2016

Republic of Macedonia INFORMATIVE INVENTORY REPORT 1990-2014

UNDER THE CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION (CLRTAP)

MINISTRY OF ENVIRONMENT AND PHYSICAL PLANNING

Contents

LIST OF ABBREVIATIONS

EEA	**European environmental agency**
CARDS	**C**ommunity **A**ssistance for **R**econstruction **D**evelopment and **S**tabilization
ETC/ACC	**E**uropean **T**opic **C**entre on **A**ir and **C**limate **C**hange
EU	**E**uropean **U**nion
UNFCCC	**U**nited **N**ations **F**ramework **C**onvention on **C**limate **C**hange
UNECE/ CLRTAP	**U**nited **N**ations **E**conomic **C**ommission for **E**urope/**C**onvention on **L**ong-range **T**ransboundary **A**ir **P**ollution
QA/QC	**Q**uality **A**ssurance / **Q**uality **C**ontrol
EMEP	Cooperative Programme for **M**onitoring and **E**valuation of the Long-range Transmission of Air **P**ollutants in **E**urope
SNAP	**S**elected **N**omenclature on **A**ir **P**ollutants
AE-DEM	**A**ir **E**missions **D**ata **E**xchange **M**odule
NFR	**N**omenclature **F**or **R**eporting
CRF	**C**ommon **R**eporting **F**ormat
GHGs	**G**reen**h**ouse **G**ase**s**
LPS	**L**arge **P**oint **S**ource
LHV	**L**ow **H**eating **V**alue
NAPFUE	**N**omenclature for **A**ir **P**ollution of **Fue**ls
IPCC	**I**ntergovernmental **P**anel on **C**limate **C**hange
GPG	**G**ood **P**ractice **G**uidance (of the IPCC)
EEA	**E**uropean **E**nvironment **A**gency
HM	**H**eavy **M**etals
POPs	**P**ersistent **O**rganic **P**ollutant**s**
RM	**R**epublic of **M**acedonia
CPAPRM	**C**adastre of **p**olluters and **a**ir **p**ollutants in **R**epublic of **M**acedonia
MEPP	**M**inistry of **E**nvironment and **P**hysical **P**lanning
MEIC	**M**acedonian **E**nvironmental **I**nformative **C**entre
NEAP	**N**ational **E**nvironmental **A**ction **P**lan
2W	Two wheelers
PCs	Passanger cars
LDTs	Light-duty trucks
HDVs	Heavy-duty vehicles

MOI	Ministry of interior
LE	Law on environment
ME	Ministry of economy
MAFWS	Ministry f agriculture, forestry and water supply
SSO	State statistical office
MS	Member state
KSA	Key source analysis
ETR	Expert review team
EB	Executive body

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Acknowledgements

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1. EXECUTIVE SUMMARY

The Republic of Macedonia has an emission inventory reporting obligation towards the Convention on transboundary air pollution (CLRTAP) and its eight protocols as well as to the International organizations such as the European environmental agency (EEA). The reporting obligations to the relevant international organizations and to the Executive body of the LRTAP convention are set down in Article 27-d of the Law on ambient air quality (LAAQ) [1].

As party to the UNECE/LRTAP convention and its protocol the Republic of Macedonia is required to annually report data on emissions of air pollutants covered by the Convention and its protocols. These are the main pollutants: nitrogen oxides (NOx), sulfur dioxide (SO_2), non -methane volatile organic compounds (NMVOC), Ammonia (NH_3), Persistent organic compounds (POPs) and Heavy metals (HM). To be able to meet the obligations, the Republic of Macedonia compiles annually an emission inventory and reports the base year emissions (1980, 1987, 1988 and 1990) in accordance with the protocols' obligations.

This report complies with the regulation under the UNECE/CLTRAP convention and its protocols which define the standards for the national emission inventory [2].

At its thirty-second session (Geneva, 9–13 December 2013), the Executive Body (EB) for the LRTAP Convention adopted revised guidelines for reporting emissions and projections data under the Convention (ECE/EB.AIR/122/Add.1, decisions 2013/3 and 2013/4). Revised 2014 Reporting guidelines (ECE/EB.AIR.125) are adopted for application in 2015 and subsequent years [3].

This informative report has been prepared according to Annex II of the Revised 2014 Reporting guidelines.

The report contains eleven chapters. The chapter introduction provides general information on the inventory preparation background, key source analysis, methodology and data sources used, QA/QC and completeness. Chapter Trend presents trends on different pollutants as well as the main reasons for incline and decline of the values. Chapters 4-9 include detailed information on activity data and emission factors used per Nomenclature for reporting (NFR) source category. The chapter projections gives information on the current situation and planned activities regarding this obligation set down in the Gothenburg protocol. Source used for the gathering of activity data and information are presented in Reference chapter.

Annex 1 of this report presents emission data for the pollutants for the year 2014.

1.1. Main differences in the inventory compared to previous year

For the first time this report contains the whole trend emissions for the period 1990-2014. In the previous submissions, the country submitted emissions only for the basic pollutants and afterwards for some of the following years, but was not in position to report for the whole reporting period.

For the preparation of the 2014 inventory, the inventories of the whole period 1990-2014 and preparation of this informative report, the Ministry of environment and physical planning (MEPP) was supported by experts engaged in the EU funded Twinning Project 'Further strengthening the capacities for effective implementation of the acquis in the field of air quality'(MK 12 IB EN 01) that is currently ongoing.

Within the framework of this project, Finland (Finnish Meteorological Institute) was the lead partner and Austria (Environment Agency Austria) served as junior partner.

The project consists of four components aimed at strengthening air quality management in the country. One of the component within the Twinning project refers to strengthening oft he capacities for performing emission inventories and dispersion modeling, including exposure modeling.

One of the mandatory results of this component is the Emission Inventory and Inventory Informative Report (IIR) for the year 2014, prepared and delivered to the international organizations. Due to the fact that this year's inventory and this report have been prepared together with experienced EU

member state experts, the quality of preparation of the inventory and IIR has improved significantly. Namely, the ten expert missions envisaged in this component were dedicated to improve the methodology (gap filling, gathering of proper activity data, and determination of implied emission factors), introduce key source analysis (KSA) as well as trend analysis calculations and introduce and enhance the implementation of QA/QC system in the preparation of the inventory.

1.2. Overview of emission trends

The report presents trend analysis in the country for the period 1990 – 2014. The evaluation of the status of the emission trends is based on emission inventories and key source analysis. In the case of basic pollutants, a decreasing trend is noticed for NOx emissions from 2011, which is a result of the shorter operation of the power plant REK Oslomej from 12 to 5 mounts per year, and a decrease in coal consumption of up to 60%, including gasification of the one heating plant. Lower NOx emissions in 2013 compared to 2012 are also a result of the modernization of the boilers in the major power plant REK Bitola as well as gasification of the existing heating plants. From 2013 to 2014 emissions remained quite stable (- 1%).

The trend on NMVOC emissions is variable. In the period from 2013 to 2014 emissions decreased by 16%, also due to reduced use of solvents as well as slightly lower emissions from the residential sector. With regards to SOx emissions, the trends vary and depend on the coal consumption considering that electricity production is the main source for SOx emissions.

The trend of ammonia emissions is constantly decreasing, which is related to decreasing livestock numbers and implementation of BAT in the bigger farms. From 2013 to 2014 emissions slightly decreased by 2%.

The trend of the particulates is variable with inclines and declines due to variable operation of the installations for ferroalloys production as a major source in the national total particulates emissions. The contribution from the 1A4 Other Sectors (residential heating has not changed much due to the fact that biomass is still the main fuel used in household heating.

The concentrations of Pb have decreased significantly starting from 2003 as a result of the closure of the smelter company “Zletovo” – Veles and the use of unleaded gasoline in transport. The closure of the smelter company also reflects on declines emissions in Hg, Cd and PCBs emissions.

With regards to PCDD/F and PAHs the trends are variable, but still decreasing trend can be notice from 2011 onward. The higher emissions in 2013 compared to 2012 are due to the colder winter. The largest source of emissions for these pollutants is the energy sector (mainly residential heating) with a share of 89% and 76% respectively. A decline in biomass fuel consumption and incline of natural gas fuel combustion in the latest year results in lower emissions of these pollutants.

1.3. Priorities for improvements

This report already includes improvements made in response to the issue related to the previous Stage 3 in depth review conducted in 2011 [4]. Nonetheless, due to limitation of staff and lack of activity data there are still lot of issues to be improved in future. Due to the fact that emissions from the Transport sector have been calculated using the Tier 1 method, the major priority is establishment of Coppert IV model for calculation of emissions coming from this sector. This is important due to the fact that Transport is one of the key sources in CO and NOx national emissions. The second priority is improvement of the methodology for calculation of NMVOC emissions coming from source category, “other solvent and product use” which activity has already being planned to be performed within the frame of the ongoing Twinning project. Establishment of better QA/QC procedure will enable better cross checking of data and better data quality. Implementaion od all QA/QC procedures was limited for this reporting round due to the fact that this reporting includes the inventories for the entire time series (all together 28 years) and the practical limitation of trained staff.

2. INTRODUCTION

2.1. Introduction

Reporting of emission data to the EB of the Convention on Long-range Trans-boundary Air Pollution (CLRTAP) is required in order to fulfill the obligations regarding strategies and policies in compliance with the implementation of Protocols under the Convention. Parties should use the reporting procedures and are required to submit annual national emissions of SO_2, NO_X, NMVOC, CO and NH_3, particulate matter, various HM and POPs using the under the Convention on Long-range Transboundary Air Pollution.

The United Nations, Economic Commission for Europe (UNECE), adopted the LRTAP Convention in 1979. The LRTAP Convention came into force in 1983 and has been extended by eight specific protocols. Republic of Macedonia has ratified the Convention on 17.11.1991. The Macedonian status of ratification to other the Conventions and Protocols is shown in the text below:

- United National Framework Convention on Climate Change (New York, 1992). The Convention was ratified by means of the Law on Ratification („Official Gazette of RM" No. 61/97), and entered into force in the Republic of Macedonia on 28.04.1998.
- Kyoto Protocol to the United Nations Framework Convention on Climate Change. The Protocol was ratified by means of the Law on Ratification („Official Gazette of RM" No. 49/04).
- Convention on Long-Range Transboundary Air Pollution (Geneva, 1979). The Convention was ratified by means of the Law on Ratification („Official Gazette of the SFRY" No. 11/86). The Convention was taken over by the Republic of Macedonia by means of succession on 17.11.1991.
- Stockholm Convention on Persistent Organic Pollutants. The Republic of Macedonia signed the Convention in Stockholm, Sweden, on 22.05.2001. The Convention was ratified by means of the Law on Ratification („Official Gazette of R.M. No.17/04).
- Vienna Convention for the Protection of the Ozone Layer (Vienna, March 1985). The Convention was ratified by means of the Law on Ratification („Official Gazette of SFRY No.1/90). The Republic of Macedonia has taken over by means of succession on 10.03.1994.
- Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal, September 1987). The Protocol was ratified by means of the Law on Ratification („Official Gazette of SFRY No.16/90). The Republic of Macedonia has taken over by means of succession on 10.03.1994.
- The Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer-London. The Protocol was ratified by means of the Law on Ratification („Official Gazette of R.M. No.25/98).
- The Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer-Copenhagen. The Protocol was ratified by means of the Law on Ratification („Official Gazette of R.M. No.25/98).
- The Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer-Montreal. The Protocol was ratified by means of the Law on Ratification („Official Gazette of R.M. No.51/99).
- The Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer-Beijing, 1991. The Protocol was ratified by means of the Law on Ratification („Official Gazette of R.M. No.13/02).

- Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, February 1991).The Convention was ratified by means of the Law on Ratification („Official Gazette of R.M. No.44/99).
- Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention). The Convention was ratified by means of the Law on Ratification („Official Gazette of R.M. No.40/99).
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal The Convention was ratified by means of the Law on Ratification („Official Gazette of R.M. No.49/97).

The eight Protocols to CLRTAP have been also ratified and published in official gazette:

- Law on Ratification of the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on long-term financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) ("Official Gazette of the Republic of Macedonia" No.24/2010);
- Law on Ratification of the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on reduction of sulphur emissions or their transboundary transmission by at least 30 percentage ("Official Gazette of the Republic of Macedonia" No.24/2010);
- Law on Ratification of the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the control of nitrogen oxides or their transboundary fluxes ("Official Gazette of the Republic of Macedonia" No.24/2010);
- Law on Ratification of the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the control of volatile organic compounds or their transboundary fluxes ("Official Gazette of the Republic of Macedonia" No.24/2010);
- Law on Ratification of the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution concerning further reduction of sulphur emissions ("Official Gazette of the Republic of Macedonia" No.24/2010).
- Law on Ratification of the Protocol to the 1979 Convention on Long-Rang Transboundary Air Pollution on heavy metals emissions ("Official Gazette of the Republic of Macedonia" No.135/2010).
- Law on Ratification of the Protocol to the 1979 Convention on Long-Rang Transboundary Air Pollution on persistent organic pollutants ("Official Gazette of the Republic of Macedonia" No.135/2010).
- Law on Ratification of the Protocol to the 1979 Convention on Long-Rang Transboundary Air Pollution to abate acidification, eutrophication and ground-level ozone ("Official Gazette of the Republic of Macedonia" No.135/2010).

Regarding the Gothenburg Protocol, negotiation were ongoing, in the period 2011-2014, on the proposed figures on the base year emission levels (1990 national emissions) and national emission ceilings (2010 national emissions). The Executive Body of the Convention on its 32nd Meeting, decided to accept the last proposed figures for Annex II of the Gothenburg Protocol and Annex II of the Protocol on sulphur of 1994. With the adoption of the proposed amendments to Annex II of the Gothenburg Protocol, in September 2014, Republic of Macedonia became a full Party to these protocols as well as first Party to the among developed countries.

2.2. National Inventory background

The Republic of Macedonia, in accordance with obligations undertaken with the signed international Conventions and Protocols, in 2005 via the Ministry of Environment and Physical Planning (MEPP) established a National Methodology for Air Emission Inventory, based on the Joint EMEP/EEA Inventory guidebook (in the further text GB year) [5,6]. This was part of the implementation of the EMEP Programme, for the purpose of the implementation of the CLRTAP in the Republic of

Macedonia, carried out through European Topic Centre on Air and Climate Change (ETC/ACC) with financial support by the Community Assistance for Reconstruction Development and Stabilization (CARDS) Programme.

The objective of the project was to establish an emission inventory and reporting system in the Republic of Macedonia that complies with the international requirements of the European Union (EU) and adaptation towards comparability with the data of the EU Member States. In 2006, TEHNOLAB Ltd authorized by the MEPP, have prepared first Air emission Inventory and Informative Inventory Report (IIR) which covers information on calculated air emissions for 2004 [7].

For 2005, 2006, 2007, 2009 emissions according to the requirements of CLRTAP, MEPP has updated the air emissions data only for the three main SNAP sectors (1, 2 and 3), without submitting IIR Report.

In 2007 Republic of Macedonia complying with CLRTAP as part of the national legislation has enforced the "Rulebook on inventory making and establishment of the level of polluting substances emission in ambient air in tonnes per year for all types of activities, as well as other data to be delivered to the Environmental Monitoring Programme of Europe (EMEP)" [8] .

In 2010, MEPP again have engaged Tehnolab Ltd a consulting company, to prepare complete Air emission Inventory and IIR for 2008 [9].

In 2011 air emissions data (only for the three main SNAP sectors (1, 2 and 3)) were updated without submition of IIR Report [10].

Republic of Macedonia, in 2011 has also participated in Stage 3 in depth review of Air Emission Inventories [4], and replaied promptly and timely on the sent questions by Expert review team (ERT).

Review made by ERT, as well as the sent questions, were of great use and importance concerning further development and improvement of Macedonian Air emission Inventory in accordance with GB 2009 [6]. Hence, recommendations given from Stage 3 review were taken into account in the Inventories submissions in the following years.

In relation to air emissions inventory submission in 2012, MOEPP have secure financial resources for full inventory and preparation of the report improved in line with Review 3 report recommendations. MOEPP involved Tehnolab Ltd, to carry out the inventory and preparation of IIR for 2010. This Inventory was improved in accordance with some remarks given in the Stage 3 review report, including HM full series emissions.

In 2013, emission inventory for 2011 was extended for the first time with calculated emissions on PM2.5, PM10, dioxins and furans. Emissions for the baseline years 1980 (SOx), 1987 (NOx), 1988 (NMVOC) and 1990 (POPs) were delivered to the Convention on Long-range Transboundary Air Pollution in accordance with the requirements of the particular protocols.

In 2014 and 2015 the emission inventory for all reporting pollutants and recalculations of the baseline years 1980 (SOx), 1987 (NOx), 1988 (NMVOC) and 1990 (POPs) were delivered due to the newer available improved activity data as well as in accordance with the updated EF form the GB 2013 for most of the source categories.

This IIR covers information on anthropogenic emissions of air pollutants for 2014 for all pollutants time series starting from 1990, and as well includes data for methods, data sources, completeness of the Inventory, quality assurance and quality control (QA/QC) activities carried out, and sectorial methodologies for emission estimations by category (NFR). The data regarding emissions, activity data and emission factors are presented in separate chapters of this Report. The NFR14 tables are used to report the emission figures.

During the preparation of this Informative Report, the below listed guidelines were followed:

- Revised 2014 Reporting guidelines (ECE/EB.AIR.125);

- Annex II of the Guidelines Recommended structure for the Informative Inventory Report (IIR) - Documentation of methods, trends, recalculations, activity data and other information relevant for understanding the inventory;
- EMEP/EEA Air Pollutant GB 2009;
- Joint EMEP/EEA air pollutant GB — 2013.

