUC in wetlands | 0 | 11 | 11 |
| 5D2.1 Forest land in wetlands | 0 | 5 | 5 |
| 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 | 834 | 27 |
| 5E1. Settlements remaining settlements | 801 | 798 | -3 |
| 5E2. LUC in settlements | 6 | 36 | 30 |
| 5E2.1 Forest land in settlements | 0 | 2 | 2 |
| 5E2.2.a Annual Cropland in settlements | 4 | 21 | 18 |
| 5E2.2.b Perennial Cropland in settlements | 0 | 1 | 1 |
| 5E2.3 Grassland in settlements | 2 | 11 | 9 |
| 5E2.4 Wetlands in settlements | 0 | 0 | 0 |
| 5E2.5 Other land in settlements | 0 | 0 | 0 |
| 5 F Other land | 556 | 617 | 61 |
| 5F1. Other land remaining other land | 556 | 617 | 61 |
| 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** | **11 100** | **11 100** |

#### 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 186) 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 the years 2009-2011. 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 2011. 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 2011, was assumed to be the same as the share of the totals of these land-use categories. LUC to settlements for the years before 2001 and the years after 2009 is extrapolated.

The LUC matrix is presented on Table 186. 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 186 Matrices for annual land use and land use changes for Bulgaria over the period 1988-2011

| kha | FL | CL | GL | WL | SL | OL | 1987 |
|---|---|---|---|---|---|---|---|
| FL | 3593,82 | | | | 0,02 | | 3593,85 |
| CL | 1,34 | 3906,76 | 12,47 | | 0,19 | | 3920,76 |
| GL | 8,34 | 15,61 | 1996,00 | | 0,10 | | 2020,05 |
| WL | | | | 202,29 | | | 202,29 |
| SL | | | | | 806,77 | | 806,77 |
| OL | 0,11 | | | | | 556,36 | 556,47 |
| 1988 | 3603,61 | 3922,37 | 2008,47 | 202,29 | 807,08 | 556,36 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1988 |
|---|---|---|---|---|---|---|---|
| FL | 3603,59 | | | | 0,02 | | 3603,61 |
| CL | 1,34 | 3903,18 | 12,47 | | 0,19 | | 3917,19 |
| GL | 8,34 | 15,61 | 2007,52 | | 0,10 | | 2031,56 |
| WL | | | | 202,27 | | | 202,27 |
| SL | | | | | 807,08 | | 807,08 |
| OL | 0,11 | | | | | 538,37 | 538,47 |
| 1989 | 3613,38 | 3918,79 | 2019,99 | 202,27 | 807,39 | 538,37 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1989 |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| FL | 3613,36 | | | | 0,02 | | 3613,38 |
| CL | 1,34 | 3896,14 | 12,47 | | 0,19 | | 3910,14 |
| GL | 8,34 | 15,61 | 2006,79 | | 0,10 | | 2030,84 |
| WL | | | | 202,25 | | | 202,25 |
| SL | | | | | 807,39 | | 807,39 |
| OL | 0,11 | | | | | 536,09 | 536,19 |
| 1990 | 3623,15 | 3911,74 | 2019,26 | 202,25 | 807,69 | 536,09 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1990 |
|---|---|---|---|---|---|---|---|
| FL | 3623,13 | | | | 0,02 | | 3623,15 |
| CL | 1,34 | 3896,14 | 12,47 | | 0,19 | | 3910,14 |
| GL | 8,34 | 15,61 | 2006,49 | | 0,10 | | 2030,53 |
| WL | | | | 202,23 | | | 202,23 |
| SL | | | | | 807,69 | | 807,69 |
| OL | 0,11 | | | | | 526,33 | 526,44 |
| 1991 | 3632,92 | 3911,75 | 2018,96 | 202,23 | 808,00 | 526,33 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1991 |
|---|---|---|---|---|---|---|---|
| FL | 3632,90 | | | | 0,02 | | 3632,92 |
| CL | 1,34 | 3896,01 | 12,47 | | 0,19 | | 3910,01 |
| GL | 8,34 | 15,61 | 2007,51 | | 0,10 | | 2031,56 |
| WL | | | | 202,21 | | | 202,21 |
| SL | | | | | 808,00 | | 808,00 |
| OL | 0,11 | | | | | 515,39 | 515,49 |
| 1992 | 3642,69 | 3911,62 | 2019,98 | 202,21 | 808,31 | 515,39 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1992 |
|---|---|---|---|---|---|---|---|
| FL | 3642,67 | | | | 0,02 | | 3642,69 |
| CL | 1,34 | 3896,48 | 12,47 | | 0,19 | | 3910,48 |
| GL | 8,34 | 15,61 | 2008,60 | | 0,10 | | 2032,65 |
| WL | | | | 202,19 | | | 202,19 |
| SL | | | | | 808,31 | | 808,31 |
| OL | 0,11 | | | | | 503,77 | 503,88 |
| 1993 | 3652,45 | 3912,08 | 2021,07 | 202,19 | 808,62 | 503,77 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1993 |
|---|---|---|---|---|---|---|---|
| FL | 3652,43 | | | | 0,02 | | 3652,45 |
| CL | 1,34 | 3896,88 | 12,47 | | 0,19 | | 3910,88 |
| GL | 8,34 | 15,61 | 2005,24 | | 0,10 | | 2029,29 |
| WL | | | | 202,17 | | | 202,17 |
| SL | | | | | 808,62 | | 808,62 |
| OL | 0,11 | | | | | 496,68 | 496,78 |
| 1994 | 3662,22 | 3912,49 | 2017,71 | 202,17 | 808,92 | 496,68 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1994 |
|---|---|---|---|---|---|---|---|
| FL | 3662,20 | | | | 0,02 | | 3662,22 |
| CL | 1,34 | 3947,05 | 12,47 | | 0,19 | | 3961,05 |
| GL | 8,34 | 15,61 | 1971,56 | | 0,10 | | 1995,60 |
| WL | | | | 202,15 | | | 202,15 |
| SL | | | | | 808,92 | | 808,92 |
| OL | 0,11 | | | | | 470,14 | 470,24 |
| 1995 | 3671,99 | 3962,66 | 1984,03 | 202,15 | 809,23 | 470,14 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1995 |
|---|---|---|---|---|---|---|---|
| FL | 3671,97 | | | | 0,02 | | 3671,99 |
| CL | 1,34 | 3947,58 | 12,47 | | 0,19 | | 3961,58 |
| GL | 8,34 | 15,61 | 1975,59 | | 0,10 | | 1999,64 |
| WL | | | | 202,13 | | | 202,13 |
| SL | | | | | 809,23 | | 809,23 |
| OL | 0,11 | | | | | 455,52 | 455,63 |
| 1996 | 3681,76 | 3963,19 | 1988,06 | 202,13 | 809,54 | 455,52 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1996 |
|---|---|---|---|---|---|---|---|
| FL | 3681,74 | | | | 0,02 | | 3681,76 |
| CL | 1,34 | 4058,98 | 12,47 | | 0,19 | | 4072,98 |
| GL | 8,34 | 15,61 | 1904,61 | | 0,10 | | 1928,66 |
| WL | | | | 202,11 | | | 202,11 |
| SL | | | | | 809,54 | | 809,54 |
| OL | 0,11 | | | | | 405,05 | 405,15 |
| 1997 | 3691,53 | 4074,58 | 1917,08 | 202,11 | 809,84 | 405,05 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1997 |
|---|---|---|---|---|---|---|---|
| FL | 3691,51 | | | | 0,02 | | 3691,53 |
| CL | 1,34 | 4058,88 | 12,47 | | 0,19 | | 4072,88 |
| GL | 8,34 | 15,61 | 1907,42 | | 0,10 | | 1931,46 |
| WL | | | | 202,09 | | | 202,09 |
| SL | | | | | 809,84 | | 809,84 |
| OL | 0,11 | | | | | 392,28 | 392,39 |
| 1998 | 3701,30 | 4074,49 | 1919,89 | 202,09 | 810,15 | 392,28 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1998 |
|---|---|---|---|---|---|---|---|
| FL | 3701,27 | | | | 0,02 | | 3701,30 |
| CL | 1,34 | 4059,86 | 12,47 | | 0,19 | | 4073,86 |
| GL | 8,34 | 15,61 | 1899,48 | | 0,10 | | 1923,53 |
| WL | | | | 202,07 | | | 202,07 |
| SL | | | | | 810,15 | | 810,15 |
| OL | 0,11 | | | | | 389,18 | 389,29 |
| 1999 | 3711,06 | 4075,47 | 1911,96 | 202,07 | 810,46 | 389,18 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 1999 |
|---|---|---|---|---|---|---|---|
| FL | 3711,04 | | | | 0,02 | | 3711,06 |
| CL | 1,34 | 4059,86 | 12,47 | | 0,19 | | 4073,86 |
| GL | 8,34 | 15,61 | 1899,48 | | 0,10 | | 1923,53 |
| WL | | | | 202,04 | | | 202,04 |
| SL | | | | | 810,46 | | 810,46 |
| OL | 0,11 | | | | | 379,13 | 379,23 |
| 2000 | 3720,83 | 4075,47 | 1911,96 | 202,04 | 810,76 | 379,13 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2000 |
|---|---|---|---|---|---|---|---|
| FL | 3720,41 | | | 0,41 | 0,01 | | 3720,83 |
| CL | 1,11 | 4058,77 | 12,47 | 0,42 | 0,51 | | 4073,27 |
| GL | 9,25 | 15,61 | 1881,93 | 0,21 | 0,25 | | 1907,25 |
| WL | | | | 202,04 | | | 202,04 |
| SL | | | | | 812,10 | | 812,10 |
| OL | 0,03 | | | | | 384,66 | 384,69 |
| 2001 | 3730,81 | 4074,38 | 1894,40 | 203,08 | 812,87 | 384,66 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2001 |
|---|---|---|---|---|---|---|---|
| FL | 3730,27 | | | 0,41 | 0,12 | | 3730,81 |
| CL | 1,12 | 4027,81 | 12,47 | 0,42 | 0,65 | | 4042,48 |
| GL | 9,35 | 15,61 | 1857,59 | 0,21 | 0,33 | | 1883,08 |
| WL | | | | 203,08 | | | 203,08 |
| SL | | | | | 813,88 | | 813,88 |
| OL | 0,04 | | | | | 426,83 | 426,87 |
| 2002 | 3740,78 | 4043,42 | 1870,06 | 204,12 | 814,98 | 426,83 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2002 |
|---|---|---|---|---|---|---|---|
| FL | 3740,29 | | | 0,42 | 0,07 | | 3740,78 |
| CL | 1,12 | 3979,72 | 12,47 | 0,41 | 0,71 | | 3994,44 |
| GL | 9,31 | 15,61 | 1892,00 | 0,21 | 0,36 | | 1917,48 |
| WL | | | | 204,12 | | | 204,12 |
| SL | | | | | 815,94 | | 815,94 |
| OL | 0,03 | | | | | 427,39 | 427,42 |
| 2003 | 3750,75 | 3995,33 | 1904,47 | 205,16 | 817,09 | 427,39 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2003 |
|---|---|---|---|---|---|---|---|
| FL | 3750,26 | | | 0,42 | 0,08 | | 3750,76 |
| CL | 1,12 | 3968,66 | 12,47 | 0,41 | 0,63 | | 3983,29 |
| GL | 9,32 | 15,61 | 1908,74 | 0,21 | 0,32 | | 1934,19 |
| WL | | | | 205,16 | | | 205,16 |
| SL | | | | | 818,16 | | 818,16 |
| OL | 0,04 | | | | | 408,59 | 408,62 |
| 2004 | 3760,73 | 3984,27 | 1921,21 | 206,20 | 819,19 | 408,59 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2004 |
|---|---|---|---|---|---|---|---|
| FL | 3760,12 | | | 0,42 | 0,19 | | 3760,73 |
| CL | 1,13 | 3810,22 | 12,47 | 0,40 | 2,32 | | 3826,53 |
| GL | 9,41 | 15,61 | 2005,26 | 0,22 | 1,16 | | 2031,66 |
| WL | | | | 206,20 | | | 206,20 |
| SL | | | | | 817,64 | | 817,64 |
| OL | 0,04 | | | | | 457,39 | 457,43 |
| 2005 | 3770,70 | 3825,83 | 2017,73 | 207,24 | 821,30 | 457,39 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2005 |
|---|---|---|---|---|---|---|---|
| FL | 3770,13 | | | 0,42 | 0,15 | | 3770,70 |
| CL | 1,13 | 3821,89 | 12,47 | 0,40 | 2,44 | | 3838,32 |
| GL | 9,38 | 15,61 | 1977,37 | 0,22 | 1,22 | | 2003,80 |
| WL | | | | 207,24 | | | 207,24 |
| SL | | | | | 819,60 | | 819,60 |
| OL | 0,04 | | | | | 460,49 | 460,53 |
| 2006 | 3780,68 | 3837,50 | 1989,84 | 208,28 | 823,41 | 460,49 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2006 |
|---|---|---|---|---|---|---|---|
| FL | 3779,96 | | | 0,42 | 0,29 | | 3780,68 |
| CL | 1,14 | 3812,83 | 12,47 | 0,40 | 2,96 | | 3829,80 |
| GL | 9,51 | 15,61 | 1944,11 | 0,22 | 1,48 | | 1970,93 |
| WL | | | | 208,28 | | | 208,28 |
| SL | | | | | 820,78 | | 820,78 |
| OL | 0,04 | | | | | 489,69 | 489,73 |
| 2007 | 3790,65 | 3828,43 | 1956,58 | 209,31 | 825,51 | 489,69 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2007 |
|---|---|---|---|---|---|---|---|
| FL | 3789,40 | | | 0,42 | 0,83 | | 3790,65 |
| CL | 1,20 | 3808,52 | 12,47 | 0,40 | 2,41 | | 3825,00 |
| GL | 9,99 | 15,61 | 1933,49 | 0,22 | 1,21 | | 1960,51 |
| WL | | | | 209,31 | | | 209,31 |
| SL | | | | | 823,17 | | 823,17 |
| OL | 0,04 | | | | | 491,50 | 491,54 |
| 2008 | 3800,62 | 3824,12 | 1945,96 | 210,35 | 827,62 | 491,50 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2008 |
|---|---|---|---|---|---|---|---|
| FL | 3800,09 | | | 0,43 | 0,10 | | 3800,63 |
| CL | 1,12 | 3760,24 | 12,47 | 0,40 | 2,08 | | 3776,31 |
| GL | 9,35 | 15,61 | 1821,55 | 0,21 | 1,04 | | 1847,75 |
| WL | | | | 210,35 | | | 210,35 |
| SL | | | | | 826,51 | | 826,51 |
| OL | 0,04 | | | | | 638,60 | 638,64 |
| 2009 | 3810,60 | 3775,84 | 1834,02 | 211,39 | 829,73 | 638,60 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2009 |
|---|---|---|---|---|---|---|---|
| FL | 3809,86 | | | 0,43 | 0,31 | | 3810,60 |
| CL | 1,15 | 3779,81 | 12,47 | 0,40 | 3,88 | | 3797,70 |
| GL | 9,53 | 15,61 | 1804,49 | 0,21 | 1,94 | | 1831,77 |
| WL | | | | 211,39 | | | 211,39 |
| SL | | | | | 825,71 | | 825,71 |
| OL | 0,04 | | | | | 622,98 | 623,02 |
| 2010 | 3820,57 | 3795,41 | 1816,96 | 212,43 | 831,84 | 622,98 | 11100,19 |

| kha | FL | CL | GL | WL | SL | OL | 2010 |
|---|---|---|---|---|---|---|---|
| FL | 3820,03 | | | 0,43 | 0,11 | | 3820,57 |
| CL | 1,13 | 3797,23 | 12,47 | 0,40 | 2,17 | | 3813,40 |
| GL | 9,36 | 15,61 | 1779,44 | 0,20 | 1,08 | | 1805,69 |
| WL | | | | 212,43 | | | 212,43 |
| SL | | | | | 830,58 | | 830,58 |
| OL | 0,04 | | | | | 617,48 | 617,52 |
| 2011 | 3830,55 | 3812,84 | 1791,91 | 213,47 | 833,94 | 617,48 | 11100,19 |

The data shows that over the period 1988-2011 the areas in the categories "Forest land", "Wetlands" and "Settlements" and "Other land" have increased by 226,93 kha, 11,18 kha, 26,86 kha and 61,12 kha and they have decreased in the categories "Cropland" and "Grassland" by 109,53 kha and 216,56 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 3 830 547 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 $CO_2$ from forests over the period 1988-2011 is 14 345.18 Gg $CO_2$ eq. for 1988 and 10 276.82 Gg $CO_2$ eq for 2011, the average quantity is 12 211,02 Gg $CO_2$ eq. The contribution of subcategory "Forests Remaining Forests" is almost 10 times bigger compared to the "Lands Converted to Forests" subcategory.

Emissions/uptake of $CO_2$ by the soils in the subcategory "Forest remaining Forest" are considered with Tier 1 as stable in time and equal to 0 (1988-2011). For the subcategory "Lands Converted to Forests" the biggest net changes in the carbon stock in the soils occurs when converting grassland to forests– emission of 954 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 67. 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.

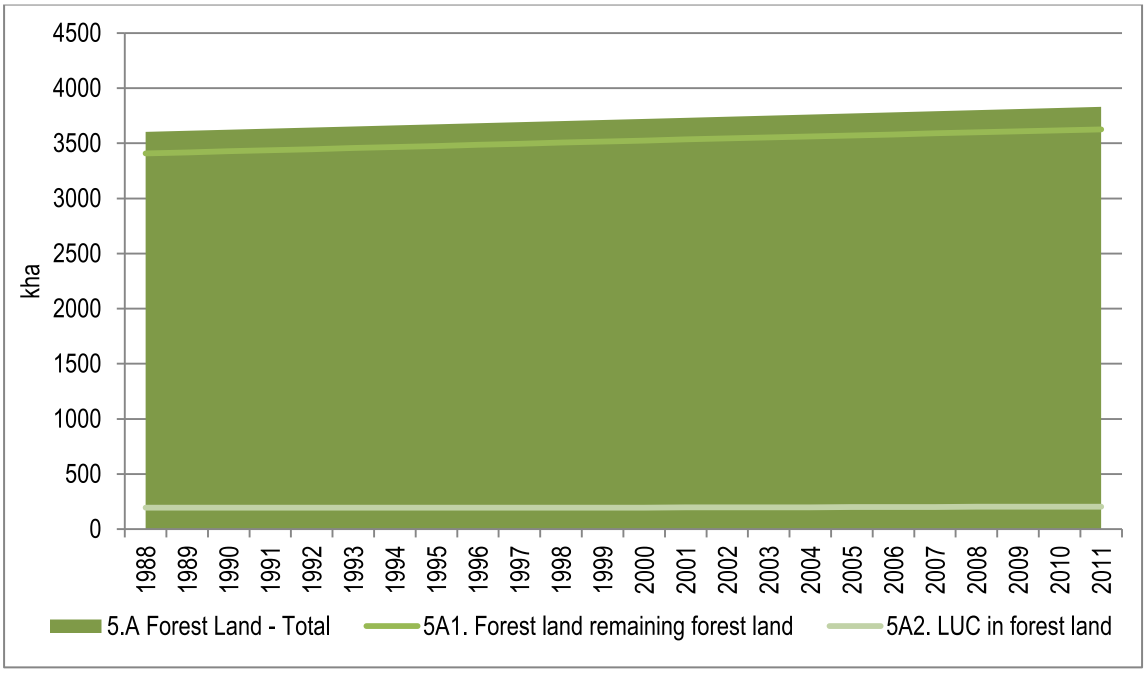



Figure 79 Trends of the changes in the areas of forest land – forest remaining forests and lands converted to forests.

Over the reporting period 1988-2011 the data for the total annual net emissions and removals of carbon dioxide (biomass, litter and soils) are presented in Table 187

Table 187 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 | -14359,19 | -13 702,82 | -656,37 | -161,14 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1989 | -14370,81 | -13 714,31 | -656,50 | -161,28 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1990 | -14406,03 | -13 749,67 | -656,36 | -161,14 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1991 | -14424,24 | -13 767,66 | -656,57 | -161,35 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1992 | -14447,03 | -13 789,55 | -657,48 | -162,25 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1993 | -14401,97 | -13 742,27 | -659,70 | -164,47 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1994 | -14435,55 | -13 774,09 | -661,45 | -166,23 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1995 | -14468,15 | -13 805,82 | -662,33 | -167,10 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1996 | -12257,42 | -11 594,87 | -662,55 | -167,32 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1997 | -12227,62 | -11 564,75 | -662,87 | -167,64 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1998 | -12183,26 | -11 521,58 | -661,68 | -166,46 | -455,12 | 0,00 | 0,00 | -40,10 |
| 1999 | -12145,09 | -11 483,18 | -661,91 | -166,68 | -455,12 | 0,00 | 0,00 | -40,10 |
| 2000 | -12098,66 | -11 444,82 | -653,84 | -158,61 | -455,12 | 0,00 | 0,00 | -40,10 |
| 2001 | -10792,25 | -10 152,93 | -639,32 | -163,23 | -437,34 | 0,00 | 0,00 | -38,75 |
| 2002 | -10801,95 | -10 163,93 | -638,02 | -161,60 | -439,02 | 0,00 | 0,00 | -37,40 |
| 2003 | -10850,63 | -10 210,33 | -640,31 | -160,57 | -443,69 | 0,00 | 0,00 | -36,05 |
| 2004 | -10845,79 | -10 205,05 | -640,74 | -158,72 | -447,31 | 0,00 | 0,00 | -34,71 |
| 2005 | -10862,99 | -10 223,18 | -639,81 | -157,25 | -449,20 | 0,00 | 0,00 | -33,36 |
| 2006 | -10409,90 | -9 767,87 | -642,02 | -156,03 | -453,97 | 0,00 | 0,00 | -32,02 |
| 2007 | -10403,87 | -9 764,27 | -639,60 | -153,37 | -455,55 | 0,00 | 0,00 | -30,68 |
| 2008 | -10426,37 | -9 795,48 | -630,89 | -150,75 | -450,76 | 0,00 | 0,00 | -29,38 |
| 2009 | -10468,84 | -9 818,79 | -650,05 | -152,30 | -469,72 | 0,00 | 0,00 | -28,04 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **2010** | -10482,97 | -9 835,31 | -647,66 | -150,91 | -470,05 | 0,00 | 0,00 | -26,70 |
| **2011** | -10494,00 | -9 839,13 | -654,87 | -151,49 | -478,02 | 0,00 | 0,00 | -25,36 |

Table 188 $CO_2$ Emissions from forest wildfires 1988-2011

| 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 |
| **2011** | 7164,30 | 217,18 | 21,15 | 4,84 |

### 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 and 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. 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. When

developing the FMP a complete forest-inventory is used for all forests (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. 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 Forest Agency.

For the period of the inventory an increase of the forest area has been registered. Bulgaria has examined the Forest Management Plans (FMPs – see below) for all State Forest Enterprises (SFE)[33], which were inventoried for the period 1991-2011. Like this all changes since 1992 in forest area for each and every SFE has been traced and identified[34]. Changes in forest area for the years 1990, 1991 are based on extrapolation. These steps have been performed by the experts from Executive Forest Agency, by using the following sources of information(results are presented in Table 236).

- Forest Inventory and FMPs[35]
- Forestry Fund Reporting Form 1FF[36] (forest area) for the 1990;
- Forest maps

In order to get information for the former land uses that became forests, an expert judgement was used. Land use (cropland, grassland, other land) typically follows ecological site condition. The experts going through the FMPs know the dominating land uses in the SFE region, so they made an expert judgement of former land use on basis of likelihoods. For example, there are regions where grassland (GL) dominates, because growth/site conditions are not good enough for cropland (CL) plants or CL management or, site conditions are so good that CL dominates. Similarly, other land (OL) can be found in extreme site conditions where FL, CL, GL cannot grow.

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[33] 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.

[34] 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.

[35] 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.

[36] 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.

## 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 (last amendment 07.08.2012, SG №60):

"***Area over 0.1 ha, covered with forest tree species higher than 5 meters and tree crown cover over 10% or with trees which can reach these parameters in natural environment***".

Areas of natural forest regeneration outside urban areas with a size of more than 0.1 ha also represent "forest". City parks with trees, forest shelter belts, and single row trees do not fall under the category "forests.

According to their functions, forests are divided in: forests for timber production, protective and recreation forests and forests in protected areas.

*Forests are also:*

- areas which are in a process of recovering and are still under the parameters, but it is expected to reach forest crown cover over 10% and tree height 5 meters;
- areas, which as the result of anthropogenic factors or natural reasons are temporarily deforested, but will be reforested;
- protective forest belts, as well as tree lines with an area over 0.1 ha and width over 10 meters;
- cork oak stands."

All forests in Bulgaria, are managed.

## 7.2.4 METHODOLOGY

### 7.2.4.1 Forest Land remaining Forest Land (5.A.1.)

#### 7.2.4.1.1 Changes in the carbon stock in the living biomass

Bulgaria follows IPCC GPG 2003 and applies the stock change method when defining carbon stock changes in living biomass. Conversion coefficients used are specific for Bulgaria and the ones given in the IPCC GPG 2003 tables. The main database includes: forest area by type (coniferous and deciduous), and the volume stock (stemwood and branches) by forest type obtained from the forestry fund reports (1 FF and 4 FF). To calculate the changes in the carbon stock of the living biomass Method 2 of IPCC GPG 2003 is used.

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.)$^{-1}$

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 189 Wood density (D)

| D- weighed mean wood density –tonnes m-3 | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| Coniferous | 0.427 | 0.430 | 0.431 | 0.430 |
| Weighed mean value | 0.430 | | | |
| Deciduous | 0.605 | 0.605 | 0.606 | 0.597 |
| Weighed mean value | 0.603 | | | |
| Weighed mean value for all forests | 0.528 | | | |

There are no specific values for the biomass expansion factor ($BEF_2$) for converting the stemwood+branches stock into a total aboveground biomass. Since the Bulgarian NFI

assesses also the stock of branches the used biomass expansion factor does not need to account for this tree compartment, so $BEF_2$ has only to add the leaf biomass. To estimate this specific $BEF_2$ data from literary sources on results from ecosystem studies for Spruce, Scots pine, Beech and Oaks 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 190 presents the values for $BEF_2$.

Table 190 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 191) 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 191 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 forests remaining forests.

#### 7.2.4.1.1.2 Changes in carbon stock in litter

Bulgaria reports CSC in litter under Tier 1 (IPCC GPG 2003), where litter inputs and outputs are assumed to balance and the pools therefore taken to be stable.

#### 7.2.4.1.2 Changes in carbon stock in soils

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 0-20 cm, 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 59,98 t C/ha and for the period 1998-2008 was 54,56 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 in protected areas, where all anthropogenic impacts are forbidden. Nevertheless 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 $CO_2$, $CH_4$ and $N_2O$ from uncontrolled fires were calculated as in the forests in Bulgaria no controlled fires are being carried out. The emissions of $CO_2$ 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 Forest 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 ranges between 223 ha in 1989 and 57 915 ha in 2000.

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 $CO_2$- 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 188.

### 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 Forest 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 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 192 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 2011.

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 Ist age class. In Table 184 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 193 and Table 194. 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.

Table 193 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 194 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 2003 |
| D - Emission factor for $CH_4$ | 75% | Default, IPCC GPG 2003 |
| D - Emission factor for $N_2O$ | 75% | Default, IPCC GPG 2003 |

Table 195 Tier 1 Uncertainty calculation and reporting

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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 | $CO_2$ | -14 345.2 | -10 276.8 | 16 | 131 | 131.94 |
| 5A1 | Forestland remaining forestland | $CO_2$ | -13 688,8 | -9 621.95 | 3 | 149 | 149,45 |
| 5A2 | Land converted to Forestland | $CO_2$ | -656,4 | -654,9 | 10 | 122 | 122,52 |
| 5B1 | Forest fires | $CO_2$ | 14.0 | 217.2 | 25 | 99 | 102.10 |
| 5B2 | Forest fires | $CH_4$ | 1.4 | 21.2 | 25 | 99 | 102.10 |
| 5C2 | Forest fires | $N_2O$ | 0.3 | 4.9 | 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 in Submission 2013 have been made due to changes in the activity data for the "Forest land" category.

The area of Forest land has been recalculated for the whole time series taking into account the results of a project implemented in the terms of an ongoing Bulgarian improvement process of reporting the supplementary information under article 3.3 of the KP (details for the project and its implementation are given in Chapter 11).

### 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 197.

Table 196 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 2011 the total area of the croplands is 3813 kha, of which 3370 kha are annual crops and 194 kha – perennials. Conversion of lands to cropland is total of 248 kha.

The annual emissions from 1988 until 2011 range from 544 Gg $CO_2$ eq. to 2160 Gg $CO_2$ eq. Major source of the emissions is the carbon stock change in the soils when converting grassland to cropland.

Table 197 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 | 3770,77 | 3410,67 | 360,10 | 151,60 | 136,44 | 15,16 |
| **1989** | 3918,79 | 3767,19 | 3409,09 | 358,10 | 151,60 | 136,44 | 15,16 |
| **1990** | 3911,74 | 3760,14 | 3399,85 | 360,30 | 151,60 | 136,44 | 15,16 |
| **1991** | 3911,75 | 3760,15 | 3402,85 | 357,30 | 151,60 | 136,44 | 15,16 |
| **1992** | 3911,62 | 3760,02 | 3416,72 | 343,30 | 151,60 | 136,44 | 15,16 |
| **1993** | 3912,08 | 3760,48 | 3452,19 | 308,30 | 151,60 | 136,44 | 15,16 |
| **1994** | 3912,49 | 3760,89 | 3480,59 | 280,30 | 151,60 | 136,44 | 15,16 |
| **1995** | 3962,66 | 3811,06 | 3542,76 | 268,30 | 151,60 | 136,44 | 15,16 |
| **1996** | 3963,19 | 3811,59 | 3547,29 | 264,30 | 151,60 | 136,44 | 15,16 |
| **1997** | 4074,58 | 3922,98 | 3659,69 | 263,30 | 151,60 | 136,44 | 15,16 |
| **1998** | 4074,49 | 3922,89 | 3640,59 | 282,30 | 151,60 | 136,44 | 15,16 |
| **1999** | 4075,47 | 3923,87 | 3645,57 | 278,30 | 151,60 | 136,44 | 15,16 |
| **2000** | 4075,47 | 3915,84 | 3638,68 | 277,16 | 159,63 | 143,33 | 16,30 |

| 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 |
|---|---|---|---|---|---|---|---|
| **2001** | 4074,38 | 3906,72 | 3632,68 | 274,04 | 167,65 | 150,21 | 17,44 |
| **2002** | 4043,42 | 3867,74 | 3600,61 | 267,12 | 175,68 | 157,10 | 18,58 |
| **2003** | 3995,33 | 3811,62 | 3555,78 | 255,84 | 183,71 | 163,99 | 19,72 |
| **2004** | 3984,27 | 3792,53 | 3534,47 | 258,06 | 191,74 | 170,87 | 20,86 |
| **2005** | 3825,83 | 3626,06 | 3385,03 | 241,03 | 199,76 | 177,76 | 22,00 |
| **2006** | 3837,50 | 3629,70 | 3392,12 | 237,58 | 207,79 | 184,65 | 23,14 |
| **2007** | 3828,43 | 3612,62 | 3363,40 | 249,22 | 215,82 | 191,53 | 24,28 |
| **2008** | 3824,12 | 3600,28 | 3351,16 | 249,12 | 223,85 | 198,42 | 25,42 |
| **2009** | 3775,84 | 3543,97 | 3315,55 | 228,42 | 231,87 | 205,31 | 26,56 |
| **2010** | 3795,41 | 3555,51 | 3335,82 | 219,70 | 239,90 | 212,20 | 27,71 |
| **2011** | 3812,84 | 3564,91 | 3370,47 | 194,44 | 247,93 | 219,08 | 28,85 |

Table 198 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** | 544,27 | 35,74 | 508,53 | 508,53 | 162,68 |
| **1989** | 705,94 | 197,41 | 508,53 | 508,53 | 162,68 |
| **1990** | 862,67 | 354,14 | 508,53 | 508,53 | 162,68 |
| **1991** | 1015,97 | 507,44 | 508,53 | 508,53 | 162,68 |
| **1992** | 1190,86 | 682,32 | 508,53 | 508,53 | 162,68 |
| **1993** | 1473,46 | 964,93 | 508,53 | 508,53 | 162,68 |
| **1994** | 1700,16 | 1191,62 | 508,53 | 508,53 | 162,68 |
| **1995** | 1812,73 | 1304,20 | 508,53 | 508,53 | 162,68 |
| **1996** | 1916,11 | 1407,57 | 508,53 | 508,53 | 162,68 |
| **1997** | 1898,79 | 1390,26 | 508,53 | 508,53 | 162,68 |
| **1998** | 1694,34 | 1185,81 | 508,53 | 508,53 | 162,68 |
| **1999** | 1638,48 | 1129,95 | 508,53 | 508,53 | 162,68 |
| **2000** | 1755,50 | 1114,82 | 640,67 | 640,67 | 162,68 |
| **2001** | 1786,98 | 1126,80 | 660,19 | 660,19 | 162,68 |
| **2002** | 1854,25 | 1174,54 | 679,71 | 679,71 | 162,68 |
| **2003** | 2025,87 | 1326,65 | 699,22 | 699,22 | 162,68 |
| **2004** | 1970,45 | 1251,71 | 718,74 | 718,74 | 162,68 |
| **2005** | 2107,98 | 1369,72 | 738,26 | 738,26 | 162,68 |
| **2006** | 2062,13 | 1304,35 | 757,78 | 757,78 | 162,68 |
| **2007** | 1913,29 | 1136,00 | 777,29 | 777,29 | 162,68 |
| **2008** | 1898,87 | 1102,06 | 796,81 | 796,81 | 162,68 |
| **2009** | 2027,12 | 1210,79 | 816,33 | 816,33 | 162,68 |
| **2010** | 2000,18 | 1164,34 | 835,84 | 835,84 | 162,68 |
| **2011** | 2159,79 | 1304,43 | 855,36 | 855,36 | 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 – 2011 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 Table 198 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 2011 ranges from 375 kha to 223 kha. In the period 1988-2011 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:

$$\begin{aligned} &\text{Annual change in the biomass carbon stock} \\ &\quad = \text{area of the perennials remaining perennials} \\ &\quad \cdot \text{coefficient of accumulation of carbon} \\ &\quad - (\text{area of the perennials } 30 \text{ year earlier}^{1} \cdot 0.033 \\ &\quad \cdot \text{coefficient of accumulation of biomass}); \end{aligned}$$

$^{1}$ *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 199 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 2011, 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 (ΔCGrowth).

$$\text{The annual change of carbon stock in biomass} = A_{conversion}(L_{conversion} + \Delta C_{growth})$$

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

$\Delta C_{growth}$ – change of the carbon stock in the biomass in the first year after the conversion, tonnes C ha-1

For Bulgaria ΔCGrowth 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 200 Coefficients used for calculating the total biomass of the annual crops are 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 200 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 - $\Delta C_{Growth}$ = 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 2011, 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

$\Delta C_{growth}$ – 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 2011 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 (∆SOC20) 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 (∆SOC20 ) 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 2011 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 (∆SOC20) 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 (∆SOC20 ) 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 1988-2011 is 248 kha, where 219 kha of them were converted to annual crops and 29 kha - to perennials. The average annual change in the area of grassland converted to cropland is 12 kha and the conversion is mainly in annual crops – 10 kha.

Considering the whole 20-year period this leads to emission release of 984.20 Gg $CO_2$ eq.

The data on the areas of grassland converted to croplands are presented in Table 197.

##### 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

$\Delta C_{growth}$ – 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

$\Delta C_{growth}$ – 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:

$\Delta C_{growth}$ = 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 (ΔCLGSoils), is calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{SOC_0 - SOC_{0-T}}{20} = -0.88\ tC/ha$$

where,

$\Delta C_{LGsoil}$ - 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,

$\Delta C_{LGsoil}$ - annual change in carbon stock in soils in land converted to CL

$SOC_0$ – carbon stocks in the soils after 20 years of transition = 53 t C/ha,

$SOC_{0-T}$ – carbon stock in the soils before the conversion = 80,99 t C/ha.

$T$ – period assessed, years (equal to 20 years),

The change in the carbon stock in soils of grassland converted to perennials was calculated by multiplying the emission factor (1.40 t C ha-1 y-1) by the area of the converted territory.

#### 7.3.4.2.2.5 $N_2O$ emissions in grasslands converted to croplands

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 197, 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 201 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 193. 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.

### 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 chnages in FL category and LUC to forests. After the calculations $CO_2$ emissions form CLrCL increased by 10,47% in the base 1988 year and 30,43% in 2010.

### 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 2011 the total area of the grassland was 1792 kha. This includes grassland of intensive and extensive use

The annual removals of $CO_2$ from grassland in the country are 787 Gg CO2 eq. The emissions from subcategory "Grassland Remaining Grassland" is assumed to be 0. CO2 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 202 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 203 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** | 1870,06 | 1620,63 | 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 |
| **2009** | 1834,02 | 1584,60 | 249,43 | 229,53 | 19,90 |
| **2010** | 1816,96 | 1567,53 | 249,43 | 229,53 | 19,90 |
| **2011** | 1791,91 | 1542,49 | 249,43 | 229,53 | 19,90 |

Table 204 Emissions (+)/removals of $CO_2$ in Grassland Remaining Grassland and Lands Converted to Grassland (Gg $CO_2$ equivalent) (other land use changes are not occurring)

| year | 5 C Grassland Total | 5.C.1 Grassland remaining grassland | 5.C.2 Land converted to grassland | 5.C.2.2 Cropland converted to grassland |
|---|---|---|---|---|
| **1988** | -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 |

| year | 5 C Grassland Total | 5.C.1 Grassland remaining grassland | 5.C.2 Land converted to grassland | 5.C.2.2 Cropland converted to grassland |
|---|---|---|---|---|
| 2001 | -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 |
| 2011 | -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 – 2011 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 Table 204 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, 2010 and 2011. 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 2011 the total area of the grassland remaining grassland is 1542 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 2011 the area of the cropland converted to grassland is 249 kha. The larger part of them – 230 kha - are lands under annual crops converted to grassland. The removals of carbon during the conversions from cropland to grassland is calculated to 787 Gg $CO_2$.

###### 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)

$$B_{total} = B_{cut} \cdot 0.5 + (B_{peak\ aboveground} \cdot 0.5) \cdot (1 + R)$$

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 was 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

$\Delta C_{growth}$ – change of the carbon stock in the biomass in the first year after the conversion, tonnes C ha-1

$\Delta C_{growth}$ = 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 2011 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 (ΔCLGSoils), converted to grassland is calculated using the following equation:

$$\Delta C_{LGsoil} = \frac{SOC_0 - SOC_{0-T}}{20} = 1.40\ tC/ha$$

where,

$\Delta C_{LGsoil}$ - 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,

$\Delta C_{LGsoil}$ - 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 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 193. The total uncertainty for Land converted to Grassland is ±444.8%.

### 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 is assumed that the carbon stocks in the biomass, the dead organic matter and the soils of the surface waters is equal to 0.

The areas of the wetlands range between 202 kha to 213 kha for the period 1988-2011. Table 205 presents data on the area of the wetlands.

Table 205 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 | 0,83 | 0,83 | 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 | 2,08 | 2,05 | 1,06 |
| 2006 | 208,28 | 202,04 | 6,23 | 2,50 | 2,45 | 1,29 |

| 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 |
|---|---|---|---|---|---|---|
| **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 |
| **2011** | 213,47 | 202,04 | 11,42 | 4,64 | 4,45 | 2,34 |

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 are presented in Table 206.

Table 206 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** | 90,83 | NE | 90,83 | 73,38 | 9,43 | 8,01 |
| **2002** | 103,11 | NE | 103,11 | 77,81 | 14,25 | 11,05 |
| **2003** | 115,14 | NE | 115,14 | 81,90 | 18,98 | 14,27 |
| **2004** | 127,12 | NE | 127,12 | 85,95 | 23,71 | 17,46 |
| **2005** | 139,59 | NE | 139,59 | 90,39 | 28,14 | 21,06 |
| **2006** | 151,64 | NE | 151,64 | 94,61 | 32,76 | 24,27 |
| **2007** | 163,97 | NE | 163,97 | 99,16 | 37,36 | 27,45 |
| **2008** | 176,04 | NE | 176,04 | 103,44 | 41,95 | 30,66 |
| **2009** | 188,87 | NE | 188,87 | 108,76 | 46,60 | 33,52 |
| **2010** | 200,68 | NE | 200,68 | 112,90 | 51,27 | 36,51 |
| **2011** | 212,42 | NE | 212,42 | 116,99 | 56,00 | 39,43 |

Note: In CRF tables version 1.3 for 5.D.1 the reporting of this subcategory "wetland remaining wetland" is voluntary and is 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 2011, 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 206.

###### 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 48.9 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 cropland areas immediately before the conversion to wetlands, t d.m../ha.

$B_{after}$ – living biomass immediately after the conversion, t d.m./ha (for TierI 1 = 0),

$CF$ –carbon fraction in the dry matter (d.m.) (under Tier 1 = 0.5 t C/t d.m.).

The average annual stock of the annual crops is 3.0 t C/ha.

During the inventory period no conversion of perennials to wetlands was assumed.

#### 7.5.3.1.2.2 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 wetland areas are calculated using the equation:

$$\Delta C_{wl} = \sum A \cdot \frac{SOC_{\ after} - SOC_{before}}{20}$$

where:

$A$ – area of the converted lands for a transition period of 20 years, ha.

$SOC_{before}$ – carbon stock in the soil immediately before the conversion, tC/ha; for soils of annual crops = 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.

$$The\ annual\ change\ in\ the\ carbon\ stock = annual\ area\ of\ cropland\ converted\ to\ wetlands \cdot (B_{after} - B_{before}) \cdot CF$$

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 193. The total uncertainty for Land converted to Wetlands is ±26.5 %.

### 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:
Changes in FL category

Changes in the figure of biomass loss when converting FL to WL due to new NFI data.

### 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 2011 the area for this category is 834 kha (Table 207). The area converted to settlements over the period (1990-2011) is 36 kha, and the emissions from the change in the carbon stock in the biomass and the soil are presented in Table 208.

The land-use change to settlements origins from the categories Forests (data provided by the Executive Forest Agency), Cropland and Grassland (data provided by the Ministry of Agriculture and Food).

Table 207 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 | 800,94 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1989** | 807,39 | 801,25 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1990** | 807,69 | 801,56 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1991** | 808,00 | 801,86 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1992** | 808,31 | 802,17 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1993** | 808,62 | 802,48 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1994** | 808,92 | 802,78 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1995** | 809,23 | 803,09 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1996** | 809,54 | 803,40 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1997** | 809,84 | 803,71 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1998** | 810,15 | 804,01 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **1999** | 810,46 | 804,32 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **2000** | 810,76 | 804,63 | 6,14 | 0,42 | 3,62 | 0,19 | 1,91 |
| **2001** | 812,87 | 806,27 | 6,60 | 0,41 | 3,92 | 0,21 | 2,06 |
| **2002** | 814,98 | 807,58 | 7,39 | 0,51 | 4,36 | 0,23 | 2,30 |
| **2003** | 817,09 | 808,86 | 8,23 | 0,56 | 4,86 | 0,26 | 2,56 |
| **2004** | 819,19 | 810,24 | 8,95 | 0,62 | 5,28 | 0,28 | 2,78 |
| **2005** | 821,30 | 808,99 | 12,31 | 0,79 | 7,29 | 0,38 | 3,84 |
| **2006** | 823,41 | 807,60 | 15,81 | 0,92 | 9,43 | 0,50 | 4,96 |
| **2007** | 825,51 | 805,28 | 20,24 | 1,19 | 12,06 | 0,63 | 6,35 |
| **2008** | 827,62 | 803,24 | 24,38 | 2,00 | 14,17 | 0,75 | 7,46 |
| **2009** | 829,73 | 802,44 | 27,29 | 2,08 | 15,97 | 0,84 | 8,40 |
| **2010** | 831,84 | 798,73 | 33,10 | 2,36 | 19,47 | 1,02 | 10,25 |
| **2011** | 833,94 | 797,78 | 36,16 | 2,45 | 21,35 | 1,12 | 11,24 |

Table 208 Emissions (+)/removals of $CO_2$ 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** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1989** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **1990** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1991** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1992** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1993** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1994** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1995** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1996** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1997** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1998** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **1999** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **2000** | 83,17 | NE | 83,17 | 7,28 | 46,24 | 29,65 |
| **2001** | 98,13 | NE | 98,13 | 6,03 | 56,54 | 35,56 |
| **2002** | 129,95 | NE | 129,95 | 24,51 | 64,85 | 40,60 |
| **2003** | 134,50 | NE | 134,50 | 17,56 | 71,90 | 45,04 |
| **2004** | 141,64 | NE | 141,64 | 19,39 | 74,99 | 47,26 |
| **2005** | 255,91 | NE | 255,91 | 38,86 | 134,98 | 82,06 |
| **2006** | 296,13 | NE | 296,13 | 34,08 | 162,42 | 99,63 |
| **2007** | 390,01 | NE | 390,01 | 60,01 | 204,37 | 125,63 |
| **2008** | 509,67 | NE | 509,67 | 157,33 | 217,04 | 135,30 |
| **2009** | 411,11 | NE | 411,11 | 35,58 | 230,56 | 144,97 |
| **2010** | 575,40 | NE | 575,40 | 72,78 | 310,29 | 192,33 |
| **2011** | 523,16 | NE | 523,16 | 41,33 | 295,05 | 186,78 |

### 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 2011 the LUC areas from forest land and agricultural land to settlements are available (Forest 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 CO2 are presented in Table 208.

##### 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 2011 the area of the croplands converted to settlements for a period of 20 years are 22,24 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 208.

#### 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 11.12 kha in 2011.

#### 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:

- Changes made in FL category
- Changes in the figure of biomass loss when converting FL to SM due to new NFI data

### 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 61 kha (in total) across the period 1988-2011. 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, and a slight decrease in 2011 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 3.77%.

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 Forest Agency and its subdivisions. Quality control could be exercised by other institutions, e.g. the Ministry of Environment and Waters, municipal authorities as well as by forest landowners. Quality control is exercised at every phase of the preparation of the FMP and the results of the check are documented and the mistakes are corrected.

Concerning the agrostatistical data, from the Agrostatistics and Strategies Directorate of MAF together with the Regional Directorates "Agriculture and forestry" and Municipal Services on agriculture and forestry at MAF organized and conducted the agricultural census

in Bulgaria. Around 4000 surveyors participated in the data collection process. Around 400 controllers supervised the work of the surveyors and provided methodological assistance. The controllers delivered the checked questionnaires to the agrostatistics experts from the Regional Directorates "Agriculture and Forestry" according to a previously adopted schedule. The operators did the data entry in the census software spread in the regional offices. The regional data bases are aggregated on national level by Agrostatistics and Strategies Directorate of MAF. The data entry from the filled in questionnaires into computer software was followed by crosschecks and coherence control in order to ensure the data quality.

## 7.9 PLANNED IMPROVEMENTS

For Submission 2014 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 80

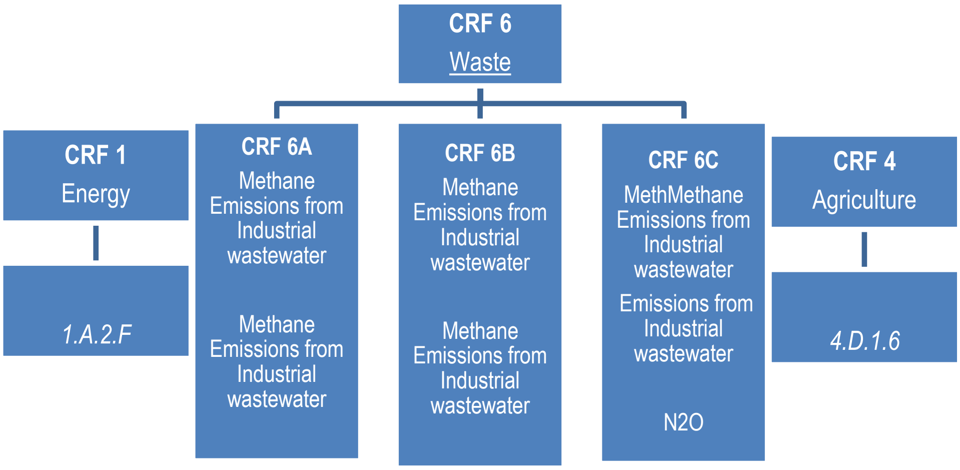


Figure 80 Allocation of Emission from waste handling and their reporting categories

### 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 209 and following figures.

Table 209 Trend in GHG emissions from Waste by sub-sectors for 1988-2011

| GHG gases | $CH_4$ | | $N_2O$ | | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ |
|---|---|---|---|---|---|---|---|---|
| **Category** | **6A** | **6B** | **6B** | **6C** | **6C** | **6D** | **6D** | **6D** |
| **1988** | 155.67 | 106.18 | 0.75 | 0.02 | 19.04 | NA | NA | NA |
| **1989** | 157.11 | 103.54 | 0.75 | 0.02 | 19.54 | NA | NA | NA |
| **1990** | 158.38 | 118.58 | 0.72 | 0.03 | 20.35 | NA | NA | NA |
| **1991** | 159.51 | 89.65 | 0.72 | 0.03 | 20.71 | NA | NA | NA |
| **1992** | 160.48 | 71.16 | 0.71 | 0.02 | 19.39 | NA | NA | NA |
| **1993** | 161.37 | 65.21 | 0.71 | 0.03 | 20.86 | NA | NA | NA |
| **1994** | 162.18 | 62.36 | 0.70 | 0.03 | 21.20 | NA | NA | NA |
| **1995** | 162.91 | 68.16 | 0.65 | 0.03 | 21.49 | NA | NA | NA |
| **1996** | 163.56 | 66.67 | 0.64 | 0.03 | 21.20 | NA | NA | NA |
| **1997** | 165.60 | 60.35 | 0.64 | 0.03 | 21.38 | NA | NA | NA |
| **1998** | 164.85 | 53.59 | 0.63 | 0.05 | 35.42 | NA | NA | NA |
| **1999** | 163.43 | 46.32 | 0.63 | 0.04 | 28.89 | NA | NA | NA |
| **2000** | 163.03 | 42.97 | 0.63 | 0.08 | 62.99 | NA | NA | NA |
| **2001** | 162.39 | 37.43 | 0.61 | 0.05 | 40.24 | NA | NA | NA |
| **2002** | 159.94 | 38.78 | 0.60 | 0.05 | 39.32 | NA | NA | NA |
| **2003** | 157.55 | 65.40 | 0.60 | 0.06 | 44.52 | NA | NA | NA |
| **2004** | 155.22 | 63.99 | 0.60 | 0.09 | 70.40 | NA | NA | NA |
| **2005** | 153.04 | 36.63 | 0.55 | 0.07 | 56.06 | NA | NA | NA |
| **2006** | 150.30 | 36.95 | 0.54 | 0.07 | 52.77 | NA | NA | NA |
| **2007** | 148.29 | 37.43 | 0.54 | 0.04 | 35.44 | NA | NA | NA |
| **2008** | 146.01 | 36.26 | 0.54 | 0.06 | 43.19 | NA | NA | NA |
| **2009** | 147.01 | 31.75 | 0.53 | 0.04 | 33.89 | NA | NA | NA |
| **2010** | 140.02 | 33.34 | 0.53 | 0.02 | 14.17 | NA | NA | NA |
| **2011** | 138.08 | 32.07 | 0.52 | 0.01 | 9.66 | 0.34 | 0.03 | NA |

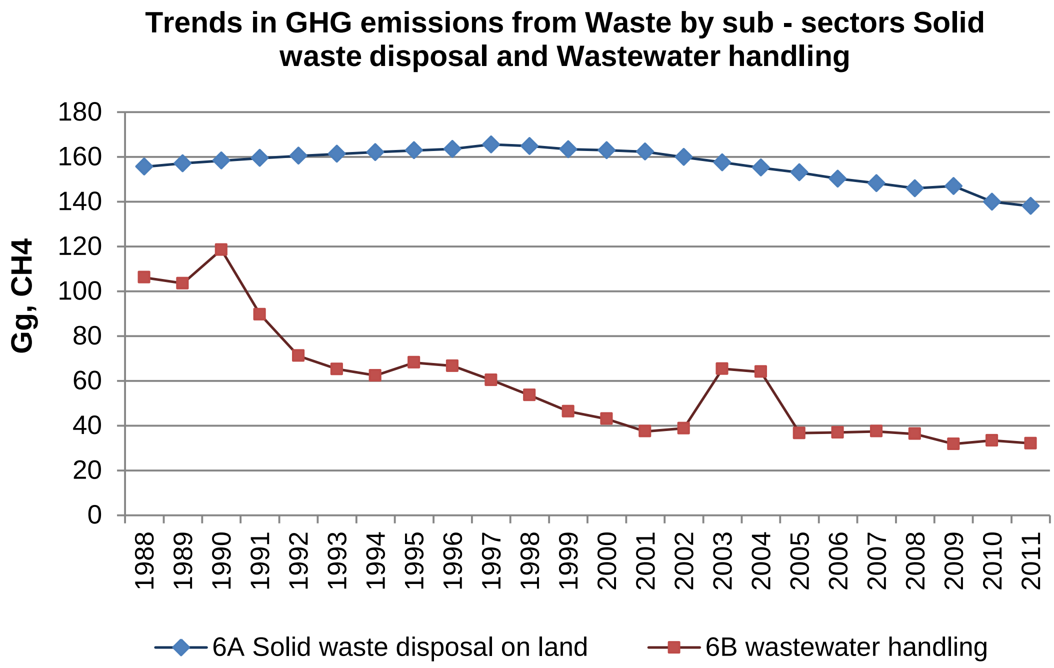


Figure 81 Trend in $CH_4$ emissions

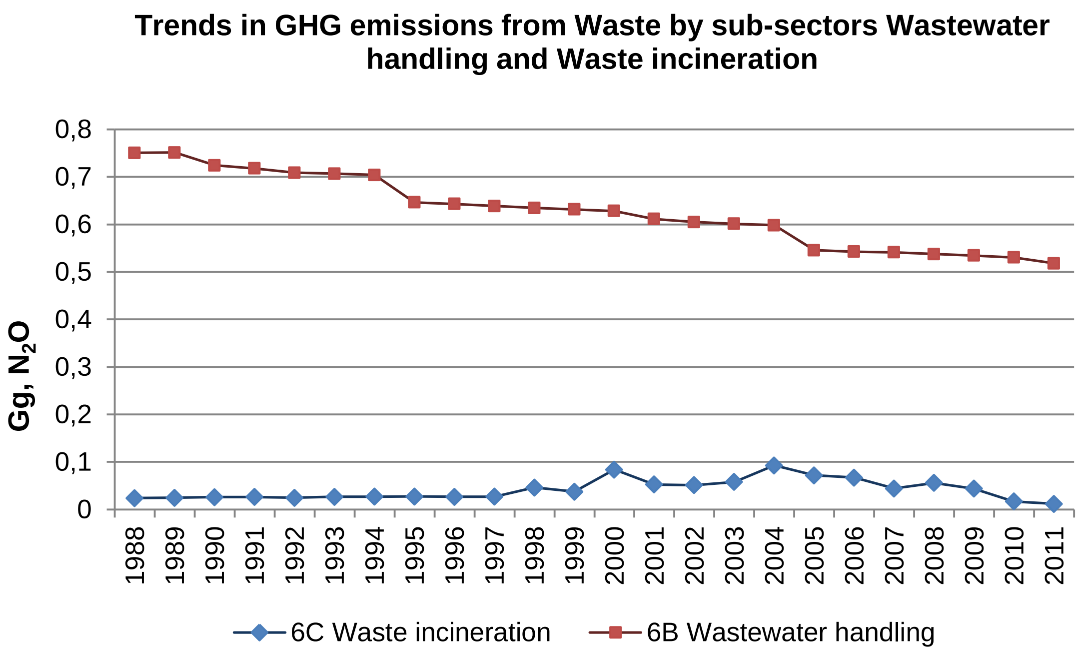


Figure 82 Trend in $N_2O$ emissions

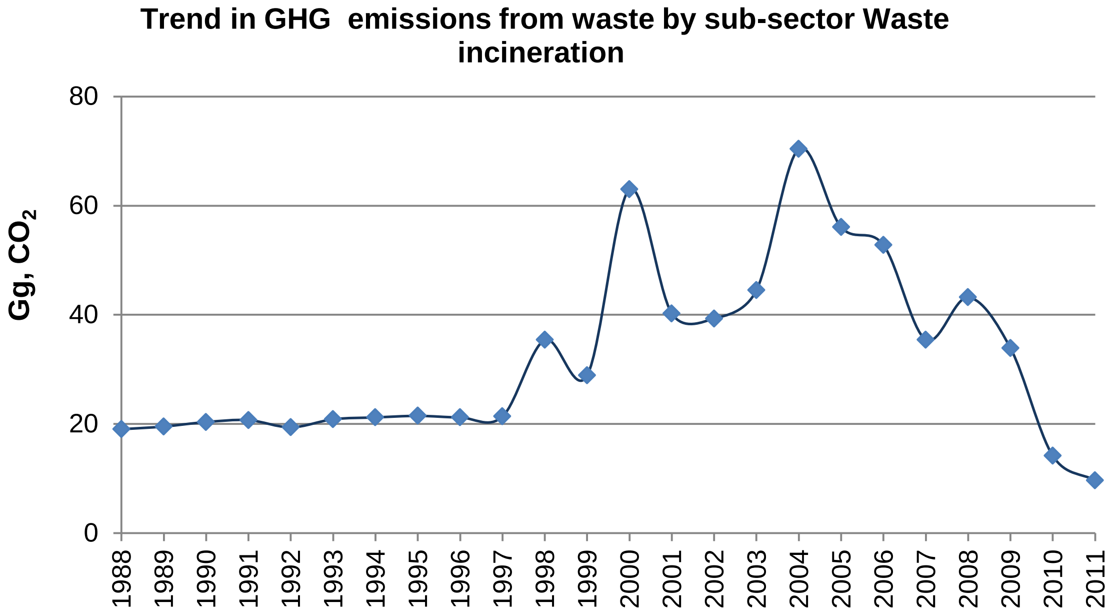


Figure 83 Trend in $CO_2$ emissions

The total annual GHG emission in $CO_2$ equivalent per year emitted from Waste sector and the trend of emissions of $CH_4$, $CO_2$ and $N_2O$, for the period 1988-2011 is presented in the following figure.

