**REPUBLIC OF BULGARIA**

**MINISTRY OF ENVIRONMENT AND WATER**

**EXECUTIVE ENVIRONMENT AGENCY**

# Bulgaria's Informative Inventory Report 2017 (IIR)

## Submission under the UNECE Convention on Long-Range Transboundary Air Pollution

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Reporting Entity

Executive Environment Agency at the Ministry of Environment and Water

136 "Tzar Boris III" Blvd

Sofia 1618

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## EXECUTIVE SUMMARY

Bulgaria has signed and ratified the 1981 Geneva Convention on Long-range Transboundary Air Pollution (CLRTAP). The aim of the Convention is to protect the population and the environment against air pollution and to limit and gradually reduce and prevent air pollution including long-range transboundary air pollution. Under the CLRTAP seven Protocols including the Gothenburg Protocol require an annual emission reporting. The Gothenburg Protocol is a multi-pollutant protocol designed to reduce acidification, eutrophication and ground-level ozone by setting national emissions ceilings for sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia which were to be met by 2010 and maintained afterwards. Negotiations on a revision of the Protocol resulted in emission reduction commitments for 2020 and beyond expressed as a percentage reduction from the 2005 emission level have been finalised in 2012.

Following its obligations under the CLRTAP, Bulgaria annually submits its air pollution emission inventory as well as an Informative Inventory Report (IIR).

Bulgarian National Inventory System

Bulgaria's reporting obligations to the

- Convention on Long-range Transboundary Air Pollution (LRTAP) of the United Nations Economic Commission for Europe (UNECE),
- United Nations Framework Convention on Climate Change (UNFCCC),
- European Commission (EC),
- European Environment Agency.

are being administered by the Ministry of Environment and Water (MoEW). The Executive Environment Agency (ExEA) has been identified as the responsible organization for preparation of Bulgaria's National GHGs inventory under the UNFCCC and the Kyoto Protocol, air pollutants inventory under UNECE/CLRTAP and it is designated as single national entity.

The legal, institutional and procedural arrangements within the Bulgarian National Inventory System (NIS) have been implemented in 2010.

The air pollutants inventory under the UNECE/CLRTAP and EU National Emissions Ceilings Directive is planned, prepared and managed in the frame of newly established NIS.

All activities on planning, preparation and management of inventory under UNFCCC and UNECE/CLRTAP are regulated by the Regulation of the Council of Ministers 261/28.08.2014 on the way and order of organization of the National Inventories of hazardous substances and greenhouse gases in the ambient air (last update SG 74/2014).

## CLARIFICATION OF THE REASON FOR DIFFERENCES IN REPORTED NATIONAL TOTALS WITH UNFCCC REPORTS

There are differences between reported national totals for UNECE/CLRTAP and UNFCCC reports. The reasons for the difference have both methodological and structural origin. Generally, the results obtained by the IPCC methods differ from the results of the air pollutant inventory, which is carried out in compliance with the CORINAIR methodology.

For UNECE/CLRTAP inventory, the National Statistical Institute (NSI) have the main responsibility for estimation of emissions in Energy (excluding sub-sector Transport and Solvents), Industrial processes and Agriculture. Thus different sources of information are still used for preparation of GHGs and air pollutant inventories for the sectors mentioned above (NSI data, EUROSTAT Energy Balance, EU-ETS data, EPRTR data, PRODPROM data, Agrostatistic data and etc.).

The future plan of the NIS is the same team, which is dealing with GHGs inventory to be also responsible for preparation of UNECE/CLRTAP inventory.

The IIR starts with **Chapter 1** Introduction, which includes general information on the process of elaboration of the inventories in Bulgaria, description of the key sources of air emissions, assessment of the methods, sources and emission factors as well as the applied QA/QC system.

**Chapter 2** analyses the trends by sources/gases type.

**Chapters 3–7** provide information in detail on the emissions from the different activity sectors.

The final **Chapter 8** presents information and results from emissions recalculations done for the period 1990-2013.

The final **Chapter 9** presents information for projections.

The annexes to the Report provide results from of key category assessment and as well as references.

# CHAPTER 1. INTRODUCTION

## NATIONAL INVENTORY BACKGROUND

Bulgaria has signed and ratified the Geneva Convention on Long-range Transboundary Air Pollution (CLRTAP) in 1981 as well as its related Protocols

- The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30%
- The 1988 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes
- The 1984 Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)
- The 1991 Geneva Protocol on the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes
- The 1994 Oslo protocol on Further Reduction of Sulphur Emissions
- The 1998 Aarhus Protocol on Heavy Metals
- The 1998 Aarhus Protocol on Persistent Organic Pollutants
- The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone

According to the obligations of the CLRTAP, Bulgaria is required to annually report data on emissions of air pollutants covered in the Convention and its Protocols: these are the main pollutants NOx, SOx, NMVOC, $NH_3$ and CO, Particulate Matter (PM), Persistent Organic Pollutants (POPs) and Heavy Metals (HM).

The complete set of tables for 1990-2015 in the NFR format (version 2014) are submitted separately in digital form only.

## INSTITUTIONAL ARRANGEMENTS

Bulgaria's reporting obligations to the

- Convention on Long-range Transboundary Air Pollution (LRTAP) of the United Nations Economic Commission for Europe (UNECE),
- United Nations Framework Convention on Climate Change (UNFCCC),
- European Commission (EC),
- European Environment Agency.

are being administered by the Ministry of Environment and Water (MoEW). The Executive Environment Agency (ExEA) has been identified as the responsible organization for preparation of Bulgaria's National GHGs inventory under the UNFCCC and the Kyoto

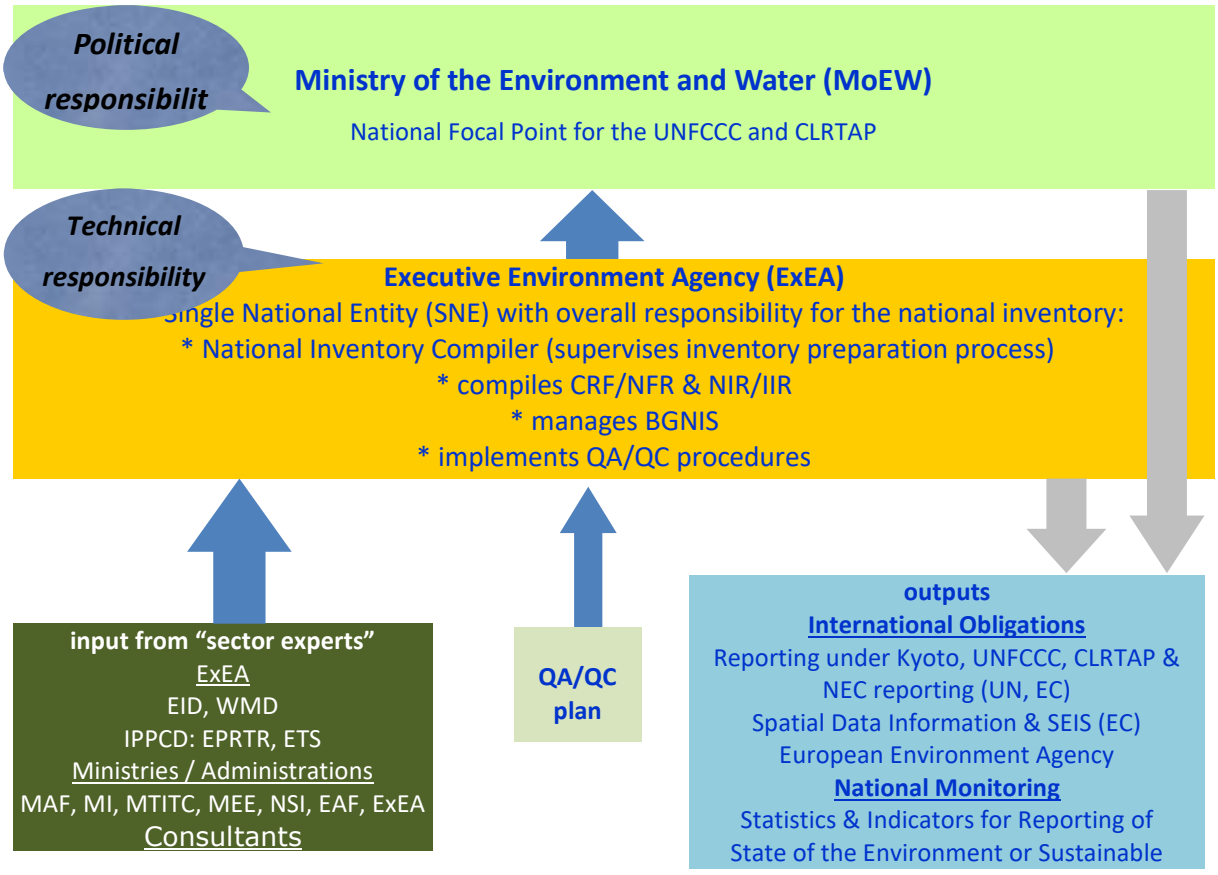
Protocol, air pollutant inventory under UNECE/CLRTAP and it is designated as single national entity**.**

The legal, institutional and procedural arrangements within the Bulgarian National Inventory System (NIS) have been implemented in 2010.

The air pollutant inventory under the UNECE/CLRTAP and EU National Emissions Ceilings Directive is planned, prepared and managed in the frame of newly established NIS.

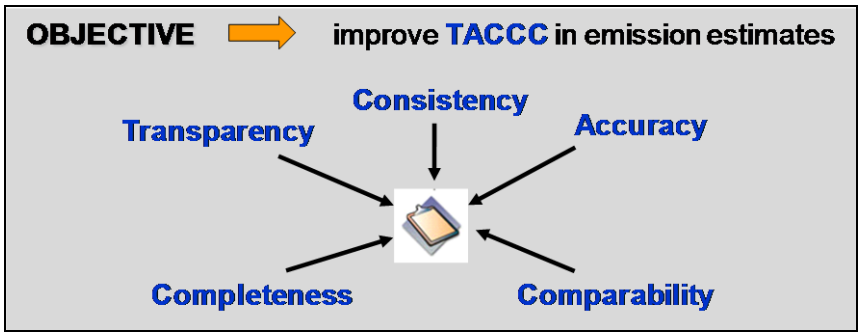
As it is illustrated in Figure 1 and outlined in the following chapter the preparation of the inventory has an institutional "home" that is ultimately responsible for managing the process and has a legal authority to collect data and submit it on behalf of the Bulgaria.

**Figure 1: Organizational Chart of the Bulgarian National Inventory System**




The overall objective of the NIS is annually to produce a high quality inventory under UNFCCC and UNECE/CLRTAP, with "quality" being defined by the TCCCA criteria.

**Figure 2: Objectives of the Bulgarian National Inventory System**




**Legal basis of the NIS**

As it illustrated in Figure 1 and outlined shortly the Bulgaria's reporting obligations to the UNFCCC, UNECE/CLRTAP and EC are being administered by the MoEW. All activities on preparation of GHG and air pollutants inventory in Bulgaria are coordinated and managed on the state level by MoEW.

The ExEA is identified as the responsible organization for preparation/compilation of Bulgaria's National Inventory under the UNFCCC and the Kyoto Protocol and UNECE/CLRTAP and it is designated as single national entity. ExEA has the technical responsibility for the national inventory:

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

The bases for NIS are:

- Environmental Protection Act (EPA, State Gazette No. 91/25.09.2002; corrected, SG No. 96/2002; last amendment 24.04.2012);
- Statute on the organization and structure of ExEA (Decision of Council of ministers 162/03.08.2010, last update 25.03.2014);
- Order № 296/04.12.2015 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 261/28.08.2014, SG 74/2014 on the way and order of organization of the National Inventories of hazardous substances from greenhouse gases in the ambient air

**Add 1.**

EPA (State Gazette No. 91/25.09.2002; corrected, SG No. 96/2002; last amendment 24.04.2012), 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:

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

Article 13:

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

(2) The Executive Environment Agency shall be a legal person.

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

(4) 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 : (1) The National Environmental Monitoring System shall comprehend:

1. the national networks for:

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

**Add 2.**

EPA establishes the national Executive Environment Agency (ExEA) according to **Regulation on the organization and structure of ExEA** (Decision of Council of ministers 162/03.08.2010), which regulate it's responsibilities for monitoring of environment as well as the responsibility for preparation of emission inventories.

The Environment Monitoring Directorate of ExEA prepares and annually updates the air emissions inventories [according to article 17 (6) 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, replaced by new **Order № 296/04.12.2015** 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 and air pollutants emission inventory (Sector experts/QC experts).

**Add 4.**

To assure the quality of information reported to UNFCCC and UNECE/CLRTAP 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 NIS has been enshrined in law through a special Regulation of the Council of Ministers 261/28.08.2014, SG 74/2014. The regulation establishes and maintain the institutional, legal and procedural arrangements necessary to perform the general and specific functions of NIS, defined in Decision 19/CMP.1 for national systems. The regulation reinforces the existing institutional agreements by specifying the roles of all data providers.

In order to strengthen the institutional arrangements and to fulfil the required general and specific functions of BGNIS **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 and Energy (14/06/2010);
- Ministry of Interior (MI) (08/06/2010).

The agreements ensure the support from these organizations 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 of GHG and air pollutant emissions by the following state authorities:

- National Statistics Institute (NSI);
- Ministry of Agriculture and Food (MAF) and their relevant services (Agrostatistic Directorate and Executive Forestry Agency);
- Ministry of Economy and Energy (MEE);
- Ministry of Interior (MI);
- Ministry of Environment and Water (MoEW);
- Ministry of Transport, Information Technologies and Communications (MTITC).

*Other arrangement of the Bulgarian National Inventory System:*

- Large industrial plants;
- Branch Business Associations

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

**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 MEE 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 261/28.08.2014, SG 74/2014.

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 inventory use also data, received directly from large point sources under EU ETS and E-PRTR obligations. These data are summarized by ExEA.

**Table 1: Sources of activity data for preparation of national air pollutant emission inventory**

| **Sectors** | **Data Source of Activity Data** | **Activity Data Supplier** | |
|---|---|---|---|
| 1. Energy | | | |
| 1.A Fuel Combustion | Plant operator data and Energy balance | NSI<br>MoEW | National Statistical Institute<br>Ministry of Environment and Water |
| 1.A.3 Transport | Energy balance | NSI | National Statistical Institute |
| | Statistics vehicle fleet | MI/RCD | Ministry of Interior/ Road Control Department |
| | | MTITC | Ministry of Transport, Information Technologies and Communications |
| 1.B Fugitive emissions | Energy balance | NSI | National Statistical Institute |

| Sectors | Data Source of Activity Data | Activity Data Supplier | |
|---|---|---|---|
| 2.1.Industrial processes | National production statistics | NSI | National Statistical Institute |
| | National registers (E-PRTR) | ExEA | Executive Environment Agency |
| 2.2. Solvents and Other product use | National production statistics<br>National VOC register | NSI<br>ExEA | National Statistical Institute<br>Executive Environment Agency |
| 3. Agriculture | National agriculture statistics | NSI and MAF | National Statistical Institute and Agrostatictis Department under the Ministry of Agriculture and Food |
| 4. Waste | National statistics | NSI | National Statistical Institute |
| | National studies | ExEA | Executive Environment Agency/ Waste Department |

**Procedural arrangements**

The inventory preparation process covers:

- Identification key source categories;
- Prepare estimates 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 emissions;
- Make a quantitative estimate of inventory uncertainty for each source category and for the inventory in total;
- Recalculations of previously submitted estimates;
- Compile the national inventory;
- Implement general inventory QC procedures (tier 1) in accordance with its QA/QC plan;

- 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;
- 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 table 2 presents the responsibilities of all engaged institutions for preparation of UNECE/CLRTAP emission inventory for 2017 submission.

**Table 2: Preparation of UNECE/CLRTAP emission inventory for 2017 submission**

| **Sector**<br>**NFR** | **Activity data** | **Methodology and selection of emission factors** | **Preparation of inventories** |
|---|---|---|---|
| Energy<br>NFR 1A1<br>NFR 1A2 | NSI<br>ExEA | NSI<br>ExEA<br>MoEW | NSI<br>ExEA |
| Energy/Transport<br>NFR 1A3 | NSI | ExEA, NSI<br>MI, MTITC | External consultants and ExEA |
| | MI | | |
| | МТИТС | | |
| Energy<br>NFR 1A4 | NSI | ExEA<br>NSI | ExEA<br>NSI |
| Energy<br>NFR 1B | NSI | NSI | NSI |
| | MEET | | |
| Industry processes<br>NFR 2 | NSI | NSI<br>Installations operators | NSI |
| Solvents use<br>NFR 2 | NSI | ExEA | ExEA |
| | ExEA | | |
| Agriculture | NSI/MAF | NSI | NSI |

| | | | |
|---|---|---|---|
| NFR 3 | | | |
| Waste<br>NFR 5 | NSI | ExEA | ExEA |
| | ExEA | | |

The National Inventory Compiler from the ExEA compiles the national air pollutant inventory (NFR-tables and IIR) for submission under the UNECE/CLRTAP.

**Expert capacity in ExEA - Emission Inventory Department (EID)**

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

The inventory team, which is dealing with GHG inventory, is still not directly involved in the preparation of UNECE/CLRTAP inventory. All emission estimations, expect Residential, Transport, Solvents and Waste, have been made by experts from National Statistical Institute.

The future plan of the NIS is the same team, which is dealing with GHG inventory to be also responsible for preparation of UNECE/CLRTAP inventory.

**The responsibilities of the Sector experts**

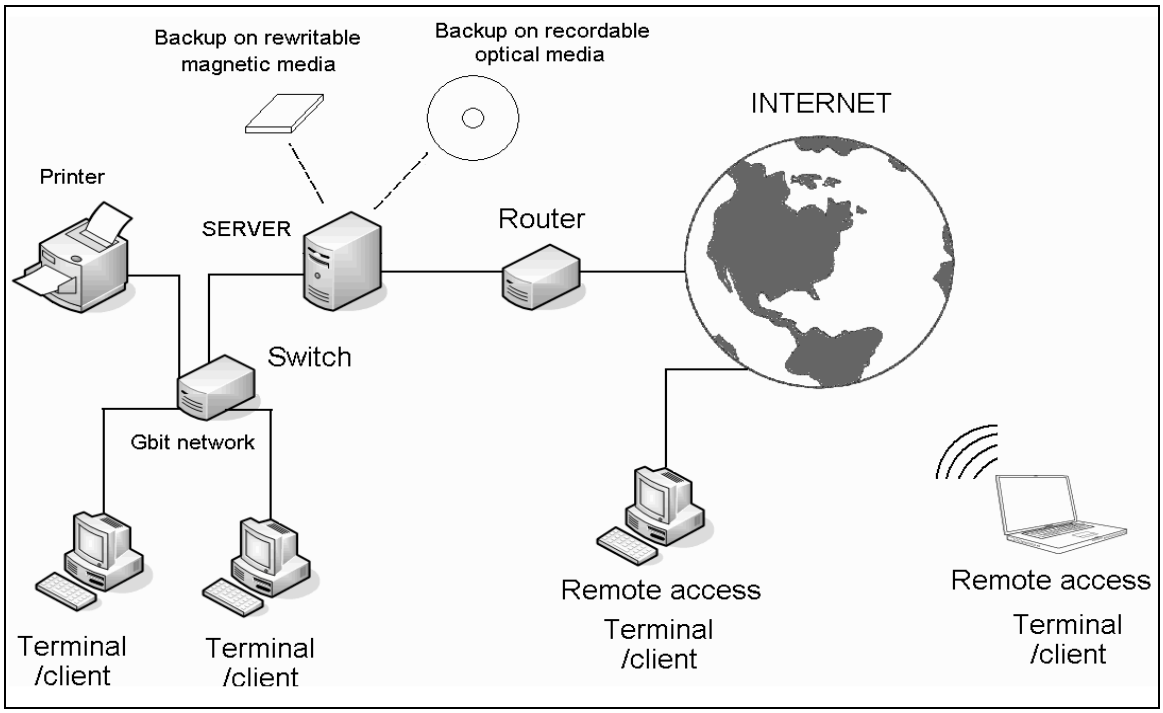
Within the inventory system specific responsibilities for the different emission source categories are defined ("sector experts"), as well as for all activities related to the preparation of the inventory, including QA/QC, data management and reporting.

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).

**Documentation and data archiving**

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

**Figure 3: Documentation and data archiving in ExEA**




## INVENTORY PREPARATION PROCESS

All activities on planning, preparation and management of inventory under UNFCCC and UNECE/CLRTAP are regulated by the Regulation of the Council of Ministers 261/28.08.2014, SG 74/2014 on the way and order of organization of the National Inventories of hazardous substances from greenhouse gases in the ambient air.

The ExEA is the responsible organization for preparation of Bulgaria's National Inventory under the UNFCCC and the Kyoto Protocol and UNECE/CLRTAP and it is 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/NFR tables and NIR/IIR;
- coordinates the work of engaged consultants for supporting inventory;
- coordinates and implements the activity of National QA/QC Plan..

The responsibilities of all engaged institutions for preparation of UNECE/CLRTAP emission inventory for 2017 submission are presented in Table 2.

As it is written above for UNECE/CLRTAP inventory the NSI continue to have the main responsibility for estimation of emissions in Energy (excluding sub-sectors Transport and Residential heating), Industry and Agriculture.

NSI uses up-to-date statistical methods and procedures for data collection, summarizing and structuring which are harmonized with EUROSTAT. NSI has two level hierarchical structures

- National office and Regional offices. The primary statistical questionnaires are collected at the regional statistical offices, examined for consistency of the data and processed.

The National office receives the primary information and the processed information from the regional offices and develops the National totals and balances.

The future plan of the NIS is the same team, which is dealing with GHG inventory to be also responsible for preparation of UNECE/CLRTAP inventory. Thus the differences between both conventions will be eliminated.

For more information related to procedural arrangements see above in Chapter 1.

## METHODS AND DATA SOURCES

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

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

In 2011, MoEW/ExEA ran a project for update of a Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (approved with Order RD 165 from 20.02.2013 of MOEW). The aim of the project was the harmonization of the Common methodology with the EMEP/EEA Guidebook, 2009.

The emission inventory under UNECE/CLRTAP for 2017 submission is prepared based on:

1. Emission Factors, taken from:
    - National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC;
    - the EMEP/EEA Guidebook 2009/2013 (where EF are not available in the national methodology);
    - International Emission Factor Data Base;
    - Country-specific EF.
2. Activity data from the NSI, MI, MTITC, MEE, MAF, EAF, ExEA, MOEW
    - Sources of activity data for preparation of national air pollutant emission inventory are presented in Table 1.

# KEY CATEGORIES

## Methodological approach to identify key categories

It is good practice for each country to identify its national key categories in a systematic and objective way. This can be achieved by a quantitative analysis of the relationship between the magnitude of emissions in any one year (level) and the change in the emissions year to year (trend) of each category's emissions compared to the total national emissions.

Key category analysis is prepared based on the methodology set in the EMEP/EEA air pollutant emission inventory guidebook.

The methodology follows the IPCC approach to produce pollutant-specific key categories and covers Approaches 1 and 2 for both level and trend assessments. The two approaches developed by the IPCC and described below, for performing the key category analysis can be used to identify the key categories for each pollutant. Both approaches identify key categories in terms of their contribution to the absolute level of the national emissions and to the trend of emissions.

- In Approach 1: the key categories are identified using a predetermined cumulative emissions threshold. Key categories are those which, when summed together in descending order of magnitude, cumulatively add up to 80% of the total level.
- In Approach 2: the key categories can be derived by inventory compilers if category uncertainties or parameter uncertainties are available. Under Approach 2 the categories are sorted according to their contribution to uncertainty.

For preparation of the key category analysis and based on the inventory data available Approach 1 has been selected.

## Level assessment

The contribution of each source category to the total national inventory level is calculated according to equation (1) (level assessment (Approach 1)):

Key category level assessment = source category estimate / total contribution

$$\mathbf{L_{x,t} = Ex,t / \Sigma Et} \qquad \mathbf{(1)}$$

Where:

$\boldsymbol{Lx,t}$ = level assessment for source x in latest inventory year (year $t$)

$\boldsymbol{Ex,t}$ = value of emission estimate of source category $x$ in year $t$

$\Sigma\boldsymbol{Et}$ = total contribution, which is the sum of the emissions in year $t$, calculated using the aggregation level chosen by the country for key category analysis

A key category analysis (Approach 1) for each pollutant, based on the latest inventory year is presented in an Appendix 1. The source categories are presented in the tables, sorted by largest contribution to national total. Key categories are those that, when summed together in descending order of magnitude, add up to 80 % of the total in column Cumulative total.

# QA/QC AND VERIFICATION METHODS

## Quality management system

As it is written above the ExEA is responsible for the preparation of GHG and air pollutant inventory under UNFCCC, UNECE/CLRTAP and EC.

The ExEA is also responsible for coordination and implementation of QA/QC activities for the national inventories. 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.