The structure of the mentioned guidelines was followed by the authors, in order to achieve transparency, consistency, completeness, accuracy and comparability of reported emission data.

2.3. Institutional arrangements

In accordance with the Law on ambient air quality Article 27-g (2) [1], the Emission inventory of pollutants for the territory of the Republic of Macedonia is performed through:

1) Calculation of emission quantities of pollutants in the air in the Republic of Macedonia;

2) Preparation of report on the annual emission inventory with emission projections;

3) Preparation of report on implementation of emission reduction measures in order to fulfil the requirements toward the 1979 Convention on Long-Range Transboundary Air Pollution and its amendments (hereinafter: LRTAP convention).

The reporting obligations to the European Environmental Agency and other relevant international organizations and to the Executive body of the LRTAP convention are set down in Article 27-d.

According to the Law on environment (LE) [11] article 40 The Macedonian Environmental Informative Center (MEIC), a department within the The Ministry of Environment and Physical Planning (MEPP) is the single entity responsible for the preparation of emission inventories. MEIC within the MEPP has the overall responsibility and submits the inventory report to CLRTAP. Within the MEIC, experts from four different departments are contributing, whereby experts from the division of Analysis and Reporting are compiling and reporting the inventory.

Data needed for the preparation of the inventory are provided by either industrial operators, State statistical office (SSO), Ministry of Economy (ME), Ministry of agriculture, forestry and water supply (MAFWS), or Ministry of Interior (MOI) etc. MEPP has signed memorandum of understanding for data exchange with the SSO and starting from this year with MOI on detail vechicles fleet data.

The Iinstitutional arrangements for the inventory system currently used in Republic of Macedonia is presented in Figure 1. The Macedonian Environmental Informative Center (MEIC) within the MEPP has the overall responsibility and submits the inventory report to CLRTAP.

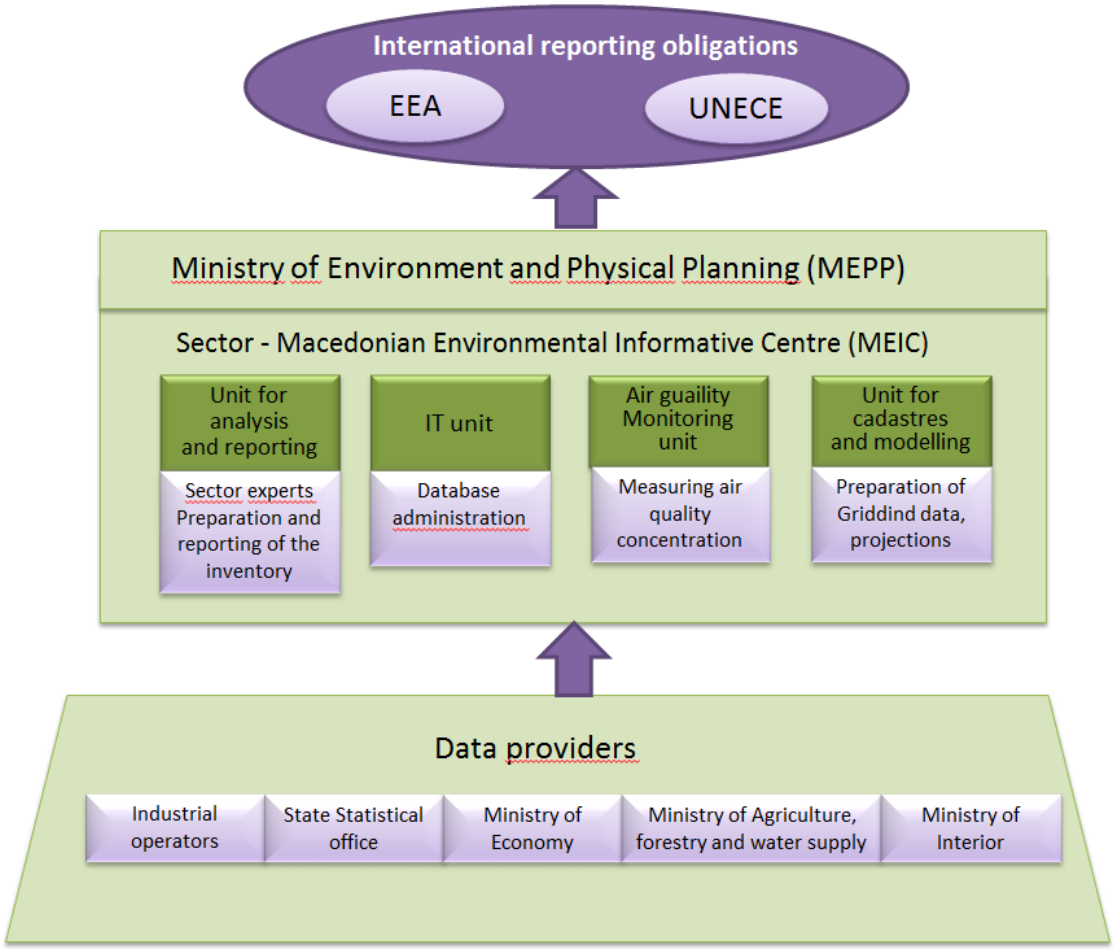

Figure 1 Institutional arrangements

2.4. Inventory preparation process

The preparation of the Inventory includes the following stages:

a) Planning

b) Preparation

c) Data management

a) Inventory planning

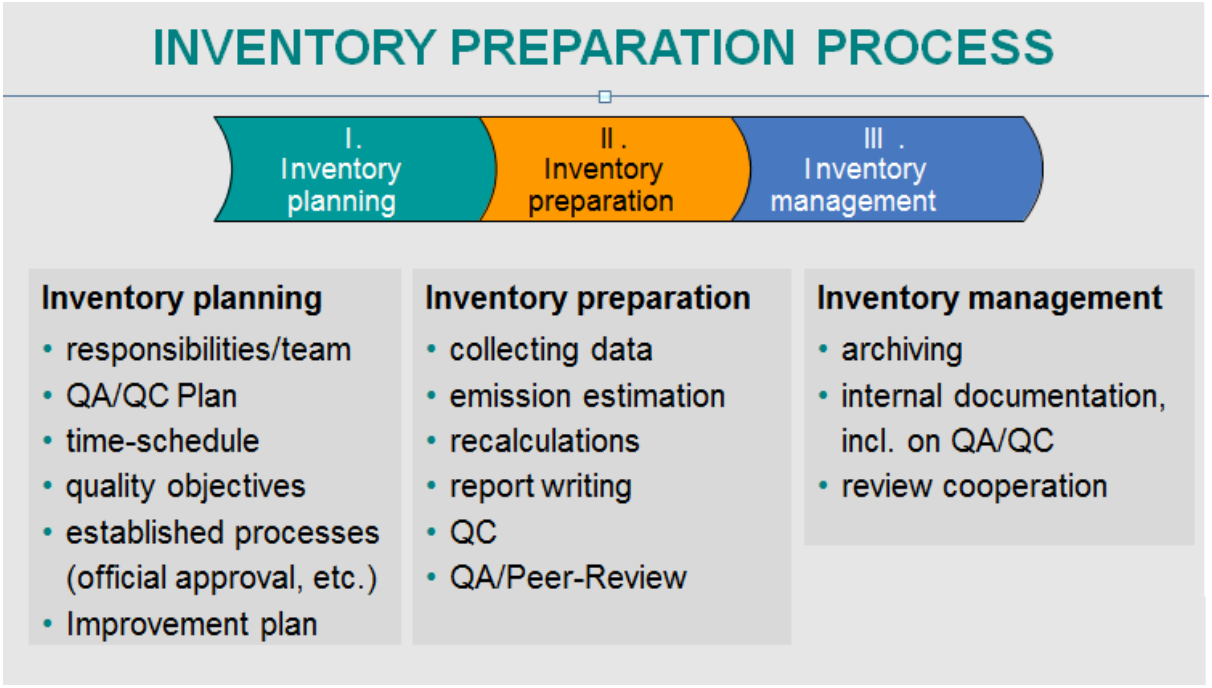

Figure 2 Sheme of inventory preparation processs

The planning of the Inventory includes organizational aspects, related to: appointment of the team of key and deputy key experts within the department, description of specific tasks and responsibilities, development of operational procedures with regard to data collection and data calculation on the activity rate and emission factors included in the database of the National Emission Inventory. At the same time, trainings have been organized for the purpose of introducing quality assurance and quality control procedures.

b) Inventory preparation

In the context of this Inventory preparation, each of the experts are involved in the identification of the sources of pollution, definition of the relevant data sources and data collection (activity data). All other activities concerning the Inventory preparation and development have been organized through this approach.

During the Inventory preparation recommendations given from Stage 3 review [4] were followed and were of great use regarding the improvements made in this IIR.

- **Identification of sources of pollution**

In the framework of the Inventory preparation, great attention has been devoted to the identification of the sources of pollution. This was necessary for two basic reasons: the first is based on the geographical position of the Republic of Macedonia (e.g.: there are no sources of pollution of marine or river traffic), and the second on the level of industrial and economic development of the country (there are no nuclear power plants, gas turbines, etc.).

- **Data sources**

Data from several sources have been used on the different sectors, including:

- Statistical Yearbooks of Republic of Macedonia 1990-2014;
- Publications published by SSO in different areas (Tranport, Industry, Energy, Agriculture and Forestry);
- Energy Balance of the Republic of Macedonia;
- Measurements data from the operators;
- International web page (FAO, Eurostate and etc).

- **Data management and processing**

Emission factors and activity data for different source categories were collected and calculated in separate NFR excel tables for the period from 1990 to 2014. NFR tables are categorized in separate folders (ENERGY, INDUSTRY and SOLVENT PRODUCT USE, AGICULTURE, WASTE, TRANSPORT, NAURAL SOURCES).

During this reporting cycle Evaluation and update emission factors of previous year has been conducted. Change of the emission factor due to use of GB 2013 [5] or more detail expert analysis in chapter agriculture for example is in detail described in the Recalcutaions chapter. Comparison of the value of input data with the previous year's value. If there are large deviations, the value was checked for errors such as typing or unit errors. If necessary, the primary data providers were contacted for an explanation.

The basic approach to the selection of the methodology used in the calculation of emissions and selection of emission factors in the frameworks of each NFR source is the information on activity data. Taking into account the above mentioned difficulties in the collection of data on activity rates, as well as the fact that the Republic of Macedonia does not have national emission factors, only the most simple methodologies and the relevant emission factors contained in the GB 2013 and GB 2009 were used in this Inventory. Only in the following sectors higher Tier 2 has been used: 1B1a, 2A3, 2D3g and 2H2. Implied emission factors have been used in categories 1A1a and 2C2.

With regard to the specification of emission factors for certain number of emission sources, mainly for point sources (Facilities), data from the multi-annual measurements of pollutants emission has been used (see chapter References [12-23].

Detailed overview and explanation of activity data and emission factors for each of the elaborated NFR sectors are presented in Chapters 4.0 to 8.0.

With regards to data processiong data from different NFR excel tables (containing EF, activity data and calculated emissions per poluttant) were linked with the Reported excel table. For processing and analysis of the data an NFR Reporting Tool (prepared by MS expert with the Twining project and implemented by IT expert from MEEP) was used. Data from the NFR tables have been transposed (rotated) from columns to rows and linked within the NFR Reporting Tool. NFR reporting tool has been used for preparation of Trends.

2.5. Methods and data sources

2.5.1. Methodology

Macedonian air emission inventory is based on a methodology accordingly providing completeness, consistency and comparability of this Inventory.

The EMEP/EEA guidebook calculation principle is to calculate the emissions as activities multiplied by emission factors. Activities are numbers referring to a specific process generating emissions, while an emission factor is the mass of emissions per unit activity. Information on activities to carry out the inventory is largely based on official statistics. The most consistent emission factors have been used, mainly default factors proposed by international guidelines.

2.5.2. Data sources

Activity data needed for emissions calculation are extracted from regular publications and databases of the State Statistical Office and other relevant governmental organizations and ministries. For particular sub-sectors and source categories more detailed data are required then those published in official statistical reports, such as disaggregated energy balance, vehicle fleet etc.). Table 1 presents the official activity data sources in relation to the NFR sectors.

Table 1 Activity data sources

NFR Sector	Data source	Data provider
Energy	Energy balance 2009-2014, Energy statistics Questionnaire for emissions in environment -2014	Ministry of economy MEPP State statistical office
Transport	State Statistical Office of the Republic of Macedonia, Transport and other communications, 2007-2014, Statistical Yearly reports 1990-2014	Ministry of Interior State statistical office
Industrial Processes	Industry in the Republic of Macedonia, 2002-2007,2003-2003-2008,2004-2009,2005-2010,2006-2011,2007-2012,2008-2013,2009-2014 Statistical Yearly reports 1990-2014 Questionnaire for emissions in environment -2014	State statistical office MEPP
Solvent and Other Product Use	Industry in the Republic of Macedonia, 2002-2007,2003-2003-2008,2004-2009,2005-2010,2006-2011,2007-2012,2008-2013,2009-2014 Statistical Yearly reports 1990-2014 Questionnaire for emissions in environment -2014	State statistical office MEPP
Agriculture	State Statistical Office of the Republic of Macedonia, Field crops, orchards and vineyards, 2007-2014, http://www.stat.gov.mk/PrikaziPoslednaPublikacija.aspx?id=5 Statistical Yearly reports 1990-2014 State Statistical Office of the Republic of Macedonia, Livestock, 2007-2014 State Statistical Office of the Republic of Macedonia, Forestry, 2000 – 2014, Census of agriculture, 2007, Individual agricultural holdings grouped by total available land, by regions, 2008	State statistical office MAKSTAT database MAFWS FAO
Waste	Statistical Yearly reports 1990-2014 Feasibility study on drisla landfill, book 1of 2, General overview, Final report, August, 2011 “Drisla” landfill , Yearly environmental reports, 2013, 2014,	State statistical office Public enterprise “Drisla” landfill EUROSTATE
Natural souces	State Statistical Office of the Republic of Macedonia, Forestry, 2000 – 2014, http://www.stat.gov.mk/Publikacii/5.4.8.02.pdf	State statistical office

2.6. Key Categories

During stage 3 review in 2011 the ERT encourages the Republic of Macedonia to present the key sources as trends and as percentage contribution to total emissions. To clarify this issue, the ERT recommended that the the Republic of Macedonia adds in the IIR paragraph “1.5 Key Source analysis” the trend of key sources over the time period. It is also recommended to only include the sources contributing to an accumulated 80% to total emissions. Currently only a level assessment was carried out for the key sources. A trend assessment is planned for future submissions. However, the section on emission trends (see chapter 3) has been included to the Macedonian IIR. So description of trends and main emission sources are available for all pollutants.

Identification of key source categories of individual pollutant was made using methodology that follows the quantitative approach 1 described in "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories". As described in Approach 1, key categories are identified using a predetermined cumulative emissions threshold. Key categories are those which when summed together cumulatively add up to 80% of the total level.

The analysis of key sources in Republic of Macedonia includes pollutants under CLRTAP: pollutants which cause acidification, eutrophication and Ground-level ozone (NOx, NMVOC, SOx, NH_3 and CO), Particles (TSP) and heavy metals (Pb, Cd, Hg, As, Cr, Cu, Ni, Se and Zn). Cumulative Table with the key sources for all reported pollutants is Table 2.

Table 2 Key sources for all gases

Pollutant	Key categories 2014 (sorted from high to low contribution from left to right)								Total %
NO_x	1A1a	1A3biii	1A2a	1A3bi					81,0%
NMVOC	1A4b	2D	1A3biv	1A3bi	3B1a	1B1	1A3bv	1B2av	81,3%
SO2	1A1a								92,0%
NH_3	3B1a	3B3	1A4	3B1b	3B2				84,7%
CO	1A4b	1A3bi	1A3biv						85,2%
TSP	1A4b	2C2	1A1a	2D					87,5%
PM2.5	1A4b	2C2	1A1a						89,2%
PM10	1A4b	2C2	1A1a						80,8%
Pb	2	1A2a	1A1a						81,0%
Cd	1A1a	1A4b	2C	1A2a					86,0%
Hg	1A1a	2C	1A2a	5					83,0%
As	1A1a	2C							94,9%
Cr	2C	1A1a	1A3biii						82,1%
Cu	1A2gvii	1A4b	1A2a						84,3%
Ni	1A1a	1A4a	1A2gviii	1A4b					81,6%
Se	1A1a								98,2%
Zn	2	1A4b	1A2a	1A1a					86,6%
DIOX	1A4b	2C1							85,5%
PAH	1A4b								89,4%
HCB	2C3								96,6%
PCBs	2	1A4b	1A2a						95,2%

In the process of key categories identification each pollutant was analysed separately. The key sources for each pollutant are presented in

Table 33 to Table 23 in ascending NFR category order.