The Figure below presents the share of $CO_2$ eqivalents from whole waste sector.

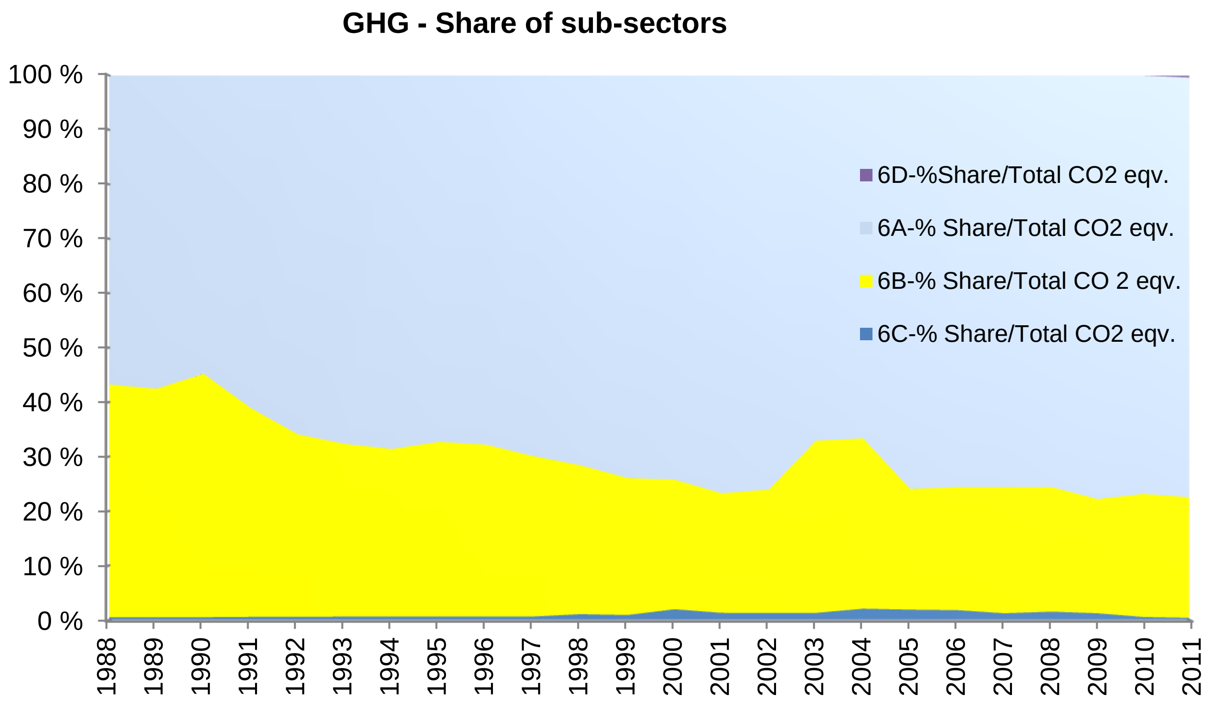


Figure 84 GHG emissions from Waste sector

Emissions from the waste sector in the year 2011 are about 3 762 Gg $CO_2$ equivalents, and they are around 7 % including LULUCF and around 6 % excluding LULUCF of national total GHGs emissions from Bulgaria.

Solid Waste Disposal on Land contributes over 77.08%, Wastewater Handling about 22.17%, Waste Incineration about 0.35% and compost production about 0.39% sector's total emissions.

Emissions from the waste sector in 2011 decreased by 34.67 % (3 761.83 Gg $CO_2$-eq in 2011 compared to 5 758.08 Gg $CO_2$-eq in 1988) compared to the base year.

Figure below presents the total $CO_2$ emissions from the whole waste sector.

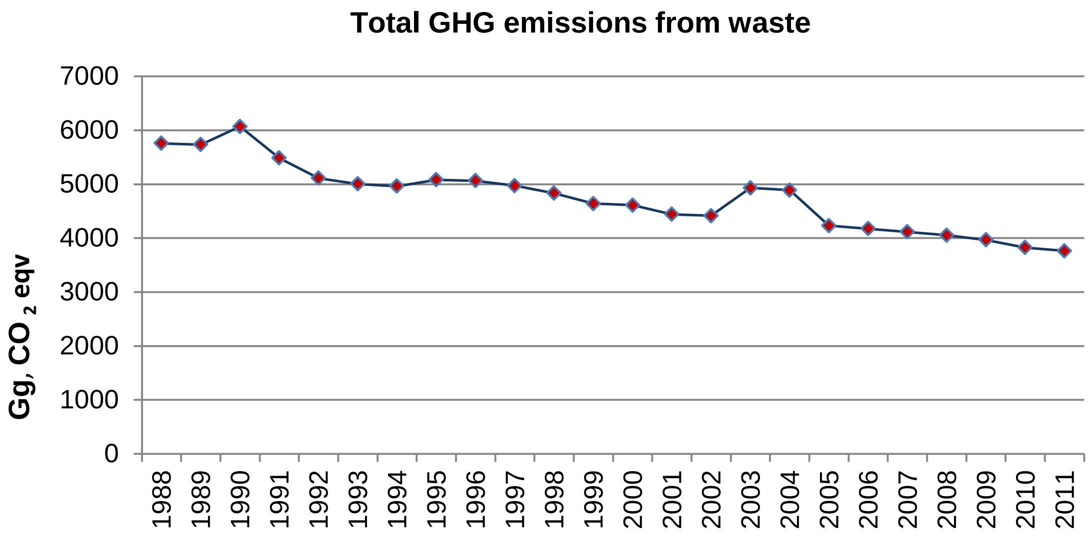


Figure 85 GHG emissions from Waste sector

### 8.1.2 KEY CATEGORIES

Table 210 described the key categories of the waste sector and type of emitted greenhouse emissions.

Table 210 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 211 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 | ▲ |
| 6D Other waste | Different type of waste(compost production and etc. | NA | ▲ | ▲ |

## 8.2 SOLID WASTE DISPOSAL ON LAND (CRF SECTOR 6A)

### 8.2.1 SOURCE CATEGORY DESCRIPTION

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 values 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 93% of municipal solid waste generated in the country has been deposited in 2011. The landfills are classified as managed and unmanaged (see below: Activity data).

### 8.2.2 EMISSION TREND

Methane emissions are shown in the Table 212 and Figure 86, respectively from managed and unmanaged sites.

Table 212 $CH_4$ emissions from SWDS

| Year | $CH_4$ emissions | | Share of populations land filled on | |
|---|---|---|---|---|
| | managed | unmanaged | managed | unmanaged |
| | Gg | | % | |
| 1988 | 0.00 | 155.67 | 0 | 100 |
| 1989 | 0.00 | 157.11 | 0 | 100 |
| 1990 | 0.00 | 158.38 | 0 | 100 |
| 1991 | 0.00 | 159.51 | 0 | 100 |
| 1992 | 0.00 | 160.48 | 0 | 100 |
| 1993 | 0.00 | 161.37 | 0 | 100 |
| 1994 | 0.00 | 162.18 | 0 | 100 |
| 1995 | 0.00 | 162.91 | 0 | 100 |
| 1996 | 0.00 | 163.56 | 0 | 100 |
| 1997 | 0.00 | 165.60 | 0 | 100 |
| 1998 | 0.00 | 164.85 | 0 | 100 |
| 1999 | 0.00 | 163.43 | 0 | 100 |
| 2000 | 2.74 | 160.29 | 31.25% | 68.75% |
| 2001 | 4.86 | 157.54 | 26.19% | 73.81% |
| 2002 | 6.27 | 153.67 | 26.47% | 73.53% |
| 2003 | 7.88 | 149.66 | 30.57% | 69.43% |
| 2004 | 9.48 | 145.74 | 32.42% | 67.58% |
| 2005 | 11.05 | 141.99 | 32.62% | 67.38% |
| 2006 | 12.45 | 137.85 | 35.35% | 64.65% |
| 2007 | 14.54 | 133.75 | 45.34% | 54.66% |
| 2008 | 17.07 | 128.93 | 48.34% | 51.66% |
| 2009 | 19.88 | 127.14 | 53.03% | 46.97% |
| 2010 | 17.70 | 122.32 | 55.38% | 44.62% |
| 2011 | 19.22 | 118.86 | 56.80% | 43.20% |

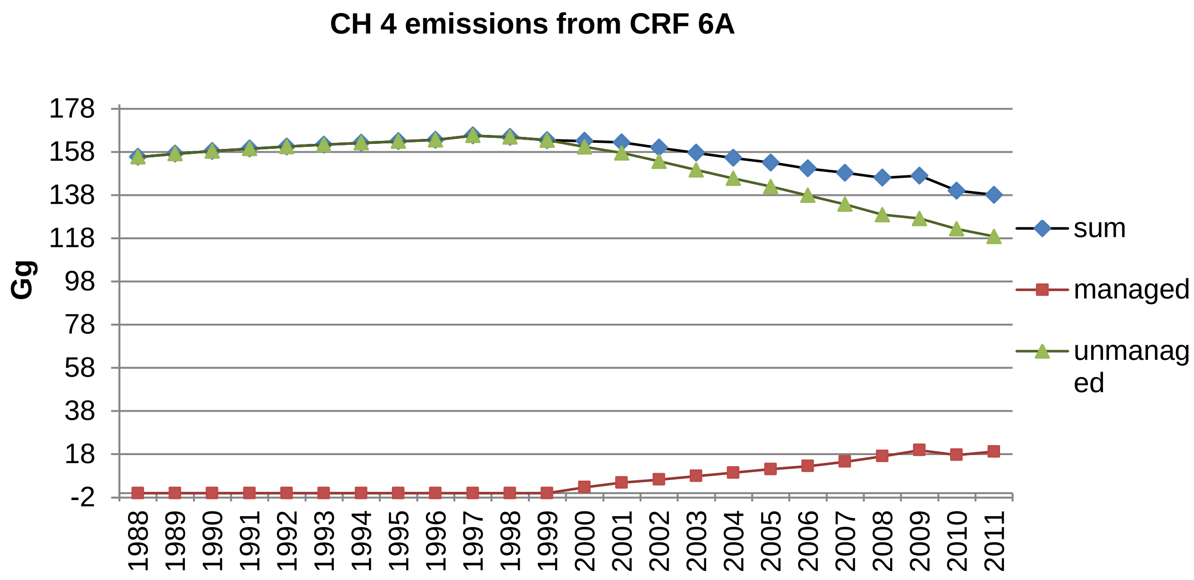


Figure 86 $CH_4$ Emissions from SWDS

## 8.2.3 METHODOLOGICAL ISSUES

### 8.2.3.1 Methodology

**A. Choice of method:**

Emissions from solid waste disposal on land have been calculated using the First Order Decay (FOD) method, which is the IPCC Tier 2 method given in the IPCC Good Practice Guidance (GPG 2000).

The choice of a good practice method will depend on national circumstances.

**B. Basics:**

- IPCC FOD Tier 2
- Multi –phase model (based on waste composition);
- Starting year 1950;
- Managed and unmanaged type of site;
- Source AD: NSI, MOEW, ExEA.

**C. Equation:**

The FOD methods can be represented by the next described Equation,$CH_4$ generated (IPCC GPG 2000, Chapter 5, eq. 5.1)

$$CH_4\ generated\ in\ year\ t\ (Gg/yr) = \sum_x \left[A \bullet k \bullet MSW_T(x) \bullet MSW_F(x) \bullet L_0(x)\right] \bullet e^{-k(t-x)}$$

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 2000, Chapter 5, eq. 5.2):

$$CH_4\ emitted\,in\,year\,t (Gg/yr) = \left[ CH_4\ generated\,in\,year\,t - R(t) \right] \bullet (1 - OX)$$

Equation 2

Where:

R = $CH_4$ recovered (Gg/yr)

OX = oxidation factor (fraction)

**D. Influencing factors/ data required:**

- Waste amounts deposited / waste generated
- Waste treatment (deposition, composting, incineration, recycling)
- Management practices at landfill sites (MCF)
- Conditions at landfill sites + Composition of waste deposited
- Organic carbon in landfill sites (DOC)
- Methane generation rate constant (k)
- Landfill gas recovery, Oxidation
- National waste management policy

### 8.2.3.2 Activity data and emission factors

The main source of activity data is NSI. Data on Municipal Solid Waste generation rate and on the quantity of MSW disposed to SWDSs and etc. are available and country specific data.

The table below presents the summarized sources of initial activity data.

Table 213 Source of Activity data by year

| Year | Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | generated waste | Source of information | waste generation rate | Source of information | landfilling waste | Source of information | waste composition | Source of information | type of landfill | | Source of information |
| | | | | | | | | | managed | unmanaged | |
| 1950-1998 | CS | NSI (proportional to the population) | CS | NSI | CS | NSI | D | IPCC GPG 2000 | not defined as such | all unmanaged | IPCC GPG 2000 |
| 1998-2000 | CS | NSI | CS | NSI | CS | NSI | D | IPCC GPG 2000 | not defined as such | all unmanaged | IPCC GPG 2000 |
| 2000-2002 | CS | NSI | CS | NSI | CS | NSI | D | IPCC GPG 2000 | CS | CS | MOEW |
| 2002-2011 | 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
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 (1950-2011), are given - Figure 87

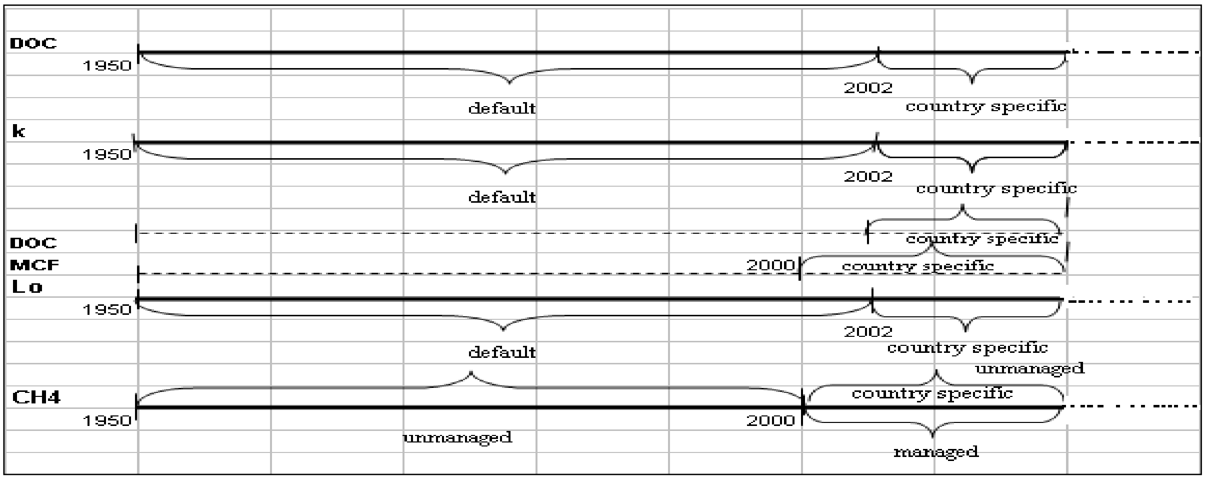


Figure 87 Regarding activity data

GPG gives the opportunity to estimate historical waste disposal, assuming it to be proportional to population for the period 1950-1998 (based on the recommendations of TERT from ESD Techincal review 2012). After 1999 the source of information is NSI, which applies new methodology for collecting waste data and thus increase the quality of collecting and analyzing information on waste generated and disposed. From this year the respondents to submit the required information are municipalities that are primarily responsible for waste management at municipal level.

The emissions of methane on basis of the activity data are calculated for the entire period 1950-2011, 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 214 shows the morphological composition of the waste % allocated according to distribution of population.

Table 214 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 |

| Population | until 3 000 | from 3 000 to 25 000 | from 25 000 to 50 000 | over 50 000 |
|---|---|---|---|---|
| A | Organic waste, % | | | |
| Rubber | 1.15 | 0.45 | 1.10 | 0.60 |
| Leather | 1.36 | 1.35 | 2.10 | 0.70 |
| Garden waste | 14.12 | 14.00 | 5.53 | 6.80 |
| Wood waste | 2.14 | 2.28 | 1.58 | 1.30 |
| B | Non-organic waste, % | | | |
| Glass | 8.85 | 3.40 | 8.75 | 9.90 |
| Metals | 2.88 | 1.30 | 2.83 | 1.70 |
| C | Other waste, % | | | |
| Inert waste | 50.78 | 43.73 | 32.35 | 14.20 |

For country specific biodegradable organic fraction of waste calculations is implemented a model, based on human settlements and distribution of population in them, with the percentage composition of different types of waste and total waste generated for a specific year. Using this model, respectively, the composition of waste is calculated, mainly in four groups (Revised 1996 Guidelines).

A - paper , paperboard and textile waste;
B - garden waste;
C - food (kitchen) waste;
D - Wood waste.
DOC is calculated according Equation 8.2.3.3 (Eq: 5.4, p.5.9, IPCC GPG 2000):

$$DOC = (0.4 \bullet A) + (0.17 \bullet B) + (0.15 \bullet C) + (0.3 \bullet D)$$

Equation 3

With the above equation are calculated the value of the decomposed organic structure of the waste for the country at 2011 as a whole:

**DOC = 11.74%**

DOC was estimated by using country-specific data on waste composition and quantities based on compiled data from 2002 to 2011. 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 215 below shows the four components (A, B, C, and D).

Table 215 Components of waste composition

| Year | waste composition, % | | degradable waste, % | DOC |
|---|---|---|---|---|
| 2002 | A | 16.52% | 46.54% | 0.1158 |
| | B | 10.22% | | |
| | C | 18.05% | | |
| | D | 1.76% | | |
| 2003 | A | 16.53% | 46.55% | 0.1158 |
| | B | 10.22% | | |
| | C | 18.05% | | |
| | D | 1.75% | | |
| 2004 | A | 16.55% | 46.60% | 0.1160 |
| | B | 10.23% | | |
| | C | 18.07% | | |
| | D | 1.76% | | |
| 2005 | A | 16.58% | 46.65% | 0.1161 |
| | B | 10.21% | | |
| | C | 18.11% | | |
| | D | 1.75% | | |
| 2006 | A | 16.62% | 46.74% | 0.1163 |
| | B | 10.19% | | |
| | C | 18.18% | | |
| | D | 1.75% | | |
| 2007 | A | 16.63% | 46.76% | 0.1164 |
| | B | 10.21% | | |
| | C | 18.17% | | |
| | D | 1.75% | | |
| 2008 | A | 16.63% | 46.76% | 0.1164 |
| | B | 10.17% | | |
| | C | 18.21% | | |
| | D | 1.75% | | |
| 2009 | A | 16.62% | 46.74% | 0.1163 |
| | B | 10.15% | | |
| | C | 18.23% | | |
| | D | 1.75% | | |
| 2010 | A | 16.66% | 46.81% | 0.1165 |
| | B | 10.13% | | |
| | C | 18.28% | | |
| | D | 1.75% | | |
| 2011 | A | 16.84% | 47.16% | 0.1174 |
| | B | 10.04% | | |
| | C | 18.55% | | |
| | D | 1.74 | | |

The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on $CH_4$ generation.

MCF accounts for the fact that unmanaged SWDS produce less $CH_4$ from a given amount of waste than anaerobic managed SWDS.

The methodology requires countries to provide data or estimates of the quantity of waste that is disposed of to each of categories of solid waste disposal sites.The IPCC Guidelines present default value for MCF (Table 6-2, p.6.8, Revised 1996 IPCC Guidelines, Reference Manual), which are presented in

Table 216 below:

Table 216 Methane Correction Factor (MCF)

| SWDS CLASSIFICATION AND METHANe CORRECTION FACTORS(MCF) | |
|---|---|
| Type of site | Methane correction factor (MCF) |
| Managed | 1 |
| Unmanaged 3 – deep (>5m waste) | 0,8 |
| Unmanaged 3 – shallow (<5m waste) | 0,4 |
| Uncategorised SWDS 5 | 0,6 |

To determine the quantity of managed and unmanaged landfills at the national level is applied the method of expert judgment, assessment by leading experts in the field of waste from the structure of MOEW (2006 IPCC Guidelines, Vol.1 General Guidance and Reporting). As the main criteria for whether landfills are managed and unmanaged, is considered the fact if the landfills meet the requirements laid down in EU Directive 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 2011 inventory year the values are:

$$\mathbf{Lo}_{\text{managed landfills}} = 0.043\ GgCH_4/Gg\ waste$$

$$\mathbf{Lo}_{\text{unmanaged landfills}} = 0.034\ GgCH_4/Gg\ waste$$

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 2011.
Country doesn't have the data about specific half-life values and therefore default values are used to calculate country specific constant k. Corresponding half-lives (2006 IPCC Guidelines) are provided below in Table 217.

Table 217 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 2011 inventory year is:

k=0.0480 (1/yr)

Before 2002 the period from 1950 to 2001, accept the default value of k=0.05 (IPCC Good Practice Guidance, p.5.7)

Besides the following parameters are chosen:

Fraction of DOC dissimilated (DOCF) is an estimate of the fraction of carbon that is ultimately degraded and released from SWDS, and reflects the fact that some organic carbon does not degrade, or degrades very slowly, when deposited in SWDS. It is also good practice to use a value of 0.5-0.6 (including lignin C) as the default (IPCC Good Practice Guidance).
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 and 2011 the methane recovery was calculated. 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 218 summarizes the parameters used to calculate emissions of methane from Solid waste Disposal Sites by IPCC Tier 2 method.

Table 218 Parameters in TIER 2 for Solid waste Disposal Sites

| Year | Total population | Waste generation rate | Fraction of MSW disposed | Fraction DOC in MSW | $CH_4$ oxidation factor | $CH_4$ fraction in landfill gas | $CH_4$ generation rate constant | Time lag | $CH_4$ emissions |
|---|---|---|---|---|---|---|---|---|---|
| | 1000s | kg/person/day | | | | | | yr | Gg/yr |
| **1988** | 8986.64 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 38 | 155.67 |
| **1989** | 8767.31 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 39 | 157.11 |
| **1990** | 8669.27 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 40 | 158.38 |
| **1991** | 8595.47 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 41 | 159.51 |
| **1992** | 8484.86 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 42 | 160.48 |
| **1993** | 8459.76 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 43 | 161.37 |
| **1994** | 8427.42 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 44 | 162.18 |
| **1995** | 8384.72 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 45 | 162.91 |
| **1996** | 8340.94 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 46 | 163.56 |

| 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 |
| 1997 | 8283.20 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 47 | 165.60 |
| 1998 | 8230.37 | 1.38 | 0,950 | 0,1500 | NO | 0,5 | 0,050 | 48 | 164.85 |
| 1999 | 8190.88 | 1.39 | 0,772 | 0,1500 | NO | 0,5 | 0,050 | 49 | 163.43 |
| 2000 | 8149.47 | 1.42 | 0,774 | 0,1500 | NO | 0,5 | 0,050 | 50 | 163.03 |
| 2001 | 7891.10 | 1.39 | 0,799 | 0,1500 | NO | 0,5 | 0,050 | 51 | 162.39 |
| 2002 | 7845.84 | 1.38 | 0,808 | 0,1158 | NO | 0,5 | 0,047 | 52 | 159.94 |
| 2003 | 7801.27 | 1.38 | 0,816 | 0,1158 | NO | 0,5 | 0,047 | 53 | 157.55 |
| 2004 | 7761.05 | 1.35 | 0,808 | 0,1160 | NO | 0,5 | 0,047 | 54 | 155.22 |
| 2005 | 7718.75 | 1.31 | 0,855 | 0,1161 | NO | 0,5 | 0,047 | 55 | 153.04 |
| 2006 | 7679.29 | 1.27 | 0,775 | 0,1163 | NO | 0,5 | 0,047 | 56 | 150.30 |
| 2007 | 7640.24 | 1.19 | 0,899 | 0,1164 | NO | 0,5 | 0,048 | 57 | 148.29 |
| 2008 | 7606.55 | 1.30 | 0,929 | 0,1164 | NO | 0,5 | 0,048 | 58 | 146.01 |
| 2009 | 7563.71 | 1.29 | 0,961 | 0,1163 | NO | 0,5 | 0,048 | 59 | 147.01 |
| 2010 | 7504.87 | 1.13 | 0,984 | 0,1165 | NO | 0,5 | 0,050 | 60 | 140.02 |
| 2011 | 7327.22 | 1.03 | 0,933 | 0,1174 | NO | 0,5 | 0,048 | 61 | 138.08 |

### 8.2.4 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

To ensure consistency over time, it is good practice (IPCC GPG 2000) a time series should be developed using the same methods. For entire time series we apply the same FOD methods for emission calculation.

Table 219 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

Recalculations of $CH_4$ emissions from solid waste disposal are made due to TERT recommendations (according to ESD) during the in country review in July 2012. During the Technical review, Bulgaria provided the revised estimates, based on change of activity data, concerning waste generation rate for period (1950-1998). GPG gives the opportunity to estimate the historical waste disposal assuming it to be proportional to population. Calculations have been made for the whole period, using TIER 2 (FOD model). Corrections in Solid waste disposal on land have been accepted on 4 July 2012 by TERT.

### 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.

For inventory 2012 we are planning the following ativities:

Sending yearly questionnaires to landfill operators for $CH_4$ recovery.

## 8.3 WASTEWATER HANDLING (CRF SECTOR 6B)

### 8.3.1 SOURCE CATEGORY DESCRIPTION

This sector includes $CH_4$ emissions from wastewater when treated or disposed anaerobically and indirect $N_2O$ emissions for the period 1988-2011. $CO_2$ emissions from wastewater are not considered in the IPCC Guidelines.

This category includes the calculation of $CH_4$ emissions in the atmosphere during the wastewater handling and indirect $N_2O$ emissions for the period 1988-2011. The calculation of the emissions is separated in two subcategories:

6B1 – Industrial wastewater treatment;

6B2 – Domestic/commercial wastewater treatment

For estimation of $CH_4$ recovery from waste water handling, a questionnaires have been sent to operators of WSS (Water Supply and Service) utilities. They include information about the type of plant treatment system for $CH_4$ utilization (e.g. gas holder system, methane tanks and gas burning system); quantity of total catched $CH_4$, $CH_4$ stored in reservoirs, utilized and flared methane) and year of commissioning of the installation for $CH_4$ utilization.

### 8.3.2 EMISSION TREND

Total $CO_2$ eqivalents from waste water handling for 2011 are 834 Gg $CO_2$ eq. Methane emissions from wastewater treatment and $CH_4$ recovery are shown on the following figures. We divide the emission by domestic and industrial origin.

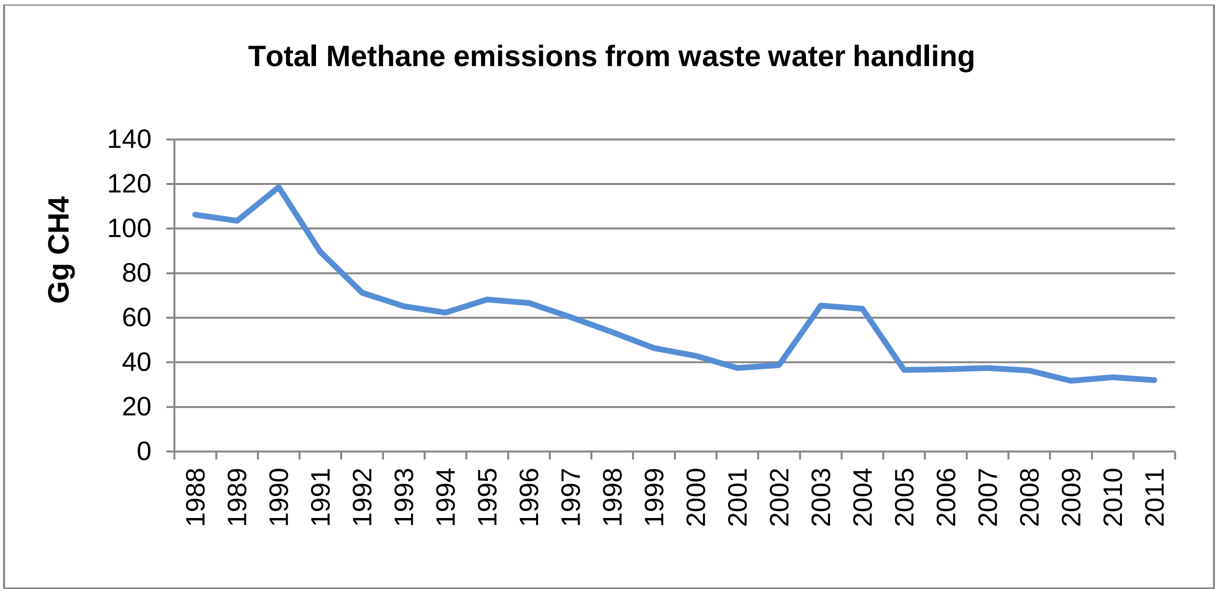


Figure 88 $CH_4$ emissions from wastewater handling

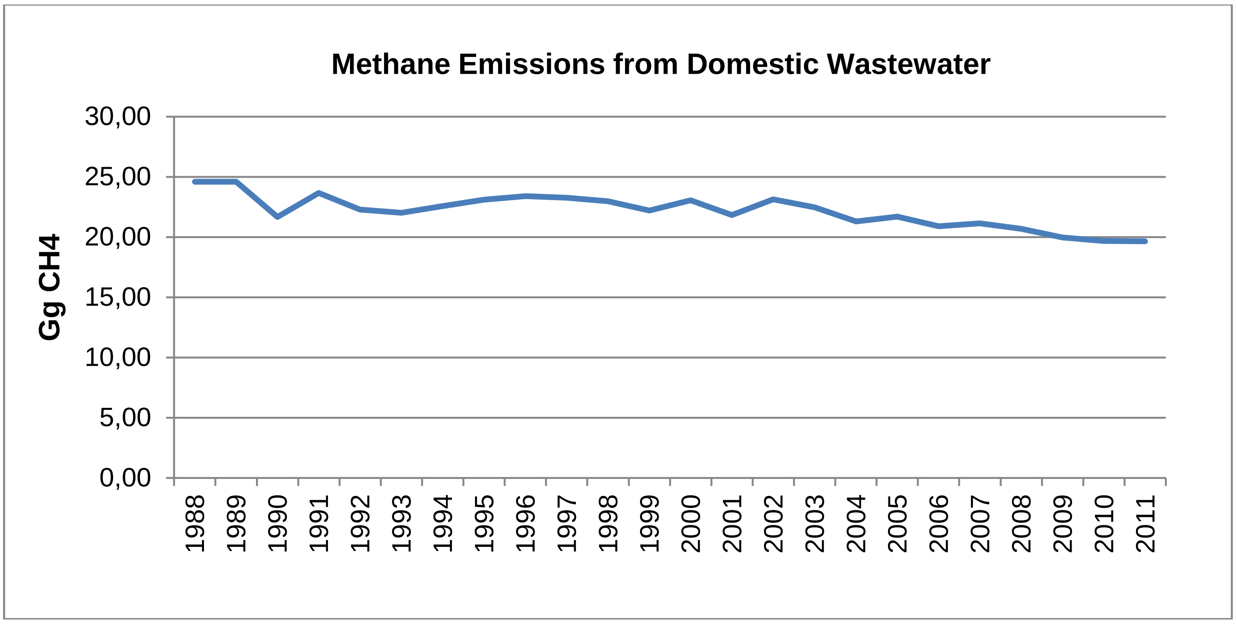


Figure 89 $CH_4$ emissions from Domestic Wastewater

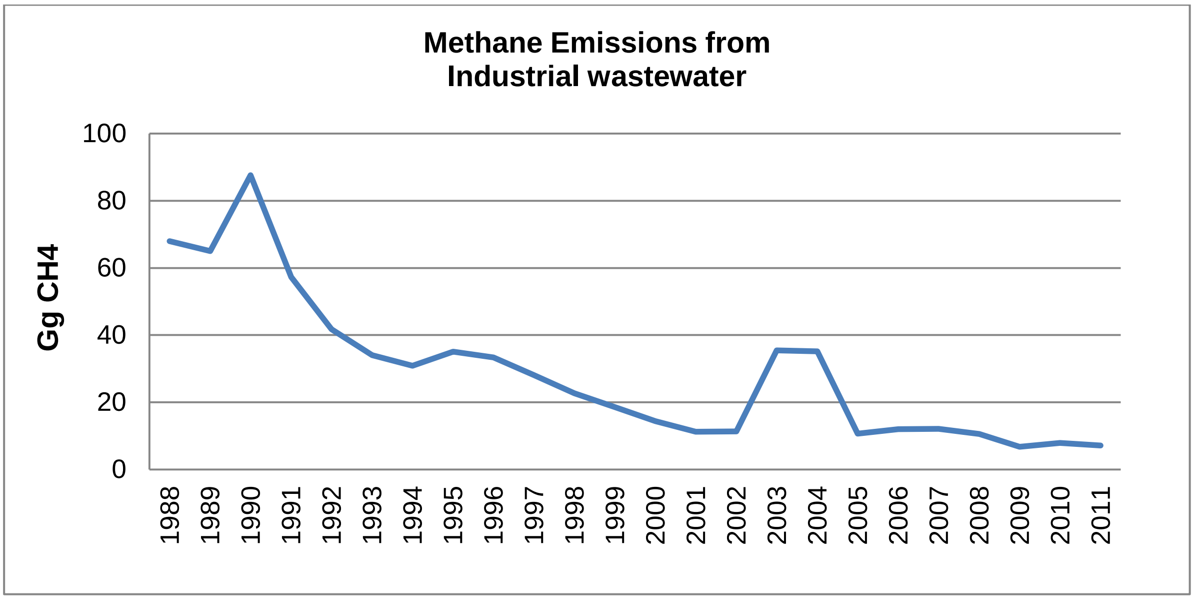


Figure 90 $CH_4$ emissions from Industrial wastewater

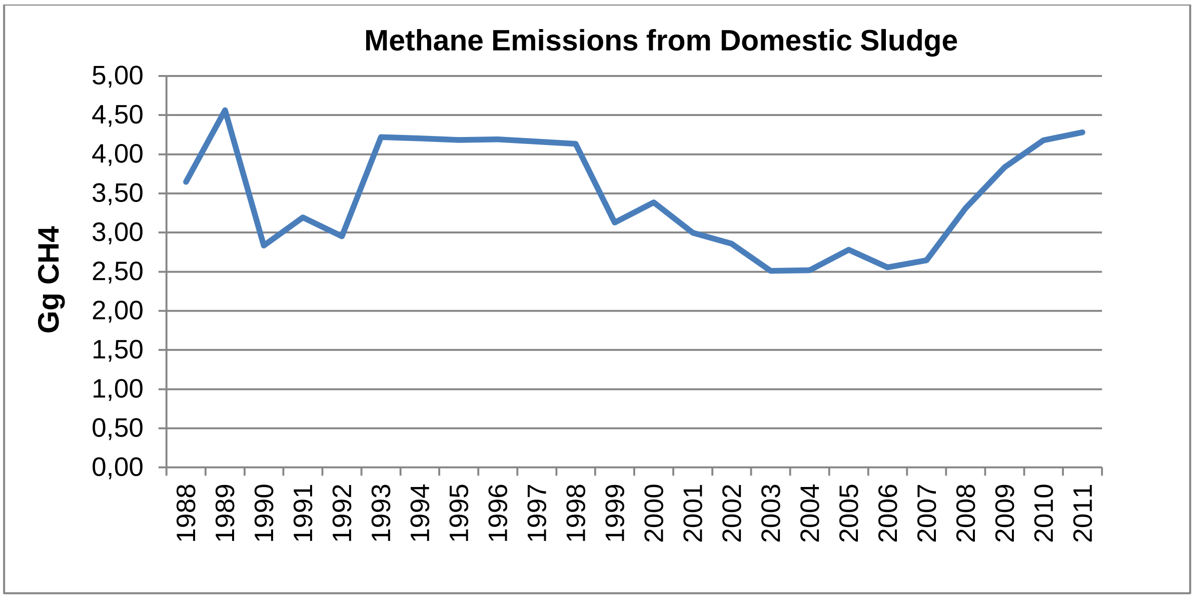


Figure 91 $CH_4$ emissions from Domestic Sludge

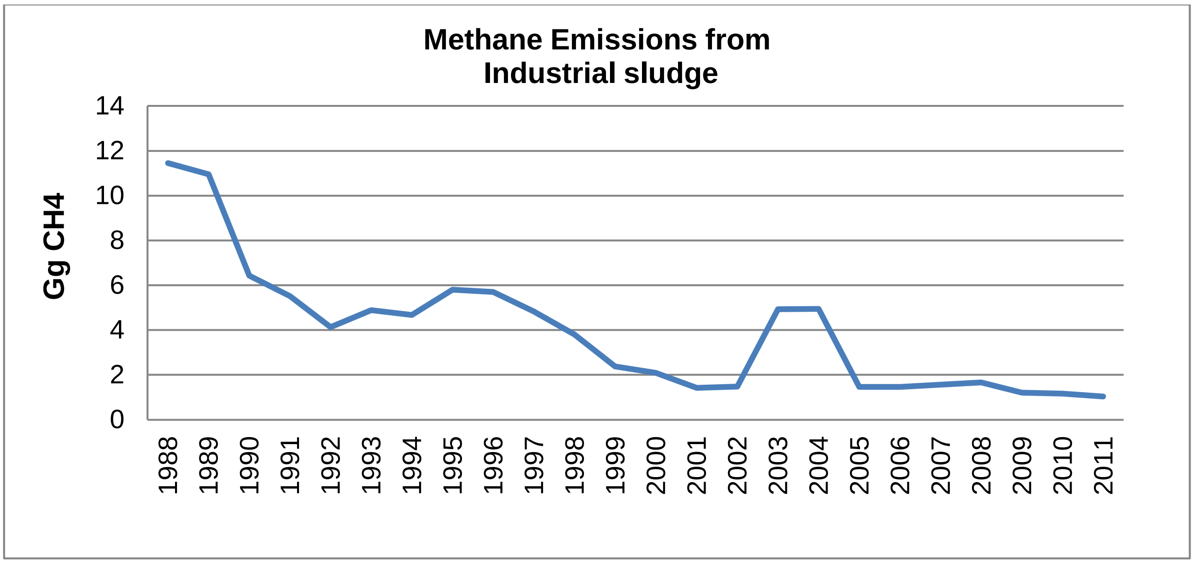


Figure 92 $CH_4$ emissions from Industrial Sludge

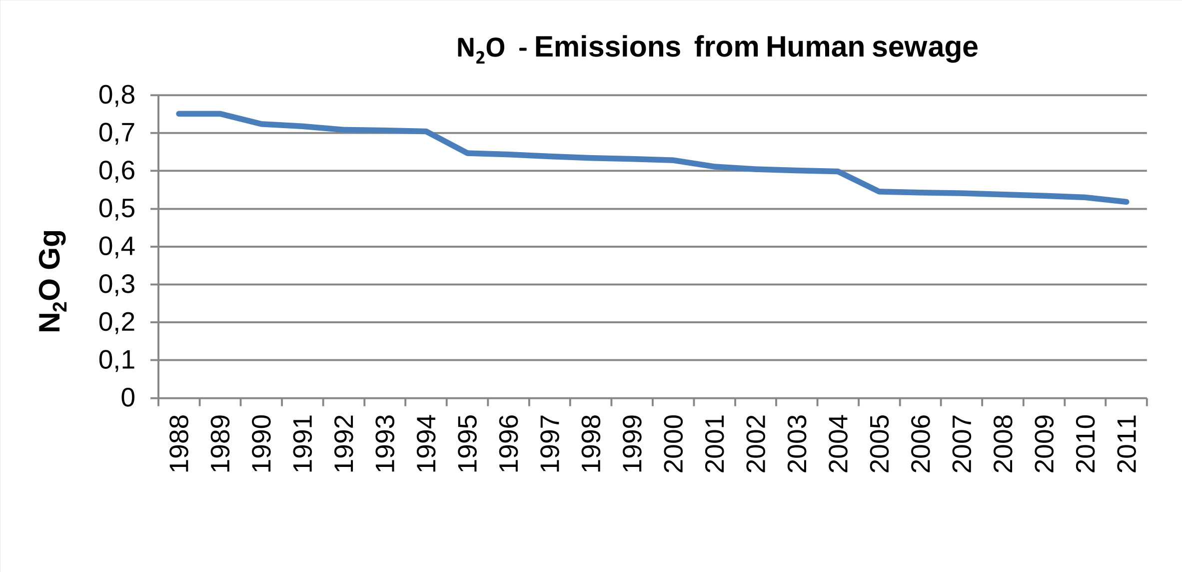


Figure 93 $N_2O$ emissions from Human sewage

## 8.3.3 METHODOLOGICAL ISSUES

### 8.3.3.1 Methodology for calculation of the methane emissions of domestic / commercial wastewater handling.

IPCC Guidelines describe a single methodology for the calculation of the methane emissions in the atmosphere during the the processes of domestic wastewater treatment. The decision tree, which describes the steps and the algorithm for calculating methane emissions, is shown on Figure 5.2, page.5.15 / IPCC GPG 2000.

The methodology for the calculation of the methane emissions from domestic wastewater handling and sludge consists of three components: definition of the total organically degradable material in domestic wastewater, emission factor and emission estimation.

The first step in the calculation is to define the total organically degradable material in domestic wastewater (TOW), expressed in the term of biochemical oxygen demand (kg BOD/year). Based on the demographic data acquired by the National Statistical Institute for the respective inventory years, we calculate TOW with the following equation:

$$TOW = P * DOC$$

Equation 4

Where:

TOW – total organics in the wastewater in inventory year, kg BOD/yr

P – country population in inventory year, (1000 person)

DOC - Degradable organic component, kg BOD/1000 person/yr..

Degradable organic component is specified 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 94. In bolded outline are shown the potential methane sources.

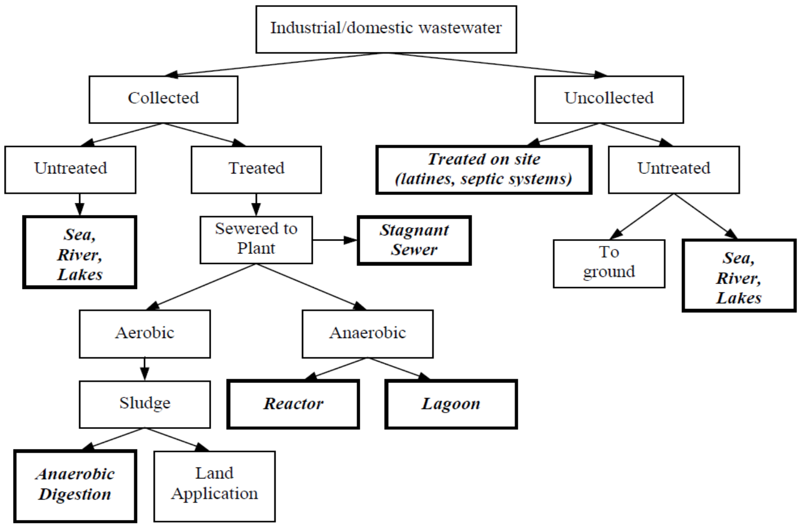


Figure 94 Potential $CH_4$ sources

Following the 2006 IPCC Guidelines, table 6.3, page.6.13, the type of wastewater treatment system and the discharge pathways are defined for the whole country. Based on the data by the National Statistical Institute, we point out three categories of methane emissions sources.

*Category 1* - waters without treatment discharged in the water sources (sea, rivers and lakes).

*Category 2* - waters discharged trough sewer systems into centralized anaerobic wastewater treatment plant. In the general case they are amortized

*Category 3* - water discharged trough stagnant sewers.

Table 220 Default MCF for Domestic wastewater

TABLE 6.3
DEFAULT MCF VALUES FOR DOMESTIC WASTEWATER

| Type of treatment and discharge pathway or system | Comments | MCF [1] | Range |
|---|---|---|---|
| **Untreated system** | | | |
| Sea, river and lake discharge | Rivers with high organics loadings can turn anaerobic. | 0.1 | 0 – 0.2 |
| Stagnant sewer | Open and warm | 0.5 | 0.4 – 0.8 |
| Flowing sewer (open or closed) | Fast moving, clean. (Insignificant amounts of $CH_4$ from pump stations, etc) | 0 | 0 |
| **Treated system** | | | |
| Centralized, aerobic treatment plant | Must be well managed. Some $CH_4$ can be emitted from settling basins and other pockets. | 0 | 0 – 0.1 |
| Centralized, aerobic treatment plant | Not well managed. Overloaded. | 0.3 | 0.2 – 0.4 |
| Anaerobic digester for sludge | $CH_4$ recovery is not considered here. | 0.8 | 0.8 – 1.0 |
| Anaerobic reactor | $CH_4$ recovery is not considered here. | 0.8 | 0.8 – 1.0 |
| Anaerobic shallow lagoon | Depth less than 2 metres, use expert judgment. | 0.2 | 0 – 0.3 |
| Anaerobic deep lagoon | Depth more than 2 metres | 0.8 | 0.8 – 1.0 |
| Septic system | Half of BOD settles in anaerobic tank. | 0.5 | 0.5 |
| Latrine | Dry climate, ground water table lower than latrine, small family (3-5 persons) | 0.1 | 0.05 – 0.15 |
| Latrine | Dry climate, ground water table lower than latrine, communal (many users) | 0.5 | 0.4 – 0.6 |
| Latrine | Wet climate/flush water use, ground water table higher than latrine | 0.7 | 0.7 – 1.0 |
| Latrine | Regular sediment removal for fertilizer | 0.1 | 0.1 |

[1] Based on expert judgment by lead authors of this section.

We use the *methane correction factor* as follows:

*Category 1* - waters without treatment discharged in the water sources (sea, rivers and lakes) MCF = 0,1

*Category 2* - waters discharged trough sewer system into centralized anaerobic wastewater treatment plant – MCF = 0,3

*Category 3* - waters discharged trough stagnant sewer – MCF = 0,5

### 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 2000 we use methane correction factor for anaerobic treatment MCF=0,8; and for aerobic treatment MCF=0

### 8.3.3.3 Methodology for calculation of the methane emissions of industrial wastewater handling.

Industrial wastewater can be treated on site or discharged into centralized sewer. Emissions from industrial wastewater discharged into centralized sewer, 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 221 Industrial wastewater treated on site

| Year | Total industrial | Treated on site | | Non treated on site | |
|---|---|---|---|---|---|
| | thou.m$^3$ | thou.m$^3$ | % | thou.m$^3$ | % |
| **1988** | 1 075 286 | 610 746 | 56,80% | 464 540 | 43,20% |
| **1989** | 1 008 789 | 572 976 | 56,80% | 435 812 | 43,20% |
| **1990** | 1 127 165 | 610 252 | 54,14% | 516 913 | 45,86% |
| **1991** | 900 404 | 460 803 | 51,18% | 439 601 | 48,82% |
| **1992** | 766 131 | 368 586 | 48,11% | 397 545 | 51,89% |
| **1993** | 608 420 | 304 300 | 50,01% | 304 120 | 49,99% |
| **1994** | 526 760 | 291 347 | 55,31% | 235 413 | 44,69% |
| **1995** | 587 085 | 361 591 | 61,59% | 225 494 | 38,41% |
| **1996** | 577 742 | 352 879 | 61,08% | 224 863 | 38,92% |
| **1997** | 489 706 | 298 698 | 61,00% | 191 008 | 39,00% |
| **1998** | 418 679 | 250 707 | 59,88% | 167 972 | 40,12% |
| **1999** | 377 265 | 206 549 | 54,75% | 170 716 | 45,25% |
| **2000** | 328 497 | 158 273 | 48,18% | 170 224 | 51,82% |
| **2001** | 274 475 | 121 677 | 44,33% | 152 797 | 55,67% |
| **2002** | 225 023 | 136 029 | 60,45% | 88 994 | 39,55% |
| **2003** | 666 142 | 558 201 | 83,80% | 107 941 | 16,20% |
| **2004** | 657 812 | 555 546 | 84,45% | 102 267 | 15,55% |
| **2005** | 180 648 | 102 945 | 56,99% | 77 703 | 43,01% |
| **2006** | 227 422 | 121 008 | 53,21% | 106 414 | 46,79% |
| **2007** | 219 057 | 119 621 | 54,61% | 99 436 | 45,39% |
| **2008** | 204 462 | 109 484 | 53,55% | 94 978 | 46,45% |
| **2009** | 172 156 | 80 950 | 47,02% | 91 206 | 52,98% |
| **2010** | 171 890 | 84 462 | 49,14% | 87 428 | 50,86% |
| **2011** | 153 581 | 69 733 | 45,40% | 83 848 | 54,60% |

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 222 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 $N_2O$ from Humane sewage

The IPCC default methodology is used for calculating $N_2O$ emissions from human sewage based on annual per capita protein intake. For calculation of nitrous oxide emissions from human sewage, the equation 15 from page 6.28 of Revised 1996 IPCC Guidelines was used. The data for the daily protein intake per person are taken from FAO statistics. The number of inhabitants is provided by NSI. The emission factor (0.01) and the fraction of nitrogen in protein (0.16) are IPCC default values.

### 8.3.4 TREND ANALYSIS

The next table shows in a systematic way quantities of methane emissions released in the treatment of domestic wastewater according to natural values of the parameters in the different years.

Table 223 $CH_4$ 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 | Gg$CH_4$ |
| 1988 | 155805178 | 0,158 | 24,60 |
| 1989 | 155904001 | 0,158 | 24,61 |
| 1990 | 150303451 | 0,144 | 21,68 |
| 1991 | 149024481 | 0,159 | 23,67 |
| 1992 | 147106954 | 0,151 | 22,29 |
| 1993 | 146671783 | 0,150 | 22,03 |
| 1994 | 146110048 | 0,155 | 22,58 |
| 1995 | 145369996 | 0,159 | 23,12 |
| 1996 | 144610978 | 0,162 | 23,41 |
| 1997 | 143609980 | 0,162 | 23,28 |
| 1998 | 142694057 | 0,161 | 22,98 |
| 1999 | 142009313 | 0,156 | 22,22 |
| 2000 | 141291402 | 0,163 | 23,06 |
| 2001 | 137477412 | 0,159 | 21,83 |
| 2002 | 136021339 | 0,170 | 23,13 |
| 2003 | 135254571 | 0,166 | 22,47 |

| Year | Total organic product | Aggregate Emission factor (CS) | Net methane Emissions |
|---|---|---|---|
| | kg BOD/yr | kg $CH_4$/kg BOD | Gg$CH_4$ |
| **2004** | 134557187 | 0,158 | 21,32 |
| **2005** | 133822961 | 0,162 | 21,69 |
| **2006** | 133139690 | 0,157 | 20,91 |
| **2007** | 132801158 | 0,159 | 21,16 |
| **2008** | 131878578 | 0,157 | 20,69 |
| **2009** | 131135822 | 0,152 | 19,97 |
| **2010** | 130115649 | 0,151 | 19,68 |
| **2011** | 127035746 | 0,155 | 19.66 |

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 224 $CH_4$ 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 | Gg$CH_4$ |
| **1988** | 8200273 | 0,445 | 3,65 |
| **1989** | 8205474 | 0,556 | 4,56 |
| **1990** | 7910708 | 0,358 | 2,83 |
| **1991** | 7843394 | 0,407 | 3,19 |
| **1992** | 7742471 | 0,381 | 2,95 |
| **1993** | 7719568 | 0,546 | 4,22 |
| **1994** | 7690003 | 0,546 | 4,20 |
| **1995** | 7651052 | 0,546 | 4,18 |
| **1996** | 7611104 | 0,550 | 4,19 |
| **1997** | 7558420 | 0,550 | 4,16 |
| **1998** | 7510214 | 0,550 | 4,13 |
| **1999** | 7474174 | 0,419 | 3,13 |
| **2000** | 7436389 | 0,455 | 3,39 |
| **2001** | 7235653 | 0,414 | 2,99 |
| **2002** | 7159018 | 0,399 | 2,86 |
| **2003** | 7118662 | 0,353 | 2,51 |
| **2004** | 7081957 | 0,356 | 2,52 |
| **2005** | 7043314 | 0,395 | 2,78 |
| **2006** | 7007352 | 0,365 | 2,56 |
| **2007** | 6989535 | 0,379 | 2,65 |
| **2008** | 6940978 | 0,477 | 3,31 |
| **2009** | 6901885 | 0,556 | 3,84 |
| **2010** | 6848192 | 0,610 | 4,18 |
| **2011** | 6686092 | 0,640 | 4,28 |

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 225 $CH_4$ 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 | Gg$CH_4$ |
| **1988** | 1957403923 | 0,035 | 67,95 |
| **1989** | 1872299405 | 0,035 | 64,99 |
| **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 |
| **2011** | 216365573 | 0,033 | 7,10 |

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 226 $CH_4$ 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 | Gg$CH_4$ |
| **1988** | 103021259 | 0,111 | 11.46 |
| **1989** | 98542074 | 0,111 | 10.96 |
| **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 | 1,17 |
| **2011** | 11387662 | 0,091 | 1,04 |

## 8.3.5 UNCERTAINTIES AND TIME-SERIES CONSISTENCY

Table 227 Uncertainty of sub-sector Waste water handling

| CRF categories | Key Category | GHG | AD uncertainty | EF uncertainty | Combined uncertainty |
|---|---|---|---|---|---|
| **6B** | Wastewater Handling | $CH_4$ | 30 | 30 | 42 |
| **6B** | Wastewater Handling | $N_2O$ | 30 | 100 | 104 |

## 8.3.6 SOURCE-SPECIFIC CHEKS 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

No specific recalculations for 2011 in this sector.

### 8.3.8 SOURCE-SPECIFIC IMPROVEMENT PLAN

For inventory 2012 we are planning the following main activity:

Sending  regularly questionnaires to operators of WSS utilities for $CH_4$ recovery  from waste water handling.

## 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, $NH_3$, NMVOCs and est. Emissions of $CH_4$ are not likely to be significant and these emissions are much dependent on the continuity of the incineration process, the incineration technology and management practices. For the purpose of this inventory are calculated emissions of $CO_2$ from waste incineration (which are significantly greater than $N_2O$ emissions.) and $N_2O$ emissions.

**A. Emissions of $CO_2$**

Generally $CO_2$ emissions are calculated indirectly from the total carbon content in different types of incinerated waste. For this purpose it is necessary to have country specific waste composition data, based on analyses and measurements.

**B. Emissions of $N_2O$**

Emissions from $N_2O$ differ with facility type and conditions of incineration process. As a result, emissions can vary from site to site.

According to Revised 1996 Guidelines only $CO_2$ emissions resulting from incineration of carbon fractions in waste of fossil origin (e.g. plastics, textiles, rubber, liquid solvents and waste oil) without energy recovery should be included in emissions estimates from Waste sector. $CO_2$ emissions results from incineration of biomass materials ( e.g. paper, food

waste, wood waste) are called biogenic emissions and should not be included in national total emissions estimates.

Currently waste incineration is a practice to incinerate clinical waste. Additionally in emission inventory in waste sector are included emissions from hazardous waste and sewage sludge.

At this stage of moment the source of activity data are operators of incineration plants, about quantity and type of incinerated waste and type of technology.

This report includes $CO_2$ and $N_2O$ emissions from: Clinical waste and Hazardous waste that practically are incinerated in country.

### 8.4.2 EMISSION TREND

Table 228 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 228 Quantity of incinerated type of waste $CO_2$ and $N_2O$ emissions

| Year | $CO_2$ emissions | | | | | $N_2O$ emissions | |
|---|---|---|---|---|---|---|---|
| | Hazardous waste | HW | Clinical waste | CW | $CO_2$ -Total | Hazardous waste | HW |
| | 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 | 14.17 | 7.47 | 0.017 |
| **2011** | 5.76 | 9.46 | 0.235 | 0.20 | 9.66 | 5.22 | 0.012 |

The emissions trends are presented in the next figures.