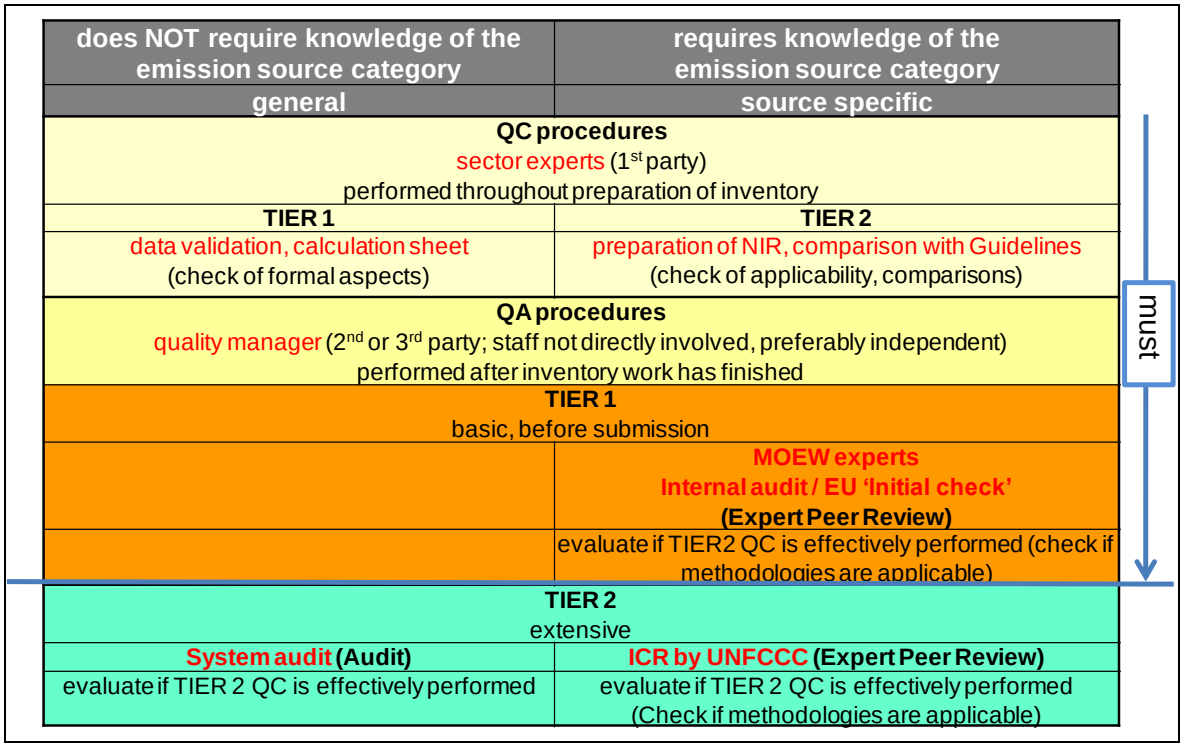
The QA/QC plan is an internal document to organize, plan and implement QA/QC activities. Once developed for the next submission, it is referenced and used in subsequent inventory preparation, or modified as appropriate.

The QA/QC plan has been updated in 2014 in order to implement the newly established legal, institutional and procedural arrangements within the NIS. The updated National QA/QC Plan was approved by the Ministry of Environment and Water in January 2015.

National QA/QC Plan includes following elements:

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

**Figure 4: National quality assurance and quality control program**




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

The QC procedures are performed by experts, 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 and/or external consultants.

**Table 3: QC experts within the BGNIS**

| Responsibility | QC experts |
|---|---|
| Activity data | NSI, MAF, MI, MTITC, MEE, EAF, ExEA, MOEW |
| Methodology and selection of emission factors | ExEA, MAF, MI, MTITC, MEE, NSI, EAF, MOEW |
| Inventory preparation | Sector experts ExEA, NSI 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 NIS 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 ECE/EB.AIR/97:

- **Transparency** means that Parties should provide clear documentation and report a level of disaggregation that sufficiently allows individuals or groups other than the designated emission expert or the compiler of the inventory or projection to understand how the inventory was compiled and assure it meets good practice requirements. The transparency of reporting is fundamental to the effective use, review and continuous improvement of the inventory and projection;
- **Consistency** means that estimates for any different inventory years, gases and source categories are made in such a way that differences in the results between years and source categories reflect real differences in emission estimates. Annual emissions, as far as possible, should be calculated using the same method and data sources for all years, and resultant trends should reflect real fluctuations in emissions and not the changes resulting from methodological differences. Consistency also means that, as far as practicable and appropriate, the same data are reported under different international reporting obligations. For projections, consistency means that a year of the submitted inventory is used as a basis;
- **Comparability** means that the national inventory and projection is reported in such a way that allows it to be compared with other Parties. This can be achieved by using accepted methodologies as elaborated in section V below, by using the reporting templates and through the use of the harmonized Nomenclature for Reporting (NFR), as specified in annex III to these Guidelines;
- **Completeness** means that estimates are reported for all pollutants, all relevant source categories and all years and for the entire territorial areas of Parties covered by the reporting requirements set forth in the provisions of the Convention and its protocols. Where numerical information on emissions under any source category is not provided, the appropriate notation key defined in section II.C of annex I to these Guidelines should be used when filling in the reporting template and their absence should be documented;

- **Accuracy** means that emissions are neither systematically overestimated nor underestimated, as far as can be judged. This implies that Parties will endeavour to remove bias from the inventory estimates and minimize uncertainty;

For 2017 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 Inventory Report or reflected in the inventory estimates.

**Information of the QA/QC activities**

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

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

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

3. 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.

4. The QA/QC Manager coordinates 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).

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

6. 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/NFR and NIR/IIR);

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

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

9. 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;

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

**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 and UNECE/CLRTAP 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/NFR).

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

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

As it is written above for 2017 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 (NFR).

The check lists are exchanged between QA experts and QC experts for correction of the findings with reporting tables and respective chapters from national reports.

**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 – 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.

## GENERAL UNCERTAINTY EVALUATION

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

The uncertainty of the emission sources can be defined during data collection and processing, and it is a part of procedures, applied by the NSI and its regional structures. Different criteria for uncertainty assessment are used, for example as statistical subtraction, on basis on differences between the production, import, export and consumption of fuels, through expert assessments, etc. The uncertainty of the emission factors depends on the origin of the factors applied.

As it is written above the further plan of the BGNIS is the same team, which is dealing with GHG inventory to be also responsible for preparation of UNECE/CLRTAP inventory. At the moment tier 1 uncertainty analysis is implemented in the GHGs inventory under UNFCCC.

For UNECE/CLRTAP a quantitative estimate of inventory uncertainty[1] for each source category and for the inventory in total will be presented in the next submissions.

## GENERAL ASSESSMENT OF COMPLETENESS

### Sources Not Estimated (NE)

The next table presents the NFR source categories, which continue to be problematic for assessment, because of the data gaps (lack of activity data and/or EFs).

**Table 4: Explanation to the Notation key NE**

| NFR 14 code | Substance(s) | Reason for not estimated |
|---|---|---|
| 1 A 2 gviii | All | Activity data gaps |
| 1 A 3 eii | All | Activity data gaps |
| 1 A 4 aii | All | Activity data gaps |
| 1 A 4 bii | All | Activity data gaps |
| 1 A 4 ciii | All | Activity data gaps |
| 1 A 5 b | All | Activity data gaps |

[1] following the IPCC good practice guidance

| | | |
|---|---|---|
| 2 C 7 d | All | Activity data gaps |
| 2 I | All | Activity data gaps |
| 2 J | All | Activity data gaps |
| 2 L | All | Activity data gaps |
| 3 D a 2a | All | Activity data gaps |
| 3 D a 2b | All | Activity data gaps |
| 5 C 1 bv | All | Activity data gaps |

**Sources Included Elsewhere (IE)**

The next table presents the NFR source categories, which are included elsewhere in the reporting table. The main reason for such aggregation is lack of representative activity data for separate assessment.

**Table 5: Explanation to the Notation key IE**

| NFR 14 code | Substance(s) | Included in NFR code | Reason for IE |
|---|---|---|---|
| 1 A 2 c | All | 1A2a | Lack of representative activity data on desegregated level |
| 1 A 2 e | All | 1A2a | Lack of representative activity data on desegregated level |
| 1 A 5 a | All | 1A4a | Lack of representative activity data on desegregated level |
| 2 C 3 | All | 1A2b | Lack of representative activity data on desegregated level |
| 2 C 4 | All | 1A2b | Lack of representative activity data on desegregated level |
| 2 C 5 | All | 1A2b | Lack of representative activity data on desegregated level |
| 2 C 6 | All | 1A2b | Lack of representative activity data on desegregated level |
| 2 C 7 a | All | 1A2b | Lack of representative activity data on desegregated level |
| 5 C 1 bii | All | 5 C 1 bi | Definitions difference |
| 5 D 2 | All | 5 D 2 | Lack of representative activity data on desegregated level |

**Other notation keys**

**Table 6: Sub-sources accounted for in reporting codes "other"**

| NFR 14 code | Substance(s) reported | Sub-source description |
|---|---|---|
| 1 A 2 gviii | All | NE |
| 1 A 3 eii | All | NE |
| 1 A 5 b | All | NE |
| 2 A 6 | All | NA |
| 2 B 10 a | All | 04 04 01 Sulfuric acid<br>04 04 04 Ammonium sulphate<br>04 04 05 Ammonium nitrate<br>04 04 06 Ammonium phosphate<br>04 04 07 NPK fertilisers<br>04 04 13 Chlorine production<br>04 04 14 Phosphate fertilizers<br>04 04 15 Storage and handling of inorganic chemical products<br>04 05 01 Ethylene<br>04 05 02 Propylene<br>04 05 07 Polyethylene – High Density<br>04 05 09 Polypropylene<br>04 05 11 Polystyrene<br>04 05 14 Styrene-butadiene rubber (SBR)<br>04 05 15 Acrylonitrile butadiene styrene (ABS) resins<br>04 05 17 Formaldehyde<br>04 05 19 Phtalic anhydride<br>04 05 20 Acrylonitrile |
| 2 C 7 c | All | NO |
| 2 D 3i | All | NA |
| 2 B 5 b | All | 04 04 15 |
| 2 G | All | 060404<br>060405<br>060406 |
| 2 H 3 | All | NO |
| 2 L | All | NE |
| 5 C 1 bvi | All | NO |

| | | |
|---|---|---|
| 5 D 3 | All | NO |
| 5 E | All | NO |
| 6 A | All | NO |

## CHAPTER 2. EXPLANATION OF KEY TRENDS

A key category analysis (Approach 1) for each pollutant, based on the latest inventory year is presented in an Appendix 1. The source categories are presented in the tables, sorted by largest contribution to national total. Key categories are those that, when summed together in descending order of magnitude, add up to 80 % of the total in column Cumulative total.

There are changes in the time trend for key categories and pollutants and the reasons for these changes are as follows:

- Till 2008 inventory year the emissions from Transport and Other mobile sources and machinery were estimated based on activity data set in the national statistic, prepared for national reporting obligations. These data were different aggregated compare to the National Energy Balance. Thus the national total for Road transport was allocated in NFR 1A3b and all other quantity of fuel used was allocated in national total for other transport in NFR 1A5b.
- In order to reduce the differences with UNFCCC report form 2011 submission, the emissions from sub-Sector Transport are estimated based on activity data, provided by Eurostat Energy Balance. The emission factors are taken from national common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC. In some cased emission factors from Emission Factor data base are used.
- The Eurostat Energy Balance provides data for Aviation, Road Transport, Railways, Navigation and Other transport.
- In 2017 submission the Eurostat Energy Balance is incorporated also in inventory of sub-Sector 1A4b i Residential: Stationary plants. The emission factors are revised in accordance with EMEP/CORINAIR Emission Inventory Guidebook 2009.

Because of the above mentioned reasons the key trends are prepared from 2007 to 2015.

**Table 7: Main sectors (sorted by largest contribution to total for 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014 and 2015)**

| Year | Component | Main sectors (sorted by largest contribution to total) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2007 | NOx | 1A1a | 1A3b | 1A5b | 2B2 | | | |
| 2008 | | 1A1a | 1A3b | 1A5b | 2B2 | | | |
| 2009 | | 1 A 3 b | 1A1a | 2B2 | 1A2f | | | |
| 2010 | | 1A1a | 2B2 | 1A3biii | 1A3bi | 1A2fi | 4F | |
| 2011 | | 1A1a | 1A3biii | 1A3bi | 1A2a | 1A2fi | 1A4bi | 4F |
| | | 2B2 | 2B5a | | | | | |
| 2012 | | 1A1a | 2B2 | 1A3biii | 1A3bi | 1A2a | | |

| Year | Component | Main sectors (sorted by largest contribution to total) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2013 | | 1A1a | 2B2 | 3B1b | 3B4gi | 3B2 | 3B4gii | 2B10a |
| | | 3B4e | | | | | | |
| 2014 | | 1A1a | 2B2 | 1A3bi | 1A3biii | 1A3di(ii) | 1A2f | 1A3bii |
| | | 1A4cii | | | | | | |
| 2015 | | 1A1a | 2B2 | 1A3bi | 1A3biii | 1A3di(ii) | 1A2f | 1A3bii |
| | | 1A4cii | 3F | 1A4bi | 1A3ai(i) | | | |
| 2007 | CO | 1A4b i | 1A3b | 2C | | | | |
| 2008 | | 1A4bi | 1A3b | 2C1 | | | | |
| 2009 | | 1 A 3 b | 1A4b i | 2 C 1 | | | | |
| 2010 | | 1A4bi | 1A3b | 2A4 | | | | |
| 2011 | | 1A4bi | 1A3b | 2A4 | | | | |
| 2012 | | 1A4bi | 1A3bi | | | | | |
| 2013 | | 1A4bi | 1A3bi | | | | | |
| 2014 | | 1A4bi | 1A3bi | | | | | |
| 2015 | | 1A4bi | 1A3bi | 2B7 | 2C1 | 1A3bii | 1A3biii | |
| 2007 | NMVOC | 1A4b i | 1A3b | 4D1 | 4F | 1A5b | 3D | 3A |
| 2008 | | 1A4bi | 1A3b | 4D1a | 4F | 1A5b | 3D3 | 2D2 |
| 2009 | | 1 A 3 b | 1A4b | 4 D1a | 4F | 1B2a iv | 3 D 3 | 3 A 2 |
| 2010 | | 1A4b i | 2D1a | 4F | 1B2aiv | 1A3bi | 3D3 | 3A2 |
| | | 2D2 | 1B2av | | | | | |
| 2011 | | 1A4b i | 4D1a | 4F | 1B2aiv | 1A3bi | 3A2 | 3D3 |
| | | 2D2 | 1B2av | 4D1a | 1B2aiv | 3D3 | 1A3bi | |
| 2012 | | 1A4b i | 4D1a | 4F | 1B2aiv | | | |
| 2013 | | 1A4b i | 3Da1 | 1A3bi | 3F | 1B2aiv | 1A3bv | |
| 2014 | | 1A4b i | 3Da1 | 2D3bi | 1A3bi | 3F | 1B2aiv | 2D3d |
| 2015 | | 1A4b i | 3Da1 | 1A3bi | 3F | 2D3a | 1B2aiv | 2D3d |
| | | 2G | 1A3bv | 2H2 | 1B2av | 2B1 | | |
| 2007 | SOx | 1A1a | 1A5b | 2B5a | | | | |
| 2008 | | 1A1a | 1A5b | 2B5a | | | | |
| 2009 | | 1A1a | 2B5a | 1A4b i | | | | |

| Year | Component | Main sectors (sorted by largest contribution to total) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2010 | | 1A1a | 2B5a | | | | | |
| 2011 | | 1A1a | 1A2a | | | | | |
| 2012 | | 1A1a | 2B5a | | | | | |
| 2013 | | 1A1a | 2B10a | | | | | |
| 2014 | | 1A1a | 2B10a | | | | | |
| 2015 | | 1A1a | 2B10a | 2H1 | 1A2f | 1A4bi | | |
| 2007 | $NH_3$ | 6A | 4B1a | 4B3 | 4D1 | 4B8 | 4B1b | 4B6 |
| 2008 | | 4B1a | 6A | 4D1a | 4B1b | 4B8 | 4B9d | 4B3 |
| 2009 | | 6A | 4 D 1 a | 4B1 a | 4B8 | 4B1 b | 4 B 9 a | 4B 9b |
| 2010 | | 6A | 4B1 a | 4 D 1 a | 4B8 | 4B1 b | 4 B 9 a | 2A4 |
| | | 4B3 | 4B9b | 4B9d | 4B6 | 2B5a | | |
| 2011 | | 4B1a | 6A | 4D1a | 4B8 | 4B1b | 4B9a | 4B3 |
| | | 2B5a | 4B9b | 4B9d | 2A4 | 4B6 | | |
| 2012 | | 4B1a | 4D1a | 4B8 | 4B1b | 4B9a | 4B9b | 4B3 |
| | | 2B5a | 2A4 | | | | | |
| 2013 | | 3B1a | 3B3 | 3B1b | 3B4gi | 3B2 | 3B4gii | 2B10a |
| | | 3B4e | | | | | | |
| 2014 | | 3B1a | 3B3 | 3B1b | 3B4gi | 3B2 | 3B4gii | 2B10a |
| | | 3B4e | | | | | | |
| 2015 | | 3B1a | 3B3 | 3B1b | 3B4gi | 3B2 | 3B4gii | 2B10a |
| | | 2B7 | 3B4e | 3B4f | 3F | 3Da1 | | |
| 2007 | Pb | 1A2b | 1A3aii(ii) | 1A3aii(i) | 2C | 1A2a | | |
| 2008 | | 2 C 5 b | 2 C 5 a | 1 A 3 a i (i) | 2C1 | 1A2f | | |
| 2009 | | 2 C 5 b | 2 C 5 a | 1 A 3 a i (i) | 2 C 1 | 1A2f | | |
| 2010 | | 1A2b | 2C1 | 1A2fi | | | | |
| 2011 | | 1A2b | 2C1 | 1A2fi | | | | |
| 2012 | | 1A2b | | | | | | |
| 2013 | | 1A2b | 1A2f | | | | | |

| Year | Component | Main sectors (sorted by largest contribution to total) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2014 | | 1A2b | 1A2f | | | | | |
| 2015 | | 1A2b | 1A2f | 2C1 | | | | |
| 2007 | Cd | 1A2b | 2C | 1A1a | 1A2a | 1A1c | 1A2f | 6C |
| 2008 | | 2 C 5 b | 2 C 5 a | 2 C 5 d | 2C1 | 1A1a | 1A2fi | 1A2a |
| 2009 | | 2 C 5 b | 2 C 5 a | 2 C 5 d | 1A1a | 2 C 1 | 1A2a | 1A2f |
| 2010 | | 1A2b | 2C1 | 1A1a | 1A2fi | | | |
| 2011 | | 1A2b | 2C1 | 1A2fi | 1A1a | | | |
| 2012 | | 1A2b | 2C1 | | | | | |
| 2013 | | 1A2b | 2C1 | 1A2f | | | | |
| 2014 | | 1A2b | 2C1 | | | | | |
| 2015 | | 1A2b | 2C1 | 1A2f | 1A1a | | | |
| 2007 | Hg | 1A1a | 1A2f | 1A2b | 2C | 1A2a | 6C | 1A4b i |
| 2008 | | 1A2f | 1A1a | 2 C 5 b | 2C1 | 6Cb | 1A2a | 1A4bi |
| 2009 | | 1A1a | 1A2f | 2 C 5 b | 2 C 1 | 6 C b | 1A4b i | 1A2a |
| 2010 | | 1A1a | 1A2b | 1A2fi | 2C1 | 1A4b i | | |
| 2011 | | 1A1a | 1A2fi | 1A2b | 2C1 | 1A4b i | | |
| 2012 | | 1A2fi | 1A2b | 1A1a | 2C1 | | | |
| 2013 | | 1A2f | 1A2b | 1A1a | 2C1 | | | |
| 2014 | | 1A2b | 1A2f | 1A1a | 2C1 | | | |
| 2015 | | 1A2b | 1A2f | 1A1a | 2C1 | 1A4bi | | |
| 2007 | PCBs | 1A4b i | 1A3b | 1A5b | | | | |
| 2008 | | 1A4bi | 1A3b | 1A5b | | | | |
| 2009 | | 1 A 3 b | 1A4b i | 1A2f | | | | |
| 2010 | | 1A4b i | 1A2fi | | | | | |
| 2011 | | 1A4b i | | | | | | |
| 2012 | | 1A4b i | | | | | | |
| 2013 | | 1A4b i | | | | | | |
| 2014 | | 1A4b i | | | | | | |
| 2015 | | 1A4bi | 1A1b | | | | | |
| 2007 | DIOX | 1A2a | 1A4b i | 1A5b | 2C | 1A2b | 1A1a | 6C |

| Year | Component | Main sectors (sorted by largest contribution to total) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2008 | | 1A4bi | 1A5b | 1A2a | 2C1 | 2 C 5 a | 1A1a | 6Cb |
| 2009 | | 1 A 3 c | 1A4b i | 2 C 1 | 2 C 5 a | 1A1a | 6 C b | |
| 2010 | | 1A4b i | 1A2b | 2C1 | 6 C a | | | |
| 2011 | | 6 C b | 1A4b i | 1A2b | 2C1 | | | |
| 2012 | | 1A4b i | 1A1b | 1A2b | 6Cb | | | |
| 2013 | | 1A4b i | 1A1b | 5C1bi | 1A2b | | | |
| 2014 | | 1A4b i | 1A1b | 1A2b | 2C1 | | | |
| 2015 | | 1A4b i | 1A1b | | | | | |
| 2007 | PAH | 1A4b i | 1A5b | 1B2a iv | | | | |
| 2008 | | 1A4bi | 1A5b | 1B2a iv | | | | |
| 2009 | | 2A6 | 1A4b i | 1A2a | | | | |
| 2010 | | 1A4b i | | | | | | |
| 2011 | | 1A4b i | | | | | | |
| 2012 | | 1A4b i | | | | | | |
| 2013 | | 1A4b i | | | | | | |
| 2014 | | 1A4b i | | | | | | |
| 2015 | | 1A4b i | 1A1b | | | | | |

# CHAPTER 3. ENERGY (NFR SECTOR 1)

## OVERVIEW

Sector 1 Energy considers emissions originating from fuel combustion activities:

- 1A1 Energy Industries
- 1A2 Manufacturing Industries and Construction
- 1A3 Transport
- 1A4 Other sectors (commercial and residential)
- 1A5 Other (Military)

as well as fugitive emissions from fuels (NFR 1B)

- 1B1 Solid fuels
- 1B2 Oil and natural gas

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

Emissions from energy sector are the main source of all pollutants in Bulgaria: in 2015 the sector is responsible for 83 % of national total SOx emissions and 75 % of national total NOx emissions

The emission inventory in Energy (NFR sector 1) for 2017 submission under UNECE/CLRTAP is prepared based on:

1. Emission Factors, taken from:
    a. National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC, last update 2011 (see chapter 1.4);
    b. Where EF are not available in the national methodology, the EMEP/EEA Guidebook 2009/2013 is used;
    c. International Emission Factor Data Base;
    d. Country-specific EF.
2. Activity data, provided by
    - National Statistic
    - Eurostat Energy Balance

The responsibility for preparation of inventory in Energy (NFR sector 1) is mixed between ExEA and NSI.

The ExEA is responsible for estimation of emissions in the following sub-categories:

- Sub-sector Transport and

- Sub-sector Residential: Stationary plants
- Sub-sector Mobile Combustion in manufacturing industries and construction: Off-road vehicles
- Sub-sector Agriculture/Forestry/Fishing: Off-road vehicles and other machinery.

The NSI is responsible for estimation of all other sub-sectors in Energy:

- Energy Industries (1A1);
- Manufacturing Industries and Construction (1A2);
- Other sectors - Commercial, Agriculture and Forestry (1A4);
- Other (1A5).

and fugitive emissions from:

- Coal Mining (1B1);
- Extraction, Transportation and Distribution of Petrol Products and Natural Gas (1B2).

NSI uses up-to-date statistical methods and procedures for data collection, summarizing and structuring which are harmonized with EUROSTAT. NSI has two level hierarchical structure - National office and Regional offices. The primary statistical questionnaires are collected at the regional statistical offices, examined for consistency of the data and processed. The National office receives the primary information and the processed information from the regional offices and develops the National totals and balances.

## SOURCE CATEGORY 1A – FUEL COMBUSTION ACTIVITIES

### Sub-sector Energy Industries (NFR 1A1)

SOURCE CATEGORY DESCRIPTION

- Public Electricity and Heat Production (NFR 1A1a);
- Petroleum Refining (NFR 1A1b);
- Manufacture of Solid fuels Production and Other Energy Industries (NFR 1A1c).

**Table 8: Sub-sector Energy Industries for 2015**

| NFR 14 code | | Sub-source description SNAP 97 items |
|---|---|---|
| 1A1a | Public electricity and heat production | **Public power**<br>010101 Combustion plants >= 300 MW (boilers)<br>010102 Combustion plants >= 50 and < 300 MW (boilers)<br>010103 Combustion plants < 50 MW (boilers)<br>010104 Gas turbines |

| | | |
|---|---|---|
| | | 010105 Stationary engines<br>**District heating plants**<br>010201 Combustion plants >= 300 MW (boilers)<br>010202 Combustion plants >= 50 and < 300 MW (boilers)<br>010203 Combustion plants < 50 MW (boilers)<br>010204 Gas turbines<br>010205 Stationary engines |
| 1A1b | Petroleum refining | **Petroleum refining plants**<br>010303 Combustion plants < 50 MW (boilers)<br>010306 Process furnaces |
| 1A1c | Manufacture of solid fuels and other energy industry | NO |

The activities under NFR 1A1c Manufacture of solid fuels and other energy industry do not exist in Bulgaria. The only plant "Kremikovci" was closed in 2008/2009.

The activity data for NFR 1A1a and 1A1b are presented in the NFR reporting tables.

**TREND DESCRIPTION**

Total energy consumption of fuels for public electricity and heat consumption changed since 1990. The main reasons are the rising electricity demand and a notable drop in 1992-1993 and 2008-2009 due to the economic crisis. From 1990 to the present time, fuel switch changed slightly from coal to natural gas. In 2009 fuel consumption of all fuels decreased as a result of the economic crises. The economic recovery in 2010 led to an increasing fuel consumption because of the increasing electricity demand. In 2011 fuel consumption of solid fuels mainly lignite increased remarkable.