Table 3 Key source categories for emissions of NO_x

	NFR sector	Gg	%	%cum
1A1a	Public electricity and heat production	12,95	41,0%	41,0%
1A3biii	Road Transport, Heavy duty vehicles	7,81	24,7%	65,8%
1A3bi	Road Transport, Passenger cars	2,60	8,2%	74,0%
1A2a	Iron and Steel	2,05	6,5%	80,5%

Table 4 Key source categories for emissions of NMVOC

	NFR sector	Gg	%	%cum
1A4b	Residential	9,12	30,4%	30,4%
2D	NON ENERGY PRODUCTS FROM FUELS AND SOLVENT USE	4,82	16,1%	46,5%
1A3biv	Road Transport, Mopeds & Motorcycles	2,05	6,8%	53,4%
1A3bi	Road Transport, Passenger cars	1,80	6,0%	59,3%
3B1a	Dairy cattle	1,65	5,5%	64,8%
1B1	Solid fuels	1,34	4,5%	69,3%
1A3bv	Road Transport, Gasoline evaporation	1,21	4,0%	73,3%
1B2av	Distribution of oil products	1,20	4,0%	77,3%

Table 5 Key source categories for emissions of SOx

	NFR sector	Gg	%	%cum
1A1a	Public electricity and heat production	76,45	91,9%	91,9%

Table 6 Key source categories for emissions of NH_3

	NFR sector	Gg	%	%cum
3B1a	Dairy cattle	3,64	38,0%	38,0%
3B3	Swine	1,32	13,8%	51,8%
1A4	Other Sectors	1,06	11,1%	62,8%
3B1b	Non-dairy cattle	1,05	11,0%	73,8%
3B2	Sheep	1,04	10,8%	84,6%

Table 7 Key source categories for emissions of CO

	NFR sector	Gg	%	%cum
1A4b	Residential	60,87	60,1%	60,1%
1A3bi	Road Transport, Passenger cars	15,55	15,4%	75,5%
1A3biv	Road Transport, Mopeds & Motorcycles	8,82	8,7%	84,2%

Table 8 Key source categories for emissions of TSP

	NFR sector	Gg	%	%cum
1A4b	Residential	12,13	29,1%	29,1%
2C2	Ferroalloys Production	9,94	23,9%	53,0%
1A1a	Public electricity and heat production	9,62	23,1%	76,1%
2D	NON ENERGY PRODUCTS FROM FUELS AND SOLVENT USE	4,73	11,4%	87,4%

Table 9 Key source categories for emissions of PM2.5

	NFR sector	Gg	%	%cum
1A4b	Residential	11,22	50,4%	50,4%
2C2	Ferroalloys Production	6,00	27,0%	77,4%
1A1a	Public electricity and heat production	2,63	11,8%	89,2%

Table 10 Key source categories for emissions of PM10

	NFR sector	Gg	%	%cum
1A4b	Residential	11,52	35,2%	35,2%
2C2	Ferroalloys Production	8,45	25,8%	60,9%
1A1a	Public electricity and heat production	6,50	19,8%	80,8%

Table 11 Key source categories for emissions of Pb

	NFR sector	Gg	%	%cum
2	INDUSTRIAL PROCESSES	2,29	50,6%	50,6%
1A2a	Iron and Steel	0,71	15,6%	66,2%
1A1a	Public electricity and heat production	0,67	14,8%	81,0%

Table 12 Key source categories for emissions of Cd

	NFR sector	Gg	%	%cum
1A1a	Public electricity and heat production	0,08	56,9%	56,9%
1A4b	Residential	0,02	15,4%	72,4%
2C	METAL PRODUCTION	0,01	7,0%	79,3%
1A2a	Iron and Steel	0,01	6,7%	86,0%

Table 13 Key source categories for emissions of Hg

	NFR sector	Gg	%	%cum
1A1a	Public electricity and heat production	0,13	48,4%	48,4%
2C	METAL PRODUCTION	0,05	18,7%	67,1%
1A2a	Iron and Steel	0,04	15,9%	83,0%

Table 14 Key source categories for emissions of As

	NFR sector	Gg	%	%cum
1A1a	Public electricity and heat production	0,64	72,3%	72,3%
2C	METAL PRODUCTION	0,20	22,6%	94,9%

Table 15 Key source categories for emissions of Cr

	NFR sector	Gg	%	%cum
2C	METAL PRODUCTION	2,24	61,2%	61,2%
1A1a	Public electricity and heat production	0,41	11,1%	72,2%
1A3biii	Road Transport, Heavy duty vehicles	0,36	9,8%	82,0%

Table 16 Key source categories for emissions of Cu

	NFR sector	Gg	%	%cum
1A2gvii	Mobile Combustion in Manufacturing Industries and Construction	1,08	69,5%	69,5%
1A4b	Residential	0,14	8,8%	78,3%
1A2a	Iron and Steel	0,09	6,0%	84,3%

Table 17 Key source categories for emissions of Ni

	NFR sector	Gg	%	%cum
1A1a	Public electricity and heat production	0,85	36,5%	36,5%
1A4a	Commercial/Institutional	0,59	25,3%	61,8%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,26	11,2%	73,0%
1A4b	Residential	0,20	8,6%	81,6%

Table 18 Key source categories for emissions of Se

	NFR sector	Gg	%	%cum
1A1a	Public electricity and heat production	1,99	98,3%	98,3%

Table 19 Key source categories for emissions of Zn

	NFR sector	Gg	%	%cum
2	INDUSTRIAL PROCESSES	1,99	30,6%	30,6%
1A4b	Residential	1,99	30,5%	61,1%
1A2a	Iron and Steel	1,12	17,2%	78,4%
1A1a	Public electricity and heat production	0,54	8,2%	86,6%

Table 20 Key source categories for emissions of DIOX

	NFR sector	Gg	%	%cum
1A4b	Residential	10,65	75,0%	75,0%
2C1	Iron and Steel Production	1,50	10,5%	85,6%

Table 21 Key source categories for emissions of PAH

	NFR sector	Gg	%	%cum
1A4b	Residential	10,69	89,4%	89,4%

Table 22 Key source categories for emissions of HCB

	NFR sector	Gg	%	%cum
2C3	Aluminium production	4,76	96,6%	96,6%

Table 23 Key source categories for emissions of PCB

	NFR sector	Gg	%	%cum
2	INDUSTRIAL PROCESSES	1,25	38,7%	38,7%
1A4b	Residential	0,92	28,6%	67,3%
1A2a	Iron and Steel	0,90	27,9%	95,2%

2.7. Quality assurance quality control

QA/QC activities are part of the annual inventory preparation process as described under this chapter. A management process has been set up, defining roles and responsibilities. The inventory team in Macedonia consists of five experts, partly having double roles. The project manager is also responsible for the QA/QC procedures, and compiles the emissions for two sectors (see Figure below).

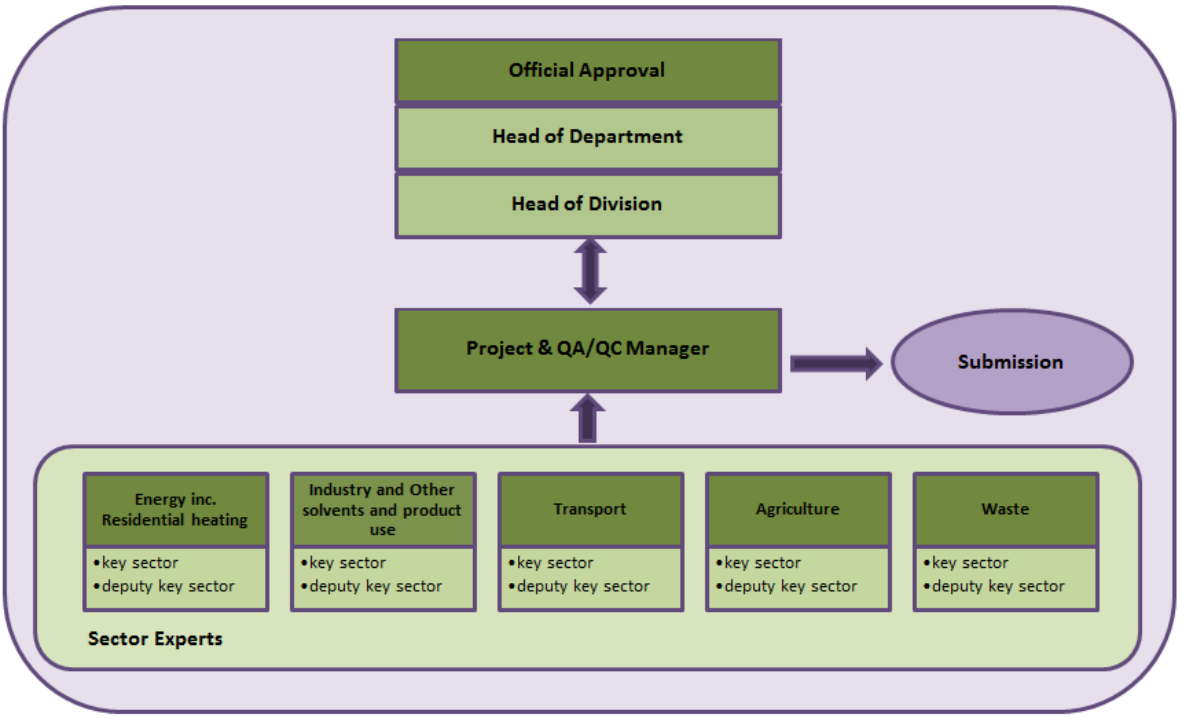

Figure 3 Roles in inventory preparation and submission

The sector experts are responsible for selection of methods, collection of input data, emissions calculation as well as QC at sectoral level. The project & QA/QC Manager is in charge of coordination of activities, timely preparation and completeness of IIR, as well as cross-cutting tasks such as basic QC of report, implementing KCA, implementation and maintaining of a QA/QC plan, review coordination within the team as well as for key category analysis and of Review communication.

QA/QC Plan and quality objectives

Currently a QA/QC plan is being developed, which lays down all procedural and technical issues to produce an inventory that complies with the reporting obligations. It will also include a list of data quality objectives, against which the Macedonian inventory can be measured, e.g. in a review or for internal purposes.

- Transparency
- Accuracy
- Completeness
- Consistency
- Comparability
- Timeliness

Progress in transparency and completeness as well as timeliness is analysed annually. The result of this years' analysis and a comparison with the previous submission is shown below. As shown completeness could be significantly improved since previous submission, whereas the transparency parameter for 2013 has slightly decreased, due to changes of notation keys (from e.g. NE to IE).

The timeliness parameter of the IIR 2016 was set to 95% as the IIR report was submitted after the official deadline according to the CLRTAP Reporting Guidelines (ECE/EP.AIR/125)[3]. It was nevertheless agreed with CEIP that the IIR report submission can be made exceptionally by April 15th this year due to ongoing Twining project in which emission inventory has been approved. Submission of emission data, i.e. NFR Tables, to CEIP was however done in time on 15th February.

For next years submission it is planned to submit both, NFR tables and IIR until set deadline by UNECE.

Table 24 Completeness Analysis 2016

Sector	Submission 2015		Submission 2016			Plan Submission 2017		
	1990	2013	1990	2013	2014	1990	2014	2015
Transparency (IE)	98%	100%	*98%*	*98%*	*98%*	*98%*	*98%*	*98%*
Completeness (NE)	80%	78%	*85%*	*85%*	*85%*	*88%*	*88%*	*88%*
Completeness (IIR)	76 pages		*~ 180 pages*			*~ 220 pages*		
Timeliness (Submission)	100%		95%*			*100%*		

Accuracy, consistency and comparability is checked in the course of the EMEP/EEA Reviews. Recommendations from last/latest stage 3 review (2011) have been almost fully implemented as presented in Table 177 of 9.2.

Although the QA/QC plan is still under preparation, the following QA/QC activities are carried out in order to ensure the quality of the inventory:

Table 25 Annual time schedule

Task	Description	Responsibility	Deadline
AD collection and QC input data	Requesting input data	*Sector expert*	*April 30*
	Quality control (QC) input data	*Sector expert*	*June 30*
Emissions calculation	Estimation of emissions for all sources	*Sector expert*	*October 30*
QC (general and category specific)	Quality Checks of sectoral inventories (category-specific QC): results, emission trends, recalculations	*Sector expert*	*November 30*
NFR compilation	Compilation of NFR/(aggregated) data tables	*Data Manager*	*December 31*
NFR submission	Submission of NFR tables	*QA/QC expert*	*February 15*
Time series reports & Recalculations & KCA & UA	Recalculation Analysis, Key Category Analysis, Uncertainty Analysis	*QA/QC expert*	*January 31*
IIR sectoral chapters	Compilation of the IIR – methodological issues	*Sector expert*	*February 15*
Preparation of "Informative Inventory Report"	Compilation of draft report	*QA/QC expert*	*February 28*
	Provide report for Peer-Review; revision of report pursuant to comments received or inclusion of recommendations in planned improvements	*QA/QC expert*	*March 1*
QC IIR	QC of IIR (requirements fulfilled, completeness, etc.)	*QA/QC expert*	*March 10*
Approval of submission	Official approval of the report	*Head of Unit*	*March 15*
UNECE Submission	Submission of the IIR	*NRC*	*March 15*
CLRTAP Review	Stage 1,2,(3) review of submission		*May-June*

2.7.1. Quality control procedures

QC activities are an important component in the annual inventory preparation process. The basic aim is to ensure quality of estimates and reporting and to improve the inventory. Sector related QC is performed by sector experts during (category-specific QC) and after (general QC) the inventory preparation. General checks relate to calculations, data processing, completeness and documentation/archiving (applicable to all source categories), category-specific checks relate to input data, emission data and emission factors.

Activities include:

- Plausibility check of data received from operators (category-specific)
- Analysis of time series data, if anything unclear, questions for clarification are sent to the data provider(category-specific)
- Assessment of reasons for recalculations (category-specific)
- Check of gap filled data / check interpolation and extrapolation methods (category-specific)
- Comparison of country specific emission factors with default values (category-specific)
- Documentation of actions taken in calculation sheets in order to ensure transparency
- Comparison of emissions calculated and imported to the NFR template (general)
- Check of consistency within NFR template (general)
- Correct use of notation keys
- Check if all data sources have a reference (general)
- Correct and complete description of methods

After finalisation of the report, but before official approval and submission the whole report is checked by the QA/QC manager or some other expert appointed for:

- Completeness of sectoral reporting (e.g. all sectors updated?)
- Completeness of general reporting (information on recalculations, KCA, UA included?)
- Complete citing of references
- Implementation of improvements
- Consistency data tables and text in the inventory report
- Correct and consistent information on key category analysis
- Explanation of significant trends in the time series

2.7.2. Quality assurance procedures

QA measures are taken in addition to QC after inventory finalisation and are done by experts not closely connected with the national inventory compilation ("independent third-party review"). A basic review of the draft IIR takes place before final submission (see Table 177). The aim is to get feedback on reporting and methodologies and define areas of improvements. Issues from these reviews are either considered immediately in the report or collected in the improvements list (see 9.2.2) In addition the report is annually sent for approval.

The basic review of the 2016 submission was done by Umweltbundesamt Austria inventory experts. In the course of this some improvements have been made and added to the planned improvements list. Please refer to chapter 9.2.

The air emission inventory reported under the LRTAP Convention is submitted to the Center of Emission Inventories and Projections (CEIP). Here, a technical review of national inventories is carried out, in order to improve transparency, consistency, comparability, completeness and accuracy of submitted data.

The review consists of three stages, whereby stage 1 and 2 are carried out annually, and the third stage – the in-depth review – on an irregular basis. The last stage 3 review of the Macedonian Inventory was carried out in 2011. The findings have been addressed in the current inventory to the extent possible.

The next stage 3 review will take place in 2016.

2.7.3. Archiving and documentation

The inventory team uses one server, where all the inventory related information is stored. As far as possible important information used as direct input data for calculation is stored electronically (scans of hardcopies).

Each sector, has a common folder system, where calculation files, raw data, references, background material and inventory report contributions are stored. Whenever a reporting cycle has been finished, the folders are closed. This is to ensure the reproducibility and transparency of the calculation for a specific reporting year. Furthermore, after each reporting cycle, all data files, spreadsheets and electronic documents are archived as 'read-only-files' so that they are protected against unintentional change and estimates can be clearly traced back, e.g. during the review process. Back-up copies (DVD) of the server are made at regular intervals. Access to files is limited to the inventory team.

In the next year, the "old" files will be copied, and used as the basis for the new inventory preparation. This shall ensure consistency in the methods and data used.

Assumptions and methodological issues related to the calculation (e.g. extrapolation or gap filling) are documented in the respective calculation files. All calculation files, have a sheet called "info" at the beginning defining the person responsibility for this calculations, noting the last update, noting problems encountered, improvements needed, data sources and the status. This is important in

order to document the work, and keep an overview, which is especially essential when one person is responsible for numerous sectors and categories.

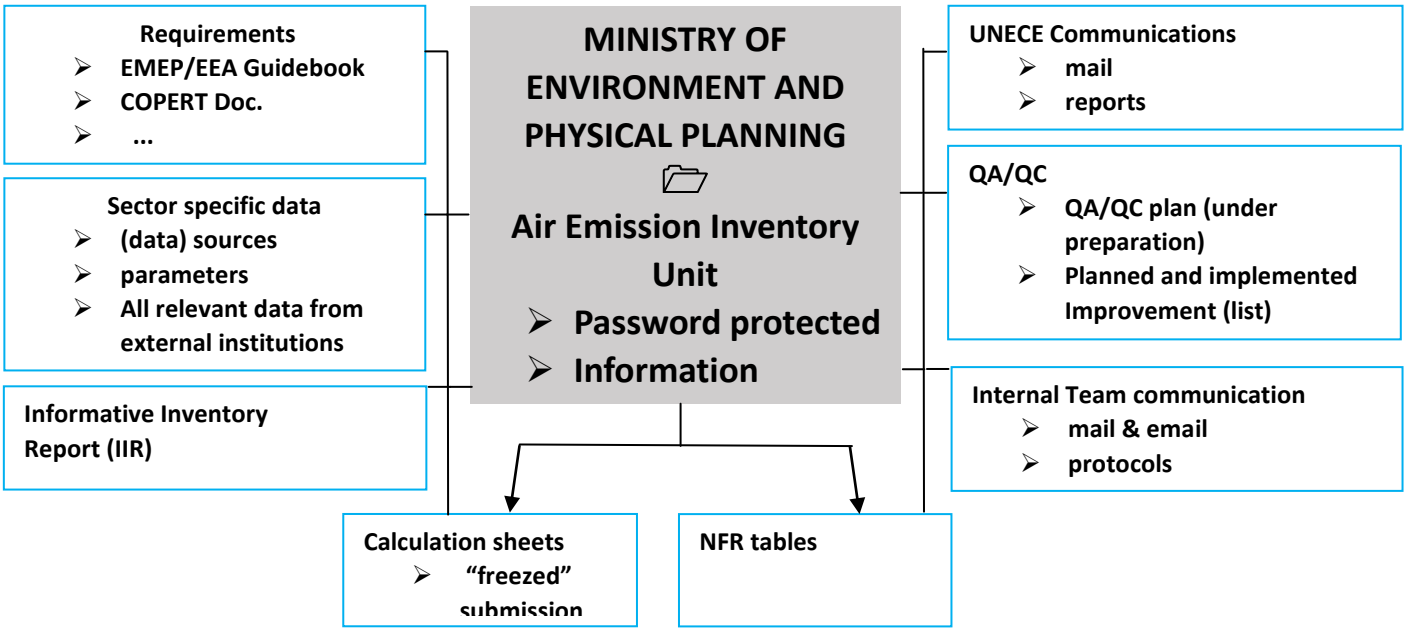

Figure 4: Archiving system

2.7.4. Continuous improvement

The Macedonian inventory is subject to continuous improvement.