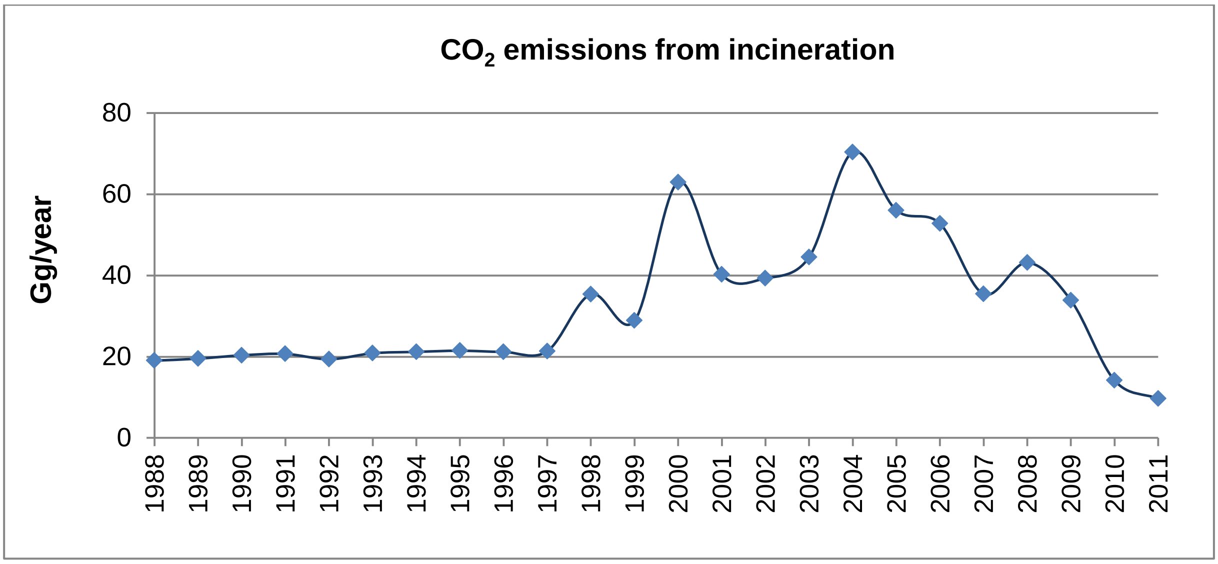


Figure 95  $CO_2$ Emissions trends for Waste Incineration

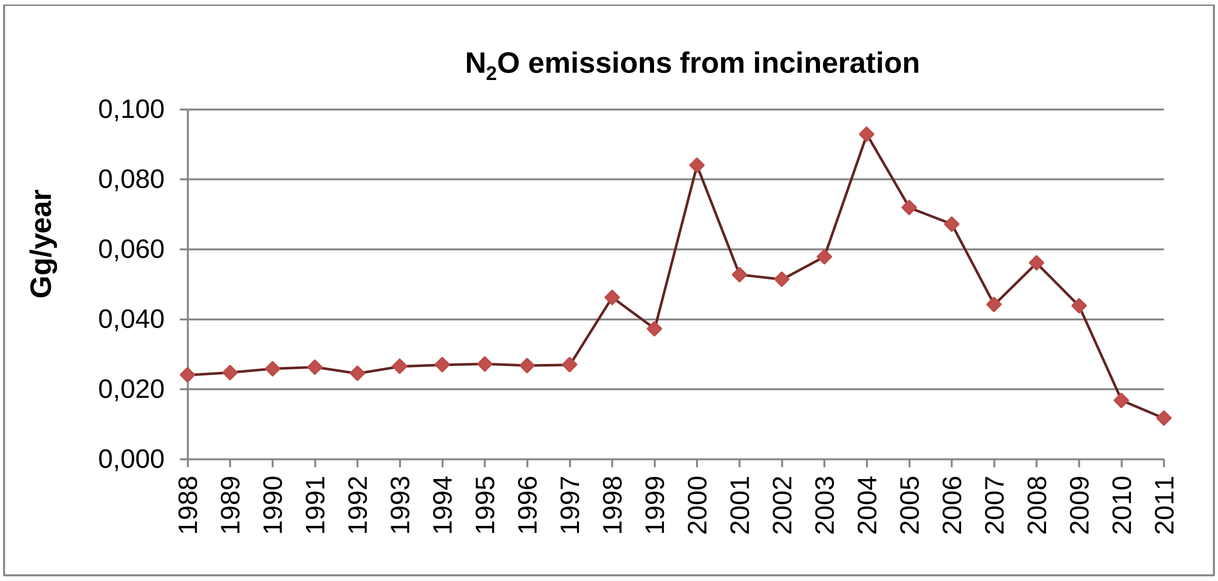


Figure 96  $N_2O$ Emissions trends for Waste Incineration

$CO_2$ 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 is a key category in the country and to what extent country and plant-specific information is available.

Concerning waste incineration, most adequate and correct results are going to complete if the information about type of waste and incineration technology are available.

The most adequate results will be obtained if the emissions are going to be estimated on the level of the incineration plant or divided by type of incinerated waste. .

The methods for estimating $CO_2$ and $N_2O$ from incineration differ because of the different factors that influence emission levels. For this reason, they are described separately.

**A1. Choice of method for estimating $CO_2$ emissions**

$CO_2$ emissions from incineration of waste have been calculated using the methodology proposed by IPCC Guidelines, by multiplying the total incinerated waste with default values for fraction of carbon content, fraction of fossil carbon and burn out efficiency of combustion.

The choice of proper method depend on national circumstances. (IPCC Good Practice Guidance, Figure 5.5, page 5.26).

**A2. Choice of method for estimating $N_2O$ emissions**

Revised 1996 IPCC Guidelines and IPCC GPG 2000 describe one method (Tier 1) for estimating $N_2O$ emissions.

**B. Choice of equations**

B1. Equations for estimation $CO_2$ emissions

For carbon dioxide emissions calculating from waste incineration, the following equation is used (eq. 5.11 from page 5.25 of IPCC GPG 2000).

$$CO2emissions(Gg/yr) = \sum_i (IW_i \bullet CCW_i \bullet FCF_i \bullet EF_i \bullet 44/12)$$

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 2000)

$$N2O\,emissions(Gg/yr) = \sum i \left(IW_i \bullet EF_i\right) \bullet 10^{-6}$$

Equation 8

Where:

IWi = Amount of incinerated waste of type I (Gg/yr);

EFi= Aggregate $N_2O$ emission factor for waste type I (kg $N_2O$/Gg)

Or (Equation 5.13 IPCC GPG)

$$N_2O\ emissions(Gg/yr) = \sum i \left(IWi \bullet ECi \bullet FGVi\right) \bullet 10^{-9}$$

Equation 9

Where:

IWi = Amount of incinerated waste of type I (Gg/yr);

ECi= $N_2O$ emission concentration in flue gas from waste of type i (mg $N_2O$/m3)

For calculation Bulgaria applies first of above equations.

The best calculations results will be obtained if greenhouse emissions estimations are on the plant level, based on the plant-specific monitored data and then all this data are summed on the national level.

**C. Influencing factors**

The main emission factors and parameters which are influencing on the emissions from waste incineration are:

- Amount of incinerated waste;
- Type of incinerated waste;
- Carbon content of waste;
- Fossil carbon as % of Total carbon in waste;
- Efficiency of combustions;
- Incineration plant type.

### 8.4.3.2 Activity data and emissions factors

For inventory 2011 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 are operating only tree big installations, for waste incineration, without energy recovery. There are two incinerators for incineration of hospital waste at the EMEPA and Medicom located in Sofia. In the installation of Lukoil Neftochim are incinerated hazardous waste, mainly sludge and other waste contaminated with oil. The country does not have incinerator for MSW.

Before 2006 in country were working considerable number of furnace for hospital waste incineration, located on the territory of the hospitals throughout the country.

Following the adoptions of more stringent requirements of Directive 2000/76 / EC transposed into Regulation № 6 / 28.04.2004 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 2011, 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.)
- Quantity of incinerated waste
- Characteristics of incinerated waste

**A. Choice of emission factors for $CO_2$ estimations**

In an analysis of completed questionnaires by the operators of incinerators for waste incineration shows lack of completed data for specifying characteristics of waste as, carbon content in the waste, fractions of "fossil" carbon and coefficient of efficiency of waste incineration. There are no country-specific emission factors.

Following the decision tree path for $CO_2$ emission estimations, we used emission factors by default, according to IPCC GPG 2000.

The next table shows the emission factors and default value (table 5.6, p.5.29, IPCC GPG 2000), used for $CO_2$ calculations. Bold frame, illustrated used emission factors, useful for type of waste incinerated in country, with default value.

Based on installation level the information is worked out in detail and summarized on the national level.

Table 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 2000)

In country almost all incinerator plants are type heart or grate. For this type of installation, according to table for emission factors from IPCC GPG it is NA for calculation of $N_2O$ emissions with default emission factors. Only $N_2O$ emission calculation is possible, in incineration plant rotating type, using default emission factors (on national level have one such type of installation)

Table 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 2011.

## 8.5 OTHER WASTE (CRF CATEGORY 6D)

### 8.5.1 SOURCE CATEGORY DESCRIPTION

The category includes calculation of $CH_4$ and $N_2O$ emissions in the atmosphere from biological treatment of solid waste (composting). The calculation of the emissions will depend of the quality of collected data, amount and type of solid waste, treated biologically and the choice of emission factors respectively. For the first time country reports the emissions from biological treatment of waste.

### 8.5.2 METHODOLOGICAL ISSUES

Methodology for calculation of $CH_4$ and $N_2O$ emissions from composting.

As the methodological guidance for estimating and reporting of emissions from biological treatment was not included in the previous IPCC Guidelines, it is recommended to follow the methodology of estimation and calculations of the emissions in 2006 IPCC Guidelines. The 2006 IPCC GL suggests three methods for emission calculation.

For the emissions estimation from biological treatment of solid waste country uses TIER 1 with default emission factors.

**Default emission factors for $CH_4$ and $N_2O$ emissons from biological treatment of waste**

| Type of biological treatment | $CH_4$ Emission Factors (g $CH_4$/kg waste treated) | | $N_2O$ Emission Factors (g $N_2O$/kg waste treated) | |
|---|---|---|---|---|
| | on a dry weight basis | on a wet weight basis | on a dry weight basis | on a wet weight basis |
| Composting | 10 (0.08-20) | 4 (0.03-8) | 0.6 (0.2-1.6) | 0.3 (0.06-0.6) |

The $CH_4$ and $N_2O$ emissions from composting can be estimated using default method given in Equations 4.1 and 4.2 shown below:

Equation 4.1

$$CH_4\ Emissions = \sum_i (Mi * EFi) * 10^{-3} - R$$

Where:

$CH_4$ emissions = total $CH_4$ emissions in inventory year, Gg $CH_4$

$M_i$ = mass of organic waste treated by biological treatment type *i*, Gg

EF = emission factor for treatment *i*, g $CH_4$/kg waste treated

*i* = composting or anaerobic digestion

R = total amount of $CH_4$ recovered in inventory year, Gg $CH_4$

Equation 4.2

$$N_2O\ Emissions = \sum_i (Mi * EFi) * 10^{-3}$$

Where:

$N_2O$ Emissions = total $N_2O$ emissions in inventory years, Gg $N_2O$

M*i* = mass of organic waste treated by biological treatment type *i*, Gg

EF = emission factor for treatment *i*, g $N_2O$/kg waste treated

*i* = composting or anaerobic digestion

#### 8.5.2.1 Activity data

The source of activity data is NSI.

The emissions from composting are given in the table No below:

Table 231 $CH_4$ and $N_2O$ emissions from composting

| Waste treated biologically (t) | 2011 |
|---|---|
| $CH_4$ Gg compost production | 0.335 |
| $N_2O$ Gg compost production | 0.025 |

#### 8.5.2.2 Emission factors

Default emission factors (on wet weight basis) are used for emission estimation of $CH_4$ and $N_2O$ from composting. Country specific emission factors or plant specific emission factors are not available at the moment.

### 8.5.3 UNCERTAINTY AND TIME – SERIES CONSISTENCY

The uncertainty in $CH_4$ emissions from compost production is estimated to be about 100% in annual emissions, 10% concerning activity data and 100% for emission factors used.

### 8.5.4 SOURCE-SPECIFIC QA/QC AND VERIFICATION

The category is covered by the general QA/QC procedures.

### 8.5.5 SOURCE-SPECIFIC RECALCULATIONS

Source specific recalculations are not planned.

### 8.5.6 SOURCE-SPECIFIC PLANNED IMPROVEMENTS

No specific activities are planned.

# 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 232 Summary of GHG emission recalculations in submission 2013

| 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 | | | |

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | DESCRIPTION OF METHODS | RECALCULATIONS | REFERENCE |
|---|---|---|---|
| F. Consumption of Halocarbons and SF6 | | √ | Revised activity data |
| G. Other | | | |
| **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 2013 has been updated and corrected since the last 2012 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 2012, 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 233 Recalculation difference of Bulgaria's greenhouse gas emissions compared to the previous submission.

| | 1988 (Base year) | 2010 |
|---|---|---|
| | Recalculation Difference [%] | |
| Total | -5,17 | -2.18 |
| $CO_2$ | -4,09 | -0,26 |
| $CH_4$ | -1,63 | -1,92 |
| $N_2O$ | 0,31 | 0,12 |
| HFC | 0.0 | 0.13 |
| PFC | 0.0 | 0.0 |
| $SF_6$ | 0.0 | 0.0 |

*Emissions without LULUCF*

Table 234 presents the recalculation differences of national total GHG emissions for all years.

Table 234 Recalculation Difference of National Total GHG Emissions.

| Year | National Total GHG emissions without LULUCF | | |
|---|---|---|---|
| | Submission 2012 [Gg $CO_2$e] | Submission 2013 [Gg $CO_2$e] | Recalculation Difference [%] |
| 1988* | 128556,3 | 121905,36 | -5,17 |
| 1989 | 126134,5 | 119350,81 | -5,38 |
| 1990 | 114450,9 | 109540,85 | -4,29 |
| 1991 | 92125,1 | 86743,18 | -5,84 |
| 1992 | 85390,81 | 80492,70 | -5,74 |
| 1993 | 82937,69 | 78715,18 | -5,09 |
| 1994 | 80359,56 | 75074,21 | -6,58 |
| 1995 | 81700,48 | 75838,72 | -7,17 |
| 1996 | 81118,78 | 75702,41 | -6,68 |
| 1997 | 77573,6 | 72074,34 | -7,09 |
| 1998 | 71605,92 | 67127,16 | -6,25 |
| 1999 | 63987,48 | 60314,70 | -5,74 |
| 2000 | 63067,38 | 59500,72 | -5,66 |
| 2001 | 65870,19 | 62659,26 | -4,87 |
| 2002 | 62731,01 | 59676,46 | -4,87 |
| 2003 | 67818,4 | 64434,79 | -4,99 |
| 2004 | 66654,52 | 63638,23 | -4,53 |
| 2005 | 66538,26 | 63749,15 | -4,19 |
| 2006 | 67581,45 | 64566,40 | -4,46 |
| 2007 | 71097,27 | 68487,99 | -3,67 |
| 2008 | 68795,76 | 66942,67 | -2,69 |
| 2009 | 59188,95 | 57803,99 | -2,34 |
| 2010 | 61704,06 | 60360,42 | -2,18 |

**Base year is 1988 for all gases*

### 10.2.2 KP-LULUCF INVENTORY

In Submission 2012 the net $CO_2$ emissions/removals for 2010 from the activities under Article 3.3 of the Kyoto Protocol have a figure of -1 393,25 Gg$CO_2$ eq. while in Submission 2013 after the recalculation that took place the figure of the net removals is -1 362,63 Gg$CO_2$ eq, which are by 2,2% 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 234 and Figure 35 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.

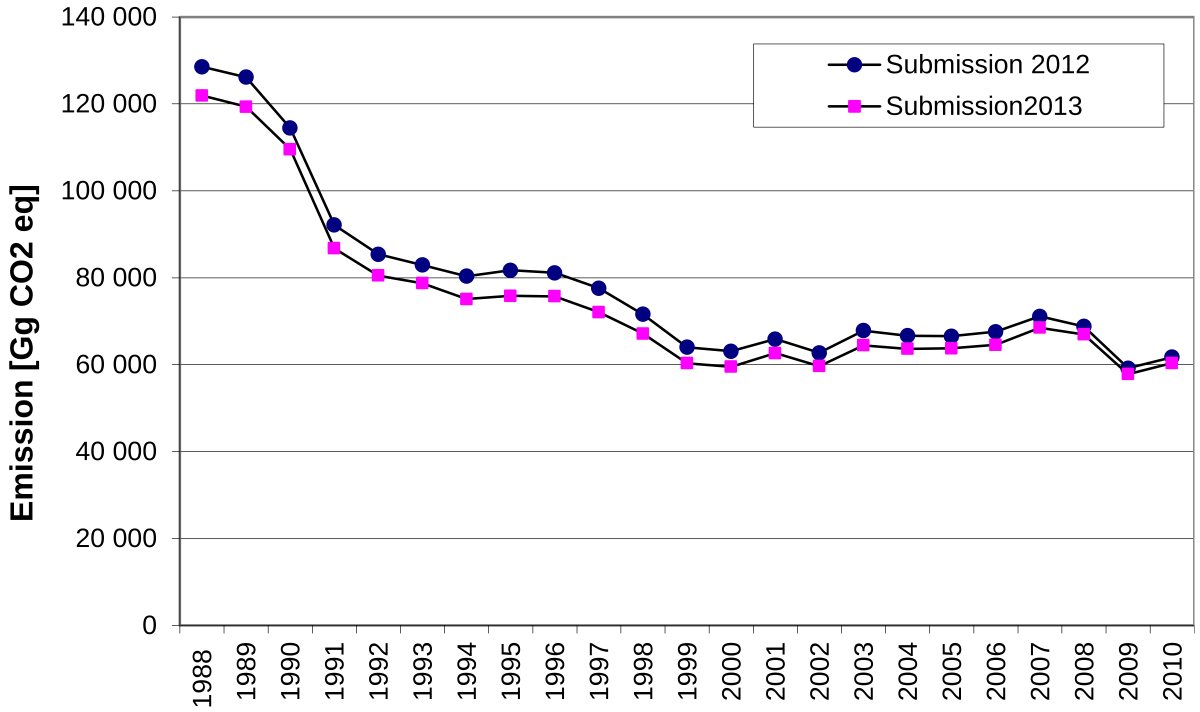


Figure 97 Emission estimates of the submission 2013 and recalculated value

### 10.3.2 KP-LULUCF INVENTORY

See chapter 11.2

## 10.4 RECALCULATIONS, INCLUDING IN RESPONSE TO THE REVIEW PROCESS, AND PLANNED IMPROVEMENTS TO THE INVENTORY

### 10.4.1 GHG INVENTORY

Many recalculation have baeen carried out in resopone to recommendations proposed in review reports. All relevant recalculations are presented in Chpt. 10.1.1. Further information on improvements due to the ERT recommendation are found Table 239.

The following general improvements are planned for the next submissions

- Update and revision of activity data, emission factors and related parameters;
- Conduct further studies for verification of emission factos and assumptions;
- Improvement of uncertainty assessment;
- Improvement of the relation with Branch Business Associations;

- Executive Environment Agency (ExEA) Communication & Information Centre (Data management);
- Further collaboration with external organizations;
- QA/QC activities and audit;
- Documentation and archiving.

All improvements will be conducted to increase TACCC.

### 10.4.2 IMPROVEMENT PLAN

The **Compliance Action Plan** (improvement plan) was prepared in 2010 according to the requirements as set out in paragraph 20 (b) of the preliminary finding (CC-2010-1-6/Bulgaria/EB), confirmed by the final decision of the Enforcement Branch concerning Bulgaria (CC-2010-1-8/Bulgaria/EB).

The activities have been planned for the period 2010-2011 in order to remedy the non-compliance and to fulfill the recommendations of Expert Review Team (ERT) as set out in the annual review report FCCC/ARR/2009/BGR.

The enclosed progress report presents the updated status of implementation of the **Compliance Action Plan** and the implementation of activities and planned improvements for the next annual submission following the recommendations of the Expert Review Team as set out in the annual review report FCCC/ARR/2010/BGR.

Specific information about improvements are mentioned in the relevant chapters 'source-specific improvements' of each subsector.

Table 235 Improvement plan for GHG Inventory

| Issue | Planned improvement for 2010 and next submissions | Priority high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| General Improvements | | | | |
| **Institutional arrangements** | To continue the intensive cooperation with the main data providers in the frame of the signed agreements | High priority 2014 | All recommendations (from FCCC/ARR/2009/BGR FCCC/ARR/2010/BGR and FCCC/ARR/2011/BGR) were already implemented in Submission 2010, 2011, 2012 and 2013 | |
| **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:<br>Establish and maintain the institutional, legal and procedural arrangements necessary to perform the functions of BGNIS, as defined in Decision 19/CMP.1.<br>reinforce the institutional agreements by specifying the roles of all data providers<br>QA/QC activities. | Adequately planned and implemented in 2010 (FCCC/ARR/2010/BGR § 203) |
| **Expert capacity** | **FCCC/ARR/2009/BGR**<br>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<br>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<br>Training of the staff within the project with the Federal Environment Agency of Austria<br>Incorporated results from completed Projects with external consultants "Energy", "LULUCF", "F-gases" (CRF tables and NIR) | |
| | **FCCC/ARR/2010/BGR**<br>Further extension of the staff involved in planning, preparation and management of the emissions inventory (§ 39).<br>Further training of the staff<br>Participation of the Bulgarian experts in the meetings, organized by UNFCCC and EC<br>Further collaboration with Austrian Environment Agency<br>On-line UNFCCC training | High priority 2011 submission | New Order N 202/29.09.2010 by the Executive Director of ExEA (see Figure 1)<br>Training of the staff in the frame of contracts with external consultants | Adequately planned and implemented in 2011 |
| | **FCCC/ARR/2011/BGR**<br>Continue the extension of the staff involved in planning, preparation and management of the emissions inventory.<br>Continue training of the staff.<br>Continue participation of the Bulgarian experts in the meetings, organized by UNFCCC and EC.<br>Continue the collaboration with Austrian Environment Agency.<br>Continue the on-line UNFCCC training. | High priority 2012 and 2013 submission | Training of the staff in the frame of contracts with external consultants | Adequately planned and implemented in 2012 and 2013 |
| | Continue training of the staff.<br>Continue participation of the Bulgarian experts in the meetings, organized by UNFCCC and EC. | High priority 2014 submission | | |
| **Collaboration with consultants and external auditors** | **FCCC/ARR/2009/BGR**<br>Strengthening the contacts with Branch Business Associations.<br>Further intensive cooperation for studies (verification of EFs) with other non-governmental institutions, universities and private consultants<br>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. | 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 |
|---|---|---|---|---|
| | **FCCC/ARR/2010/BGR**<br>Sustainable development of inventory planning, preparation and management (§ 37) | High priority 2011 submission 15/04/2011 | Signed new contracts with the same consultants for the 2011 submission | Adequately planned and implemented in 2011 |
| | **FCCC/ARR/2011/BGR**<br>Continue the intensive cooperation for studies (verification of EFs) with other non-governmental institutions, universities and private consultants.<br>Continue support of external auditors for improvement of QA procedures. | High priority 2012 and 2013 | Signed contracts with external consultants for supporting the preparation of 2012 GHGs inventory and NIR 2012 | Adequately planned and implemented in 2012 and 2013 |
| | Continue the intensive cooperation for studies (verification of EFs) with other non-governmental institutions, universities and private consultants.<br>Continue support of external auditors for improvement of QA procedures. | High priority 2014 | | |
| **Quality Management System** | **FCCC/ARR/2009/BGR**<br>Improvement of the activity in QMS<br>Ensuring that other institutions are engaged in the checking and review of the annual submission as set out in its QA/QC plan<br>Improvement of Sector specific QA/QC procedures<br>Starting the documentation and archiving process<br>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<br>A new System for sector experts workflow organization, documentation and archiving has been implemented in the ExEA<br>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)<br><br>Need of better implementation in the next submission (FCCC/ARR/2010/BGR §52 ) |
| | **FCCC/ARR/2010/BGR**<br>Improvement of implementation of QA/QC in the next submission (§ 52)<br>Including of provisions of QA/QC activities for a final check of the consistency between the NIR and CRF.<br>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<br>Support of external auditors for improvement of QA | High priority 2011 submission | Revision of QA/QC check lists following the recommendations of ERT<br>Preparation of Manual for using of documentation and archiving system | Adequately planned and implemented in 2011 |

| Issue | Planned improvement for 2010 and next submissions | Priority<br>high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| | procedures | | | |
| | **FCCC/ARR/2011/BGR**<br>Continue to improve implementation of QA/QC. Support of external auditors for improvement of QA procedures. | High priority 2012 and 2013 submission | Project for "Improvement of National Quality Management System for GHG Inventories" has been started in collaboration with the Austrian Environment Agency, started since 2011 and it will be finalized 2013. | Complete implementation of the project results will be in the next submission 2014 |
| **Source categories improvements** | | | | |
| **Energy sector** | **FCCC/ARR/2009/BGR**<br>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<br>Revision of the EF. Investigation whether it would be possible to update country specific emission factors<br>A cross-check with ETS, EPRTR, IPPC permits data<br>Comparison of emissions using alternative approaches.<br>Documentation and archiving of all information required in NIR, background documentation and archive.<br>Improvements in transparency by updating and revising EF and AD.<br>Recalculations and time-series consistency<br>To ensure TACCC internal energy experts and external consultants were involved in the submission 2010. Further collaboration is foreseen for the future submission.<br>Implementation of Sector specific QA/QC procedures<br>Support of consultants and external auditors for 2010 and next submissions | High priority 13/08/2010 | Contract with external consultants for supporting preparation of GHGs inventory and NIR for Sector Energy (excluding sub-sector Transport)<br>Recalculated emissions in Energy Sector based on revised AD for entire time series (IEA/EUROSTAT questionnaire).<br>A cross-check with ETS, EPRTR, IPPC permits was realized;<br>Improved documentation and archiving of the inventory, including work sheets<br>QA procedures have been performed by the Sector expert in the MoEW. | Adequately planned and implemented in 2010 (FCCC/ARR/2010/BGR §63-80) |

| Issue | Planned improvement for 2010 and next submissions | Priority high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| | **FCCC/ARR/2010/BGR (§62 - §82)**<br>Sustainable development of inventory planning, preparation and management (§ 37)<br>Implementation of higher tier method for Road Transport (COPERT 4)<br>Develop and use country-specific EFs.<br>A cross-check with ETS, EPRTR, IPPC permits data<br>Estimation of fugitive emissions from solid fuels and oil and natural gas activities.<br>Estimation of emissions from combusting waste fuels at industrial facilities.<br>Estimation of emissions from the combustion of biofuels in transport.<br>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.<br>Determine a better allocation of emissions for residual fuel oil in road transport<br>Improved QA/QC activities<br>Revising of AD in domestic aviation and navigation | High priority 2011 submission | Signed Contract with consultant for preparation of 2011GHG inventory in Sector Energy and implementation of model COPERT in sub sector "Road transport".<br>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.<br>➢ Investigation whether it would be possible to update country specific emission factor (CS EF) for liquid fuels.<br>➢ Implement a higher tier method for subcategory 1A3a based on LTOs and aircraft types.<br>➢ Improve vehicles distribution and technology split matrix used by COPERT model by obtaining better country-specific data. | High priority 2012 submission | ➢ For the submission 2012 were used automated checks for subcategories 1A3 and 1B. For the other subcategories were manually checked the totals.<br>➢ Data on LTOs was collected. Detailed data on aircraft types will be collected for domestic and international aviation. | Adequately planned and implemented in 2012 |
| **Industrial processes (CRF sector 2)** | **FCCC/ARR/2009/BGR**<br>Revising of the AD with ETS, EPRTR, IPPC permits data.<br>Revising of the EF. Investigation to update country specific emission factors<br>Sector specific QA/QC procedures were implemented in | 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 | Adequately planned and implemented in 2010 (FCCC/ARR/2010/BGR §84, 92)<br>Need of improvements in the next submission |

| Issue | Planned improvement for 2010 and next submissions | Priority high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| | 2010 submission.<br>Support of external auditors are envisaged for 2010 and next submissions<br>Comparison of emissions using alternative approaches.<br>Documentation and archiving of all information required in NIR, background documentation and archive. | | 2.C.1 Iron and steel, 2.A.7 Glass and Bricks.<br>Sector specific QA/QC procedures were implemented in 2010 submission. QA procedures have been performed by the Sector expert in the MoEW.<br>Improved documentation and archiving of the inventory, including work sheets | |
| | **FCCC/ARR/2010/BGR**<br>Continue to develop expertise and level of engagement with industry<br>Provide additional information in relation to recalculations made as a response of 2010 Saturday Paper (§93)<br>Assessment of underestimates in the industrial processes sector, namely missing activities under limestone and dolomite use and under soda ash use<br>Improved QA/QC activities (§ 94)<br>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 | | Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory |
| | **FCCC/ARR/2011/BGR**<br>Improve the information on calcium and magnesium oxide contents and particularly for the split between high-calcium lime and dolomitic lime.<br>Verify that the plant-specific data for glass production include only emissions from limestone and dolomite use in order to ensure that double counting is avoided.<br>Make a detail discussion of the method and EFs used to estimate emissions from BOF and OHF steel production | High priority 2012 and 2013 submission | Emissions form BOF steel production were recalculated due to doubts for double counting of the emissions from coke used in blast furnaces whish are reported in the energy sector. | Adequately planned and implemented in 2012 and 2013 |
| | Continue comparison of emissions using alternative approaches<br>Continue to develop expertise and level of engagement with industry. | Medium priority 2014 submission | | |
| **Consumption of** | **FCCC/ARR/2009/BGR** | High priority | Contract with external consultants. | Adequately planned and |

| Issue | Planned improvement for 2010 and next submissions | Priority high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| **Halocarbons and $SF_6$ (CRF 2.F)** | Support of consultants and external auditors for 2010 and next submissions<br>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".<br>Incorporation of final results of the study in the August resubmission of the inventory. | 13/08/2010 | For the NIR 2010 a complete new and changed estimation was carried out for CRF 2.F (F-gases) (complete time series).<br>Incorporated results from completed Project 4 "F-gases" (CRF tables and NIR)<br>Improved documentation and archiving of the inventory, including work sheets | implemented in 2010 |
| | **FCCC/ARR/2010/BGR**<br>Sustainable development of inventory planning, preparation and management<br>Report a complete time series for the F-gases between 1988 and 1994<br>Using of appropriate notation keys<br>Improved QA/QC activities | High priority 2011 submission | Signed Contract with external consultants for preparation of 2011 F-gases inventory.<br>Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory | Adequately planned and implemented in 2011 |
| | **FCCC/ARR/2011/BGR**<br>Continue the research on the F-gases Refrigeration and air-conditioning subsector in order to improve the current assumptions. | High priority 2012 submission | | Adequately planned and implemented in 2012 |
| | A recalculation was made in some sub-categories of the Consumption of Halocarbons and $SF_6$ category due to that in the previous submission base of the ERT recommendations. | High priority 2013 submission | | Adequately planned and implemented in 2012 |
| | It s planned to make a step by step revision of data and models about each category in order to increase the transparency. | Medium priority 2014 submission | | |
| **Solvent and other product use (CRF sector 3)** | **FCCC/ARR/2009/BGR**<br>**FCCC/ARR/2010/BGR**<br>Recalculation of all the estimates based on the updated EMEP/CORINAIR Emission Inventory Guidebook<br>Implementation of Sector specific QA/QC procedures<br>QA procedures by the Sector expert in the MoEW (Order № RD-218/05.03.2010 by the Minister of Environment and Water).<br>Documentation and archiving of all information required | Medium priority 2011 submission 15/04/2011 | Recalculations of Sub-sectors 3A, 3B and 3C are already incorporated into preliminary inventory<br>In the final GHG inventory also Sub-sector 3D will be incorporated | Adequately planned in 2010 and implemented in 2011 |

| Issue | Planned improvement for 2010 and next submissions | Priority high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| | in NIR, Background documentation and archive. | | | |
| | **FCCC/ARR/2011/BGR** Obtaining additional data and comparing data for some sources using the National VOC Register. Check if it is possible to provide the necessary activity data for $N_2O$ of aerosol cans from Bulgarian customs or other institution. At this moment there are no activity data for manufacturers and distributors or import and export of these $N_2O$ products. | Medium priority 2013 submission 15/04/2013 | There is no information in imported product if they contain the N2O or not. | Adequately planned and implemented in 2013 |
| | Continue the research on activity data for $N_2O$ of aerosol cans from Bulgarian customs or other institution. | Medium priority 2014 submission 15/04/2014 | | |
| **Agriculture (CRF sector 4)** | **FCCC/ARR/2009/BGR** Collection of data for implementation higher TIER method. Revision of activity data and emission factor. Sector specific QA/QC procedures have to be intensified. Comparison of emissions using alternative approaches. Documentation for national statistics of agriculture and food provided by MAF and FAO. Support of external auditors are envisaged for 2010 and next submissions. Documentation and archiving of all information required in NIR, background documentation and archive. | High priority 13/08/2010 | Recalculated emissions in Agriculture Sector based on revised AD for entire time series in accordance with data provided by national agro statistic (MAF) Implementation of higher tier method for key categories like cattle Improving QA/QC, documentation and archiving of the inventory, including work sheets | Adequately planned and implemented in 2010<br><br>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**<br>Improvement the consistency of the time series by using national statistics in the first instance, and, if this is not possible, use of international statistical data from the FAO for the years before 2001 which are well harmonized with recent national statistics.<br>Improvement of the transparency of information on emission trends by explaining any fluctuations in the trends.<br>Improvement of documentation on the milk yield of dairy cattle or the live weight of animals (cattle, sheep and swine) in the NIR.<br>Obtaining more precise data on animal populations by climate zone within the country.<br>Obtaining information on the amount of sewage sludge that is applied to agricultural soil and to estimate emissions from this activity.<br>Estimation of $N_2O$ emissions from other (sewage sludge applied to soil – 4.D.1.6) in the agriculture sector<br>Use higher-tier methods to estimate emissions from agricultural soils;<br>Improved QA/QC, documentation and archiving of all information required in NIR, background documentation and archive. | High priority 2011 submission | Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory | Adequately planned and implemented in 2011 |
| | **FCCC/ARR/2011/BGR**<br><br>Obtaining more precise data on animal populations by climate zone within the country.<br>Use higher-tier methods to estimate emissions from agricultural soils. | High priority 2012 and 2013 submission | | Adequately planned and implemented in 2012 and 2013 |
| | Continue to increase expertise and comparison of emissions using alternative approaches. | Medium priority 2014 submission | | |
| **LAND-USE, LAND-USE CHANGES AND** | **FCCC/ARR/2009/BGR**<br>Incorporation of the results from successfully completed Project "Development of methodology for calculation of | High priority 13/08/2010 | For the NIR2010 a complete new and changed estimate was carried out for the whole LULUCF-sector of | Adequately planned and implemented in 2010 |

| Issue | Planned improvement for 2010 and next submissions | Priority high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| **FORESTRY (CRF sector 5)**<br><br>**KP-LULUCF (see Chapter 10.4.3)** | emissions and removals for LULUCF sector according to requirements of UNFCCC and Kyoto Protocol".<br>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.<br>In 2011 estimations of the organic carbon stock in forest soil, by soil groups (WRB, 2006) is planed.<br>Support of consultants and external auditors are envisaged for 2010 and next submissions.<br>Bulgaria will carry out an assessment of the most important factors contributing to the results of the LULUCF sectors together with their uncertainties and needs to improve them as well as the available resources for improvements. On basis of this assessment a prioritization and a plan of improvement will be made. | High priority 2011 submission | Bulgaria (complete time series).<br>Incorporated results from completed Projects 1 "LULUCF" (CRF tables and NIR)<br>Improved documentation and archiving of the inventory, including work sheets<br>Internal Review of the national system by EEA/EC (JRC) in July 2010 | Need of improvements in the next submission (FCCC/ARR/2010/BGR §139) |
| | **FCCC/ARR/2010/BGR**<br>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;<br>Improve the transparency of the LULUCF inventory by reporting information in the NIR on methodologies, parameters and AD used;<br>Ensure consistency in land classification by using the LUC matrices;<br>Check the coherence of reported data and apply QC checks, ensuring consistency and accuracy in the estimation process and in the reporting phase;<br>Include the LULUCF sector in its uncertainty analysis, assessing the uncertainties for each LULUCF category.<br>Improved QA/QC activities<br>Documentation and archiving of all information required in NIR, Background documentation and archive. | High priority 2011 submission | See Chapter 7.9 BG NIR 2011 | |
| | **FCCC/ARR/2011/BGR**<br>To continue the process of improvements in land use classification and representation | High priority 2012 and 2013 submission | All recommendations (from FCCC/ARR/2009/BGR and FCCC/ARR/2010/BGR) were already implemented in | Adequately planned and implemented in 2013 |

| Issue | Planned improvement for 2010 and next submissions | Priority high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| | 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.<br>To continuously check the coherence of reported data, ensuring consistency and accuracy in the estimation process and in the reporting phase. | | Submission 2010 and 2011.<br>In Submission 2012, improvements in area representation were made according to recommendations from the review 2011. | |
| | ➢ To continue the process of improvements in land use classification and representation<br>➢ 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<br>➢ To continuously check the coherence of reported data, ensuring consistency and accuracy in the estimation process and in the reporting phase;<br>➢ To continue assessing the uncertainties for each LULUCF and KP-LULUCF category Tier 2. | High priority 2014 submission | | |
| **Waste (CRF sector 6)** | **FCCC/ARR/2009/BGR**<br>Incorporation of the FOD model provided by the 2006 IPCC Guidelines<br>Revision of activity data and emission factor - Waste statistics and DOC value and other related parameters<br>Sector specific QA/QC procedures were implemented in 2010 submission. QA procedures have been performed by the Sector expert in the ExEA and MoEW.<br>Collaboration with external auditors are envisaged for 2010 and next submissions | High priority 13/08/2010 | The complete new and changed estimation was carried out for the sub-sector CRF 6 A Solid waste Disposal on Land (complete time series).<br>The complete new estimation was carried out for the sub-sector CRF 6 C Waste Incineration 2004 – 2008<br>Recalculation of the emissions in | Adequately planned and implemented in 2010<br>Need of improvements in the next submission (FCCC/ARR/2010/BGR §) |

| Issue | Planned improvement for 2010 and next submissions | Priority<br>high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| | Documentation and archiving of all information required in NIR, background documentation and archive.<br>Recalculations and time-series consistency<br>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. | | sub-sector CRF 6C Waste Incineration, based on revised AD for entire time series (IPA questionnaire) | |

| Issue | Planned improvement for 2010 and next submissions | Priority high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| | **FCCC/ARR/2010/BGR**<br>Improve consistency between CRF and NIR<br>To provide information and detailed descriptions of background data and references, AD and EFs and methodologies and assumptions used.<br>To provide more information on waste management policies and existing practices and technologies of waste recovery and waste disposal facilities<br>To provide an explanation for the trend in the waste generation rate in the next annual submission<br>Revision of the landfill parameters for the entire time series<br>Estimate of $CH_4$ recovery from landfill<br>Provision of information on the wastewater streams and treatment technologies used at wastewater treatment plants<br>$N_2O$ emissions from human sewage in the waste sector; and $CO_2$ emissions from waste incineration (without energy recovery) in the waste sector | High priority 2011 submission | Signed contract with University of Chemical technology and metallurgy for Preparation of 2011 GHG inventory in Sector Waste – 6C. The contractor has to Support of ExEA staff in preparation of 2011 submission (6C CRF tables and NIR). Training of ExEA's staff.<br>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<br>➢ Documentation and archiving of all information required in NIR, Background documentation and archive. | | The complete new and changed estimation was carried out for the sub-sector CRF 6 B Wastewater treatment. | Adequately planned and implemented in 2012<br><br>Need of improvements in the next submission |

| Issue | Planned improvement for 2010 and next submissions | Priority high - medium -low | Status of implementation | Comments |
|---|---|---|---|---|
| | | High priority 2012 submission | Signed contract with Astra Consult for Preparation of 2012 GHG inventory in Sector Waste – 6B. The contractor has to Support of ExEA staff in preparation of 2012 submission (6W CRF tables and NIR). Training of ExEA's staff.<br><br>Most of the ERT recommendations for 2009 and 2010 are implemented in the 2012 GHGs inventory. | |
| | **FCCC/ARR/2011/BGR**<br>➢ Improve consistency between CRF and NIR<br>➢ Estimate of $CH_4$ emissions from waste composting activities;<br>➢ Estimate a $CH_4$ recovery from wastewater treatment facilities;<br>➢ Send the questionnaire about methane to operators of treatment facilities | High priority 2013 submission | | Adequately planned and implemented in 2013 |

# 11 KP-LULUCF

## 11.1 GENERAL INFORMATION

### 11.1.1 DEFINITION OF FOREST AND ANY OTHER CRITERIA

For defining forest, Bulgaria uses the definition in the Bulgarian Forest Act (last amendment 07.08.2012, SG №60):

"Area over 0.1 ha, covered with forest tree species higher than 5 meters and tree crown cover over 10% or with trees which can reach these parameters in natural environment".

Areas of natural forest regeneration outside urban areas with a size of more than 0.1 ha also represent "forest". City parks with trees, forest shelter belts, and single row trees do not fall under the category "forests.

According to their functions, forests are divided in: forests for timber production, protective and recreation forests and forests in protected areas.

All forests in Bulgaria, are managed.

**Forests are also:**

- areas which are in a process of recovering and are still under the parameters, but it is expected to reach forest crown cover over 10% and tree height 5 meters;
- areas, which as the result of anthropogenic factors or natural reasons are temporarily deforested, but will be reforested;
- protective forest belts, as well as tree lines with an area over 0.1 ha and width over 10 meters;
- cork oak stands."

**For reaching the targets of KP the minimal figures of the defined range of parameters for tree height, tree crown cover and minimum area have been chosen by Bulgaria:**

**Minimum forest area – 0.1 ha;**

**Tree crown cover -10%;**

**Tree height - 5 meters.**

In accordance with Article 7 of the Kyoto Protocol the country will report in the National Inventories the following activities, following the definitions of the forest related activities, as given in **Decision 16/CMP.1 Land use, land-use change and forestry:**

"Afforestation" as a direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources

"Reforestation" as a direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

"Deforestation" as a direct human-induced conversion of forested land to non-forested land

Forest Fund according to the Forest Act is a territory, with a main purpose to be forest. It covers forested area, area covered by mountain pine and non-timber production lands. Urbanized areas, separated settlements and agricultural lands are not included in the Forest Fund. The National Forest Inventory (NFI) contains the following reporting forms: forest areas (1FF), afforestated area (2FF), tree biomass stock (3FF), stock by groups of forests and forest cover (4FF), wood harvest (5FF), age and density (6FF) and types of forest stands (7FF). The reporting forms 1FF and 5FF are updated annually. The remaining reporting forms are updated every 5th year (e.g. 1985, 1990, 1995, 2000, 2005) and are submitted to the Regional Forestry Offices and in the Executive Forest Agency.

Forests and lands from the Forestry Fund are managed and utilized based on the Forest Management Projects, Plans and Programmes. The Forest Management Projects, Plans and Programmes are elaborated on ownership base according the order and period pointed in the Regulation for planning the management of forests and lands in the Forest Fund of the Republic of Bulgaria, issued by the Minister of Agriculture and Food on a proposal of the Head of the National Forestry Board.

The Forest Management Projects are approved by the Head of the Executive Forest Agency after coordination with other stakeholder ministries and organizations.

### 11.1.2 ELECTED ACTIVITIES UNDER ARTICLE 3, PARAGRAPH 4, OF THE KYOTO PROTOCOL

Bulgaria has decided not to elect any of the activities under Article 3, paragraph 4, in the first commitment period.

### 11.1.3 DESCRIPTION OF HOW THE DEFINITIONS OF EACH ACTIVITY UNDER ARTICLE 3.3 AND EACH ELECTED ACTIVITY UNDER ARTICLE 3.4 HAVE BEEN IMPLEMENTED AND APPLIED CONSISTENTLY OVER TIME

Bulgaria has chosen to account for each activity under Article 3, paragraph 3 at the end of the commitment period.

The base year for reporting ARD activities is 1990. The area units reported as Afforestation/Reforestation (AR) and Deforestation (D) have the same basis as the area of land-use change to and from forest under the UNFCCC GHG inventory reporting taking into account the different time frame. All LUC from and to forests are considered to be direct human induced. Afforestation/Reforestation (AR) activities are reported together.

The National Forest Inventory (NFI) and the information from the Forest Management Plans (FMP) are the main sources of information for the ARD units of land (see chapter 11.2.1).

Forest inventory presents collection of qualitative and quantitative data about the investigated area. 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. The management planning gives recommendations about the silvicultural operations and activities for the next 10 years period. The process of forest inventory and planning is stable and consistent over time.

## 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 NFI in Bulgaria covers assessments for the entire country territory in 10 years' cycles. The measurements of the forest inventory are carried out for all sub-compartments in each and every State Forest Enterprises SFE. In other words all forest stands are surveyed once in every 10 years.The reports on the forest fund from the NFI and the FMPs for all SFEs since 1991 are the main data source for determining the emission/removals of greenhouse gases from forests (see chapter 1.2.2).

In response to the issue raised in the Saturday paper 2012, Bulgaria continues to follow the plan for improvement of the estimation of AR units of land as accepted by the ERT team as answer to the related Saturday paper issue of the 2011 review. The plan has been implemented in stages starting in Submission 2012 and it will be completed until the Submission 2014. . This plan consists of 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.

Bulgaria will further examine the Forest Management Plans (FMPs – see below) for all State Forest Enterprises (SFE) , which were inventoried for the period 1991-2011. Like this all changes since 1992 in forest area for each and every SFE has been and will be traced and identified . Changes in forest area for the years 1990, 1991 are based on extrapolation. For those SFE, where there is an increase in the forest area since 1990, the increase was and is derived into:

a. New forest areas which are included in the forest total, but which were forested before 1990, so new forests with stands of older age classes.
b. And the new forested areas with stands of the youngest age class, which are due to afforestation and reforestation activities (planting and seeding) on barren areas or afforestation and reforestation activities (planting, manual and natural seeding) 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). The new forest areas between 2011 and 1990 according to point b represent the net AR areas (planted or manually and naturally seeded on grassland or on croplands). These improvement steps have been performed by the experts from Executive Forest Agency, by using the following sources of information(results are given in Table 236):

- Forest Inventory and FMPs[37];

[37] Forest Inventory and FMPs are carried out for each State Forest Enterprise. The inventory aims measurement and processing of the following main data:

1) Forest area and its changes
2) Tree composition, origin, age, management purpose

- Forestry Fund Reporting Form 1FF[38] (forest area) for the 1990;
- Forest maps

Table 236 Intermediate results from the revision of the FMPs for all SFEs for the period 2001-2011, representing the net AR activities since 1990 till 2011

| State Forest Enterprises | Forest area in ha for 1991 | Forest area in ha for 2011. | Planted or manually seeded in ha 1992-2000 | Planted or manually seeded in 2001-2011 | AR with natural seeding in ha. 1992-2000 | AR with natural seeding in ha 2001-2011 | Forest area forested before 1990 |
|---|---|---|---|---|---|---|---|
| **I. DISTRICT VIDIN** | | | | | | | |
| 1. Vidin | 25 249 | 31 700 | - | 21.0 | 1 438.3 | 4 991.7 | - |
| 2. Belogradjik | 27 185 | 27 611 | 620.0 | 6.0 | - | 3 127.8 | 906.0 |
| 3. Midjur | 16 532 | 23 878 | - | - | 70.1 | 2 548.5 | 494.6 |
| **Total** | **68 965** | **83 189** | **620.0** | **27.0** | **1 508.4** | **10 668.0** | **1 400.6** |
| **II. DISTRICT MONTANA** | | | | | | | |
| 1. Montana | 27 219.0 | 14 796.0 | - | 27.2 | 542.1 | 20.2 | 183.6 |
| 2. Chiprovtsi | - | 15 314.0 | 1.2 | 2.0 | 18.9 | 815.7 | 818.1 |
| 3. Berkovitsa | 23 199.0 | 26 177.0 | 59.1 | - | 195.7 | 1 961.7 | 19.5 |
| 4. Lom | 4 712.0 | 6 053.0 | - | 50.0 | 110.0 | 573.0 | 608.0 |
| 5. Govejda | 14 820.0 | 16 364.0 | - | 2 264.0 | - | - | 22.0 |
| 6. Burziya | 6 902.0 | 6 523.0 | | | | | 83.0 |
| **Total** | **76 852.0** | **85 227.0** | **60.3** | **2 343.2** | **866.7** | **3 370.6** | **1 734.2** |
| **III. DISTRICT OF VRATSA** | | | | | | | |
| 1. Vratsa | 22 240.0 | 24 341.0 | - | - | 287.8 | 627.0 | 1 068.2 |
| 2. Mezdra | 24 265.0 | 30 726.0 | 756.9 | 1 070.1 | 2 109.4 | 2 342.2 | 300.4 |
| 3. Oryahovi | 4 113.0 | 4 160.0 | - | - | - | 47.0 | - |
| **Total** | **50 618.0** | **59 227.0** | **756.9** | **1 070.1** | **2 397.2** | **3 016.2** | **1 368.6** |
| **IV. DISTRICT OF PLEVEN** | | | | | | | |
| 1. Pleven | 20 126.0 | 30 855.0 | 2 174.1 | - | 4 767.0 | 3 467.4 | 320.5 |
| 2. Nikopol | 10 743.0 | 13 028.0 | - | 39.5 | - | 198.0 | 2 053.5 |
| **Total** | **30 869.0** | **43 883.0** | **2 174.1** | **39.5** | **4 767.0** | **3 659.4** | **2 374.0** |
| **V. DISTRICT OF LOVECH** | | | | | | | |
| 1. Lovech | 19 195.0 | 26 162.0 | 35.3 | 3 657.4 | - | 4 061.1 | 407.5 |
| 2. Teteven | 20 748.0 | 17 614.0 | 118.6 | 54.3 | 11.4 | 18.6 | 406.7 |
| 3. Ribaritsa | 15 720.0 | 19 886.0 | - | 18.0 | - | 76.3 | 1.9 |

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.

[38] The reporting forms 1FF to 7 FF represent the forest fund reporting forms. The data gathered during the forest inventories is used as data base for preparation of the reporting forms of the forest fund

| State Forest Enterprises | Forest area in ha for 1991 | Forest area in ha for 2011. | Planted or manually seeded in ha 1992-2000 | Planted or manually seeded in 2001-2011 | AR with natural seeding in ha. 1992-2000 | AR with natural seeding in ha 2001-2011 | Forest area forested before 1990 |
|---|---|---|---|---|---|---|---|
| 4. Cherni Vit | 10 027.0 | 11 981.0 | - | 4.0 | 313.9 | 12.5 | 433.4 |
| 5. Troyan | 31 033.0 | 25 138.0 | 35.3 | 8.0 | - | 1 407.0 | 367.7 |
| 6. Rusalka, Apriltsi | 12 021.0 | 12 796.0 | - | - | 334.9 | 356.1 | 84.0 |
| 7. Cherni Osam | 12 966.0 | 13 349.0 | - | 2.0 | 0.4 | 312.4 | 68.0 |
| 8. Borima | - | 7 716.0 | - | 3.0 | - | - | - |
| 9. Lesidren | 17 586.0 | 32 065.0 | 158.6 | 118.3 | - | 1 186.4 | - |
| 10. Lukovit | 13 338.0 | - | - | - | - | - | - |
| **Total** | **152 634.0** | **166 707.0** | **347.8** | **3 865.0** | **660.6** | **7 430.4** | **1 769.2** |
| **VI. DISTRICT OF GABROVO** | | | | | | | |
| 1. Gabrovo | 25 279.0 | 28 566.0 | 35.7 | 11,20 | - | 3 229.9 | 10.2 |
| 2. Sevlievo | 20 543.0 | 22 377,0 | - | - | 1 525.2 | 297.4 | 11.4 |
| 3. Rositsa | 14 168.0 | 14 615.0 | - | 7.0 | - | 350.2 | 89.8 |
| 4. Plachkovtsi | 19 762.0 | 27 063.0 | - | - | 1 327.0 | 5 897.0 | 77.0 |
| **Total** | **79 752.0** | **92 621.0** | **35.7** | **18,20** | **2 852.2** | **9 774.5** | **188.4** |
| **VII. DISTRICT OF VELIKO TARNOVO** | | | | | | | |
| 1. Bolyarka, V.Tarnovo | 31 699.0 | 42 485.0 | 504.0 | 841.8 | - | 9 440.2 | - |
| 2. Svishtov | 3 847.0 | 4 710.0 | - | 745.9 | 12.9 | - | 404.2 |
| 3. Gorna Oryahovitsa | 18 929.0 | 20 289.0 | 211.2 | 12.0 | 4.4 | 738.0 | 94.1 |
| 4. Elena | 30 179.0 | 33 206.0 | - | 6.8 | - | 2 736.1 | 284.1 |
| 5. Buinovtsi | 14 960.0 | 15 080.0 | - | 33.1 | - | - | 86.9 |
| **Total** | **99 614.0** | **115 770.0** | **715.2** | **1 639.6** | **17.3** | **12 914.3** | **869.6** |
| **VIII. DISTRICT OF ROUSSE** | | | | | | | |
| 1. Dunav, Rousse | 16 297.0 | 18 398.0 | - | 192.0 | - | 800.0 | 1 109.0 |
| 2. Byala | 15 033.0 | 19 857.0 | - | 3 380.9 | - | 858.8 | 584.3 |
| **Total** | **31 330.0** | **38 255.0** | **-** | **3 572.9** | **-** | **1 658.8** | **1 693.3** |
| **IX. DISTRICT OF TARGOVISHTE** | | | | | | | |
| 1. Tyrgovishte | 15 569.0 | 16 060.0 | - | - | 16.1 | 93.5 | 196.1 |
| 2. Omurtag | 26 433.0 | 28 660.0 | 3.0 | 319.8 | - | 486.8 | 767.7 |
| 3. Cherni Lom, Popovo | 24 782.0 | 28 170.0 | 900.0 | 422.9 | 1 848.7 | 385.1 | 757.3 |
| **Total** | **66 784.0** | **72 890.0** | **903.0** | **742.7** | **1 864.8** | **965.4** | **1 630.1** |
| **X. DISTRICT OF SHUMEN** | | | | | | | |
| 1. Shumen | 15 847.0 | 15 785.0 | 478.9 | 0.5 | 760.5 | 36.0 | 169.4 |
| 2. Preslav | 16 756.0 | 15 218.0 | 183.6 | - | - | 546.8 | 84.4 |
| 3. Varbitsa | 15 117.0 | 18 782.0 | 221.2 | - | - | 514.8 | 212.0 |
| 4. Smyadovo | 17 410.0 | 18 078.0 | - | - | 91.4 | 536.6 | 404.2 |
| 5. Palamara, Venets | 29 650.0 | 33 455.0 | 587.9 | 40.8 | - | 1 569.0 | 100.0 |

| State Forest Enterprises | Forest area in ha for 1991 | Forest area in ha for 2011. | Planted or manually seeded in ha 1992-2000 | Planted or manually seeded in 2001-2011 | AR with natural seeding in ha. 1992-2000 | AR with natural seeding in ha 2001-2011 | Forest area forested before 1990 |
|---|---|---|---|---|---|---|---|
| **Total** | **94 780.0** | **101 318.0** | **1 471.6** | **41.3** | **851.9** | **3 203.2** | **970.0** |
| **XI. DISTRICT OF RAZGRAD** | | | | | | | |
| 1. Razgrad | 20 484.0 | 22 039.0 | 775.1 | 1 235.1 | - | 445.7 | 166.3 |
| 2. Seslav | 27 917.0 | 29 827.0 | - | - | - | 219.4 | 623.4 |
| 3. Iri-Hisar | 13 139.0 | 13 139.0 | - | - | - | - | - |
| **Total** | **61 540.0** | **65 005.0** | **775.1** | **1 235.1** | **-** | **665.1** | **789.7** |
| **XII. DISTRICT OF SILISTRA** | | | | | | | |
| 1. Silistra | 25 037.0 | 24 098.0 | - | 665.0 | - | 704.1 | 3 599.1 |
| 2. Karakuz | 16 844.0 | 24 238.0 | 311.4 | 58.8 | - | 615.1 | 452.1 |
| 3. Tutrakan | 8 590.0 | 10 315.0 | 29.9 | 921.8 | 157.9 | 85.4 | 579.4 |
| **Total** | **50 471.0** | **58 651.0** | **341.3** | **1 645.6** | **157.9** | **1 404.6** | **4 630.6** |
| **XIII. DISTRICT OF DOBRICH** | | | | | | | |
| 1. Dobrich | 23 478.0 | 16 735.0 | 1 198.7 | 286.2 | 123.3 | 246.5 | 2 466.4 |
| 2. Balchik | 11 918.0 | 14 101.0 | 778.2 | 176.2 | - | 183.3 | 1 045.3 |
| 3. Tervel | 10 737.0 | 14 215.0 | 586.5 | 51.1 | - | 519.0 | 2 321.4 |
| 4. General Toshevo | - | 13 988.0 | 2 267.8 | 108.5 | 26.0 | 93.0 | 428.6 |
| **Total** | **46 133.0** | **59 039.0** | **4 831.2** | **622.0** | **149.3** | **1 041.8** | **6 261.7** |
| **XIV. DISTRICT OF VARNA** | | | | | | | |
| 1. Varna | 30 138.0 | 31 362.0 | - | - | 455.7 | - | 768.3 |
| 2. Suvorovo | 11 066.0 | 11 792.0 | 27.7 | 25.4 | - | 378.8 | 294.1 |
| 3. Provadiya | 19 536.0 | 12 234.0 | 394.3 | 13.0 | - | 470.5 | 173.1 |
| 4. Tsonevo | 12 024.0 | 22 298.0 | 644.4 | 650.2 | 417.6 | 69.3 | 119.6 |
| 5. Sherba | 12 041.0 | 37 443.0 | - | 30.0 | - | 761.3 | 1 369.7 |
| 6. Staro Oryahovo | 23 241.0 | - | - | - | - | - | - |
| **Total** | **108 046.0** | **115 109.0** | **1 066.4** | **718.6** | **873.3** | **1 679.9** | **2 724.8** |
| **XV. DISTRICT OF BOURGAS** | | | | | | | |
| 1. Bourgas | 21 693.0 | 17 711.0 | 428.0 | 278.0 | 162.4 | 406.3 | 1 426.6 |
| 2. Nesebar | 29 598.0 | 34 721.0 | 24.6 | 104.1 | 188.9 | 502.6 | 2 167.6 |
| 3. Aytos | 39 807.0 | 41 508.0 | 252.4 | 128.5 | 250.8 | 932.5 | 136.8 |
| 4. Karnobat | 6 834.0 | 25 750.0 | 69.7 | - | - | 144.5 | 1 242.2 |
| 5. Sungurlare | 35 767.0 | 20 144.0 | 136.3 | 50.0 | 775.0 | 80.0 | 795.3 |
| 6. Sredets | 34 007.0 | 39 535.0 | 16.6 | 38.9 | 294.0 | 1 889.3 | 3 389.2 |
| 7. Ropotamo | 9 418.0 | 14 768.0 | 88.0 | 12.1 | 88.6 | 76.7 | 521.7 |
| 8. Novo Panicharevo | 19 202.0 | 20 326.0 | 133.0 | 8.0 | - | 226.0 | 39.0 |
| 9. Tsarevo | 27 546,.00 | 27 879.0 | - | 1.0 | - | 609.0 | - |
| 10. Gramatikovo | 19 252.0 | 20 453.0 | - | - | 33.8 | 128.5 | 1 234.5 |
| 11. Kosti | 12 534.0 | 12 848.0 | 57.0 | - | 79.0 | 248.0 | - |