Figures for emissions of sulphur dioxide, nitrogen oxides and TSP, emitted into the atmosphere from large combustion plants, included in energy sector (1 A 1 a Public electricity and heat production), are derived from the monthly reports from automatic system for continuous measurement of the plants for the years 2012, 2013,2014 and 2015.

For the category 1A1a Public electricity and heat production, sulphur dioxide emissions decreased from 137.03 kt in 2014 to 94.32 kt in 2015 due to the increase of decommissioning of old facilities and improve the capacity of flue gas desulphurization installations.

## METHODOLOGICAL ISSUES

The activity data are collected by the NSI. The primary statistical questionnaires are collected at the regional statistical offices directly from the plant operators, examined for consistency of the data and processed. The National office receives the primary information and the processed information from the regional offices and develops the National totals and balances.

The emission factors for estimation of emissions in Energy Industries are taken from:

- National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see chapter 1.4) and
- Country specific EF.

The next table presents the EF used for calculation of emissions in Energy Industries for some of the pollutants, where this sector is key category.

**Table 9: EF used for calculation of emissions in Sub-sector Energy Industries for 2015**

| | | **EF*** **Main pollutants [g/GJ] and HMs [g/Mg]** | | |
|---|---|---|---|---|
| **SNAP** | **Pollutant** | **Liquid Fuels** | **Solid Fuels** | **Gaseous Fuels** |
| 010101 | SOx | 26-1124 | 278-5316 | |
| 010102 | SOx | 958-1800 | 231-1712 | |
| 010103 | SOx | 155-1349 | 1672-3733 | |
| 010105 | SOx | | | |
| 010201 | SOx | 156-1224 | 471-739 | |
| 010202 | SOx | 900-1223 | 470-1829 | |
| 010203 | SOx | 44-1350 | 340-1359 | |
| 010204 | SOx | | | |
| 010205 | SOx | | | |
| 010303 | SOx | 155-1200 | | |
| 010306 | SOx | | | 0.7 |
| 010101 | NOx | 211 | 105-447 | 31 |
| 010102 | NOx | 25-323 | 69-432 | 31 |
| 010103 | NOx | 48-176 | 109-113 | 36-60 |
| 010105 | NOx | | | 181 |
| 010201 | NOx | 48-210 | 451-466 | |

| | | EF* Main pollutants [g/GJ] and HMs [g/Mg] | | |
|---|---|---|---|---|
| **SNAP** | **Pollutant** | **Liquid Fuels** | **Solid Fuels** | **Gaseous Fuels** |
| 010202 | NOx | 53-323 | 113-432 | 31-36 |
| 010203 | NOx | 49-177 | 378 | 60 |
| 010204 | NOx | | | 52 |
| 010205 | NOx | | | 181 |
| 010303 | NOx | 49-176 | | 60 |
| 010306 | NOx | | | 71 |
| 010101 | PM10 | | 18-35 | |
| 010102 | PM10 | | 15-70 | |
| 010103 | PM10 | | 15-19 | |
| 010105 | PM10 | | | |
| 010201 | PM10 | | 9-18 | |
| 010202 | PM10 | | 15-44 | |
| 010203 | PM10 | | 8 | |
| 010204 | PM10 | | | |
| 010205 | PM10 | | | |
| 010303 | PM10 | | | |
| 010306 | PM10 | | | |
| 010101 | TSP | 0.22-0.44 | 40-123 | |
| 010102 | TSP | 0.52 | 33-246 | |
| 010103 | TSP | 0.52 | 50-69 | |
| 010105 | TSP | | | |
| 010201 | TSP | 0.44 | 20-40 | |
| 010202 | TSP | 0.52 | 33-142 | |
| 010203 | TSP | 0.52 | 17 | |
| 010204 | TSP | 0.34-0.52 | | |
| 010205 | TSP | | | |
| 010303 | TSP | | | |

| | | EF* Main pollutants [g/GJ] and HMs [g/Mg] | | |
|---|---|---|---|---|
| **SNAP** | **Pollutant** | **Liquid Fuels** | **Solid Fuels** | **Gaseous Fuels** |
| 010306 | TSP | | | |
| 010101 | Cd | 0.22-0.56 | 0.0013-0.0048 | |
| 010102 | Cd | 0.55 | 0.004-0.019 | |
| 010103 | Cd | 0.55 | 0.004 | |
| 010105 | Cd | | | |
| 010201 | Cd | 0.51-0.55 | 0.0019-0.0025 | |
| 010202 | Cd | 0.55 | 0.0044-0.0058 | |
| 010203 | Cd | 0.51-0.55 | 0.0018 | |
| 010204 | Cd | | | |
| 010205 | Cd | | | |
| 010303 | Cd | 0.22-0.55 | | |
| 010306 | Cd | | | 0.000075 |
| 010101 | Hg | 0.07-0.17 | 0.003-0.010 | 0.0001 |
| 010102 | Hg | 0.007-0.044 | 0.175 | 0.0001 |
| 010103 | Hg | 0.007 | 0.175 | 0.0001 |
| 010105 | Hg | | | 0.0001 |
| 010201 | Hg | 0.162-0.174 | 0.0040-0.0050 | |
| 010202 | Hg | 0.174-0.177 | 0.008-0.011 | 0.0001 |
| 010203 | Hg | 0.161-0.167 | 0.0035 | 0.0001 |
| 010204 | Hg | | | 0.0001 |
| 010205 | Hg | | | 0.0001 |
| 010303 | Hg | 0.07-0.176 | | 0.0001 |
| 010306 | Hg | | | |

**NSI real used EF for individual calculation of emissions after correction in accordance with sulphur and dust content in the fuel.*

No source specific recalculation has been made.

## SUB-SECTOR MANUFACTURING INDUSTRIES AND CONSTRUCTION (NFR 1A2)

### SOURCE CATEGORY DESCRIPTION

Sub-sector Manufacturing Industries and Construction (NFR 1A2) includes emissions from fuel combustion in the following sub categories:

- Ferrous Metallurgy (NFR 1A2a);
- Non-ferrous Metallurgy (NFR 1A2b);
- Chemical Industry (NFR 1A2c);
- Pulp and Paper Production and Printing Industry (NFR 1A2d);
- Food Industry (NFR 1A2e);
- Other (NFR 1A2f).

**Table 10: Sub-sector Manufacturing Industries and Construction for 1990-2015**

| NFR 14 code | | Sub-source description SNAP 97 items |
|---|---|---|
| 1A2a | Iron and steel | **Comb. in boilers, gas turbines and stationary engines**<br>030101 Combustion plants >= 300 MW (boilers)<br>030102 Combustion plants >= 50 and < 300 MW (boilers)<br>030103 Combustion plants < 50 MW (boilers)<br>030104 Gas turbines<br>030105 Stationary engines<br>030203 Blast furnace cowpers<br>030301 Sinter and pelletizing plants<br>030302 Reheating furnaces steel and iron<br>030303 Grey iron foundries |
| 1A2b | Non-ferrous metals | 030304 Primary lead production<br>030305 Primary zinc production<br>030306 Primary copper production<br>030307 Secondary lead production<br>030308 Secondary zinc production<br>030309 Secondary copper production |

| | | |
|---|---|---|
| | | 030310 Secondary aluminium production |
| 1A2c | Chemicals | Included in 1A2a |
| 1A2d | Pulp, paper and print | 030321 Paper-mill industry (drying processes) |
| 1A2e | Food processing, beverages and tobacco | Included in 1A2a |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | 030204 Plaster furnaces<br>030311 Cement (f)<br>030312 Lime (includ. iron and steel and paper pulp industr.)(f)<br>030313 Asphalt concrete plants<br>030314 Flat glass (f)<br>030315 Container glass (f)<br>030317 Other glass (f)<br>030319 Bricks and tiles<br>030320 Fine ceramic materials |
| 1 A 2 g viii | Stationary combustion in manufacturing industries and construction: Other | 030326 Other – Off-road in construction sector |

## METHODOLOGICAL ISSUES

The activity data are collected by the NSI and it is presented in the reporting table.

The emission factors for estimation of emissions in Manufacturing Industries and Construction are taken from:

- National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see chapter 1.4) and
- Country specific EF.

## TRANSPORT (NFR 1.A 3)

SOURCE CATEGORY DESCRIPTION

The ExEA is the responsible institution for estimation of emissions in sub-sector Transport (NFR 1.A.3).

Till 2008 inventory year the emissions from Transport and Other mobile sources and machinery were estimated based on activity data set in the national statistic, prepared for

national reporting obligations. These data were different aggregated compare to the National Energy Balance. Thus the national total for Road transport was allocated in NFR 1A3b and all other quantity of fuel used was allocated in national total for other transport in NFR 1A5b.

In order to improve 2017 submission under UNECE/CLRTAP and to reduce the differences with UNFCCC report, the emissions from sub-Sector Transport are estimated based on activity data, provided by Eurostat Energy Balance. The emission factors are taken from national common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see chapter 1.4). In some cased emission factors from Emission Factor Data Base are used.

The Eurostat Energy Balance provides data for Aviation, Road Transport, Railways, Navigation and Other transport. The Energy balance data for Navigation and Other transport are inconsistent in the time series 1990 – 2015.

**Table 11: Sub-sector Transport for 1990-2015**

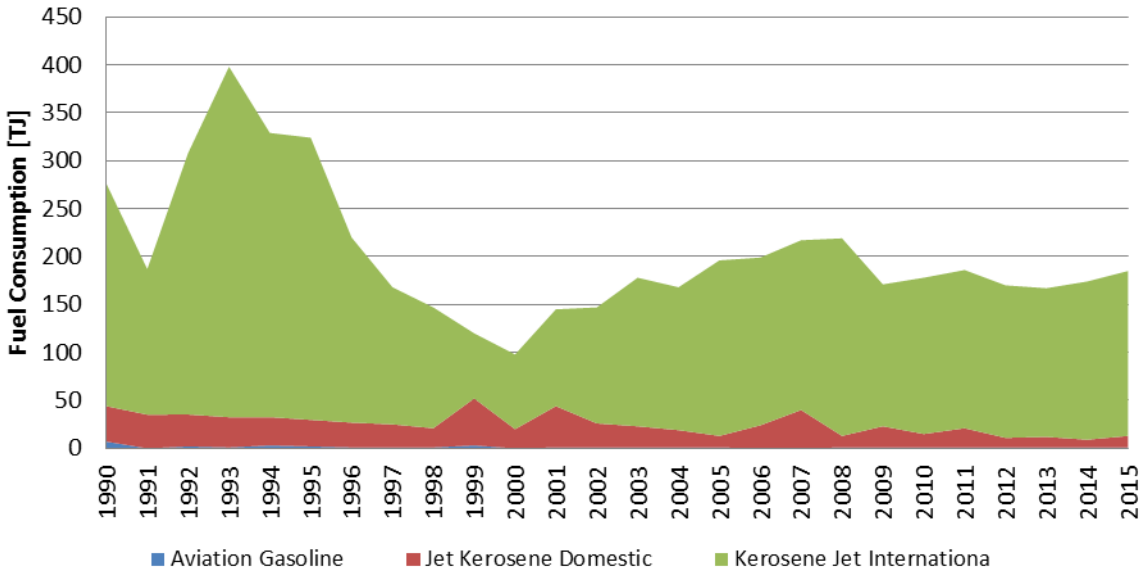
| NFR 14 code | | Sub-source description SNAP 97 items |
|---|---|---|
| 1A3aii (i) | Civil aviation (Domestic, LTO) | **Air traffic**<br>080501 Domestic airport traffic (LTO cycles - <1000 m) |
| 1A3ai (i) | International aviation (LTO) | 080502 International airport traffic (LTO cycles - <1000 m) |
| 1A3aii (ii) | Civil aviation (Domestic, Cruise) | 080503 Domestic cruise traffic (>1000 m) |
| 1A3ai (ii) | International aviation (Cruise) | 080504 International cruise traffic (>1000 m)(i) |
| 1A3bi | Road transport: Passenger cars | 070101 Highway driving<br>070102 Rural driving<br>070103 Urban driving |
| 1A3b ii | Road transport: Light duty vehicles | 070201 Highway driving<br>070202 Rural driving<br>070203 Urban driving |
| 1A3b iii | Road transport: Heavy duty vehicles | 070301 Highway driving<br>070302 Rural driving<br>070303 Urban driving |
| 1A3b iv | Road transport: Mopeds and motorcycles | 0704 Mopeds and Motorcycles < 50 cm3<br>0705 Motorcycles > 50 cm3<br>070501 Highway driving |

| | | |
|---|---|---|
| | | 070502 Rural driving<br>070503 Urban driving |
| 1A3b v | Road transport: Gasoline evaporation | 0706 Gasoline evaporation from vehicles |
| 1A3b vi | Road transport: Automobile tyre and brake wear | 0707 Automobile tyre and brake wear |
| 1A3b vii | Road transport: Automobile road abrasion | NE |
| 1A3c | Railways | 080201 Shunting locs<br>080202 Rail-cars<br>080203 Locomotives |
| 1A3d ii | National navigation | 080402 National sea traffic within EMEP area<br>080403 National fishing<br>080404 International sea traffic (international bunkers)<br>080304 Inland goods carrying vessels |
| 1A3e i | Pipeline compressors | NO |

**NFR 1.A.3.a Civil Aviation**

The emissions from NFR 1A3a are estimated based on Eurostat energy balance, which provides a fuel split between domestic and international aviation and country specific Net Caloric Values (NCV). The emission factors are taken from national common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see chapter 1.4). In some cases emission factors from Emission Factor Data Base are used.

**Figure 5: Fuel consumption in NFR 1.A.3.a Civil aviation – domestic (1990-2015)**




The next table presents calculation of emissions in domestic and international aviation for 2015.

**Table 12: Calculation of emissions in domestic and international aviation for 2015**

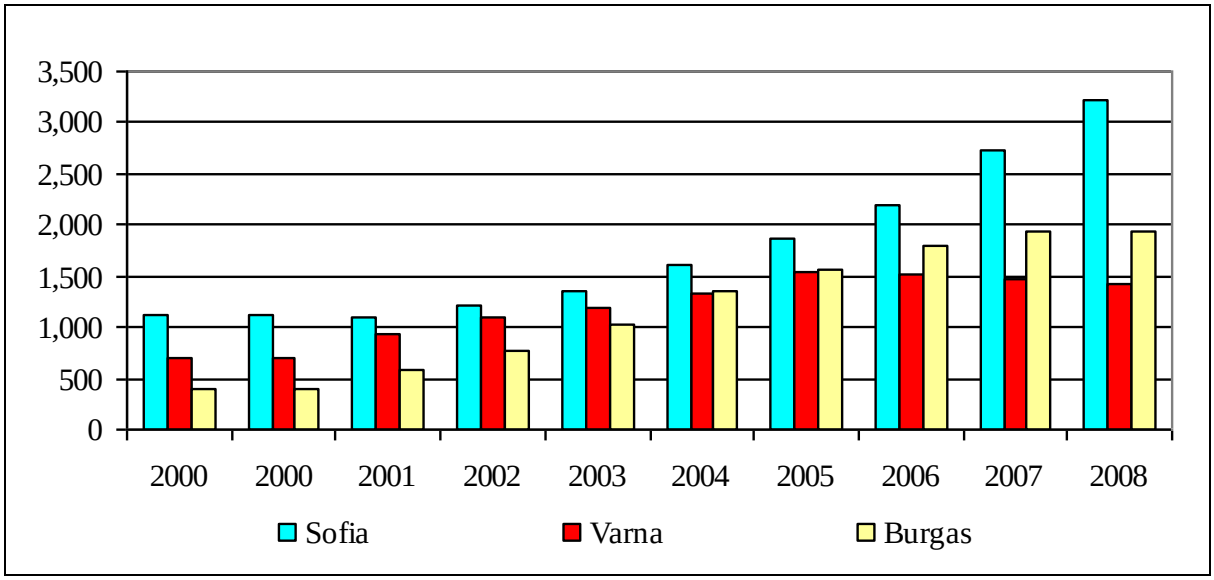
| Type of fuel | Domestic Aviation | 2015 |
|---|---|---|
| Aviation Gasoline | Gg | 1 |
| Aviation Gasoline | t | 1000 |
| NCV | GJ/t | 44 |
| Aviation Gasoline | TJ | 44 |
| EF $SO_2$ default | kg/TJ | 0 |
| $SO_2$ | Gg | NO |
| EF NOx default | kg/TJ | 250 |
| NOx | Gg | 0.011 |
| EF NMVOC default | kg/TJ | 0 |
| NMVOC | Gg | NO |
| EF CO default | kg/TJ | 0 |
| CO | Gg | NO |
| | **Domestic Aviation** | **2015** |
| Kerosene Type Jet Fuel | Gg | 12 |
| Kerosene Type Jet Fuel | t | 12 000 |
| NCV | GJ/t | 43 |
| Kerosene Type Jet Fuel | TJ | 516 |
| EF $SO_2$ default | kg/t | 1 |

| | | |
|---|---|---|
| $SO_2$ | Gg | 0.01 |
| EF NOx default | kg/t | 11 |
| NOx | Gg | 0.13 |
| EF NMVOC default | kg/t | 0.7 |
| NMVOC | Gg | 0.01 |
| EF CO default | kg/t | 7 |
| CO | Gg | 0.08 |
| **INTERNATIONAL BUNKERS** | **International Aviation** | **2015** |
| Kerosene Type Jet Fuel | Gg | 172 |
| Kerosene Type Jet Fuel | t | 172 000 |
| NCV | GJ/t | 43 |
| Kerosene Type Jet Fuel | TJ | 7 396 |
| EF $SO_2$ default | kg/t | 1 |
| $SO_2$ | Gg | 0.17 |
| EF NOx default | kg/t | 17 |
| NOx | Gg | 2.92 |
| EF NMVOC default | kg/t | 2.7 |
| NMVOC | Gg | 0.46 |
| EF CO default | kg/t | 5 |
| CO | Gg | 0.86 |

For estimation of emissions in NFR 1 A 3 a ii (i) Civil aviation (Domestic, LTO) and NFR 1 A 3 a i (i) International aviation (LTO) the activity data from Ministry of Transport – DG Civil Aviation are used.

There are five airports in Bulgaria, located in the towns of Sofia, Burgas, Plovdiv, Varna and Gorna Oriahovitza. For the three of the bigger Bulgarian airports the number of passengers rapidly increases for about three times in the period 2000 – 2008 (see Figure 9). It is due to development of international tourism as well as increased number of business trips.

**Figure 6: Number of passengers on airports Sofia, Varna and Burgas (thousand passengers)**




In the following table the Aircraft Movements from which the Landing/Take-Off (LTO) cycle can be derived, are presented. At this stage the whole time series from 1990 to 2015 of the Landing/Take-Off (LTO) cycle is available, based on the extrapolation data for 1990 to 1997.

The next table presents calculation of emissions from NFR 1A3aii Civil aviation (domestic, LTO).

**Table 133: Calculation of emissions from NFR 1A3aii Civil aviation (domestic, LTO) for 2015**

| NFR 1A3aii Civil aviation (domestic, LTO) | | | |
|---|---|---|---|
| **Component** | **Number of LTO** | **National methodology** | **Emissions** |
| | | **EF t/LTO** | **Mg** |
| SOx ($SO_2$) | 5762 | 0.0008 | 4.60 |
| NMVOC | 5762 | 0.0005 | 2.88 |
| CO | 5762 | 0.0118 | 67.99 |
| NOx | 5762 | 0.0083 | 47.82 |
| PM2.5 | 5762 | 0.00007 | 0.40 |

The next table presents calculation of emissions from NFR 1A3ai (i) International aviation (LTO).

**Table 14: Calculation of emissions from NFR 1A3ai(i) International aviation (LTO) for 2015**

| **Component** | **Number of LTO** | **National methodology** | **Emissions** |
|---|---|---|---|
| | | **EF t/LTO** | **Mg** |

| | | | |
|---|---|---|---|
| SOx | 81409 | 0.0016 | 130.25 |
| NMVOC | 81409 | 0.0002 | 16.28 |
| CO | 81409 | 0.0061 | 496.59 |
| NOx | 81409 | 0.026 | 211.63 |
| PM2.5 | 81409 | 0.00015 | 12.21 |

Emissions of domestic and international aviation have been estimated based on extrapolation data from 1990 to 1997 in order to ensure the time series consistency.

**ROAD TRANSPORT (NFR 1.A.3.b)**

SOURCE CATEGORY 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).

Special feature of Bulgarian vehicle fleet is its age structure. In 2015 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 – 2015 is presented in the next table.

**Table 15: Number of vehicles, 1990 - 2015**

| | Trucks | Special cars | Trucks Trailer | Busses | Passenger cars | Motor-cycles | Mopeds |
|---|---|---|---|---|---|---|---|
| 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 |
| 2012 | 331763 | 32871 | 35266 | 22792 | 2806816 | 77972 | 61841 |
| 2013 | 348834 | 33825 | 39125 | 22792 | 2910235 | 79178 | 65479 |
| 2014 | 369189 | 35228 | 42686 | 23040 | 3013863 | 88035 | 68982 |
| 2015 | 396582 | 37349 | 47809 | 23470 | 3162037 | 93869 | 71885 |

*Source of information: Ministry of Internal Affairs*

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 2015 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).

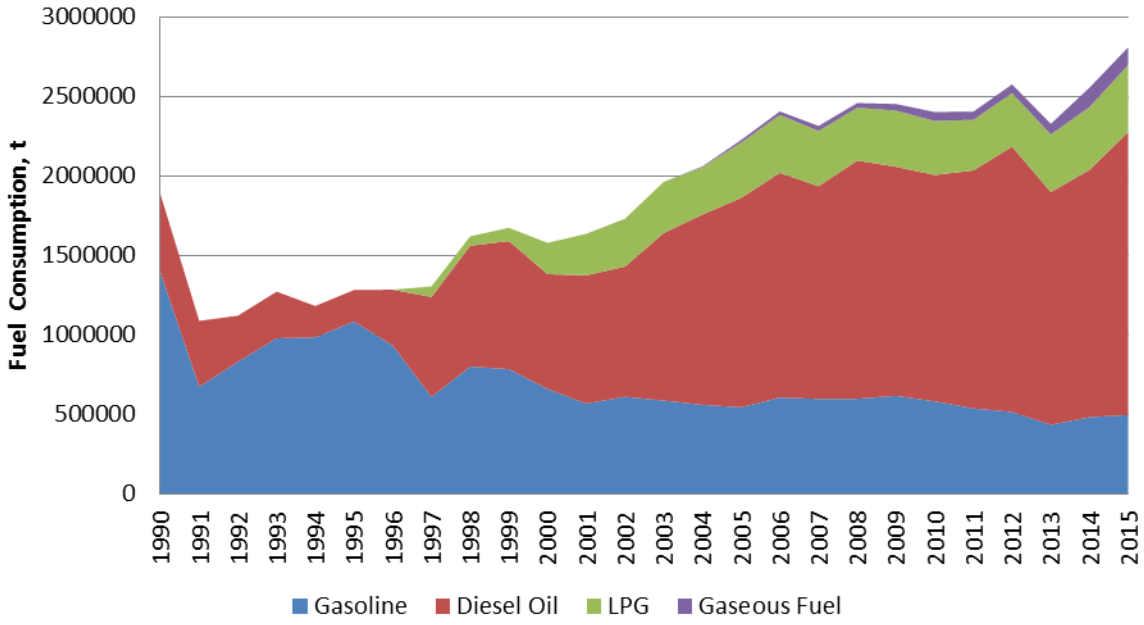
Fuel consumption (liquid, gaseous and biofuels) is obtained from Energy Balance and converted into energy units using the CS NCV. Activity data is illustrated in Figure 10. The emission factors are taken from national common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see chapter 1.4). In some cases emission factors from Emission Factor data base are used.

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. 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.

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.

**Figure 7: Fuel consumption in NFR 1.A.3.b Road transport (1990 - 2015)**




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

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 16: Average operational speed (km/h)**

| Vehicle type/ Year | 2009 | 2006 | 2002 | 1995 | 1989 |
|---|---|---|---|---|---|
| Trolleybus | 14,4 | 14 | 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 17: 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 10.0, 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. The calibration procedure aimed to match the statistical with the calculated fuel consumption.

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

## 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, emissions, emission factors and IEF (time series)
- Ensure 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.

## SOURCE SPECIFIC RECALCULATIONS

No source specific recalculation has been made.

## SOURCE SPECIFIC PLANNED IMPROVEMENTS

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

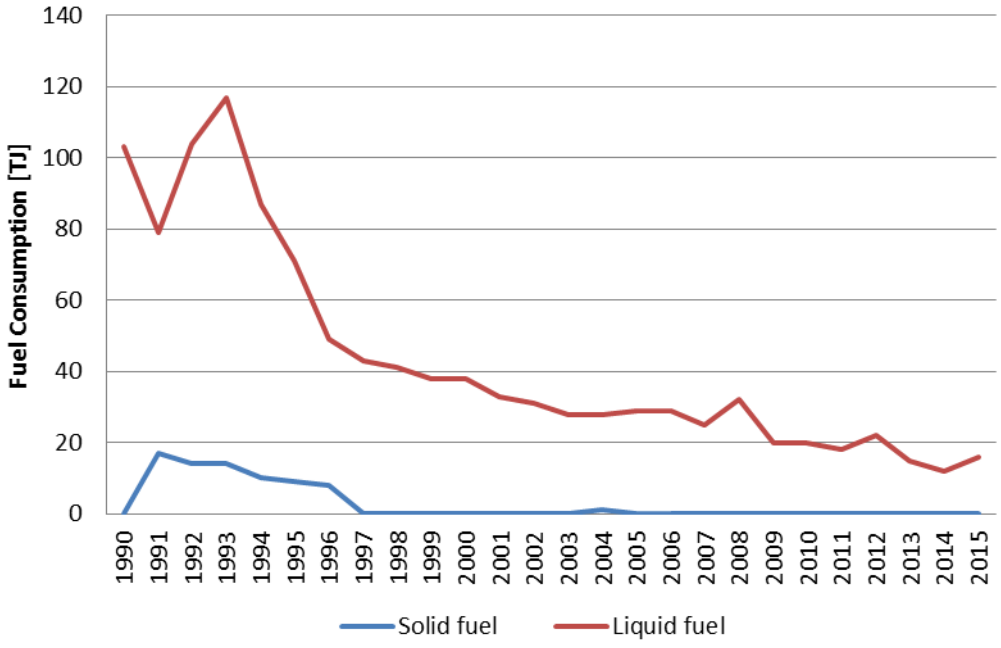
Require more detailed information from the Ministry of Internal affairs on vehicles distribution and technology split.