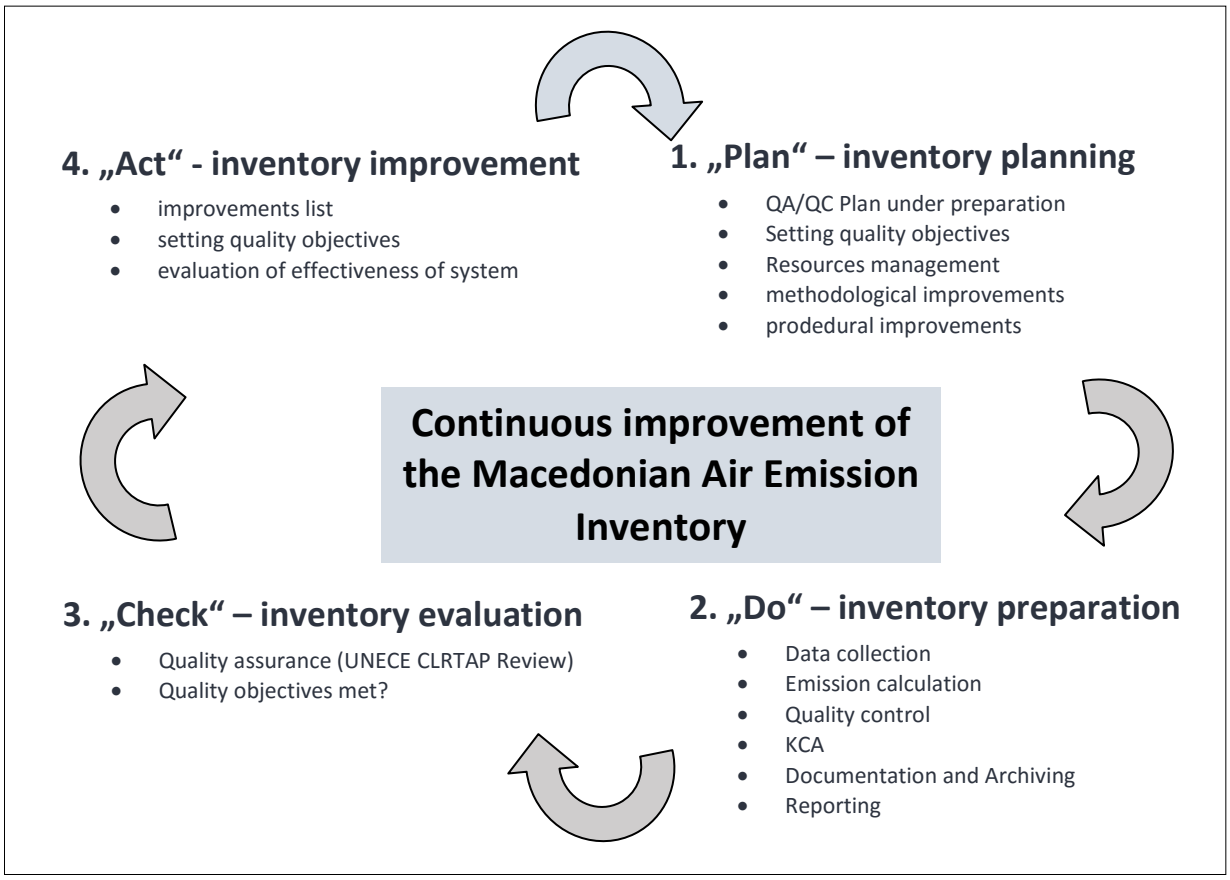

Figure 5: Improvement Cycle

For documentation and monitoring purposes, an improvement list was introduced (updated after each reporting cycle), where suggestions for improvements are collected and their implementation is monitored.

The improvement list is filled by the sector experts based on their notes in the calculation sheets. General (cross-cutting) issues are identified and collected by the project and QA/QC manager in an own list. Also findings from technical review of submitted LRTAP data are added to this lists.

Sources of improvements are CLRTAP review findings but also improvement ideas from the inventory experts or suggestions from outside experts (in the frame of QA). Besides the source, the list includes concrete improvement measures, prioritisation, timeline for implementation of the measures as well as documentation field for the status of implementation (“finished”).

During an internal inventory team meeting the improvements needed are discussed and prioritised.

2.8. General uncertainty evaluation

So far, no uncertainty assessment for any of the pollutants of the Macedonian emission inventory has been made. It is planned to include an uncertainty assessment in future submissions.

2.9. General assessment of completeness

Notation keys are used according to the revised 2014 Reporting guidelines (ECE/EB.AIR.125)[4] (see table below) to indicate where emissions are not occurring in Macedonia, where emissions have not been estimated or have been included elsewhere as suggested by GB 2009/2013 [5,6].

Table 26 Notation keys used in the NFR

Abbreviation	Meaning	Objective
NA	not applicable	is used for activities in a given source category which are believed not to result in significant emissions of a specific compound;
NE	not estimated	for activity data and/or emissions by sources of pollutants which have not been estimated but for which a corresponding activity may occur within a Party. Where NE is used in an inventory to report emissions of pollutants, the Party should indicate in the IIR why such emissions have not been estimated. Furthermore, a Party may consider that a disproportionate amount of effort would be required to collect data for a pollutant from a specific category that would be insignificant in terms of the overall level and trend in national emissions and in such cases use the notation key NE. The Party should in the IIR provide justifications for their use of NE notation keys, e.g., lack of robust data, lack of methodology, etc. Once emissions from a specific category have been reported in a previous submission, emissions from this specific category should be reported in subsequent inventory submissions;
IE	included elsewhere	for emissions by sources of pollutants estimated but included elsewhere in the inventory instead of under the expected source category. Where IE is used in an inventory, the Party should indicate, in the IIR, where in the inventory the emissions for the displaced source category have been included, and the Party should explain such a deviation from the inclusion under the expected category, especially if it is due to confidentiality;
C	confidential	(confidential information), for emissions by sources of pollutants of which the reporting could lead to the disclosure of confidential information. The source category where these emissions are included should be indicated;
NO	not occurring	for categories or processes within a particular source category that do not occur within a Party;
NR	not relevant	according to paragraph 37 in the Guidelines, emission inventory reporting for the main pollutants should cover all years from 1990 onwards if data are available. However, NR is introduced to ease the reporting where reporting of emissions is not strictly required by the different protocols, e.g., emissions for some Parties prior to agreed base years.

2.9.1. Sources not estimated (NE)

Table 27 Number of "not estimated" (NE) per sector and pollutant in 2014

Gas	Energy	Fugitives	IPPU	Agriculture	Waste	Other
NOx (as NO_2)	7	0	6	3	1	1
NMVOC	7	0	6	3	3	1
SOx (as SO_2)	8	0	6	0	1	1
NH_3	12	1	6	3	5	1
PM2.5	7	0	8	4	1	1
PM10	7	0	8	4	1	1
TSP	7	0	8	4	1	1
CO	7	0	6	2	1	1
Pb	7	0	7	0	0	1
Cd	7	0	7	0	0	1
Hg	7	1	7	0	0	1
As	8	1	7	0	0	1

Gas	Energy	Fugitives	IPPU	Agriculture	Waste	Other
Cr	7	0	6	0	1	1
Cu	7	0	6	0	1	1
Ni	7	0	6	0	0	1
Se	7	0	6	0	2	1
Zn	7	0	6	0	2	1
PCDD/ PCDF	11	2	7	0	0	1
PAHs	11	0	7	0	2	1
HCB	12	0	6	0	0	1
PCBs	7	0	8	0	1	1
Reasons for NE	**lack of activity data**					
Plans how to report in future	Please refer to Table 178					

The main reasons of the use of NE is lack of activity data, mainly for the historical years due to the fact that the methodology has changed in the statistical yearbooks.

2.9.2. Sources included elsewhere (IE)

Table 28 Number of "included elsewhere" (IE) per sector and pollutant in 2014

Gas	Energy	Fugitives	IPPU	Agriculture	Waste	Other
NOx (as NO_2)	0	0	1	3	0	0
NMVOC	0	0	1	3	0	0
SOx (as SO_2)	0	0	1	3	0	0
NH_3	0	0	1	3	0	0
PM2.5	0	0	1	3	0	0
PM10	0	0	1	3	0	0
TSP	0	0	1	3	0	0
CO	0	0	1	1	0	0
Pb	0	0	1	1	0	0
Cd	0	0	1	1	0	0
Hg	0	0	1	1	0	0
As	0	0	1	1	0	0
Cr	0	0	1	1	0	0
Cu	0	0	1	1	0	0
Ni	0	0	1	1	0	0
Se	0	0	1	1	0	0
Zn	0	0	1	1	0	0
PCDD/ PCDF	0	0	1	1	0	0
PAHs	0	0	1	1	0	0
HCB	0	0	1	1	0	0
PCBs	0	0	1	1	0	0
Reasons for IE	**lack of activity data**					
Plans how to report in future	Please refer to Table 178					

The notation keys included elsewhere is used in those source categories for which activity data are not available in the statistical yearbooks but have been included in other source categories.

For both categories, MEPP will contact responsible institutions for data collection and ask them to gather needed data or define separate category for data included in other sector.

3. EMISSION TRENDS

This chapter describes the trends and the drivers of the air pollutants required for the report.

3.1. Emission Trends for the Main Air Pollutants and CO

National total emissions and trends for the main air pollutants (NOx, NMVOC, SO_2 and NH_3) and CO, which are covered by the Gothenburg Protocol, from 1990-2014 are presented in the following table.

Table 29 Emission trends 1990 – 2014 for the main air pollutants and CO

Year	Emission in kt				
	NO_x	NMVOC	SO_2	NH_3	CO
1990	43,899	47,820	109,755	14,979	131,105
1991	36,060	41,860	88,934	14,042	110,200
1992	37,796	44,054	86,594	14,172	122,172
1993	39,013	46,017	88,370	14,553	131,909
1994	35,156	40,899	88,975	14,567	119,554
1995	37,819	43,384	95,081	14,447	123,990
1996	35,794	42,968	89,023	13,443	121,763
1997	36,647	44,001	92,981	13,076	125,038
1998	41,167	43,751	107,802	12,220	128,022
1999	38,983	44,739	98,333	12,833	131,133
2000	42,437	46,876	106,512	13,230	143,660
2001	39,448	38,595	108,490	12,269	110,588
2002	38,320	37,559	97,759	11,954	112,239
2003	34,165	37,067	95,544	11,702	113,786
2004	35,887	37,005	96,621	11,027	118,812
2005	36,718	35,460	97,331	10,986	112,166
2006	36,452	36,459	94,506	10,059	115,794
2007	39,374	37,034	99,683	10,746	110,863
2008	34,947	40,343	78,411	10,885	121,474
2009	38,225	40,850	104,998	10,090	130,979
2010	40,004	33,335	86,946	10,238	111,589
2011	42,227	35,777	106,540	10,544	118,097
2012	37,491	34,923	92,261	9,705	109,334
2013	31,933	35,552	83,650	9,770	112,057
2014	31,559	29,969	83,142	9,576	101,264
Trend 1990-2014	**-28%**	**-37%**	**-24%**	**-36%**	**-23%**

3.1.1. NOx emissions

In 1990 national total NOx emissions amounted to 44 kt. Since then emissions decreased by 28% and in 2014 emissions were on the level of about 32 kt. Reasons for the decrease are due to significantly declining emissions from Energy Industries (Public electricity and heat production) and Manufacturing Industries (mainly mobile combustion). The jump of emissions between 2006 and 2007 is due to the higher consumption of heavy fuel oil in 1A1a sector and the sharp fall of emissions between 2011 and 2012 is due to the lower consumption of coal in the major power plant. In the period 2012 – 2013 the decrease of emissions is due to shorter operation of the second power plant

from 12 to 5 mounts and decrease of coal consumption up to 60%. Lower NOx emissions in 2013 compare to 2012 are also a result of the modernization of the boilers in the major power plant REK Bitola. From 2013 to 2014 emissions remained quite stable (- 1%).

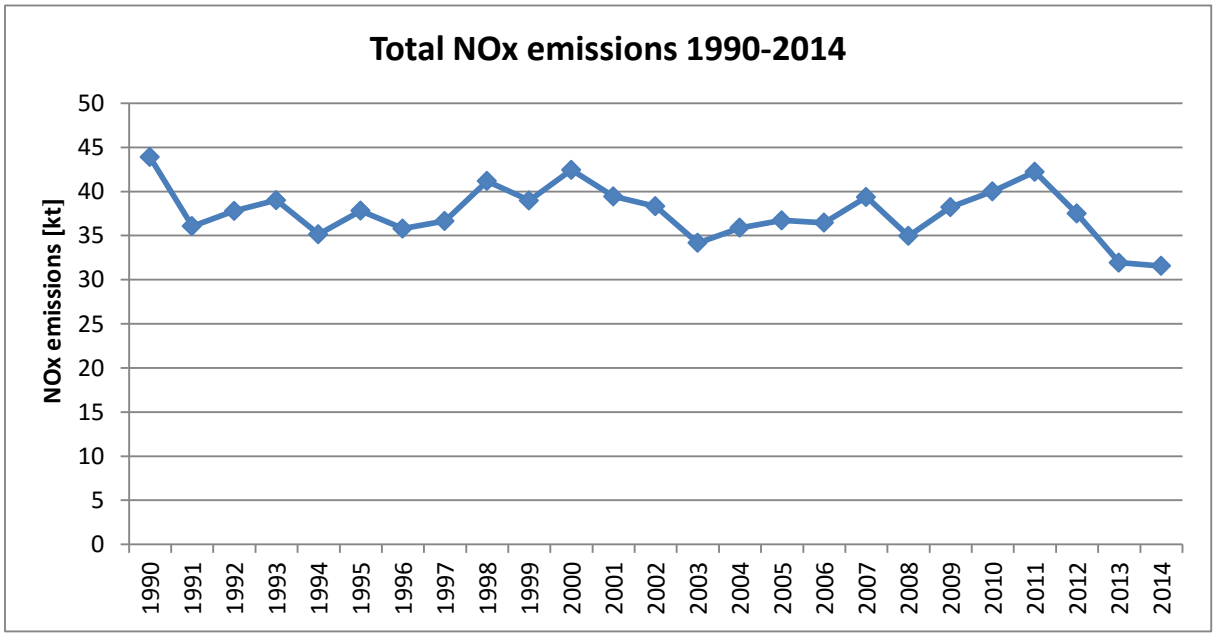

Figure 6 National total NOx emissions 1990-2014

Target value for NOx according to Gothenburg Protocol for the year 2010 is 39 kt NOx. Republic of Macedonia met that target value in 2014, emissions were 19 % below the national ceiling value. The country is in compliance with the Protocol on the control of nitrogen oxides or their transboundary fluxes since 2014 NOx emissions are below emissions reported for 1987.

Main emission sources in Macedonia

Almost all NOx emissions are stemming from the sector Energy, but the major sources of total emissions changed compared to 1990 due to growing importance of NFR sector 1A3 Transport. So, the main emission sources in 2014 are NFR source categorys 1A3 Transport and 1A1 Energy Industries, which contributed to 40% (22% in 1990) and 41% (55% in 1990) respectively, of the national total NOx emissions. From NFR source category 1A2 Manufacturing Industries also 14% (19% in 1990) of total NOx emissions are stemming.

NFR sectors 1B Fugitive emissions, 2 Industrial Processes and Product Use, 3 Agriculture and 5 Waste are minor sources of NOx emissions.