| State Forest Enterprises | Forest area in ha for 1991 | Forest area in ha for 2011. | Planted or manually seeded in ha 1992-2000 | Planted or manually seeded in 2001-2011 | AR with natural seeding in ha. 1992-2000 | AR with natural seeding in ha 2001-2011 | Forest area forested before 1990 |
|---|---|---|---|---|---|---|---|
| 12. Malko Tarnovo | 30 587.0 | 20 552.0 | 3.3 | 2.0 | 162.1 | 133.9 | 3 985.3 |
| 13. Zvezdets | - | 19 568.0 | - | 18.1 | - | 1 394.5 | 3 833.8 |
| **Total** | **286 245.0** | **315 673.0** | **1 208.9** | **640.7** | **2 034.6** | **6 771.8** | **18 772.0** |
| XVI. DISTRICT OF YAMBOL | | | | | | | |
| 1. Tundja, Yambol | 17 978.0 | 19 046.0 | - | 33.0 | 18.3 | 110.0 | 906.7 |
| 2. Elhovo | 25 539.0 | 30 756.0 | 194.2 | 703.4 | 214.0 | 1 581.7 | 2 523.7 |
| **Total** | **43 517.0** | **49 802.0** | **194.2** | **736.4** | **232.3** | **1 691.7** | **3 430.4** |
| XVII. DISTRICT OF SLIVEN | | | | | | | |
| 1. Sliven | 42 721.0 | 43 866.0 | 513.4 | 37.6 | - | 300.0 | 294.0 |
| 2. Kotel | 37 535.0 | 40 480.0 | 40.0 | 2.0 | - | 565.5 | 1 079.5 |
| 3. Tvarditsa | 26 448.0 | 26 747.0 | - | 3.2 | - | 236.2 | 59.6 |
| 4. Nova Zagora | 9 508.0 | 10 126.0 | 83.0 | - | - | 99.2 | 435.8 |
| 5. Ticha | 12 295.0 | 12 930.0 | - | 12.0 | 568.0 | 72.6 | 1 145.7 |
| 6. Stara reka | 7 431.0 | 8 138.0 | - | 21.0 | - | 67.4 | 713.3 |
| **Total** | **135 938.0** | **142 287.0** | **636.4** | **75.8** | **568.0** | **1 340.9** | **3 727.9** |
| XVIII. DISTRICT OF STARA ZAGORA | | | | | | | |
| 1. Stara Zagora | 34 337.0 | 36 262.0 | 1 248.5 | 74.8 | 120.3 | 392.6 | 88.8 |
| 2. Chirpan | 21 352.0 | 24 302.0 | 46.5 | 19.7 | 571.9 | 634.8 | 1 551.7 |
| 3. Mazalat | 27 782.0 | 34 613.0 | 170.7 | 98.9 | - | 272.0 | 1 206.7 |
| 4. Gurkovo | 21 119.0 | 22 214.0 | - | - | - | 355.6 | - |
| 5. Maglij | 23 877.0 | 23 877.0 | 19.0 | 121.8 | 53.7 | 539.3 | 131.0 |
| 6. Kazanlak | 28 545.0 | 23 940.0 | 14.1 | 36.6 | - | - | 427.0 |
| **Total** | **157 012.0** | **165 208.0** | **1 498.8** | **351.8** | **745.9** | **2 194.3** | **3 405.2** |
| XIX. DISTRICT OF HASKOVO | | | | | | | |
| 1. Haskovo | 73 978.0 | 79 507.0 | - | 1 896.7 | 566.9 | 2 944.0 | 121.4 |
| 2. Topolovgrad | 19 764.0 | 20 966.0 | 145.8 | 172.0 | 239.8 | 369.0 | 275.4 |
| 3. Svilengrad | 24 232.0 | 27 754.0 | 607.2 | 275.8 | 354.3 | 2 107.1 | 177.6 |
| 4. Ivaylovgrad | 41 977.0 | 47 923.0 | 104.5 | 64.8 | 244.5 | 1 909.1 | 3 623.1 |
| **Total** | **159 951.0** | **176 150.0** | **857.5** | **2 409.3** | **1 405.5** | **7 329.2** | **4 197.5** |
| XX. DISTRICT OF KARDJALI | | | | | | | |
| 1. Kardjali | 34 001.0 | 21 986.0 | 597.8 | 345.4 | - | - | 128.9 |
| 2. Jenda | 3 487.0 | 16 770.0 | - | 36.9 | - | 123.3 | 35.7 |
| 3. Momichilgrad | 52 266.0 | 24 467.0 | 21.4 | 68.5 | - | - | 885.6 |
| 4. Kirkovo | - | 28 776.0 | - | 1.5 | - | - | - |
| 5. Krumovgrad | 39 848.0 | 42 907.0 | 134.1 | 16.8 | - | 1 024.4 | 1 883.7 |
| 6. Ardino | 17 932.0 | 18 366.0 | 93.0 | 56.2 | 88.6 | 196.2 | - |
| **Total** | **147 534.0** | **153 272.0** | **846.3** | **525.3** | **88.6** | **1 343.9** | **2 933.9** |
| XXI. DISTRICT OF SMOLYAN | | | | | | | |

| State Forest Enterprises | Forest area in ha for 1991 | Forest area in ha for 2011. | Planted or manually seeded in ha 1992-2000 | Planted or manually seeded in 2001-2011 | AR with natural seeding in ha. 1992-2000 | AR with natural seeding in ha 2001-2011 | Forest area forested before 1990 |
|---|---|---|---|---|---|---|---|
| 1. Smolyan | 22 362.0 | 27 746.0 | 27.4 | 45.6 | 147.5 | 2 143.1 | 493.0 |
| 2. Zlatograd | 32 671.0 | 31 975.0 | - | - | 80.4 | 26.7 | - |
| 3. Smilyan | 30 526.0 | 31 565.0 | - | - | 10.8 | 1 028.2 | - |
| 4. Slaveyno | 26 975.0 | 28 788.0 | - | - | 38.4 | 459.0 | - |
| 5. Pamporovo | 8 627.0 | - | - | - | - | - | - |
| 6. Chepelare | 10 895.0 | - | - | - | - | - | - |
| 7. Hvoyna | 11 444.0 | 27 978.0 | 37.3 | 272.7 | 894.4 | 125.0 | 63.5 |
| 8. Shiroka Laka | 8 102.0 | 9 019.0 | - | - | 1.4 | 568.8 | 346.8 |
| 9. Mihalkovo | 13 702.0 | 14 495.0 | - | 7.0 | 356.4 | 448.2 | 981.4 |
| 10. Izvora | 2 238.0 | 17 390.0 | 12.1 | 3.2 | 43.0 | 569.2 | 826.5 |
| 11. Devin | 12 698.0 | - | - | - | - | - | - |
| 12. Trigrad | 7 680.0 | 9 979,.00 | 255.7 | 36.1 | 628.2 | 595.1 | 783.9 |
| 13. Borino | 10 469.0 | 12 501.0 | - | 4.0 | 837.5 | 160.5 | 1 030.0 |
| 14. Dospat | 19 171.0 | 20 269.0 | 5.0 | 35.0 | 138.0 | 463.0 | 457.0 |
| **Total** | **217 560.0** | **233 046.0** | **337.5** | **403.6** | **3 176.0** | **6 586.8** | **4 982.1** |
| **XXII. DISTRICT OF PLOVDIV** | | | | | | | |
| 1. Plovdiv | 25 336.0 | 24 377.0 | 543.5 | 143.8 | - | 945.2 | 5 254.9 |
| 2. Hisar | 23 239.0 | 25 757.0 | 1 077.5 | 49.5 | 283.4 | 456.2 | 651.4 |
| 3. Klisura | 7 089.0 | 20 041.0 | 52.3 | 60.6 | - | - | 516.1 |
| 4. Rozino | 12 323.0 | - | - | - | - | - | - |
| 5. Karlovo | 28 248.0 | 30 298.0 | 49.1 | 54.6 | 148.5 | 1 130.1 | 667.7 |
| 6. Chekeritsa | 12 646.0 | 21 243.0 | 28.5 | 26.1 | - | 265.3 | 430.7 |
| 7. Parvomai | 9 192.0 | 9 505.0 | 111.5 | 22.9 | - | 178.6 | - |
| 8. Asenovgrad | 24 662.0 | 27 817.0 | 85.6 | 286.5 | 124.6 | 1 670.1 | 988.2 |
| 9. Kormisosh, Laki | 19 106.0 | 21 196.0 | 200.4 | 34.4 | 1 098.9 | 612.2 | 144.1 |
| 10. Krichim | 7 873.0 | 9 001.0 | - | - | 608.8 | 47.4 | 471.8 |
| **Total** | **169 714.0** | **189 235.0** | **2 148.4** | **678.4** | **2 264.2** | **5 305.1** | **9 124.9** |
| **XXIII. DISTRICT OF PAZARDJIK** | | | | | | | |
| 1. Pazardjik | 24 390.0 | 25 571.0 | - | 27.0 | - | 149.0 | 983.0 |
| 2. Panagurishte | 37 158.0 | 37 784.0 | 370.9 | 50.1 | - | - | 207.0 |
| 3. Belovo | 22 634.0 | 24 350.0 | 43.5 | 52.3 | 356.8 | 198.8 | 1 064.6 |
| 4. Yundola | 4 831.0 | 4 825.0 | - | 1.0 | - | - | - |
| 5. Alabak | 26 165.0 | 25 606.0 | 107.0 | 121.0 | - | 238.4 | 456.7 |
| 6. Chepino | 2 529.0 | 19 216.0 | - | - | 18.0 | 136.1 | 134.8 |
| 7. Chehlyovo | 14 929.0 | - | - | - | - | - | - |
| 8. Selishte | 15 472.0 | 15 898.0 | 79.9 | 13.6 | - | 121.7 | 210.8 |
| 9. Shiroka Polyana | 15 060.0 | 10 704.0 | - | - | - | 86.4 | 147.7 |
| 10. Rodopi | 2 486.0 | 19 726.0 | - | 1.0 | - | 120.9 | 181.0 |

| State Forest Enterprises | Forest area in ha for 1991 | Forest area in ha for 2011. | Planted or manually seeded in ha 1992-2000 | Planted or manually seeded in 2001-2011 | AR with natural seeding in ha. 1992-2000 | AR with natural seeding in ha 2001-2011 | Forest area forested before 1990 |
|---|---|---|---|---|---|---|---|
| 11. Beglika | 12 350,.00 | - | - | - | - | - | - |
| 12. Borovo | 14 538.0 | 15 123.0 | - | - | - | 104.5 | 477.5 |
| 13. Batak | 9 520.0 | 9 888.0 | - | - | - | 98.7 | 269.3 |
| 14. Rakitovo | 18 255,.00 | 19 320.0 | 92.8 | 109.2 | 69.7 | 14.3 | 779.0 |
| 15. Peshtera | 18 580.0 | 19 416.0 | 476.3 | 118.1 | 21.4 | 17.4 | 202.8 |
| **Total** | **238 897.0** | **247 427.0** | **1 170.4** | **493.3** | **465.9** | **1 286.2** | **5 114.2** |
| XXIV. DISTRICT OF BLAGOEVGRAD | | | | | | | |
| 1. Blagoevgrad | 24 222.0 | 26 347.0 | 15.7 | 130.8 | 345.0 | 2 490.3 | 559.3 |
| 2. Simitli | 30 136.0 | 33 979.0 | 422.8 | 235.2 | 300.9 | 1 079.7 | 388.3 |
| 3. Kresna | 22 516.0 | 23 274.0 | - | - | 92.2 | 234.8 | 431.0 |
| 4. Strumyani | 18 450.0 | 20 763.0 | - | 3.0 | - | 148.5 | 970.5 |
| 5. Parvomay | 18 422.0 | 17 785.0 | 252.0 | 42.7 | - | 442.1 | 0.3 |
| 6. Petrich | 10 727.0 | 11 249.0 | - | - | - | 260.1 | 78.8 |
| 7. Sandanski | 22 122.0 | 22 261.0 | 242.5 | - | 57.1 | 290.3 | 107.3 |
| 8. Katuntsi | 26 366.0 | 27 944.0 | - | - | 62.0 | 48.0 | 909.8 |
| 9. Gotse Delchev | 28 748.0 | 29 049.0 | 46.2 | 42.5 | 129.0 | 176.0 | - |
| 10. Dikchan, Satovcha | 17 729.0 | 17 870.0 | 60.0 | 91.0 | - | - | - |
| 11. Garmen | 24 657.0 | 26 580.0 | 39.6 | 8.5 | - | 62.0 | - |
| 12. Mesta | 16 789.0 | 11 563.0 | 48.9 | 81.8 | 1.2 | 5.5 | - |
| 13. Dobrinishte | 12 021.0 | 17 210.0 | 28.7 | 80.0 | 359.0 | 639.1 | 429.0 |
| 14. Eleshnitsa | 16 510.0 | 16 650.0 | 178.7 | 131.7 | - | - | - |
| 15. Yakoruda | 19 967.0 | 21 103.0 | 1 162.2 | 688.0 | - | - | - |
| 16. Belitsa | 10 351.0 | 11 139.0 | 99.8 | 268.7 | - | 218.5 | - |
| 17. Razlog | 18 023.0 | 19 334.0 | 112.0 | 54.4 | 461.0 | - | - |
| **Total** | **337 756.0** | **354 100.0** | **2 709.1** | **1 858.3** | **1 807.4** | **6 094.9** | **3 874.3** |
| XXVI. DISTRICT OF KUSTENDIL | | | | | | | |
| 1. Osogovo | 46 949.0 | 57 834.0 | - | - | 867.9 | 5 990.0 | 3 175.5 |
| 2. Nevestino | 21 353.0 | 22 957.0 | 407.1 | 525.3 | 510.2 | 497.4 | 515.6 |
| 3. Dupnitsa | 45 428.0 | 48 371.0 | - | - | - | 381.8 | 2 561.2 |
| **Total** | **113 730.0** | **129 162.0** | **407.1** | **525.3** | **1 378.1** | **6 869.2** | **6 252.3** |
| XXVI. DISTRICT OF PERNIK | | | | | | | |
| 1. Radomir | 24 496.0 | 20 239.0 | 3 834.0 | 215.0 | - | 124.3 | 134.3 |
| 2. Zemen | 15 029.0 | 18 363.0 | 28.4 | 53.7 | 740.0 | 764.3 | 1 742.6 |
| 3. Breznik | 8 884.0 | 10 299.0 | 153.0 | 110.1 | - | 980.4 | 176.5 |
| 4. Tran | 29 326.0 | 31 502.0 | 955.6 | 2.0 | 797.0 | - | 421.4 |
| 5. Vitoshko-Studena | - | 8 693.0 | - | - | - | - | 128.4 |
| **Total** | **77 735.0** | **89 096.0** | **4 971.0** | **380.8** | **1 537.0** | **1 869.0** | **2 603.2** |
| XXVII. DISTRICT OF SOFIA | | | | | | | |
| 1. Sofia | 49 478.0 | 54 199.0 | - | 2 382.3 | - | 123.3 | 265.7 |

| State Forest Enterprises | Forest area in ha for 1991 | Forest area in ha for 2011. | Planted or manually seeded in ha 1992-2000 | Planted or manually seeded in 2001-2011 | AR with natural seeding in ha. 1992-2000 | AR with natural seeding in ha 2001-2011 | Forest area forested before 1990 |
|---|---|---|---|---|---|---|---|
| 2. Svoge | 46 054.0 | 44 720.0 | - | 405.2 | 239.7 | 265.6 | 221.1 |
| 3. Vitinya | 7 723.0 | 16 900.0 | - | - | - | - | - |
| 4. Botevgrad | 40 497.0 | 33 657.0 | - | 110.0 | - | 1 425.0 | 307.1 |
| 5. Godech | 10 093.0 | 10 981.0 | - | 5.0 | 14.5 | 242.7 | 625.8 |
| 6. Etropole | 20 756.0 | 22 511.0 | 144.1 | 11.1 | - | 1 335.3 | 264.5 |
| 7. Pirdop | 42 773.0 | 44 442.0 | - | 46.0 | - | 823.9 | 883.1 |
| 8. Elin Pelin | 24 539.0 | 19 747.0 | 25.0 | 74.0 | 150.0 | 629.0 | 21.9 |
| 9. Aramliets | - | 9 334.0 | - | 27.1 | - | 3.1 | - |
| 10. Ihtiman | 27 362.0 | 25 288.0 | - | 56.5 | 214.3 | 625.5 | 1 274.6 |
| 11. Kostenets | 18 864.0 | 19 491.0 | 13.8 | 208.4 | 315.6 | 408.7 | 264.5 |
| 12. Samokov | 64 626.0 | 67 301.0 | - | - | 191.6 | 2 607.2 | 14.2 |
| 13. Iskar | 3 270.0 | 3 398.0 | - | - | - | - | 128.0 |
| **Total** | **356 035.0** | **373 429.0** | **182.9** | **3 325.6** | **1 125.7** | **8 489.3** | **4 270.5** |
| **Total for the Country** | **3 460 012** | **3 774 778** | **31 267.1** | **29 985.4** | **33 795.8** | **118 624.5** | **10 1093.2** |

The outcome of the project of revision of FMPs in Table 236 represents the intermediate results of AR lands for every single SFE. This assessment will be completed until submission 2014. Until then and for submission 2013 these results of Table 236 were extrapolated to the total forest area increase since 1990 that is not based on forests that were planted before 1.1.1990. This increase consists of LUC to forest due to planting and manual and natural seeding activities on land for two periods 1990-2000 and since 2000. Additional improvement in order to assess the former land use of the identified "planted or seeding" lands was made by using expert judgment. Land use (cropland, grassland, other land) typically follows ecological site condition. The experts know the dominating land uses in the SFE region or at the region of identified AR lands, so they made an expert judgement of former land use on basis of likelihoods. For example, there are regions where grassland (GL) dominates, because growth/site conditions are not good enough for cropland (CL) plants or CL management or, site conditions are so good that CL dominates. Similarly, other land (OL) can be found in extreme site conditions where FL, CL, GL cannot grow. It should be noticed that considering the growing conditions on other land which consist of rocks, landslides and barren areas, regrowth of forests on such lands without planting or manual seeding cannot happen. So, any conversion from OL to FL is based on planting or manual seeding measures and reported as such.

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 need of inspection of the full period 1.1.1990 to 31.12.2012 and due to the statistical nature of the assessments.

The total AR area for the period 1990-2011 is 224.29 kha.

Table 237 AR areas identified and extrapolated between the NFI period 1990-2010(EFA)

| 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) | 12% | 27.21 |
| Grassland (5 A.2.2) | 87% | 195.51 |
| Wetlands (5 A.2.3) | 0% | 0 |
| Settlements (5 A.2.4) | 0% | 0 |
| Others (5 A.2.5) | 0,7% | 1.57 |
| Total | 100% | 224.29 |

As shown in ARs mainly occur from croplands – 12%. ARs from grasslands and other lands have lower values – 87% and 0.7%, respectively.

Activity data for deforestation to settlements (SM) in the time period 2000 - 2011 are provided by the EFA. For the years before 2000 the same share of LUC from FL to SM was assumed which matched with the observed increase in SM for the years before 2000. Deforestations to cropland and grassland can be excluded due to the legal provisions. The observed increase in wetlands (from 2001 to 2011) 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 supposed that the wetlands increase comes from such lands).

Therefore, the total D area for the period 1990-2011 is estimated to be 7.14 kha.

Table 238 D areas observed between the NFI period 1990-2011 (Executive Forest 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) | 65% | 4.64 |
| Settlements (5 E.2.4) | 35% | 2.50 |
| Others (5 F.2.5) | 0% | 0 |
| Total | 100% | 7.14 |

Ds occur from wetlands – 65 % and settlements – 35%.

As it is mentioned above, the presented data are from the intermediate results from the revision of the FMPs for all SFEs for the period 2001-2011, representing the net AR activities since 1990 till 2011

### 11.2.2 METHODOLOGY USED TO DEVELOP THE LAND TRANSITION MATRIX

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 NFI and FMPs following the improvement plan described in chapter 11.2.1. On basis of these statistics and data, the annual net change of forest area was derived from the net increase in forest area for two periods 1990-2000 and since 2000.

Information for D areas is only available for changes to settlements in the period 2001 to 2011. For the years before 2001 it was assumed that the observed (smaller) increase in settlement area was also caused by LUC from forest areas. The annual D to SM (for the

years before 2001) was derived from the total increase in settlement area adjusted according to the share of the categories FL, CL and GL 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 resulted after D (together with LUC from agricultural land to WL) in an amount that represents the increase in wetland adjusted by the ratio forest land to agricultural land in Bulgaria.

Since the improvement steps (see 11.2.1) has been implemented in Submission 2012 and 2013 all changes in forest area since 1992 are traced and identified. The increase in forest area is derived into

a) New forest areas which are included in the forest total, but which were forested before 1990, so new forests with stands of older age classes

b) And the new forested areas with stands of the youngest age class, which are due to afforestation and reforestation activities (planting and seeding) on barren areas or afforestation and reforestation activities (planting, manual and natural seeding) 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). The new forest areas between 2011 and 1990 according to point b represent the net AR areas (planted or manually and naturally seeded on grassland or on croplands). Changes in forest area for the years 1990, 1991 are based on extrapolation using the same forest change as in the year 1992.

Therefore, the net increase in forest areas plus the annual deforestation areas must represent the annual AR areas to be consistent with the known annual increase in forest areas in the equations (1) and (2).

$$AR_x = FL_x - FL_{x-1} + D_{WLx} + D_{SMx} \quad (1)$$

$$D_x = D_{WLx} + D_{SMx} \quad (2)$$

Where,

$AR$ – AR area

$X$ - year

$FL$ – forest area

$D$ – D area

$D_{WL}$ – D area for wetlands

$D_{SM}$ – D area for settlements

Since the last improvements made for Submission 2013, specific data on previous land use of AR areas is already available. The former land use of the identified "planted, manual and natural seeding" lands were defined by expert judgment on basis of likelihoods.

Table 239 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 | 192,56 | NO | | | | | | 192,56 |
| | Deforestation | | 5.32 | | | | | | 5,32 |
| Article 3.4 activities | Forest Management (if elected) | | NA | NA | | | | | NA |
| | Cropland Management (if elected) | NA | NA | | NA | NA | NA | | NA |
| | Grazing Land Management (if elected) | NA | NA | | NA | NA | NA | | NA |
| | Revegetation (if elected) | NA | | | NA | NA | NA | | NA |
| Other | | 11.23 | 1,25 | NA | NA | NA | NA | 10 889.83 | 10 902,31 |
| Total area at the end of the current inventory year | | 203.78 | 6,57 | NA | NA | NA | NA | 10 889.83 | 11 100,19 |

Table 240 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 | 203.06 | NO | | | | | | 203.06 |
| | Deforestation | | 5.85 | | | | | | 5.85 |
| Article 3.4 activities | Forest Management (if elected) | | NA | NA | | | | | NA |
| | Cropland Management (if elected) | NA | NA | | NA | NA | NA | | NA |
| | Grazing Land Management (if elected) | NA | NA | | NA | NA | NA | | NA |
| | Revegetation (if elected) | NA | | | NA | NA | NA | | NA |
| Other | | 10.51 | 0.53 | NA | NA | NA | NA | 10 880.24 | 10 891.28 |
| Total area at the end of the current inventory year | | 213.57 | 6.39 | NA | NA | NA | NA | 10 880.24 | 11 100.19 |

Table 241 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 | 213.77 | NO | | | | | | 213.77 |
| | Deforestation | | 6.59 | | | | | | 6.59 |
| Article 3.4 activities | Forest Management (if elected) | | NA | NA | | | | | NA |
| | Cropland Management (if elected) | NA | NA | | NA | NA | NA | | NA |
| | Grazing Land Management (if elected) | NA | NA | | NA | NA | NA | | NA |
| | Revegetation (if elected) | NA | | | NA | NA | NA | | NA |
| Other | | 10.71 | 0.74 | NA | NA | NA | NA | 10 868.38 | 10 879.83 |
| Total area at the end of the current inventory year | | 224.48 | 7.33 | NA | NA | NA | NA | 10 868.38 | 11 100.19 |

Table 242 Land transition matrix. Area change between the current and the previous year for 2011 (CRF NIR-2 table)

| (kha) | | Article 3.3 activities | | Article 3.4 activities | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Afforestation and Reforestation | Deforestation | Forest Management (if elected) | Cropland Management (if elected) | Grazing Land Management (if elected) | Revegetation (if elected) | Other | Total area at the beginning of the current inventory year |
| Article 3.3 activities | Afforestation and Reforestation | 224.29 | NO | | | | | | 224.29 |
| | Deforestation | | 7.14 | | | | | | 7.14 |
| Article 3.4 activities | Forest Management (if elected) | | NA | NA | | | | | NA |
| | Cropland Management (if elected) | NA | NA | | NA | NA | NA | | NA |
| | Grazing Land Management (if elected) | NA | NA | | NA | NA | NA | | NA |
| | Revegetation (if elected) | NA | | | NA | NA | NA | | NA |
| Other | | 10.52 | 0.55 | NA | NA | NA | NA | 10 857.70 | 10 868.76 |
| Total area at the end of the current inventory year | | 234.81 | 7.68 | NA | NA | NA | NA | 10 857.70 | 11 100.19 |

### 11.2.3 MAPS AND/OR DATABASE TO IDENTIFY THE GEOGRAPHICAL LOCATIONS, AND THE SYSTEM OF IDENTIFICATION CODES FOR THE GEOGRAPHICAL LOCATIONS

The database used to identify the geographical locations of the ARD activities is the NFI in Bulgaria. All measurements gathered in accordance with the forest inventory and FMP are mapped. Forest Inventory and FMP are carried out for each State Forest Enterprise. The SFE is divided into compartments and sub-compartments. The forest maps in Bulgaria are carried out for each State Forest Enterprise (SFE) as a result of the Forest Inventory (therefore, the maps are updated every 10th years for each SFE). The country territory is divided into almost 180 State Forest Enterprises. The territory of one SFE may include the territory of one or several municipalities. The area of one sub-compartment or forest management unit is between 1-25 ha, when forested. The area of the non-forested unit is 0,1 ha. The sub-compartments are defined based on uniformity of stands by species, age class structure, etc. According to Ordinance N 6 on the Forestry Planning and the Lands from the Forest Fund and the Game management Regions of Republic of Bulgaria (State Gazette 27 /2004) section 2 – types of forest maps, forest maps are elaborated by SFE. The forest maps have unified consecutive numbering in the adopted geodesic coordinating system (BG, 2000), and contain information on areas or parts of them with permanent use as forests according to the Forest act. Forest maps are maintained separately by Forestry enterprises according to their FMP.

The forest maps give detailed data on:

- state boundary and all administrative boundaries in the scope of the particular map
- the boundaries of the urbanized areas
- the boundaries of the transportation areas
- the boundaries of the agricultural lands
- the boundaries of the State forestry enterprises and State game management areas and their subdivisions (forestry compartments and subcompartments)
- main and secondary watersheds
- roads, track and underground line facilities, within the boundaries of the forestry departments

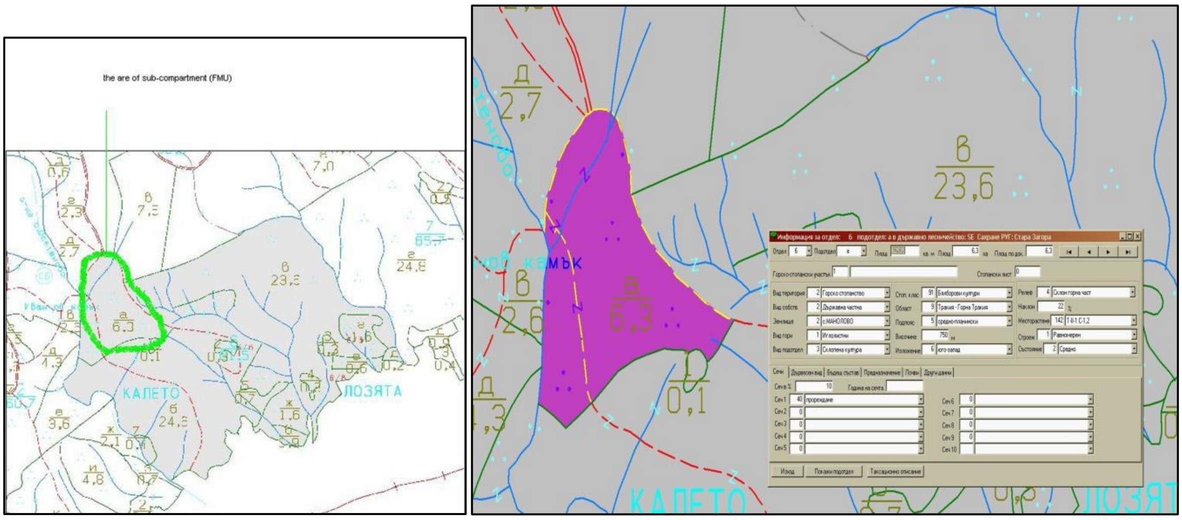


Figure 98 A map of one SFE (on left side), showing a forest land compartment (in grey colour and) and a sub-compartment (green line). On the right side - the area of sub-compartment and its details in the table.

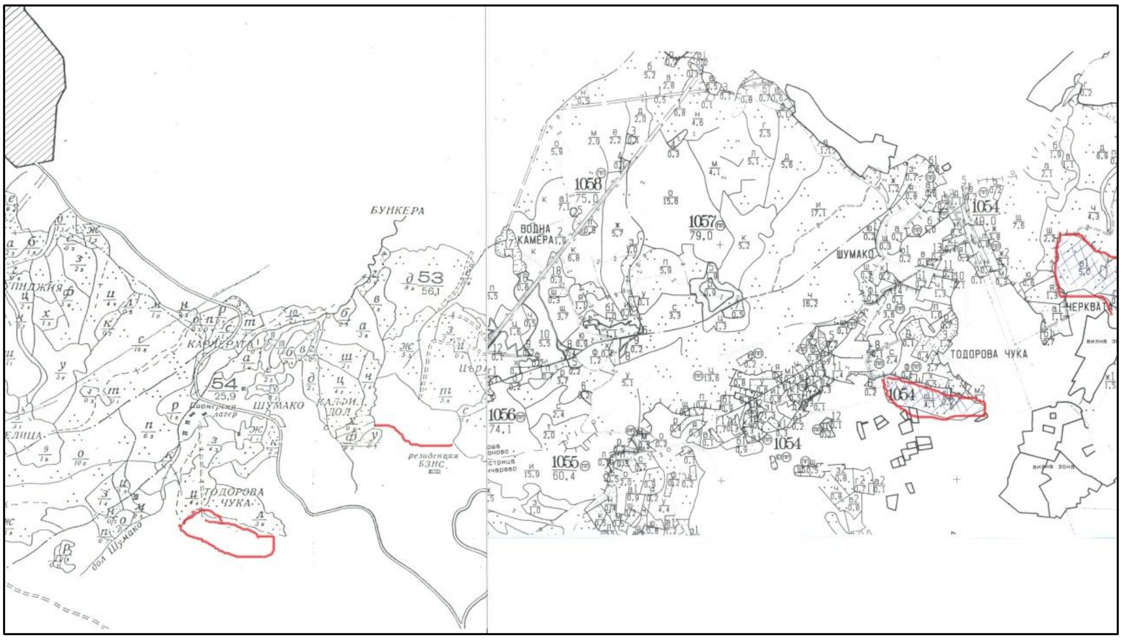


Figure 99 A map of the area of one SFE before (left) and now (right), which trace the changes in the forest land (in red).

## 11.3 ACTIVITY-SPECIFIC INFORMATION

### 11.3.1 METHODS FOR CARBON STOCK CHANGE AND GHG EMISSION AND REMOVAL ESTIMATES

#### 11.3.1.1 Description of the methodologies and the underlying assumptions used

The methodologies and assumptions used for the reporting under the Kyoto Protocol Art. 3.3. follow completely those for the areas of LUCs from and to forests (see Chapter 7.2.4.2 Lands converted to Forest Land - 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 $m^3$/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 $m^3$/ha/y.

There are no specific values for the biomass expansion factor ($BEF_2$) for converting the stemwood + branches stock into total aboveground biomass of the Ist age class. Since the Bulgarian NFI assesses also the stock of branches the used biomass expansion factor does not need to account for this tree compartment, so $BEF_2$ has only to add the leaf biomass. To estimate this specific $BEF_2$ data from literary sources on results from ecosystem studies for Spruce, Scots pine, Beech and Oaks for the Ist age class stands were used (compiled in Korner et al.1993). The coefficients were recalculated as weighed mean according to the relative share of Spruce, Scots pine, Beech and Oak the in the first age class of the Bulgarian forests Table 243 presents the values for $BEF_2$.

Table 243 Biomass expansion factor for converting stemwood +branches into total aboveground biomass ($BEF_2$) 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/m3 for deciduous), stemwood plus branches expanded to the whole aboveground tree biomass (1.08 for coniferous, 1.03 for deciduous), root-to-shoot ratios (0.32 for coniferous, 0.28 for deciduous) and C-content (0.50 t C/t d.m.). 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.

Deadwood is assumed not to occur on AR areas. Due to the young age of the forests at AR areas (since 1990) and the assumed lack of dead wood at areas of all other land uses it is assumed that a stock change of dead wood does not occur at AR areas. If there was any in

the young forests of AR areas it would represent a C stock increase due to the lack of dead wood in the previous land uses. So, the assumption is conservative.

There is no practice of biomass burning at ARD areas in Bulgaria. Furthermore, forests are not fertilised and liming does not exist in Bulgaria. So, fertilisation at AR areas and liming at ARD areas do not occur.

#### 11.3.1.7 Information on whether or not indirect and natural GHG emissions and removals have been factored out

Due to a lack of available methods in the IPCC GPG and elsewhere, indirect and natural GHG emissions/removals have not been factored out.

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

Details on changes in data and method are given in Chapter 11.2.1

#### 11.3.1.9 Uncertainty estimates

The assessment of the uncertainties of emissions/removals of the ARD lands is planned for Submission 2014 when the plan for improvements of ARD units will be completed until then.

#### 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 2011 the following ARD activities were presumed: AR at 10 519 ha, D at 545 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

The improvement steps (see 11.2.1) has been implemented in Submission 2012 and 2013 in order to demonstrate that the activities under Art. 3.3 began on or after 1st January 1990. As a result of this all changes in forest area since 1992 are traced and identified. The increase in forest area is derived into:

a) New forest areas which are included in the forest total, but which were forested before 1990, so new forests with stands of older age classes
b) And the new forested areas with stands of the youngest age class, which are due to afforestation and reforestation activities (planting and seeding) on barren areas or afforestation and reforestation activities (planting, manual and natural seeding) 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). Like this those areas are not reported as AR. The new forest areas between 2011 and 1990 according to point b represent the AR areas (planted or manually and naturally seeded on grassland or on croplands). Changes in forest area for the years 1990, 1991 are based on extrapolation using the same forest change as in the year 1992. Table 244 shows the AR areas and their consistency with the observed forest land changes.

Table 244 AR areas, forest land changes and D areas

| Years | AR | FLx - FLx-1 | Planted or manually seeded (kha) | Naturally seeded (kha) | Dx |
|---|---|---|---|---|---|
| **1992-2011** | 204.72 | 197.63 | 64.39 | 133.24 | 7.09 |
| **1991** | 9.79 | 9.77 | 4.69 | 5.07 | 0.02 |
| **1990** | 9.79 | 9.77 | 4.69 | 5.07 | 0.02 |
| **Total** | **224.30** | **217.17** | | | **7.13** |

The AR areas stem mainly from grassland, cropland and other land. As it can be observed in Table 9, 30% of the LUC to forest land is based on planting and manual seeding activities 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 regrowth on basis of direct human induced natural seeding. This is based on a human induced promotion, as the re-growth in this case is the result of the direct human induced stop of the agricultural management at these lands, which in fact leads to a direct human induced natural seeding from the adjacent forests and (re-)growth of managed forests (all forests in Bulgaria are managed and reported as such). In addition to this, there is a specific administrative procedure when as a result of the forest inventory assessment an agricultural land is identified as becoming a forest. The basics of this procedure is the owner's decision (please see art. 83 and 84 from the Forest Law 2011(last amendment 07.08.2012, SG №60) cited below). In the case when the new forest is less than 10 years old the land owner is informed on the risk of conversion of the agricultural land into forest land. If the land owner decides to keep the former agricultural land under agricultural use, he has to submit a declaration to the Executive director of the Executive Forest Agency. After the submission of the declaration, in

3 years term, the land owner is obliged to cut the re-grown forest vegetation and return the land into an active status of agricultural management. As a consequence of this procedure, it can be assumed that the lack of back conversion of such new forests into agricultural lands afterwards represents clear evidence for the nature of a land owner's decision of an intended land use change into forests.

When the new forest is older than 10 years, then this forested area belongs to the Forest Fund at once and the land owner cannot change the designation.

The Bulgarian administrative system ensures that the agricultural lands converted to forests by natural seeding and accounted as new forests are "direct human induced AR" because it entirely depends on the owners' decision. Only those of these lands are accounted as new forests where the land owner does not – after receiving information on the potential future forest land status of his land – reconvert these lands into agricultural lands.

According to the Forest Act this procedure is described in following articles:

*Art. 83. (1) Where as a result of the inventory of forest territories it is established, that the farm territories have acquired characteristics of a forest in the meaning of this law, the persons, who have performed the inventory shall produce to the Executive director of the a list of the properties upon the lands of the populated areas.*

*(2) The list under Para. 1 shall be published in one local and one central daily newspaper and shall be announced in public on the internet site of the relevant regional administration, Regional directorate of forests and the Executive Forest Agency.*

*(3) On the basis of the list under Para. 1, the Executive director of the Executive Forest Agency or an official, authorized by him shall invite in writing the owners of the relevant properties to declare if they wish to use their properties as farm or forest territories.*

*(4) **Within 6-month term** from receiving the invitation under Para. 3, the owner, **who wishes to use his property as a farm territory** shall submit a declaration to the Executive director of the Executive Forest Agency.*

*(5) If the owner fails to submit a declaration within the term under Para. 4, the Executive director of the Executive Forest Agency shall propose to the Minister of Agriculture and Food to issue an order for change of function of the properties as forest territory. The proposal shall describe the size of the properties, the type and origin of the forest and a plan of the property shall be attached from the map of the restored ownership or from the cadastre map and taxation characteristics.*

*(6) The order under Para. 5 shall be sent to the owner, to the relevant Regional directorate of forests, as well as to the relevant Office of geodesy, cartography and cadastre – for reflecting the change in the cadastre map and cadastre registers, or to the Municipal office of agriculture – for reflecting the change in the map of the restored ownership.*

*(7) The provisions of Para. 1 – 6 shall not apply to territories, provided to sites of the national security and defence.*

*Art. 84. (1) Where as a result of the inventory of the forest territories it is established, that farm territories have acquired the characteristics of a forest in the meaning of this law and the owner declares in writing before the Executive director of the Executive Forest Agency that he wishes to use his property as a farm territory within the term of 3 years from*

*submitting the declaration he shall be obliged to clean his property from the forest timber vegetation.*

*(2) In case that within the term of Para. 1 the owner fails to clean his property from forest-timber vegetation, the provision of Art. 83, Para. 4 – 6 shall apply.*

*(3) Notwithstanding of the inventory under Para. 1, unfit for farm use territories may be included on the forest territories on the basis of a written application of the owner under Art. 83, Para. 5 and 6*

As regards Deforestation activities, Forest Act clearly inscribes all cases in which forest is taken out of the Forest Fund (existing woods). This is followed by LUC and they are transformed from forested to non-forested lands. The procedure for taking out of the Forest Fund is given in the Forest Act (please see the respective articles below). **Therefore all changes in the function or designation of the forests are considered as deforestation and are reported as such.**

All forests in Bulgaria are protected by the Forest Act.

*Art. 3. (1) Decreasing the existing woods shall not be allowed:*

*1. on the territory of the Republic of Bulgaria;*

*2. on the territory of Municipalities, in which the woods are under 10%.*

All changes of designation of forest are registered in Executive Forest Agency for each year for the period 2000-2011. 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 (2000-2011) 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 2000-2011.

**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 NFI is used.

According to the Forest Law (last amendment 07.08.2012, SG №60) all harvest activities in the forests and lands with forest are planned under the FMP.

*Art. 101. (1) Felling shall be conducted for restoration, growing and improving the conditions of forests and for achieving the objectives, laid down in the forestry plans and programmes.*

*(3) The Minister of Agriculture and Food shall adopt an Ordinance, which shall determine:*

*Art. 102. Restoring felling shall be conducted at an age not smaller than:*

*1. 60 years in high-stem forests with the exception of birch and poplar trees, as well as the artificially created plantations out of their natural region of spreading;*

*2. 20 years and not bigger than 30 years in forests for sucker restoration;*

*3. 15 years for acacia forests.*

Clear cuttings are forbidden by Law.

*Art. 104. (1) It shall be prohibited:*

*1. conducting clear fell in all the forests with the exception of the poplar and low-stem forests*;

When there is forest disturbance the owner of the forest should replant the area if it cannot be restored by naturally up to 7 years.

*Art. 97. (1) Wood-cutting areas and burned out areas, which cannot be restored naturally up to 7 years after the timber cutting or burning during fire shall be planted by their owner up to 2 years after expiry the 7-year period.*

*(2) Where the forestry plan or programme envisages restoration in an artificial way, the forestation shall be done within the term of 3 years after cutting the plantation*.

It is forbidden by the Law to convert burnt by wildfires area to other land use during the 20 years period after the damage, caused by wildfires.

The delimitation between deforestation (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 management 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. The regulation describes the type of felling and specifies the conditions in which felling are carried out.

Deforestation needs administrative steps as described above, so there are only two possibilities 1) forest areas that have lost forest plant cover (e.g. clear cut areas, damaged areas): These areas remain forests by law, and there is no transition to non-forest 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 245 Key category analysis

| Category | Net $CO_2$ | Abs | % | sum |
|---|---|---|---|---|
| Annual Cropland converted to Forestland | -739.98 | 739.98 | 64.8 | 64.8 |
| Grassland converted to Forestland | -192.98 | 192.98 | 16.9 | 81.7 |
| Other land converted to Forestland | 134.03 | 134.03 | 11.7 | 93.4 |
| Perennial Cropland converted to Forestland | 45.81 | 45.81 | 4.0 | 97.4 |
| Settlement converted to Forestland | -28.72 | 28.72 | 2.5 | 99.9 |
| Wetland converted to Forestland | -0.59 | 0.59 | 0.1 | 100.0 |
| Forest land converted to wetland | NO | 0 | 0 | 100.0 |

| Category | Net $CO_2$ | Abs | % | sum |
|---|---|---|---|---|
| Forest land converted to grassland | NO | 0 | 0 | 100.0 |
| Forest land converted to other land | IE,NO | 0 | 0 | 100.0 |
| Forest land converted to settlements | IE,NO | 0 | 0 | 100.0 |
| Forestland converted to annual cropland | IE,NO | 0 | 0 | 100.0 |
| Forestland converted to perennial cropland | IE,NO | 0 | 0 | 100.0 |
| Total emissions/removals | | 1142.10 | | |

## 11.7 INFORMATION REGARDING TO ARTICLE 6

NA for Bulgaria

# 12 INFORMATION ON ACCOUNTING OF KYOTO UNITS

## 12.1 BACKGROUND INFORMATION

Annex I parties are required to report from its national registry holding of and transaction of Kyoto Protocol units and inform about related issues as specified in Decision 15/CMP.1 Section E. Information about the transactions of the Kyoto-units is attached in to this document.

## 12.2 SUMMARY OF INFORMATION REPORTED IN THE SEF TABLES

The Standart Electronic Format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for 2012 is submitted (April 2013). The SEF has been generated with the SEF application version 1.2.1, provided by the secretariat at 30 January 2013.

## 12.3 DISCREPANCIES AND NOTIFICATION

Further information on Kyoto Protocol units referning to the respective paragraphs on decision 15/CMP 1 will be reported.

Paragraph 12: Discrepancies identified by the transaction log;

No discrepant transaction for the reporting period, pursuant of 15/CMP.1 annex I.E paragraph 12.

Paragraph13 & § 14: No CDM notifications occurred in 2012;

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 2012;

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 2012;

No invalid units exist for the reporting period, pursuant of 15/CMP.1 annex I.E paragraph 16

Paragraph 17: Actions necessary to correct any problem causing a discrepancy.

No actions were taken or changes made to address discrepancies for the period under review;

## 12.4 PUBLICLY ACCSSIBLE INFORMATION

Section E of the annex to decision 15/CMP.1 outlines provisions for the national registry to support, via a user-interface, non-confidential information being made available to the public. Bulgaria has made this information available on the former Registry's website which was fully operational until May 2012 year:

**http://bg-server1.etr.moew.government.bg/**

On 20 June 2012 year after the go-alive and the successful migration of the data from the National registry to the Bulgarian registry successfully launched it's work as part of the Union registry.

The new internet address of the Bulgarian registry in the Union registry is:

***https://ets-registry.webgate.ec.europa.eu/euregistry/BG/index.xhtml***

The following information has been made accessible to the public in line with the requirements That this information is non-confidential. Bulgaria considers all information to be confidential that is determined to be confidential according to article 75 of the EU Registry Regulation No 920/2010/EC. Accounts holding's publicly accessible information:

***http://bg-server1.etr.moew.government.bg/iaos/contacts.php***

The registry terms and conditions, operators guide, forms and guidance for opening the holding accounts are available at the website of Executive Environment Agency:

***http://eea.government.bg/bg/about/rr/r-te/registry/doc.html***

Joint implementation (JI) projects' publicly accessible information:

***http://bg-server1.etr.moew.government.bg/iaos/projects.php***

The information of approved Joint Implementation projects and their documentation is added on the website of the competent authority (Ministry of the Environment and Waters) of JI projects and can be downloaded from the following link:

***http://www3.moew.government.bg/?show=top&cid=357&lang=en***

*Information according to paragraph 45 - 48 of the annex to decision 13/CMP.1:*

(a) Account name: the holder of the account

(b) Account type: the type of account (holding, cancellation or retirement)

(c) Commitment period: the commitment period with which a cancellation or retirement account is associated

(d) Representative identifier: the representative of the account holder, using the Party identifier (the two-letter country code defined by ISO 3166) and a number unique to that representative within the Party's registry

(e) Representative names nominated by the account holder and authorized to work with the account.

The Information includes the following Article 6 project information, for each project identifier if the Party has issued ERUs for a project:

(a) Project name: a unique name for the project

(b) Project location: the Party and town or region in which the project is located

(c) Years of ERU issuance: the years in which ERUs have been issued as a result of the Article 6 project

(d) Reports: downloadable electronic versions of all publicly available documentation relating to the project, including proposals, monitoring, verification and issuance of ERUs, where relevant, subject to the confidentiality provisions in decision 9/CMP.1.

The information includes the following holding and transaction information relevant to the national registry, by serial number, for each calendar year:

(a) The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year (displayed in the year X+5, according to EU Registry Regulation No 920/2010/EC the information is confidential until the year X+5)

(b) The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3, paragraphs 7 and 8 (displayed in the year X+1)

(c) The total quantity of ERUs issued on the basis of Article 6 projects (displayed in the year X+1)

(d) The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries and the identity of the transferring accounts and registries (displayed in the year X+5, according to EU Registry Regulation No 920/2010/EC the information is confidential until the year X+5)

(e) The total quantity of RMUs issued on the basis of each activity under Article 3, paragraphs 3 and 4 (displayed in the year X+1)

(f) The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries and the identity of the acquiring accounts and registries (displayed in the year X+5, according to EU Registry Regulation No 920/2010/EC the information is confidential until the year X+5)

(g) The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3, paragraphs 3 and 4 (displayed in the year X+1)

(h) The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1 (displayed in the year X+1)

(i) The total quantity of other ERUs, CERs, AAUs and RMUs cancelled (displayed in the year X+1)

(j) The total quantity of ERUs, CERs, AAUs and RMUs retired (displayed in the year X+1)

(k) The total quantity of ERUs, CERs, and AAUs carried over from the previous commitment period (displayed in the year X+1)

(l) The Information does not include current holdings of ERUs, CERs, AAUs and RMUs in each account because this is confidential according to EU Registry Regulation No 920/2010/EC.

The information includes a list of legal entities authorized by the Party to hold ERUs, CERs, AAUs and/or RMUs under its responsibility.

## 12.5 CALCULATION OF THE COMMITEMENT PERIOD RESERVE CPR

According to paragraph 6 of the annex of decision 11/CMP.1 each Party included in Annex I shall maintain, in its national registry, a commitment period reserve which should not drop below of the Kyoto Protocol, or 100 per cent of five times its most recently reviewed inventory, whichever is lowest.

Bulgaria's assigned amount was fixed at 610 045 827 tonnes $CO_2$ equivalent in its initial review report (FCCC/IRR/2007/BGR)[39].

Bulgaria calculated the Commitment Period Reserve (CPR) 330 666 404,9 $CO_2$ eq in accordance with a Decision 11/CMP.1 Annex Paragraph 6:
90% of the assigned amount (AAU) or five times the of 100 percent of the most recently reviewed inventory whichever is lowest.

| | |
|---|---|
| Assigned amount | **610 045 827** |
| 90% of this assigned amount | **549 041 244,3** tonnes $CO_2$-eq |
| CPR = 100 % of five times Bulgaria's most recent inventory (2011) | **330 666 404,9** tonnes $CO_2$-eq |

## 12.6 KP-LULUCF ACCOUNTING

In Table 246 data on accounting for the KP-LULUCF activities based on the reporting for the year 2011 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 246 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 | 2011 | Total(6) | | |
| A. Article 3.3 activities | | | | | | | |
| A.1. Afforestation and Reforestation | | | | | | | -5 161,76 |
| A.1.1. Units of land not harvested since the beginning of the commitment period(2) | -1 057,96 | -1 196,90 | -1 362,63 | -1 544,28 | -5 161,76 | | -5 161,76 |
| A.1.2. Units of land harvested since the beginning of the commitment period(2) | | | | | | | NO |

[39] 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 | | NO |
| **A.2. Deforestation** | 289,25 | 159,31 | 205,43 | 174,81 | 828,81 | | 828,81 |
| **B. Article 3.4 activities** | | | | | | | |
| **B.1. Forest Management (if elected)** | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | | NA,NO |
| 3.3 offset[(3)] | | | | | | 0,00 | NA,NO |
| FM cap[(4)] | | | | | | 6 783,33 | NA,NO |
| **B.2. Cropland Management (if elected)** | NA,NO | 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 | NA,NO | 0,00 | 0,00 |
| **B.4. Revegetation (if elected)** | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0,00 | 0,00 |

*Notes:*

(1) All estimates in this table include emissions and removals from projects under Article 6 hosted by the reporting Party.

(2) If Cropland Management, Grazing Land Management and/or Revegetation are elected, this table and all relevant CRF tables should also be reported for the base year for these activities.

(3) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and by changing the sign for net $CO_2$ removals to be negative (-) and net $CO_2$ emissions to be positive (+).

(4) $CO_2$ emissions from liming, biomass burning and drained organic soils, where applicable, are included in this column.

(5) $CH_4$ emissions reported here for Cropland Management, Grazing Land Management and Revegetation, if elected, include only emissions from biomass burning (with the exception of savannah burning and agricultural residue burning which are reported in the Agriculture sector). Any other $CH_4$ emissions from Agriculture should be reported in the Agriculture sector.

(6) $N_2O$ emissions reported here for Cropland Management, if elected, include only emissions from biomass burning (with the exception of savannah burning and agricultural residue burning which are reported in the Agriculture sector) and $N_2O$ emissions from mineral soils from conversion to Cropland of lands other than Forest Land (Table 5(KP-II)3). Any other $N_2O$ emissions from Agriculture should be reported in the Agriculture sector.

(7) As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to decision 16/CMP.1, they can be reported together.

# 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

Directive 2009/29/EC adopted in 2009, provides for the centralization of the EU ETS operations into a single European Union registry operated by the European Commission as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol (25) plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries - in particular Decision 13/CMP.1 and decision 24/CP.8.

With a view to complying with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011, in addition to implementing the platform shared by the consolidating Parties, the registry of EU has undergone a major re-development. The consolidated platform which implements the national registries in a consolidated manner (including the registry of EU) is called Consolidated System of EU registries (CSEUR) and was developed together with the new EU registry.

Following the successful implementation of the CSEUR platform, the 28 national registries concerned were re-certified in June 2012 and switched over to their new national registry on 20 June 2012. During the go-live process, all relevant transaction and holdings data were migrated to the CSEUR platform and the individual connections to and from the ITL were re-established for each Party.

All the conditions for the accession of the National registry for issuance, holding, transfer and cancellation of greenhouse gas emission allowances to the Union registry were met. In January 2012 year the National registry was successfully partially linked with the Union registry to include the aircraft operators in the European Emission Trading Scheme and on 20 June 2012 year after the go-alive and the successful migration of the data from the National registry to the Bulgarian registry successfully launched it's work as part of the Union registry.

**Registry administrator**

No changes to the Registry administrator of the national registry occurred during the reported period.

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 16<br>Fax +359 2 955 90 38 |
| 2 | Mr. Ivaylo Rangelov | registry@eea.government.bg | |

### Consolidated system with other parties

The EU Member States who are also Parties to the Kyoto Protocol (25) plus Iceland, Liechtenstein and Norway have decided to operate their registries in a consolidated manner. The Consolidated System of EU registries was certified on 1 June 2012 and went to production on 20 June 2012.

A complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. This description includes:

- Readiness questionnaire
- Application logging plan
- Change management procedure
- Disaster recovery plan
- Manual Interventions
- Operational Plan
- Roles and responsibilities
- Security Plan
- Time Validation Plan
- Version change Management

The documents above are "ETS Limited" and these documents cannot be made publicly available.

A new central service desk was also set up to support the registry administrators of the consolidated system. The new service desk acts as 2nd level of support to the local support provided by the Parties. It also plays a key communication role with the ITL Service Desk with regards notably to connectivity or reconciliation issues.

### Database structure and capacity

In 2012, the EU registry has undergone a major redevelopment with a view to comply with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011 in addition to implementing the Consolidated System of EU registries (CSEUR).
The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.
During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and lead to successful certification on 1 June 2012.

**Conformity with data exchange standards(des)**

The overall change to a Consolidated System of EU Registries triggered changes the registry software and required new conformance testing. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the DES. All tests were executed successfully and lead to successful certification on 1 June 2012.

**Minimization of discrepancies**

The overall change to a Consolidated System of EU Registries also triggered changes to discrepancies procedures, as reflected in the updated manual intervention document and the operational plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

**Overview of security measures**

The overall change to a Consolidated System of EU Registries also triggered changes to security, as reflected in the updated security plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

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.

**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 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***

The information of approved Joint Implementation projects and their documentation is added on the website of the competent authority (Ministry of the Environment and Waters) of JI projects and can be downloaded from the following link:

***http://www3.moew.government.bg/?show=top&cid=357&lang=en***

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://eea.government.bg/bg/about/rr/r-te/registry/doc.html***

No changes of the information publicly accessible occurred during the reported period.

**The Internet address of the interface to Bulgarian registry in Union registry:**

The new internet address of the Bulgarian registry is:

***https://ets-registry.webgate.ec.europa.eu/euregistry/BG/index.xhtml***

**Disaster recovery**

The overall change to a Consolidated System of EU Registries also triggered changes to data integrity measures, as reflected in the updated disaster recovery plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

**Results of any test procedures**

On 2 October 2012 a new software release (called V4) including functionalities enabling the auctioning of phase 3 and aviation allowances, a new EU ETS account type (trading account) and a trusted account list went into Production. The trusted account list adds to the set of security measures available in the CSEUR. This measure prevents any transfer from a holding account to an account that is not trusted.

# 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 developing countries due to our national climate change policy.

The majority of Bulgarian legislation measures in the climate change area, are connected mainly with transposing of the European legislation, as well as other activities on implementation of directives, connected with the politics on climate change.

The table below summarizes how the Party gives priority to selected actions, identified in paragraph 24 of the Annex to Decision 15/CMP.1.