**RAILWAY (NFR 1.A.3.c)**

SOURCE CATEGORY DESCRIPTION

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

**Figure 8: Fuel consumption in NFR 1.A.3.c Railway (1990 - 2015)**




As it can be observed from the figure above, emissions from Railway transport decreased steeply since 1993 with 86% to 2015. The emissions are mainly due to the consumption of liquid fuels (Gas-Diesel Oil).

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.

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

Calculation of emissions of the main pollutants in Railways in 2015 is presented in the next table.

**Table 18: Calculation of emissions of the main pollutants in Railways in 2015**

| **RAILWAYS** | **Unit** | **2015** |
|---|---|---|
| Gas-Diesel Oil | Gg | 16 |
| Gas-Diesel Oil | t | 16 000 |
| NCV | GJ/t | 42.30 |
| Gas-Diesel Oil | TJ | 672.56 |
| EF NOx default | kg/t | 39.6 |
| NOx | Gg | 0,84 |
| EF NMVOC default | kg/t | 4.65 |
| NMVOC | Gg | 0,07 |
| EF CO default | kg/t | 10.7 |
| CO | | 0,17 |
| EF NH3 default | kg/t | 0.007 |
| NH3 | Gg | 0,0001 |

The emission factor used for calculation of emissions of HMs and POPs in Railways in 2015 are presented in the following table.

**Table 19: Emission factors used for HMs and POPs in 1A3c for 2015**

| **Type of Fuel** | **Pollutants** | **EF** | **Unit** |
|---|---|---|---|
| Gas-Diesel Oil | TSP | 1.52 | kg/t |
| Gas-Diesel Oil | PM10 | 1.44 | kg/t |
| Gas-Diesel Oil | PM2.5 | 1.37 | kg/t |
| Gas-Diesel Oil | DIOX | 10.9 | µg/t |
| Gas-Diesel Oil | Cd | 0.01 | mg/kg |

| | | | |
|---|---|---|---|
| Gas-Diesel Oil | Cu | 1.7 | mg/kg |
| Gas-Diesel Oil | Cr | 0.05 | mg/kg |
| Gas-Diesel Oil | Ni | 0.07 | mg/kg |
| Gas-Diesel Oil | Se | 0.01 | mg/kg |
| Gas-Diesel Oil | Zn | 1 | mg/kg |
| Gas-Diesel Oil | PAH | 0.03 | g/t |

**Source-specific planned improvements**

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

**NAVIGATION (NFR 1.A.3.d)**

SOURCE CATEGORY DESCRIPTION

In Bulgaria 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 fuel 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.

Currently cargo is predominantly transported on international routes. Very limited amounts are 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 of Bulgaria – either in Romania or on their way to other countries.

**Method**

Tier 1 approach for navigation has been applied:

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

*Where:*

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

*b = water-borne navigation type (i.e., ship or boat, and possibly engine type.)*

**Emission factors**

For Tier 1, emissions are estimated using fuel-specific default emission factors.

**Table 20: Activity data for Sub-category 1A3d Navigation: 1990-2015**

| | | Gas-Diesel Oil | | |
|---|---|---|---|---|
| | **Gg** | **t** | **TJ** | **NCV GJ/t** |
| **1990** | 18 | 18,000.00 | 761.4 | 42.30 |
| **1991** | 1 | 1,000.00 | 42.3 | 42.30 |
| **1992** | 2 | 2,000.00 | 84.6 | 42.30 |
| **1993** | 2 | 2,000.00 | 84.6 | 42.30 |
| **1994** | 3 | 3,000.00 | 126.9 | 42.30 |
| **1995** | 3 | 3,000.00 | 126.9 | 42.30 |
| **1996** | 6 | 6,000.00 | 253.8 | 42.30 |
| **1997** | 2 | 2,000.00 | 84.6 | 42.30 |
| **1998** | 2 | 2,000.00 | 84.6 | 42.30 |
| **1999** | 2 | 2,000.00 | 84.6 | 42.30 |
| **2000** | 2 | 2,000.00 | 84.6 | 42.30 |
| **2001** | 2 | 2,000.00 | 77.3 | 42.30 |
| **2002** | 3 | 3,000.00 | 114.2 | 42.30 |
| **2003** | 3 | 3,000.00 | 140.9 | 42.30 |

| | | Gas-Diesel Oil | | |
|---|---|---|---|---|
| | **Gg** | **t** | **TJ** | **NCV GJ/t** |
| **2004** | 3 | 3,000.00 | 131.9 | 42.30 |
| **2005** | 4 | 4,000.00 | 152.7 | 42.30 |
| **2006** | 4 | 4,000.00 | 161.2 | 41.87 |
| **2007** | 4 | 4,000.00 | 179.4 | 42.30 |
| **2008** | 5 | 5,000.00 | 207.1 | 42.30 |
| **2009** | 4 | 4,000.00 | 151.8 | 42.30 |
| **2010** | 3 | 3,000.00 | 116.8 | 42.30 |
| **2011** | 3 | 3,000.00 | 127.3 | 42.30 |
| **2012** | 3 | 3,000.00 | 114.6 | 42.30 |
| **2013** | 2 | 2,000.00 | 96.9 | 42.30 |
| **2014** | 3 | 3,000.00 | 116,52 | 42.30 |
| **2015** | 3 | 3,000.00 | 138.02 | 42.30 |

**Table 21: Activity data for Sub-category 1A3d – Navigation: 1990-2015**

| | | Residual Fuel Oil | | |
|---|---|---|---|---|
| | **Gg** | **t** | **TJ** | **NCV GJ/t** |
| **1990** | NO | 0.00 | NO | 40 |
| **1991** | NO | 0.00 | NO | 40 |
| **1992** | NO | 0.00 | NO | 40 |
| **1993** | 1 | 1,000.00 | 40 | 40 |
| **1994** | 1 | 1,000.00 | 40 | 40 |
| **1995** | 1 | 1,000.00 | 40 | 40 |

| | | Residual Fuel Oil | | |
|---|---|---|---|---|
| | **Gg** | **t** | **TJ** | **NCV GJ/t** |
| **1996** | NO | 0.00 | NO | 40 |
| **1997** | NO | 0.00 | NO | 40 |
| **1998** | 1 | 1,000.00 | 40 | 40 |
| **1999** | 3 | 3,000.00 | 120 | 40 |
| **2000** | NO | 0.00 | NO | 40 |
| **2001** | NO | 0.00 | NO | 40 |
| **2002** | NO | 0.00 | NO | 40 |
| **2003** | NO | 0.00 | NO | 40 |
| **2004** | NO | 0.00 | NO | 40 |
| **2005** | NO | 0.00 | NO | 40 |
| **2006** | NO | 0.00 | NO | 40 |
| **2007** | NO | 0.00 | NO | 40 |
| **2008** | NO | 0.00 | NO | 40 |
| **2009** | NO | 0.00 | NO | 40 |
| **2010** | NO | 0.00 | NO | 40 |
| **2011** | NO | 0.00 | NO | 40 |
| **2012** | NO | 0.00 | NO | 40 |
| **2013** | NO | 0.00 | NO | 40 |
| **2014** | NO | 0.00 | NO | 40 |
| **2015** | NO | 0.00 | NO | 40 |

**Recalculation:**

No source specific recalculation has been made.

**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.

**Source-specific planned improvements**

No specific improvements for this subcategory are planned.

## OTHER SECTORS (NFR 1A4)

SOURCE CATEGORY DESCRIPTION

Sub-sector Other sectors includes the groups:

- Commercial/Institutional (NFR 1A4a);
- Residential (NFR 1A4b);
- Agriculture/Forestry/Fisheries (NFR 1A4c).

These groups include only stationary sources, as the aggregation level is the type of the fuel and the combustion technology in the corresponding group (services, households, agriculture).

**Table 22: Other Sectors (NFR 1A4) for 1990-2015**

| NFR 14 code | | Sub-source description<br>SNAP 97 items |
|---|---|---|
| 1A4ai | Commercial /Institutional: Stationary | **Commercial and institutional plants**<br>020103 Combustion plants < 50 MW (boilers)<br>020105 Stationary engines |
| 1A4a ii | Commercial / Institutional: Mobile | NE |
| 1A4b i | Residential: Stationary plants | **Residential plants**<br>020201 Combustion plants >= 50 MW (boilers)<br>020202 Combustion plants < 50 MW |

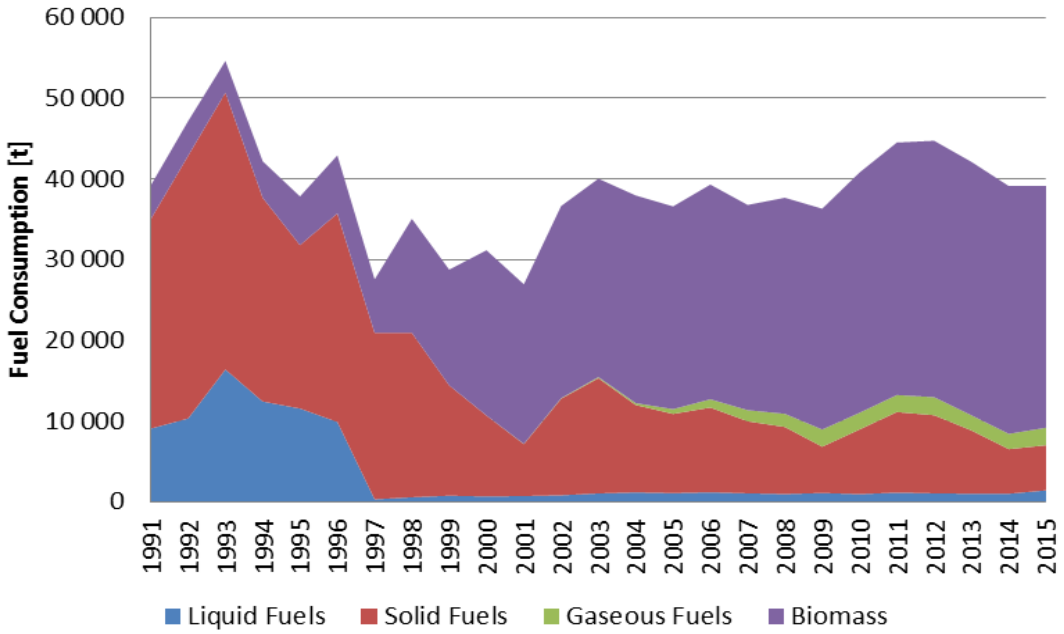
| | | |
|---|---|---|
| | | (boilers)<br>020203 Gas turbines<br>020204 Stationary engines<br>020205 Other equipment |
| 1A4b ii | Residential: Household and gardening (mobile) | NE |
| 1A4c i | Agriculture/Forestry/Fishing: Stationary | 020302 Combustion plants < 50 MW (boilers)<br>020304 Stationary engines |
| 1A4c ii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | 080600 Agriculture<br>080601 Exhaust engine, agriculture<br>080602 Tyre and brake wear abrasion, agriculture<br>080700 Forestry<br>080701 Exhaust engine, forestry<br>080702 Tyre and brake wear abrasion, forestry |
| 1A4c iii | Agriculture/Forestry/Fishing: National fishing | NE |

The emission factors for estimation of emissions in Other Sectors NFR 1A4 (excluding NFR 1A4bi) are taken from National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see chapter 1.4). The activity data for calculation of emissions are collected by NSI and it is presented in the reporting table.

In 2017 submission, the Eurostat Energy Balance is incorporated in inventory of sub-Sector 1A4bi Residential: Stationary plants. The emission factors are in accordance with EMEP/CORINAIR Emission Inventory Guidebook 2009 (Chapter 3.2.2.1 Table 3-3 to Table 3-6).

The next figure presents fuel consumption in Residential plant for the period 1990 – 2015.

**Figure 9: Fuel consumption in NFR 1A4bi Residential plant (1990 - 2015)**




## FUGITIVE EMISSIONS

SOURCE CATEGORY DESCRIPTION

- Coal Mining (NRF 1B1);
- Extraction, Transportation and Distribution of Petrol Products and Natural Gas (NFR 1B2).

**Table 23: Fugitive emissions for 1990-2015**

| NFR 14 code | | Sub-source description<br>SNAP 97 items |
|---|---|---|
| 1B1a | Fugitive emission from solid fuels: Coal mining and handling | 050101 Open cast mining<br>050102 Underground mining<br>050103 Storage of solid fuel |
| 1B1b | Fugitive emission from solid fuels: Solid fuel transformation | NO |
| 1B1c | Other fugitive emissions from solid fuels | NO |
| 1B2a i | Fugitive emissions oil: Exploration, production, transport | 050201 Land-based activities |
| 1B2a iv | Fugitive emissions oil: Refining / storage | 040101 Petroleum products processing<br>040102 Fluid catalytic cracking - CO |

| | | |
|---|---|---|
| | | boiler<br>040103 Sulphur recovery plants<br>040104 Storage and handling of petroleum production in refinery |
| 1B2a v | Distribution of oil products | 050501 Refinery dispatch station<br>050502 Transport and depots<br>050503 Service stations |
| 1B2b | Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) | 050302 Land-based activities<br>050303 Off-shore activities<br>050601 Pipelines |
| 1B2c | Venting and flaring (oil, gas, combined oil and gas) | 090203 Flaring in oil refinery |
| 1B2d | Other fugitive emissions from energy production | NO |

The emission factors for estimation of emissions in NFR 1B are taken from National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see chapter 1.4). The activity data for calculation of emissions are collected by NSI and it is presented in the reporting table.

**Source specific QA/QC and verification**

All activities regarding QC as described in QA/QC System have been undertaken in Energy (NFR sector 1).
The following sector specific QA/QC procedures have been carried out:

- Check of methodology, emissions, emission factors (time series),
- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR.

**Source-specific planned improvements**

- To improve the accuracy of the estimates in Energy (NFR sector 1);
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory;

# CHAPTER 4. INDUSTRIAL PROCESSES AND PRODUCT USE (NFR SECTOR 2)

## OVERVIEW

This chapter includes information on and descriptions of methodologies used for estimating emissions as well as references for activity data and emission factors reported under NFR Category 2 Industrial Processes and Product use for the period from 1990 to 2015 in the NFR.

Emissions from this category comprise emissions from the following sub categories:

- 2A Mineral Products;
- 2B Chemical Industry;
- 2 C Metal Production;
- 2D, 2G Other solvent and product use.

Only process related emissions are considered in this Sector, emission due to fuel combustion in manufacturing industries are allocated in the NFR 1A2 Fuel Combustion – Manufacturing Industries and Construction.

Some categories in this sector are not occurring (NO) in Bulgaria as there is no such production. For some categories emissions have not been estimated (NE) or are included elsewhere (IE). In Chapter 1.7 a general and specific description regarding completeness is given.

The emissions of air pollutants in Industrial processes and product use (NFR sector 2) for 2015 are calculated based on the activity data, collected by NSI and emission factors. The latter are set in the national common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see point 1.4). Where EF are not available in the national methodology the EMEP/EEA Guidebook is used.

As it is written above for UNECE/CLRTAP inventory the National Statistical Institute continue to have the main responsibility for estimation of emissions in NFR sector 2 Industrial processes and product use. NSI uses up-to-date statistical methods and procedures for data collection, summarizing and structuring which are harmonized with EUROSTAT.

NSI has two level hierarchical structure - National office and Regional offices. The primary statistical questionnaires are collected at the regional statistical offices, examined for consistency of the data and processes. The National office receives the primary information and the processed information from the regional offices and develops the National totals and balances.

The further plan of the BGNIS is the same team, which is dealing with GHG inventory to be also responsible for preparation of CLRTAP inventory. Thus differences with UNFCCC report will be eliminated. For estimation of emissions in GHGs inventory the activity data are taken mainly from PROTPROM, EU-ETS and EPRTR data bases. The data, provided by Branch business associations are also taken into account.

The activity data for Industrial processes and product use (NFR sector 2) are presented in the reporting table.

**Table 24: Industrial processes for 1990-2015**

| NFR 14 code | | Sub-source description<br>SNAP items |
|---|---|---|
| 2A1 | Cement Production | 040612 Cement (decarbonizing) |
| 2A2 | Lime Production | 040614 Lime (decarbonizing) |
| 2A3 | Glass production | 040613 Glass (decarbonizing) |
| 2A5a | Quarrying and mining of minerals other than coal | 040616 Extraction of mineral ores (NA) |
| 2A5b | Construction and demolition | 040624 Public works and building sites (NA) |
| 2A5c | Storage, handling and transport of mineral products | 040900 Storage, handling and transport of mineral products (NA) |
| 2B1 | Ammonia Production | 040403 Ammonia |
| 2B2 | Nitric Acid Production | 040402 Nitric acid |
| 2B3 | Adipic Acid Production | NA |
| 2B5 | Carbide Production | 040412 Calcium carbide production |
| 2B6 | Titanium dioxide production | NO |
| 2B7 | Soda Ash Production | 040619 Soda ash production and use |
| 2B5a | Other chemical industry | 040401 Sulphuric acid<br>040404 Ammonium sulphate<br>040405 Ammonium nitrate<br>040406 Ammonium phosphate<br>040407 NPK fertilisers<br>040413 Chlorine production<br>040414 Phosphate fertilizers<br>040415 Storage and handling of inorganic chemical prod<br>040501 Ethylene<br>040502 Propylene |

| NFR 14 code | | Sub-source description<br>SNAP items |
|---|---|---|
| | | 040507 Polyethylene High Density<br>040509 Polypropylene<br>040511 Polystyrene<br>040514 Styrene-butadiene rubber (SBR)<br>040515 Acrylonitrile Butadiene Styrene (ABS) resins<br>040517 Formaldehyde<br>040519 Phthalic anhydride<br>040520 Acrylonitrile |
| 2C | Metal Production | |
| 2C1 | Iron and Steel Production | 040202 Blast furnace charging<br>040203 Pig iron tapping<br>040206 Basic oxygen furnace steel plant<br>040207 Electric furnace steel plant |
| 2C2 | Ferroalloys Production | 040302 Ferro alloys |
| 2C3 | Aluminium Production | Including in 1A2b |
| 2C4 | Magnesium production | Including in 1A2b |
| 2C5 | Lead Production | Including in 1A2b |
| 2C6 | Zinc Production | Including in 1A2b |
| 2C7a | Copper Production | Including in 1A2b |
| 2C7b | Nickel Production | NO |
| 2C7c | Other metal production | NO |
| 2C7d | Storage, handling and transport of metal products | NE |
| 2D3a | Domestic solvent use including fungicides | NA |
| 2D3b | Road Paving with Asphalt | 040611 Road paving with asphalt |

| NFR 14 code | | Sub-source description<br>SNAP items |
|---|---|---|
| 2D3c | Asphalt Roofing | 040610 Roof covering with asphalt materials |
| 2D3d | Coating applications | 060100 Paint application<br>060101 Paint application: manufacture of automobiles<br>060102 Paint application: car repairing<br>060103 Paint application: construction and buildings (except item 06 01 07)<br>060104 Paint application: domestic use (except 06.01.07)<br>060105 Paint application: coil coating<br>060106 Paint application: boat building<br>060107 Paint application: wood<br>060108 Other industrial paint application<br>060109 Other non-industrial paint application |
| 2D3e | Degreasing | 060200 Degreasing, dry cleaning and electronics<br>060201 Metal degreasing<br>060203 Electronic components manufacturing<br>060204 Other industrial cleaning |
| 2D3f | Dry cleaning | 060202 Dry cleaning |
| 2D3g | Chemical products | 060300 Chemical products manufacturing or processing<br>060301 Polyester processing |

| NFR 14 code | | Sub-source description<br>SNAP items |
|---|---|---|
| | | 060302 Polyvinylchloride processing<br>060303 Polyurethane processing<br>060304 Polystyrene foam processing (c)<br>060305 Rubber processing<br>060306 Pharmaceutical products manufacturing<br>060307 Paints manufacturing<br>060308 Inks manufacturing<br>060309 Glues manufacturing<br>060310 Asphalt blowing<br>060311 Adhesive, magnetic tapes, films and photographs manufacturing<br>060312 Textile finishing<br>060313 Leather tanning<br>060314 Other |
| 2D3h | Printing | 060403 Printing industry |
| 2D3i | Other solvent use (please specify in the IIR) | NA |
| 2G | Other product use (please specify in the IIR) | 060404 Fat, edible and non edible oil extraction<br>060405 Application of glues and adhesives<br>060406 Preservation of wood<br>060407 Underseal treatment and conservation of vehicles |
| 2H1 | Pulp and Paper Industry | 040602 Paper pulp (kraft process)<br>040603 Paper pulp (acid sulfite process) |

| NFR 14 code | | Sub-source description<br>SNAP items |
|---|---|---|
| | | 040604 Paper pulp (Neutral Sulphite Semi-Chemical process) |
| 2H2 | Food and Drink | 040605 Bread<br>040606 Wine<br>040607 Beer<br>040608 Spirits |
| 2I | Wood processing | NA |
| 2J | Production of POPs | NA |
| 2K | Consumption of POPs and Heavy Metals (e.g. electrical and scientific equipment) | NA |
| 2L | Other | NA |

Based on the recommendations of the ERT set in the report from stage 3 in-depth review for some categories/pollutants, which are not well developed in the national methodology, EFs from EMEP/CORINAIR Emission Inventory Guidebook 2009 were applied in order to improve the inventory.

**Table 25: EF in some of the Industrial processes (EMEP/EEA Guidebook 2009)**

| | Ef Mg/Mg | | | | | |
|---|---|---|---|---|---|---|
| **SNAP** | **NMVOC** | **NH3** | **PM2.5** | **PM10** | **TSP** | **CO** |
| 040302 | | | | | 0.001 | |
| 040403 | | 0.00001 | | | | 0.001 |
| 040404 | | | | | 0.02300 | |
| 040405 | | 0.002 | | | 0.02000 | |
| 040406 | | | 0.00018 | 0.00024 | 0.00030 | |
| 040414 | | | 0.00018 | 0.00024 | 0.00030 | |
| 040602 | | | 0.00060 | 0.00080 | 0.00100 | |
| 040611 | 0.000016 | | 0.00040 | 0.00300 | 0.01400 | |
| 040612 | | | 0.00011 | 0.00020 | 0.00022 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 040614 | | | 0.00005 | 0.00024 | 0.00059 | |
| 040618 | | | | | | |
| 040619 | | 0.0009 | | | 0.00010 | 0.009 |

## 2A MINERAL PRODUCTS

### Cement production (NFR 2A1)

SOURCE CATEGORY DESCRIPTION

Since 1997 until present there are only 5 existing/operational cement plants in Bulgaria (respectively, 2 within HOLCIM Group, 2 within ITALCEMENTI Group and 1 within TITAN CEMENT Group. All 5 plants are covered by the EU ETS and the IPPC Directive and have been modernized accordingly during the last 10 years. In addition all plant sites are certified at present according to ISO 9001 and 14 001 standards. One more (6th) installation was operational from 1988 till 1996 and decommissioned finally during that last year. One from the 5th existing/operational installation was the decrease substantially its production during 2010.

During 2015 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 197-1.

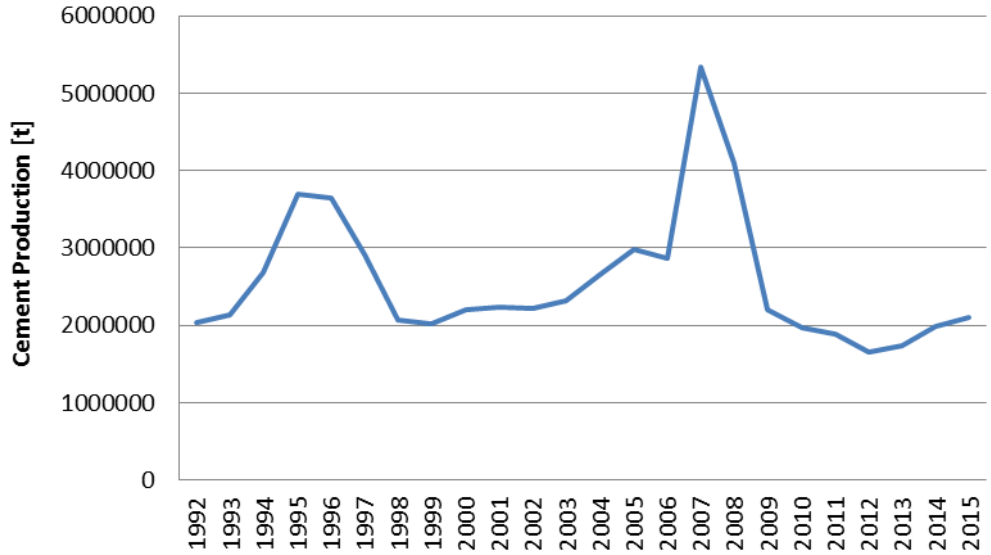
Additional information on the above installations (operators) may be obtained through the Bulgarian Association of Cement Industry (BACI) at www.bacibg.org and/or their own internet sites.