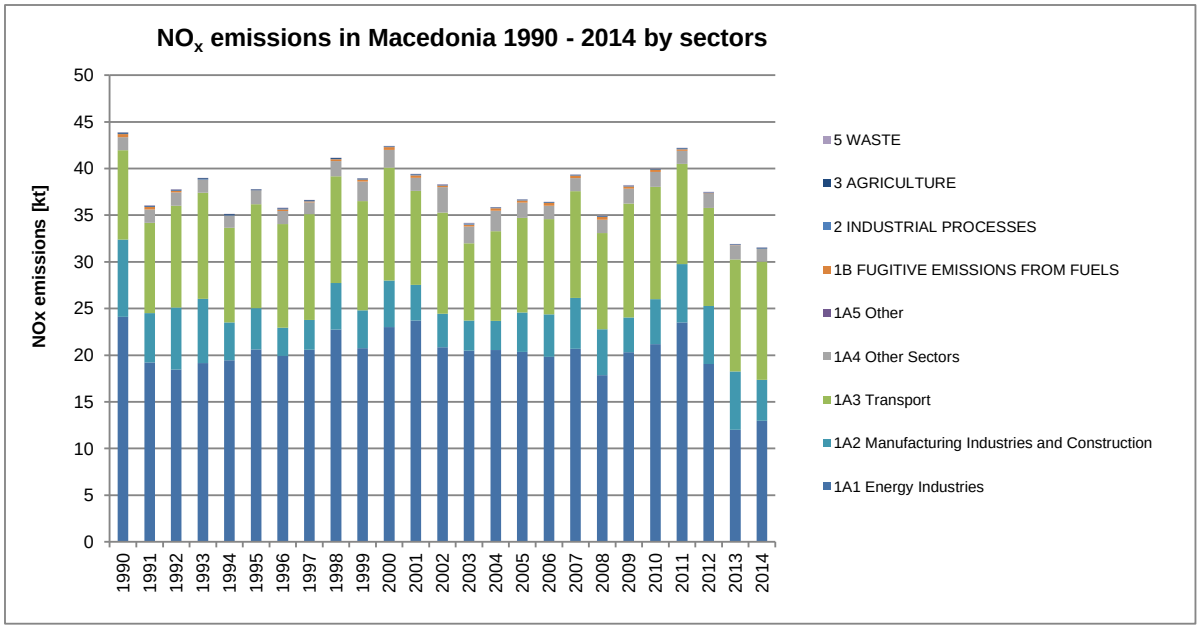

Figure 7 NOx emissions in Macedonia 1990-2014 by sectors

3.1.2. NMVOC emissions

In 1990 national total NMVOC emissions amounted to about 44 kt. Emissions were down by 37% compared to 2014 and amounted to around 30 kt. Reasons for the decrease are mainly due to declining emissions from Transport and Solvent Use. From 2013 to 2014 emissions decreased by 16% also due to a reduced use of solvents as well as slightly lower emissions from the residential sector.

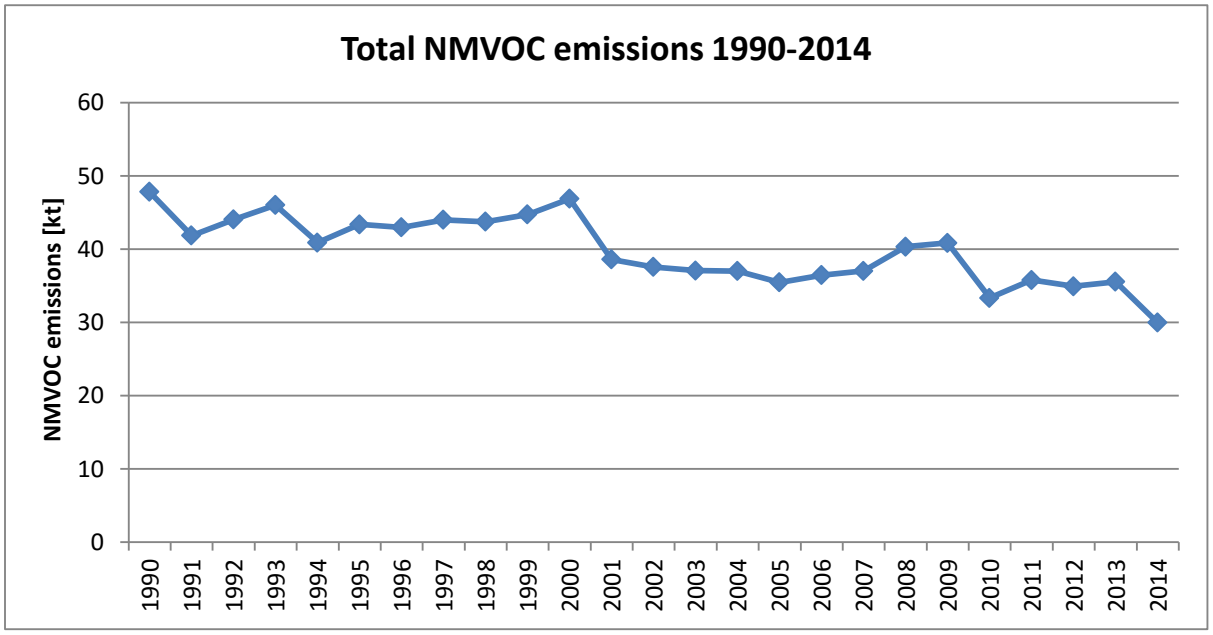

Figure 8 National total NMVOC emissions 1990-2014

Target value for NMVOC according to Gothenburg Protocol for year 2010 is 30 kt NMVOC. Republic of Macedonia met that target value in 2014. The country is in compliance with the Protocol on the control of volatile organic compounds or their transboundary fluxes since 1988. NMVOC emissions (44 kt) in 1988 are below emissions reported for 2014.

Main emission sources in Macedonia

The main emission sources in 2014 are NFR source categories 1A4 Other Sectors (mainly residential heating) and 2 Industrial Processes and Product Use (mainly Solvent Use), which contributed with 31% (23% in 1990) and 21% (22% in 1990) respectively, to the national total NMVOC emissions. From NFR source category 1A3 Transport also 19% (31% in 1990) of total NMVOC emissions are stemming. Agricultural NMVOC emissions, mainly resulting from agricultural soils, also contribute with 14% (11% in 1990) to national total emissions.

NFR sectors 1B Fugitive emissions and 5 Waste are minor sources of NMVOC emissions.

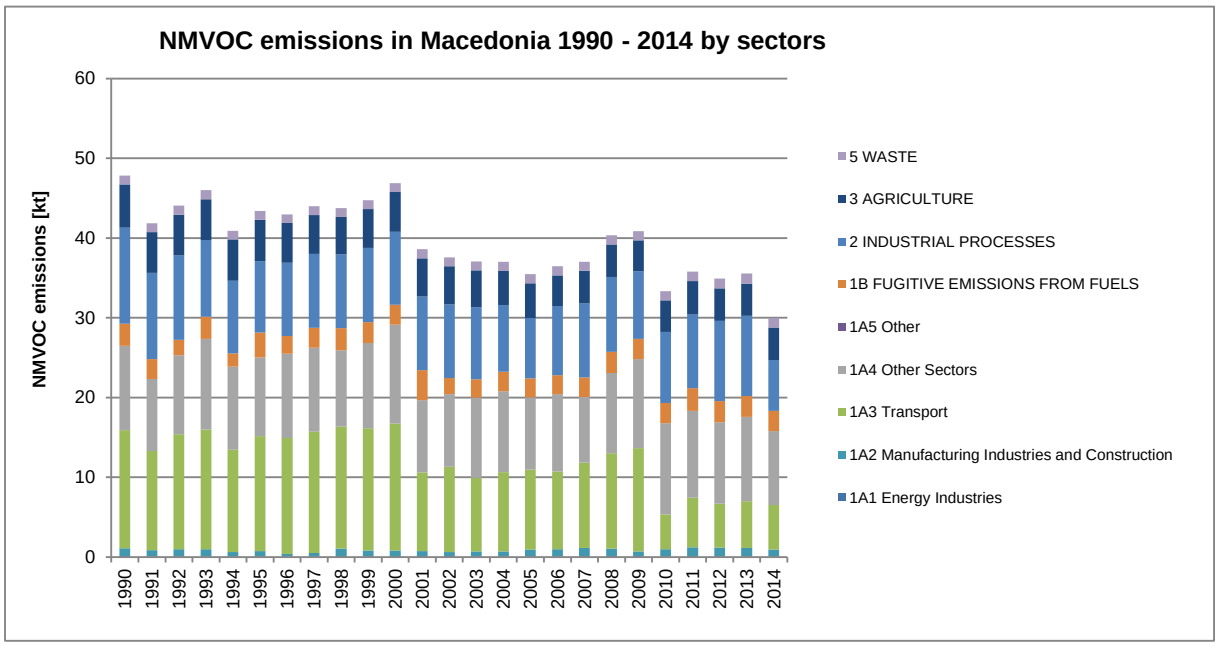

Figure 9 NMVOC emissions in Macedonia 1990-2014 by sectors

3.1.3. SO_2 emissions

In 1990 national total SO_2 emissions amounted to 110 kt. In 2014 emissions were down by 24% compared to 2014 and amounted to 83 kt. Reasons for the decline are mainly decreasing emissions from Public electricity and heat production. The emission peaks for the years 2009 and 2011 are due to higher consumption of coal by the major power plant REK Bitola compared to 2010 when the consumption was lower. In the period 2012 – 2013 decrease of emissions is due to lower capacity of work of the second by capacitry power plant REK Oslomej from 12 to 5 mounts and decrease of coal consumption up to 60%. Lower SO_2 emissions in 2013 compare to 2012 are also result to modernization of the boilers in the major power plant REK Bitola. From 2013 to 2014 emissions remained quite stable (- 1%).From 2013 to 2014 emissions nearly remained at the same level (-1%) due to the fact that no major changes were carried out.

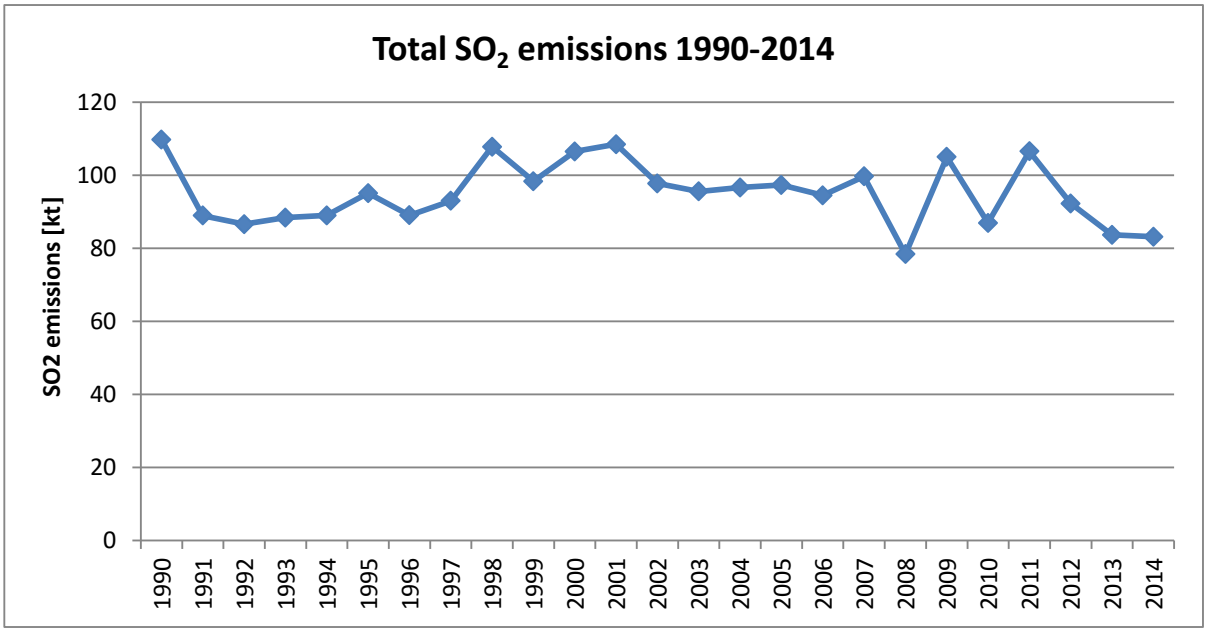

Figure 10 National total SO_2 emissions 1990-2014

As a party to the three protocols concerning sulphur, the emission of sulphur dioxide are below 1990 base year emissions and respective ceiling in 2010 which reflects with compliance with both protocols the 1994 Protocol on further reduction on sulphur and Gothenburg protocol respectively. Emissions in 2014 (83 Gg SOx) were around 25% below national ceiling value (110 Gg SOx) in the Republic of Macedonia

The country is in non-compliance with the Protocol on reduction of sulphur emissions or their transboundary transmission by at least 30 percent, due to the fact that emission since 1980 have not reduced for 30% up to now. Due to the fact that the major source of this pollutant is power plant production, the compliance with the oldest protocol on sulphur is expected to be achieved with installation of desulfurization unit in the Power plant REK Bitola. According to the agreement with Energy community the compliance with SOx emission limites which will also mean compliance with the protocol should be reached ate the end of 2017.

Main emission sources in Macedonia

Almost all SO_2 emissions are resulting from sector Energy. So, the main emission source in 2014 is NFR source category 1A1 Energy Industries (Public electricity and heat production) which contributed with 92% (94% in 1990) to national total SO_2 emissions. About 7% (4% in 1990) of total emissions are stemming from NFR source category 1A2 Manufacturing Industries.

NFR sectors 1B Fugitive emissions and 5 Waste are minor sources of SO_2 emissions.

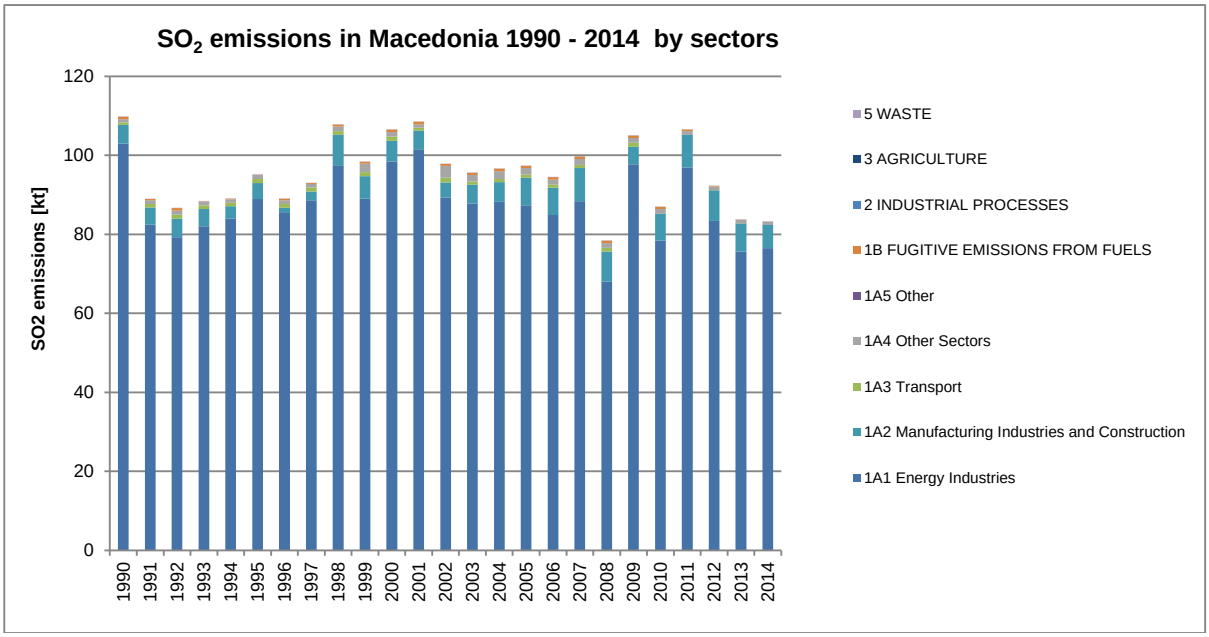

Figure 11 SO_2 emissions in Macedonia 1990 – 2014 by sectors

3.1.4. NH_3 emissions

In 1990 national total NH_3 emissions amounted to 15 kt. Emissions were down by 36% compared to 2014 and amounted to 10 kt. Reasons for the decline are mainly decreasing emissions from Agriculture (Manure Management) related to decreasing livestock numbers. From 2013 to 2014 emissions slightly decreased by 2%.

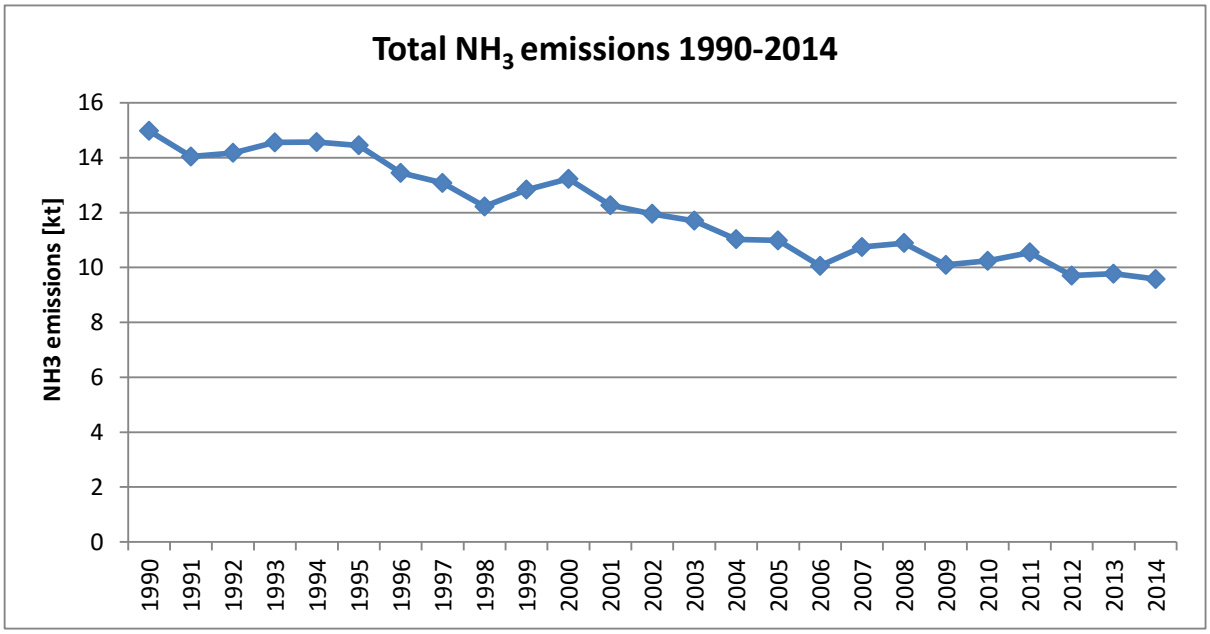

Figure 12 National total NH_3 emissions 1990-2014

Emissions of NH_3 are well below the respective ceiling. Emissions in 2014 were 20% below national ceiling value (12 Gg NH_3).