Table 247 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**<br>The Environmental Protection Act and Clean Air Act and related secondary legislation, including a permit system for meeting minimum standards in accordance with EU regulation on Large Combustion Plants (LPS), participation in the EU ETS and technical inspection (e.g. for cars) etc;<br>The Energy Act, in its part on combined heat and power generation introduces the requirements of the related EU directives and the use preferential feed-in tariffs and mandates the state regulations to the licensed activities in the power sector and purchase obligations for the Transmission and Distribution Companies to buy all electricity produced from high efficient cogeneration, and for district heating companies to buy all utilized waste thermal energy.<br>The Renewable Energy Sources Act introduces the requirements of the related EU directives and the use of instruments such as green certificates and preferential feed in tariffs, mandates the state regulations to the licensed activities in the power sector and purchase obligations for the Transmission and Distribution Companies to by all electricity produced from renewable sources. It regulates the acceptance and realization of national indicative targets for consumption of bio fuels and other renewable fuels in the transport sector as a part of the total consumption of transport fuels;<br>The Energy Efficiency Law and related secondary legislation, including obligation to adopt municipal energy efficiency |

| Action | Implementation by the Party |
|---|---|
| | 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;<br>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;<br>**Fiscal policy**<br>A number of stimulating measures for the subjects of taxation were introduced in the Act on amendment and supplement of the Act on the Corporate Income Tax and also in the Act on amendment and supplement of the Personal Income Tax Act;<br>The on-going liberalization of energy market is in line with EU policies and directives;<br>The main instrument addressing externalities is emission trading under the EU ETS. |

# 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;

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Operational Program Environment 2007-2013;

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IPCC Guidelines

Revised 1996 IPCC Guidelines;
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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
Regulation establishing measures for the implementation of Regulation (EC) № 842/2006 on certain fluorinated greenhouse gases
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Schwarz W., 2007a. Establishment of Leakage Rates of Mobile Air Conditioners in Heavy Duty Vehicles, Part 1: Trucks, prepared for the European Commission

Schwarz W., 2007b. Establishment of Leakage Rates of Mobile Air Conditioners in Heavy Duty Vehicles, Part 2: Buses and Coaches, prepared for the European Commission

Bulgarian inventory of the additional greenhouse gases (HFC, PFC and $SF_6$), included in the Kyoto Protocol for 1995

Strategy for phase-out of hydro chlorofluorocarbons in Bulgaria, MEW, Danish Agency for Environmental Protection, 2003

**NIR- Other Country**

SVN NIR 2010;
Romania NIR 1989-2008;
Croatia NIR-2010;
DK_NIR2010_27may2010_NIR;
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**Web-pages:**

UNFCCC;
IPCC;
NSI, 2010. National Statistical Institute, Bulgaria, online database: http://www.nsi.bg;
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Eurostat, 2010. online database, available at: http://epp.eurostat.ec.europa.eu/
IPCC Third Assessment Report - Climate Change 2001 - online versions, available at: http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/248.htm
Kyoto Protocol to the United Nations Framework Convention on Climate Change, United Nations, 1998. Online version, available at: http://unfccc.int/resource/docs/convkp/kpeng.pdf

World Bank, 2010. Online database of the World Bank:
http://databank.worldbank.org/ddp/home.do
Ministry of Agriculture and food (MAF)
http://www.mzh.government.bg

## 16.2 REFERENCE-SECTOR WASTE

Literature

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);
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Revised 1996 IPCC Guidelines;
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IPCC- Good Practice Guidance;

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Ordinance № 3 on waste classification (SG 44/25.05.2004);
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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);
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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)

## 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 Forest 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

RIEW – Regional Inspectorate of Enviroment and Waters
UAA – Utilised Agricultural Area

# PART 2: ANEXES TO THE NATIONAL INVENTORY REPORT

# ANNEX 1 KEY CATEGORIES

- Description of methodology used for identifying key categories, including for KP-LULUCF.
- Reference to the key category tables in the CRF, including in the KP-LULUCF CRF tables).
- Information on the level of disaggregation
- Tables 7.A1 - 7.A3 of the IPCC good practice guidance
- Table NIR.3, as contained in the annex to decision 6/CMP.3.

1.1 Introduction

According to the definition of Good Practice Guidance, key sources of GHG emissions are these sources, which are responsible for 95% of the sum of aggregated GHG emission expressed in $CO_2$-eq. in the country.

The key sources are defined according to the IPCC classification. It is advisably that the key sources in superior degree are correspondent to the structure of the fuels and the activities in the country.

By method type Tier 1 are defined key sources accounting two rules:

- Rule A – Level assessment of the GHG emissions in absolute value expressed in Gg;

- Rule B – Trend assessment of the emissions from the base year until the current year of the inventory.

By applying rule A is used information for the volume of the source emissions only for the current year of the inventory.

The application of rule B requires information for the GHG emissions for the base year in the country. That means that the trend assessment includes additional information and gives the possibility for thorough analysis of the key sources.

1.2 Tier 1 method for Assessment of Key Sources.

The method used to indentify key source categories follows the Tier 1 method – quantitative approach described in the Good Pratice Guidance (IPCC-GPG, 2000), Chapter 7 Methodological Choice and Recalculation and in the IPCC Good Pratice Guidance for Land Use, Land Use Change and Forestry (IPCC GPG-LULUCF, 2003), Chapter 5.4 Methodological Choice – Indetification of key categories.

The analysis includes all greenhouse gases reported under UNFCCC: $CO_2$, $CH_4$, $N_2O$, HFC, PFC and $SF_6$. All IPCC catetegories are included.

The identification of key categories consists of following steps:

- Identifying categories
- Level Assessment excluding LULUCF
- Level Assessment including LULUCF
- Trend Assessment excluding LULUCF
- Trend Assessment including LULUCF

The following tables present results from key source analysis:

Table 250 and Table 252 present results from the Level Assessment of the key category analysis excluding LULUCF

Table 247 present results from the Trend Assessment of the key category analysis excluding LULUCF

Table 251 and

Table 253 presents the results from the Level Assessment of the key category analysis including LULUCF

Table 249 presents the results from the Trend Assessment of the key category analysis including LULUCF.

Table 248 Key category Analysis T1: Trend assessment excluding LULUCF

| Source | Gas | Fuel/Cat. | 1988 (BY) Gg $CO_2$-eq. | 2011 Gg $CO_2$-eq. | % excl. (2011) | Trend | Contribution to Trend | cumul. % |
|---|---|---|---|---|---|---|---|---|
| **1A1a** | $CO_2$ | **Solid Fuels** | 25 497,3 | 32 516,2 | 49,17% | 0,521007 | 36,65% | 36,65% |
| **1A2f** | $CO_2$ | **Solid Fuels** | 9 069,4 | 413,9 | 0,63% | 0,125599 | 8,83% | 45,48% |
| **1A1a** | $CO_2$ | **Liquid Fuels** | 8 155,6 | 424,9 | 0,64% | 0,111474 | 7,84% | 53,32% |
| **1A3b** | $CO_2$ | **Diesel Oil** | 2 631,3 | 4 664,5 | 7,05% | 0,090257 | 6,35% | 59,67% |
| **2C1** | $CO_2$ | | 3 481,4 | 68,0 | 0,10% | 0,050748 | 3,57% | 63,24% |
| **4B8** | $CH_4$ | | 3 906,8 | 559,1 | 0,85% | 0,043485 | 3,06% | 66,30% |
| **1A2e** | $CO_2$ | **Liquid Fuels** | 2 731,9 | 51,3 | 0,08% | 0,039880 | 2,81% | 69,11% |
| **1A1a** | $CO_2$ | **Gaseous Fuels** | 6 476,1 | 2 273,4 | 3,44% | 0,034543 | 2,43% | 71,54% |
| **6A** | $CH_4$ | | 3 269,2 | 2 899,7 | 4,38% | 0,031410 | 2,21% | 73,75% |
| **1A2f** | $CO_2$ | **Liquid Fuels** | 3 122,9 | 568,1 | 0,86% | 0,031383 | 2,21% | 75,95% |
| **1A4b** | $CO_2$ | **Solid Fuels** | 3 403,0 | 954,2 | 1,44% | 0,024853 | 1,75% | 77,70% |
| **4D1** | $N_2O$ | | 5 426,7 | 2 057,8 | 3,11% | 0,024685 | 1,74% | 79,44% |
| **2B2** | $N_2O$ | | 2 009,8 | 234,4 | 0,35% | 0,023854 | 1,68% | 81,12% |
| **4D3** | $N_2O$ | | 3 723,1 | 1 206,3 | 1,82% | 0,022665 | 1,59% | 82,71% |
| **1A3b** | $CO_2$ | **Gasoline** | 4 364,4 | 1 668,6 | 2,52% | 0,019473 | 1,37% | 84,08% |
| **1A2a** | $CO_2$ | **Solid Fuels** | 1 164,2 | 41,5 | 0,06% | 0,016447 | 1,16% | 85,24% |
| **1A4b** | $CO_2$ | **Liquid Fuels** | 1 155,6 | 72,0 | 0,11% | 0,015465 | 1,09% | 86,32% |
| **6B** | $CH_4$ | | 2 260,8 | 673,5 | 1,02% | 0,015408 | 1,08% | 87,41% |
| **4A3** | $CH_4$ | | 1 336,2 | 197,2 | 0,30% | 0,014707 | 1,03% | 88,44% |
| **2A1** | $CO_2$ | | 2 406,4 | 790,7 | 1,20% | 0,014340 | 1,01% | 89,45% |
| **1A4c** | $CO_2$ | **Liquid Fuels** | 1 639,9 | 411,8 | 0,62% | 0,013315 | 0,94% | 90,39% |
| **3** | $CO_2$ | | 866,6 | 22,3 | 0,03% | 0,012483 | 0,88% | 91,27% |
| **1A2d** | $CO_2$ | **Liquid Fuels** | 873,2 | 30,6 | 0,05% | 0,012349 | 0,87% | 92,13% |
| **2A2** | $CO_2$ | | 1 103,3 | 1 037,2 | 1,57% | 0,012236 | 0,86% | 92,99% |
| **2A7** | $CO_2$ | | 737,5 | 804,9 | 1,22% | 0,011289 | 0,79% | 93,79% |
| **HFCs** | $CO_2$e | | 2,4 | 395,7 | 0,60% | 0,010997 | 0,77% | 94,56% |
| **2B1** | $CO_2$ | | 1 693,3 | 526,4 | 0,80% | 0,010929 | 0,77% | 95,33% |

Table 249 Key category Analysis T1: Trend assessment including LULUCF

| Source | Gas | Fuel/Cat. | 1988 (BY) Gg $CO_2$-eq. | 2011 Gg $CO_2$-eq. | % incl. (2011) | Trend | Contribution to Trend | cumul. % |
|---|---|---|---|---|---|---|---|---|
| 1A1a | $CO_2$ | Solid Fuels | 25 497,3 | 32 516,2 | 40,50% | 0,433036 | 33,37% | 33,37% |
| 1A2f | $CO_2$ | Solid Fuels | 9 069,4 | 413,9 | 0,52% | 0,103416 | 7,97% | 41,33% |
| 1A1a | $CO_2$ | Liquid Fuels | 8 155,6 | 424,9 | 0,53% | 0,091780 | 7,07% | 48,41% |
| 1A3b | $CO_2$ | Diesel Oil | 2 631,3 | 4 664,5 | 5,81% | 0,074903 | 5,77% | 54,18% |
| 5A1 | $CO_2$ | | 13 688,8 | 9 622,0 | 11,99% | 0,051612 | 3,98% | 58,15% |
| 2C1 | $CO_2$ | | 3 481,4 | 68,0 | 0,08% | 0,041797 | 3,22% | 61,37% |
| 4B8 | $CH_4$ | | 3 906,8 | 559,1 | 0,70% | 0,035756 | 2,75% | 64,13% |
| 1A2e | $CO_2$ | Liquid Fuels | 2 731,9 | 51,3 | 0,06% | 0,032846 | 2,53% | 66,66% |
| 5B1 | $CO_2$ | | 35,7 | 1 304,4 | 1,62% | 0,029668 | 2,29% | 68,95% |
| 1A1a | $CO_2$ | Gaseous Fuels | 6 476,1 | 2 273,4 | 2,83% | 0,028187 | 2,17% | 71,12% |
| 6A | $CH_4$ | | 3 269,2 | 2 899,7 | 3,61% | 0,026218 | 2,02% | 73,14% |
| 1A2f | $CO_2$ | Liquid Fuels | 3 122,9 | 568,1 | 0,71% | 0,025786 | 1,99% | 75,12% |
| 1A4b | $CO_2$ | Solid Fuels | 3 403,0 | 954,2 | 1,19% | 0,020360 | 1,57% | 76,69% |
| 4D1 | $N_2O$ | | 5 426,7 | 2 057,8 | 2,56% | 0,020092 | 1,55% | 78,24% |
| 2B2 | $N_2O$ | | 2 009,8 | 234,4 | 0,29% | 0,019623 | 1,51% | 79,75% |
| 4D3 | $N_2O$ | | 3 723,1 | 1 206,3 | 1,50% | 0,018528 | 1,43% | 81,18% |
| 1A3b | $CO_2$ | Gasoline | 4 364,4 | 1 668,6 | 2,08% | 0,015844 | 1,22% | 82,40% |
| 1A2a | $CO_2$ | Solid Fuels | 1 164,2 | 41,5 | 0,05% | 0,013544 | 1,04% | 83,44% |
| 5B2 | $CO_2$ | | 508,5 | 855,4 | 1,07% | 0,013412 | 1,03% | 84,48% |
| 1A4b | $CO_2$ | Liquid Fuels | 1 155,6 | 72,0 | 0,09% | 0,012731 | 0,98% | 85,46% |
| 6B | $CH_4$ | | 2 260,8 | 673,5 | 0,84% | 0,012613 | 0,97% | 86,43% |
| 4A3 | $CH_4$ | | 1 336,2 | 197,2 | 0,25% | 0,012092 | 0,93% | 87,36% |
| 2A1 | $CO_2$ | | 2 406,4 | 790,7 | 0,98% | 0,011720 | 0,90% | 88,27% |
| 5E2 | $CO_2$ | | 83,2 | 523,2 | 0,65% | 0,011041 | 0,85% | 89,12% |
| 1A4c | $CO_2$ | Liquid Fuels | 1 639,9 | 411,8 | 0,51% | 0,010920 | 0,84% | 89,96% |
| 3 | $CO_2$ | | 866,6 | 22,3 | 0,03% | 0,010280 | 0,79% | 90,75% |
| 2A2 | $CO_2$ | | 1 103,3 | 1 037,2 | 1,29% | 0,010202 | 0,79% | 91,54% |
| 1A2d | $CO_2$ | Liquid Fuels | 873,2 | 30,6 | 0,04% | 0,010169 | 0,78% | 92,32% |
| 2A7 | $CO_2$ | | 737,5 | 804,9 | 1,00% | 0,009395 | 0,72% | 93,04% |
| HFCs | $CO_2e$ | | 2,4 | 395,7 | 0,49% | 0,009106 | 0,70% | 93,75% |
| 2B1 | $CO_2$ | | 1 693,3 | 526,4 | 0,66% | 0,008941 | 0,69% | 94,43% |
| 5C2 | $CO_2$ | | 786,6 | 786,6 | 0,98% | 0,008361 | 0,64% | 95,08% |

Table 250 Key category Analysis T1: 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 | 20,9% | 20,9% |
| **1A2f** | $CO_2$ | **Solid Fuels** | 9 069,4 | 7,4% | 28,3% |
| **1A1a** | $CO_2$ | **Liquid Fuels** | 8 155,6 | 6,7% | 35,0% |
| **1A1a** | $CO_2$ | **Gaseous Fuels** | 6 476,1 | 5,3% | 40,3% |
| **4D1** | $N_2O$ | | 5 426,7 | 4,5% | 44,8% |
| **1A3b** | $CO_2$ | **Gasoline** | 4 364,4 | 3,6% | 48,4% |
| **4B8** | $CH_4$ | | 3 906,8 | 3,2% | 51,6% |
| **4D3** | $N_2O$ | | 3 723,1 | 3,1% | 54,6% |
| **2C1** | $CO_2$ | | 3 481,4 | 2,9% | 57,5% |
| **1A4b** | $CO_2$ | **Solid Fuels** | 3 403,0 | 2,8% | 60,3% |
| **6A** | $CH_4$ | | 3 269,2 | 2,7% | 63,0% |
| **1A5a** | $CO_2$ | **Gaseous Fuels** | 3 253,6 | 2,7% | 65,6% |
| **1A2f** | $CO_2$ | **Liquid Fuels** | 3 122,9 | 2,6% | 68,2% |
| **1A5a** | $CO_2$ | **Liquid Fuels** | 2 781,7 | 2,3% | 70,5% |
| **1A2e** | $CO_2$ | **Liquid Fuels** | 2 731,9 | 2,2% | 72,7% |
| **1A3b** | $CO_2$ | **Diesel Oil** | 2 631,3 | 2,2% | 74,9% |
| **2A1** | $CO_2$ | | 2 406,4 | 2,0% | 76,8% |
| **4A1** | $CH_4$ | | 2 348,9 | 1,9% | 78,8% |
| **6B** | $CH_4$ | | 2 260,8 | 1,9% | 80,6% |
| **2B2** | $N_2O$ | | 2 009,8 | 1,6% | 82,3% |
| **1B1a** | $CH_4$ | **natural gas** | 1 858,4 | 1,5% | 83,8% |
| **1A1b** | $CO_2$ | **Liquid Fuels** | 1 838,2 | 1,5% | 85,3% |
| **2B1** | $CO_2$ | | 1 693,3 | 1,4% | 86,7% |
| **1A4c** | $CO_2$ | **Liquid Fuels** | 1 639,9 | 1,3% | 88,0% |
| **4B13** | $N_2O$ | | 1 620,8 | 1,3% | 89,4% |
| **4A3** | $CH_4$ | | 1 336,2 | 1,1% | 90,5% |
| **4D2** | $N_2O$ | | 1 168,4 | 1,0% | 91,4% |
| **1A2a** | $CO_2$ | **Solid Fuels** | 1 164,2 | 1,0% | 92,4% |
| **1A4b** | $CO_2$ | **Liquid Fuels** | 1 155,6 | 0,9% | 93,3% |
| **2A2** | $CO_2$ | | 1 103,3 | 0,9% | 94,2% |
| **1B2b** | $CH_4$ | | 1 097,0 | 0,9% | 95,1% |

Table 251 Key category Analysis T1: 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 | 18,5% | 18,5% |
| **5A1** | $CO_2$ | | 13 688,8 | 9,9% | 28,4% |
| **1A2f** | $CO_2$ | **Solid Fuels** | 9 069,4 | 6,6% | 35,0% |
| **1A1a** | $CO_2$ | **Liquid Fuels** | 8 155,6 | 5,9% | 40,9% |
| **1A1a** | $CO_2$ | **Gaseous Fuels** | 6 476,1 | 4,7% | 45,6% |
| **4D1** | $N_2O$ | | 5 426,7 | 3,9% | 49,6% |
| **1A3b** | $CO_2$ | **Gasoline** | 4 364,4 | 3,2% | 52,7% |
| **4B8** | $CH_4$ | | 3 906,8 | 2,8% | 55,6% |
| **4D3** | $N_2O$ | | 3 723,1 | 2,7% | 58,3% |
| **2C1** | $CO_2$ | | 3 481,4 | 2,5% | 60,8% |
| **1A4b** | $CO_2$ | **Solid Fuels** | 3 403,0 | 2,5% | 63,2% |
| **6A** | $CH_4$ | | 3 269,2 | 2,4% | 65,6% |
| **1A5a** | $CO_2$ | **Gaseous Fuels** | 3 253,6 | 2,4% | 68,0% |
| **1A2f** | $CO_2$ | **Liquid Fuels** | 3 122,9 | 2,3% | 70,2% |
| **1A5a** | $CO_2$ | **Liquid Fuels** | 2 781,7 | 2,0% | 72,3% |
| **1A2e** | $CO_2$ | **Liquid Fuels** | 2 731,9 | 2,0% | 74,2% |
| **1A3b** | $CO_2$ | **Diesel Oil** | 2 631,3 | 1,9% | 76,2% |
| **2A1** | $CO_2$ | | 2 406,4 | 1,7% | 77,9% |
| **4A1** | $CH_4$ | | 2 348,9 | 1,7% | 79,6% |
| **6B** | $CH_4$ | | 2 260,8 | 1,6% | 81,2% |
| **2B2** | $N_2O$ | | 2 009,8 | 1,5% | 82,7% |
| **1B1a** | $CH_4$ | **natural gas** | 1 858,4 | 1,3% | 84,0% |
| **1A1b** | $CO_2$ | **Liquid Fuels** | 1 838,2 | 1,3% | 85,4% |
| **2B1** | $CO_2$ | | 1 693,3 | 1,2% | 86,6% |
| **1A4c** | $CO_2$ | **Liquid Fuels** | 1 639,9 | 1,2% | 87,8% |
| **4B13** | $N_2O$ | | 1 620,8 | 1,2% | 89,0% |
| **4A3** | $CH_4$ | | 1 336,2 | 1,0% | 89,9% |
| **4D2** | $N_2O$ | | 1 168,4 | 0,8% | 90,8% |
| **1A2a** | $CO_2$ | **Solid Fuels** | 1 164,2 | 0,8% | 91,6% |
| **1A4b** | $CO_2$ | **Liquid Fuels** | 1 155,6 | 0,8% | 92,5% |
| **2A2** | $CO_2$ | | 1 103,3 | 0,8% | 93,3% |
| **1B2b** | $CH_4$ | | 1 097,0 | 0,8% | 94,1% |
| **1A2d** | $CO_2$ | **Liquid Fuels** | 873,2 | 0,6% | 94,7% |
| **3** | $CO_2$ | | 866,6 | 0,6% | 95,3% |

Table 252 Key category Analysis T1: Level Assessment excluding LULUCF 2011

| Source | Gas | Fuel/Cat. | GHG emission [Gg $CO_2$ eq] | % excl. | cumul. % |
|---|---|---|---|---|---|
| **1A1a** | $CO_2$ | **Solid Fuels** | 32 516,2 | 49,2% | 49,2% |
| **1A3b** | $CO_2$ | **Diesel Oil** | 4 664,5 | 7,1% | 56,2% |
| **6A** | $CH_4$ | | 2 899,7 | 4,4% | 60,6% |
| **1A1a** | $CO_2$ | **Gaseous Fuels** | 2 273,4 | 3,4% | 64,0% |
| **4D1** | $N_2O$ | | 2 057,8 | 3,1% | 67,2% |
| **1A3b** | $CO_2$ | **Gasoline** | 1 668,6 | 2,5% | 69,7% |
| **4D3** | $N_2O$ | | 1 206,3 | 1,8% | 71,5% |
| **1B1a** | $CH_4$ | **natural gas** | 1 069,3 | 1,6% | 73,1% |
| **2A2** | $CO_2$ | | 1 037,2 | 1,6% | 74,7% |
| **1A3b** | $CO_2$ | **Liquefied Petroleum Gases (LPG)** | 961,5 | 1,5% | 76,1% |
| **4A1** | $CH_4$ | | 961,3 | 1,5% | 77,6% |
| **1A4b** | $CO_2$ | **Solid Fuels** | 954,2 | 1,4% | 79,0% |
| **1A1b** | $CO_2$ | **Liquid Fuels** | 908,2 | 1,4% | 80,4% |
| **2A7** | $CO_2$ | | 804,9 | 1,2% | 81,6% |
| **2A1** | $CO_2$ | | 790,7 | 1,2% | 82,8% |
| **1A2f** | $CO_2$ | **Gaseous Fuels** | 774,2 | 1,2% | 84,0% |
| **1A2c** | $CO_2$ | **Gaseous Fuels** | 711,5 | 1,1% | 85,1% |
| **6B** | $CH_4$ | | 673,5 | 1,0% | 86,1% |
| **1B2b** | $CH_4$ | | 661,8 | 1,0% | 87,1% |
| **1A2f** | $CO_2$ | **Liquid Fuels** | 568,1 | 0,9% | 87,9% |
| **4B8** | $CH_4$ | | 559,1 | 0,8% | 88,8% |
| **4B13** | $N_2O$ | | 533,9 | 0,8% | 89,6% |
| **2B1** | $CO_2$ | | 526,4 | 0,8% | 90,4% |
| **1A3e** | $CO_2$ | **Gaseous Fuels** | 468,9 | 0,7% | 91,1% |
| **1A1a** | $CO_2$ | **Liquid Fuels** | 424,9 | 0,6% | 91,7% |
| **1A2f** | $CO_2$ | **Solid Fuels** | 413,9 | 0,6% | 92,4% |
| **1A4c** | $CO_2$ | **Liquid Fuels** | 411,8 | 0,6% | 93,0% |
| **HFCs** | $CO_2e$ | | 395,7 | 0,6% | 93,6% |
| **1A2c** | $CO_2$ | **Solid Fuels** | 370,6 | 0,6% | 94,2% |
| **4D2** | $N_2O$ | | 276,0 | 0,4% | 94,6% |
| **1A2e** | $CO_2$ | **Gaseous Fuels** | 256,3 | 0,4% | 95,0% |
| **2B2** | $N_2O$ | | 234,4 | 0,4% | 95,3% |

Table 253 Key category Analysis T1: Level Assessment including LULUCF 2011

| Source | Gas | Fuel/Cat. | GHG emission [Gg $CO_2$ eq] | % incl. | cumul. % |
|---|---|---|---|---|---|
| **1A1a** | $CO_2$ | **Solid Fuels** | 32 516,2 | 40,5% | 40,5% |
| **5A1** | $CO_2$ | | 9 622,0 | 12,0% | 52,5% |
| **1A3b** | $CO_2$ | **Diesel Oil** | 4 664,5 | 5,8% | 58,3% |
| **6A** | $CH_4$ | | 2 899,7 | 3,6% | 61,9% |
| **1A1a** | $CO_2$ | **Gaseous Fuels** | 2 273,4 | 2,8% | 64,7% |
| **4D1** | $N_2O$ | | 2 057,8 | 2,6% | 67,3% |
| **1A3b** | $CO_2$ | **Gasoline** | 1 668,6 | 2,1% | 69,4% |
| **5B1** | $CO_2$ | | 1 304,4 | 1,6% | 71,0% |
| **4D3** | $N_2O$ | | 1 206,3 | 1,5% | 72,5% |
| **1B1a** | $CH_4$ | **natural gas** | 1 069,3 | 1,3% | 73,8% |
| **2A2** | $CO_2$ | | 1 037,2 | 1,3% | 75,1% |
| **1A3b** | $CO_2$ | **Liquefied Petroleum Gases (LPG)** | 961,5 | 1,2% | 76,3% |
| **4A1** | $CH_4$ | | 961,3 | 1,2% | 77,5% |
| **1A4b** | $CO_2$ | **Solid Fuels** | 954,2 | 1,2% | 78,7% |
| **1A1b** | $CO_2$ | **Liquid Fuels** | 908,2 | 1,1% | 79,9% |
| **5B2** | $CO_2$ | | 855,4 | 1,1% | 80,9% |
| **2A7** | $CO_2$ | | 804,9 | 1,0% | 81,9% |
| **2A1** | $CO_2$ | | 790,7 | 1,0% | 82,9% |
| **5C2** | $CO_2$ | | 786,6 | 1,0% | 83,9% |
| **1A2f** | $CO_2$ | **Gaseous Fuels** | 774,2 | 1,0% | 84,8% |
| **1A2c** | $CO_2$ | **Gaseous Fuels** | 711,5 | 0,9% | 85,7% |
| **6B** | $CH_4$ | | 673,5 | 0,8% | 86,6% |
| **1B2b** | $CH_4$ | | 661,8 | 0,8% | 87,4% |
| **5A2** | $CO_2$ | | 654,9 | 0,8% | 88,2% |
| **1A2f** | $CO_2$ | **Liquid Fuels** | 568,1 | 0,7% | 88,9% |
| **4B8** | $CH_4$ | | 559,1 | 0,7% | 89,6% |
| **4B13** | $N_2O$ | | 533,9 | 0,7% | 90,3% |
| **2B1** | $CO_2$ | | 526,4 | 0,7% | 90,9% |
| **5E2** | $CO_2$ | | 523,2 | 0,7% | 91,6% |
| **1A3e** | $CO_2$ | **Gaseous Fuels** | 468,9 | 0,6% | 92,2% |
| **1A1a** | $CO_2$ | **Liquid Fuels** | 424,9 | 0,5% | 92,7% |
| **1A2f** | $CO_2$ | **Solid Fuels** | 413,9 | 0,5% | 93,2% |
| **1A4c** | $CO_2$ | **Liquid Fuels** | 411,8 | 0,5% | 93,7% |
| **HFCs** | $CO_2e$ | | 395,7 | 0,5% | 94,2% |
| **1A2c** | $CO_2$ | **Solid Fuels** | 370,6 | 0,5% | 94,7% |
| **4D2** | $N_2O$ | | 276,0 | 0,3% | 95,0% |

## 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 254 and Table 256 for 2011, while in

Table 255 Table 257 the results, including LULUCF categories, are shown.

Table 254 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 |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 4D3 | Indirect Emissions | $N_2O$ | 0,016 | 500,009 | 7,980 | 0,354 | 0,354 | 1 |
| 12 | 4D1 | Direct soil emissions | $N_2O$ | 0,017 | 250,018 | 4,348 | 0,193 | 0,546 | 2 |
| 27 | | All Others | | 0,047 | 59,619 | 2,803 | 0,124 | 0,670 | 3 |
| 10 | 6A | Solid Waste Disposal on Land | $CH_4$ | 0,022 | 85,440 | 1,886 | 0,084 | 0,754 | 4 |
| 1 | 1A1a | Solid fuel | $CO_2$ | 0,366 | 2,236 | 0,819 | 0,036 | 0,790 | 5 |
| 6 | 4B8 | Swine | $CH_4$ | 0,031 | 20,100 | 0,615 | 0,027 | 0,817 | 6 |
| 3 | 1A1a | Liquid fuel | $CO_2$ | 0,078 | 7,616 | 0,597 | 0,026 | 0,844 | 7 |
| 18 | 6B | Waste Water Handling | $CH_4$ | 0,011 | 42,426 | 0,446 | 0,020 | 0,864 | 8 |
| 5 | 2C1 | Iron and Steel Production | $CO_2$ | 0,036 | 11,180 | 0,399 | 0,018 | 0,881 | 9 |
| 26 | HFCs | ODS substitutes | $CO_2e$ | 0,008 | 50,990 | 0,394 | 0,017 | 0,899 | 10 |
| 4 | 1A3b | Diesel Oil | $CO_2$ | 0,063 | 5,831 | 0,370 | 0,016 | 0,915 | 11 |
| 22 | 3 | Solvent and other product use | $CO_2$ | 0,009 | 31,623 | 0,278 | 0,012 | 0,927 | 12 |
| 7 | 1A2e | Liquid fuel | $CO_2$ | 0,028 | 7,616 | 0,214 | 0,009 | 0,937 | 13 |
| 19 | 4A3 | Sheep | $CH_4$ | 0,010 | 20,100 | 0,208 | 0,009 | 0,946 | 14 |
| 2 | 1A2f | Solid fuel | $CO_2$ | 0,088 | 2,236 | 0,198 | 0,009 | 0,955 | 15 |
| 9 | 1A2f | Liquid fuel | $CO_2$ | 0,022 | 7,616 | 0,168 | 0,007 | 0,962 | 17 |
| 13 | 2B2 | Nitric Acid Production | $N_2O$ | 0,017 | 7,616 | 0,128 | 0,006 | 0,968 | 17 |
| 11 | 1A4b | Solid fuel | $CO_2$ | 0,017 | 5,385 | 0,094 | 0,004 | 0,972 | 18 |
| 17 | 1A4b | Liquid fuel | $CO_2$ | 0,011 | 8,602 | 0,094 | 0,004 | 0,976 | 19 |
| 21 | 1A4c | Liquid fuel | $CO_2$ | 0,009 | 8,602 | 0,081 | 0,004 | 0,980 | 20 |
| 15 | 1A3b | Gasoline | $CO_2$ | 0,014 | 5,831 | 0,080 | 0,004 | 0,983 | 21 |
| 20 | 2A1 | Ammonia Production | $CO_2$ | 0,010 | 7,826 | 0,079 | 0,004 | 0,987 | 22 |
| 23 | 1A2d | Liquid fuel | $CO_2$ | 0,009 | 7,616 | 0,066 | 0,003 | 0,990 | 23 |
| 25 | 2A7 | Other – DeSOx, Glass and Bricks | $CO_2$ | 0,008 | 8,026 | 0,064 | 0,003 | 0,993 | 24 |
| 27 | 2B1 | Ammonia Production | $CO_2$ | 0,008 | 7,826 | 0,060 | 0,003 | 0,995 | 25 |
| 8 | 1A1a | Gaseous fuel | $CO_2$ | 0,024 | 2,236 | 0,054 | 0,002 | 0,998 | 26 |
| 16 | 1A2a | Solid fuel | $CO_2$ | 0,012 | 2,236 | 0,026 | 0,001 | 0,999 | 27 |
| 24 | 2A2 | Lime Production | $CO_2$ | 0,009 | 2,828 | 0,024 | 0,001 | 1 | 28 |

Table 255 Key category Analysis T2: Trend assessment including LULUCF

| T1 | Source | Fuel/Cat. | GHG | Share | Uncertainty | T*U | Relevant trend assessment including LULUCF | Cumulative Percentage | T2 |
|---|---|---|---|---|---|---|---|---|---|
| 16 | 4D3 | Indirect Emissions | $N_2O$ | 0,014 | 500,009 | 7,146 | 0,185 | 0,185 | 1 |
| 5 | 5A1 | Forest Land remaining Forest Land | $CO_2$ | 0,037 | 149,451 | 5,515 | 0,143 | 0,328 | 2 |
| 10 | 5B1 | Cropland remainig Cropland | $CO_2$ | 0,021 | 184,043 | 3,887 | 0,101 | 0,429 | 3 |
| 14 | 4D1 | Direct soil emissions | $N_2O$ | 0,016 | 250,018 | 3,879 | 0,101 | 0,530 | 4 |
| 26 | 5B2 | Land converted to Cropland | $CO_2$ | 0,008 | 415,466 | 3,429 | 0,089 | 0,619 | 5 |
| 33 | 5C2 | Land converted to Grassland | $CO_2$ | 0,006 | 444,813 | 2,855 | 0,074 | 0,693 | 6 |
| 34 | | All Others | | 0,044 | 63,718 | 2,811 | 0,073 | 0,766 | 7 |
| 11 | 6A | Solid Waste Disposal on Land | $CH_4$ | 0,020 | 85,440 | 1,719 | 0,045 | 0,810 | 8 |
| 17 | 5A2 | Land converted to Forest Land | $CO_2$ | 0,014 | 122,520 | 1,657 | 0,043 | 0,853 | 9 |
| 1 | 1A1a | Solid fuel | $CO_2$ | 0,333 | 2,236 | 0,744 | 0,019 | 0,873 | 10 |
| 24 | 5E2 | Land converted to Settlements | $CO_2$ | 0,009 | 75,000 | 0,641 | 0,017 | 0,889 | 11 |
| 7 | 4B8 | Swine | $CH_4$ | 0,028 | 20,100 | 0,554 | 0,014 | 0,904 | 12 |
| 3 | 1A1a | Liquid fuel | $CO_2$ | 0,071 | 7,616 | 0,538 | 0,014 | 0,918 | 13 |
| 21 | 6B | Waste Water Handling | $CH_4$ | 0,009 | 42,426 | 0,400 | 0,010 | 0,928 | 14 |
| 6 | 2C1 | Iron and Steel Production | $CO_2$ | 0,032 | 11,180 | 0,360 | 0,009 | 0,937 | 15 |
| 31 | HFCs | ODS substitutes | $CO_2e$ | 0,007 | 50,990 | 0,357 | 0,009 | 0,947 | 17 |
| 4 | 1A3b | Diesel Oil | $CO_2$ | 0,058 | 5,831 | 0,336 | 0,009 | 0,955 | 17 |
| 27 | 3 | Solvent and other product use | $CO_2$ | 0,008 | 31,623 | 0,250 | 0,006 | 0,962 | 18 |
| 8 | 1A2e | Liquid fuel | $CO_2$ | 0,025 | 7,616 | 0,193 | 0,005 | 0,967 | 19 |
| 22 | 4A3 | Sheep | $CH_4$ | 0,009 | 20,100 | 0,187 | 0,005 | 0,972 | 20 |
| 2 | 1A2f | Solid fuel | $CO_2$ | 0,080 | 2,236 | 0,178 | 0,005 | 0,976 | 21 |
| 12 | 1A2f | Liquid fuel | $CO_2$ | 0,020 | 7,616 | 0,151 | 0,004 | 0,980 | 22 |
| 15 | 2B2 | Nitric Acid Production | $N_2O$ | 0,015 | 7,616 | 0,115 | 0,003 | 0,983 | 23 |
| 13 | 1A4b | Solid fuel | $CO_2$ | 0,016 | 5,385 | 0,085 | 0,002 | 0,985 | 24 |
| 20 | 1A4b | Liquid fuel | $CO_2$ | 0,010 | 8,602 | 0,084 | 0,002 | 0,988 | 25 |
| 25 | 1A4c | Liquid fuel | $CO_2$ | 0,008 | 8,602 | 0,072 | 0,002 | 0,989 | 26 |
| 18 | 1A3b | Gasoline | $CO_2$ | 0,012 | 5,831 | 0,071 | 0,002 | 0,991 | 27 |
| 23 | 2A1 | Ammonia Production | $CO_2$ | 0,009 | 7,826 | 0,071 | 0,002 | 0,993 | 28 |
| 29 | 1A2d | Liquid fuel | $CO_2$ | 0,008 | 7,616 | 0,060 | 0,002 | 0,995 | 29 |
| 30 | 2A7 | Other – DeSOx, Glass and Bricks | $CO_2$ | 0,007 | 8,026 | 0,058 | 0,002 | 0,996 | 30 |
| 32 | 2B1 | Ammonia Production | $CO_2$ | 0,007 | 7,826 | 0,054 | 0,001 | 0,998 | 31 |
| 9 | 1A1a | Gaseous fuel | $CO_2$ | 0,022 | 2,236 | 0,049 | 0,001 | 0,999 | 32 |
| 19 | 1A2a | Solid fuel | $CO_2$ | 0,010 | 2,236 | 0,023 | 0,001 | 0,999 | 33 |
| 28 | 2A2 | Lime Production | $CO_2$ | 0,008 | 2,828 | 0,022 | 0,001 | 1,000 | 34 |

Table 256 Key category Analysis T2: Level Assessment excluding LULUCF 2011

| T1 | Source | Fuel/Cat. | GHG | Share | Uncertainty | L*U | Level assessment excluding LULUCF | Cumulative Percentage | T2 |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 4D3 | Indirect Emissions | $N_2O$ | 0,018 | 500,009 | 9,118 | 0,272 | 0,272 | 1 |
| 5 | 4D1 | Direct soil emissions | $N_2O$ | 0,031 | 250,018 | 7,778 | 0,232 | 0,504 | 2 |
| 33 | | All Others | | 0,047 | 91,748 | 4,319 | 0,129 | 0,633 | 3 |
| 3 | 6A | Solid Waste Disposal on Land | $CH_4$ | 0,044 | 85,440 | 3,745 | 0,112 | 0,745 | 4 |
| 22 | 4B13 | N2O em. from Manure Management | $N_2O$ | 0,008 | 300,007 | 2,422 | 0,072 | 0,817 | 5 |
| 1 | 1A1a | Solid fuel | $CO_2$ | 0,492 | 2,236 | 1,099 | 0,033 | 0,850 | 6 |
| 30 | 4D2 | Pasture, Range and Paddock Manure | $N_2O$ | 0,004 | 250,018 | 1,043 | 0,031 | 0,881 | 7 |
| 8 | 1B1a | Oil and Natural Gas | $CH_4$ | 0,016 | 50,249 | 0,812 | 0,024 | 0,906 | 8 |
| 19 | 1B2b | Oil and Natural Gas | $CH_4$ | 0,010 | 50,249 | 0,503 | 0,015 | 0,921 | 9 |
| 18 | 6B | Waste Water Handling | $CH_4$ | 0,010 | 42,426 | 0,432 | 0,013 | 0,934 | 10 |
| 2 | 1A3b | Diesel Oil | $CO_2$ | 0,071 | 5,831 | 0,411 | 0,012 | 0,946 | 11 |
| 28 | HFCs | ODS substitutes | $CO_2e$ | 0,006 | 50,990 | 0,305 | 0,009 | 0,955 | 12 |
| 11 | 4A1 | Cattle | $CH_4$ | 0,015 | 20,100 | 0,292 | 0,009 | 0,964 | 13 |
| 21 | 4B8 | Swine | $CH_4$ | 0,008 | 20,100 | 0,170 | 0,005 | 0,969 | 14 |
| 6 | 1A3b | Gasoline | $CO_2$ | 0,025 | 5,831 | 0,147 | 0,004 | 0,973 | 15 |
| 13 | 1A1b | Liquid fuel | $CO_2$ | 0,014 | 7,616 | 0,105 | 0,003 | 0,976 | 17 |
| 14 | 2A7 | Other – DeSOx, Glass and Bricks | $CO_2$ | 0,012 | 8,026 | 0,098 | 0,003 | 0,979 | 17 |
| 10 | 1A3b | LPG | $CO_2$ | 0,015 | 5,831 | 0,085 | 0,003 | 0,982 | 18 |
| 12 | 1A4b | Solid fuel | $CO_2$ | 0,014 | 5,385 | 0,078 | 0,002 | 0,984 | 19 |
| 4 | 1A1a | Gaseous fuel | $CO_2$ | 0,034 | 2,236 | 0,077 | 0,002 | 0,986 | 20 |
| 20 | 1A2f | Liquid fuel | $CO_2$ | 0,009 | 7,616 | 0,065 | 0,002 | 0,988 | 21 |
| 23 | 2B1 | Ammonia Production | $CO_2$ | 0,008 | 7,826 | 0,062 | 0,002 | 0,990 | 22 |
| 27 | 1A4c | Liquid fuel | $CO_2$ | 0,006 | 8,602 | 0,054 | 0,002 | 0,992 | 23 |
| 25 | 1A1a | Liquid fuel | $CO_2$ | 0,006 | 7,616 | 0,049 | 0,001 | 0,993 | 24 |
| 9 | 2A2 | Lime Production | $CO_2$ | 0,016 | 2,828 | 0,044 | 0,001 | 0,995 | 25 |
| 24 | 1A3e | Gaseous fuel | $CO_2$ | 0,007 | 5,099 | 0,036 | 0,001 | 0,996 | 26 |
| 15 | 2A1 | Cement Production | $CO_2$ | 0,012 | 2,828 | 0,034 | 0,001 | 0,997 | 27 |
| 32 | 2B2 | Nitric Acid Production | $N_2O$ | 0,004 | 7,616 | 0,027 | 0,001 | 0,997 | 28 |
| 16 | 1A2f | Gaseous fuel | $CO_2$ | 0,012 | 2,236 | 0,026 | 0,001 | 0,998 | 29 |
| 17 | 1A2c | Gaseous fuel | $CO_2$ | 0,011 | 2,236 | 0,024 | 0,001 | 0,999 | 30 |
| 26 | 1A2f | Solid fuel | $CO_2$ | 0,006 | 2,236 | 0,014 | 0,000 | 0,999 | 31 |
| 29 | 1A2c | Solid fuel | $CO_2$ | 0,006 | 2,236 | 0,013 | 0,000 | 1,000 | 32 |
| 31 | 1A2e | Gaseous fuel | $CO_2$ | 0,004 | 2,236 | 0,009 | 0,000 | 1 | 33 |

Table 257 Key category Analysis T2: Level Assessment including LULUCF 2011

| T1 | Source | Fuel/Cat. | GHG | Share | Uncertainty | L*U | Level assessment including LULUCF | Cumulative Percentage | T2 |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 5A1 | Forest Land remaining Forest Land | $CO_2$ | 0,119 | 149,451 | 17,761 | 0,292 | 0,292 | 1 |
| 9 | 4D3 | Indirect Emissions | $N_2O$ | 0,015 | 500,009 | 7,450 | 0,123 | 0,415 | 2 |
| 6 | 4D1 | Direct soil emissions | $N_2O$ | 0,025 | 250,018 | 6,355 | 0,105 | 0,520 | 3 |
| 13 | 5B2 | Land converted to Cropland | $CO_2$ | 0,012 | 415,466 | 5,191 | 0,085 | 0,605 | 4 |
| 37 | | All Others | | 0,049 | 89,326 | 4,420 | 0,073 | 0,678 | 5 |
| 20 | 5C2 | Land converted to Grassland | $CO_2$ | 0,010 | 444,813 | 4,322 | 0,071 | 0,749 | 6 |
| 4 | 6A | Solid Waste Disposal on Land | CH4 | 0,036 | 85,440 | 3,060 | 0,050 | 0,799 | 7 |
| 8 | 5B1 | Cropland remainig Cropland | $CO_2$ | 0,016 | 184,043 | 2,910 | 0,048 | 0,847 | 8 |
| 27 | 4B13 | N2O em. from Manure Management | $N_2O$ | 0,007 | 300,007 | 1,979 | 0,033 | 0,880 | 9 |
| 10 | 5A2 | Land converted to Forest Land | $CO_2$ | 0,015 | 122,520 | 1,803 | 0,030 | 0,910 | 10 |
| 1 | 1A1a | Solid fuel | $CO_2$ | 0,402 | 2,236 | 0,898 | 0,015 | 0,924 | 11 |
| 36 | 4D2 | Pasture, Range and Paddock Manure | $N_2O$ | 0,003 | 250,018 | 0,852 | 0,014 | 0,938 | 12 |
| 11 | 1B1a | Oil and Natural Gas | $CH_4$ | 0,013 | 50,249 | 0,664 | 0,011 | 0,949 | 13 |
| 29 | 5E2 | Land converted to Settlements | $CO_2$ | 0,006 | 75,000 | 0,482 | 0,008 | 0,957 | 14 |
| 24 | 1B2b | Oil and Natural Gas | $CH_4$ | 0,008 | 50,249 | 0,411 | 0,007 | 0,964 | 15 |
| 23 | 6B | Waste Water Handling | $CH_4$ | 0,008 | 42,426 | 0,353 | 0,006 | 0,970 | 17 |
| 3 | 1A3b | Diesel Oil | $CO_2$ | 0,058 | 5,831 | 0,336 | 0,006 | 0,975 | 17 |
| 34 | HFCs | ODS substitutes | $CO_2e$ | 0,005 | 50,990 | 0,249 | 0,004 | 0,979 | 18 |
| 15 | 4A1 | Cattle | $CH_4$ | 0,012 | 20,100 | 0,239 | 0,004 | 0,983 | 19 |
| 26 | 4B8 | Swine | $CH_4$ | 0,007 | 20,100 | 0,139 | 0,002 | 0,986 | 20 |
| 7 | 1A3b | Gasoline | $CO_2$ | 0,021 | 5,831 | 0,120 | 0,002 | 0,988 | 21 |
| 17 | 1A1b | Liquid fuel | $CO_2$ | 0,011 | 7,616 | 0,085 | 0,001 | 0,989 | 22 |
| 18 | 2A7 | Other | $CO_2$ | 0,010 | 8,026 | 0,080 | 0,001 | 0,990 | 23 |
| 19 | 2A1 | Ammonia Production | $CO_2$ | 0,010 | 7,826 | 0,076 | 0,001 | 0,992 | 24 |
| 14 | 1A3b | Gasoline | $CO_2$ | 0,012 | 5,831 | 0,069 | 0,001 | 0,993 | 25 |
| 16 | 1A4b | Solid fuel | $CO_2$ | 0,012 | 5,385 | 0,063 | 0,001 | 0,994 | 26 |
| 5 | 1A1a | Gaseous fuel | $CO_2$ | 0,028 | 2,236 | 0,063 | 0,001 | 0,995 | 27 |
| 25 | 1A2f | Liquid fuel | $CO_2$ | 0,007 | 7,616 | 0,053 | 0,001 | 0,996 | 28 |
| 28 | 2B1 | Ammonia Production | $CO_2$ | 0,007 | 7,826 | 0,051 | 0,001 | 0,997 | 29 |
| 33 | 1A4c | Liquid fuel | $CO_2$ | 0,005 | 8,602 | 0,044 | 0,001 | 0,997 | 30 |
| 31 | 1A1a | Liquid fuel | $CO_2$ | 0,005 | 7,616 | 0,040 | 0,001 | 0,998 | 31 |
| 12 | 2A2 | Lime Production | $CO_2$ | 0,013 | 2,828 | 0,036 | 0,001 | 0,998 | 32 |
| 30 | 1A3e | Gaseous fuel | $CO_2$ | 0,006 | 5,099 | 0,030 | 0,0005 | 0,999 | 33 |
| 21 | 1A2f | Gaseous fuel | $CO_2$ | 0,010 | 2,236 | 0,021 | 0,0004 | 0,999 | 34 |

| T1 | Source | Fuel/Cat. | GHG | Share | Uncertainty | L*U | Level assessment including LULUCF | Cumulative Percentage | T2 |
|---|---|---|---|---|---|---|---|---|---|
| 22 | 1A2c | Gaseous fuel | CO2 | 0,009 | 2,236 | 0,020 | 0,0003 | 1,000 | 35 |
| 32 | 1A2f | Solid fuel | CO2 | 0,005 | 2,236 | 0,011 | 0,0002 | 1,000 | 36 |
| 35 | 1A2c | Gaseous fuel | CO2 | 0,005 | 2,236 | 0,010 | 0,0002 | 1,000 | 37 |

# ANNEX 2 DETAILED DISCUSSION OF METHODOLOGY AND DATA FOR ESTIMATING $CO_2$ EMISSIONS FROM FOSSIL FUEL COMBUSTION

**Correspondence between the Eurostat format energy balances and the CRF categories.**

The following sector allocation was applied in the calculation model.

| Eurostat Category | CRF Category |
|---|---|
| Indigenous Production | |
| Underground Production | |
| Surface Production | |
| From Other Sources | |
| From Other Sources - Oil | |
| From Other Sources - Natural Gas | |
| From Other Sources - Renewables | |
| Total Imports (Balance) | |
| Total Exports (Balance) | |
| International Marine Bunkers | |
| Stock Changes (National Territory) | |
| Inland Consumption (Calculated) | |
| Statistical Differences | |
| **Transformation Sector** | |
| Main Activity Producer Electricity Plants | 1A1a |
| Main Activity Producer CHP Plants | 1A1a |
| Main Activity Producer Heat Plants | 1A1a |
| Autoproducer Electricity Plants | 1A2f |
| Autoproducer CHP Plants | 1A2f |
| Autoproducer Heat Plants | 1A2f |
| Patent Fuel Plants (Transformation) | |
| Coke Ovens (Transformation) | |
| BKB Plants (Transformation) | |
| Gas Works (Transformation) | |
| Blast Furnaces (Transformation) | |
| Coal Liquefaction Plants (Transformation) | |
| For Blended Natural Gas | |
| Non-specified (Transformation) | |
| **Energy Sector** | |
| Own Use in Electricity, CHP and Heat Plants | 1A1a |
| Coal Mines | 1A1c |
| Patent Fuel Plants (Energy) | 1A1c |
| Coke Ovens (Energy) | 1A1c |

| Eurostat Category | CRF Category |
|---|---|
| BKB Plants (Energy) | 1A1c |
| Gas Works (Energy) | |
| Blast Furnaces (Energy) | 1A2a |
| Petroleum Refineries | 1A1b |
| Coal Liquefaction Plants (Energy) | |
| Non-specified (Energy) | 1A1c |
| Distribution Losses | |
| Total Final Consumption | |
| Total Non-Energy Use | |
| Non-Energy Use Industry/Transformation/Energy | |
| Of which: Non-Energy Use-Chemical/Petrochem | |
| Non-Energy Use in Transport | |
| Non-Energy Use in Other Sectors | |
| Final Energy Consumption | |
| **Industry Sector** | |
| Iron and Steel | 1A2a |
| Chemical (including Petrochemical) | 1A2c |
| Non-Ferrous Metals | 1A2b |
| Non-Metallic Minerals | 1A2f |
| Transport Equipment | 1A2f |
| Machinery | 1A2f |
| Mining and Quarrying | 1A2f |
| Food, Beverages and Tobacco | 1A2e |
| Paper, Pulp and Printing | 1A2d |
| Wood and Wood Products | 1A2f |
| Construction | 1A2f |
| Textiles and Leather | 1A2f |
| Non-specified (Industry) | 1A2f |
| **Transport Sector** | |
| Rail | 1A3c |
| Domestic Navigation | 1A3d |
| Non-specified (Transport) | 1A3e |
| **Other Sectors** | |
| Commercial and Public Services | 1A4a |
| Residential | 1A4b |
| Agriculture/Forestry | 1A4c |
| Fishing | 1A4c |
| Non-specified (Other) | 1A5a |

For the sectoral approach were considered all fuels for which there was reported energy consumption.

| **Solid fuels:** | **Liquid fuels:** |
|---|---|
| Anthracite | Crude Oil |
| Coking Coal | Refinery Gas |

| | |
|---|---|
| Other Bituminous Coal<br>Sub-bituminous Coal<br>Lignite/Brown Coal<br>Coke Oven Coke<br>Coal Tar<br>BKB/PB<br>Coke Oven Gas<br>Blast Furnace Gas | LPG<br>Motor Gasoline<br>Aviation Gasoline<br>Kerosene Type Jet Fuel<br>Gas-Diesel Oil<br>Residual Fuel Oil<br>Petroleum Coke<br>Other Products |
| **Gaseous fuels:**<br>Natural Gas | |

In order to avoid double counting in the Energy sector, the following categories were not considered:

- Lignite/Brown coal used in BKB Plants (Transformation). The quantities which were considered instead are BKBs in all sectors.
- Coking coal used in Coke Ovens (Transformation). The quantities which were considered instead are:
  - Coke oven coke used in Blast Furnaces (Transformation) and Iron and Steel industry sector
  - Coke oven gas used in Autoproducer CHP Plants, Blast Furnaces (Energy) and Iron and Steel industry sector.
- Blast Furnace Gas used in Autoproducer CHP Plants, Blast Furnaces (Energy) and Iron and Steel industry sector. The quantities which were considered instead are Coke oven coke used in Blast Furnaces (Transformation) and Iron and Steel industry sector.

In addition, following the recommendation of the Technical review of GHG inventories under the EU Effort Sharing Decision (ESD) in 2012, we revised the methodology concerning Iron & Steel sector in order to remove the double counting with the IP sector. The following quantities were disregarded from the Energy sector:

- Coke Oven Gas reported under blast furnaces;
- Blast Furnace Gas reported under blast furnaces, Autoproducers and Iron & Steel subcategories;
- Coke oven coke in blast furnaces.

The NCVs which were provided in the energy balances were applied to the appropriate sectors, according to the following allocation:

| Eurostat Category | NCVs |
|---|---|
| Indigenous Production | |
| Underground Production | |
| Surface Production | |
| From Other Sources | |
| From Other Sources - Oil | |
| From Other Sources - Natural Gas | |
| From Other Sources - Renewables | |

| Eurostat Category | NCVs |
|---|---|
| Total Imports (Balance) | |
| Total Exports (Balance) | |
| International Marine Bunkers | |
| Stock Changes (National Territory) | |
| Inland Consumption (Calculated) | |
| Statistical Differences | |
| **Transformation Sector** | |
| Main Activity Producer Electricity Plants | Used in Main Activity Plants (net) |
| Main Activity Producer CHP Plants | Used in Main Activity Plants (net) |
| Main Activity Producer Heat Plants | Used in Main Activity Plants (net) |
| Autoproducer Electricity Plants | Used in industry (net) |
| Autoproducer CHP Plants | Used in industry (net) |
| Autoproducer Heat Plants | Used in industry (net) |
| Patent Fuel Plants (Transformation) | |
| Coke Ovens (Transformation) | |
| BKB Plants (Transformation) | |
| Gas Works (Transformation) | |
| Blast Furnaces (Transformation) | Used in blast furnaces (net) |
| Coal Liquefaction Plants (Transformation) | |
| For Blended Natural Gas | |
| Non-specified (Transformation) | |
| **Energy Sector** | |
| Own Use in Electricity, CHP and Heat Plants | Used in Main Activity Plants (net) |
| Coal Mines | Production (net) |
| Patent Fuel Plants (Energy) | Used in industry (net) |
| Coke Ovens (Energy) | Used in coke ovens (net) |
| BKB Plants (Energy) | Used in industry (net) |
| Gas Works (Energy) | |
| Blast Furnaces (Energy) | Used in blast furnaces (net) |
| Petroleum Refineries | |
| Coal Liquefaction Plants (Energy) | |
| Non-specified (Energy) | |
| Distribution Losses | |
| Total Final Consumption | |
| Total Non-Energy Use | |

| Eurostat Category | NCVs |
|---|---|
| Non-Energy Use Industry/Transformation/Energy | |
| Of which: Non-Energy Use-Chemical/Petrochem | |
| Non-Energy Use in Transport | |
| Non-Energy Use in Other Sectors | |
| Final Energy Consumption | |
| **Industry Sector** | |
| Iron and Steel | Used in industry (net) |
| Chemical (including Petrochemical) | Used in industry (net) |
| Non-Ferrous Metals | Used in industry (net) |
| Non-Metallic Minerals | Used in industry (net) |
| Transport Equipment | Used in industry (net) |
| Machinery | Used in industry (net) |
| Mining and Quarrying | Used in industry (net) |
| Food, Beverages and Tobacco | Used in industry (net) |
| Paper, Pulp and Printing | Used in industry (net) |
| Wood and Wood Products | Used in industry (net) |
| Construction | Used in industry (net) |
| Textiles and Leather | Used in industry (net) |
| Non-specified (Industry) | Used in industry (net) |
| **Transport Sector** | |
| Rail | |
| Domestic Navigation | |
| Non-specified (Transport) | |
| **Other Sectors** | |
| Commercial and Public Services | For Other Uses (net) |
| Residential | For Other Uses (net) |
| Agriculture/Forestry | For Other Uses (net) |
| Fishing | For Other Uses (net) |
| Non-specified (Other) | For Other Uses (net) |

# ANNEX 3 $CO_2$ REFERENCE APPROACH AND COMPARISON WITH SECTORAL APPROACH, AND RELEVANT INFORMATION ON THE NATIONAL ENERGY BALANCE

For the reference approach both fuels were considered for which there was reported energy and non-energy consumption.

| Solid fuels: | Liquid fuels: |
|---|---|
| Anthracite<br>Coking Coal<br>Other Bituminous Coal<br>Sub-bituminous Coal<br>Lignite/Brown Coal<br>Coke Oven Coke<br>Coal Tar<br>BKB/PB<br>Coke Oven Gas<br>Blast Furnace Gas<br><br>**Gaseous fuels:**<br>Natural Gas | Crude Oil<br>Refinery Gas<br>LPG<br>Motor Gasoline<br>Aviation Gasoline<br>Kerosene Type Jet Fuel<br>Gas-Diesel Oil<br>Residual Fuel Oil<br>Petroleum Coke<br>Other Products<br>Naphtha<br>White spirit<br>Lubricants<br>Bitumen<br>Paraffin waxes<br>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 258 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 | - | 18.367 |
| **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** | - | 32.658 | 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 | - | 25.527 | - | 6.987 | 28.500 | - | 12.568 |
| **2009** | 25.200 | - | 25.756 | - | 7.006 | 28.500 | - | 12.212 |
| **2010** | 24.812 | - | 26.171 | - | 7.004 | 28.500 | - | 12.768 |
| **2011** | 24.349 | | 26.712 | | 6.973 | 28.500 | | 13.064 |

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.