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. 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. At present there are only 4 operating plants, one of which has significantly reduced production with tendency to cease it completely.

**Figure 10: Cement production in NFR 2A1 (1990 - 2015)**




METHODOLOGICAL ISSUES

Emissions are calculated based on Tier 1 approach for process emissions from cement uses the general equation:

$$E = AR \times EF$$

where:

• E - pollutant is the emission of a pollutant (kg)

• AR - production is the annual production of cement (in Mg)

• EF - pollutant is the emission factor of the relevant pollutant (in kg pollutant/Mg cement produced)

This equation is applied at the national level, using annual national total cement production data.

The aggregated national cement production data are provided by the NSI.

The emission factors for estimation of emissions in Cement production are taken from National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC.

**SOURCE SPECIFIC QA/QC AND VERIFICATION**

All activities regarding QC as described in QA/QC System have been undertaken in category Cement production (NFR sector 2A1).

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

- Check of methodology, emissions, emission factors (time series),

- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR.

**SOURCE SPECIFIC RECALCULATIONS**

No source specific recalculation has been made.

**SOURCE SPECIFIC PLANNED IMPROVEMENTS**

- Apply of higher tier method for estimation of emissions,
- Incorporation of EU-ETS and EPRTR data bases,
- Incorporation of data, provided by Branch business associations,
- To improve the accuracy of the estimates in Industrial processes (NFR sector 2),
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

**Lime production (NFR 2A2)**

SOURCE CATEGORY DESCRIPTION

Lime (CaO) is the high-temperature product of the calcination of limestone. The production occurs in vertical and rotary kilns fired by coal, oil or natural gas. Calcium limestone contains 97–98 % calcium carbonate on a dry basis. The rest includes magnesium carbonate, aluminium oxide, iron oxide and silica. However, some limestone contains as much as 35–45 % magnesium carbonate and is classified as dolomite.

Atmospheric emissions in the lime manufacturing industry include particulate emissions from the mining, handling, crushing, screening and calcining of the limestone and emissions of air pollutants generated during fuel combustion in kilns. These emissions are not very significant on a global or even regional scale. However, lime works can be an important emission source of air pollutants on a local scale.

The production of lime causes emissions from both processes and combustion. This chapter only covers the process emissions. Emissions from combustion activities are addressed in chapter 1.A.2.f Manufacturing Industries and Construction (Combustion) — Other.

Currently there are 5 lime producing plants in Bulgaria which fall under IPPC and EU ETS. They produce high calcium quicklime. After the largest metallurgic 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 produce dolomitic lime.

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 economic crises.

METHODOLOGICAL ISSUES

Emissions are calculated based on Tier 1 approach for process emissions from lime uses the general equation:

$$E = AR \times EF$$

where:

• E - pollutant is the emission of a pollutant (kg)

• AR - production is the annual production of lime (in Mg)

• EF - pollutant is the emission factor of the relevant pollutant (in kg pollutant/Mg lime produced)

This equation is applied at the national level, using annual national total lime production data.

The aggregated national lime production data are provided by the NSI.

The emission factors for estimation of emissions in Lime production are taken from National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC.

**SOURCE SPECIFIC QA/QC AND VERIFICATION**

All activities regarding QC as described in QA/QC System have been undertaken in category Lime production (NFR sector 2A2).

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

- Check of methodology, emissions, emission factors (time series),
- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR.

**SOURCE SPECIFIC RECALCULATIONS**

No source specific recalculation has been made.

**SOURCE SPECIFIC PLANNED IMPROVEMENTS**

- Apply of higher tier method for estimation of emissions,
- Incorporation of EU-ETS and EPRTR data bases,
- Incorporation of data, provided by Branch business associations,
- To improve the accuracy of the estimates,
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

## 2B CHEMICAL INDUSTRY

### Ammonia production (NFR 2B1)

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.

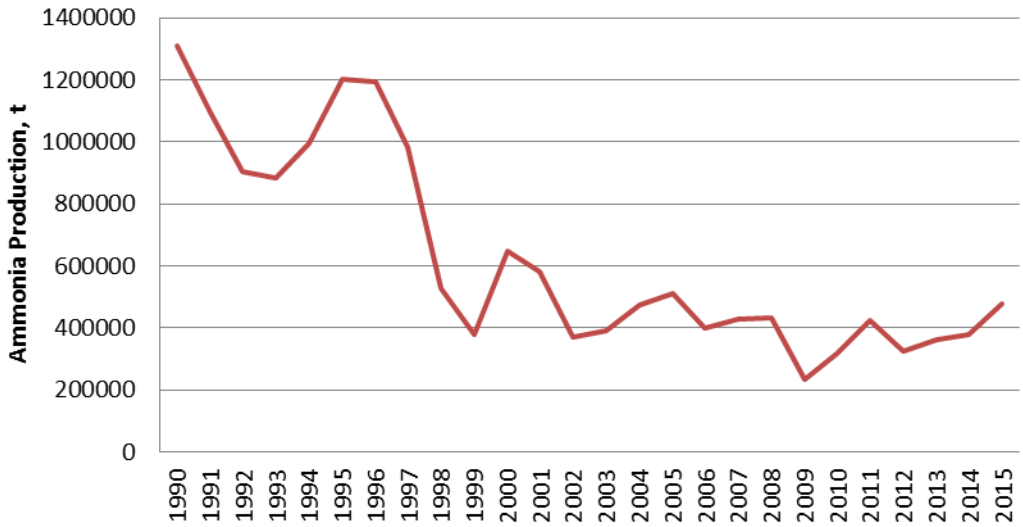
Currently ammonia is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and EU ETS. Until the year of 2002 there were four plants operating.

TREND DESCRIPTION

The periods around 1992/1993 and 1998/1999 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 33% of the ammonia production 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 11: Ammonia Production in NFR 2B1 (1990 - 2015)**




METHODOLOGICAL ISSUES

Emissions are calculated based on Tier 1 approach uses the general equation:

$$E = AR \times EF$$

where:

• E - the emission of the specified pollutant

• AR - the activity rate for the ammonia production

• EF - is the emission factor of the relevant pollutant

This equation is applied at the national level, using annual national total ammonia production data.

The aggregated national data are provided by the NSI.

The emission factors for estimation of emissions in Ammonia Production are taken from National Common methodology for emissions inventory under UNECE/CLRTAR.

**SOURCE SPECIFIC QA/QC AND VERIFICATION**

All activities regarding QC as described in QA/QC System have been undertaken in category Ammonia production (NFR sector 2B1). The following sector specific QA/QC procedures have been carried out:

- Check of methodology, emissions, emission factors (time series),
- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR.

**SOURCE SPECIFIC RECALCULATIONS**

No source specific recalculation has been made.

**SOURCE SPECIFIC PLANNED IMPROVEMENTS**

- Apply of higher tier method for estimation of emissions,
- Incorporation of EU-ETS and EPRTR data bases,
- Incorporation of data, provided by Branch business associations,
- To improve the accuracy of the estimates,
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

**Nitric acid production (NFR 2B2)**

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 counter currently 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)

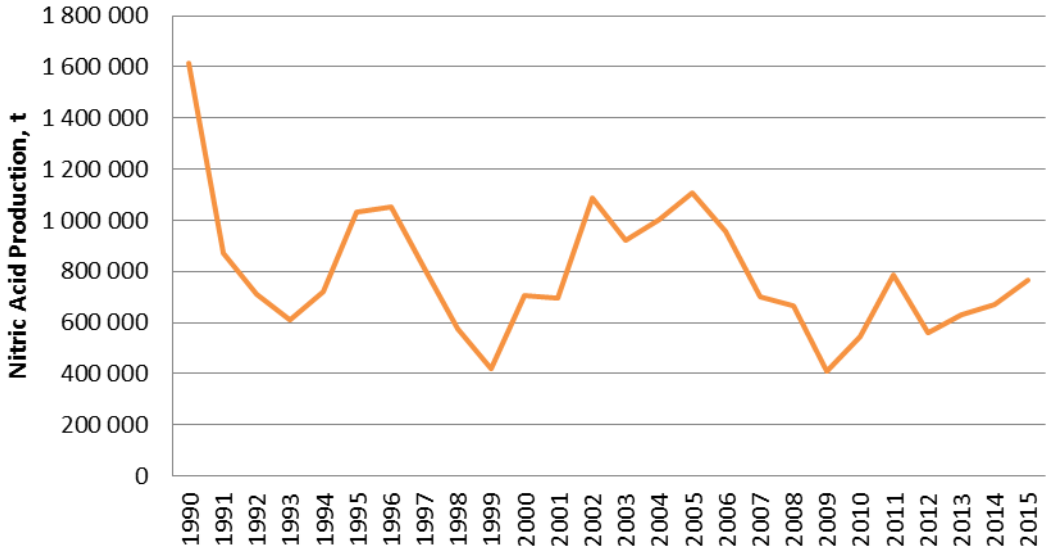
NSCR (Selective Non-Catalytic Reduction, for NOx and $N_2O$ abatement)

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.

**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.

**Figure 12: Nitric Acid Production in NFR 2B2 (1990 - 2015)**




## METHODOLOGICAL ISSUES

Emissions are calculated based on Tier 1 approach uses the general equation:

$$E = AR \times EF$$

where:

• E - the emission of the specified pollutant

• AR - the activity rate for the nitric acid production

• EF - is the emission factor of the relevant pollutant

This equation is applied at the national level, using annual national total nitric acid production data.

The aggregated national data are provided by the NSI.

The emission factors for estimation of emissions in nitric acid production are taken from National Common methodology for emissions inventory under UNECE/CLRTAR.

## SOURCE SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken in category Nitric acid production (NFR sector 2B2). The following sector specific QA/QC procedures have been carried out:

- Check of methodology, emissions, emission factors (time series),
- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR.

**SOURCE SPECIFIC RECALCULATIONS**

No source specific recalculation has been made.

**SOURCE SPECIFIC PLANNED IMPROVEMENTS**

- Apply of higher tier method for estimation of emissions,
- Incorporation of EU-ETS and EPRTR data bases,
- Incorporation of data, provided by Branch business associations,
- To improve the accuracy of the estimates,
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

**Carbide Production (NFR 2B5)**

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:

$$CaO + 3C \rightarrow CaC_2 + CO \ (+ \tfrac{1}{2} O_2 \rightarrow CO_2)$$

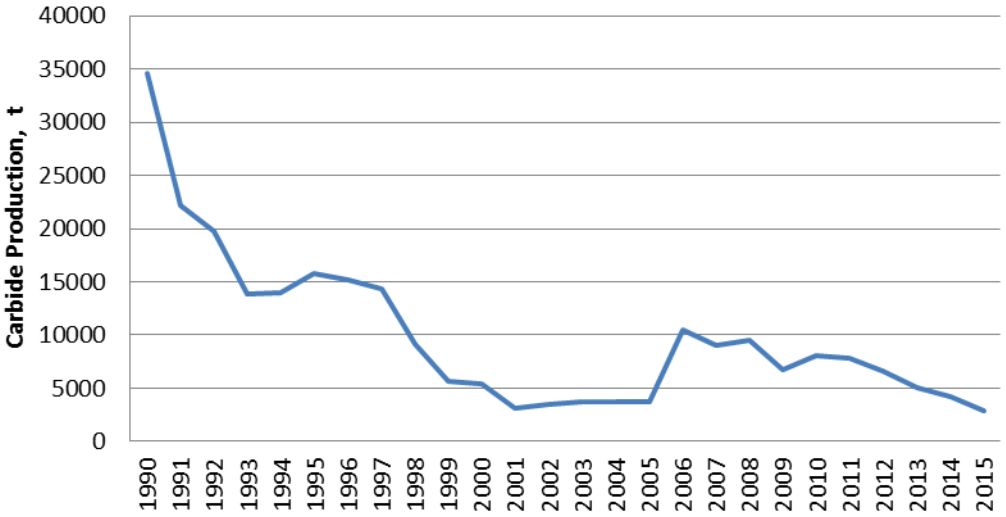
The CaO used for carbide production is produced by the same plant from limestone.

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 insignificant decrease in calcium carbide production, which leads to decrease in emissions with approximately 3%.

**Figure 13: Carbide Production in NFR 2B5 (1990 - 2015)**




## METHODOLOGICAL ISSUES

Emissions are calculated based on Tier 1 approach uses the general equation:

$$E = AR \times EF$$

where:

• E - the emission of the specified pollutant

• AR - the activity rate for the carbide production

• EF - is the emission factor of the relevant pollutant

This equation is applied at the national level, using annual national total carbide production data.

The aggregated national data are provided by the NSI.

The emission factors for estimation of emissions in carbide production are taken from National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC.

## SOURCE SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken in category carbide production (NFR sector 2B4). The following sector specific QA/QC procedures have been carried out:

- Check of methodology, emissions, emission factors (time series),
- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR.

**SOURCE SPECIFIC RECALCULATIONS**

No source specific recalculation has been made.

**SOURCE SPECIFIC PLANNED IMPROVEMENTS**

- Apply of higher tier method for estimation of emissions,
- Incorporation of EU-ETS and EPRTR data bases,
- Incorporation of data, provided by Branch business associations,
- To improve the accuracy of the estimates in Industrial processes (NFR sector 2),
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

**Soda ash production (NFR 2B7)**

SOURCE CATEGORY DESCRIPTION

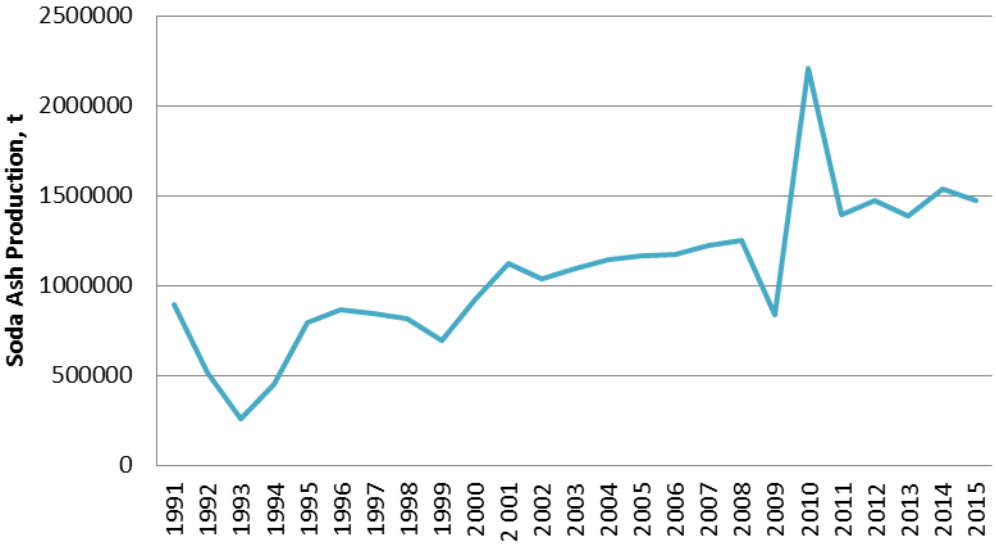
Soda ash production

Soda ash production and consumption (including sodium carbonate, $Na_2CO_3$) results in the release of pollutants. The main pollutant is carbon dioxide ($CO_2$). 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.

**TREND DESCRIPTION**

The periods around 1992/1993 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.

**Figure 14: Soda Ash Production in NFR 2B7 (1990 - 2015)**




## METHODOLOGICAL ISSUES

Emissions are calculated based on Tier 1 approach uses the general equation:

$$E = AR \times EF$$

where:

• E - the emission of the specified pollutant

• AR - the activity rate for the soda ash production

• EF - is the emission factor of the relevant pollutant

This equation is applied at the national level, using annual national total soda ash production data.

The aggregated national data are provided by the NSI.

The emission factors for estimation of emissions in Soda Ash Production are taken from National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC in accordance with EMEP/CORINAR Emission Inventory Guidebook - 2009.

## SOURCE SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken in category Soda ash production (NFR sector 2B7). The following sector specific QA/QC procedures have been carried out:

- Check of methodology, emissions, emission factors (time series),
- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR.

**SOURCE SPECIFIC RECALCULATIONS**

No source-specific recalculations are to be performed.

**SOURCE SPECIFIC PLANNED IMPROVEMENTS**

- Apply of higher tier method for estimation of emissions,
- Incorporation of EU-ETS and EPRTR data bases,
- Incorporation of data, provided by Branch business associations,
- To improve the accuracy of the estimates,
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

## 2C METAL PRODUCTION

### Iron and steel production (NFR 2C1)

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%).

The following steel making processes are present in Bulgaria:

*Basic oxygen steelmaking*

The objective in oxygen steelmaking is to burn (i.e., oxidise) the undesirable impurities contained in the metallic feedstock. The main elements thus converted into oxides are carbon, silicon, manganese, phosphorus, and sulphur. The purpose of this oxidation process, therefore, is:

- to reduce the carbon content to a specified level (from approximately 4% to less than 1%, but often lower)
- to adjust the contents of desirable foreign elements
- to remove undesirable impurities to the greatest possible extent

The production of steel by the basic oxygen furnace (BOF) process is a discontinuous process which involves the following steps:

- transfer and storage of hot metal
- pre-treatment of hot metal (desulphurisation)
- oxidation in the BOF (decarburisation and oxidation of impurities)
- secondary metallurgical treatment
- casting (continuous or/and ingot)

*Electric steelmaking*

The direct smelting of iron-containing materials, such as scrap is usually performed in electric arc furnaces (EAF). The major feed stock for the EAF is ferrous scrap, which may comprise of scrap from inside the steelworks (e.g. offcuts), cut-offs from steel product manufacturers (e.g. vehicle builders) and capital or post-consumer scrap (e.g. end of life products).

With respect to the end-products distinction has to be made between production of ordinary, so called carbon steel as well as low alloyed steel and high alloyed steels/stainless steels. In the EU about 85% of steel production is carbon or low alloyed steel [EC Study, 1996].For the production of carbon steel and low alloyed steels, following main operations are performed:

- 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.

**TREND DESCRIPTION**

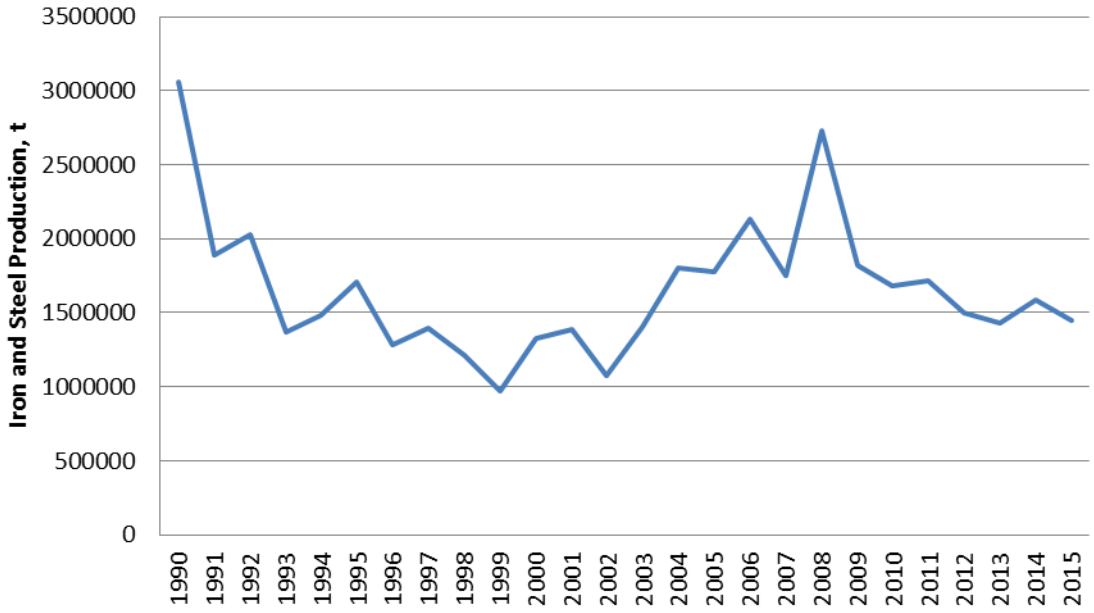
The periods around 1991/1992 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by

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.

**Figure 15: Iron and Steel Production in NFR 2C1 (1990 - 2015)**




## METHODOLOGICAL ISSUES

Emissions are calculated based on Tier 2 approach to the various processes in the iron and steel industry use the equation:

$$E = AR \times EF$$

where:

• E - the emission of the specified pollutant

• AR - the production rate within the source category, using this specific technology

• EF - the emission factor for this technology and this pollutant

The aggregated national data are provided by the NSI.

The emission factors for estimation of emissions from various processes in the iron and steel industry are taken from National Common methodology for emissions inventory under UNECE/CLRTAR.

## SOURCE SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken in category Iron and Steel production (NFR sector 2C1). The following sector specific QA/QC procedures have been carried out:

- Check of methodology, emissions, emission factors (time series),
- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR.

## SOURCE SPECIFIC RECALCULATIONS

No source specific recalculation has been made.

## SOURCE SPECIFIC PLANNED IMPROVEMENTS

- Apply of higher tier method for estimation of emissions,
- Incorporation of EU-ETS and EPRTR data bases,
- Incorporation of data, provided by Branch business associations,
- To improve the accuracy of the estimates,
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

# FERROALLOYS PRODUCTION (NFR 2C2)

SOURCE CATEGORY DESCRIPTION

Ferroalloys production involves a metallurgical reduction process. There is one ferroalloys producer in Bulgaria.

## TREND DESCRIPTION

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

There is a significant decrease of the total emission in the sector in 2012 compared to 2011. This is due to the fact that a steel making plant which produced sinter, pig iron and steel ceased operation in November 2008.

## METHODOLOGICAL ISSUES

Emissions are calculated based on Tier 1 approach to the ferroalloys produced use the equation:

$$E = AR \times EF$$

where:

• E - the emission of the specified pollutant

• AR - ferroalloys produced (tonnes/yr)

• EF - the emission factor for this pollutant

The aggregated national data are provided by the NSI.

The emission factors for estimation of emissions from ferroalloys produced are taken from National Common methodology for emissions inventory under UNECE/CLRTAR.

**SOURCE SPECIFIC QA/QC AND VERIFICATION**

All activities regarding QC as described in QA/QC System have been undertaken in category Iron and Steel production (NFR sector 2C1). The following sector specific QA/QC procedures have been carried out:

- Check of methodology, emissions, emission factors (time series),
- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR.

**SOURCE SPECIFIC RECALCULATIONS**

No source specific recalculation has been made.

**SOURCE SPECIFIC PLANNED IMPROVEMENTS**

- Apply of higher tier method for estimation of emissions,
- Incorporation of EU-ETS and EPRTR data bases,
- Incorporation of data, provided by Branch business associations,
- To improve the accuracy of the estimates,
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

## 2.D-2.L OTHER SOLVENT AND PRODUCT USE

SOURCE CATEGORY DESCRIPTION

This chapter describes the methodology used for calculating NMVOC emissions from solvent use in Bulgaria, which is also basis for calculating GHG emissions from Solvent use. 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 $CO_2$.

The activity data are provided by the National Statistical Institute and National Register under the Industrial Emissions Directive 2010/75/EU (CHAPTER V SPECIAL PROVISIONS FOR INSTALLATIONS AND ACTIVITIESUSING ORGANIC SOLVENTS).

The emissions are estimated by ExEA.

Source category 2D3 comprises mainly NMVOC emissions from about 40 different solvent applications within source categories as follows:

- 2D3a Domestic solvent use including fungicides,
- 2D3b Road paving with asphalt,
- 2D3c Asphalt roofing,
- 2D3d Coating applications,
- 2D3e Degreasing,
- 2D3f Dry cleaning,
- 2D3g Chemical products,
- 2D3h Printing and
- 2D3i Other solvent use.

Source category 2G Other product use includes about several sources releasing NMVOC as: use of spray cans in industry; application of glues and adhesives; use of concrete additives; car underbody sealant; de-icing of airplanes; impregnating of glass and mineral wool; use of cooling and other lubricants; use of pesticides; house cleaning industry/craft/services; hairdressers; cosmetic institutions; use of tobacco products; wood preservation; medical practitioners; other health care institutions; other use of gases; use of fireworks; renovation of corrosion inhibiting coatings.

The activity data for estimation of emissions in categories NFR 2.D-2.L are provided by the NSI. For the most SNAP activities the NSI has provided activity data just for the period 1992 – 2014.

The possibilities for using of activity data in National Register under the Industrial Emissions Directive 2010/75/EU (CHAPTER V SPECIAL PROVISIONS FOR INSTALLATIONS AND ACTIVITIESUSING ORGANIC SOLVENTS) are also checked. For some categories as 060307 Paints manufacturing, the activity data for the last five years are taken from the National Register.

Due to lack of data, the activity data for the period 1990 – 1991 are taken the same as first available year.

METHODOLOGICAL ISSUES

Within source categories 2D, 2G Other solvent and product use the major NMVOC emission sources are 2D3a Domestic solvent use including fungicides and 2D3d Coating applications.

**Domestic solvent use including fungicides (NFR 2D3a)**

This category deals with the following activities:

- Domestic solvent use (other than paint application) (SNAP activity 060408)
- Domestic use of pharmaceutical products (SNAP activity 060411)

It comprises mainly the application of cleaning agents and solvents in private households for building and furniture cleaning and personal hygiene. The cleaning agents contain solvents which evaporate during use or after the application.

Activity data

All emissions related to domestic use of solvents and pharmaceuticals are calculated proportional to the Bulgarian population.