Main emission sources in Macedonia

NH_3 emissions are mainly resulting from the Agriculture sector contributing with 89% (93% in 1990) to national total NH_3 emissions. Within Agriculture sector NH_3 is almost exclusively emitted by source category 3.B Manure Management (99% in 2014) and emissions from cattle have the highest contribution (55%).

About 11% (7% in 1990) of the total emissions are stemming from NFR source category 1A4 Other Sectors (residential heating).

NFR sectors 1B Fugitive emissions and 2 Industrial Processes and Product Use are minor sources of NH_3 emissions.

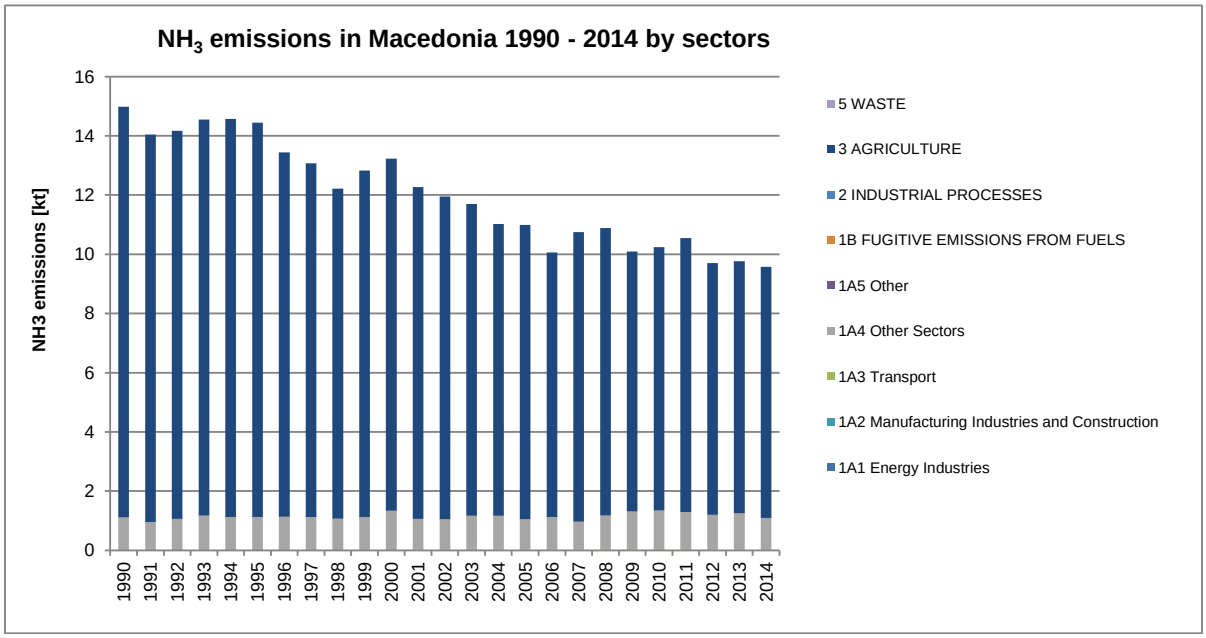

Figure 13 NH_3 emissions in Macedonia 1990-2014 by sectors

3.1.5. CO emissions

In 1990 the national total CO emissions amounted to 131 kt. The decrease in 2001 compared to 2000 is attributed to lower fuel consumption in 1A4 sector. Emissions decreased by 23% compared to 2014 and amounted to 112 kt. The reason for the decrease is mainly due to declining emissions from the Transport sector (road transport). From 2013 to 2014 emissions decreased by 10% mainly due to warmer winter which results in lower wood consumption.

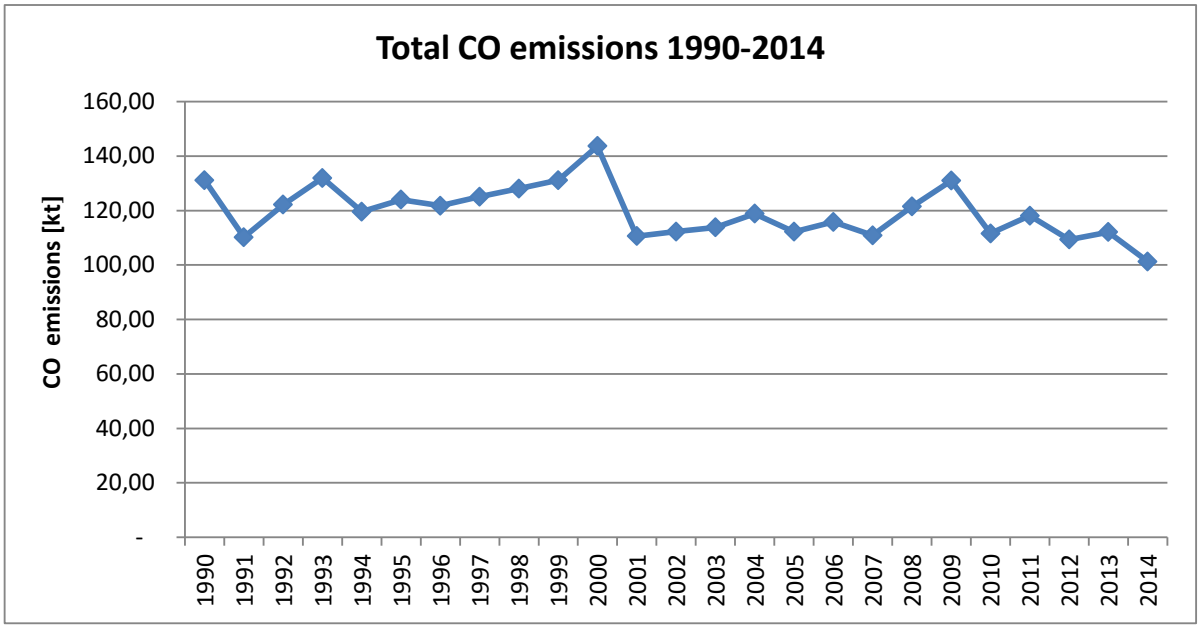

Figure 14 National total CO emissions 1990-2014

Main emission sources in Macedonia

Almost all CO emissions are resulting from the Energy sector. So the main emission sources in 2014 are NFR sectors 1A4 Other Sectors (residential heating) and 1A3 Transport, contributing with 61% (52% in 1990) and 27% (40% in 1990) to the national total CO emissions. Further emission sources in 2014 are 1A2 Manufacturing Industries and 1A1 Energy Industries with shares of 6% and 3%, respectively.

NFR sectors 1B Fugitive emissions, 2 Industrial Processes and Product Use and 5 Waste are minor sources of CO emissions.

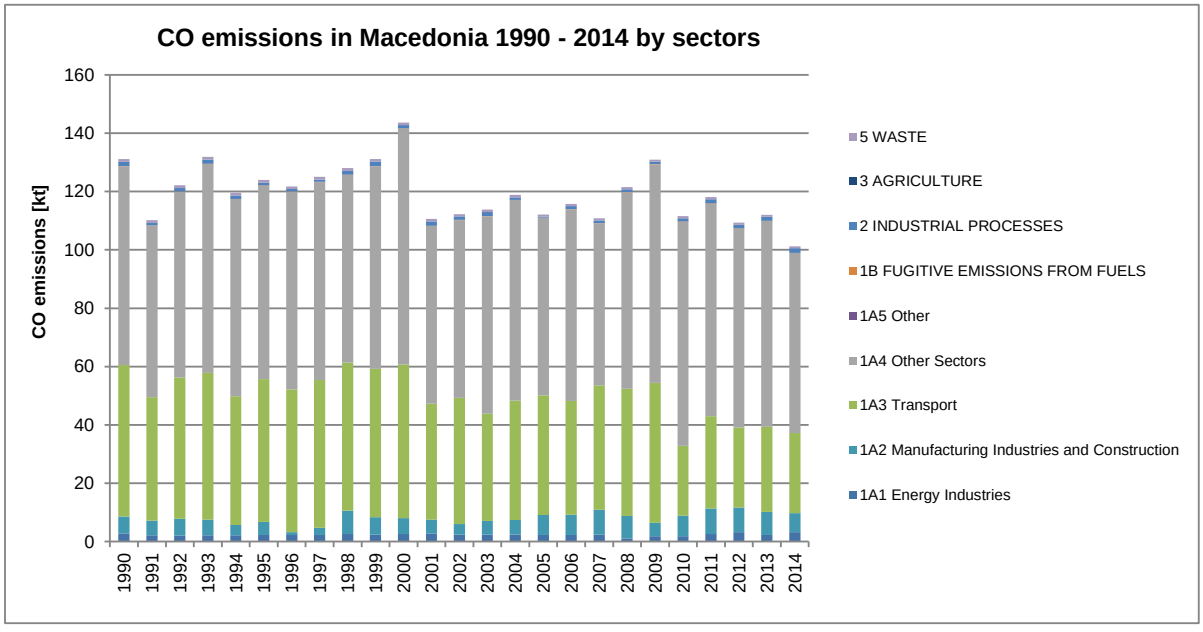

Figure 15 CO emissions in Macedonia 1990-2014 by sectors

3.2. Emission Trends for Particulate Matter

Particulate Matter emissions in Macedonia mainly derive from energy industries, residential heating and industrial processes. Emission trends and the main sources are described in more detail for PM10, PM2.5 and TSP in the following sections.

Table 30 Emission trends for particulate matter 1990-2014

Year	Emissions		
	PM10 [kt]	PM2.5 [kt]	TSP [kt]
1990	48,186	32,490	57,124
1991	42,202	28,452	49,764
1992	50,544	34,763	58,857
1993	44,784	31,113	52,346
1994	42,401	29,099	49,822
1995	43,018	29,378	50,744
1996	47,051	32,207	55,428
1997	45,619	31,290	53,395
1998	52,161	35,659	61,611
1999	45,083	31,007	53,385
2000	43,629	29,897	53,707
2001	27,746	18,131	33,825
2002	28,126	18,698	33,848
2003	41,971	28,966	49,810
2004	45,667	31,487	54,458
2005	41,610	28,167	50,425
2006	39,596	27,158	47,360
2007	31,869	21,379	38,525
2008	34,642	24,278	41,797
2009	29,681	20,239	37,544
2010	33,463	23,817	40,654
2011	42,058	28,975	53,059
2012	39,465	26,959	49,614
2013	43,154	29,817	54,398
2014	32,777	22,259	41,671
Trend 1990–2014	***-32%***	***-31%***	***-27%***

3.2.1. PM10 emissions

In 1990 national the total PM10 emissions amounted to 48 kt. Emissions decreased by 32% compared to 2014 and were at the level of 33 kt. The main reason for the decrease is due to declining emissions from Industrial Processes (Ferroalloys Production). For the years 2001, 2002 and 2009 emissions are very low compared to the other years. The reason is also due to low emissions coming from Ferroalloys Production due to the fact that in those years the company for ferrosilicon production was operating with limited operating hours and the produced quantity of ferrosilicon decreased up to 80-90 % in those years compared to 2014.

From 2013 to 2014 emissions decreased again by 24% due to a drop of emission from Ferroalloys Production and decreasing emissions from residential heating.

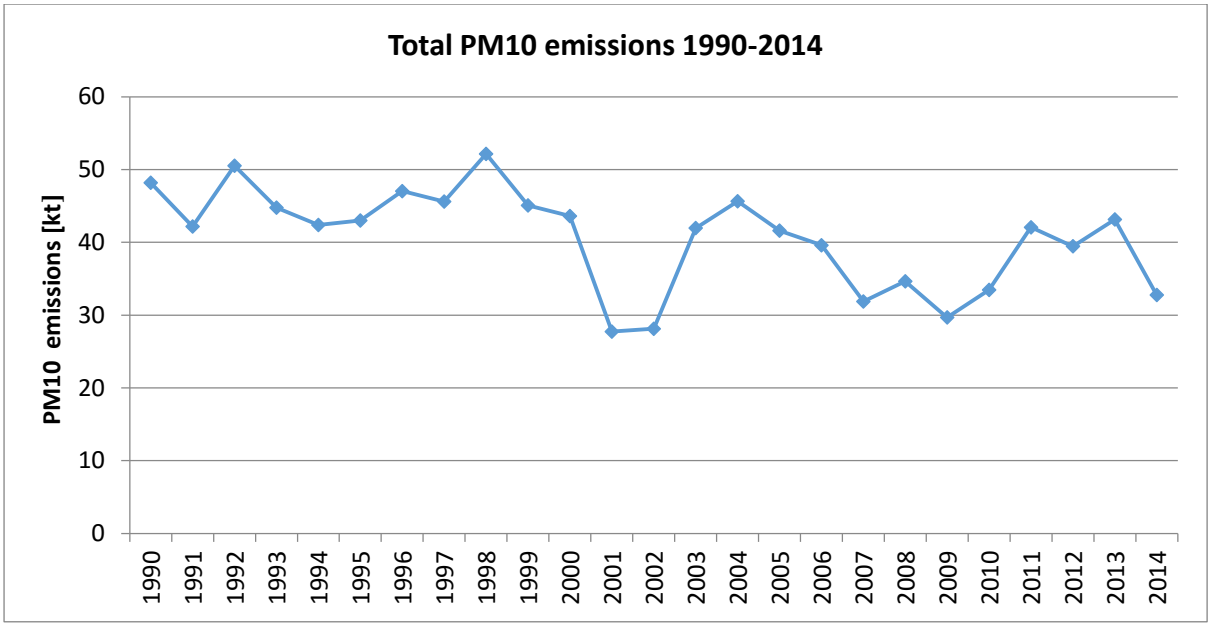

Figure 16 National total PM10 emissions 1990-2014

Main emission sources in Macedonia

The main emission sources for PM10 in 2014 are NFR sectors 1A4 Other Sectors (residential heating) with a share of 36% (25% in 1990) in total PM10 emissions, 2 Industrial Processes and Product Use (mainly 2C2 Ferroalloys Production) with 33% (47% in 1990) and 1A1 Energy Industries with 20% (18% in 1990). With a share of 7% in 2014 (6% in 1990) the sector Agriculture is also contributing to the total PM10 emissions.

NFR sectors 1B Fugitive emissions and 5 Waste are minor sources of PM10 emissions.

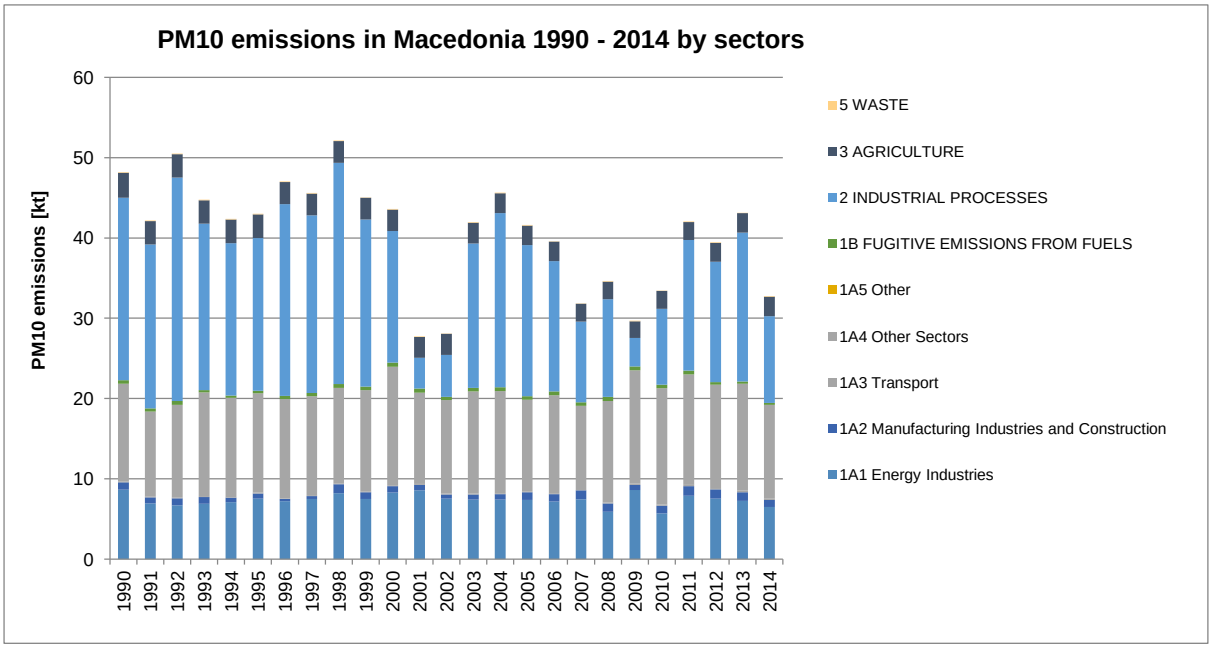

Figure 17 PM10 emissions in Macedonia 1990-2014 by sectors

3.2.2. PM2.5 emissions

In 1990 national total PM2.5 emissions amounted to 32 kt. Emissions decreased by 32% compared to 2014 and amounted to 22 kt. The main reason for the decrease is a decline of emissions from Industrial Processes (Ferroalloys Production). For the years 2001, 2002 and 2009 emissions are very low compared to the other years. The reason is also due to low emissions from Ferroalloys Production due to the fact that in those years the company for production of ferrosilicon was operating with limited operating hours and the produced quantity of ferrosilicon decreased up to 80-90 % in those years compared to 2014.