For the uncertainties of the national total emissions estimated by Tier 2 analysis (the Monte Carlo approach), that have been made in Submission 2012, Bulgaria decided to perform the Monte Carlo analysis every two-years instead of every year. The next Tier 2 analysis will be provided in submission 2014.

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 Tier 1 approach allows considering co-variance between years for one source category, but does not cover co-variances between source categories.

Table 259 Tier 1 Uncertainty Calculation and Reporting (level assessment), Gg $CO_2$-eq.(excluding LULUCF)

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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 | 8,4 | 3 | 50 | 50,09 | 0,006 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| 1A1 | | $N_2O$ | 134,1 | 140,5 | 3 | 200 | 200,02 | 0,425 | 0,001 | 0,001 | 0,111 | 0,005 | 0,111 |
| 1A1 | Gaseous fuel | $CO_2$ | 6476,1 | 2360,0 | 1 | 2 | 2,24 | 0,080 | -0,009 | 0,019 | -0,019 | 0,027 | 0,033 |
| 1A1 | Liquid fuel | $CO_2$ | 9993,9 | 1333,1 | 3 | 7 | 7,62 | 0,154 | -0,033 | 0,011 | -0,234 | 0,046 | 0,239 |
| 1A1 | Solid fuel | $CO_2$ | 25497,3 | 32518,1 | 1 | 2 | 2,24 | 1,101 | 0,153 | 0,267 | 0,306 | 0,377 | 0,486 |
| 1A2 | Gaseous fuel | $CO_2$ | 0,0 | 2021,0 | 1 | 2 | 2,24 | 0,068 | 0,017 | 0,017 | 0,033 | 0,023 | 0,041 |
| 1A2 | Liquid fuel | $CO_2$ | 7243,4 | 757,2 | 3 | 7 | 7,62 | 0,087 | -0,026 | 0,006 | -0,182 | 0,026 | 0,184 |
| 1A2 | Solid fuel | $CO_2$ | 10233,6 | 834,8 | 1 | 2 | 2,24 | 0,028 | -0,039 | 0,007 | -0,077 | 0,010 | 0,078 |
| 1A2 | | $CH_4$ | 25,5 | 11,7 | 3 | 50 | 50,09 | 0,009 | 0,000 | 0,000 | -0,001 | 0,000 | 0,001 |
| 1A2 | | $N_2O$ | 60,4 | 17,4 | 3 | 200 | 200,02 | 0,053 | 0,000 | 0,000 | -0,025 | 0,001 | 0,025 |
| 1A3a | Liquid fuel | $CO_2$ | 208,9 | 64,8 | 5 | 5 | 7,07 | 0,007 | 0,000 | 0,001 | -0,002 | 0,004 | 0,004 |
| 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 | $N_2O$ | 1,8 | 0,6 | 5 | 40 | 40,31 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| 1A3b | Diesel Oil | $CO_2$ | 2631,3 | 4664,5 | 3 | 5 | 5,83 | 0,412 | 0,027 | 0,038 | 0,133 | 0,162 | 0,210 |
| 1A3b | Gasoline | $CO_2$ | 4364,4 | 1668,6 | 3 | 5 | 5,83 | 0,147 | -0,006 | 0,014 | -0,029 | 0,058 | 0,065 |
| 1A3b | | $CH_4$ | 84,5 | 12,5 | 3 | 40 | 40,11 | 0,008 | 0,000 | 0,000 | -0,011 | 0,000 | 0,011 |
| 1A3b | | $N_2O$ | 89,3 | 71,3 | 3 | 40 | 40,11 | 0,043 | 0,000 | 0,001 | 0,008 | 0,002 | 0,008 |
| 1A3b | LPG | $CO_2$ | 0,0 | 961,5 | 3 | 5 | 5,83 | 0,085 | 0,008 | 0,008 | 0,039 | 0,033 | 0,052 |
| 1A3b | Gaseous fuel | $CO_2$ | 0,0 | 143,0 | 3 | 5 | 5,83 | 0,013 | 0,001 | 0,001 | 0,006 | 0,005 | 0,008 |

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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 | $CO_2$ | 0,0 | 55,5822 | 5 | 5 | 7,07 | 0,006 | 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 | | 0,0 | 0,0 | 5 | 60 | 60,21 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| 1A3e | Gaseous fuel | | 0,0 | 468,9 | 1 | 5 | 5,10 | 0,036 | 0,004 | 0,004 | 0,019 | 0,005 | 0,020 |
| 1A3e | Gaseous fuel | | 0,0 | 0,0 | 1 | 50 | 50,01 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| 1A3e | Gaseous fuel | | 0,0 | 0,0 | 1 | 150 | 150,00 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| 1A4 | | | 283,7 | 267,1 | 5 | 50 | 50,25 | 0,203 | 0,001 | 0,002 | 0,047 | 0,015 | 0,049 |
| 1A4 | | | 31,6 | 45,5 | 5 | 200 | 200,06 | 0,138 | 0,000 | 0,000 | 0,047 | 0,003 | 0,047 |
| 1A4 | Gaseous fuel | | 0,0 | 387,8 | 5 | 2 | 5,39 | 0,032 | 0,003 | 0,003 | 0,006 | 0,022 | 0,023 |
| 1A4 | Liquid fuel | | 2795,5 | 590,7 | 5 | 7 | 8,60 | 0,077 | -0,008 | 0,005 | -0,053 | 0,034 | 0,063 |
| 1A4 | Solid fuel | | 3403,0 | 992,7 | 2 | 5 | 5,39 | 0,081 | -0,007 | 0,008 | -0,035 | 0,023 | 0,042 |
| 1A5 | Stationary | | 6497,6 | 0,0 | 5 | 7 | 8,60 | 0,000 | -0,029 | 0,000 | -0,202 | 0,000 | 0,202 |
| 1B1 | Solid Fuels | | 1859,8 | 1069,3 | 10 | 200 | 200,25 | 3,242 | 0,001 | 0,009 | 0,101 | 0,124 | 0,160 |
| 1B2 | Oil and Natural Gas | | 1125,0 | 672,4 | 5 | 50 | 50,25 | 0,512 | 0,001 | 0,006 | 0,026 | 0,039 | 0,047 |
| 2A1 | Cement Production | | 2406,4 | 790,7 | 2 | 2 | 2,83 | 0,034 | -0,004 | 0,006 | -0,008 | 0,018 | 0,020 |
| 2A2 | Lime Production | | 1103,3 | 1037,2 | 2 | 2 | 2,83 | 0,044 | 0,004 | 0,009 | 0,007 | 0,024 | 0,025 |
| 2A3 | Limestone and Dolomite Use | | 0,0 | 0,0 | 5 | 15 | 15,81 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| 2A4 | Soda Ash | | 126,6 | 87,9 | 2 | 3 | 3,61 | 0,005 | 0,000 | 0,001 | 0,000 | 0,002 | 0,002 |
| 2A7 | Other - Glass | | 186,2 | 70,3 | 6 | 60 | 60,30 | 0,064 | 0,000 | 0,001 | -0,015 | 0,005 | 0,016 |
| 2A7 | Other Bricks | | 551,2 | 26,4 | 3 | 5 | 5,83 | 0,002 | -0,002 | 0,000 | -0,011 | 0,001 | 0,011 |

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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. | | % | % | % | % | % | % | % | % | % |
| 2A7 | Other - DeSOx | | 0,0 | 708,2 | 1,5 | 2,5 | 2,92 | 0,031 | 0,006 | 0,006 | 0,015 | 0,012 | 0,019 |
| 2B1 | Ammonia Production | | 1693,3 | 526,4 | 3,5 | 7 | 7,83 | 0,062 | -0,003 | 0,004 | -0,022 | 0,021 | 0,031 |
| 2B2 | Nitric Acid Production | | 2009,8 | 234,4 | 3 | 7 | 7,62 | 0,027 | -0,007 | 0,002 | -0,049 | 0,008 | 0,050 |
| 2B4.2 | Calcium Carbide | | 89,3 | 17,2 | 5 | 10 | 11,18 | 0,003 | 0,000 | 0,000 | -0,003 | 0,001 | 0,003 |
| 2B5 | Other (please specify) | $CH_4$ | 9,1 | 0,0 | 5 | 50 | 50,25 | 0,000 | 0,000 | 0,000 | -0,002 | 0,000 | 0,002 |
| 2C | Metal Production | $CH_4$ | 73,3 | 0,0 | 10 | 25 | 26,93 | 0,000 | 0,000 | 0,000 | -0,008 | 0,000 | 0,008 |
| 2C1 | Iron and Steel Production | $CO_2$ | 3481,4 | 68,0 | 5 | 10 | 11,18 | 0,012 | -0,015 | 0,001 | -0,149 | 0,004 | 0,149 |
| 2C2 | Ferroalloys Production | $CO_2$ | 218,8 | 0,5 | 5 | 25 | 25,50 | 0,000 | -0,001 | 0,000 | -0,024 | 0,000 | 0,024 |
| 2F | ODS substitutes | HFCs | 0,0 | 395,7 | 10 | 50 | 50,99 | 0,306 | 0,003 | 0,003 | 0,162 | 0,046 | 0,169 |
| 2F8 | Electrical Equipment | $SF_6$ | 3,5 | 14,9 | 10 | 50 | 50,99 | 0,011 | 0,000 | 0,000 | 0,005 | 0,002 | 0,006 |
| 2G | Other | $CH_4$ | 7,6 | 0,0 | 10 | 50 | 50,99 | 0,000 | 0,000 | 0,000 | -0,002 | 0,000 | 0,002 |
| 3 | Solvent and other product use | $CO_2$ | 866,61 | 22,28 | 10 | 30 | 31,62 | 0,011 | -0,004 | 0,000 | -0,110 | 0,003 | 0,110 |
| 3 | Solvent and other product use | $N_2O$ | 33,2 | 19,0 | 10 | 100 | 100,50 | 0,029 | 0,000 | 0,000 | 0,001 | 0,002 | 0,002 |
| 4A1 | Cattle | $CH_4$ | 2348,9 | 961,3 | 2 | 20 | 20,10 | 0,293 | -0,003 | 0,008 | -0,051 | 0,022 | 0,056 |
| 4A.2 | Buffalo | $CH_4$ | 29,2 | 11,0 | 2 | 50 | 50,04 | 0,008 | 0,000 | 0,000 | -0,002 | 0,000 | 0,002 |
| 4A.3 | Sheep | $CH_4$ | 1336,2 | 197,2 | 2 | 20 | 20,10 | 0,060 | -0,004 | 0,002 | -0,086 | 0,005 | 0,087 |
| 4A.4 | Goats | $CH_4$ | 45,7 | 36,6 | 2 | 50 | 50,04 | 0,028 | 0,000 | 0,000 | 0,005 | 0,001 | 0,005 |
| 4A.6 | Horses | $CH_4$ | 46,2 | 54,4 | 2 | 50 | 50,04 | 0,041 | 0,000 | 0,000 | 0,012 | 0,001 | 0,012 |
| 4A.7 | Mules and Asses | $CH_4$ | 74,6 | 28,9 | 2 | 50 | 50,04 | 0,022 | 0,000 | 0,000 | -0,005 | 0,001 | 0,005 |
| 4A.8 | Swine | $CH_4$ | 127,3 | 20,0 | 2 | 50 | 50,04 | 0,015 | 0,000 | 0,000 | -0,020 | 0,000 | 0,020 |

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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 | $N_2O$ em. from Manure Management | $N_2O$ | 1637,4 | 536,3 | 2 | 300 | 300,01 | 2,436 | -0,003 | 0,004 | -0,863 | 0,012 | 0,863 |
| 4B1 | Cattle | $CH_4$ | 62,1 | 26,4 | 2 | 20 | 20,10 | 0,008 | 0,000 | 0,000 | -0,001 | 0,001 | 0,001 |
| 4B.2 | Buffalo | $CH_4$ | 4,8 | 1,8 | 2 | 50 | 50,04 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| 4B.3 | Sheep | $CH_4$ | 23,9 | 3,5 | 2 | 50 | 50,04 | 0,003 | 0,000 | 0,000 | -0,004 | 0,000 | 0,004 |
| 4B.4 | Goats | $CH_4$ | 1,6 | 1,3 | 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 | 3,3 | 2 | 50 | 50,04 | 0,002 | 0,000 | 0,000 | -0,001 | 0,000 | 0,001 |
| 4B.8 | Swine | $CH_4$ | 3906,8 | 559,1 | 2 | 20 | 20,10 | 0,170 | -0,013 | 0,005 | -0,255 | 0,013 | 0,256 |
| 4B.9 | Poultry | $CH_4$ | 66,7 | 25,1 | 2 | 50 | 50,04 | 0,019 | 0,000 | 0,000 | -0,005 | 0,001 | 0,005 |
| 4C | Rice Cultivation | $CH_4$ | 114,2 | 99,4 | 25 | 80 | 83,82 | 0,126 | 0,000 | 0,001 | 0,025 | 0,029 | 0,038 |
| 4D1 | Direct soil emissions | $N_2O$ | 5426,7 | 2057,8 | 3 | 250 | 250,02 | 7,789 | -0,007 | 0,017 | -1,809 | 0,072 | 1,810 |
| 4D2 | Pasture, Range and Paddock Manure | $N_2O$ | 1168,4 | 276,0 | 3 | 250 | 250,02 | 1,045 | -0,003 | 0,002 | -0,732 | 0,010 | 0,732 |
| 4D3 | Indirect Emissions | $N_2O$ | 3723,1 | 1206,3 | 3 | 500 | 500,01 | 9,132 | -0,007 | 0,010 | -3,325 | 0,042 | 3,325 |
| 4F | Field Burning | $CH_4$ | 34,1 | 24,3 | 25 | 50 | 55,90 | 0,021 | 0,000 | 0,000 | 0,002 | 0,007 | 0,007 |
| 4F | Field Burning | $N_2O$ | 14,6 | 11,8 | 25 | 200 | 201,56 | 0,036 | 0,000 | 0,000 | 0,006 | 0,003 | 0,007 |
| 6A | Solid Waste Disposal on Land | $CH_4$ | 3269,2 | 2899,7 | 30 | 80 | 85,44 | 3,751 | 0,009 | 0,024 | 0,740 | 1,009 | 1,252 |
| 6B | Waste Water Handling | $CH_4$ | 2260,8 | 673,5 | 30 | 30 | 42,43 | 0,433 | -0,005 | 0,006 | -0,136 | 0,234 | 0,271 |
| 6B | Waste Water Handling | $N_2O$ | 232,7 | 160,5 | 30 | 100 | 104,40 | 0,254 | 0,000 | 0,001 | 0,028 | 0,056 | 0,063 |
| 6C | Waste Incineration | $CO_2$ | 19,0 | 9,7 | 15 | 100 | 101,12 | 0,015 | 0,000 | 0,000 | -0,001 | 0,002 | 0,002 |
| | | | | | | | | | | | | | |

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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-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. | | % | % | % | % | % | % | % | % | % |
| Total | | | 121904,3 | 66050,1 | | | | 13,35 | | | | | 4,23 |
| % | | | 99,97 | 99,87 | | | | | | | | | |
| National Total | | | 121936,4 | 66133,3 | | | | | | | | | |
| | | | | | | | | | | | | | |

Table 260 Tier 1 Uncertainty Calculation and Reporting (level assessment), Gg $CO_2$-eq.(Including LULUCF)

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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-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 | 8,4 | 3 | 50 | 50,09 | 0,007 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| 1A1 | | $N_2O$ | 134,1 | 140,5 | 3 | 200 | 200,02 | 0,484 | 0,001 | 0,001 | 0,127 | 0,006 | 0,127 |

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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 | Gaseous fuel | $CO_2$ | 6476,1 | 2360,0 | 1 | 2 | 2,24 | 0,091 | -0,011 | 0,022 | -0,021 | 0,031 | 0,038 |
| 1A1 | Liquid fuel | $CO_2$ | 9993,9 | 1333,1 | 3 | 7 | 7,62 | 0,175 | -0,038 | 0,012 | -0,264 | 0,053 | 0,269 |
| 1A1 | Solid fuel | $CO_2$ | 25497,3 | 32518,1 | 1 | 2 | 2,24 | 1,252 | 0,174 | 0,302 | 0,348 | 0,428 | 0,551 |
| 1A2 | Gaseous fuel | $CO_2$ | 0,0 | 2021,0 | 1 | 2 | 2,24 | 0,078 | 0,019 | 0,019 | 0,038 | 0,027 | 0,046 |
| 1A2 | Liquid fuel | $CO_2$ | 7243,4 | 757,2 | 3 | 7 | 7,62 | 0,099 | -0,029 | 0,007 | -0,205 | 0,030 | 0,207 |
| 1A2 | Solid fuel | $CO_2$ | 10233,6 | 834,8 | 1 | 2 | 2,24 | 0,032 | -0,044 | 0,008 | -0,087 | 0,011 | 0,088 |
| 1A2 | | $CH_4$ | 25,5 | 11,7 | 3 | 50 | 50,09 | 0,010 | 0,000 | 0,000 | -0,001 | 0,000 | 0,001 |
| 1A2 | | $N_2O$ | 60,4 | 17,4 | 3 | 200 | 200,02 | 0,060 | 0,000 | 0,000 | -0,028 | 0,001 | 0,028 |
| 1A3a | Liquid fuel | $CO_2$ | 208,9 | 64,8 | 5 | 5 | 7,07 | 0,008 | 0,000 | 0,001 | -0,002 | 0,004 | 0,005 |
| 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 | $N_2O$ | 1,8 | 0,6 | 5 | 40 | 40,31 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| 1A3b | Diesel Oil | $CO_2$ | 2631,3 | 4664,5 | 3 | 5 | 5,83 | 0,468 | 0,030 | 0,043 | 0,151 | 0,184 | 0,238 |
| 1A3b | Gasoline | $CO_2$ | 4364,4 | 1668,6 | 3 | 5 | 5,83 | 0,168 | -0,006 | 0,016 | -0,032 | 0,066 | 0,073 |
| 1A3b | | $CH_4$ | 84,5 | 12,5 | 3 | 40 | 40,11 | 0,009 | 0,000 | 0,000 | -0,012 | 0,000 | 0,012 |
| 1A3b | | $N_2O$ | 89,3 | 71,3 | 3 | 40 | 40,11 | 0,049 | 0,000 | 0,001 | 0,009 | 0,003 | 0,009 |
| 1A3b | LPG | $CO_2$ | 0,0 | 961,5 | 3 | 5 | 5,83 | 0,097 | 0,009 | 0,009 | 0,045 | 0,038 | 0,059 |
| 1A3b | Gaseous fuel | $CO_2$ | 0,0 | 143,0 | 3 | 5 | 5,83 | 0,014 | 0,001 | 0,001 | 0,007 | 0,006 | 0,009 |
| 1A3c | Liquid fuel | $CO_2$ | 0,0 | 55,5822 | 5 | 5 | 7,07 | 0,007 | 0,001 | 0,001 | 0,003 | 0,004 | 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 |

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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. | | % | % | % | % | % | % | % | % | % |
| 1A3e | Gaseous fuel | $CO_2$ | 0,0 | 468,9 | 1 | 5 | 5,10 | 0,041 | 0,004 | 0,004 | 0,022 | 0,006 | 0,023 |
| 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 | 267,1 | 5 | 50 | 50,25 | 0,231 | 0,001 | 0,002 | 0,053 | 0,018 | 0,056 |
| 1A4 | | $N_2O$ | 31,6 | 45,5 | 5 | 200 | 200,06 | 0,157 | 0,000 | 0,000 | 0,053 | 0,003 | 0,053 |
| 1A4 | Gaseous fuel | $CO_2$ | 0,0 | 387,8 | 5 | 2 | 5,39 | 0,036 | 0,004 | 0,004 | 0,007 | 0,025 | 0,026 |
| 1A4 | Liquid fuel | $CO_2$ | 2795,5 | 590,7 | 5 | 7 | 8,60 | 0,088 | -0,009 | 0,005 | -0,060 | 0,039 | 0,071 |
| 1A4 | Solid fuel | $CO_2$ | 3403,0 | 992,7 | 2 | 5 | 5,39 | 0,092 | -0,008 | 0,009 | -0,039 | 0,026 | 0,047 |
| 1A5 | Stationary | $CO_2$ | 6497,6 | 0,0 | 5 | 7 | 8,60 | 0,000 | -0,033 | 0,000 | -0,228 | 0,000 | 0,228 |
| 1B1 | Solid Fuels | $CH_4$ | 1859,8 | 1069,3 | 10 | 200 | 200,25 | 3,687 | 0,001 | 0,010 | 0,121 | 0,141 | 0,186 |
| 1B2 | Oil and Natural Gas | $CH_4$ | 1125,0 | 672,4 | 5 | 50 | 50,25 | 0,582 | 0,001 | 0,006 | 0,030 | 0,044 | 0,054 |
| 2A1 | Cement Production | $CO_2$ | 2406,4 | 790,7 | 2 | 2 | 2,83 | 0,039 | -0,005 | 0,007 | -0,009 | 0,021 | 0,023 |
| 2A2 | Lime Production | $CO_2$ | 1103,3 | 1037,2 | 2 | 2 | 2,83 | 0,051 | 0,004 | 0,010 | 0,008 | 0,027 | 0,028 |
| 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 | 87,9 | 2 | 3 | 3,61 | 0,005 | 0,000 | 0,001 | 0,001 | 0,002 | 0,002 |
| 2A7 | Other - Glass | $CO_2$ | 186,2 | 70,3 | 6 | 60 | 60,30 | 0,073 | 0,000 | 0,001 | -0,017 | 0,006 | 0,018 |
| 2A7 | Other Bricks | $CO_2$ | 551,2 | 26,4 | 3 | 5 | 5,83 | 0,003 | -0,003 | 0,000 | -0,013 | 0,001 | 0,013 |
| 2A7 | Other - DeSOx | $CO_2$ | 0,0 | 708,2 | 1,5 | 2,5 | 2,92 | 0,036 | 0,007 | 0,007 | 0,016 | 0,014 | 0,022 |
| 2B1 | Ammonia Production | $CO_2$ | 1693,3 | 526,4 | 3,5 | 7 | 7,83 | 0,071 | -0,004 | 0,005 | -0,025 | 0,024 | 0,035 |
| 2B2 | Nitric Acid Production | $N_2O$ | 2009,8 | 234,4 | 3 | 7 | 7,62 | 0,031 | -0,008 | 0,002 | -0,055 | 0,009 | 0,056 |

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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 | 17,2 | 5 | 10 | 11,18 | 0,003 | 0,000 | 0,000 | -0,003 | 0,001 | 0,003 |
| 2B5 | Other (please specify) | $CH_4$ | 9,1 | 0,0 | 5 | 50 | 50,25 | 0,000 | 0,000 | 0,000 | -0,002 | 0,000 | 0,002 |
| 2C | Metal Production | $CH_4$ | 73,3 | 0,0 | 10 | 25 | 26,93 | 0,000 | 0,000 | 0,000 | -0,009 | 0,000 | 0,009 |
| 2C1 | Iron and Steel Production | $CO_2$ | 3481,4 | 68,0 | 5 | 10 | 11,18 | 0,013 | -0,017 | 0,001 | -0,168 | 0,004 | 0,168 |
| 2C2 | Ferroalloys Production | $CO_2$ | 218,8 | 0,5 | 5 | 25 | 25,50 | 0,000 | -0,001 | 0,000 | -0,027 | 0,000 | 0,027 |
| 2F | ODS substitutes | HFCs | 0,0 | 395,7 | 10 | 50 | 50,99 | 0,347 | 0,004 | 0,004 | 0,184 | 0,052 | 0,191 |
| 2F8 | Electrical Equipment | $SF_6$ | 3,5 | 14,9 | 10 | 50 | 50,99 | 0,013 | 0,000 | 0,000 | 0,006 | 0,002 | 0,006 |
| 2G | Other | $CH_4$ | 7,6 | 0,0 | 10 | 50 | 50,99 | 0,000 | 0,000 | 0,000 | -0,002 | 0,000 | 0,002 |
| 3 | Solvent and other product use | $CO_2$ | 866,61 | 22,28 | 10 | 30 | 31,62 | 0,012 | -0,004 | 0,000 | -0,124 | 0,003 | 0,124 |
| 3 | Solvent and other product use | $N_2O$ | 33,2 | 19,0 | 10 | 100 | 100,50 | 0,033 | 0,000 | 0,000 | 0,001 | 0,002 | 0,003 |
| 4A1 | Cattle | $CH_4$ | 2348,9 | 961,3 | 2 | 20 | 20,10 | 0,333 | -0,003 | 0,009 | -0,057 | 0,025 | 0,062 |
| 4A.2 | Buffalo | $CH_4$ | 29,2 | 11,0 | 2 | 50 | 50,04 | 0,010 | 0,000 | 0,000 | -0,002 | 0,000 | 0,002 |
| 4A.3 | Sheep | $CH_4$ | 1336,2 | 197,2 | 2 | 20 | 20,10 | 0,068 | -0,005 | 0,002 | -0,097 | 0,005 | 0,098 |
| 4A.4 | Goats | $CH_4$ | 45,7 | 36,6 | 2 | 50 | 50,04 | 0,032 | 0,000 | 0,000 | 0,006 | 0,001 | 0,006 |
| 4A.6 | Horses | $CH_4$ | 46,2 | 54,4 | 2 | 50 | 50,04 | 0,047 | 0,000 | 0,001 | 0,014 | 0,001 | 0,014 |
| 4A.7 | Mules and Asses | $CH_4$ | 74,6 | 28,9 | 2 | 50 | 50,04 | 0,025 | 0,000 | 0,000 | -0,005 | 0,001 | 0,005 |
| 4A.8 | Swine | $CH_4$ | 127,3 | 20,0 | 2 | 50 | 50,04 | 0,017 | 0,000 | 0,000 | -0,023 | 0,001 | 0,023 |
| 4B | $N_2O$ em. from Manure Management | $N_2O$ | 1637,4 | 536,3 | 2 | 300 | 300,01 | 2,771 | -0,003 | 0,005 | -0,970 | 0,014 | 0,970 |
| 4B1 | Cattle | $CH_4$ | 62,1 | 26,4 | 2 | 20 | 20,10 | 0,009 | 0,000 | 0,000 | -0,001 | 0,001 | 0,001 |
| 4B.2 | Buffalo | $CH_4$ | 4,8 | 1,8 | 2 | 50 | 50,04 | 0,002 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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.3 | Sheep | $CH_4$ | 23,9 | 3,5 | 2 | 50 | 50,04 | 0,003 | 0,000 | 0,000 | -0,004 | 0,000 | 0,004 |
| 4B.4 | Goats | $CH_4$ | 1,6 | 1,3 | 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 | 0,002 | 0,000 | 0,002 |
| 4B.7 | Mules and Asses | $CH_4$ | 8,5 | 3,3 | 2 | 50 | 50,04 | 0,003 | 0,000 | 0,000 | -0,001 | 0,000 | 0,001 |
| 4B.8 | Swine | $CH_4$ | 3906,8 | 559,1 | 2 | 20 | 20,10 | 0,194 | -0,014 | 0,005 | -0,288 | 0,015 | 0,288 |
| 4B.9 | Poultry | $CH_4$ | 66,7 | 25,1 | 2 | 50 | 50,04 | 0,022 | 0,000 | 0,000 | -0,005 | 0,001 | 0,005 |
| 4C | Rice Cultivation | $CH_4$ | 114,2 | 99,4 | 25 | 80 | 83,82 | 0,143 | 0,000 | 0,001 | 0,028 | 0,033 | 0,043 |
| 4D1 | Direct soil emissions | $N_2O$ | 5426,7 | 2057,8 | 3 | 250 | 250,02 | 8,860 | -0,008 | 0,019 | -2,025 | 0,081 | 2,027 |
| 4D2 | Pasture, Range and Paddock Manure | $N_2O$ | 1168,4 | 276,0 | 3 | 250 | 250,02 | 1,188 | -0,003 | 0,003 | -0,824 | 0,011 | 0,825 |
| 4D3 | Indirect Emissions | $N_2O$ | 3723,1 | 1206,3 | 3 | 500 | 500,01 | 10,387 | -0,007 | 0,011 | -3,734 | 0,048 | 3,735 |
| 4F | Field Burning | $CH_4$ | 34,1 | 24,3 | 25 | 50 | 55,90 | 0,023 | 0,000 | 0,000 | 0,003 | 0,008 | 0,008 |
| 4F | Field Burning | $N_2O$ | 14,6 | 11,8 | 25 | 200 | 201,56 | 0,041 | 0,000 | 0,000 | 0,007 | 0,004 | 0,008 |
| 5A1 | Forest Land remaining Forest Land | $CO_2$ | -13687,1 | -9596,0 | 3 | 149 | 149,45 | -24,696 | -0,021 | -0,089 | -3,069 | -0,378 | 3,093 |
| 5A2 | Land converted to Forest Land | $CO_2$ | -656,4 | -654,9 | 10 | 122 | 122,52 | -1,382 | -0,003 | -0,006 | -0,341 | -0,086 | 0,352 |
| 5B1 | Cropland remainig Cropland | $CO_2$ | 35,7 | 1304,4 | 3 | 184 | 184,04 | 4,134 | 0,012 | 0,012 | 2,199 | 0,051 | 2,199 |
| 5B2 | Land converted to Cropland | $CO_2$ | 671,2 | 1018,0 | 10 | 415 | 415,47 | 7,284 | 0,006 | 0,009 | 2,532 | 0,134 | 2,535 |
| 5C2 | Land converted to Grassland | $CO_2$ | -786,6 | -786,6 | 10 | 445 | 444,81 | -6,026 | -0,003 | -0,007 | -1,497 | -0,103 | 1,500 |
| 5D2 | Land converted to Wetlands | $CO_2$ | 0,0 | 212,4 | 10 | 25 | 26,50 | 0,097 | 0,002 | 0,002 | 0,048 | 0,028 | 0,056 |
| 5E2 | Land converted to Settlements | $CO_2$ | 83,2 | 523,2 | 10 | 74 | 75,00 | 0,676 | 0,004 | 0,005 | 0,330 | 0,069 | 0,338 |
| 6A | Solid Waste Disposal on Land | $CH_4$ | 3269,2 | 2899,7 | 30 | 80 | 85,44 | 4,266 | 0,011 | 0,027 | 0,844 | 1,144 | 1,421 |

| IPCC Source category | | GHG | Base year emissions (1988) | Year 2011 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. | | % | % | % | % | % | % | % | % | % |
| 6B | Waste Water Handling | $CH_4$ | 2260,8 | 673,5 | 30 | 30 | 42,43 | 0,492 | -0,005 | 0,006 | -0,153 | 0,266 | 0,306 |
| 6B | Waste Water Handling | $N_2O$ | 232,7 | 160,5 | 30 | 100 | 104,40 | 0,289 | 0,000 | 0,001 | 0,032 | 0,063 | 0,071 |
| 6C | Waste Incineration | $CO_2$ | 19,0 | 9,7 | 15 | 100 | 101,12 | 0,017 | 0,000 | 0,000 | -0,001 | 0,002 | 0,002 |
| | | | | | | | | | | | | | |
| **Total** | | | **107564,3** | **58070,7** | | | | **30,81** | | | | | **6,78** |
| **%** | | | **99,97** | **99,86** | | | | | | | | | |
| **National Total** | | | **107596,4** | **58153,9** | | | | | | | | | |
| | | | | | | | | | | | | | |

***** *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.*

# ANNEX 8 VEHICLE FLEET AND MILEAGE DATA FOR ROAD TRANSPORT

Table 261 Vehicle fleet data for Road transport (number of vehicles) 1988-1999

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gasoline 0,8 - 1,4 l | PRE ECE | 0 | 0 | 0 | 0 | 21342 | 18075 | 12777 | 10537 | 8303 | 6685 | 5405 | 4292 |
| Gasoline 0,8 - 1,4 l | ECE 15/00-01 | 0 | 0 | 0 | 0 | 96940 | 82209 | 62087 | 49854 | 38910 | 29821 | 22561 | 16235 |
| Gasoline 0,8 - 1,4 l | ECE 15/02 | 1023092 | 1053975 | 1085830 | 1104395 | 116231 | 101485 | 81978 | 65165 | 49795 | 37221 | 27090 | 18245 |
| Gasoline 0,8 - 1,4 l | ECE 15/03 | 0 | 0 | 0 | 0 | 215702 | 205685 | 188537 | 163962 | 136430 | 107210 | 82328 | 57393 |
| Gasoline 0,8 - 1,4 l | ECE 15/04 | 0 | 0 | 0 | 0 | 670107 | 667350 | 678010 | 651038 | 628871 | 584427 | 550850 | 500271 |
| Gasoline 0,8 - 1,4 l | Improved Conventional | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline 0,8 - 1,4 l | Open Loop | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline 0,8 - 1,4 l | PC Euro 1 - 91/441/EEC | 0 | 0 | 0 | 0 | 7 | 89285 | 159612 | 246735 | 322449 | 321910 | 320137 | 322493 |
| Gasoline 0,8 - 1,4 l | PC Euro 2 - 94/12/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63894 | 136783 | 230370 |
| Gasoline 0,8 - 1,4 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline 0,8 - 1,4 l | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline 0,8 - 1,4 l | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline 1,4 - 2,0 l | PRE ECE | 0 | 0 | 0 | 0 | 5021 | 4422 | 3159 | 2634 | 2066 | 1768 | 1435 | 1197 |
| Gasoline 1,4 - 2,0 l | ECE 15/00-01 | 0 | 0 | 0 | 0 | 11805 | 10477 | 8583 | 7100 | 5725 | 4390 | 3366 | 2433 |
| Gasoline 1,4 - 2,0 l | ECE 15/02 | 107853 | 118617 | 127810 | 141777 | 15128 | 13903 | 11663 | 9825 | 7980 | 6304 | 4902 | 3457 |
| Gasoline 1,4 - 2,0 l | ECE 15/03 | 0 | 0 | 0 | 0 | 16625 | 16981 | 16823 | 15855 | 14775 | 13500 | 12164 | 10519 |
| Gasoline 1,4 - 2,0 l | ECE 15/04 | 0 | 0 | 0 | 0 | 117676 | 121710 | 135725 | 140647 | 142186 | 136090 | 134319 | 132515 |
| 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 | 0 | 0 | 0 | 0 | 0 | 38866 | 78459 | 125743 | 180987 | 188908 | 190602 | 194456 |
| Gasoline 1,4 - 2,0 l | PC Euro 2 - 94/12/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41501 | 104639 | 170749 |
| Gasoline 1,4 - 2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 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 |
| Gasoline 1,4 - 2,0 l | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline >2,0 l | PRE ECE | 0 | 0 | 0 | 0 | 424 | 401 | 312 | 286 | 279 | 273 | 243 | 227 |
| Gasoline >2,0 l | ECE 15/00-01 | 0 | 0 | 0 | 0 | 870 | 878 | 806 | 688 | 614 | 533 | 462 | 360 |
| Gasoline >2,0 l | ECE 15/02 | 3739 | 4855 | 5832 | 7157 | 159 | 150 | 136 | 124 | 112 | 988 | 822 | 605 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 8 | 4 | 1 | 3 | 4 | | | |
| Gasoline >2,0 l | ECE 15/03 | 0 | 0 | 0 | 0 | 1469 | 1553 | 1692 | 1646 | 1603 | 1443 | 1351 | 1170 |
| Gasoline >2,0 l | ECE 15/04 | 0 | 0 | 0 | 0 | 5363 | 6678 | 9263 | 11392 | 12619 | 12314 | 12135 | 12117 |
| Gasoline >2,0 l | PC Euro 1 - 91/441/EEC | 0 | 0 | 0 | 0 | 0 | 2335 | 4769 | 7160 | 10304 | 12155 | 13694 | 14390 |
| Gasoline >2,0 l | PC Euro 2 - 94/12/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2205 | 4969 | 9288 |
| Gasoline >2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline >2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline >2,0 l | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diesel 1,4 - 2,0 l | Conventional | 78624 | 84497 | 90446 | 97186 | 102894 | 104706 | 110447 | 109587 | 109134 | 105434 | 104533 | 102298 |
| Diesel 1,4 - 2,0 l | PC Euro 1 - 91/441/EEC | 0 | 0 | 0 | 0 | 0 | 3989 | 7450 | 11684 | 17467 | 19350 | 20758 | 22188 |
| Diesel 1,4 - 2,0 l | PC Euro 2 - 94/12/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5842 | 15125 | 28567 |
| Diesel 1,4 - 2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diesel 1,4 - 2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diesel 1,4 - 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 | 7477 | 8015 | 7518 | 8461 | 7637 | 8551 | 9858 | 10111 | 10227 | 9917 | 9699 | 9296 |
| Diesel >2,0 l | PC Euro 1 - 91/441/EEC | 0 | 0 | 0 | 0 | 0 | 461 | 1092 | 1763 | 2896 | 3604 | 4123 | 4532 |
| Diesel >2,0 l | PC Euro 2 - 94/12/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 904 | 2381 | 4477 |
| Diesel >2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diesel >2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diesel >2,0 l | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LPG | Conventional | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6098 | 11187 | 14957 |
| LPG | PC Euro 1 - 91/441/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3382 | 6826 | 10442 |
| LPG | PC Euro 2 - 94/12/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 696 | 3207 | 8066 |
| LPG | PC Euro 3 - 98/69/EC Stage2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LPG | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LPG | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CNG | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CNG | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Stroke | Conventional | 0 | 0 | 0 | 0 | 4441 | 3949 | 3408 | 2915 | 2278 | 1737 | 1253 | 785 |
| 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 | 0 | 0 | 0 | 0 | 48538 | 52201 | 47293 | 41087 | 34853 | 29263 | 24002 | 19178 |
| Gasoline <3,5t | LD Euro 1 - 93/59/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 6845 | 14799 | 23040 | 23369 | 21477 | 20347 |
| Gasoline <3,5t | LD Euro 2 - 96/69/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9230 | 20136 |
| Gasoline <3,5t | LD Euro 3 - 98/69/EC Stage2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline <3,5t | LD Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline <3,5t | LD Euro 5 - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diesel <3,5 t | Conventional | 0 | 0 | 0 | 0 | 75083 | 85209 | 85103 | 80123 | 74673 | 70843 | 67092 | 60219 |
| Diesel <3,5 t | LD Euro 1 - 93/59/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 8614 | 21881 | 34848 | 48892 | 51574 | 49593 |
| Diesel <3,5 t | LD Euro 2 - 96/69/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11868 | 27807 |
| Diesel <3,5 t | LD Euro 3 - 98/69/EC Stage2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diesel <3,5 t | LD Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diesel <3,5 t | LD Euro 5 - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline >3,5 t | Conventional | 0 | 0 | 0 | 0 | 2029 | 2095 | 2051 | 1925 | 1783 | 1457 | 1218 | 1100 |
| Rigid <=7,5 t | Conventional | 0 | 0 | 0 | 0 | 28264 | 29575 | 29527 | 28227 | 26283 | 24796 | 22611 | 19457 |
| Rigid <=7,5 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 1517 | 3704 | 6154 | 6517 | 6586 | 6929 | 6922 |
| Rigid <=7,5 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1486 | 3418 | 5736 | 8006 |
| Rigid <=7,5 t | HD Euro III - 2000 Standards | 0 | 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 | 0 |
| Rigid <=7,5 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 7,5 - 12 t | Conventional | 46061 | 48166 | 50372 | 53581 | 13237 | 12864 | 12072 | 10908 | 9777 | 8796 | 7624 | 6619 |
| Rigid 7,5 - 12 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 220 | 488 | 759 | 801 | 821 | 839 | 833 |
| Rigid 7,5 - 12 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 208 | 396 | 632 | 910 |
| Rigid 7,5 - 12 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 7,5 - 12 t | HD Euro IV - 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Standards | | | | | | | | | | | | |
| Rigid 7,5 - 12 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 12 - 14 t | Conventional | 46061 | 48166 | 50372 | 53581 | 13237 | 12864 | 12072 | 10908 | 9777 | 8796 | 7624 | 6619 |
| Rigid 12 - 14 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 220 | 488 | 759 | 801 | 821 | 839 | 833 |
| Rigid 12 - 14 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 208 | 396 | 632 | 910 |
| Rigid 12 - 14 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 12 - 14 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 12 - 14 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 14 - 20 t | Conventional | 46061 | 48166 | 50372 | 53581 | 16098 | 15796 | 14967 | 13746 | 12471 | 11388 | 10069 | 8859 |
| Rigid 14 - 20 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 245 | 618 | 1068 | 1199 | 1272 | 1349 | 1375 |
| Rigid 14 - 20 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 319 | 641 | 1117 | 1718 |
| Rigid 14 - 20 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 14 - 20 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 14 - 20 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 20 - 26 t | Conventional | 0 | 0 | 0 | 0 | 2861 | 2938 | 2895 | 2843 | 2694 | 2592 | 2444 | 2240 |
| Rigid 20 - 26 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 26 | 131 | 309 | 394 | 451 | 510 | 542 |
| Rigid 20 - 26 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 111 | 245 | 489 | 809 |
| Rigid 20 - 26 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 20 - 26 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 20 - 26 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 26 - 28 t | Conventional | 0 | 0 | 0 | 0 | 2861 | 2938 | 2895 | 2843 | 2694 | 2592 | 2444 | 2240 |
| Rigid 26 - 28 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 26 | 131 | 309 | 394 | 451 | 510 | 542 |
| Rigid 26 - 28 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 111 | 245 | 489 | 809 |
| Rigid 26 - 28 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 26 - 28 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 26 - 28 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 28 - 32 t | Conventional | 0 | 0 | 0 | 0 | 2861 | 2938 | 2895 | 2843 | 2694 | 2592 | 2444 | 2240 |
| Rigid 28 - 32 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 26 | 131 | 309 | 394 | 451 | 510 | 542 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rigid 28 - 32 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 111 | 245 | 489 | 809 |
| Rigid 28 - 32 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 28 - 32 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid 28 - 32 t | HD Euro V - 2008 Standards | 0 | 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 | 97 |
| Rigid >32 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 56 | 75 | 73 | 72 | 73 |
| Rigid >32 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 26 | 46 | 133 |
| Rigid >32 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid >32 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rigid >32 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 14 - 20 t | Conventional | 46061 | 48166 | 50372 | 53581 | 16098 | 15796 | 14967 | 13746 | 12471 | 11388 | 10069 | 8859 |
| Articulated 14 - 20 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 245 | 618 | 1068 | 1199 | 1272 | 1349 | 1375 |
| Articulated 14 - 20 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 319 | 641 | 1117 | 1718 |
| Articulated 14 - 20 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 14 - 20 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 14 - 20 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 20 - 28 t | Conventional | 0 | 0 | 0 | 0 | 2861 | 2938 | 2895 | 2843 | 2694 | 2592 | 2444 | 2240 |
| Articulated 20 - 28 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 26 | 131 | 309 | 394 | 451 | 510 | 542 |
| Articulated 20 - 28 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 111 | 245 | 489 | 809 |
| Articulated 20 - 28 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 20 - 28 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 20 - 28 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 28 - 34 t | Conventional | 0 | 0 | 0 | 0 | 2983 | 3050 | 3005 | 2960 | 2814 | 2721 | 2554 | 2337 |
| Articulated 28 - 34 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 26 | 146 | 365 | 469 | 524 | 582 | 615 |
| Articulated 28 - 34 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 128 | 271 | 531 | 942 |
| Articulated 28 - 34 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 28 - 34 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 28 - 34 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Articulated 34 - 40 t | Conventional | 0 | 0 | 0 | 0 | 127 | 112 | 111 | 117 | 119 | 125 | 110 | 97 |
| Articulated 34 - 40 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 56 | 75 | 73 | 72 | 73 |
| Articulated 34 - 40 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 26 | 46 | 133 |
| Articulated 34 - 40 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 34 - 40 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 34 - 40 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 40 - 50 t | Conventional | 0 | 0 | 0 | 0 | 127 | 112 | 111 | 117 | 119 | 125 | 110 | 97 |
| Articulated 40 - 50 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 56 | 75 | 73 | 72 | 73 |
| Articulated 40 - 50 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 26 | 46 | 133 |
| Articulated 40 - 50 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 40 - 50 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 40 - 50 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 50 - 60 t | Conventional | 0 | 0 | 0 | 0 | 127 | 112 | 111 | 117 | 119 | 125 | 110 | 97 |
| Articulated 50 - 60 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 56 | 75 | 73 | 72 | 73 |
| Articulated 50 - 60 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 26 | 46 | 133 |
| Articulated 50 - 60 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 50 - 60 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Articulated 50 - 60 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Buses Midi <=15 t | Conventional | 1257 | 1241 | 1251 | 2341 | 7367 | 7216 | 6978 | 6737 | 6338 | 5682 | 5112 | 4559 |
| Urban Buses Midi <=15 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 181 | 388 | 414 | 439 | 442 | 445 | 470 |
| Urban Buses Midi <=15 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 186 | 612 | 1051 | 1447 |
| Urban Buses Midi <=15 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Buses Midi <=15 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Buses Midi <=15 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Buses Standard 15 - 18 t | Conventional | 1257 | 1241 | 1251 | 2341 | 7367 | 7216 | 6978 | 6737 | 6338 | 5682 | 5112 | 4559 |
| Urban Buses Standard 15 - 18 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 181 | 388 | 414 | 439 | 442 | 445 | 470 |
| Urban Buses Standard 15 - 18 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 186 | 612 | 1051 | 1447 |
| Urban Buses Standard 15 - 18 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Buses Standard 15 - 18 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Urban Buses Standard 15 - 18 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Buses Articulated >18 t | Conventional | 1257 | 1241 | 1251 | 2341 | 7367 | 7216 | 6978 | 6737 | 6338 | 5682 | 5112 | 4559 |
| Urban Buses Articulated >18 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 181 | 388 | 414 | 439 | 442 | 445 | 470 |
| Urban Buses Articulated >18 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 186 | 612 | 1051 | 1447 |
| Urban Buses Articulated >18 t | HD Euro III - 2000 Standards | 0 | 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 | 0 |
| Urban Buses Articulated >18 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coaches Standard <=18 t | Conventional | 14137 | 14585 | 15005 | 14269 | 7492 | 8061 | 8222 | 8210 | 7961 | 7571 | 7375 | 6947 |
| Coaches Standard <=18 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 483 | 1034 | 1573 | 1809 | 1905 | 2084 | 2135 |
| Coaches Standard <=18 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 203 | 629 | 1372 | 2189 |
| Coaches Standard <=18 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coaches Standard <=18 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coaches Standard <=18 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coaches Articulated >18 t | Conventional | 14137 | 14585 | 15005 | 14269 | 7492 | 8061 | 8222 | 8210 | 7961 | 7571 | 7375 | 6947 |
| Coaches Articulated >18 t | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 483 | 1034 | 1573 | 1809 | 1905 | 2084 | 2135 |
| Coaches Articulated >18 t | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 203 | 629 | 1372 | 2189 |
| Coaches Articulated >18 t | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coaches Articulated >18 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coaches Articulated >18 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban CNG Buses | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban CNG Buses | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban CNG Buses | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban CNG Buses | EEV | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Biodiesel Buses | Conventional | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Biodiesel Buses | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Biodiesel Buses | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Biodiesel Buses | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Biodiesel Buses | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Urban Biodiesel Buses | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2-stroke <50 cm³ | Conventional | 276901 | 279077 | 281270 | 282137 | 282792 | 283963 | 284571 | 285901 | 286760 | 288690 | 281749 | 284031 |
| 2-stroke <50 cm³ | Mop - Euro I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2-stroke <50 cm³ | Mop - Euro II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2-stroke <50 cm³ | Mop - Euro III | 0 | 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 | 20953 |
| 2-stroke >50 cm³ | Mot - Euro I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 227 |
| 2-stroke >50 cm³ | Mot - Euro II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2-stroke >50 cm³ | Mot - Euro III | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4-stroke <250 cm³ | Conventional | 0 | 0 | 0 | 0 | 116162 | 112243 | 107120 | 102374 | 97655 | 93737 | 87942 | 75255 |
| 4-stroke <250 cm³ | Mot - Euro I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14289 |
| 4-stroke <250 cm³ | Mot - Euro II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4-stroke <250 cm³ | Mot - Euro III | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4-stroke 250 - 750 cm³ | Conventional | 217360 | 221416 | 225533 | 226853 | 44237 | 52042 | 60696 | 68527 | 73770 | 79784 | 84026 | 73513 |
| 4-stroke 250 - 750 cm³ | Mot - Euro I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13153 |
| 4-stroke 250 - 750 cm³ | Mot - Euro II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4-stroke 250 - 750 cm³ | Mot - Euro III | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4-stroke >750 cm³ | Conventional | 0 | 0 | 0 | 0 | 13386 | 15007 | 17848 | 20521 | 25665 | 30838 | 35384 | 30597 |
| 4-stroke >750 cm³ | Mot - Euro I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7195 |
| 4-stroke >750 cm³ | Mot - Euro II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4-stroke >750 cm³ | Mot - Euro III | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 262 Vehicle fleet data for Road transport (number of vehicles) 2000-2011