**Table 27: Activity data of 2D3a Domestic solvent use including fungicides in 1990-2015**

| Years | Inhabitants, 1000 person | NMVOCs emissions, Gg |
|---|---|---|
| 1990 | 8669,269 | 11,35674 |
| 1991 | 8595,465 | 11,26006 |
| 1992 | 8484,863 | 11,11517 |
| 1993 | 8459,763 | 11,08229 |

| | | |
|---|---|---|
| 1994 | 8427,418 | 11,03992 |
| 1995 | 8384,715 | 10,98398 |
| 1996 | 8340,936 | 10,92663 |
| 1997 | 8283,2 | 10,85099 |
| 1998 | 8230,371 | 10,78179 |
| 1999 | 8190,876 | 10,73005 |
| 2000 | 8149,468 | 10,6758 |
| 2001 | 7891,095 | 10,33733 |
| 2002 | 7845,841 | 10,27805 |
| 2003 | 7801,273 | 10,21967 |
| 2004 | 7761,049 | 10,16697 |
| 2005 | 7718,75 | 10,11156 |
| 2006 | 7679,29 | 10,05987 |
| 2007 | 7640,238 | 10,00871 |

| | | |
|---|---|---|
| 2008 | 7606,551 | 9,964582 |
| 2009 | 7563,71 | 9,90846 |
| 2010 | 7504,868 | 9,83137708 |
| 2011 | 7327,224 | 9,5986634 |
| 2012 | 7284,552 | 9,54276312 |
| 2013 | 7245,677 | 9,4918369 |
| 2014 | 7202,198 | 9,4348794 |
| 2015 | 7153,784 | 5.72 |

Emission Factor

The emission factor has been derived from an assessment of the emission factors presented in GAINS model developed by IIASA. So, for Bulgaria we assume to use the EF of 0.8 kt/ M people.

Recalculations, QA/QC activities and planned improvements

Time-series have been created due to application of EMEP/EEA 2013 Guidebook.

**Road Paving with Asphalt (NFR 2D3b)**

SOURCE CATEGORY DESCRIPTION

The present chapter covers emissions from the asphalt roofing industry. The industry manufactures saturated felt, roofing and siding shingles, and roll roofing and sidings. Most of these products are used in roofing and other building applications. This source category covers emissions of non-methane volatile organic compounds (NMVOC), carbon monoxide (CO) and particulate material from all related facilities.

Combustion emissions of e.g. sulphur oxides (SOx) and nitrogen oxides (NOx) occurring during the asphalt roofing processes are inventoried under source category 1.A.2.f.i.

METHODOLOGICAL ISSUES

The Tier 1 approach for emissions from asphalt roofing uses the general equation:

$$E = AR \times EF$$

Where:

E = the emission of the specified pollutant

AR = the activity rate for the asphalt roofing

EF = the emission factor for this pollutant

This equation is applied at the national level, using annual national total production of the asphalt roofing industry.

The aggregated national data are provided by the NSI.

The emission factors for estimation of emissions in Asphalt roofing are taken from National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC.

**Asphalt Roofing (NFR 2D3c)**

SOURCE CATEGORY DESCRIPTION

Asphalt is commonly referred to as bitumen, asphalt cement, asphalt concrete or road oil and is mainly produced in petroleum refineries. Asphalt surfaces and pavements are composed of compacted aggregate and an asphalt binder. The asphalt binder may consist of heated asphalt cement (hot mix) or liquefied asphalts (cutback or emulsified). This section covers emissions from asphalt paving operations as well as subsequent releases from the paved surfaces.

METHODOLOGICAL ISSUES

The Tier 1 approach for emissions from road paving with asphalt uses the general equation:

$$E = AR \times EF$$

Where:

E = the emission of the specified pollutant

AR = the activity rate for the road paving with asphalt

EF = the emission factor for this pollutant

This equation is applied at the national level, using annual national total production of the road paving with asphalt.

The aggregated national data are provided by the NSI.

The emission factors for estimation of emissions in Asphalt roofing are taken from National Common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC.

**Coating applications (2.D.3.d)**

SOURCE CATEGORY DESCRIPTION

This sector deals with the use of paints within the industrial and domestic sectors.

Decorative coating application, which includes:

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

Industrial coating application, which includes:

- Paint application: manufacture of automobiles (SNAP activity 060101)
- Paint application: car repairing (SNAP activity 060102)
- Paint application: coil coating (SNAP activity 060105)
- Paint application: boat building (SNAP activity 060106)
- Paint application: wood (SNAP activity 060107)
- Other industrial paint application (SNAP activity 060108)

Other coating application**,** which includes:

- Other non-industrial paint application (SNAP activity 060109)

METHODOLOGICAL ISSUES

TIER 1 method is applied due to absence of detailed activity data (such as amount of paint used for wood preservation, number of cars, busses, trucks and boats painted, mass of wire coated, etc.).

TIER1 EFs provided in the EMEP/EEA 2013 Guidebook are used for NMVOC.

**Table 28: Emission factors of Coating applications (2.D.3.d)**

| SNAP activity | Name of activity | Emission factor | Unit | Reference |
|---|---|---|---|---|
| **Paint application** | | | | |
| 060101 | Manufacture of automobiles | 500 | g/kg of paint | EMEP/EEA guidebook 2013 |
| 060102 | Car repairing | 720 | g/kg of paint | EMEP/EEA guidebook 2013 |
| 060103 | Construction and buildings (except 060107) | 230 | g/kg of paint | EMEP/EEA guidebook 2013 |
| 060104 | Domestic use (except 060107) | 230 | g/kg of paint | EMEP/EEA guidebook 2013 |
| 060105 | Coil coating | 480 | g/kg of paint | EMEP/EEA guidebook 2013 |
| 060106 | Boat building | 750 | g/kg of paint | EMEP/EEA guidebook 2013 |
| 060107 | Wood | 800 | g/kg of paint | EMEP/EEA guidebook 2013 |
| 060108 | Other industrial paint application | 750 | g/kg of paint | EMEP/EEA guidebook 2013 |
| 060109 | Other non-industrial paint application | 740 | g/kg of paint | EMEP/EEA guidebook 2013 |

The activity data correspond to the annual consumption of paints.

**Degreasing (NFR 2D3e)**

SOURCE CATEGORY DESCRIPTION

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.

This category deals with the following activities:

- Metal degreasing (SNAP activity 060201)
- Electronic components manufacturing (SNAP activity 060203)
- Other industrial cleaning (SNAP activity 060204)

METHODOLOGICAL ISSUES

TIER 1 method is applied and TIER1 EFs provided in the EMEP/EEA 2013 Guidebook are used for NMVOC.

**Table 29: Emission factors of Degreasing (NFR 2D3e)**

| SNAP activity | Name of activity | Emission factor | Unit | Reference |
|---|---|---|---|---|
| **Degreasing** | | | | |
| 060201 | Metal degreasing | 1000 | kg/Mg solvent use | EMEP/EEA guidebook 2013 |
| 060203 | Electronic components manufacturing | 740 | kg/Mg wafer | EMEP/EEA guidebook 2013 |

**Dry cleaning (NFR 2D3f)**

SOURCE CATEGORY DESCRIPTION

Dry cleaning - refers to any process to remove contamination from furs, leather, down leathers, textiles or other objects made of fibres using organic solvents.

This category deals with the following activity Dry cleaning (SNAP activity 060202).

METHODOLOGICAL ISSUES

TIER 1 method is applied and TIER1 EFs provided in the EMEP/EEA 2013 Guidebook are used for NMVOC.

**Table 30: Emission factors of Dry cleaning (NFR 2D3f)**

| SNAP activity | Name of activity | Emission factor | Unit | Reference |
|---|---|---|---|---|
| **Dry cleaning** | | | | |
| 060202 | Dry cleaning | 1000 | kg/Mg solvent use | EMEP/EEA guidebook 2013 |
| 060202 | Dry cleaning - Open-circuit machine | 177 | g/kg textiles cleaned | EMEP/EEA guidebook 2013 |
| 060202 | Dry cleaning - closed -circuit | 19.47 | g/kg | EMEP/EEA |

| | | | | |
|---|---|---|---|---|
| | machine (abatement n=89%) | | textiles cleaned | guidebook 2013 |

**Chemical products (2D3g)**

SOURCE CATEGORY DESCRIPTION

This sector covers the emissions from the use of chemical products.

- Polyester processing (SNAP activity 060301)
- Polyvinylchloride processing (SNAP activity 060302)
- Polyurethane foam processing (SNAP activity 060303)
- Polystyrene foam processing (SNAP activity 060304)
- Rubber processing (SNAP activity 060305)
- Pharmaceutical products manufacturing (SNAP activity 060306)
- Paints manufacturing (SNAP activity 060307)
- Inks manufacturing (SNAP activity 060308)
- Glues manufacturing (SNAP activity 060309)
- Asphalt blowing (SNAP activity 060310)
- Adhesive, magnetic tapes, films and photographs manufacturing (SNAP activity 060311)
- Textile finishing (SNAP activity 060312)
- Leather tanning (SNAP activity 060313)
- Other (SNAP activity 060314)

METHODOLOGICAL ISSUES

TIER 1 method is applied and TIER1 EFs provided in the EMEP/EEA 2013 Guidebook are used for NMVOC.

**Table 31: Emission factors of Chemical products (2D3g)**

| SNAP activity | Name of activity | Emission factor | Unit | Reference |
|---|---|---|---|---|
| **Chemical products** | | | | |
| O60301 | Polyester processing | 50 | g/kg monomer | EMEP/EEA |

| | | | | |
|---|---|---|---|---|
| | | | used | guidebook 2013 |
| O60302 | Polyvinylchloride processing | 10 | g/kg product | EMEP/EEA guidebook 2013 |
| O60303 | Polyurethane foam processing | 120 | g/kg foam processed | EMEP/EEA guidebook 2013 |
| 060304 | Polystyrene foam processing | 60 | g/kg foam processed | EMEP/EEA guidebook 2013 |
| 060305 | Rubber processing | 8 | g/kg rubber produced | EMEP/EEA guidebook 2013 |
| 060306 | Pharmaceutical products manufacturing | 300 | g/kg solvents used | EMEP/EEA guidebook 2013 |
| 060307 | Paints manufacturing | 11 | g/kg product | EMEP/EEA guidebook 2013 |
| 060308 | Inks manufacturing | 11 | g/kg product | EMEP/EEA guidebook 2013 |
| 060309 | Glues manufacturing | 11 | g/kg product | EMEP/EEA guidebook 2013 |
| 060310 | Asphalt blowing | 1710 | g/Mg asphalt | EMEP/EEA guidebook 2013 |

**Printing (2D3h)**

SOURCE CATEGORY DESCRIPTION

The printing industry is an important manufacturing industry in most European countries. Printing processes convert original text and pictures into an image on a carrier and the main process types are named according to how this image is carried. The main processes in the printing industry are described in the process description. In this document, the following printing categories are identified:

- heat set offset printing
- publication packaging
- rotogravure and flexography

Printing industry (SNAP activity 060403)

METHODOLOGICAL ISSUES

TIER 1 method is applied and TIER1 EFs provided in the EMEP/EEA 2013 Guidebook are used for NMVOC.

**Table 32: Emission factors of Printing (2D3h)**

| SNAP activity | Name of activity | Emission factor | Unit | Reference |
|---|---|---|---|---|
| **Other product use*** | | | | |
| 060403 | Printing industry | 800 | g/kg ink | EMEP/EEA guidebook 2013 |

**Other product use (NFR2G)**

SOURCE CATEGORY DESCRIPTION

This category deals with the following activities:

- Fat, edible and non-edible oil extraction (SNAP activity 060404)
- Application of glues and adhesives (SNAP activity 060405)
- Preservation of wood (SNAP activity 060406)

METHODOLOGICAL ISSUES

The Tier 1 default approach has been implemented. The general equation is:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

where:

E pollutant = the emission of the specified pollutant,

AR production = the activity rate (consumption of paint, chemical production data, solvent consumption)

EF pollutant = the emission factor for this pollutant.

This equation is applied at the national level, using annual national total figures for the activity data.

TIER1 EFs provided in the EMEP/EEA 2013 Guidebook are used for NMVOC.

**Table 33: Emission factors used for Other product use (NFR 2G)**

| SNAP activity | Name of activity | Emission factor | Unit | Reference |
|---|---|---|---|---|
| **Other product use*** | | | | |

| | | | | |
|---|---|---|---|---|
| 060404 | Fat, edible and non-edible oil extraction | 3 | g/kg seed | EMEP/EEA guidebook 2013 |
| 060405 | Application of glues and adhesives | 780 | g/kg adhesives | EMEP/EEA guidebook 2013 |
| 060406 | Preservation of wood | 900 | g/kg preservative | EMEP/EEA guidebook 2013 |

** The other SNAP activities under 3.D Other product use are not estimated due to lack of activity data.*

**2H – OTHER (NFR 2H)**

Source category 2H Other comprises process emissions from the production of pulp and paper, including chipboard, fibreboard and cellulose production, from the production of food and beverage, from Claus units and blasting and shooting operations.

**Pulp and paper industry (2H1)**

SOURCE CATEGORY DESCRIPTION

The present chapter covers emissions from pulp and paper production. Pulp and paper production consists of three major processing steps: pulping, bleaching and paper production. The type of pulping and the amount of bleaching used depends on the nature of the feedstock and the desired qualities of the end product. This chapter discusses three different chemical pulping processes:

- Kraft (sulphate) pulping is the most widely used pulping process and is typically used to produce strong paper products. The Kraft pulping process includes wood (or other cellulose-bearing materials) digestion in a water solution of sodium sulphite and sodium hydroxide, pulp washing, bleaching, chemical recovery and by-product recovery.
- Sulphite pulping (acid sulphite process) involves chemically pulping the wood using sulphur dioxide (SO2) adsorbed in a base solution. Sulphite pulping produces a weaker paper than some other types of pulping, but the pulp is less coloured making it more suitable for printing, often with little bleaching.
- Neutral sulphite semi-chemical pulping (NSSC) is one of the chemical pulping processes that can be used. It involves partial delignification of wood feedstock using a buffered sodium sulphite solution, with completion of the pulping process by mechanical means. NSSC pulps are used in corrugating media and in certain writing and printing papers.

Emissions from paper and pulp production include non-methane volatile organic compounds (NMVOC), sulphur oxides (SOx), particulates, nitrogen oxides (NOx) and carbon monoxide (CO). Not all emissions from pulping or one of the related processes are reported in source category 2.H.1.

Chipboard - SNAP 040601

Paper pulp (Kraft process) - SNAP 040602

Paper pulp (acid sulphite process) - SNAP 040603

Paper pulp (neutral sulphite semi-chemical process) - SNAP 040604

METHODOLOGICAL ISSUES

The Tier 1 default approach has been implemented. The general equation is:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

where:

E pollutant = the emission of the specified pollutant,

AR production = the activity rate

EF pollutant = the emission factor for this pollutant.

This equation is applied at the national level, using annual national total figures for the activity data.

TIER1 EFs provided in the EMEP/EEA 2009 Guidebook are used for NMVOC.

**Food and beverages industry (2.H.2)**

SOURCE CATEGORY DESCRIPTION

NMVOC emissions from food and beverages manufacturing, except emissions from vegetable oil extraction (it is good practice to report emissions from this activity in source category 3.D.3). Emissions from food manufacturing include all processes in the food production chain which occur after the slaughtering of animals and the harvesting of crops. Emissions from drink manufacturing include the production of alcoholic beverages, especially wine, beer and spirits. Emissions from the production of other alcoholic drinks are not covered in this edition. It is good practice to include emissions from the distribution of alcoholic beverages.

Bread – SNAP 040605

Wine – SNAP 040606

Beer – SNAP 040607

Spirits – SNAP 040608

Sugar production – SNAP 040625

Flour production – SNAP 040626

Meat, fish etc. frying / curing - – SNAP 040627

METHODOLOGICAL ISSUES

The Tier 1 default approach has been implemented. The general equation is:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

where:

E pollutant = the emission of the specified pollutant,

AR production = the activity rate

EF pollutant = the emission factor for this pollutant.

This equation is applied at the national level, using annual national total figures for the activity data.

TIER1 EFs provided in the EMEP/EEA 2009 Guidebook are used for NMVOC.

**Source specific QA/QC and verification**

All activities regarding QC as described in QA/QC System have been undertaken in NFR sector Other solvent and product use.

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

- Check of methodology, emissions, emission factors (time series)
- Time series consistency
- Plausibility checks of dips and jumps
- Documentation and archiving of all information required in IIR,
- Background documentation and archive.

**Source-specific planned improvements**

- Apply of higher tier method for estimation of emissions,
- Incorporation of national VOC data base,
- Improve the accuracy of the estimates in NFR sector Other solvent and product use,
- Improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

# CHAPTER 5. AGRICULTURE (NFR SECTOR 3)

This chapter gives information on the estimations of emissions from Sector Agriculture in correspondence to the data reported under the Sector 3 in the NFR Format. The following sources exist in Bulgaria:

- domestic livestock activities with enteric fermentation and manure management,
- agricultural soils, and
- agricultural residue burning.

The agricultural holdings surveyed during the census in 2011 were 371 100, which is a decrease of 44% compared to the number of holdings surveyed during the census in 2003. A trend of decrease has been maintained over the recent years. Conducted sample surveys of the structure of agricultural holdings in 2005 and 2007 show that the number of holdings decreased by 19.7% in 2005 compared to 2003, by 7.8% in 2007 compared to 2005 and by 24.7% in 2010 compared to 2007.

The holdings owned by individuals are 363 700 or 98% of all agricultural holdings; followed by those owned by commercial companies – 1%, sole traders – 0.6%, cooperatives – about 0.3% and other holdings – about 0.1%.

357 900 agricultural holdings use agricultural area to the amount of 3 620 900 ha. An agricultural holding manages the average of 10.1 ha of utilized agricultural area, this indicator being the highest in the Northeast region (17.6 ha) and lowest in the Southwest region (3.6 ha).

Natural persons manage 33.8% of the UAA. The commercial companies manage 31.6% of the UAA of the country, the cooperatives – 17.7%, sole traders – 14.9%, and the remaining holdings – 2%.

In the UAA of 3 620 900 ha of the agricultural holdings, the share of arable land of 86.5% is the highest, followed by permanent grassland – 10.4% of the UAA. Permanent crops occupy 2.8% of the UAA.

The arable land is 3 133 000 hectares and is divided into 250 900 agricultural holdings. Cereals are grown on 47.8% of the holdings, representing 58.1% of the arable land. Industrial crops occupy 33.9% of the arable land and are grown on 23.1% of the holdings possessing arable land. Most industrial plants are grown in the Northwest region – 250 300 ha or 23.6%. Vegetables occupy 1.2% of the arable land and are grown mainly in the South Central region - 44.6% of the land under vegetables. Fodder crops are grown in 30% of the holdings on an area of 106,300 ha. This area is only 3.4% of the arable land.

The agricultural holdings with UAA from 0.00 to 1.99 ha in 2010 were 83.2% of all holdings. Over 78.2% of the UAA is located in holdings with an area of 100.00 ha or more, the average UAA of these holdings was 534 ha.

Around 280 300 were the holdings that kept livestock, poultry and bees as of 31 August 2010. Of these 91.5% used agricultural area from 0.01 ha to 10 ha (the analysis of the UAA of the holdings does not include collectively used common land for grazing animals). In the holdings with UAA from 0.01 ha to 10 ha 86.6% of equidae species, 82.5% of goats and 65.8% of sheep were raised. Cattle were raised in 34.1% of the holdings. Of these 4.4% did not have UAA and raised 7.7% of cattle, and the holdings with UAA from 0.01 ha to 10 ha were 89.1% and they raised 51.0% of the cattle. In the holdings without UAA 45.1% of the pigs and 47.6% of the birds were raised. 66.2% of the livestock holdings raised poultry. Over 10 ha of UAA were owned by 3.8% of the livestock breeding holdings. 5% of the holdings that raised pigs farmed more than 10 ha of the UAA and they raised 23.9% of the pigs.

About 100 of the surveyed agricultural holdings were engaged in activities for the production of mushrooms, growing of silkworms, hatcheries and others.

Labour force in agriculture

371 100 agricultural holdings employed 751 700 persons in 2010, the proportion of family labour force was 92.8% or 697 400 employed persons. 54 300 persons were employed in agriculture as paid workers. The total reduction of the persons employed in agriculture compared to those in 2007 was 20.8%. The annual work units (AWU) of all employed were 394 100, of these 343 100 were family labour force and 51 000 were paid labour force.

The proportion of men employed in agricultural holdings in 2010 was 55.7%. Employed men were by 22.1% less compared to 2007. Total of 61.0% of employed persons were aged 35 to 64 years. In the agricultural holdings 9.8% of the persons employed were aged between 15 and 34 years, and 29.2% were persons over 65 years of age.

The emissions of air pollutants in Agriculture (NFR sector 3) for 2011 are calculated based on the activity data and emission factors set in the national methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see point 1.4).

The collection of the necessary activity data is responsibility of NSI. The activity data for Agriculture (NFR sector 3) are presented in the reporting table.

**Table 3426: Agriculture (NFR sector 3)**

| **NFR 14 code** | | **Sub-source description**<br>**SNAP 97 items** |
|---|---|---|
| 3B | MANURE MANAGEMENT | |
| 4B1 | Cattle | |
| 3B1 a | Dairy | 100501 Dairy cows |
| 3B1 b | Non- Dairy | 100502 Other cattle |
| 3B2 | Sheep | 100505 Sheep |

| | | |
|---|---|---|
| 3B3 | Swine | 100503 Fattening pigs<br>100504 Sows |
| 3B4a | Buffalo | 100514 Buffalo |
| 3B4d | Goats | 100511 Goats |
| 3B4e | Horses | 100506 Horses |
| 3B4f | Mules and Asses | 100512 Mules and asses |
| 3B4gi | Laying Hens | 100507 Laying hens |
| 3B4gii | Broilers | 100508 Broilers |
| 3B4giii | Turkeys | Included in 4B9d |
| 3B4giv | Other Poultry | 100509 Other poultry (ducks, gooses, etc.) |
| 3B4h | Other | NA |
| 3Da1 | Inorganic N-fertilizers (includes also urea application) | 100101 Permanent crops<br>100102 Arable land crops<br>100103 Rice field<br>100104 Market gardening<br>100105 Grassland<br>100201 Permanent crops<br>100202 Arable land crops<br>100204 Market gardening<br>100205 Grassland |
| 3Da2a | Animal manure applied to soils | NE |
| 3Da2b | Sewage sludge applied to soils | NE |
| 3Da2c | Other organic fertilizers applied to soils (including compost) | NA |
| 3Da3 | Urine and dung deposited by grazing animals | NA |
| 3Da4 | Crop residues applied to soils | NA |

| | | |
|---|---|---|
| 3Db | Indirect emissions from managed soils | NA |
| 3Dc | Farm-level agricultural operations including storage, handling and transport of agricultural products | NA |
| 3Dd | Off-farm storage, handling and transport of bulk agricultural products | NA |
| 3De | Cultivated crops | IE |
| 3Df | Use of pesticides | NA |
| 3F | Field burning of agricultural residues | 100301 Cereals<br>100302 Pulse<br>100303 Tuber and Root<br>100304 Sugar Cane<br>100305 Other |
| 3I | Other | NA |

**Table 35: EF used in Manure management (NFR 3B)**

| **SNAP** | **$NH_3$** |
|---|---|
| | **EF Mg/head/y** |
| 100501 | 0.0285 |
| 100502 | 0.0143 |
| 100503 | 0.00639 |
| 100505 | 0.00134 |
| 100506 | 0.008 |
| 100507 | 0.00037 |
| 100508 | 0.00028 |
| 100509 | 0.00092 |
| 100511 | 0,00134 |
| 100512 | 0,008 |
| 100514 | 0.0285 |

## SOURCE SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken in Agriculture (NFR sector 4).

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

- Check of methodology, emissions, emission factors (time series)
- Time series consistency
- Plausibility checks of dips and jumps
- Documentation and archiving of all information required in IIR,
- Background documentation and archive

## SOURCE SPECIFIC RECALCULATIONS

No source specific recalculation has been made.

## SOURCE SPECIFIC PLANNED IMPROVMENTS

- To improve the accuracy of the estimates in Agriculture (NFR sector 3).
- To update the national methodology with the requirements of last version of EMEP/CORINAIR Emission Inventory Guidebook.
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

As it is written above the further plan of the BGNIS is the same team, which is dealing with GHG inventory to be also responsible for preparation of UNECE/CLRTAP inventory. Thus differences with UNFCCC report will be eliminated.

# CHAPTER 6. WASTE (NFR SECTOR 5)

This Chapter includes information on the estimating emissions of NEC gases, CO, heavy metals, persistent organic pollutants and particulate matter, as well as references of activity data and emissions factors concerning waste management and treatment activities reported under NFR Category 6 Waste.

The following categories are included in this sector:

- Biological treatment of waste - Solid waste disposal on land (NFR 5A);
- Biological treatment of waste – Composting (NFR 5B1)
- Waste incineration (NFR 5C)
- Wastewater handling (NFR 5D);

The emissions of air pollutants in Waste (NFR sector 5) for 2014 are calculated based on the activity data and emission factors set in the national common methodology for emissions inventory under UNECE/CLRTAR and UNFCCC (see point 1.4). The methodology is harmonized with EMEP/CORINAIR Emission Inventory Guidebook 2009/2013.

The collection of the necessary activity data is mixed between NSI and ExEA.

The NSI is responsible for NFR 5A Solid Waste Disposal on Land, NFR 5B1 Composting and NFR 5D Waste-Water Handling.

The ExEA has the responsibility for collection of the necessary activity data for NFR 6C Waste Incineration.

The activity data for Waste (NFR sector 5) are presented in the reporting table for the entire time series 1990-2015.