From 2013 to 2014 emissions decreased again by 25% due to a drop of emission from Ferroalloys Production and decreasing emissions from residential heating.

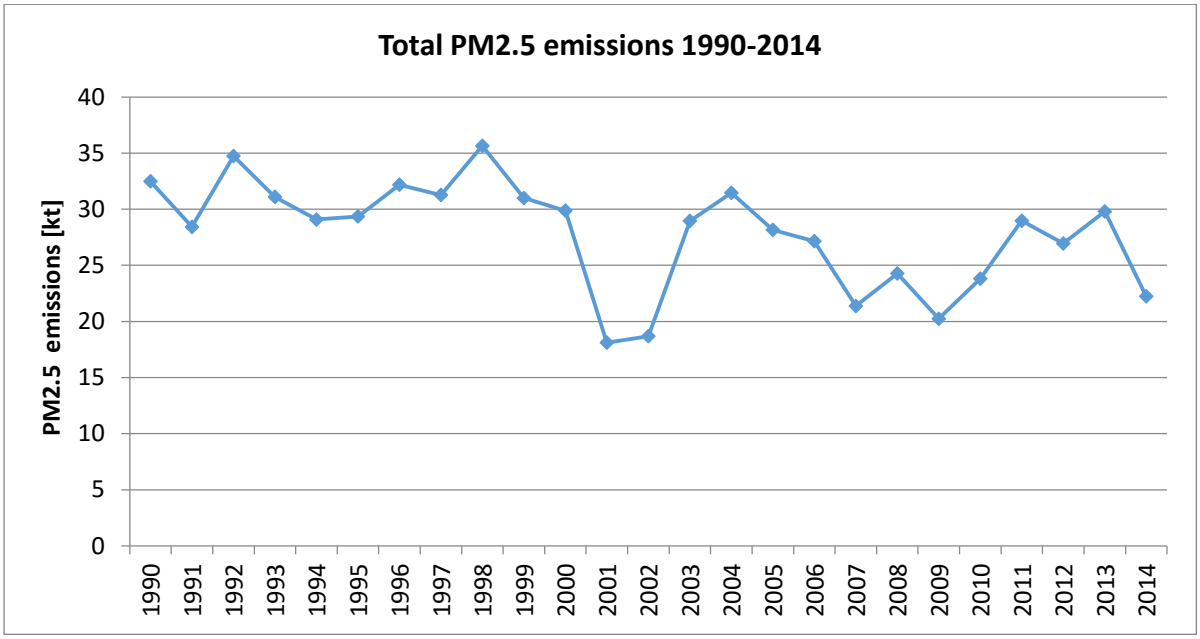

Figure 18 National total PM2.5 emissions 1990-2014

Main emission sources in Macedonia

The main emission sources for PM2.5 in 2014 are NFR sectors 1A4 Other Sectors (residential heating) with a share of 51% (36% in 1990) in total PM10 emissions, 2 Industrial Processes and Product Use (mainly 2C2 Ferroalloys Production) with 32% (48% in 1990) and 1A1 Energy Industries with 12% (11% in 1990).

NFR sectors 1B Fugitive emissions, 3 Agriculture and 5 Waste are minor sources of PM2.5 emissions.

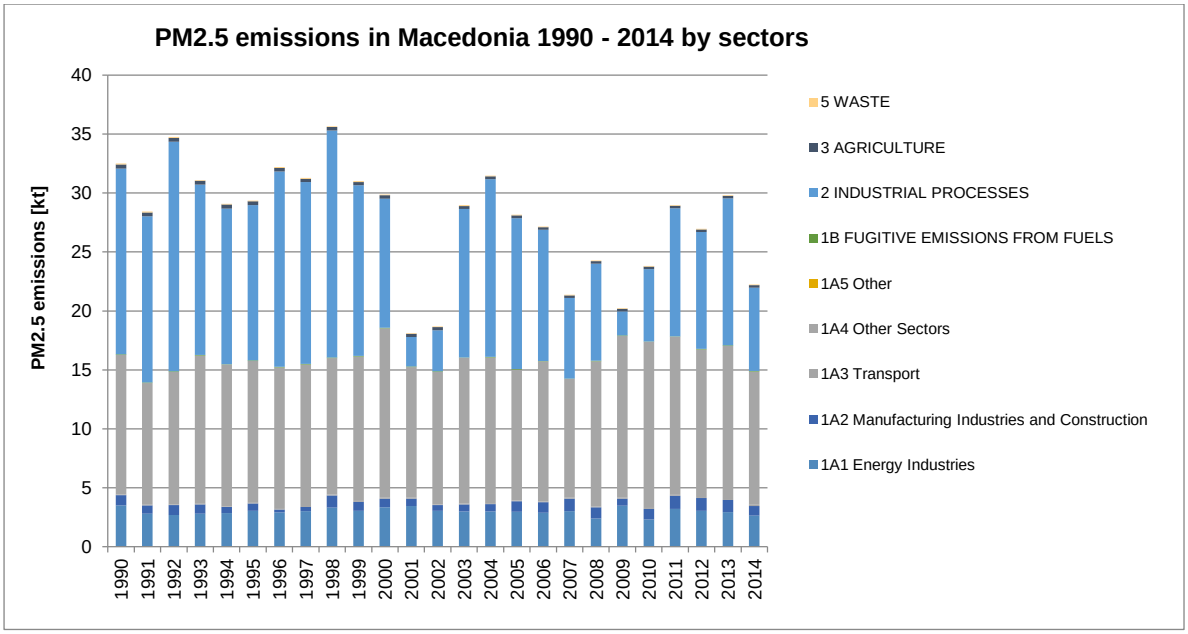

Figure 19 PM2.5 emissions in Macedonia 1990-2014 by sectors

3.2.3. TSP emissions

In 1990 national total TSP emissions amounted to about 57 kt. Emissions decreased by 28% compared to 2014 and amounted to about 41,6 kt. The main reason for the decrease is due to a decline of emissions from Industrial Processes (Ferroalloys Production). For the years 2001, 2002 and 2009 emissions are very low compared to the other years. The reason is also due to low emissions from Ferroalloys Production due to the fact that in those years the company for production of ferrosilicon was operating with limited operating hours and the produced quantity of ferrosilicon decreased up to 80-90 % in those years compared to 2014.

From 2013 to 2014 emissions decreased again by 23% due to a drop of emission from Ferroalloys Production also decreasing emissions from residential heating.

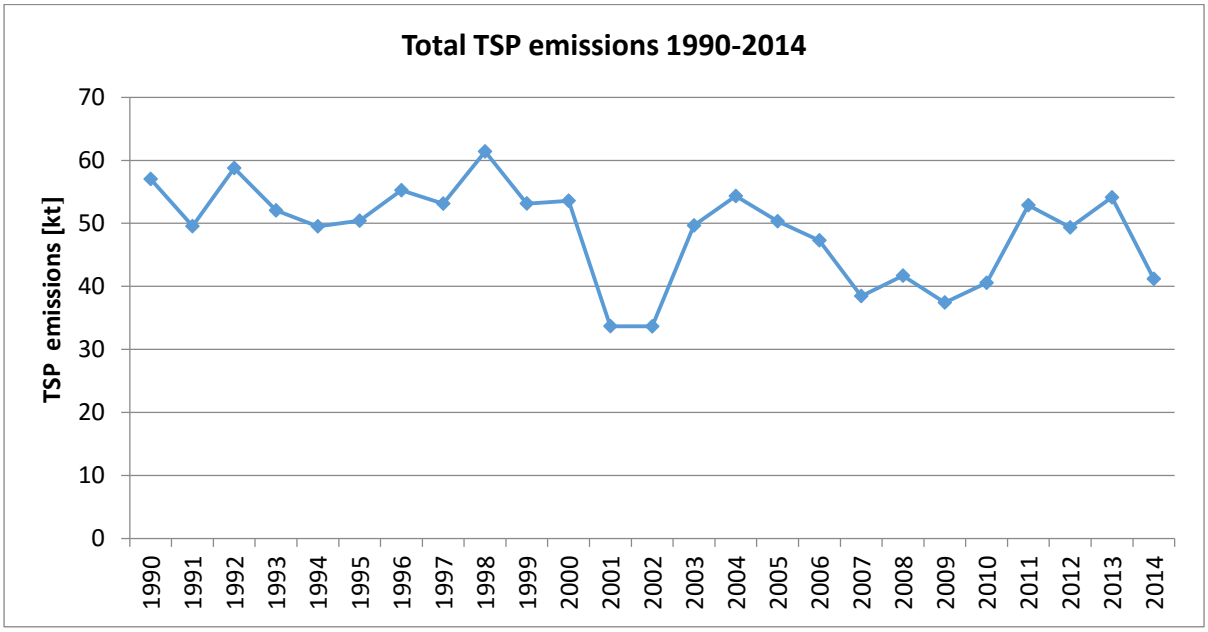

Figure 20 National total TSP emissions 1990-2014

Main emission sources in Macedonia

The main emission sources for TSP in 2014 are NFR sectors 2 Industrial Processes and Other Product Use (mainly NFR sector 2C2 Ferroalloys Production) with a share of 40% (49% in 1990) in total TSP emissions, 1A4 Other Sectors (residential heating) with 29% (22% in 1990) and 1A1 Energy Industries with 23% (22% in 1990).

NFR sectors 1B Fugitive emissions, 3 Agriculture and 5 Waste are minor sources of PM2.5 emissions.

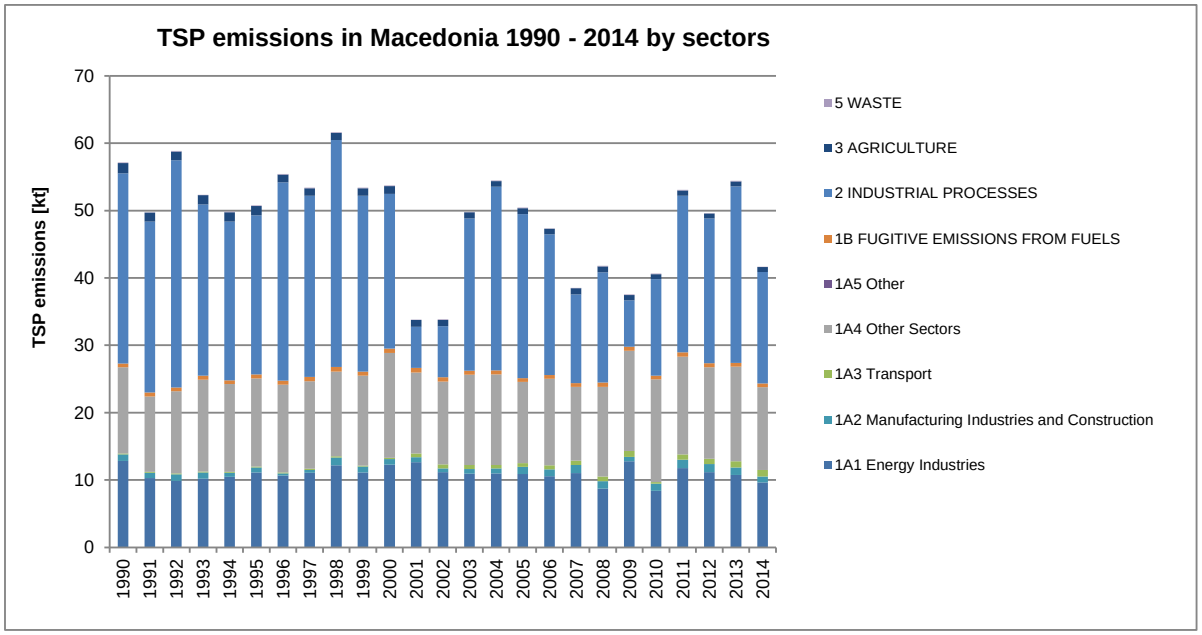

Figure 21 TSP emissions in Macedonia 1990-2014 by sectors

3.3. Emission trends for Heavy Metals

In the following table the trends of the three priority heavy metals are presented. The detailed trend descriptions as well as the main emission sources for the respective air pollutants are provided in the following sections.

Table 31 Emission trends for heavy metals 1990-2014

Year	Emissions		
	Cd [kt]	Hg [kt]	Pb [kt]
1990	0,481	0,846	107,885
1991	0,459	0,700	86,377
1992	0,532	0,766	96,386
1993	0,323	0,528	90,435
1994	0,295	0,444	87,185
1995	0,387	0,606	95,117
1996	0,543	0,580	95,466
1997	0,392	0,701	99,115
1998	0,508	0,774	101,666
1999	0,462	0,774	97,238
2000	0,515	0,775	99,752
2001	0,503	0,708	95,874
2002	0,435	0,771	103,040

Year	Emissions		
	Cd [kt]	Hg [kt]	Pb [kt]
2003	0,386	0,669	94,629
2004	0,416	0,646	25,952
2005	0,348	0,556	23,211
2006	0,371	0,554	8,171
2007	0,372	0,581	8,875
2008	0,379	0,559	6,235
2009	0,354	0,489	5,558
2010	0,398	0,513	6,405
2011	0,314	0,397	6,780
2012	0,212	0,310	5,259
2013	0,154	0,264	4,167
2014	0,143	0,266	4,530
Trend 1990–2014	***-70%***	***-69%***	***-96%***

The Republic of Macedonia in 2014 did not exceed emission levels set in HM Protocol. Emissions are much below the values from the reference year 1990.

3.3.1. Lead (Pb) emissions

National total Pb emissions amounted to 108 t in 1990; emissions have decreased steadily and in the year 2014 emissions were down by 96% to 4,5 t in the period 1990-2014. The most important reductions could be observed in sectors 1A3 Transport and 2 Industrial Processes and Other Product Use (mainly Lead Production). The big decline in the trend of Pb emissions from 2003 and 2004 is related to the main source of these emissions – Road transport and Lead production. From 2004 the content of Pb in the gasoline decreased from 0,0006 kg/l to 0,00015 kg/l. Also in 2003 the Pb-Zn smelter "Zletovo" – Veles stopped the production of lead and zinc. From 2006 in Macedonia, passenger cars can use only unleaded gasoline fuels which additionally reduced the Pb emissions.

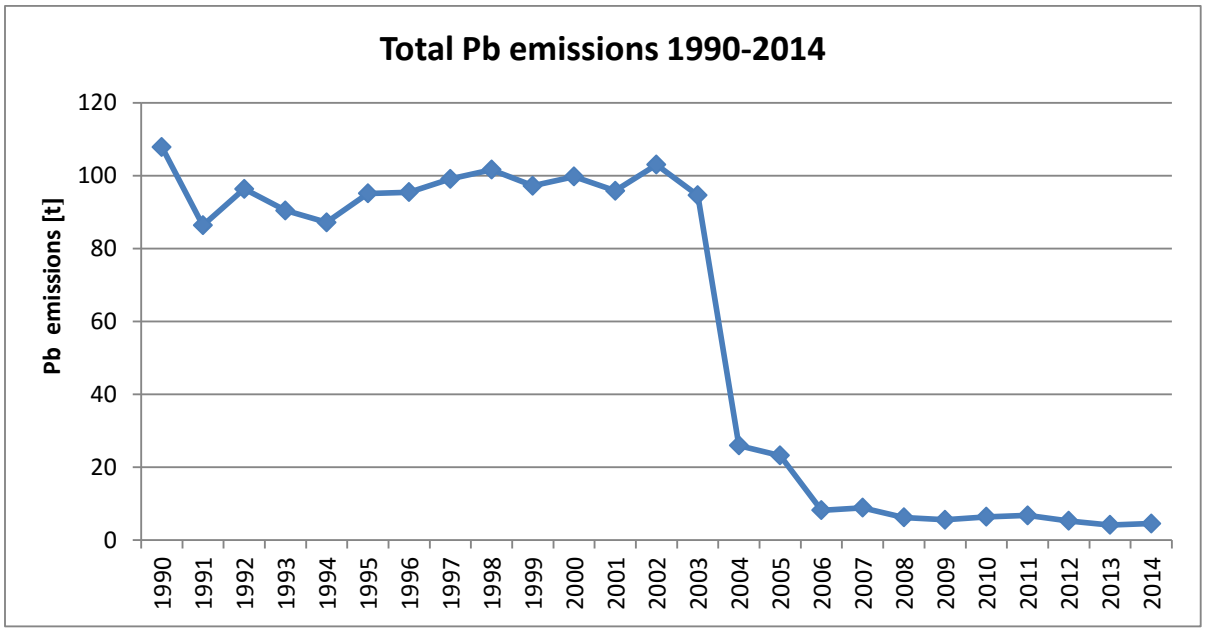

Figure 22 National total Pb emissions 1990-2014

Main emission sources in Macedonia

The most important emission sources of Pb in 2014 are NFR sectors 2 Industrial Processes and Product Use and 1 Energy with shares in national total emissions of 51% (13% in 1990) and 48% (88% in 1990), respectively. Within NFR sector 2 Industrial Processes and Product Use all Pb emissions result from 2C Metal Production (2C1 Iron and Steel Production) in 2014. In the Energy sector the main sources in 2014 are 1A2 Manufacturing Industries with a share of 18% in the national total as well as sectors 1A1 Energy Industries and 1A4 Other Sectors with a share of 15%, respectively.