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gasoline 0,8 - 1,4 l | PRE ECE | 3597 | 3156 | 2684 | 2566 | 2348 | 2439 | 1621 | 1927 | 2203 | 2340 | 2454 | 2549 |
| Gasoline 0,8 - 1,4 l | ECE 15/00-01 | 12139 | 9534 | 7477 | 6307 | 5624 | 4554 | 2756 | 3101 | 3419 | 3480 | 3488 | 3544 |
| Gasoline 0,8 - 1,4 l | ECE 15/02 | 12643 | 9152 | 6647 | 5267 | 4145 | 2718 | 1501 | 1594 | 1704 | 1652 | 1655 | 1703 |
| Gasoline 0,8 - 1,4 l | ECE 15/03 | 39979 | 28586 | 20381 | 15046 | 10899 | 6012 | 2894 | 2635 | 2488 | 2279 | 2212 | 2196 |
| Gasoline 0,8 - 1,4 l | ECE 15/04 | 446081 | 394716 | 335834 | 282816 | 221610 | 169965 | 82424 | 69428 | 56873 | 43162 | 33211 | 26266 |
| Gasoline 0,8 - 1,4 l | Improved Conventional | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline 0,8 - 1,4 l | Open Loop | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gasoline 0,8 - 1,4 l | PC Euro 1 - 91/441/EEC | 326387 | 331281 | 335211 | 340298 | 339267 | 326248 | 200337 | 206996 | 201047 | 175318 | 146740 | 121932 |
| Gasoline 0,8 - 1,4 l | PC Euro 2 - 94/12/EEC | 312064 | 333600 | 340087 | 350985 | 357592 | 359564 | 241129 | 269452 | 290964 | 291793 | 283466 | 273170 |
| Gasoline 0,8 - 1,4 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 51253 | 108802 | 169727 | 233750 | 238940 | 158471 | 178634 | 194348 | 199185 | 202324 | 204105 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gasoline 0,8 - 1,4 l | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 52671 | 71086 | 121559 | 181740 | 230600 | 284667 | 292219 |
| Gasoline 0,8 - 1,4 l | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42525 |
| Gasoline 1,4 - 2,0 l | PRE ECE | 1048 | 935 | 780 | 761 | 688 | 805 | 588 | 731 | 836 | 861 | 903 | 936 |
| Gasoline 1,4 - 2,0 l | ECE 15/00-01 | 1780 | 1399 | 1094 | 884 | 801 | 697 | 456 | 571 | 589 | 625 | 646 | 674 |
| Gasoline 1,4 - 2,0 l | ECE 15/02 | 2431 | 1761 | 1284 | 1003 | 751 | 539 | 339 | 389 | 451 | 464 | 467 | 481 |
| Gasoline 1,4 - 2,0 l | ECE 15/03 | 8738 | 6819 | 5199 | 3902 | 2856 | 1972 | 993 | 934 | 920 | 828 | 813 | 830 |
| Gasoline 1,4 - 2,0 l | ECE 15/04 | 130242 | 126794 | 120273 | 112299 | 97977 | 82560 | 43298 | 38529 | 32799 | 25579 | 20028 | 16017 |
| 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 | 198250 | 200915 | 202840 | 203432 | 202367 | 194421 | 120227 | 125610 | 123738 | 110286 | 94242 | 79872 |
| Gasoline 1,4 - 2,0 l | PC Euro 2 - 94/12/EEC | 224629 | 244688 | 252696 | 262127 | 267592 | 270379 | 177309 | 198354 | 213059 | 211817 | 204130 | 195136 |
| Gasoline 1,4 - 2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 26550 | 54932 | 83268 | 108565 | 112804 | 76274 | 87597 | 96279 | 99201 | 100253 | 100729 |
| Gasoline 1,4 - 2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 24614 | 34775 | 64863 | 104056 | 135974 | 167382 | 172794 |
| Gasoline 1,4 - 2,0 l | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23036 |
| Gasoline >2,0 l | PRE ECE | 231 | 243 | 212 | 220 | 230 | 306 | 230 | 309 | 373 | 471 | 537 | 618 |
| Gasoline >2,0 l | ECE 15/00-01 | 304 | 273 | 223 | 195 | 202 | 222 | 150 | 197 | 239 | 270 | 293 | 321 |
| Gasoline >2,0 l | ECE 15/02 | 495 | 396 | 290 | 230 | 195 | 207 | 134 | 152 | 228 | 277 | 284 | 318 |
| Gasoline >2,0 l | ECE 15/03 | 1023 | 882 | 701 | 551 | 432 | 332 | 195 | 213 | 333 | 405 | 458 | 502 |
| Gasoline >2,0 l | ECE 15/04 | 11860 | 11566 | 11024 | 10036 | 8705 | 7410 | 3958 | 3667 | 3474 | 2889 | 2465 | 2273 |
| Gasoline >2,0 l | PC Euro 1 - 91/441/EEC | 14871 | 15066 | 15089 | 15088 | 14731 | 13961 | 8705 | 8860 | 8693 | 7847 | 6912 | 6067 |
| Gasoline >2,0 l | PC Euro 2 - 94/12/EEC | 12940 | 14495 | 15127 | 15723 | 16068 | 16180 | 10882 | 12254 | 13301 | 13085 | 12720 | 12078 |
| Gasoline >2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 2328 | 4163 | 6035 | 8222 | 9747 | 6972 | 8526 | 9737 | 10185 | 10348 | 10270 |
| Gasoline >2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 1333 | 2112 | 4307 | 6995 | 9381 | 10872 | 11228 |
| Gasoline >2,0 l | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 423 |
| Diesel 1,4 - 2,0 l | Conventional | 99524 | 97670 | 95145 | 93398 | 87789 | 79063 | 45729 | 44806 | 41624 | 35269 | 29654 | 25149 |
| Diesel 1,4 - 2,0 l | PC Euro 1 - 91/441/EEC | 23041 | 24104 | 24935 | 25971 | 27085 | 27586 | 19028 | 21060 | 22047 | 21008 | 19263 | 17728 |
| Diesel 1,4 - 2,0 l | PC Euro 2 - 94/12/EEC | 41099 | 47629 | 57070 | 70788 | 81202 | 88061 | 65205 | 75126 | 83052 | 87288 | 87136 | 86101 |
| Diesel 1,4 - 2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 15304 | 50243 | 103211 | 181861 | 206600 | 161431 | 204048 | 234271 | 247671 | 254578 | 256776 |
| Diesel 1,4 - 2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 51816 | 70772 | 130164 | 204960 | 277959 | 351645 | 379337 |
| Diesel 1,4 - 2,0 l | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48993 |
| Diesel >2,0 l | Conventional | 8909 | 8735 | 8484 | 8140 | 7994 | 7612 | 6814 | 7134 | 7121 | 6573 | 6076 | 5710 |
| Diesel >2,0 l | PC Euro 1 - 91/441/EEC | 4805 | 5039 | 5262 | 5466 | 5726 | 5975 | 7423 | 8279 | 8646 | 8406 | 7935 | 7349 |
| Diesel >2,0 l | PC Euro 2 - 94/12/EEC | 6639 | 8039 | 9560 | 11711 | 13611 | 15357 | 15473 | 18845 | 21312 | 22623 | 22871 | 22614 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diesel >2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 0 | 2188 | 6184 | 12763 | 24106 | 31143 | 27321 | 36976 | 44507 | 48483 | 50795 | 51603 |
| Diesel >2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 6493 | 12862 | 27943 | 46495 | 62215 | 74015 | 77767 |
| Diesel >2,0 l | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5524 |
| LPG | Conventional | 17741 | 19788 | 20613 | 20818 | 18804 | 16337 | 9039 | 7637 | 6124 | 4823 | 3797 | 3300 |
| LPG | PC Euro 1 - 91/441/EEC | 14231 | 18164 | 22178 | 26315 | 29268 | 31112 | 21027 | 20965 | 19099 | 16536 | 13463 | 11583 |
| LPG | PC Euro 2 - 94/12/EEC | 14498 | 19674 | 24374 | 29613 | 33733 | 37601 | 27416 | 29475 | 29629 | 29116 | 27173 | 26768 |
| LPG | PC Euro 3 - 98/69/EC Stage2000 | 0 | 2660 | 6732 | 12198 | 18440 | 21037 | 15436 | 16870 | 17203 | 17388 | 16995 | 17558 |
| LPG | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 4575 | 6895 | 11710 | 16769 | 21185 | 25142 | 26537 |
| LPG | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3677 |
| CNG | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 3007 | 6042 | 5997 | 9023 | 12364 | 15127 | 17794 | 15183 |
| CNG | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 651 |
| 2-Stroke | Conventional | 532 | 352 | 252 | 186 | 141 | 84 | 55 | 67 | 83 | 95 | 99 | 102 |
| 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 | 15938 | 9385 | 7688 | 6340 | 4955 | 5852 | 2150 | 1736 | 1510 | 1197 | 1059 | 888 |
| Gasoline <3,5t | LD Euro 1 - 93/59/EEC | 19345 | 16585 | 15819 | 15052 | 13882 | 15079 | 4989 | 4426 | 4039 | 3370 | 2785 | 2238 |
| Gasoline <3,5t | LD Euro 2 - 96/69/EEC | 28040 | 27929 | 27988 | 27775 | 27081 | 28740 | 6257 | 6737 | 6660 | 6340 | 5869 | 5306 |
| Gasoline <3,5t | LD Euro 3 - 98/69/EC Stage2000 | 0 | 4891 | 9826 | 13291 | 15322 | 18653 | 7746 | 7920 | 7841 | 7681 | 7326 | 7033 |
| Gasoline <3,5t | LD Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 1238 | 2828 | 4899 | 6095 | 7463 | 7274 |
| Gasoline <3,5t | LD Euro 5 - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1142 |
| Diesel <3,5 t | Conventional | 55114 | 48668 | 44853 | 41364 | 37078 | 36252 | 21224 | 19773 | 18131 | 15855 | 13955 | 12297 |
| Diesel <3,5 t | LD Euro 1 - 93/59/EEC | 47750 | 44046 | 42724 | 41869 | 40397 | 43270 | 25565 | 24590 | 23377 | 21534 | 19606 | 17462 |
| Diesel <3,5 t | LD Euro 2 - 96/69/EEC | 40460 | 38727 | 39087 | 39982 | 40408 | 45523 | 27308 | 27978 | 28564 | 28286 | 27073 | 26143 |
| Diesel <3,5 t | LD Euro 3 - 98/69/EC Stage2000 | 0 | 2793 | 8392 | 16821 | 25614 | 93720 | 58245 | 61460 | 65279 | 68575 | 69952 | 69329 |
| Diesel <3,5 t | LD Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 16689 | 38753 | 64264 | 82506 | 99754 | 101604 |
| Diesel <3,5 t | LD Euro 5 - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16860 |
| Gasoline >3,5 t | Conventional | 993 | 4494 | 3619 | 3021 | 2295 | 318 | 217 | 183 | 177 | 124 | 81 | 83 |
| Rigid <=7,5 t | Conventional | 17453 | 14555 | 12444 | 10352 | 7974 | 6078 | 4507 | 4261 | 4094 | 3829 | 3494 | 3409 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rigid <=7,5 t | HD Euro I - 91/542/EEC Stage I | 6803 | 5772 | 5054 | 4352 | 3544 | 2993 | 2364 | 2268 | 2248 | 2083 | 1912 | 1719 |
| Rigid <=7,5 t | HD Euro II - 91/542/EEC Stage II | 1023 0 | 9013 | 8283 | 7612 | 6792 | 6600 | 5016 | 5018 | 4936 | 4972 | 4717 | 4546 |
| Rigid <=7,5 t | HD Euro III - 2000 Standards | 0 | 7617 | 1868 0 | 3087 5 | 4542 9 | 4629 | 3670 | 3669 | 3677 | 3685 | 3755 | 3695 |
| Rigid <=7,5 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 461 | 1063 | 1868 | 1959 | 2085 | 2159 |
| Rigid <=7,5 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 478 | 841 | 1167 |
| Rigid 7,5 - 12 t | Conventional | 5755 | 4057 | 3445 | 2933 | 2470 | 2062 | 1516 | 1356 | 1226 | 1112 | 963 | 874 |
| Rigid 7,5 - 12 t | HD Euro I - 91/542/EEC Stage I | 813 | 1391 | 1371 | 1292 | 1200 | 498 | 404 | 398 | 395 | 373 | 354 | 329 |
| Rigid 7,5 - 12 t | HD Euro II - 91/542/EEC Stage II | 1252 | 2412 | 2501 | 2512 | 2476 | 1389 | 1245 | 1310 | 1344 | 1395 | 1383 | 1378 |
| Rigid 7,5 - 12 t | HD Euro III - 2000 Standards | 0 | 385 | 695 | 974 | 1293 | 983 | 919 | 1018 | 1126 | 1205 | 1288 | 1311 |
| Rigid 7,5 - 12 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 193 | 412 | 646 | 676 | 747 | 797 |
| Rigid 7,5 - 12 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 124 | 238 | 350 |
| Rigid 12 - 14 t | Conventional | 5755 | 4057 | 3445 | 2933 | 2470 | 2062 | 1516 | 1356 | 1226 | 1112 | 963 | 874 |
| Rigid 12 - 14 t | HD Euro I - 91/542/EEC Stage I | 813 | 1391 | 1371 | 1292 | 1200 | 498 | 404 | 398 | 395 | 373 | 354 | 329 |
| Rigid 12 - 14 t | HD Euro II - 91/542/EEC Stage II | 1252 | 2412 | 2501 | 2512 | 2476 | 1389 | 1245 | 1310 | 1344 | 1395 | 1383 | 1378 |
| Rigid 12 - 14 t | HD Euro III - 2000 Standards | 0 | 385 | 695 | 974 | 1293 | 983 | 919 | 1018 | 1126 | 1205 | 1288 | 1311 |
| Rigid 12 - 14 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 193 | 412 | 646 | 676 | 747 | 797 |
| Rigid 12 - 14 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 124 | 238 | 350 |
| Rigid 14 - 20 t | Conventional | 7812 | 6485 | 5563 | 4738 | 3957 | 3005 | 2181 | 1937 | 1750 | 1574 | 1345 | 1196 |
| Rigid 14 - 20 t | HD Euro I - 91/542/EEC Stage I | 1390 | 1748 | 1762 | 1685 | 1577 | 1047 | 824 | 796 | 764 | 719 | 652 | 604 |
| Rigid 14 - 20 t | HD Euro II - 91/542/EEC Stage II | 2304 | 3334 | 3627 | 3760 | 3891 | 3256 | 2906 | 3021 | 3057 | 3121 | 3008 | 2922 |
| Rigid 14 - 20 t | HD Euro III - 2000 Standards | 0 | 501 | 1086 | 1661 | 2462 | 3105 | 3388 | 3930 | 4275 | 4338 | 4290 | 4023 |
| Rigid 14 - 20 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 861 | 2254 | 3710 | 3883 | 4328 | 4480 |
| Rigid 14 - 20 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 381 | 905 | 1722 |
| Rigid 20 - 26 t | Conventional | 2057 | 2428 | 2118 | 1804 | 1488 | 943 | 665 | 585 | 524 | 463 | 382 | 322 |
| Rigid 20 - 26 t | HD Euro I - 91/542/EEC Stage I | 577 | 354 | 395 | 393 | 378 | 549 | 417 | 398 | 369 | 346 | 297 | 275 |
| Rigid 20 - 26 t | HD Euro II - 91/542/EEC Stage II | 1052 | 922 | 1126 | 1252 | 1415 | 1867 | 1662 | 1711 | 1713 | 1726 | 1626 | 1544 |
| Rigid 20 - 26 t | HD Euro III - 2000 Standards | 0 | 119 | 391 | 688 | 1169 | 2122 | 2466 | 2912 | 3153 | 3133 | 3002 | 2712 |
| Rigid 20 - 26 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 668 | 1842 | 3064 | 3207 | 3582 | 3683 |
| Rigid 20 - 26 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 253 | 667 | 1372 |
| Rigid 26 - 28 t | Conventional | 2057 | 2428 | 2118 | 1804 | 1488 | 943 | 665 | 585 | 524 | 463 | 382 | 322 |
| Rigid 26 - 28 t | HD Euro I - | 577 | 354 | 395 | 393 | 378 | 549 | 417 | 398 | 369 | 346 | 297 | 275 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91/542/EEC Stage I | | | | | | | | | | | | |
| Rigid 26 - 28 t | HD Euro II - 91/542/EEC Stage II | 1052 | 922 | 1126 | 1252 | 1415 | 1867 | 1662 | 1711 | 1713 | 1726 | 1626 | 1544 |
| Rigid 26 - 28 t | HD Euro III - 2000 Standards | 0 | 119 | 391 | 688 | 1169 | 2122 | 2466 | 2912 | 3153 | 3133 | 3002 | 2712 |
| Rigid 26 - 28 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 668 | 1842 | 3064 | 3207 | 3582 | 3683 |
| Rigid 26 - 28 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 253 | 667 | 1372 |
| Rigid 28 - 32 t | Conventional | 2057 | 2428 | 2118 | 1804 | 1488 | 943 | 665 | 585 | 524 | 463 | 382 | 322 |
| Rigid 28 - 32 t | HD Euro I - 91/542/EEC Stage I | 577 | 354 | 395 | 393 | 378 | 549 | 417 | 398 | 369 | 346 | 297 | 275 |
| Rigid 28 - 32 t | HD Euro II - 91/542/EEC Stage II | 1052 | 922 | 1126 | 1252 | 1415 | 1867 | 1662 | 1711 | 1713 | 1726 | 1626 | 1544 |
| Rigid 28 - 32 t | HD Euro III - 2000 Standards | 0 | 119 | 391 | 688 | 1169 | 2122 | 2466 | 2912 | 3153 | 3133 | 3002 | 2712 |
| Rigid 28 - 32 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 668 | 1842 | 3064 | 3207 | 3582 | 3683 |
| Rigid 28 - 32 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 253 | 667 | 1372 |
| Rigid >32 t | Conventional | 94 | 1581 | 1399 | 1236 | 1020 | 52 | 37 | 39 | 30 | 31 | 26 | 22 |
| Rigid >32 t | HD Euro I - 91/542/EEC Stage I | 75 | 664 | 664 | 644 | 612 | 68 | 51 | 49 | 48 | 47 | 43 | 35 |
| Rigid >32 t | HD Euro II - 91/542/EEC Stage II | 228 | 1192 | 1304 | 1427 | 1501 | 318 | 295 | 313 | 314 | 264 | 252 | 215 |
| Rigid >32 t | HD Euro III - 2000 Standards | 0 | 131 | 312 | 572 | 989 | 322 | 302 | 345 | 377 | 369 | 357 | 316 |
| Rigid >32 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 153 | 359 | 524 | 536 | 524 | 426 |
| Rigid >32 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 56 | 81 |
| Articulated 14 - 20 t | Conventional | 7812 | 6485 | 5563 | 4738 | 3957 | 3005 | 2181 | 1937 | 1750 | 1574 | 1345 | 1196 |
| Articulated 14 - 20 t | HD Euro I - 91/542/EEC Stage I | 1390 | 1748 | 1762 | 1685 | 1577 | 1047 | 824 | 796 | 764 | 719 | 652 | 604 |
| Articulated 14 - 20 t | HD Euro II - 91/542/EEC Stage II | 2304 | 3334 | 3627 | 3760 | 3891 | 3256 | 2906 | 3021 | 3057 | 3121 | 3008 | 2922 |
| Articulated 14 - 20 t | HD Euro III - 2000 Standards | 0 | 501 | 1086 | 1661 | 2462 | 3105 | 3388 | 3930 | 4275 | 4338 | 4290 | 4023 |
| Articulated 14 - 20 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 861 | 2254 | 3710 | 3883 | 4328 | 4480 |
| Articulated 14 - 20 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 381 | 905 | 1722 |
| Articulated 20 - 28 t | Conventional | 2057 | 2428 | 2118 | 1804 | 1488 | 943 | 665 | 585 | 524 | 463 | 382 | 322 |
| Articulated 20 - 28 t | HD Euro I - 91/542/EEC Stage I | 577 | 354 | 395 | 393 | 378 | 549 | 417 | 398 | 369 | 346 | 297 | 275 |
| Articulated 20 - 28 t | HD Euro II - 91/542/EEC Stage II | 1052 | 922 | 1126 | 1252 | 1415 | 1867 | 1662 | 1711 | 1713 | 1726 | 1626 | 1544 |
| Articulated 20 - 28 t | HD Euro III - 2000 Standards | 0 | 119 | 391 | 688 | 1169 | 2122 | 2466 | 2912 | 3153 | 3133 | 3002 | 2712 |
| Articulated 20 - 28 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 668 | 1842 | 3064 | 3207 | 3582 | 3683 |
| Articulated 20 - 28 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 253 | 667 | 1372 |
| Articulated 28 - 34 t | Conventional | 2151 | 4005 | 3516 | 3041 | 2508 | 995 | 702 | 623 | 554 | 494 | 408 | 344 |
| Articulated 28 - 34 t | HD Euro I - 91/542/EEC Stage I | 652 | 1017 | 1059 | 1037 | 989 | 613 | 471 | 447 | 417 | 393 | 340 | 309 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Articulated 28 - 34 t | HD Euro II - 91/542/EEC Stage II | 1280 | 2114 | 2430 | 2675 | 2916 | 2181 | 1957 | 2021 | 2027 | 1990 | 1878 | 1759 |
| Articulated 28 - 34 t | HD Euro III - 2000 Standards | 0 | 250 | 703 | 1260 | 2158 | 2448 | 2771 | 3257 | 3529 | 3502 | 3358 | 3028 |
| Articulated 28 - 34 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 821 | 2201 | 3588 | 3743 | 4106 | 4109 |
| Articulated 28 - 34 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 288 | 723 | 1453 |
| Articulated 34 - 40 t | Conventional | 94 | 1581 | 1399 | 1236 | 1020 | 52 | 37 | 39 | 30 | 31 | 26 | 22 |
| Articulated 34 - 40 t | HD Euro I - 91/542/EEC Stage I | 75 | 664 | 664 | 644 | 612 | 68 | 51 | 49 | 48 | 47 | 43 | 35 |
| Articulated 34 - 40 t | HD Euro II - 91/542/EEC Stage II | 228 | 1192 | 1304 | 1427 | 1501 | 318 | 295 | 313 | 314 | 264 | 252 | 215 |
| Articulated 34 - 40 t | HD Euro III - 2000 Standards | 0 | 131 | 312 | 572 | 989 | 322 | 302 | 345 | 377 | 369 | 357 | 316 |
| Articulated 34 - 40 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 153 | 359 | 524 | 536 | 524 | 426 |
| Articulated 34 - 40 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 56 | 81 |
| Articulated 40 - 50 t | Conventional | 94 | 1581 | 1399 | 1236 | 1020 | 52 | 37 | 39 | 30 | 31 | 26 | 22 |
| Articulated 40 - 50 t | HD Euro I - 91/542/EEC Stage I | 75 | 664 | 664 | 644 | 612 | 68 | 51 | 49 | 48 | 47 | 43 | 35 |
| Articulated 40 - 50 t | HD Euro II - 91/542/EEC Stage II | 228 | 1192 | 1304 | 1427 | 1501 | 318 | 295 | 313 | 314 | 264 | 252 | 215 |
| Articulated 40 - 50 t | HD Euro III - 2000 Standards | 0 | 131 | 312 | 572 | 989 | 322 | 302 | 345 | 377 | 369 | 357 | 316 |
| Articulated 40 - 50 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 153 | 359 | 524 | 536 | 524 | 426 |
| Articulated 40 - 50 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 56 | 81 |
| Articulated 50 - 60 t | Conventional | 94 | 1581 | 1399 | 1236 | 1020 | 52 | 37 | 39 | 30 | 31 | 26 | 22 |
| Articulated 50 - 60 t | HD Euro I - 91/542/EEC Stage I | 75 | 664 | 664 | 644 | 612 | 68 | 51 | 49 | 48 | 47 | 43 | 35 |
| Articulated 50 - 60 t | HD Euro II - 91/542/EEC Stage II | 228 | 1192 | 1304 | 1427 | 1501 | 318 | 295 | 313 | 314 | 264 | 252 | 215 |
| Articulated 50 - 60 t | HD Euro III - 2000 Standards | 0 | 131 | 312 | 572 | 989 | 322 | 302 | 345 | 377 | 369 | 357 | 316 |
| Articulated 50 - 60 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 153 | 359 | 524 | 536 | 524 | 426 |
| Articulated 50 - 60 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 56 | 81 |
| Urban Buses Midi <=15 t | Conventional | 4001 | 3363 | 3039 | 2525 | 1629 | 1298 | 675 | 504 | 359 | 263 | 141 | 104 |
| Urban Buses Midi <=15 t | HD Euro I - 91/542/EEC Stage I | 486 | 503 | 510 | 517 | 422 | 427 | 444 | 435 | 390 | 324 | 258 | 186 |
| Urban Buses Midi <=15 t | HD Euro II - 91/542/EEC Stage II | 1926 | 2107 | 2196 | 2307 | 1998 | 2087 | 1321 | 1384 | 1416 | 1345 | 1214 | 1085 |
| Urban Buses Midi <=15 t | HD Euro III - 2000 Standards | 0 | 406 | 686 | 1153 | 1281 | 1693 | 1051 | 1137 | 1201 | 1204 | 1174 | 1119 |
| Urban Buses Midi <=15 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 202 | 415 | 729 | 728 | 736 | 719 |
| Urban Buses Midi <=15 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 212 | 448 | 640 |
| Urban Buses Standard 15 - 18 t | Conventional | 4001 | 3363 | 3039 | 2525 | 1629 | 1298 | 675 | 504 | 359 | 263 | 141 | 104 |
| Urban Buses | HD Euro I - | 486 | 503 | 510 | 517 | 422 | 427 | 444 | 435 | 390 | 324 | 258 | 186 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard 15 - 18 t | 91/542/EEC Stage I | | | | | | | | | | | | |
| Urban Buses Standard 15 - 18 t | HD Euro II - 91/542/EEC Stage II | 1926 | 2107 | 2196 | 2307 | 1998 | 2087 | 1321 | 1384 | 1416 | 1345 | 1214 | 1085 |
| Urban Buses Standard 15 - 18 t | HD Euro III - 2000 Standards | 0 | 406 | 686 | 1153 | 1281 | 1693 | 1051 | 1137 | 1201 | 1204 | 1174 | 1119 |
| Urban Buses Standard 15 - 18 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 202 | 415 | 729 | 728 | 736 | 719 |
| Urban Buses Standard 15 - 18 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 212 | 448 | 640 |
| Urban Buses Articulated >18 t | Conventional | 4001 | 3363 | 3039 | 2525 | 1629 | 1298 | 675 | 504 | 359 | 263 | 141 | 104 |
| Urban Buses Articulated >18 t | HD Euro I - 91/542/EEC Stage I | 486 | 503 | 510 | 517 | 422 | 427 | 444 | 435 | 390 | 324 | 258 | 186 |
| Urban Buses Articulated >18 t | HD Euro II - 91/542/EEC Stage II | 1926 | 2107 | 2196 | 2307 | 1998 | 2087 | 1321 | 1384 | 1416 | 1345 | 1214 | 1085 |
| Urban Buses Articulated >18 t | HD Euro III - 2000 Standards | 0 | 406 | 686 | 1153 | 1281 | 1693 | 1051 | 1137 | 1201 | 1204 | 1174 | 1119 |
| Urban Buses Articulated >18 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 202 | 415 | 729 | 728 | 736 | 719 |
| Urban Buses Articulated >18 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 212 | 448 | 640 |
| Coaches Standard <=18 t | Conventional | 6506 | 5953 | 5196 | 4574 | 3084 | 2416 | 1003 | 761 | 544 | 384 | 211 | 151 |
| Coaches Standard <=18 t | HD Euro I - 91/542/EEC Stage I | 2225 | 2319 | 2313 | 2346 | 1835 | 1824 | 665 | 652 | 595 | 486 | 393 | 279 |
| Coaches Standard <=18 t | HD Euro II - 91/542/EEC Stage II | 2804 | 3170 | 3411 | 3619 | 3124 | 3550 | 1986 | 2075 | 2114 | 2023 | 1820 | 1627 |
| Coaches Standard <=18 t | HD Euro III - 2000 Standards | 0 | 425 | 1020 | 1551 | 1961 | 2531 | 1572 | 1710 | 1806 | 1800 | 1766 | 1674 |
| Coaches Standard <=18 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 299 | 623 | 1108 | 1092 | 1104 | 1078 |
| Coaches Standard <=18 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 324 | 677 | 960 |
| Coaches Articulated >18 t | Conventional | 6506 | 5953 | 5196 | 4574 | 3084 | 2416 | 1003 | 761 | 544 | 384 | 211 | 151 |
| Coaches Articulated >18 t | HD Euro I - 91/542/EEC Stage I | 2225 | 2319 | 2313 | 2346 | 1835 | 1824 | 665 | 652 | 595 | 486 | 393 | 279 |
| Coaches Articulated >18 t | HD Euro II - 91/542/EEC Stage II | 2804 | 3170 | 3411 | 3619 | 3124 | 3550 | 1986 | 2075 | 2114 | 2023 | 1820 | 1627 |
| Coaches Articulated >18 t | HD Euro III - 2000 Standards | 0 | 425 | 1020 | 1551 | 1961 | 2531 | 1572 | 1710 | 1806 | 1800 | 1766 | 1674 |
| Coaches Articulated >18 t | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 299 | 623 | 1108 | 1092 | 1104 | 1078 |
| Coaches Articulated >18 t | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 324 | 677 | 960 |
| 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 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Urban Biodiesel Buses | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Biodiesel Buses | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Biodiesel Buses | HD Euro IV - 2005 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Biodiesel Buses | HD Euro V - 2008 Standards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2-stroke <50 cm$^3$ | Conventional | 286047 | 288290 | 195658 | 166876 | 22107 | 23047 | 14081 | 14898 | 16063 | 16554 | 17053 | 18175 |
| 2-stroke <50 cm$^3$ | Mop - Euro I | 0 | 0 | 82018 | 92950 | 13303 | 12331 | 7325 | 7515 | 7805 | 7741 | 7684 | 7468 |
| 2-stroke <50 cm$^3$ | Mop - Euro II | 0 | 0 | 12955 | 33402 | 9276 | 13468 | 11969 | 16987 | 22933 | 26971 | 30246 | 32377 |
| 2-stroke <50 cm$^3$ | Mop - Euro III | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2-stroke >50 cm$^3$ | Conventional | 17105 | 14318 | 13181 | 10392 | 3668 | 3506 | 1247 | 970 | 1060 | 1159 | 1241 | 1286 |
| 2-stroke >50 cm$^3$ | Mot - Euro I | 263 | 358 | 578 | 594 | 216 | 209 | 151 | 192 | 265 | 310 | 301 | 321 |
| 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 | 64862 | 59044 | 55055 | 56326 | 18963 | 18074 | 5897 | 4142 | 4189 | 4065 | 3908 | 3755 |
| 4-stroke <250 cm$^3$ | Mot - Euro I | 25295 | 33212 | 37439 | 45277 | 17982 | 19167 | 8049 | 7572 | 9465 | 10772 | 11406 | 11829 |
| 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 | 68968 | 63894 | 56355 | 47971 | 16801 | 16314 | 6960 | 7315 | 7528 | 7496 | 7440 | 7352 |
| 4-stroke 250 - 750 cm$^3$ | Mot - Euro I | 19652 | 25304 | 32138 | 37770 | 17474 | 21066 | 10900 | 16752 | 20483 | 23182 | 25032 | 26343 |
| 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 | 28237 | 25810 | 23557 | 19617 | 7053 | 6846 | 3070 | 3438 | 3576 | 3618 | 3619 | 3591 |
| 4-stroke >750 cm$^3$ | Mot - Euro I | 11945 | 15815 | 21329 | 24494 | 11112 | 12669 | 6606 | 10539 | 13545 | 15729 | 17441 | 19323 |
| 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 263 Mileage data for Road transport (average km/ year/vehicle) 1988-1999

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gasoline 0,8 - 1,4 l | PRE ECE | 15053 | 16132 | 14159 | 6635 | 5697 | 6088 | 5665 | 5799 | 4672 | 2959 | 3637 | 3296 |
| Gasoline 0,8 - 1,4 l | ECE 15/00-01 | 18131 | 19431 | 17055 | 7992 | 6861 | 7333 | 6824 | 6985 | 5627 | 3564 | 4381 | 3970 |
| Gasoline 0,8 - 1,4 l | ECE 15/02 | 18361 | 19676 | 17271 | 8093 | 6948 | 7425 | 6910 | 7073 | 5699 | 3609 | 4436 | 4021 |
| Gasoline 0,8 - 1,4 l | ECE 15/03 | 21637 | 23188 | 20353 | 9537 | 8188 | 8751 | 8143 | 8336 | 6716 | 4254 | 5228 | 4738 |
| Gasoline 0,8 - 1,4 l | ECE 15/04 | 29068 | 31150 | 27342 | 12812 | 11000 | 11755 | 10940 | 11198 | 9022 | 5714 | 7023 | 6365 |
| Gasoline 0,8 - 1,4 l | Improved Conventional | 23877 | 25588 | 22459 | 10524 | 9036 | 9656 | 8986 | 9198 | 7411 | 4694 | 5769 | 5228 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gasoline 0,8 - 1,4 l | Open Loop | 25901 | 27757 | 24363 | 11416 | 9802 | 10475 | 9748 | 9978 | 8039 | 5092 | 6258 | 5672 |
| Gasoline 0,8 - 1,4 l | PC Euro 1 - 91/441/EEC | 34992 | 37500 | 32914 | 15423 | 13242 | 14151 | 13169 | 13481 | 10860 | 6879 | 8455 | 7662 |
| Gasoline 0,8 - 1,4 l | PC Euro 2 - 94/12/EEC | 40546 | 43451 | 38138 | 17871 | 15344 | 16397 | 15259 | 15620 | 12584 | 7971 | 9797 | 8878 |
| Gasoline 0,8 - 1,4 l | PC Euro 3 - 98/69/EC Stage2000 | 46783 | 50135 | 44005 | 20620 | 17704 | 18920 | 17607 | 18023 | 14520 | 9197 | 11304 | 10244 |
| Gasoline 0,8 - 1,4 l | PC Euro 4 - 98/69/EC Stage2005 | 49560 | 53112 | 46618 | 21845 | 18755 | 20043 | 18652 | 19093 | 15382 | 9743 | 11975 | 10852 |
| Gasoline 0,8 - 1,4 l | PC Euro 5 - EC 715/2007 | 55456 | 59429 | 52163 | 24443 | 20986 | 22427 | 20871 | 21364 | 17212 | 10902 | 13399 | 12143 |
| Gasoline 1,4 - 2,0 l | PRE ECE | 16133 | 17289 | 15175 | 7111 | 6105 | 6524 | 6072 | 6215 | 5007 | 3171 | 3898 | 3533 |
| Gasoline 1,4 - 2,0 l | ECE 15/00-01 | 19315 | 20699 | 18168 | 8513 | 7309 | 7811 | 7269 | 7441 | 5995 | 3797 | 4667 | 4230 |
| Gasoline 1,4 - 2,0 l | ECE 15/02 | 20264 | 21716 | 19061 | 8932 | 7669 | 8195 | 7626 | 7807 | 6289 | 3984 | 4896 | 4437 |
| Gasoline 1,4 - 2,0 l | ECE 15/03 | 23227 | 24891 | 21847 | 10238 | 8790 | 9393 | 8741 | 8948 | 7209 | 4566 | 5612 | 5086 |
| Gasoline 1,4 - 2,0 l | ECE 15/04 | 31237 | 33475 | 29382 | 13768 | 11821 | 12633 | 11756 | 12034 | 9695 | 6141 | 7547 | 6840 |
| Gasoline 1,4 - 2,0 l | Improved Conventional | 23877 | 25588 | 22459 | 10524 | 9036 | 9656 | 8986 | 9198 | 7411 | 4694 | 5769 | 5228 |
| Gasoline 1,4 - 2,0 l | Open Loop | 29401 | 31507 | 27655 | 12959 | 11126 | 11890 | 11065 | 11326 | 9125 | 5780 | 7104 | 6438 |
| Gasoline 1,4 - 2,0 l | PC Euro 1 - 91/441/EEC | 38655 | 41425 | 36360 | 17038 | 14628 | 15633 | 14548 | 14892 | 11997 | 7599 | 9340 | 8464 |
| Gasoline 1,4 - 2,0 l | PC Euro 2 - 94/12/EEC | 43591 | 46714 | 41003 | 19213 | 16496 | 17629 | 16405 | 16793 | 13529 | 8569 | 10532 | 9545 |
| Gasoline 1,4 - 2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 50300 | 53904 | 47313 | 22170 | 19035 | 20342 | 18930 | 19378 | 15611 | 9888 | 12153 | 11014 |
| Gasoline 1,4 - 2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 55826 | 59827 | 52511 | 24606 | 21126 | 22577 | 21010 | 21507 | 17327 | 10975 | 13489 | 12225 |
| Gasoline 1,4 - 2,0 l | PC Euro 5 - EC 715/2007 | 61649 | 66066 | 57988 | 27173 | 23330 | 24932 | 23201 | 23750 | 19134 | 12119 | 14895 | 13499 |
| Gasoline >2,0 l | PRE ECE | 16967 | 18182 | 15959 | 7478 | 6421 | 6862 | 6385 | 6536 | 5266 | 3335 | 4099 | 3715 |
| Gasoline >2,0 l | ECE 15/00-01 | 20297 | 21751 | 19091 | 8946 | 7681 | 8208 | 7639 | 7819 | 6299 | 3990 | 4904 | 4444 |
| Gasoline >2,0 l | ECE 15/02 | 20651 | 22130 | 19424 | 9102 | 7815 | 8351 | 7772 | 7956 | 6409 | 4060 | 4990 | 4522 |
| Gasoline >2,0 l | ECE 15/03 | 24493 | 26248 | 23039 | 10796 | 9269 | 9906 | 9218 | 9436 | 7602 | 4815 | 5918 | 5363 |
| Gasoline >2,0 l | ECE 15/04 | 32495 | 34824 | 30566 | 14323 | 12297 | 13142 | 12230 | 12519 | 10086 | 6388 | 7851 | 7116 |
| Gasoline >2,0 l | PC Euro 1 - 91/441/EEC | 39603 | 42440 | 37251 | 17456 | 14987 | 16016 | 14904 | 15257 | 12291 | 7785 | 9569 | 8672 |
| Gasoline >2,0 l | PC Euro 2 - 94/12/EEC | 46525 | 49859 | 43763 | 20507 | 17607 | 18816 | 17510 | 17924 | 14440 | 9146 | 11241 | 10188 |
| Gasoline >2,0 l | PC Euro 3 - 98/69/EC | 51798 | 55509 | 48722 | 22831 | 19602 | 20948 | 19494 | 19955 | 16076 | 10183 | 12515 | 11342 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stage2000 | | | | | | | | | | | | |
| Gasoline >2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 58230 | 62403 | 54773 | 25666 | 22036 | 23549 | 21915 | 22433 | 18073 | 11447 | 14069 | 12751 |
| Gasoline >2,0 l | PC Euro 5 - EC 715/2007 | 64328 | 68937 | 60508 | 28354 | 24343 | 26015 | 24210 | 24782 | 19965 | 12646 | 15543 | 14086 |
| Diesel 1,4 - 2,0 l | Conventional | 9304 | 8766 | 5050 | 3974 | 3680 | 3533 | 2298 | 2293 | 4039 | 7151 | 8372 | 8624 |
| Diesel 1,4 - 2,0 l | PC Euro 1 - 91/441/EEC | 10482 | 9875 | 5689 | 4477 | 4146 | 3980 | 2588 | 2584 | 4550 | 8056 | 9432 | 9715 |
| Diesel 1,4 - 2,0 l | PC Euro 2 - 94/12/EEC | 12346 | 11631 | 6700 | 5273 | 4883 | 4688 | 3049 | 3043 | 5359 | 9489 | 11110 | 11443 |
| Diesel 1,4 - 2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 14009 | 13198 | 7603 | 5984 | 5541 | 5319 | 3460 | 3453 | 6081 | 10767 | 12606 | 12984 |
| Diesel 1,4 - 2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 14132 | 13314 | 7670 | 6036 | 5589 | 5366 | 3490 | 3483 | 6135 | 10862 | 12717 | 13099 |
| Diesel 1,4 - 2,0 l | PC Euro 5 - EC 715/2007 | 15896 | 14976 | 8627 | 6790 | 6287 | 6035 | 3926 | 3918 | 6900 | 12217 | 14304 | 14734 |
| Diesel >2,0 l | Conventional | 10275 | 9680 | 5576 | 4389 | 4064 | 3901 | 2537 | 2533 | 4460 | 7897 | 9246 | 9523 |
| Diesel >2,0 l | PC Euro 1 - 91/441/EEC | 11641 | 10967 | 6318 | 4972 | 4604 | 4420 | 2875 | 2869 | 5053 | 8947 | 10475 | 10790 |
| Diesel >2,0 l | PC Euro 2 - 94/12/EEC | 13087 | 12329 | 7102 | 5590 | 5176 | 4969 | 3232 | 3226 | 5681 | 10058 | 11776 | 12130 |
| Diesel >2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 15298 | 14413 | 8303 | 6534 | 6051 | 5809 | 3778 | 3771 | 6641 | 11758 | 13766 | 14180 |
| Diesel >2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 15829 | 14912 | 8591 | 6761 | 6260 | 6010 | 3909 | 3902 | 6871 | 12166 | 14244 | 14671 |
| Diesel >2,0 l | PC Euro 5 - EC 715/2007 | 17658 | 16635 | 9583 | 7542 | 6984 | 6704 | 4361 | 4352 | 7665 | 13571 | 15890 | 16367 |
| LPG | Conventional | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 110810 | 47245 | 41868 |
| LPG | PC Euro 1 - 91/441/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 125776 | 53625 | 47523 |
| LPG | PC Euro 2 - 94/12/EEC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 133539 | 56935 | 50456 |
| LPG | PC Euro 3 - 98/69/EC Stage2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 139981 | 59682 | 52890 |
| LPG | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 136841 | 58343 | 51704 |
| LPG | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 143944 | 61371 | 54387 |
| CNG | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CNG | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2-Stroke | Conventional | 12572 | 13473 | 11826 | 5541 | 4758 | 5084 | 4732 | 4843 | 3902 | 2472 | 3038 | 2753 |
| Hybrid Gasoline <1,4 l | PC Euro 4 - 98/69/EC | 60802 | 65159 | 57192 | 26800 | 23009 | 24590 | 22883 | 23424 | 18871 | 11953 | 14691 | 13314 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stage2005 | | | | | | | | | | | | |
| Hybrid Gasoline 1,4 - 2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 61903 | 66338 | 58227 | 27285 | 23426 | 25034 | 23297 | 23848 | 19213 | 12169 | 14957 | 13555 |
| Hybrid Gasoline >2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 72149 | 77319 | 67865 | 31801 | 27303 | 29178 | 27153 | 27795 | 22393 | 14183 | 17433 | 15799 |
| Gasoline <3,5t | Conventional | 41301 | 44260 | 38848 | 18204 | 15629 | 16703 | 15544 | 15911 | 12818 | 8119 | 9979 | 9044 |
| Gasoline <3,5t | LD Euro 1 - 93/59/EEC | 47536 | 50942 | 44713 | 20952 | 17989 | 19224 | 17890 | 18313 | 14754 | 9345 | 11485 | 10409 |
| Gasoline <3,5t | LD Euro 2 - 96/69/EEC | 53174 | 56984 | 50017 | 23437 | 20123 | 21505 | 20012 | 20485 | 16504 | 10453 | 12848 | 11644 |
| Gasoline <3,5t | LD Euro 3 - 98/69/EC Stage2000 | 60322 | 64645 | 56740 | 26588 | 22828 | 24395 | 22702 | 23239 | 18722 | 11858 | 14575 | 13209 |
| Gasoline <3,5t | LD Euro 4 - 98/69/EC Stage2005 | 68208 | 73096 | 64158 | 30064 | 25812 | 27585 | 25670 | 26277 | 21170 | 13409 | 16480 | 14936 |
| Gasoline <3,5t | LD Euro 5 - 2008 Standards | 74602 | 79947 | 70172 | 32882 | 28231 | 30170 | 28076 | 28740 | 23154 | 14666 | 18025 | 16336 |
| Diesel <3,5 t | Conventional | 9582 | 9027 | 5200 | 4093 | 3790 | 3638 | 2366 | 2362 | 4159 | 7365 | 8622 | 8881 |
| Diesel <3,5 t | LD Euro 1 - 93/59/EEC | 11116 | 10473 | 6033 | 4748 | 4396 | 4221 | 2745 | 2740 | 4825 | 8544 | 10003 | 10303 |
| Diesel <3,5 t | LD Euro 2 - 96/69/EEC | 12228 | 11520 | 6636 | 5223 | 4836 | 4643 | 3020 | 3014 | 5308 | 9398 | 11004 | 11334 |
| Diesel <3,5 t | LD Euro 3 - 98/69/EC Stage2000 | 13342 | 12569 | 7241 | 5699 | 5277 | 5066 | 3295 | 3289 | 5791 | 10254 | 12006 | 12366 |
| Diesel <3,5 t | LD Euro 4 - 98/69/EC Stage2005 | 15384 | 14493 | 8349 | 6571 | 6084 | 5841 | 3799 | 3792 | 6678 | 11824 | 13843 | 14259 |
| Diesel <3,5 t | LD Euro 5 - 2008 Standards | 16497 | 15542 | 8953 | 7046 | 6524 | 6263 | 4074 | 4066 | 7161 | 12679 | 14845 | 15290 |
| Gasoline >3,5 t | Conventional | 54337 | 58230 | 51110 | 23950 | 20563 | 21975 | 20449 | 20933 | 16864 | 10682 | 13129 | 11898 |
| Rigid <=7,5 t | Conventional | 13872 | 13069 | 7528 | 5925 | 5486 | 5267 | 3426 | 3419 | 6021 | 10662 | 12483 | 12857 |
| Rigid <=7,5 t | HD Euro I - 91/542/EEC Stage I | 16265 | 15323 | 8827 | 6947 | 6433 | 6175 | 4017 | 4009 | 7060 | 12501 | 14636 | 15075 |
| Rigid <=7,5 t | HD Euro II - 91/542/EEC Stage II | 19162 | 18053 | 10400 | 8185 | 7579 | 7276 | 4732 | 4723 | 8318 | 14728 | 17243 | 17761 |
| Rigid <=7,5 t | HD Euro III - 2000 Standards | 22423 | 21125 | 12169 | 9578 | 8868 | 8514 | 5537 | 5527 | 9734 | 17234 | 20178 | 20784 |
| Rigid <=7,5 t | HD Euro IV - 2005 Standards | 24248 | 22844 | 13159 | 10357 | 9590 | 9206 | 5988 | 5977 | 10525 | 18636 | 21819 | 22474 |
| Rigid <=7,5 t | HD Euro V - 2008 Standards | 7536 | 7100 | 4090 | 3219 | 2981 | 2861 | 1861 | 1857 | 3271 | 5792 | 6781 | 6985 |
| Rigid 7,5 - 12 t | Conventional | 14270 | 13444 | 7745 | 6095 | 5644 | 5418 | 3524 | 3517 | 6194 | 10968 | 12841 | 13227 |
| Rigid 7,5 - 12 t | HD Euro I - 91/542/EEC Stage I | 17920 | 16883 | 9725 | 7654 | 7087 | 6804 | 4425 | 4417 | 7779 | 13773 | 16126 | 16610 |
| Rigid 7,5 - 12 t | HD Euro II - | 2104 | 1982 | 1142 | 8990 | 8324 | 7991 | 5197 | 5188 | 9136 | 1617 | 1893 | 1950 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91/542/EEC Stage II | 7 | 8 | 2 | | | | | | | 6 | 9 | 7 |
| Rigid 7,5 - 12 t | HD Euro III - 2000 Standards | 24890 | 23449 | 13508 | 10631 | 9844 | 9450 | 6147 | 6135 | 10804 | 19130 | 22398 | 23070 |
| Rigid 7,5 - 12 t | HD Euro IV - 2005 Standards | 27172 | 25598 | 14746 | 11606 | 10746 | 10317 | 6710 | 6697 | 11795 | 20884 | 24451 | 25185 |
| Rigid 7,5 - 12 t | HD Euro V - 2008 Standards | 7536 | 7100 | 4090 | 3219 | 2981 | 2861 | 1861 | 1857 | 3271 | 5792 | 6781 | 6985 |
| Rigid 12 - 14 t | Conventional | 12444 | 11724 | 6754 | 5315 | 4922 | 4725 | 3073 | 3067 | 5402 | 9564 | 11198 | 11534 |
| Rigid 12 - 14 t | HD Euro I - 91/542/EEC Stage I | 16254 | 15313 | 8821 | 6943 | 6428 | 6171 | 4014 | 4006 | 7056 | 12493 | 14626 | 15065 |
| Rigid 12 - 14 t | HD Euro II - 91/542/EEC Stage II | 19431 | 18306 | 10546 | 8300 | 7685 | 7378 | 4799 | 4789 | 8435 | 14934 | 17485 | 18010 |
| Rigid 12 - 14 t | HD Euro III - 2000 Standards | 24243 | 22839 | 13157 | 10355 | 9588 | 9205 | 5987 | 5975 | 10523 | 18633 | 21815 | 22470 |
| Rigid 12 - 14 t | HD Euro IV - 2005 Standards | 25002 | 23554 | 13569 | 10679 | 9888 | 9493 | 6174 | 6162 | 10853 | 19216 | 22498 | 23174 |
| Rigid 12 - 14 t | HD Euro V - 2008 Standards | 7536 | 7100 | 4090 | 3219 | 2981 | 2861 | 1861 | 1857 | 3271 | 5792 | 6781 | 6985 |
| Rigid 14 - 20 t | Conventional | 15662 | 14755 | 8500 | 6690 | 6194 | 5947 | 3868 | 3860 | 6799 | 12037 | 14094 | 14517 |
| Rigid 14 - 20 t | HD Euro I - 91/542/EEC Stage I | 19639 | 18502 | 10658 | 8388 | 7767 | 7457 | 4850 | 4841 | 8525 | 15094 | 17673 | 18203 |
| Rigid 14 - 20 t | HD Euro II - 91/542/EEC Stage II | 22632 | 21322 | 12283 | 9667 | 8951 | 8593 | 5589 | 5578 | 9824 | 17395 | 20366 | 20977 |
| Rigid 14 - 20 t | HD Euro III - 2000 Standards | 26240 | 24721 | 14241 | 11208 | 10378 | 9963 | 6480 | 6468 | 11390 | 20168 | 23613 | 24321 |
| Rigid 14 - 20 t | HD Euro IV - 2005 Standards | 26815 | 25263 | 14553 | 11454 | 10605 | 10181 | 6622 | 6609 | 11640 | 20610 | 24130 | 24854 |
| Rigid 14 - 20 t | HD Euro V - 2008 Standards | 7536 | 7100 | 4090 | 3219 | 2981 | 2861 | 1861 | 1857 | 3271 | 5792 | 6781 | 6985 |
| Rigid 20 - 26 t | Conventional | 15685 | 14777 | 8513 | 6700 | 6203 | 5955 | 3873 | 3866 | 6809 | 12055 | 14114 | 14538 |
| Rigid 20 - 26 t | HD Euro I - 91/542/EEC Stage I | 19901 | 18749 | 10800 | 8500 | 7871 | 7556 | 4915 | 4905 | 8639 | 15295 | 17908 | 18446 |
| Rigid 20 - 26 t | HD Euro II - 91/542/EEC Stage II | 22821 | 21499 | 12385 | 9747 | 9025 | 8664 | 5636 | 5625 | 9906 | 17539 | 20535 | 21152 |
| Rigid 20 - 26 t | HD Euro III - 2000 Standards | 27103 | 25534 | 14709 | 11577 | 10719 | 10291 | 6693 | 6680 | 11765 | 20831 | 24389 | 25121 |
| Rigid 20 - 26 t | HD Euro IV - 2005 Standards | 24692 | 23263 | 13401 | 10547 | 9766 | 9375 | 6098 | 6086 | 10718 | 18978 | 22220 | 22887 |
| Rigid 20 - 26 t | HD Euro V - 2008 Standards | 7536 | 7100 | 4090 | 3219 | 2981 | 2861 | 1861 | 1857 | 3271 | 5792 | 6781 | 6985 |
| Rigid 26 - 28 t | Conventional | 15623 | 14718 | 8479 | 6673 | 6179 | 5932 | 3858 | 3851 | 6782 | 12007 | 14058 | 14480 |
| Rigid 26 - 28 t | HD Euro I - 91/542/EEC Stage I | 19229 | 18116 | 10436 | 8213 | 7605 | 7301 | 4749 | 4740 | 8347 | 14779 | 17304 | 17823 |
| Rigid 26 - 28 t | HD Euro II - | 2210 | 2082 | 1199 | 9442 | 8743 | 8393 | 5459 | 5449 | 9596 | 1699 | 1989 | 2048 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91/542/EEC Stage II | 6 | 6 | 7 | | | | | | | 0 | 2 | 9 |
| Rigid 26 - 28 t | HD Euro III - 2000 Standards | 25976 | 24472 | 14097 | 11095 | 10273 | 9862 | 6415 | 6403 | 11276 | 19964 | 23375 | 24076 |
| Rigid 26 - 28 t | HD Euro IV - 2005 Standards | 26679 | 25135 | 14479 | 11395 | 10552 | 10130 | 6588 | 6576 | 11581 | 20505 | 24008 | 24728 |
| Rigid 26 - 28 t | HD Euro V - 2008 Standards | 7536 | 7100 | 4090 | 3219 | 2981 | 2861 | 1861 | 1857 | 3271 | 5792 | 6781 | 6985 |
| Rigid 28 - 32 t | Conventional | 15658 | 14752 | 8498 | 6688 | 6193 | 5945 | 3867 | 3859 | 6797 | 12035 | 14090 | 14513 |
| Rigid 28 - 32 t | HD Euro I - 91/542/EEC Stage I | 19481 | 18353 | 10572 | 8321 | 7705 | 7396 | 4811 | 4802 | 8456 | 14972 | 17530 | 18056 |
| Rigid 28 - 32 t | HD Euro II - 91/542/EEC Stage II | 22414 | 21117 | 12165 | 9574 | 8865 | 8510 | 5535 | 5525 | 9730 | 17227 | 20170 | 20775 |
| Rigid 28 - 32 t | HD Euro III - 2000 Standards | 26615 | 25074 | 14444 | 11368 | 10526 | 10105 | 6573 | 6560 | 11553 | 20456 | 23950 | 24669 |
| Rigid 28 - 32 t | HD Euro IV - 2005 Standards | 25088 | 23635 | 13615 | 10716 | 9922 | 9525 | 6195 | 6184 | 10890 | 19282 | 22575 | 23253 |
| Rigid 28 - 32 t | HD Euro V - 2008 Standards | 7536 | 7100 | 4090 | 3219 | 2981 | 2861 | 1861 | 1857 | 3271 | 5792 | 6781 | 6985 |
| Rigid >32 t | Conventional | 19292 | 18175 | 10470 | 8240 | 7630 | 7325 | 4764 | 4755 | 8374 | 14828 | 17360 | 17881 |
| Rigid >32 t | HD Euro I - 91/542/EEC Stage I | 21287 | 20055 | 11553 | 9092 | 8419 | 8082 | 5257 | 5247 | 9240 | 16361 | 19155 | 19730 |
| Rigid >32 t | HD Euro II - 91/542/EEC Stage II | 26121 | 24608 | 14176 | 11157 | 10331 | 9917 | 6450 | 6438 | 11338 | 20076 | 23505 | 24210 |
| Rigid >32 t | HD Euro III - 2000 Standards | 30085 | 28343 | 16328 | 12850 | 11899 | 11423 | 7430 | 7415 | 13059 | 23123 | 27072 | 27885 |
| Rigid >32 t | HD Euro IV - 2005 Standards | 27560 | 25964 | 14957 | 11771 | 10900 | 10464 | 6806 | 6793 | 11963 | 21182 | 24800 | 25544 |
| Rigid >32 t | HD Euro V - 2008 Standards | 7536 | 7100 | 4090 | 3219 | 2981 | 2861 | 1861 | 1857 | 3271 | 5792 | 6781 | 6985 |
| Articulated 14 - 20 t | Conventional | 20400 | 19219 | 11071 | 8713 | 8068 | 7745 | 5038 | 5028 | 8855 | 15679 | 18357 | 18908 |
| Articulated 14 - 20 t | HD Euro I - 91/542/EEC Stage I | 24652 | 23224 | 13379 | 10529 | 9750 | 9360 | 6088 | 6076 | 10701 | 18947 | 22183 | 22849 |
| Articulated 14 - 20 t | HD Euro II - 91/542/EEC Stage II | 29495 | 27787 | 16007 | 12598 | 11665 | 11198 | 7284 | 7270 | 12803 | 22669 | 26541 | 27338 |
| Articulated 14 - 20 t | HD Euro III - 2000 Standards | 36774 | 34645 | 19958 | 15707 | 14544 | 13962 | 9081 | 9064 | 15963 | 28264 | 33092 | 34085 |
| Articulated 14 - 20 t | HD Euro IV - 2005 Standards | 39036 | 36776 | 21185 | 16673 | 15439 | 14821 | 9640 | 9622 | 16945 | 30002 | 35127 | 36181 |
| Articulated 14 - 20 t | HD Euro V - 2008 Standards | 35277 | 33234 | 19145 | 15068 | 13952 | 13394 | 8712 | 8695 | 15313 | 27113 | 31744 | 32697 |
| Articulated 20 - 28 t | Conventional | 22619 | 21310 | 12276 | 9661 | 8946 | 8588 | 5586 | 5575 | 9819 | 17385 | 20354 | 20965 |
| Articulated 20 - 28 t | HD Euro I - 91/542/EEC Stage I | 26871 | 25315 | 14583 | 11477 | 10627 | 10202 | 6636 | 6623 | 11664 | 20653 | 24180 | 24906 |
| Articulated 20 - 28 t | HD Euro II - | 3217 | 3031 | 1746 | 1374 | 1272 | 1221 | 7946 | 7931 | 1396 | 2473 | 2895 | 2982 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91/542/EEC Stage II | 6 | 3 | 2 | 3 | 6 | 7 | | | 7 | 0 | 4 | 3 |
| Articulated 20 - 28 t | HD Euro III - 2000 Standards | 38994 | 36736 | 21162 | 16655 | 15422 | 14805 | 9630 | 9611 | 16926 | 29970 | 35089 | 36142 |
| Articulated 20 - 28 t | HD Euro IV - 2005 Standards | 39036 | 36776 | 21185 | 16673 | 15439 | 14821 | 9640 | 9622 | 16945 | 30002 | 35127 | 36181 |
| Articulated 20 - 28 t | HD Euro V - 2008 Standards | 35277 | 33234 | 19145 | 15068 | 13952 | 13394 | 8712 | 8695 | 15313 | 27113 | 31744 | 32697 |
| Articulated 28 - 34 t | Conventional | 24284 | 22878 | 13179 | 10372 | 9604 | 9220 | 5997 | 5986 | 10541 | 18664 | 21852 | 22508 |
| Articulated 28 - 34 t | HD Euro I - 91/542/EEC Stage I | 28495 | 26845 | 15465 | 12171 | 11270 | 10819 | 7037 | 7024 | 12369 | 21901 | 25642 | 26412 |
| Articulated 28 - 34 t | HD Euro II - 91/542/EEC Stage II | 34081 | 32108 | 18496 | 14557 | 13479 | 12940 | 8416 | 8400 | 14794 | 26194 | 30668 | 31589 |
| Articulated 28 - 34 t | HD Euro III - 2000 Standards | 41103 | 38723 | 22307 | 17556 | 16256 | 15606 | 10150 | 10131 | 17842 | 31591 | 36987 | 38097 |
| Articulated 28 - 34 t | HD Euro IV - 2005 Standards | 44751 | 42160 | 24287 | 19114 | 17699 | 16991 | 11051 | 11030 | 19425 | 34394 | 40269 | 41478 |
| Articulated 28 - 34 t | HD Euro V - 2008 Standards | 35277 | 33234 | 19145 | 15068 | 13952 | 13394 | 8712 | 8695 | 15313 | 27113 | 31744 | 32697 |
| Articulated 34 - 40 t | Conventional | 23158 | 21817 | 12568 | 9891 | 9159 | 8792 | 5719 | 5708 | 10052 | 17798 | 20839 | 21464 |
| Articulated 34 - 40 t | HD Euro I - 91/542/EEC Stage I | 29771 | 28047 | 16157 | 12716 | 11774 | 11304 | 7352 | 7338 | 12923 | 22882 | 26790 | 27594 |
| Articulated 34 - 40 t | HD Euro II - 91/542/EEC Stage II | 35311 | 33267 | 19164 | 15082 | 13966 | 13407 | 8720 | 8704 | 15328 | 27139 | 31775 | 32729 |
| Articulated 34 - 40 t | HD Euro III - 2000 Standards | 42633 | 40164 | 23137 | 18210 | 16861 | 16187 | 10528 | 10508 | 18506 | 32767 | 38364 | 39515 |
| Articulated 34 - 40 t | HD Euro IV - 2005 Standards | 45194 | 42577 | 24527 | 19304 | 17874 | 17159 | 11161 | 11139 | 19618 | 34735 | 40668 | 41889 |
| Articulated 34 - 40 t | HD Euro V - 2008 Standards | 35277 | 33234 | 19145 | 15068 | 13952 | 13394 | 8712 | 8695 | 15313 | 27113 | 31744 | 32697 |
| Articulated 40 - 50 t | Conventional | 26735 | 25187 | 14509 | 11419 | 10574 | 10151 | 6602 | 6590 | 11605 | 20548 | 24058 | 24780 |
| Articulated 40 - 50 t | HD Euro I - 91/542/EEC Stage I | 32794 | 30896 | 17798 | 14007 | 12970 | 12451 | 8099 | 8083 | 14235 | 25205 | 29510 | 30396 |
| Articulated 40 - 50 t | HD Euro II - 91/542/EEC Stage II | 40352 | 38016 | 21900 | 17236 | 15959 | 15321 | 9965 | 9946 | 17516 | 31014 | 36311 | 37401 |
| Articulated 40 - 50 t | HD Euro III - 2000 Standards | 48189 | 45399 | 26153 | 20583 | 19059 | 18296 | 11900 | 11878 | 20918 | 37037 | 43363 | 44665 |
| Articulated 40 - 50 t | HD Euro IV - 2005 Standards | 45194 | 42577 | 24527 | 19304 | 17874 | 17159 | 11161 | 11139 | 19618 | 34735 | 40668 | 41889 |
| Articulated 40 - 50 t | HD Euro V - 2008 Standards | 35277 | 33234 | 19145 | 15068 | 13952 | 13394 | 8712 | 8695 | 15313 | 27113 | 31744 | 32697 |
| Articulated 50 - 60 t | Conventional | 24586 | 23163 | 13343 | 10502 | 9724 | 9335 | 6072 | 6060 | 10673 | 18897 | 22124 | 22789 |
| Articulated 50 - 60 t | HD Euro I - 91/542/EEC Stage I | 29201 | 27510 | 15848 | 12473 | 11549 | 11087 | 7211 | 7197 | 12676 | 22443 | 26277 | 27066 |
| Articulated 50 - 60 t | HD Euro II - | 3535 | 3330 | 1918 | 1510 | 1398 | 1342 | 8731 | 8715 | 1534 | 2717 | 3181 | 3277 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91/542/EEC Stage II | 7 | 9 | 8 | 2 | 3 | 4 | | | 8 | 4 | 6 | 1 |
| Articulated 50 - 60 t | HD Euro III - 2000 Standards | 43080 | 40586 | 23380 | 18401 | 17038 | 16357 | 10639 | 10618 | 18700 | 33111 | 38766 | 39930 |
| Articulated 50 - 60 t | HD Euro IV - 2005 Standards | 45194 | 42577 | 24527 | 19304 | 17874 | 17159 | 11161 | 11139 | 19618 | 34735 | 40668 | 41889 |
| Articulated 50 - 60 t | HD Euro V - 2008 Standards | 35277 | 33234 | 19145 | 15068 | 13952 | 13394 | 8712 | 8695 | 15313 | 27113 | 31744 | 32697 |
| Urban Buses Midi <=15 t | Conventional | 24800 | 23364 | 13459 | 10593 | 9808 | 9416 | 6124 | 6113 | 10765 | 19061 | 22317 | 22987 |
| Urban Buses Midi <=15 t | HD Euro I - 91/542/EEC Stage I | 30534 | 28767 | 16571 | 13042 | 12076 | 11593 | 7540 | 7526 | 13254 | 23468 | 27477 | 28301 |
| Urban Buses Midi <=15 t | HD Euro II - 91/542/EEC Stage II | 32591 | 30704 | 17687 | 13921 | 12890 | 12374 | 8048 | 8033 | 14147 | 25049 | 29327 | 30208 |
| Urban Buses Midi <=15 t | HD Euro III - 2000 Standards | 34765 | 32752 | 18867 | 14849 | 13750 | 13200 | 8585 | 8569 | 15091 | 26720 | 31284 | 32223 |
| Urban Buses Midi <=15 t | HD Euro IV - 2005 Standards | 32842 | 30941 | 17824 | 14028 | 12989 | 12469 | 8110 | 8095 | 14256 | 25242 | 29553 | 30440 |
| Urban Buses Midi <=15 t | HD Euro V - 2008 Standards | 33256 | 31330 | 18048 | 14205 | 13153 | 12627 | 8213 | 8197 | 14436 | 25560 | 29926 | 30824 |
| Urban Buses Standard 15 - 18 t | Conventional | 26260 | 24740 | 14252 | 11216 | 10386 | 9970 | 6485 | 6473 | 11399 | 20183 | 23630 | 24340 |
| 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 | 29582 |
| 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 | 32973 |
| Urban Buses Standard 15 - 18 t | HD Euro III - 2000 Standards | 37936 | 35739 | 20588 | 16203 | 15004 | 14403 | 9368 | 9350 | 16467 | 29157 | 34137 | 35162 |
| Urban Buses Standard 15 - 18 t | HD Euro IV - 2005 Standards | 36730 | 34603 | 19934 | 15688 | 14527 | 13946 | 9070 | 9053 | 15944 | 28230 | 33052 | 34044 |
| Urban Buses Standard 15 - 18 t | HD Euro V - 2008 Standards | 49884 | 46996 | 27072 | 21307 | 19729 | 18940 | 12319 | 12295 | 21654 | 38340 | 44888 | 46236 |
| Urban Buses Articulated >18 t | Conventional | 25157 | 23700 | 13653 | 10745 | 9949 | 9552 | 6212 | 6201 | 10920 | 19335 | 22638 | 23317 |
| Urban Buses Articulated >18 t | HD Euro I - 91/542/EEC Stage I | 32094 | 30236 | 17418 | 13708 | 12693 | 12186 | 7926 | 7911 | 13932 | 24667 | 28880 | 29747 |
| Urban Buses Articulated >18 t | HD Euro II - 91/542/EEC Stage II | 36150 | 34057 | 19619 | 15441 | 14297 | 13726 | 8927 | 8910 | 15692 | 27784 | 32530 | 33507 |
| Urban Buses Articulated >18 t | HD Euro III - 2000 Standards | 38368 | 36146 | 20823 | 16388 | 15174 | 14567 | 9475 | 9457 | 16655 | 29489 | 34525 | 35562 |
| Urban Buses Articulated >18 t | HD Euro IV - 2005 Standards | 36427 | 34318 | 19769 | 15559 | 14407 | 13831 | 8996 | 8979 | 15812 | 27997 | 32779 | 33763 |
| Urban Buses Articulated >18 t | HD Euro V - 2008 Standards | 49884 | 46996 | 27072 | 21307 | 19729 | 18940 | 12319 | 12295 | 21654 | 38340 | 44888 | 46236 |
| Coaches Standard <=18 t | Conventional | 25304 | 23839 | 13733 | 10808 | 10008 | 9607 | 6249 | 6237 | 10984 | 19448 | 22770 | 23454 |
| Coaches Standard <=18 t | HD Euro I - 91/542/EEC Stage I | 29587 | 27874 | 16057 | 12637 | 11701 | 11233 | 7306 | 7293 | 12843 | 22740 | 26624 | 27423 |
| Coaches Standard | HD Euro II - | 3261 | 3073 | 1770 | 1393 | 1290 | 1238 | 8055 | 8040 | 1415 | 2507 | 2935 | 3023 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <=18 t | 91/542/EEC Stage II | 8 | 0 | 2 | 2 | 0 | 4 | | | 9 | 0 | 2 | 3 |
| Coaches Standard <=18 t | HD Euro III - 2000 Standards | 35308 | 33264 | 19162 | 15081 | 13964 | 13406 | 8719 | 8703 | 15326 | 27137 | 31772 | 32726 |
| Coaches Standard <=18 t | HD Euro IV - 2005 Standards | 36935 | 34797 | 20045 | 15776 | 14608 | 14024 | 9121 | 9104 | 16033 | 28388 | 33237 | 34234 |
| Coaches Standard <=18 t | HD Euro V - 2008 Standards | 49884 | 46996 | 27072 | 21307 | 19729 | 18940 | 12319 | 12295 | 21654 | 38340 | 44888 | 46236 |
| Coaches Articulated >18 t | Conventional | 25043 | 23593 | 13591 | 10697 | 9905 | 9508 | 6184 | 6173 | 10871 | 19248 | 22535 | 23212 |
| Coaches Articulated >18 t | HD Euro I - 91/542/EEC Stage I | 30191 | 28443 | 16385 | 12896 | 11941 | 11463 | 7456 | 7442 | 13105 | 23204 | 27168 | 27983 |
| Coaches Articulated >18 t | HD Euro II - 91/542/EEC Stage II | 34487 | 32490 | 18716 | 14730 | 13639 | 13094 | 8516 | 8500 | 14970 | 26506 | 31033 | 31965 |
| Coaches Articulated >18 t | HD Euro III - 2000 Standards | 36554 | 34437 | 19838 | 15613 | 14457 | 13879 | 9027 | 9010 | 15867 | 28094 | 32893 | 33881 |
| Coaches Articulated >18 t | HD Euro IV - 2005 Standards | 36517 | 34403 | 19818 | 15597 | 14442 | 13865 | 9018 | 9001 | 15851 | 28066 | 32860 | 33847 |
| Coaches Articulated >18 t | HD Euro V - 2008 Standards | 49884 | 46996 | 27072 | 21307 | 19729 | 18940 | 12319 | 12295 | 21654 | 38340 | 44888 | 46236 |
| 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 | 26260 | 24740 | 14252 | 11216 | 10386 | 9970 | 6485 | 6473 | 11399 | 20183 | 23630 | 24340 |
| Urban Biodiesel Buses | HD Euro I - 91/542/EEC Stage I | 31916 | 30068 | 17321 | 13632 | 12623 | 12118 | 7882 | 7867 | 13854 | 24530 | 28719 | 29582 |
| Urban Biodiesel Buses | HD Euro II - 91/542/EEC Stage II | 35574 | 33514 | 19306 | 15195 | 14069 | 13507 | 8785 | 8768 | 15442 | 27341 | 32012 | 32973 |
| Urban Biodiesel Buses | HD Euro III - 2000 Standards | 37936 | 35739 | 20588 | 16203 | 15004 | 14403 | 9368 | 9350 | 16467 | 29157 | 34137 | 35162 |
| Urban Biodiesel Buses | HD Euro IV - 2005 Standards | 36730 | 34603 | 19934 | 15688 | 14527 | 13946 | 9070 | 9053 | 15944 | 28230 | 33052 | 34044 |
| Urban Biodiesel Buses | HD Euro V - 2008 Standards | 49884 | 46996 | 27072 | 21307 | 19729 | 18940 | 12319 | 12295 | 21654 | 38340 | 44888 | 46236 |
| 2-stroke <50 cm³ | Conventional | 8756 | 9384 | 8236 | 3859 | 3314 | 3541 | 3295 | 3373 | 2718 | 1721 | 2116 | 1917 |
| 2-stroke <50 cm³ | Mop - Euro I | 9230 | 9891 | 8682 | 4068 | 3493 | 3733 | 3474 | 3556 | 2865 | 1814 | 2230 | 2021 |
| 2-stroke <50 cm³ | Mop - Euro II | 6848 | 7339 | 6442 | 3019 | 2592 | 2770 | 2577 | 2638 | 2126 | 1346 | 1655 | 1500 |
| 2-stroke <50 cm³ | Mop - Euro III | 5729 | 6139 | 5388 | 2525 | 2168 | 2317 | 2156 | 2207 | 1778 | 1126 | 1384 | 1254 |
| 2-stroke >50 cm³ | Conventional | 13022 | 13956 | 12249 | 5740 | 4928 | 5266 | 4901 | 5017 | 4042 | 2560 | 3146 | 2852 |
| 2-stroke >50 cm³ | Mot - Euro I | 13582 | 14555 | 12775 | 5986 | 5140 | 5493 | 5111 | 5232 | 4215 | 2670 | 3282 | 2974 |
| 2-stroke >50 cm³ | Mot - Euro II | 15385 | 16488 | 14472 | 6781 | 5822 | 6222 | 5790 | 5927 | 4775 | 3024 | 3717 | 3369 |
| 2-stroke >50 cm³ | Mot - Euro III | 1576 | 1689 | 1483 | 6951 | 5968 | 6377 | 5935 | 6075 | 4894 | 3100 | 3810 | 3453 |