**Table 36: Waste (NFR sector 5)**

| **NFR 14 code** | | **Sub-source description**<br>**SNAP 97 items** |
|---|---|---|
| 5A | Solid Waste Disposal on Land | 090401 Managed Waste Disposal on Land |
| 5B1 | Composting | 091005 Compost production |
| 5C1a | Municipal waste incineration | NO |
| 5C1bi | Industrial waste incineration | 090202 Incineration of industrial wastes (except flaring)<br>090204 Flaring in chemical industries<br>090208 Incineration of waste oil |
| 5C1bii | Hazardous waste incineration | IE |

| | | |
|---|---|---|
| 5C1biii | Clinical waste incineration | 090207 Incineration of hospital wastes |
| 5C1biv | Sewage sludge incineration | NO |
| 5C1bv | Cremation | NE |
| 5C1bvi | Other waste incineration | NO |
| 5C2 | Open burning of waste | NO |
| 5D1 | Domestic wastewater handling | 091001 Waste water treatment in industry<br>091002 Waste water treatment in residential/ commercial sector |
| 5D2 | Industrial wastewater handling | IE |
| 5D3 | Other wastewater handling | NO |
| 5E | Other waste | NO |

**METHODOLOGICAL ISSUES**

The Tier 1 approach for process emissions from NFR 5A, NFR 5B, NFR 5C and NRF 5D uses the general equation:

$$E = AR \times EF$$

where:

• E - the emission of the specified pollutant

• AR - the activity rate for waste disposal, waste-water handling and waste incineration;

• EF - is the emission factor of the relevant pollutant.

This equation is applied at the national level, using annual national total data for waste disposal, waste-water handling and waste incineration.

The next table presents EF used for assessment of emissions in NFR 5A and NFR 5C according to the EMEP/CORINAIR Emission Inventory Guidebook.

**Table 27: EF used for assessment of emissions in NFR 5A and NFR 5C for 2015**

| Component | 5A Solid Waste Disposal on Land | 5C1biii Clinical Waste Incineration | 5C1bi Industrial Waste Incineration | Unit |
|---|---|---|---|---|
| | EF | EF | EF | EF |
| SOx | - | 0.00007 | 0.00007 | Mg/Mg |

| Component | 5A Solid Waste Disposal on Land | 5C1biii Clinical Waste Incineration | 5C1bi Industrial Waste Incineration | Unit |
|---|---|---|---|---|
| NOx | - | 0.0025 | 0.0025 | Mg/Mg |
| NMVOCs | 0.00004 | 0.0074 | 0.0074 | Mg/Mg |
| NH3 | - | - | - | Mg/Mg |
| CO | - | 0.000125 | 0.000125 | Mg/Mg |
| TSP | - | 0.5 | 0.01 | kg/Mg |
| PM10 | - | 0 | 0.007 | kg/Mg |
| PM2.5 | - | 0 | 0.004 | kg/Mg |
| Hg | - | 3 | 3 | g/Mg |
| Cd | - | 3 | 3 | g/Mg |
| Pb | - | 35 | 35 | g/Mg |
| PAH | - | 0.02 | 0.02 | g/Mg |
| PCBs | - | 0.5 | 0.5 | mg/Mg |
| DIOX | - | 150 | 30 | µg/Mg |
| HCB | - | 0.1 | 0.002 | g/Mg |

The next table presents calculation of emissions in NFR 5D1 Domestic Wastewater Handling.

For 2017 submissions also NMVOC emissions are estimated based on EF set in EMEP/CORINAIR Emission Inventory Guidebook 2009.

**Table 28: EF used for assessment of emissions in NFR 5D1 for 2014**

| NFR 5D1 | EF | Activity data, $m^3$ | Emission, Gg |
|---|---|---|---|
| NMVOC | 15 $mg/m^3$ | 528088966 | 0,0079 |

## SOURCE SPECIFIC QA/QC AND VERIFICATION

All activities regarding QC as described in QA/QC System have been undertaken in Waste (NFR sector 6).

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

- Check of methodology, emissions, emission factors (time series),
- Time series consistency,
- Plausibility checks of dips and jumps,
- Documentation and archiving of all information required in IIR,
- Background documentation and archive.

**SOURCE SPECIFIC RECALCULATIONS**

No source specific recalculation has been made.

.**SOURCE SPECIFIC PLANNED IMPROVEMENTS**

- To improve the accuracy of the estimates in Waste (NFR sector 5).
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

# CHAPTER 7. OTHER AND NATURAL EMISSIONS

No emissions are reported under this sector.

# CHAPTER 8. RECALCULATIONS AND IMPROVEMENTS

## RECALCULATIONS

### Recalculations in 1A2b

For 2017 submission a recalculation for 2014 is made for Pb emissions due to the technical error.

## IMPROVEMENTS

Planned improvements:

- Apply of higher tier method for estimation of emissions,
- Incorporation of ETS and EPRTR data bases into emission inventory in NFR sector 1 Energy and NFR sector 2 Industrial processes and other solvents and product use,
- Incorporation of data, provided by Branch business associations,
- Revising of activity data in NFR sector 3 Agriculture in accordance with Agrostatistic data of the Ministry of Agriculture and Food,
- To improve the accuracy of the estimates,
- To improve transparency, completeness, consistency, including recalculations and time-series and comparability of national emission inventory.

# CHAPTER 9. PROJECTIONS

According to the art.44 of the Guidelines for reporting emission data under the CLRTAP, the Parties shall report their latest available projections at least every four years, and provide any updated projections annually by 15-th of February for the years 2020, 2025 and 2030 etc.

Bulgaria submitted the projection only for 2020, 2025 and 2030.

# PART 2: ANNEXES TO THE INFORMATIVE INVENTORY REPORT

## ANNEX 1: KEY CATEGORY ANALYSIS

### Approach 1 analysis — level assessment of NOx

| NFR category code | NFR category | Pollutant, Gg | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total [%] |
|---|---|---|---|---|---|
| 1A1a | Public electricity and heat production | NOx | 38,87 | **29,15%** | **29,15%** |
| 2B2 | Nitric acid production | NOx | 25,383607 | **19,04%** | **48,19%** |
| 1A3bi | Road transport: Passenger cars | NOx | 18,54 | **13,90%** | **62,09%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | NOx | 15,88 | **11,91%** | **74,00%** |
| 1A3di(ii) | International inland waterways | NOx | 6,46 | **4,84%** | **78,84%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | NOx | 4,41 | **3,31%** | **82,15%** |
| 1A3bii | Road transport: Light duty vehicles | NOx | 4,38 | **3,28%** | **85,43%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | NOx | 4,14 | **3,10%** | **88,54%** |
| 3F | Field burning of agricultural residues | NOx | 3,779845 | **2,83%** | **91,37%** |
| 1A4bi | Residential: Stationary | NOx | 3,101 | **2,33%** | **93,70%** |

| | | | | | |
|---|---|---|---|---|---|
| 1A3ai(i) | International aviation LTO (civil) | NOx | 2,06 | **1,54%** | **95,24%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | NOx | 1,76 | **1,32%** | **96,56%** |
| 1A1b | Petroleum refining | NOx | 0,97 | **0,73%** | **97,29%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | NOx | 0,69 | **0,52%** | **97,80%** |
| 1A3c | Railways | NOx | 0,63 | **0,47%** | **98,27%** |
| 1A4ai | Commercial/institutional: Stationary | NOx | 0,56 | **0,42%** | **98,70%** |
| 2H1 | Pulp and paper industry | NOx | 0,3403445 | **0,26%** | **98,95%** |
| 1B2c | Venting and flaring (oil, gas, combined oil and gas) | NOx | 0,32 | **0,24%** | **99,19%** |
| 1A3dii | National navigation (shipping) | NOx | 0,22 | **0,16%** | **99,36%** |
| 2C1 | Iron and steel production | NOx | 0,2068546 | **0,16%** | **99,51%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | NOx | 0,1732 | **0,13%** | **99,64%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | NOx | 0,17 | **0,13%** | **99,77%** |
| 2D3b | Road paving with asphalt | NOx | 0,1485593 | **0,11%** | **99,88%** |
| 1A2d | Stationary combustion in manufacturing | NOx | 0,07 | **0,05%** | **99,93%** |

| | | | | | |
|---|---|---|---|---|---|
| | industries and construction: Pulp, Paper and Print | | | | |
| 1A3aii(i) | Domestic aviation LTO (civil) | NOx | 0,05 | **0,04%** | **99,96%** |
| 1A3biv | Road transport: Mopeds & motorcycles | NOx | 0,04 | **0,03%** | **99,99%** |
| 5C1bi | Industrial waste incineration | NOx | 0,0055937 | **0,00%** | **100,00%** |
| 5C1biii | Clinical waste incineration | NOx | 0,0013398 | **0,00%** | **100,00%** |
| 1B2aiv | Fugitive emissions oil: Refining / storage | NOx | 0,00 | **0,00%** | **100,00%** |
| 2C2 | Ferroalloys production | NOx | 1,51E-06 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of NMVOC**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A4bi | Residential: Stationary | NMVOC | 31,11 | 32,80% | 32,80% |
| 3Da1 | Inorganic N-fertilizers (includes also urea application) | NMVOC | 16,31 | 17,19% | 49,99% |
| 1A3bi | Road transport: Passenger cars | NMVOC | 7,77 | 8,20% | 58,18% |
| 3F | Field burning of agricultural residues | NMVOC | 7,56 | 7,97% | 66,15% |

| | | | | | |
|---|---|---|---|---|---|
| 2D3a | Domestic solvent use including fungicides | NMVOC | 5,76 | 6,07% | 72,23% |
| 1B2aiv | Fugitive emissions oil: Refining / storage | NMVOC | 5,56 | 5,86% | 78,09% |
| 2D3d | Coating applications | NMVOC | 3,59 | 3,78% | 81,87% |
| 2G | Other product use (please specify in the IIR) | NMVOC | 3,26 | 3,44% | 85,31% |
| 1A3bv | Road transport: Gasoline evaporation | NMVOC | 3,26 | 3,43% | 88,74% |
| 2H2 | Food and beverages industry | NMVOC | 2,38 | 2,51% | 91,25% |
| 1B2av | Distribution of oil products | NMVOC | 1,89 | 1,99% | 93,24% |
| 2B1 | Ammonia production | NMVOC | 1,79 | 1,88% | 95,12% |
| 2D3h | Printing | NMVOC | 0,97 | 1,02% | 96,15% |
| 1A3biii | Road transport: Heavy duty vehicles and buses | NMVOC | 0,68 | 0,71% | 96,86% |
| 1A3biv | Road transport: Mopeds & motorcycles | NMVOC | 0,58 | 0,61% | 97,47% |
| 1A3bii | Road transport: Light duty vehicles | NMVOC | 0,54 | 0,56% | 98,04% |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | NMVOC | 0,40 | 0,42% | 98,45% |
| 1A3di(ii) | International inland waterways | NMVOC | 0,23 | 0,24% | 98,69% |
| 2H1 | Pulp and paper industry | NMVOC | 0,21 | 0,22% | 98,91% |
| 2D3g | Chemical products | NMVOC | 0,19 | 0,20% | 99,11% |

| | | | | | |
|---|---|---|---|---|---|
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | NMVOC | 0,16 | 0,17% | 99,28% |
| 2D3e | Degreasing | NMVOC | 0,13 | 0,13% | 99,42% |
| 2C1 | Iron and steel production | NMVOC | 0,07 | 0,08% | 99,49% |
| 2B10a | Chemical industry: Other (please specify in the IIR) | NMVOC | 0,07 | 0,07% | 99,57% |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | NMVOC | 0,07 | 0,07% | 99,64% |
| 1A3c | Railways | NMVOC | 0,06 | 0,06% | 99,70% |
| 1A1a | Public electricity and heat production | NMVOC | 0,05 | 0,06% | 99,76% |
| 5A | Biological treatment of waste - Solid waste disposal on land | NMVOC | 0,05 | 0,05% | 99,81% |
| 2D3b | Road paving with asphalt | NMVOC | 0,05 | 0,05% | 99,86% |
| 5C1bi | Industrial waste incineration | NMVOC | 0,05 | 0,05% | 99,91% |
| 1A1b | Petroleum refining | NMVOC | 0,02 | 0,02% | 99,94% |
| 1A3ai(i) | International aviation LTO (civil) | NMVOC | 0,02 | 0,02% | 99,96% |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | NMVOC | 0,01 | 0,01% | 99,96% |
| 1A3dii | National navigation (shipping) | NMVOC | 0,01 | 0,01% | 99,97% |

| | | | | | |
|---|---|---|---|---|---|
| 5D1 | Domestic wastewater handling | NMVOC | 0,01 | 0,01% | 99,98% |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | NMVOC | 0,00 | 0,00% | 99,98% |
| 1A2d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | NMVOC | 0,00 | 0,00% | 99,99% |
| 2D3f | Dry cleaning | NMVOC | 0,00 | 0,00% | 99,99% |
| 1A3aii(i) | Domestic aviation LTO (civil) | NMVOC | 0,00 | 0,00% | 99,99% |
| 1B2b | Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) | NMVOC | 0,00 | 0,00% | 100,00% |
| 1B2ai | Fugitive emissions oil: Exploration, production, transport | NMVOC | 0,00 | 0,00% | 100,00% |
| 5C1biii | Clinical waste incineration | NMVOC | 0,00 | 0,00% | 100,00% |
| 1A4ai | Commercial/institutional: Stationary | NMVOC | 0,00 | 0,00% | 100,00% |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | NMVOC | 0,00 | 0,00% | 100,00% |
| 2C2 | Ferroalloys production | NMVOC | 0,00 | 0,00% | 100,00% |
| 2D3c | Asphalt roofing | NMVOC | 0,00 | 0,00% | 100,00% |

**Approach 1 analysis — level assessment of SOx**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A1a | Public electricity and heat production | SOx | 137,03 | **72,53%** | **72,53%** |
| 2B10a | Chemical industry: Other (please specify in the IIR) | SOx | 21,22 | **11,23%** | **83,76%** |
| 2H1 | Pulp and paper industry | SOx | 7,20 | **3,81%** | **87,57%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | SOx | 6,85 | **3,62%** | **91,19%** |
| 1A4bi | Residential: Stationary | SOx | 5,72 | **3,03%** | **94,22%** |
| 1B2aiv | Fugitive emissions oil: Refining / storage | SOx | 4,77 | **2,52%** | **96,75%** |
| 1A3di(ii) | International inland waterways | SOx | 1,64 | **0,87%** | **97,61%** |
| 1A1b | Petroleum refining | SOx | 1,30 | **0,69%** | **98,30%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | SOx | 1,01 | **0,53%** | **98,84%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | SOx | 0,63 | **0,33%** | **99,17%** |
| 1B2c | Venting and flaring (oil, gas, combined oil and gas) | SOx | 0,46 | **0,24%** | **99,41%** |
| 1A4ai | Commercial/institutional: Stationary | SOx | 0,38 | **0,20%** | **99,62%** |

| | | | | | |
|---|---|---|---|---|---|
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | SOx | 0,19 | **0,10%** | **99,72%** |
| 2D3b | Road paving with asphalt | SOx | 0,19 | **0,10%** | **99,82%** |
| 1A3ai(i) | International aviation LTO (civil) | SOx | 0,13 | **0,07%** | **99,88%** |
| 1A3bi | Road transport: Passenger cars | SOx | 0,09 | **0,05%** | **99,93%** |
| 1A3dii | National navigation (shipping) | SOx | 0,06 | **0,03%** | **99,96%** |
| 2C1 | Iron and steel production | SOx | 0,04 | **0,02%** | **99,99%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | SOx | 0,01 | **0,00%** | **99,99%** |
| 2B5 | Carbide production | SOx | 0,01 | **0,00%** | **99,99%** |
| 1A3bii | Road transport: Light duty vehicles | SOx | 0,00 | **0,00%** | **100,00%** |
| 1A3aii(i) | Domestic aviation LTO (civil) | SOx | 0,00 | **0,00%** | **100,00%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | SOx | 0,00 | **0,00%** | **100,00%** |
| 2B1 | Ammonia production | SOx | 0,00 | **0,00%** | **100,00%** |
| 5C1biii | Clinical waste incineration | SOx | 0,00 | **0,00%** | **100,00%** |
| 1A2d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | SOx | 0,00 | **0,00%** | **100,00%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and | SOx | 0,00 | **0,00%** | **100,00%** |

| | | | | | |
|---|---|---|---|---|---|
| | construction: (please specify in the IIR) | | | | |
| 5C1bi | Industrial waste incineration | SOx | 0,00 | **0,00%** | **100,00%** |
| 1B2b | Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) | SOx | 0,00 | **0,00%** | **100,00%** |
| 2C2 | Ferroalloys production | SOx | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of $NH_3$**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 3B1a | Manure management - Dairy cattle | NH3 | 8,45 | **27,14%** | **27,14%** |
| 3B3 | Manure management - Swine | NH3 | 4,33 | **13,90%** | **41,03%** |
| 3B1b | Manure management - Non-dairy cattle | NH3 | 2,98 | **9,57%** | **50,60%** |
| 3B4gi | Manure mangement - Laying hens | NH3 | 2,52 | **8,10%** | **58,70%** |
| 3B2 | Manure management - Sheep | NH3 | 1,79 | **5,75%** | **64,45%** |
| 3B4gii | Manure mangement - Broilers | NH3 | 1,72 | **5,54%** | **69,98%** |
| 2B10a | Chemical industry: Other (please specify in the | NH3 | 1,56 | **5,01%** | **75,00%** |

| | | | | | |
|---|---|---|---|---|---|
| | IIR) | | | | |
| 2B7 | Soda ash production | NH3 | 1,38 | **4,45%** | **79,44%** |
| 3B4e | Manure management - Horses | NH3 | 1,37 | **4,41%** | **83,85%** |
| 3B4f | Manure management - Mules and asses | NH3 | 1,26 | **4,04%** | **87,90%** |
| 3F | Field burning of agricultural residues | NH3 | 1,13 | **3,64%** | **91,54%** |
| 3Da1 | Inorganic N-fertilizers (includes also urea application) | NH3 | 1,13 | **3,64%** | **95,18%** |
| 1A3bi | Road transport: Passenger cars | NH3 | 0,86 | **2,77%** | **97,94%** |
| 3B4d | Manure management - Goats | NH3 | 0,39 | **1,26%** | **99,20%** |
| 1A4bi | Residential: Stationary | NH3 | 0,12 | **0,38%** | **99,58%** |
| 5B1 | Biological treatment of waste - Composting | NH3 | 0,04 | **0,12%** | **99,71%** |
| 3B4giv | Manure management - Other poultry | NH3 | 0,04 | **0,12%** | **99,83%** |
| 1A3bii | Road transport: Light duty vehicles | NH3 | 0,03 | **0,10%** | **99,93%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | NH3 | 0,01 | **0,03%** | **99,96%** |
| 2B2 | Nitric acid production | NH3 | 0,01 | **0,02%** | **99,98%** |
| 2B1 | Ammonia production | NH3 | 0,00 | **0,01%** | **99,99%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles | NH3 | 0,00 | **0,00%** | **100,00%** |

| | | | | | |
|---|---|---|---|---|---|
| | and other machinery | | | | |
| 1A3biv | Road transport: Mopeds & motorcycles | NH3 | 0,00 | **0,00%** | **100,00%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | NH3 | 0,00 | **0,00%** | **100,00%** |
| 1A3c | Railways | NH3 | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of PM2.5**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A4bi | Residential: Stationary | PM2.5 | 23,54 | **82,69%** | **82,69%** |
| 2D3b | Road paving with asphalt | PM2.5 | 1,23 | **4,30%** | **86,99%** |
| 1A3bi | Road transport: Passenger cars | PM2.5 | 1,14 | **4,01%** | **91,01%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | PM2.5 | 0,39 | **1,38%** | **92,39%** |
| 1A3bvi | Road transport: Automobile tyre and brake wear | PM2.5 | 0,39 | **1,37%** | **93,76%** |
| 1A1a | Public electricity and heat production | PM2.5 | 0,37 | **1,29%** | **95,05%** |
| 1A3bii | Road transport: Light duty vehicles | PM2.5 | 0,36 | **1,28%** | **96,32%** |
| 1A3di(ii) | International inland waterways | PM2.5 | 0,22 | **0,79%** | **97,11%** |
| 2A1 | Cement production | PM2.5 | 0,22 | **0,77%** | **97,88%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinary | PM2.5 | 0,21 | **0,72%** | **98,60%** |
| 2H1 | Pulp and paper industry | PM2.5 | 0,11 | **0,40%** | **99,00%** |

| | | | | | |
|---|---|---|---|---|---|
| 1A2f | Stationary combustion in manufacturing industr0s and construction: non-metallic minerals | PM2.5 | 0,07 | **0,23%** | **99,23%** |
| 1A2d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | PM2.5 | 0,07 | **0,23%** | **99,46%** |
| 2B10a | Chemical industry: Other (please specify in the IIR) | PM2.5 | 0,05 | **0,19%** | **99,65%** |
| 1A2gvii | Mobile Combustion in manufacturing industr0s and construction: (please specify in the IIR) | PM2.5 | 0,04 | **0,15%** | **99,80%** |
| 1A3c | Railways | PM2.5 | 0,02 | **0,06%** | **99,86%** |
| 1A3ai(i) | International aviation LTO (civil) | PM2.5 | 0,01 | **0,04%** | **99,90%** |
| 2A2 | Lime production | PM2.5 | 0,01 | **0,04%** | **99,94%** |
| 1A3biv | Road transport: Mopeds & motorcycles | PM2.5 | 0,01 | **0,04%** | **99,98%** |
| 1A3dii | National Navigation (shipping) | PM2.5 | 0,00 | **0,01%** | **100,00%** |
| 1A3aii(i) | Domestic aviation LTO (civil) | PM2.5 | 0,00 | **0,00%** | **100,00%** |
| 1A2a | Stationary combustion in manufacturing industr0s and construction: Iron and steel | PM2.5 | 0,00 | **0,00%** | **100,00%** |
| 1A4ci | Agriculture/Forestry/Fishing: Statio0ry | PM2.5 | 0,00 | **0,00%** | **100,00%** |
| 1A4ai | Commercial/institutio0l: Statio0ry | PM2.5 | 0,00 | **0,00%** | **100,00%** |
| 5C1bi | Industrial waste inci0ration | PM2.5 | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of PM10**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A4bi | Residential: Stationary | PM10 | 23,57 | **50,84%** | **50,84%** |
| 2D3b | Road paving with asphalt | PM10 | 9,19 | **19,82%** | **70,66%** |
| 1A1a | Public electricity and heat production | PM10 | 4,92 | **10,60%** | **81,27%** |

| | | | | | |
|---|---|---|---|---|---|
| 1A3di(ii) | International inland waterways | PM10 | 4,28 | **9,22%** | **90,49%** |
| 1A3bi | Road transport: Passenger cars | PM10 | 1,14 | **2,46%** | **92,95%** |
| 1A3bvi | Road transport: Automobile tyre and brake wear | PM10 | 0,72 | **1,56%** | **94,51%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | PM10 | 0,63 | **1,35%** | **95,86%** |
| 2A1 | Cement production | PM10 | 0,40 | **0,85%** | **96,71%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | PM10 | 0,39 | **0,85%** | **97,56%** |
| 1A3bii | Road transport: Light duty vehicles | PM10 | 0,36 | **0,78%** | **98,34%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | PM10 | 0,21 | **0,44%** | **98,79%** |
| 1A2f | Statio0ry combustion in manufacturing industr0s and construction: non-metallic minerals | PM10 | 0,18 | **0,39%** | **99,18%** |
| 2H1 | Pulp and paper industry | PM10 | 0,17 | **0,36%** | **99,54%** |
| 2B10a | Chemical industry: Other (please specify in the IIR) | PM10 | 0,07 | **0,16%** | **99,69%** |
| 2A2 | Lime production | PM10 | 0,06 | **0,12%** | **99,81%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | PM10 | 0,04 | **0,09%** | **99,91%** |
| 1A3c | Railways | PM10 | 0,02 | **0,04%** | **99,95%** |
| 1A3biv | Road transport: Mopeds & motorcycles | PM10 | 0,01 | **0,02%** | **99,97%** |
| 1A3dii | National Navigation (shipping) | PM10 | 0,00 | **0,01%** | **99,98%** |
| 1A4ci | Agriculture/Forestry/Fishing: Statio0ry | PM10 | 0,00 | **0,01%** | **99,99%** |
| 1A2d | Stationary combustion in manufacturing industr0s and construction: Pulp, Paper and Print | PM10 | 0,00 | **0,01%** | **100,00%** |
| 1A4ai | Commercial/institutional: Statio0ry | PM10 | 0,00 | **0,00%** | **100,00%** |
| 5C1bi | Industrial waste inci0ration | PM10 | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of TSP**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 2D3b | Road paving with asphalt | TSP | 42,88 | **44,65%** | **44,65%** |
| 1A4bi | Residential: Stationary | TSP | 24,87 | **25,90%** | **70,55%** |
| 2B10a | Chemical industry: Other (please specify in the IIR) | TSP | 15,69 | **16,34%** | **86,89%** |
| 1A1a | Public electricity and heat production | TSP | 4,15 | **4,32%** | **91,21%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: non-metallic minerals | TSP | 3,27 | **3,41%** | **94,62%** |
| 1A3bi | Road transport: Passenger cars | TSP | 1,14 | **1,19%** | **95,81%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | TSP | 0,70 | **0,73%** | **96,54%** |
| 2C1 | Iron and steel production | TSP | 0,56 | **0,58%** | **97,12%** |
| 2A1 | Cement production | TSP | 0,44 | **0,45%** | **97,57%** |
| 1A2b | Statio0ry combustion in manufacturing industr0s and construction: non-ferrous metals | TSP | 0,41 | **0,42%** | **98,00%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | TSP | 0,39 | **0,41%** | **98,41%** |
| 1A3bii | Road transport: Light duty vehicles | TSP | 0,36 | **0,38%** | **98,79%** |
| 2H1 | Pulp and paper industry | TSP | 0,32 | **0,34%** | **99,12%** |
| 1A3di(ii) | International inland waterways | TSP | 0,25 | **0,26%** | **99,38%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machi0ry | TSP | 0,21 | **0,21%** | **99,59%** |
| 2B7 | Soda ash production | TSP | 0,15 | **0,16%** | **99,75%** |
| 2A2 | Lime production | TSP | 0,14 | **0,14%** | **99,89%** |
| 1A2gvii | Mobile Combustion in manufacturing industr0s and construction: (please specify in the IIR) | TSP | 0,04 | **0,05%** | **99,94%** |
| 1A3c | Railways | TSP | 0,02 | **0,02%** | **99,96%** |

| | | | | | |
|---|---|---|---|---|---|
| 1A3biv | Road transport: Mopeds & motorcycles | TSP | 0,01 | **0,01%** | **99,97%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | TSP | 0,01 | **0,01%** | **99,98%** |
| 1A4ai | Commercial/institutio0l: Statio0ry | TSP | 0,01 | **0,01%** | **99,99%** |
| 1A3dii | National Navigation (shipping) | TSP | 0,00 | **0,00%** | **99,99%** |
| 2D3c | Asphalt roofing | TSP | 0,00 | **0,00%** | **100,00%** |
| 5C1biii | Clinical waste inci0ration | TSP | 0,00 | **0,00%** | **100,00%** |
| 1B2aiv | Fugitive emissions oil: Refining / storage | TSP | 0,00 | **0,00%** | **100,00%** |
| 1A2d | Stationary combustion in manufacturing industr0s and construction: Pulp, Paper and Print | TSP | 0,00 | **0,00%** | **100,00%** |
| 5C1bi | Industrial waste incineration | TSP | 0,00 | **0,00%** | **100,00%** |
| 1A1b | Petroleum refining | TSP | 0,00 | **0,00%** | **100,00%** |
| 2C2 | Ferroalloys production | TSP | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of CO**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A4bi | Residential: Stationary | CO | 188,21 | **64,57%** | **64,57%** |
| 1A3bi | Road transport: Passenger cars | CO | 59,43 | **20,39%** | **84,96%** |
| 2B7 | Soda ash production | CO | 13,84 | **4,75%** | **89,71%** |
| 2C1 | Iron and steel production | CO | 6,40 | **2,20%** | **91,90%** |
| 1A3bii | Road transport: Light duty vehicles | CO | 4,66 | **1,60%** | **93,50%** |

| | | | | | |
|---|---|---|---|---|---|
| 1A3biii | Road transport: Heavy duty vehicles and buses | CO | 3,94 | **1,35%** | **94,86%** |
| 2B1 | Ammonia production | CO | 3,00 | **1,03%** | **95,89%** |
| 1A3biv | Road transport: Mopeds & motorcycles | CO | 2,60 | **0,89%** | **96,78%** |
| 3F | Field burning of agricultural residues | CO | 1,97 | **0,67%** | **97,45%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | CO | 1,29 | **0,44%** | **97,90%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | CO | 1,08 | **0,37%** | **98,27%** |
| 1A1a | Public electricity and heat production | CO | 0,86 | **0,30%** | **98,56%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | CO | 0,78 | **0,27%** | **98,83%** |
| 1A1b | Petroleum refining | CO | 0,71 | **0,24%** | **99,08%** |
| 1A3di(ii) | International inland waterways | CO | 0,61 | **0,21%** | **99,28%** |
| 2H1 | Pulp and paper industry | CO | 0,51 | **0,17%** | **99,46%** |
| 1A3ai(i) | International aviation LTO (civil) | CO | 0,48 | **0,17%** | **99,62%** |
| 2D3b | Road paving with asphalt | CO | 0,31 | **0,11%** | **99,73%** |
| 1A2gvii | Mobile Combustion in manufacturing industries | CO | 0,23 | **0,08%** | **99,81%** |

| | | | | | |
|---|---|---|---|---|---|
| | and construction: (please specify in the IIR) | | | | |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | CO | 0,14 | **0,05%** | **99,86%** |
| 1A3c | Railways | CO | 0,13 | **0,04%** | **99,90%** |
| 1B2c | Venting and flaring (oil, gas, combined oil and gas) | CO | 0,07 | **0,02%** | **99,93%** |
| 1B2aiv | Fugitive emissions oil: Refining / storage | CO | 0,07 | **0,02%** | **99,95%** |
| 1A3aii(i) | Domestic aviation LTO (civil) | CO | 0,07 | **0,02%** | **99,97%** |
| 5B1 | Biological treatment of waste - Composting | CO | 0,03 | **0,01%** | **99,98%** |
| 1A3dii | National navigation (shipping) | CO | 0,02 | **0,01%** | **99,99%** |
| 1A4ai | Commercial/institutional: Stationary | CO | 0,01 | **0,00%** | **99,99%** |
| 1A2d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | CO | 0,01 | **0,00%** | **100,00%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | CO | 0,01 | **0,00%** | **100,00%** |
| 5C1biii | Clinical waste incineration | CO | 0,00 | **0,00%** | **100,00%** |
| 5C1bi | Industrial waste incineration | CO | 0,00 | **0,00%** | **100,00%** |
| 2D3c | Asphalt roofing | CO | 0,00 | **0,00%** | **100,00%** |

| | | | | | |
|---|---|---|---|---|---|
| 2C2 | Ferroalloys production | CO | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of Pb**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | Pb | 63,86 | **73,88%** | **73,88%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | Pb | 9,40 | **10,87%** | **84,75%** |
| 2C1 | Iron and steel production | Pb | 8,79 | **10,17%** | **94,92%** |
| 1A4bi | Residential: Stationary | Pb | 1,96 | **2,27%** | **97,20%** |
| 1A3bvi | Road transport: Automobile tyre and brake wear | Pb | 0,96 | **1,11%** | **98,30%** |
| 1A1a | Public electricity and heat production | Pb | 0,87 | **1,01%** | **99,31%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | Pb | 0,41 | **0,47%** | **99,79%** |
| 1A3bi | Road transport: Passenger cars | Pb | 0,07 | **0,08%** | **99,87%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | Pb | 0,03 | **0,03%** | **99,90%** |

| | | | | | |
|---|---|---|---|---|---|
| 5C1biii | Clinical waste incineration | Pb | 0,03 | **0,03%** | **99,93%** |
| 1A4ai | Commercial/institutional: Stationary | Pb | 0,02 | **0,02%** | **99,95%** |
| 1A3bii | Road transport: Light duty vehicles | Pb | 0,02 | **0,02%** | **99,97%** |
| 1A3di(ii) | International inland waterways | Pb | 0,01 | **0,01%** | **99,99%** |
| 5C1bi | Industrial waste incineration | Pb | 0,01 | **0,01%** | **100,00%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | Pb | 0,00 | **0,00%** | **100,00%** |
| 1A1b | Petroleum refining | Pb | 0,00 | **0,00%** | **100,00%** |
| 1A3dii | National navigation (shipping) | Pb | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of Cd**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | Cd | 1,58 | **76,25%** | **76,25%** |
| 2C1 | Iron and steel production | Cd | 0,16 | **7,60%** | **83,85%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic | Cd | 0,15 | **7,38%** | **91,23%** |

| | | | | | |
|---|---|---|---|---|---|
| | minerals | | | | |
| 1A1a | Public electricity and heat production | Cd | 0,06 | **3,06%** | **94,30%** |
| 1A4bi | Residential: Stationary | Cd | 0,05 | **2,60%** | **96,90%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | Cd | 0,02 | **0,84%** | **97,74%** |
| 1A3bi | Road transport: Passenger cars | Cd | 0,02 | **0,81%** | **98,55%** |
| 1A4ai | Commercial/institutional: Stationary | Cd | 0,01 | **0,47%** | **99,02%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | Cd | 0,01 | **0,24%** | **99,27%** |
| 1A3bvi | Road transport: Automobile tyre and brake wear | Cd | 0,00 | **0,22%** | **99,49%** |
| 1A3bii | Road transport: Light duty vehicles | Cd | 0,00 | **0,15%** | **99,64%** |
| 5C1biii | Clinical waste incineration | Cd | 0,00 | **0,11%** | **99,75%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | Cd | 0,00 | **0,06%** | **99,80%** |
| 1A3di(ii) | International inland waterways | Cd | 0,00 | **0,05%** | **99,86%** |
| 1A1b | Petroleum refining | Cd | 0,00 | **0,05%** | **99,91%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | Cd | 0,00 | **0,04%** | **99,95%** |
| 5C1bi | Industrial waste incineration | Cd | 0,00 | **0,03%** | **99,98%** |

| | | | | | |
|---|---|---|---|---|---|
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | Cd | 0,00 | **0,01%** | **99,99%** |
| 1A3c | Railways | Cd | 0,00 | **0,01%** | **100,00%** |
| 1A3biv | Road transport: Mopeds & motorcycles | Cd | 0,00 | **0,00%** | **100,00%** |
| 1A3dii | National navigation (shipping) | Cd | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of Hg**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | Hg | 0,22 | **28,47%** | **28,47%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | Hg | 0,21 | **27,65%** | **56,12%** |
| 1A1a | Public electricity and heat production | Hg | 0,15 | **19,24%** | **75,36%** |
| 2C1 | Iron and steel production | Hg | 0,09 | **12,15%** | **87,51%** |
| 1A4bi | Residential: Stationary | Hg | 0,04 | **5,67%** | **93,18%** |
| 5C1biii | Clinical waste incineration | Hg | 0,04 | **5,18%** | **98,37%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | Hg | 0,01 | **0,71%** | **99,07%** |
| 1A4ai | Commercial/institutional: Stationary | Hg | 0,00 | **0,50%** | **99,57%** |
| 1A3di(ii) | International inland waterways | Hg | 0,00 | **0,28%** | **99,85%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | Hg | 0,00 | **0,05%** | **99,91%** |

| | | | | | |
|---|---|---|---|---|---|
| 5C1bi | Industrial waste incineration | Hg | 0,00 | **0,05%** | **99,95%** |
| 1A1b | Petroleum refining | Hg | 0,00 | **0,04%** | **99,99%** |
| 1A3dii | National navigation (shipping) | Hg | 0,00 | **0,01%** | **100,00%** |

**Approach 1 analysis — level assessment of As**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A1a | Public electricity and heat production | As | 2,18 | **49,26%** | **49,26%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | As | 1,65 | **37,33%** | **86,59%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | As | 0,42 | **9,48%** | **96,07%** |
| 2C1 | Iron and steel production | As | 0,06 | **1,42%** | **97,50%** |
| 1A4bi | Residential: Stationary | As | 0,05 | **1,03%** | **98,53%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | As | 0,03 | **0,70%** | **99,23%** |
| 1A3di(ii) | International inland waterways | As | 0,02 | **0,45%** | **99,68%** |
| 1A4ai | Commercial/institutional: Stationary | As | 0,01 | **0,25%** | **99,93%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | As | 0,00 | **0,04%** | **99,97%** |
| 1A1b | Petroleum refining | As | 0,00 | **0,02%** | **99,99%** |
| 1A3dii | National navigation (shipping) | As | 0,00 | **0,00%** | **100,00%** |
| 5C1bi | Industrial waste incineration | As | 0,00 | **0,00%** | **100,00%** |
| 5C1biii | Clinical waste incineration | As | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of Cr**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | Cr | 3,91 | **70,37%** | **70,37%** |
| 2C1 | Iron and steel production | Cr | 0,63 | **11,30%** | **81,68%** |
| 1A3bvi | Road transport: Automobile tyre and brake wear | Cr | 0,35 | **6,38%** | **88,05%** |
| 1A1a | Public electricity and heat production | Cr | 0,25 | **4,47%** | **92,52%** |
| 1A4bi | Residential: Stationary | Cr | 0,17 | **3,02%** | **95,54%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | Cr | 0,10 | **1,88%** | **97,43%** |
| 1A3bi | Road transport: Passenger cars | Cr | 0,04 | **0,64%** | **98,07%** |
| 1A4ai | Commercial/institutional: Stationary | Cr | 0,03 | **0,48%** | **98,55%** |
| 1A3di(ii) | International inland waterways | Cr | 0,02 | **0,39%** | **98,94%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | Cr | 0,02 | **0,32%** | **99,25%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | Cr | 0,02 | **0,30%** | **99,55%** |
| 1A3bii | Road transport: Light duty vehicles | Cr | 0,01 | **0,18%** | **99,73%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | Cr | 0,01 | **0,11%** | **99,84%** |
| 1A1b | Petroleum refining | Cr | 0,00 | **0,05%** | **99,88%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | Cr | 0,00 | **0,04%** | **99,93%** |
| 5C1bi | Industrial waste incineration | Cr | 0,00 | **0,03%** | **99,96%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | Cr | 0,00 | **0,02%** | **99,98%** |
| 1A3c | Railways | Cr | 0,00 | **0,01%** | **99,99%** |

| | | | | | |
|---|---|---|---|---|---|
| 5C1biii | Clinical waste incineration | Cr | 0,00 | **0,01%** | **100,00%** |
| 1A3dii | National navigation (shipping) | Cr | 0,00 | **0,00%** | **100,00%** |
| 1A3biv | Road transport: Mopeds & motorcycles | Cr | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of Cu**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A3bvi | Road transport: Automobile tyre and brake wear | Cu | 7,75 | **39,31%** | **39,31%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | Cu | 7,23 | **36,66%** | **75,97%** |
| 1A1a | Public electricity and heat production | Cu | 2,26 | **11,47%** | **87,44%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | Cu | 1,11 | **5,63%** | **93,08%** |
| 2C1 | Iron and steel production | Cu | 0,50 | **2,55%** | **95,62%** |
| 1A4bi | Residential: Stationary | Cu | 0,40 | **2,01%** | **97,63%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | Cu | 0,20 | **1,02%** | **98,65%** |
| 1A3di(ii) | International inland waterways | Cu | 0,08 | **0,41%** | **99,06%** |
| 1A3bi | Road transport: Passenger cars | Cu | 0,05 | **0,27%** | **99,33%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | Cu | 0,04 | **0,18%** | **99,51%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | Cu | 0,03 | **0,17%** | **99,68%** |
| 1A3c | Railways | Cu | 0,02 | **0,10%** | **99,79%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | Cu | 0,01 | **0,06%** | **99,85%** |

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|---|---|---|---|---|---|
| 1A4ai | Commercial/institutional: Stationary | Cu | 0,01 | **0,05%** | **99,90%** |
| 1A3bii | Road transport: Light duty vehicles | Cu | 0,01 | **0,04%** | **99,94%** |
| 5C1biii | Clinical waste incineration | Cu | 0,00 | **0,02%** | **99,97%** |
| 1A3dii | National navigation (shipping) | Cu | 0,00 | **0,01%** | **99,98%** |
| 5C1bi | Industrial waste incineration | Cu | 0,00 | **0,01%** | **99,99%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | Cu | 0,00 | **0,01%** | **99,99%** |
| 1A1b | Petroleum refining | Cu | 0,00 | **0,00%** | **100,00%** |
| 1A3biv | Road transport: Mopeds & motorcycles | Cu | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of Ni**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | Ni | 1,98 | **34,43%** | **34,43%** |
| 1A1a | Public electricity and heat production | Ni | 1,49 | **25,98%** | **60,42%** |
| 1A3di(ii) | International inland waterways | Ni | 0,89 | **15,46%** | **75,88%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | Ni | 0,64 | **11,22%** | **87,11%** |
| 1A4bi | Residential: Stationary | Ni | 0,45 | **7,82%** | **94,93%** |
| 2C1 | Iron and steel production | Ni | 0,16 | **2,74%** | **97,66%** |
| 1A3bvi | Road transport: Automobile tyre and brake wear | Ni | 0,06 | **0,98%** | **98,65%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | Ni | 0,03 | **0,53%** | **99,18%** |
| 1A3bi | Road transport: Passenger cars | Ni | 0,02 | **0,31%** | **99,49%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles | Ni | 0,01 | **0,14%** | **99,63%** |

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|---|---|---|---|---|---|
| | and other machinery | | | | |
| 1A4ai | Commercial/institutional: Stationary | Ni | 0,01 | **0,09%** | **99,72%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | Ni | 0,01 | **0,09%** | **99,81%** |
| 1A3bii | Road transport: Light duty vehicles | Ni | 0,00 | **0,06%** | **99,87%** |
| 1A3dii | National navigation (shipping) | Ni | 0,00 | **0,05%** | **99,91%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | Ni | 0,00 | **0,03%** | **99,94%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | Ni | 0,00 | **0,02%** | **99,96%** |
| 5C1bi | Industrial waste incineration | Ni | 0,00 | **0,02%** | **99,97%** |
| 1A3c | Railways | Ni | 0,00 | **0,01%** | **99,99%** |
| 1A1b | Petroleum refining | Ni | 0,00 | **0,01%** | **99,99%** |
| 5C1biii | Clinical waste incineration | Ni | 0,00 | **0,00%** | **100,00%** |
| 1A3biv | Road transport: Mopeds & motorcycles | Ni | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of Se**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | Se | 18,13 | **94,99%** | **94,99%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | Se | 0,79 | **4,13%** | **99,11%** |
| 1A1a | Public electricity and heat production | Se | 0,08 | **0,40%** | **99,51%** |
| 2C1 | Iron and steel production | Se | 0,03 | **0,16%** | **99,68%** |
| 1A4bi | Residential: Stationary | Se | 0,02 | **0,11%** | **99,79%** |
| 1A3di(ii) | International inland waterways | Se | 0,01 | **0,06%** | **99,84%** |

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|---|---|---|---|---|---|
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | Se | 0,01 | **0,05%** | **99,89%** |
| 1A4ai | Commercial/institutional: Stationary | Se | 0,01 | **0,05%** | **99,94%** |
| 1A3bvi | Road transport: Automobile tyre and brake wear | Se | 0,01 | **0,04%** | **99,98%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | Se | 0,00 | **0,01%** | **99,99%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | Se | 0,00 | **0,00%** | **99,99%** |
| 1A1b | Petroleum refining | Se | 0,00 | **0,00%** | **100,00%** |
| 1A3dii | National navigation (shipping) | Se | 0,00 | **0,00%** | **100,00%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | Se | 0,00 | **0,00%** | **100,00%** |
| 1A3bi | Road transport: Passenger cars | Se | 0,00 | **0,00%** | **100,00%** |
| 1A3c | Railways | Se | 0,00 | **0,00%** | **100,00%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | Se | 0,00 | **0,00%** | **100,00%** |
| 1A3bii | Road transport: Light duty vehicles | Se | 0,00 | **0,00%** | **100,00%** |
| 1A3biv | Road transport: Mopeds & motorcycles | Se | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of Zn**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | Zn | 76,37 | **56,25%** | **56,25%** |
| 2C1 | Iron and steel production | Zn | 31,41 | **23,14%** | **79,39%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | Zn | 12,35 | **9,10%** | **88,49%** |

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|---|---|---|---|---|---|
| 1A4bi | Residential: Stationary | Zn | 5,24 | **3,86%** | **92,35%** |
| 1A3bi | Road transport: Passenger cars | Zn | 3,34 | **2,46%** | **94,81%** |
| 1A3bvi | Road transport: Automobile tyre and brake wear | Zn | 3,09 | **2,28%** | **97,08%** |
| 1A1a | Public electricity and heat production | Zn | 1,65 | **1,22%** | **98,30%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | Zn | 1,01 | **0,75%** | **99,05%** |
| 1A3bii | Road transport: Light duty vehicles | Zn | 0,64 | **0,47%** | **99,51%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | Zn | 0,33 | **0,24%** | **99,76%** |
| 5C1bi | Industrial waste incineration | Zn | 0,14 | **0,10%** | **99,86%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | Zn | 0,12 | **0,09%** | **99,94%** |
| 1A3di(ii) | International inland waterways | Zn | 0,04 | **0,03%** | **99,97%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | Zn | 0,02 | **0,02%** | **99,99%** |
| 1A3biv | Road transport: Mopeds & motorcycles | Zn | 0,02 | **0,01%** | **100,00%** |
| 1A4ai | Commercial/institutional: Stationary | Zn | 0,00 | **0,00%** | **100,00%** |
| 1A3c | Railways | Zn | 0,00 | **0,00%** | **100,00%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | Zn | 0,00 | **0,00%** | **100,00%** |
| 1A3dii | National navigation (shipping) | Zn | 0,00 | **0,00%** | **100,00%** |
| 1A1b | Petroleum refining | Zn | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of DIOX**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A4bi | Residential: Stationary | PCDD/ PCDF | 25,92 | **52,05%** | **52,05%** |

| | | | | | |
|---|---|---|---|---|---|
| 1A1b | Petroleum refining | PCDD/ PCDF | 8,44 | **16,95%** | **69,00%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | PCDD/ PCDF | 5,81 | **11,66%** | **80,67%** |
| 2C1 | Iron and steel production | PCDD/ PCDF | 3,14 | **6,30%** | **86,97%** |
| 5C1bi | Industrial waste incineration | PCDD/ PCDF | 2,25 | **4,52%** | **91,49%** |
| 1A1a | Public electricity and heat production | PCDD/ PCDF | 2,15 | **4,31%** | **95,80%** |
| 1A3bi | Road transport: Passenger cars | PCDD/ PCDF | 1,15 | **2,32%** | **98,11%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | PCDD/ PCDF | 0,33 | **0,66%** | **98,77%** |
| 1A3bii | Road transport: Light duty vehicles | PCDD/ PCDF | 0,20 | **0,41%** | **99,18%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | PCDD/ PCDF | 0,20 | **0,40%** | **99,58%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | PCDD/ PCDF | 0,14 | **0,28%** | **99,86%** |
| 5C1biii | Clinical waste incineration | PCDD/ PCDF | 0,03 | **0,06%** | **99,92%** |
| 1A3di(ii) | International inland waterways | PCDD/ PCDF | 0,02 | **0,04%** | **99,96%** |
| 2H1 | Pulp and paper industry | PCDD/ PCDF | 0,01 | **0,02%** | **99,98%** |
| 1A4ai | Commercial/institutional: Stationary | PCDD/ PCDF | 0,01 | **0,01%** | **99,99%** |
| 1A3biv | Road transport: Mopeds & motorcycles | PCDD/ PCDF | 0,00 | **0,01%** | **100,00%** |

| | | | | | |
|---|---|---|---|---|---|
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | PCDD/ PCDF | 0,00 | **0,00%** | **100,00%** |
| 1A3dii | National navigation (shipping) | PCDD/ PCDF | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of PAH**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A4bi | Residential: Stationary | PAH | 7,74 | **99,47%** | **99,47%** |
| 1A3bi | Road transport: Passenger cars | PAH | 0,03 | **0,34%** | **99,82%** |
| 1A3bii | Road transport: Light duty vehicles | PAH | 0,01 | **0,09%** | **99,91%** |
| 1A4cii | Agriculture/Forestry/Fishing: Off-road vehicles and other machinery | PAH | 0,00 | **0,05%** | **99,96%** |
| 1A3biii | Road transport: Heavy duty vehicles and buses | PAH | 0,00 | **0,03%** | **99,99%** |
| 1A2gvii | Mobile Combustion in manufacturing industries and construction: (please specify in the IIR) | PAH | 0,00 | **0,01%** | **99,99%** |
| 1A3c | Railways | PAH | 0,00 | **0,00%** | **100,00%** |
| 1A3biv | Road transport: Mopeds & motorcycles | PAH | 0,00 | **0,00%** | **100,00%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | PAH | 0,00 | **0,00%** | **100,00%** |
| 1A1a | Public electricity and heat production | PAH | 0,00 | **0,00%** | **100,00%** |
| 1A4ai | Commercial/institutional: Stationary | PAH | 0,00 | **0,00%** | **100,00%** |
| 1A4ci | Agriculture/Forestry/Fishing: Stationary | PAH | 0,00 | **0,00%** | **100,00%** |
| 1A1b | Petroleum refining | PAH | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of HCB**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A1a | Public electricity and heat production | HCB | 15,70 | **98,51%** | **98,51%** |
| 1A1b | Petroleum refining | HCB | 0,19 | **1,18%** | **99,69%** |
| 1A1c | Manufacture of solid fuels and other energy industries | HCB | 0,02 | **0,11%** | **99,80%** |
| 1A2a | Stationary combustion in manufacturing industries and construction: Iron and steel | HCB | 0,01 | **0,08%** | **99,88%** |
| 1A2b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | HCB | 0,01 | **0,07%** | **99,95%** |
| 1A2c | Stationary combustion in manufacturing industries and construction: Chemicals | HCB | 0,01 | **0,05%** | **100,00%** |
| 1A2d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | HCB | 0,00 | **0,00%** | **100,00%** |
| 1A2e | Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco | HCB | 0,00 | **0,00%** | **100,00%** |

**Approach 1 analysis — level assessment of PCB**

| NFR category code | NFR category | Pollutant | Latest year estimate (Lx,t) | Level Assessment Lx,t | Comulative total |
|---|---|---|---|---|---|
| 1A4bi | Residential: Stationary | PCBs | 2,78 | **82,01%** | **82,01%** |
| 1A1b | Petroleum refining | PCBs | 0,27 | **7,95%** | **89,95%** |
| 1A2f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | PCBs | 0,23 | **6,89%** | **96,85%** |
| 1A2a | Stationary combustion in manufacturing | PCBs | 0,07 | **2,21%** | **99,06%** |

| | | | | | |
|---|---|---|---|---|---|
| | industries and construction: Iron and steel | | | | |
| 1A3di(ii) | International inland waterways | PCBs | 0,02 | **0,50%** | **99,56%** |
| 5C1biii | Clinical waste incineration | PCBs | 0,01 | **0,44%** | **100,00%** |
| 1A3dii | National navigation (shipping) | PCBs | 0,00 | **0,00%** | **100,00%** |