| Subsector | Technology | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 9 | 9 | 3 | | | | | | | | | |
| 4-stroke <250 cm³ | Conventional | 1686 9 | 1807 8 | 1586 7 | 7435 | 6384 | 6822 | 6349 | 6499 | 5236 | 3316 | 4076 | 3694 |
| 4-stroke <250 cm³ | Mot - Euro I | 1876 1 | 2010 5 | 1764 7 | 8269 | 7100 | 7587 | 7061 | 7228 | 5823 | 3688 | 4533 | 4108 |
| 4-stroke <250 cm³ | Mot - Euro II | 1661 6 | 1780 7 | 1563 0 | 7324 | 6288 | 6720 | 6254 | 6401 | 5157 | 3267 | 4015 | 3639 |
| 4-stroke <250 cm³ | Mot - Euro III | 1774 7 | 1901 9 | 1669 3 | 7822 | 6716 | 7177 | 6679 | 6837 | 5508 | 3489 | 4288 | 3886 |
| 4-stroke 250 - 750 cm³ | Conventional | 1735 8 | 1860 2 | 1632 7 | 7651 | 6569 | 7020 | 6533 | 6687 | 5387 | 3412 | 4194 | 3801 |
| 4-stroke 250 - 750 cm³ | Mot - Euro I | 1952 8 | 2092 7 | 1836 8 | 8607 | 7390 | 7897 | 7349 | 7523 | 6061 | 3839 | 4718 | 4276 |
| 4-stroke 250 - 750 cm³ | Mot - Euro II | 1749 9 | 1875 3 | 1646 0 | 7713 | 6622 | 7077 | 6586 | 6741 | 5431 | 3440 | 4228 | 3832 |
| 4-stroke 250 - 750 cm³ | Mot - Euro III | 1774 7 | 1901 9 | 1669 3 | 7822 | 6716 | 7177 | 6679 | 6837 | 5508 | 3489 | 4288 | 3886 |
| 4-stroke >750 cm³ | Conventional | 1762 1 | 1888 3 | 1657 5 | 7767 | 6668 | 7126 | 6632 | 6788 | 5469 | 3464 | 4258 | 3859 |
| 4-stroke >750 cm³ | Mot - Euro I | 2008 2 | 2152 1 | 1889 0 | 8852 | 7600 | 8122 | 7558 | 7737 | 6233 | 3948 | 4852 | 4398 |
| 4-stroke >750 cm³ | Mot - Euro II | 1795 6 | 1924 2 | 1688 9 | 7914 | 6795 | 7262 | 6758 | 6917 | 5573 | 3530 | 4338 | 3932 |
| 4-stroke >750 cm³ | Mot - Euro III | 1774 7 | 1901 9 | 1669 3 | 7822 | 6716 | 7177 | 6679 | 6837 | 5508 | 3489 | 4288 | 3886 |

Table 264 Mileage data for Road transport (average km/year/vehicle) 1999-2010

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gasoline 0,8 - 1,4 l | PRE ECE | 2570 | 2082 | 2158 | 1980 | 1903 | 1797 | 3090 | 2646 | 2351 | 2323 | 2126 | 1908 |
| Gasoline 0,8 - 1,4 l | ECE 15/00-01 | 3095 | 2508 | 2600 | 2385 | 2292 | 2164 | 3721 | 3188 | 2831 | 2798 | 2561 | 2298 |
| Gasoline 0,8 - 1,4 l | ECE 15/02 | 3134 | 2539 | 2633 | 2415 | 2321 | 2191 | 3769 | 3228 | 2867 | 2833 | 2593 | 2327 |
| Gasoline 0,8 - 1,4 l | ECE 15/03 | 3694 | 2993 | 3102 | 2846 | 2735 | 2582 | 4441 | 3804 | 3379 | 3339 | 3056 | 2742 |
| Gasoline 0,8 - 1,4 l | ECE 15/04 | 4962 | 4020 | 4168 | 3823 | 3674 | 3469 | 5966 | 5110 | 4539 | 4485 | 4106 | 3684 |
| Gasoline 0,8 - 1,4 l | Improved Conventional | 4076 | 3302 | 3424 | 3140 | 3018 | 2850 | 4901 | 4198 | 3728 | 3684 | 3373 | 3026 |
| Gasoline 0,8 - 1,4 l | Open Loop | 4421 | 3582 | 3714 | 3406 | 3274 | 3091 | 5316 | 4554 | 4044 | 3997 | 3659 | 3283 |
| Gasoline 0,8 - 1,4 l | PC Euro 1 - 91/441/EEC | 5973 | 4840 | 5017 | 4602 | 4423 | 4176 | 7182 | 6152 | 5464 | 5400 | 4943 | 4435 |
| Gasoline 0,8 - 1,4 l | PC Euro 2 - 94/12/EEC | 6921 | 5608 | 5814 | 5332 | 5124 | 4839 | 8322 | 7128 | 6331 | 6257 | 5727 | 5139 |
| Gasoline 0,8 - 1,4 l | PC Euro 3 - 98/69/EC Stage2000 | 7986 | 6471 | 6708 | 6153 | 5913 | 5584 | 9602 | 8225 | 7305 | 7219 | 6608 | 5929 |
| Gasoline 0,8 - 1,4 l | PC Euro 4 - 98/69/EC Stage2005 | 8460 | 6855 | 7106 | 6518 | 6264 | 5915 | 1017 2 | 8713 | 7739 | 7648 | 7000 | 6281 |
| Gasoline 0,8 - 1,4 l | PC Euro 5 - EC 715/2007 | 9467 | 7670 | 7951 | 7293 | 7009 | 6619 | 1138 2 | 9750 | 8659 | 8557 | 7833 | 7029 |
| Gasoline 1,4 - 2,0 l | PRE ECE | 2754 | 2231 | 2313 | 2122 | 2039 | 1925 | 3311 | 2836 | 2519 | 2489 | 2279 | 2045 |
| Gasoline 1,4 - 2,0 l | ECE 15/00-01 | 3297 | 2671 | 2769 | 2540 | 2441 | 2305 | 3964 | 3396 | 3016 | 2980 | 2728 | 2448 |
| Gasoline 1,4 - 2,0 l | ECE 15/02 | 3459 | 2803 | 2906 | 2665 | 2561 | 2419 | 4159 | 3563 | 3164 | 3127 | 2862 | 2568 |
| Gasoline 1,4 - 2,0 l | ECE 15/03 | 3965 | 3212 | 3330 | 3055 | 2936 | 2772 | 4767 | 4083 | 3627 | 3584 | 3281 | 2944 |
| Gasoline 1,4 - 2,0 l | ECE 15/04 | 5332 | 4320 | 4479 | 4108 | 3948 | 3728 | 6411 | 5492 | 4878 | 4820 | 4412 | 3959 |
| Gasoline 1,4 - 2,0 l | Improved | 4076 | 3302 | 3424 | 3140 | 3018 | 2850 | 4901 | 4198 | 3728 | 3684 | 3373 | 3026 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Conventional | | | | | | | | | | | | |
| Gasoline 1,4 - 2,0 l | Open Loop | 5019 | 4066 | 4216 | 3867 | 3716 | 3509 | 6034 | 5169 | 4591 | 4537 | 4153 | 3726 |
| Gasoline 1,4 - 2,0 l | PC Euro 1 - 91/441/EEC | 6599 | 5346 | 5542 | 5084 | 4885 | 4614 | 7934 | 6796 | 6036 | 5965 | 5460 | 4899 |
| Gasoline 1,4 - 2,0 l | PC Euro 2 - 94/12/EEC | 7441 | 6029 | 6250 | 5733 | 5509 | 5203 | 8947 | 7664 | 6807 | 6726 | 6157 | 5525 |
| Gasoline 1,4 - 2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 8586 | 6957 | 7212 | 6615 | 6357 | 6003 | 10324 | 8843 | 7854 | 7762 | 7105 | 6375 |
| Gasoline 1,4 - 2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 9530 | 7721 | 8004 | 7342 | 7056 | 6663 | 11458 | 9815 | 8717 | 8614 | 7886 | 7076 |
| Gasoline 1,4 - 2,0 l | PC Euro 5 - EC 715/2007 | 10524 | 8527 | 8839 | 8108 | 7792 | 7358 | 12653 | 10838 | 9626 | 9513 | 8708 | 7814 |
| Gasoline >2,0 l | PRE ECE | 2896 | 2347 | 2433 | 2231 | 2144 | 2025 | 3482 | 2983 | 2649 | 2618 | 2397 | 2150 |
| Gasoline >2,0 l | ECE 15/00-01 | 3465 | 2807 | 2910 | 2669 | 2565 | 2422 | 4166 | 3568 | 3169 | 3132 | 2867 | 2572 |
| Gasoline >2,0 l | ECE 15/02 | 3525 | 2856 | 2961 | 2716 | 2610 | 2465 | 4238 | 3631 | 3225 | 3187 | 2917 | 2617 |
| Gasoline >2,0 l | ECE 15/03 | 4181 | 3388 | 3512 | 3221 | 3096 | 2923 | 5027 | 4306 | 3825 | 3780 | 3460 | 3104 |
| Gasoline >2,0 l | ECE 15/04 | 5547 | 4494 | 4659 | 4274 | 4107 | 3878 | 6670 | 5713 | 5074 | 5014 | 4590 | 4119 |
| Gasoline >2,0 l | PC Euro 1 - 91/441/EEC | 6760 | 5477 | 5678 | 5208 | 5005 | 4727 | 8128 | 6962 | 6184 | 6111 | 5594 | 5019 |
| Gasoline >2,0 l | PC Euro 2 - 94/12/EEC | 7942 | 6435 | 6671 | 6119 | 5880 | 5553 | 9549 | 8180 | 7265 | 7179 | 6572 | 5897 |
| Gasoline >2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 8842 | 7164 | 7427 | 6812 | 6547 | 6182 | 10631 | 9106 | 8088 | 7993 | 7316 | 6565 |
| Gasoline >2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 9940 | 8054 | 8349 | 7658 | 7359 | 6950 | 11952 | 10237 | 9093 | 8985 | 8225 | 7380 |
| Gasoline >2,0 l | PC Euro 5 - EC 715/2007 | 10981 | 8897 | 9223 | 8460 | 8130 | 7678 | 13203 | 11309 | 10045 | 9926 | 9086 | 8153 |
| Diesel 1,4 - 2,0 l | Conventional | 7434 | 6975 | 6572 | 7719 | 8330 | 9619 | 12654 | 9693 | 9143 | 8137 | 7517 | 7573 |
| Diesel 1,4 - 2,0 l | PC Euro 1 - 91/441/EEC | 8375 | 7858 | 7404 | 8696 | 9385 | 10836 | 14255 | 10919 | 10301 | 9167 | 8469 | 8532 |
| Diesel 1,4 - 2,0 l | PC Euro 2 - 94/12/EEC | 9865 | 9256 | 8721 | 10242 | 11054 | 12763 | 16791 | 12861 | 12133 | 10797 | 9975 | 10049 |
| Diesel 1,4 - 2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 11193 | 10502 | 9895 | 11622 | 12543 | 14483 | 19052 | 14594 | 13767 | 12252 | 11318 | 11403 |
| Diesel 1,4 - 2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 11292 | 10595 | 9983 | 11724 | 12653 | 14610 | 19220 | 14722 | 13888 | 12360 | 11418 | 11503 |
| Diesel 1,4 - 2,0 l | PC Euro 5 - EC 715/2007 | 12701 | 11917 | 11228 | 13187 | 14232 | 16434 | 21619 | 16559 | 15621 | 13902 | 12843 | 12939 |
| Diesel >2,0 l | Conventional | 8210 | 7703 | 7258 | 8524 | 9199 | 10622 | 13974 | 10704 | 10097 | 8986 | 8301 | 8363 |
| Diesel >2,0 l | PC Euro 1 - 91/441/EEC | 9301 | 8727 | 8223 | 9657 | 10422 | 12034 | 15832 | 12127 | 11440 | 10181 | 9405 | 9475 |
| Diesel >2,0 l | PC Euro 2 - 94/12/EEC | 10456 | 9811 | 9244 | 10856 | 11717 | 13529 | 17798 | 13633 | 12860 | 11445 | 10573 | 10652 |
| Diesel >2,0 l | PC Euro 3 - 98/69/EC Stage2000 | 12224 | 11469 | 10806 | 12691 | 13697 | 15816 | 20806 | 15937 | 15034 | 13379 | 12360 | 12452 |
| Diesel >2,0 l | PC Euro 4 - 98/69/EC | 12648 | 11867 | 11181 | 13131 | 14172 | 16364 | 21528 | 16490 | 15555 | 13843 | 12789 | 12884 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stage2005 | | | | | | | | | | | | |
| Diesel >2,0 l | PC Euro 5 - EC 715/2007 | 14109 | 13238 | 12473 | 14649 | 15809 | 18255 | 24015 | 18395 | 17353 | 15443 | 14266 | 14373 |
| LPG | Conventional | 70366 | 71190 | 66539 | 58509 | 47772 | 50136 | 72309 | 63572 | 58800 | 62047 | 61191 | 55055 |
| LPG | PC Euro 1 - 91/441/EEC | 79870 | 80805 | 75526 | 66411 | 54224 | 56907 | 82075 | 72158 | 66741 | 70428 | 69456 | 62491 |
| LPG | PC Euro 2 - 94/12/EEC | 84799 | 85792 | 80188 | 70510 | 57570 | 60419 | 87140 | 76612 | 70861 | 74774 | 73743 | 66348 |
| LPG | PC Euro 3 - 98/69/EC Stage2000 | 88890 | 89930 | 84056 | 73911 | 60347 | 63334 | 91344 | 80307 | 74279 | 78381 | 77300 | 69548 |
| LPG | PC Euro 4 - 98/69/EC Stage2005 | 86897 | 87914 | 82171 | 72253 | 58994 | 61913 | 89295 | 78506 | 72613 | 76624 | 75566 | 67988 |
| LPG | PC Euro 5 - EC 715/2007 | 91407 | 92477 | 86436 | 76004 | 62056 | 65127 | 93930 | 82581 | 76382 | 80601 | 79488 | 71517 |
| CNG | PC Euro 4 - 98/69/EC Stage2005 | 0 | 0 | 0 | 0 | 30704 | 50366 | 67163 | 64663 | 44930 | 51117 | 58306 | 60178 |
| CNG | PC Euro 5 - EC 715/2007 | 0 | 0 | 0 | 0 | 32298 | 52980 | 70649 | 68019 | 47262 | 53770 | 61332 | 63302 |
| 2-Stroke | Conventional | 2146 | 1739 | 1803 | 1653 | 1589 | 1501 | 2580 | 2210 | 1963 | 1940 | 1776 | 1593 |
| Hybrid Gasoline <1,4 l | PC Euro 4 - 98/69/EC Stage2005 | 10379 | 8410 | 8718 | 7997 | 7685 | 7257 | 12480 | 10690 | 9494 | 9382 | 8588 | 7706 |
| Hybrid Gasoline 1,4 - 2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 10567 | 8562 | 8876 | 8141 | 7824 | 7388 | 12705 | 10883 | 9666 | 9552 | 8744 | 7846 |
| Hybrid Gasoline >2,0 l | PC Euro 4 - 98/69/EC Stage2005 | 12316 | 9979 | 10345 | 9489 | 9119 | 8611 | 14808 | 12684 | 11266 | 11133 | 10191 | 9144 |
| Gasoline <3,5t | Conventional | 7050 | 5712 | 5922 | 5432 | 5220 | 4929 | 8477 | 7261 | 6449 | 6373 | 5834 | 5235 |
| Gasoline <3,5t | LD Euro 1 - 93/59/EEC | 8115 | 6575 | 6816 | 6252 | 6008 | 5673 | 9757 | 8357 | 7423 | 7335 | 6714 | 6025 |
| Gasoline <3,5t | LD Euro 2 - 96/69/EEC | 9077 | 7355 | 7624 | 6993 | 6720 | 6346 | 10914 | 9348 | 8303 | 8205 | 7511 | 6739 |
| Gasoline <3,5t | LD Euro 3 - 98/69/EC Stage2000 | 10297 | 8343 | 8649 | 7933 | 7624 | 7200 | 12381 | 10605 | 9419 | 9308 | 8521 | 7645 |
| Gasoline <3,5t | LD Euro 4 - 98/69/EC Stage2005 | 11644 | 9434 | 9780 | 8971 | 8621 | 8141 | 14000 | 11992 | 10651 | 10525 | 9634 | 8645 |
| Gasoline <3,5t | LD Euro 5 - 2008 Standards | 12735 | 10318 | 10697 | 9811 | 9429 | 8904 | 15312 | 13116 | 11649 | 11512 | 10538 | 9455 |
| Diesel <3,5 t | Conventional | 7656 | 7183 | 6768 | 7949 | 8579 | 9906 | 13032 | 9982 | 9416 | 8380 | 7742 | 7799 |
| Diesel <3,5 t | LD Euro 1 - 93/59/EEC | 8882 | 8333 | 7852 | 9222 | 9953 | 11492 | 15118 | 11580 | 10924 | 9722 | 8981 | 9048 |
| Diesel <3,5 t | LD Euro 2 - 96/69/EEC | 9771 | 9167 | 8638 | 10144 | 10948 | 12642 | 16631 | 12739 | 12017 | 10695 | 9880 | 9953 |
| Diesel <3,5 t | LD Euro 3 - 98/69/EC Stage2000 | 10660 | 10002 | 9424 | 11068 | 11945 | 13793 | 18145 | 13899 | 13111 | 11668 | 10779 | 10860 |
| Diesel <3,5 t | LD Euro 4 - 98/69/EC | 12292 | 11533 | 10866 | 12762 | 13773 | 15904 | 20922 | 16026 | 15118 | 13454 | 12429 | 12522 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stage2005 | | | | | | | | | | | | |
| Diesel <3,5 t | LD Euro 5 - 2008 Standards | 13181 | 12367 | 11653 | 13685 | 14770 | 17054 | 22436 | 17185 | 16211 | 14427 | 13328 | 13427 |
| Gasoline >3,5 t | Conventional | 9276 | 7515 | 7791 | 7146 | 6867 | 6485 | 11153 | 9553 | 8485 | 8385 | 7675 | 6887 |
| Rigid <=7,5 t | Conventional | 11084 | 10399 | 9798 | 11508 | 12420 | 14341 | 18866 | 14451 | 13632 | 12132 | 11208 | 11291 |
| Rigid <=7,5 t | HD Euro I - 91/542/EEC Stage I | 12996 | 12193 | 11489 | 13493 | 14562 | 16814 | 22120 | 16943 | 15983 | 14224 | 13141 | 13239 |
| Rigid <=7,5 t | HD Euro II - 91/542/EEC Stage II | 15311 | 14366 | 13536 | 15897 | 17156 | 19810 | 26061 | 19962 | 18831 | 16759 | 15482 | 15597 |
| Rigid <=7,5 t | HD Euro III - 2000 Standards | 17917 | 16810 | 15839 | 18602 | 20076 | 23182 | 30496 | 23359 | 22036 | 19611 | 18117 | 18251 |
| Rigid <=7,5 t | HD Euro IV - 2005 Standards | 19374 | 18178 | 17128 | 20115 | 21709 | 25068 | 32977 | 25260 | 23828 | 21206 | 19591 | 19736 |
| Rigid <=7,5 t | HD Euro V - 2008 Standards | 6021 | 5650 | 5323 | 6252 | 6747 | 7791 | 10249 | 7851 | 7406 | 6591 | 6089 | 6134 |
| Rigid 7,5 - 12 t | Conventional | 11402 | 10698 | 10080 | 11838 | 12776 | 14753 | 19408 | 14866 | 14023 | 12480 | 11529 | 11615 |
| Rigid 7,5 - 12 t | HD Euro I - 91/542/EEC Stage I | 14318 | 13434 | 12658 | 14866 | 16044 | 18526 | 24372 | 18668 | 17610 | 15672 | 14478 | 14586 |
| Rigid 7,5 - 12 t | HD Euro II - 91/542/EEC Stage II | 16817 | 15778 | 14866 | 17460 | 18843 | 21758 | 28624 | 21925 | 20683 | 18407 | 17004 | 17131 |
| Rigid 7,5 - 12 t | HD Euro III - 2000 Standards | 19888 | 18660 | 17581 | 20648 | 22285 | 25732 | 33851 | 25929 | 24460 | 21768 | 20110 | 20259 |
| Rigid 7,5 - 12 t | HD Euro IV - 2005 Standards | 21711 | 20370 | 19193 | 22541 | 24327 | 28090 | 36954 | 28306 | 26702 | 23763 | 21953 | 22116 |
| Rigid 7,5 - 12 t | HD Euro V - 2008 Standards | 6021 | 5650 | 5323 | 6252 | 6747 | 7791 | 10249 | 7851 | 7406 | 6591 | 6089 | 6134 |
| Rigid 12 - 14 t | Conventional | 9943 | 9329 | 8790 | 10324 | 11142 | 12865 | 16925 | 12964 | 12229 | 10883 | 10054 | 10129 |
| Rigid 12 - 14 t | HD Euro I - 91/542/EEC Stage I | 12987 | 12185 | 11481 | 13484 | 14553 | 16804 | 22106 | 16932 | 15973 | 14215 | 13132 | 13230 |
| Rigid 12 - 14 t | HD Euro II - 91/542/EEC Stage II | 15526 | 14567 | 13725 | 16120 | 17397 | 20088 | 26427 | 20242 | 19095 | 16994 | 15699 | 15816 |
| Rigid 12 - 14 t | HD Euro III - 2000 Standards | 19371 | 18174 | 17124 | 20112 | 21705 | 25063 | 32971 | 25255 | 23824 | 21202 | 19587 | 19733 |
| Rigid 12 - 14 t | HD Euro IV - 2005 Standards | 19977 | 18743 | 17660 | 20741 | 22385 | 25847 | 34003 | 26045 | 24570 | 21866 | 20200 | 20350 |
| Rigid 12 - 14 t | HD Euro V - 2008 Standards | 6021 | 5650 | 5323 | 6252 | 6747 | 7791 | 10249 | 7851 | 7406 | 6591 | 6089 | 6134 |
| Rigid 14 - 20 t | Conventional | 12514 | 11741 | 11063 | 12993 | 14023 | 16192 | 21301 | 16316 | 15391 | 13697 | 12654 | 12748 |
| Rigid 14 - 20 t | HD Euro I - 91/542/EEC Stage I | 15692 | 14723 | 13872 | 16292 | 17583 | 20303 | 26710 | 20459 | 19300 | 17176 | 15867 | 15985 |
| Rigid 14 - 20 t | HD Euro II - 91/542/EEC Stage II | 18084 | 16967 | 15987 | 18775 | 20263 | 23398 | 30780 | 23577 | 22241 | 19793 | 18286 | 18422 |
| Rigid 14 - 20 t | HD Euro III - | 2096 | 1967 | 1853 | 2176 | 2349 | 2712 | 3568 | 2733 | 2578 | 2294 | 2120 | 2135 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2000 Standards | 6 | 2 | 5 | 8 | 3 | 8 | 7 | 5 | 7 | 9 | 1 | 8 |
| Rigid 14 - 20 t | HD Euro IV - 2005 Standards | 21426 | 20103 | 18941 | 22245 | 24008 | 27722 | 36469 | 27934 | 26352 | 23452 | 21665 | 21826 |
| Rigid 14 - 20 t | HD Euro V - 2008 Standards | 6021 | 5650 | 5323 | 6252 | 6747 | 7791 | 10249 | 7851 | 7406 | 6591 | 6089 | 6134 |
| Rigid 20 - 26 t | Conventional | 12533 | 11759 | 11079 | 13012 | 14043 | 16216 | 21332 | 16340 | 15414 | 13718 | 12673 | 12767 |
| Rigid 20 - 26 t | HD Euro I - 91/542/EEC Stage I | 15901 | 14919 | 14057 | 16509 | 17818 | 20574 | 27066 | 20731 | 19557 | 17405 | 16079 | 16198 |
| Rigid 20 - 26 t | HD Euro II - 91/542/EEC Stage II | 18234 | 17108 | 16120 | 18931 | 20432 | 23592 | 31036 | 23773 | 22426 | 19958 | 18438 | 18575 |
| Rigid 20 - 26 t | HD Euro III - 2000 Standards | 21656 | 20319 | 19145 | 22484 | 24266 | 28020 | 36861 | 28234 | 26635 | 23703 | 21898 | 22061 |
| Rigid 20 - 26 t | HD Euro IV - 2005 Standards | 19730 | 18511 | 17442 | 20484 | 22108 | 25527 | 33582 | 25723 | 24266 | 21595 | 19950 | 20098 |
| Rigid 20 - 26 t | HD Euro V - 2008 Standards | 6021 | 5650 | 5323 | 6252 | 6747 | 7791 | 10249 | 7851 | 7406 | 6591 | 6089 | 6134 |
| Rigid 26 - 28 t | Conventional | 12483 | 11712 | 11035 | 12960 | 13987 | 16151 | 21247 | 16275 | 15353 | 13663 | 12622 | 12716 |
| Rigid 26 - 28 t | HD Euro I - 91/542/EEC Stage I | 15364 | 14416 | 13583 | 15952 | 17216 | 19879 | 26152 | 20032 | 18897 | 16817 | 15536 | 15652 |
| Rigid 26 - 28 t | HD Euro II - 91/542/EEC Stage II | 17663 | 16572 | 15615 | 18339 | 19792 | 22853 | 30064 | 23028 | 21724 | 19333 | 17860 | 17993 |
| Rigid 26 - 28 t | HD Euro III - 2000 Standards | 20755 | 19473 | 18348 | 21549 | 23257 | 26854 | 35328 | 27060 | 25527 | 22717 | 20987 | 21143 |
| Rigid 26 - 28 t | HD Euro IV - 2005 Standards | 21317 | 20001 | 18845 | 22133 | 23887 | 27581 | 36284 | 27793 | 26218 | 23333 | 21555 | 21716 |
| Rigid 26 - 28 t | HD Euro V - 2008 Standards | 6021 | 5650 | 5323 | 6252 | 6747 | 7791 | 10249 | 7851 | 7406 | 6591 | 6089 | 6134 |
| Rigid 28 - 32 t | Conventional | 12511 | 11739 | 11060 | 12990 | 14019 | 16188 | 21296 | 16312 | 15388 | 13694 | 12651 | 12745 |
| Rigid 28 - 32 t | HD Euro I - 91/542/EEC Stage I | 15565 | 14604 | 13760 | 16161 | 17441 | 20139 | 26494 | 20294 | 19144 | 17037 | 15739 | 15856 |
| Rigid 28 - 32 t | HD Euro II - 91/542/EEC Stage II | 17910 | 16804 | 15833 | 18595 | 20068 | 23172 | 30484 | 23350 | 22027 | 19603 | 18110 | 18244 |
| Rigid 28 - 32 t | HD Euro III - 2000 Standards | 21266 | 19953 | 18800 | 22079 | 23829 | 27515 | 36197 | 27726 | 26155 | 23277 | 21503 | 21663 |
| Rigid 28 - 32 t | HD Euro IV - 2005 Standards | 20045 | 18808 | 17721 | 20812 | 22462 | 25936 | 34120 | 26135 | 24654 | 21941 | 20269 | 20420 |
| Rigid 28 - 32 t | HD Euro V - 2008 Standards | 6021 | 5650 | 5323 | 6252 | 6747 | 7791 | 10249 | 7851 | 7406 | 6591 | 6089 | 6134 |
| Rigid >32 t | Conventional | 15415 | 14463 | 13627 | 16004 | 17273 | 19944 | 26238 | 20097 | 18959 | 16872 | 15587 | 15703 |
| Rigid >32 t | HD Euro I - 91/542/EEC Stage I | 17009 | 15958 | 15036 | 17659 | 19059 | 22007 | 28951 | 22176 | 20919 | 18617 | 17199 | 17327 |
| Rigid >32 t | HD Euro II - 91/542/EEC Stage II | 20871 | 19582 | 18451 | 21669 | 23386 | 27004 | 35525 | 27211 | 25669 | 22844 | 21104 | 21261 |
| Rigid >32 t | HD Euro III - | 2403 | 2255 | 2125 | 2495 | 2693 | 3110 | 4091 | 3134 | 2956 | 2631 | 2430 | 2448 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2000 Standards | 8 | 4 | 1 | 8 | 6 | 2 | 6 | 1 | 5 | 1 | 7 | 8 |
| Rigid >32 t | HD Euro IV - 2005 Standards | 22021 | 20661 | 19467 | 22863 | 24675 | 28492 | 37482 | 28710 | 27083 | 24103 | 22267 | 22432 |
| Rigid >32 t | HD Euro V - 2008 Standards | 6021 | 5650 | 5323 | 6252 | 6747 | 7791 | 10249 | 7851 | 7406 | 6591 | 6089 | 6134 |
| Articulated 14 - 20 t | Conventional | 16300 | 15293 | 14410 | 16923 | 18264 | 21090 | 27744 | 21251 | 20047 | 17841 | 16482 | 16604 |
| Articulated 14 - 20 t | HD Euro I - 91/542/EEC Stage I | 19697 | 18481 | 17413 | 20450 | 22071 | 25485 | 33527 | 25680 | 24225 | 21559 | 19917 | 20065 |
| Articulated 14 - 20 t | HD Euro II - 91/542/EEC Stage II | 23567 | 22111 | 20834 | 24468 | 26407 | 30492 | 40113 | 30725 | 28985 | 25795 | 23830 | 24007 |
| Articulated 14 - 20 t | HD Euro III - 2000 Standards | 29383 | 27569 | 25976 | 30507 | 32925 | 38018 | 50014 | 38309 | 36139 | 32161 | 29711 | 29932 |
| Articulated 14 - 20 t | HD Euro IV - 2005 Standards | 31190 | 29264 | 27573 | 32383 | 34950 | 40356 | 53089 | 40665 | 38361 | 34139 | 31538 | 31773 |
| Articulated 14 - 20 t | HD Euro V - 2008 Standards | 28187 | 26446 | 24918 | 29265 | 31584 | 36470 | 47977 | 36749 | 34667 | 30852 | 28502 | 28714 |
| Articulated 20 - 28 t | Conventional | 18073 | 16957 | 15977 | 18765 | 20252 | 23384 | 30763 | 23563 | 22228 | 19782 | 18275 | 18411 |
| Articulated 20 - 28 t | HD Euro I - 91/542/EEC Stage I | 21470 | 20145 | 18981 | 22292 | 24058 | 27780 | 36545 | 27993 | 26407 | 23500 | 21710 | 21872 |
| Articulated 20 - 28 t | HD Euro II - 91/542/EEC Stage II | 25709 | 24122 | 22728 | 26693 | 28808 | 33264 | 43760 | 33519 | 31620 | 28140 | 25996 | 26190 |
| Articulated 20 - 28 t | HD Euro III - 2000 Standards | 31157 | 29233 | 27544 | 32349 | 34912 | 40312 | 53032 | 40621 | 38320 | 34103 | 31505 | 31739 |
| Articulated 20 - 28 t | HD Euro IV - 2005 Standards | 31190 | 29264 | 27573 | 32383 | 34950 | 40356 | 53089 | 40665 | 38361 | 34139 | 31538 | 31773 |
| Articulated 20 - 28 t | HD Euro V - 2008 Standards | 28187 | 26446 | 24918 | 29265 | 31584 | 36470 | 47977 | 36749 | 34667 | 30852 | 28502 | 28714 |
| Articulated 28 - 34 t | Conventional | 19403 | 18205 | 17153 | 20146 | 21742 | 25105 | 33027 | 25297 | 23864 | 21238 | 19620 | 19766 |
| Articulated 28 - 34 t | HD Euro I - 91/542/EEC Stage I | 22768 | 21362 | 20128 | 23639 | 25512 | 29459 | 38754 | 29685 | 28003 | 24921 | 23022 | 23194 |
| Articulated 28 - 34 t | HD Euro II - 91/542/EEC Stage II | 27231 | 25550 | 24074 | 28273 | 30514 | 35234 | 46351 | 35503 | 33492 | 29806 | 27535 | 27740 |
| Articulated 28 - 34 t | HD Euro III - 2000 Standards | 32842 | 30814 | 29033 | 34098 | 36800 | 42493 | 55900 | 42818 | 40392 | 35947 | 33209 | 33456 |
| Articulated 28 - 34 t | HD Euro IV - 2005 Standards | 35756 | 33548 | 31610 | 37124 | 40066 | 46264 | 60862 | 46618 | 43977 | 39137 | 36156 | 36425 |
| Articulated 28 - 34 t | HD Euro V - 2008 Standards | 28187 | 26446 | 24918 | 29265 | 31584 | 36470 | 47977 | 36749 | 34667 | 30852 | 28502 | 28714 |
| Articulated 34 - 40 t | Conventional | 18503 | 17361 | 16358 | 19211 | 20733 | 23941 | 31495 | 24124 | 22757 | 20253 | 18710 | 18849 |
| Articulated 34 - 40 t | HD Euro I - 91/542/EEC Stage I | 23788 | 22319 | 21029 | 24698 | 26655 | 30778 | 40489 | 31014 | 29257 | 26037 | 24053 | 24232 |
| Articulated 34 - 40 t | HD Euro II - 91/542/EEC Stage II | 28214 | 26472 | 24942 | 29293 | 31615 | 36505 | 48024 | 36785 | 34701 | 30882 | 28529 | 28742 |
| Articulated 34 - 40 t | HD Euro III - | 3406 | 3196 | 3011 | 3536 | 3817 | 4407 | 5798 | 4441 | 4189 | 3728 | 3444 | 3470 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2000 Standards | 4 | 1 | 4 | 7 | 0 | 4 | 1 | 2 | 6 | 5 | 5 | 1 |
| Articulated 34 - 40 t | HD Euro IV - 2005 Standards | 36111 | 33881 | 31923 | 37492 | 40463 | 46722 | 61464 | 47080 | 44413 | 39525 | 36514 | 36785 |
| Articulated 34 - 40 t | HD Euro V - 2008 Standards | 28187 | 26446 | 24918 | 29265 | 31584 | 36470 | 47977 | 36749 | 34667 | 30852 | 28502 | 28714 |
| Articulated 40 - 50 t | Conventional | 21362 | 20043 | 18885 | 22179 | 23937 | 27639 | 36360 | 27851 | 26273 | 23382 | 21600 | 21761 |
| Articulated 40 - 50 t | HD Euro I - 91/542/EEC Stage I | 26203 | 24585 | 23165 | 27206 | 29362 | 33903 | 44601 | 34163 | 32228 | 28681 | 26496 | 26693 |
| Articulated 40 - 50 t | HD Euro II - 91/542/EEC Stage II | 32242 | 30251 | 28503 | 33476 | 36128 | 41717 | 54880 | 42036 | 39655 | 35291 | 32602 | 32845 |
| Articulated 40 - 50 t | HD Euro III - 2000 Standards | 38504 | 36126 | 34039 | 39977 | 43145 | 49818 | 65538 | 50200 | 47356 | 42144 | 38934 | 39223 |
| Articulated 40 - 50 t | HD Euro IV - 2005 Standards | 36111 | 33881 | 31923 | 37492 | 40463 | 46722 | 61464 | 47080 | 44413 | 39525 | 36514 | 36785 |
| Articulated 40 - 50 t | HD Euro V - 2008 Standards | 28187 | 26446 | 24918 | 29265 | 31584 | 36470 | 47977 | 36749 | 34667 | 30852 | 28502 | 28714 |
| Articulated 50 - 60 t | Conventional | 19645 | 18432 | 17367 | 20396 | 22013 | 25418 | 33438 | 25613 | 24161 | 21502 | 19864 | 20012 |
| Articulated 50 - 60 t | HD Euro I - 91/542/EEC Stage I | 23332 | 21891 | 20626 | 24225 | 26144 | 30188 | 39714 | 30420 | 28696 | 25538 | 23593 | 23768 |
| Articulated 50 - 60 t | HD Euro II - 91/542/EEC Stage II | 28250 | 26506 | 24975 | 29331 | 31656 | 36552 | 48086 | 36832 | 34745 | 30922 | 28566 | 28778 |
| Articulated 50 - 60 t | HD Euro III - 2000 Standards | 34422 | 32296 | 30430 | 35739 | 38571 | 44537 | 58590 | 44878 | 42336 | 37676 | 34806 | 35065 |
| Articulated 50 - 60 t | HD Euro IV - 2005 Standards | 36111 | 33881 | 31923 | 37492 | 40463 | 46722 | 61464 | 47080 | 44413 | 39525 | 36514 | 36785 |
| Articulated 50 - 60 t | HD Euro V - 2008 Standards | 28187 | 26446 | 24918 | 29265 | 31584 | 36470 | 47977 | 36749 | 34667 | 30852 | 28502 | 28714 |
| Urban Buses Midi <=15 t | Conventional | 19816 | 18592 | 17518 | 20574 | 22204 | 25639 | 33729 | 25835 | 24371 | 21689 | 20037 | 20186 |
| Urban Buses Midi <=15 t | HD Euro I - 91/542/EEC Stage I | 24398 | 22891 | 21568 | 25331 | 27338 | 31567 | 41527 | 31809 | 30007 | 26704 | 24670 | 24853 |
| Urban Buses Midi <=15 t | HD Euro II - 91/542/EEC Stage II | 26041 | 24433 | 23021 | 27037 | 29179 | 33693 | 44324 | 33951 | 32028 | 28503 | 26332 | 26527 |
| Urban Buses Midi <=15 t | HD Euro III - 2000 Standards | 27778 | 26063 | 24557 | 28841 | 31126 | 35941 | 47281 | 36216 | 34164 | 30404 | 28088 | 28297 |
| Urban Buses Midi <=15 t | HD Euro IV - 2005 Standards | 26241 | 24621 | 23198 | 27245 | 29404 | 33953 | 44666 | 34213 | 32274 | 28722 | 26534 | 26732 |
| Urban Buses Midi <=15 t | HD Euro V - 2008 Standards | 26572 | 24931 | 23491 | 27588 | 29775 | 34380 | 45229 | 34644 | 32681 | 29084 | 26869 | 27069 |
| Urban Buses Standard 15 - 18 t | Conventional | 20982 | 19687 | 18549 | 21785 | 23511 | 27148 | 35714 | 27356 | 25806 | 22966 | 21217 | 21374 |
| Urban Buses Standard 15 - 18 t | HD Euro I - 91/542/EEC Stage I | 25501 | 23926 | 22544 | 26477 | 28575 | 32995 | 43406 | 33247 | 31364 | 27912 | 25786 | 25978 |
| Urban Buses Standard 15 - 18 t | HD Euro II - 91/542/EEC Stage II | 28424 | 26669 | 25128 | 29512 | 31850 | 36777 | 48381 | 37059 | 34959 | 31112 | 28742 | 28956 |
| Urban Buses | HD Euro III - | 3031 | 2844 | 2679 | 3147 | 3396 | 3921 | 5159 | 3951 | 3728 | 3317 | 3065 | 3087 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard 15 - 18 t | 2000 Standards | 1 | 0 | 6 | 1 | 5 | 9 | 3 | 9 | 0 | 7 | 0 | 8 |
| Urban Buses Standard 15 - 18 t | HD Euro IV - 2005 Standards | 29348 | 27536 | 25945 | 30470 | 32885 | 37972 | 49953 | 38263 | 36095 | 32123 | 29676 | 29896 |
| Urban Buses Standard 15 - 18 t | HD Euro V - 2008 Standards | 39858 | 37397 | 35236 | 41383 | 44662 | 51571 | 67843 | 51966 | 49022 | 43626 | 40303 | 40603 |
| Urban Buses Articulated >18 t | Conventional | 20101 | 18859 | 17770 | 20870 | 22523 | 26007 | 34214 | 26207 | 24722 | 22001 | 20325 | 20476 |
| Urban Buses Articulated >18 t | HD Euro I - 91/542/EEC Stage I | 25644 | 24060 | 22670 | 26625 | 28735 | 33180 | 43649 | 33434 | 31540 | 28069 | 25930 | 26123 |
| Urban Buses Articulated >18 t | HD Euro II - 91/542/EEC Stage II | 28885 | 27101 | 25535 | 29990 | 32366 | 37373 | 49165 | 37659 | 35525 | 31616 | 29207 | 29425 |
| Urban Buses Articulated >18 t | HD Euro III - 2000 Standards | 30656 | 28763 | 27101 | 31829 | 34351 | 39665 | 52181 | 39969 | 37704 | 33555 | 30999 | 31229 |
| Urban Buses Articulated >18 t | HD Euro IV - 2005 Standards | 29106 | 27308 | 25731 | 30219 | 32614 | 37659 | 49541 | 37947 | 35797 | 31858 | 29431 | 29650 |
| Urban Buses Articulated >18 t | HD Euro V - 2008 Standards | 39858 | 37397 | 35236 | 41383 | 44662 | 51571 | 67843 | 51966 | 49022 | 43626 | 40303 | 40603 |
| Coaches Standard <=18 t | Conventional | 20218 | 18970 | 17874 | 20992 | 22655 | 26160 | 34414 | 26360 | 24867 | 22130 | 20444 | 20596 |
| Coaches Standard <=18 t | HD Euro I - 91/542/EEC Stage I | 23640 | 22180 | 20899 | 24545 | 26490 | 30587 | 40238 | 30821 | 29075 | 25875 | 23904 | 24082 |
| Coaches Standard <=18 t | HD Euro II - 91/542/EEC Stage II | 26062 | 24453 | 23040 | 27059 | 29204 | 33721 | 44361 | 33979 | 32054 | 28527 | 26353 | 26550 |
| Coaches Standard <=18 t | HD Euro III - 2000 Standards | 28212 | 26469 | 24940 | 29291 | 31612 | 36502 | 48019 | 36781 | 34698 | 30879 | 28527 | 28739 |
| Coaches Standard <=18 t | HD Euro IV - 2005 Standards | 29512 | 27690 | 26090 | 30641 | 33069 | 38184 | 50233 | 38477 | 36297 | 32302 | 29842 | 30064 |
| Coaches Standard <=18 t | HD Euro V - 2008 Standards | 39858 | 37397 | 35236 | 41383 | 44662 | 51571 | 67843 | 51966 | 49022 | 43626 | 40303 | 40603 |
| Coaches Articulated >18 t | Conventional | 20010 | 18774 | 17689 | 20775 | 22422 | 25890 | 34059 | 26088 | 24610 | 21902 | 20233 | 20384 |
| Coaches Articulated >18 t | HD Euro I - 91/542/EEC Stage I | 24123 | 22634 | 21326 | 25046 | 27031 | 31212 | 41061 | 31451 | 29669 | 26404 | 24393 | 24574 |
| Coaches Articulated >18 t | HD Euro II - 91/542/EEC Stage II | 27555 | 25854 | 24360 | 28609 | 30877 | 35653 | 46902 | 35926 | 33890 | 30161 | 27863 | 28070 |
| Coaches Articulated >18 t | HD Euro III - 2000 Standards | 29207 | 27403 | 25820 | 30324 | 32727 | 37790 | 49714 | 38079 | 35922 | 31968 | 29533 | 29753 |
| Coaches Articulated >18 t | HD Euro IV - 2005 Standards | 29178 | 27376 | 25794 | 30294 | 32694 | 37752 | 49664 | 38041 | 35886 | 31936 | 29504 | 29723 |
| Coaches Articulated >18 t | HD Euro V - 2008 Standards | 39858 | 37397 | 35236 | 41383 | 44662 | 51571 | 67843 | 51966 | 49022 | 43626 | 40303 | 40603 |
| Urban CNG Buses | HD Euro I - 91/542/EEC Stage I | 0 | 0 | 0 | 0 | 52690 | 86430 | 115254 | 110964 | 77101 | 87719 | 100055 | 103268 |
| Urban CNG Buses | HD Euro II - 91/542/EEC Stage II | 0 | 0 | 0 | 0 | 58730 | 96338 | 128466 | 123684 | 85939 | 97774 | 111524 | 115106 |
| Urban CNG Buses | HD Euro III - 2000 Standards | 0 | 0 | 0 | 0 | 62629 | 102734 | 136995 | 131895 | 91645 | 104265 | 118928 | 122748 |
| Urban CNG Buses | EEV | 0 | 0 | 0 | 0 | 6262 | 1027 | 1369 | 1318 | 9164 | 1042 | 1189 | 1227 |

| Subsector | Technology | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 9 | 34 | 95 | 95 | 5 | 65 | 28 | 48 |
| Urban Buses Biodiesel | Conventional | 20982 | 19687 | 18549 | 21785 | 23511 | 27148 | 35714 | 27356 | 25806 | 22966 | 21217 | 21374 |
| Urban Buses Biodiesel | HD Euro I - 91/542/EEC Stage I | 25501 | 23926 | 22544 | 26477 | 28575 | 32995 | 43406 | 33247 | 31364 | 27912 | 25786 | 25978 |
| Urban Buses Biodiesel | HD Euro II - 91/542/EEC Stage II | 28424 | 26669 | 25128 | 29512 | 31850 | 36777 | 48381 | 37059 | 34959 | 31112 | 28742 | 28956 |
| Urban Buses Biodiesel | HD Euro III - 2000 Standards | 30311 | 28440 | 26796 | 31471 | 33965 | 39219 | 51593 | 39519 | 37280 | 33177 | 30650 | 30878 |
| Urban Buses Biodiesel | HD Euro IV - 2005 Standards | 29348 | 27536 | 25945 | 30470 | 32885 | 37972 | 49953 | 38263 | 36095 | 32123 | 29676 | 29896 |
| Urban Buses Biodiesel | HD Euro V - 2008 Standards | 39858 | 37397 | 35236 | 41383 | 44662 | 51571 | 67843 | 51966 | 49022 | 43626 | 40303 | 40603 |
| 2-stroke <50 cm³ | Conventional | 1495 | 1211 | 1255 | 1152 | 1107 | 1045 | 1797 | 1539 | 1367 | 1351 | 1237 | 1110 |
| 2-stroke <50 cm³ | Mop - Euro I | 1576 | 1277 | 1323 | 1214 | 1167 | 1102 | 1894 | 1623 | 1441 | 1424 | 1304 | 1170 |
| 2-stroke <50 cm³ | Mop - Euro II | 1169 | 947 | 982 | 901 | 866 | 817 | 1406 | 1204 | 1069 | 1057 | 967 | 868 |
| 2-stroke <50 cm³ | Mop - Euro III | 978 | 792 | 821 | 753 | 724 | 684 | 1176 | 1007 | 894 | 884 | 809 | 726 |
| 2-stroke >50 cm³ | Conventional | 2223 | 1801 | 1867 | 1713 | 1646 | 1554 | 2673 | 2289 | 2033 | 2009 | 1839 | 1651 |
| 2-stroke >50 cm³ | Mot - Euro I | 2318 | 1878 | 1947 | 1786 | 1717 | 1621 | 2788 | 2388 | 2121 | 2096 | 1918 | 1721 |
| 2-stroke >50 cm³ | Mot - Euro II | 2626 | 2128 | 2206 | 2023 | 1944 | 1836 | 3158 | 2705 | 2402 | 2374 | 2173 | 1950 |
| 2-stroke >50 cm³ | Mot - Euro III | 2692 | 2181 | 2261 | 2074 | 1993 | 1882 | 3237 | 2772 | 2462 | 2433 | 2227 | 1999 |
| 4-stroke <250 cm³ | Conventional | 2880 | 2333 | 2419 | 2219 | 2132 | 2013 | 3462 | 2966 | 2634 | 2603 | 2383 | 2138 |
| 4-stroke <250 cm³ | Mot - Euro I | 3203 | 2595 | 2690 | 2467 | 2371 | 2239 | 3851 | 3298 | 2929 | 2895 | 2650 | 2378 |
| 4-stroke <250 cm³ | Mot - Euro II | 2837 | 2298 | 2382 | 2185 | 2100 | 1983 | 3411 | 2921 | 2595 | 2564 | 2347 | 2106 |
| 4-stroke <250 cm³ | Mot - Euro III | 3030 | 2455 | 2545 | 2334 | 2243 | 2118 | 3643 | 3120 | 2771 | 2739 | 2507 | 2249 |
| 4-stroke 250 - 750 cm³ | Conventional | 2963 | 2401 | 2489 | 2283 | 2194 | 2072 | 3563 | 3052 | 2710 | 2678 | 2452 | 2200 |
| 4-stroke 250 - 750 cm³ | Mot - Euro I | 3334 | 2701 | 2800 | 2568 | 2468 | 2331 | 4008 | 3433 | 3049 | 3013 | 2758 | 2475 |
| 4-stroke 250 - 750 cm³ | Mot - Euro II | 2987 | 2420 | 2509 | 2301 | 2212 | 2088 | 3592 | 3076 | 2732 | 2700 | 2472 | 2218 |
| 4-stroke 250 - 750 cm³ | Mot - Euro III | 3030 | 2455 | 2545 | 2334 | 2243 | 2118 | 3643 | 3120 | 2771 | 2739 | 2507 | 2249 |
| 4-stroke >750 cm³ | Conventional | 3008 | 2437 | 2527 | 2317 | 2227 | 2103 | 3617 | 3098 | 2751 | 2719 | 2489 | 2233 |
| 4-stroke >750 cm³ | Mot - Euro I | 3428 | 2778 | 2879 | 2641 | 2538 | 2397 | 4122 | 3531 | 3136 | 3099 | 2837 | 2545 |
| 4-stroke >750 cm³ | Mot - Euro II | 3065 | 2483 | 2575 | 2361 | 2269 | 2143 | 3685 | 3157 | 2804 | 2771 | 2536 | 2276 |
| 4-stroke >750 cm³ | Mot - Euro III | 3030 | 2455 | 2545 | 2334 | 2243 | 2118 | 3643 | 3120 | 2771 | 2739 | 2507 | 2249 |