Pb emissions from NFR sectors 1B Fugitive Emissions, 3 Agriculture and 5 Waste are minor sources.

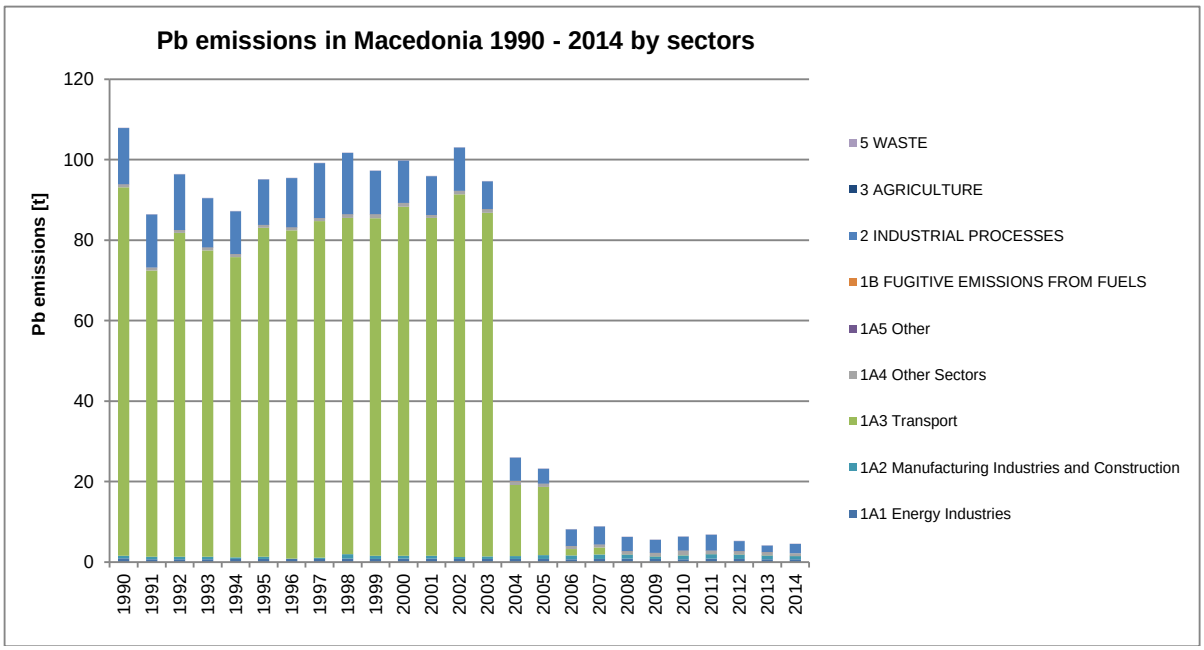

Figure 23 Pb emissions in Macedonia 1990-2014 by sectors

3.3.2. Cadmium (Cd) emissions

National total Cd emissions amounted to 0.48 t in 1990; emissions have decreased steadily and in the year 2014 emissions were down by 70% to 0,143 t in the period 1990-2014. The most important reductions could be observed in sector 2 Industrial Processes and Other Product Use (Metal Production) as Zinc Production was stopped in 2003. Between 2013 and 2014 emissions slightly decreased by 7% mainly due to lower fugitive emissions (NFR sector 1B).

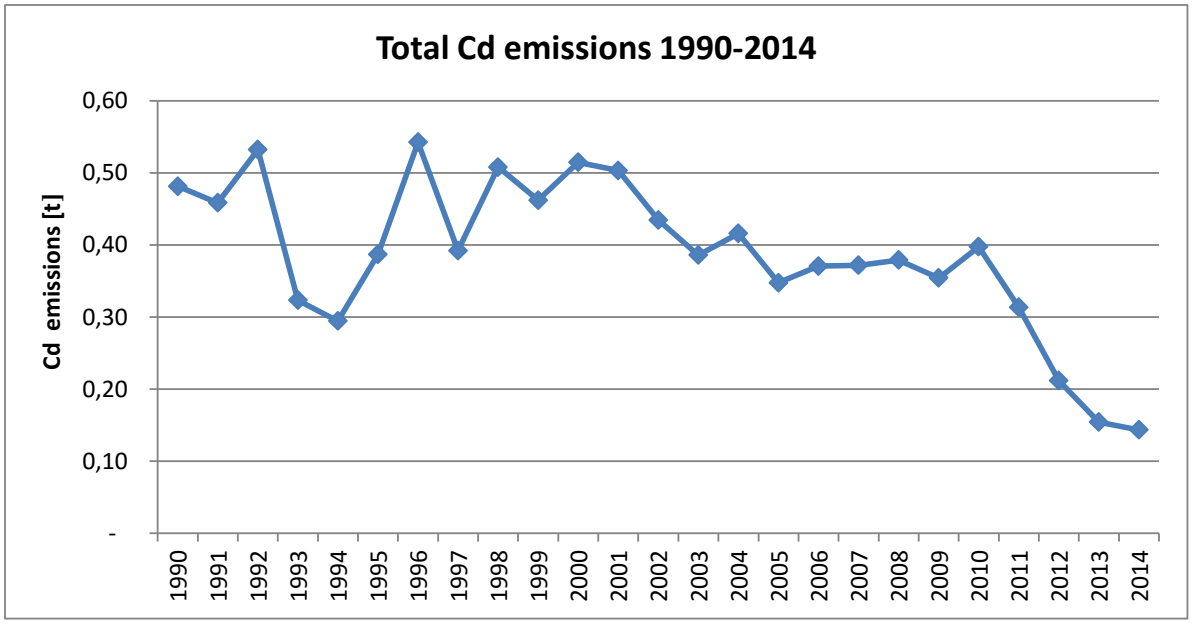

Figure 24 National total Cd emissions 1990-2014

Main emission sources in Macedonia

The most important emission source in 2014 of Cd is NFR sector 1 Energy. Within the Energy sector the main contributors in 2014 are 1A1 Energy Industries with a share of 57% (23% in 1990), 1A4 Other Sectors Energy with 16% (5% in 1990) and 1A2 Manufacturing Industries with 10% (2%) in the national total emissions. NFR category 2 Industrial Processes and Product use is also contributing with 7% (68%) to the national total Cadmium emissions.

Cd emissions from NFR sectors 1B Fugitive Emissions, 3 Agriculture and 5 Waste are minor sources.

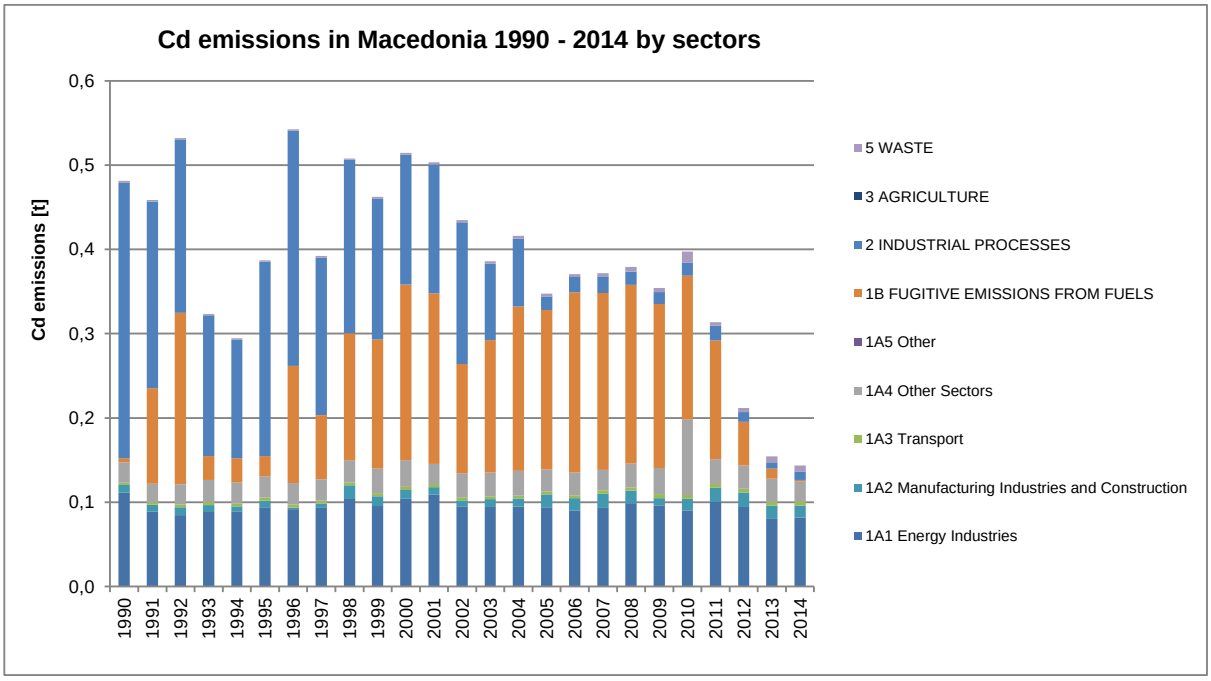

Figure 25 Cd emissions in Macedonia 1990-2014 by sectors

3.3.3. Mercury (Hg) emissions

National total Hg emissions amounted to 0,84 t in 1990; emissions have decreased steadily and in the year 2014 emissions were down by 69% to 0,26 t in the period 1990-2014. The most important reductions could be observed in sector 2 Industrial Processes and Other Product Use (Metal Production) as Zinc production stopped in 2003. Also fugitive emissions have been reduced significantly. Between 2013 and 2014 total Pb emissions slightly decreased by 3%.

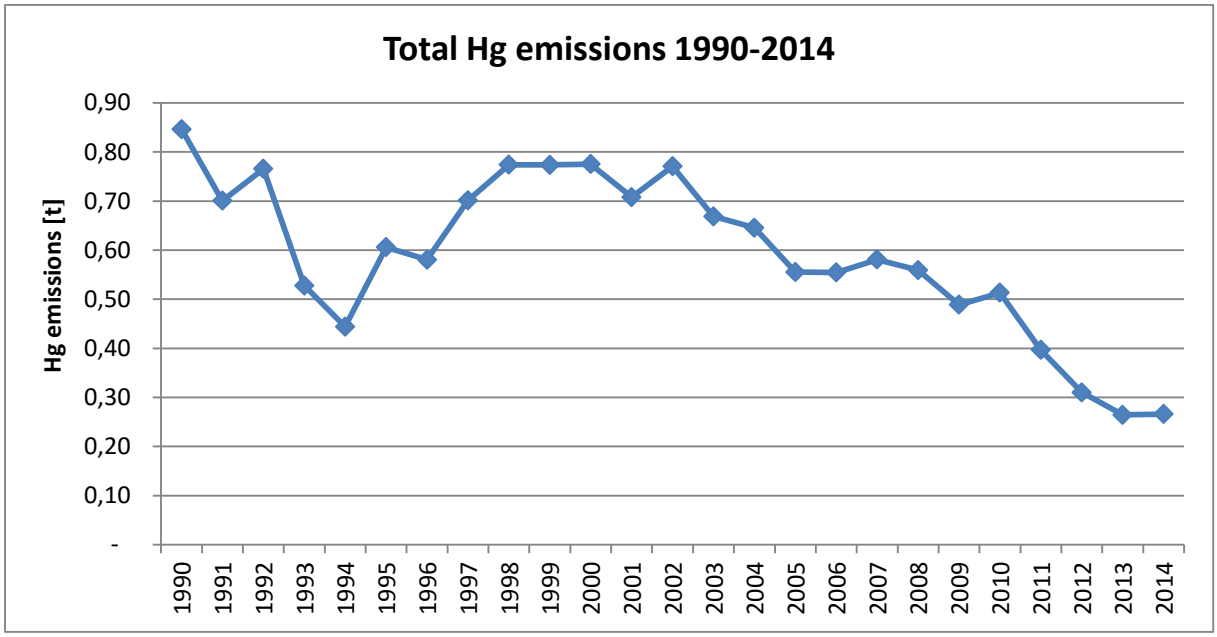

Figure 26 National total Hg emissions 1990-2014

Main emission sources in Macedonia

The most important emission source in 2014 of Hg is NFR sector 1 Energy. Within the Energy sector the main contributors in 2014 are 1A1 Energy Industries with a share of 48% (20% in 1990) and 1A4 Other Sectors Energy with 18% (4% in 1990) in the national total emissions. NFR category 2 Industrial Processes and Product use is also a main contributor with 19% (47%) to the national total Mercury emissions. 11% of total mercury emissions are stemming from sector 5 Waste.

Hg emissions from NFR sectors 1B Fugitive Emissions and 3 Agriculture are minor sources.

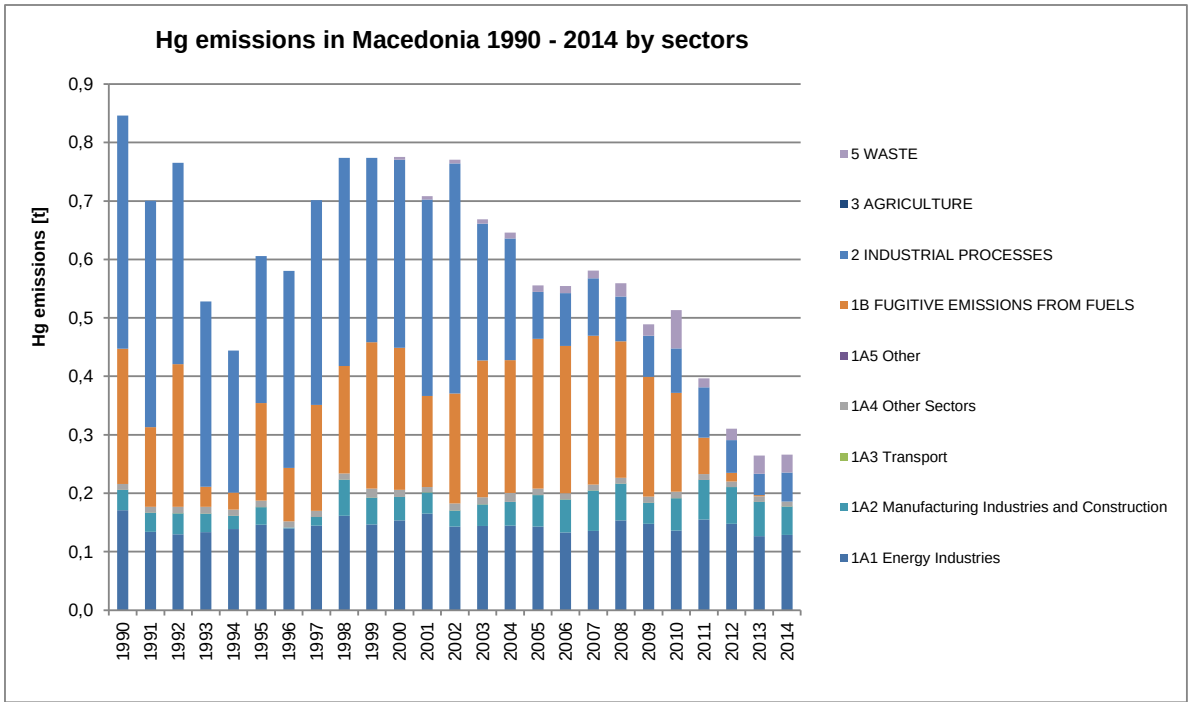

Figure 27 Hg emissions in Macedonia 1990-2014 by sectors

3.4. Emission trends for POPs

In the following table the trends of the POPs are presented. The detailed trend descriptions for the respective pollutants are provided in the following sections.

Table 32 Emission trends for POPs 1990-2014

Year	Emission			
	PAH [t]	PCDD/F [g]	HCB [kg]	PCB [kg]
1990	12,237	16,493	44,303	187,536
1991	10,805	14,503	39,230	177,689
1992	11,668	14,745	25,843	177,557
1993	12,776	15,228	24,199	131,331
1994	11,966	13,786	25,054	123,052
1995	12,111	13,977	18,644	237,824
1996	11,880	13,465	19,717	266,608
1997	11,922	14,002	27,903	150,210
1998	12,193	15,347	29,347	178,046
1999	12,394	15,311	53,986	128,318
2000	14,479	17,603	38,335	104,827
2001	11,433	14,612	34,151	93,288
2002	11,486	15,667	52,686	92,509
2003	12,820	16,245	42,984	49,306
2004	12,960	16,317	8,519	38,083
2005	12,177	15,177	7,563	4,232
2006	12,946	16,295	11,707	4,629

Year	Emission			
	PAH [t]	PCDD/F [g]	HCB [kg]	PCB [kg]
2007	11,501	15,118	10,141	4,873
2008	13,313	16,453	10,422	4,359
2009	14,096	16,858	7,442	3,801
2010	14,876	17,900	9,670	4,279
2011	14,570	17,836	9,915	4,686
2012	13,460	16,008	7,271	3,798
2013	13,670	15,590	6,583	3,234
2014	11,954	14,200	4,928	3,219
Trend 1990–2014	***-2%***	***-14%***	***-89%***	***-98%***

As it can be seen from the figures presented in the previous table, Republic of Macedonia in 2014 did not exceed the emission levels set in POPs Protocols. Emissions are much below the values from the reference year 1990 in the case of HCB and PCBs.

3.4.1. PAH emissions

National total PAH emissions amounted to 12 t in 1990; emissions have been quite stable since then and in the year 2014 emissions were nearly at 1990 levels to 12 t. The most important reductions could be observed in sector for residential heating. Between 2013 and 2014 total PAH emissions decreased by 13% also due to a fall of emissions from residential heating due to warmer weather resulting with lower wood consumption.

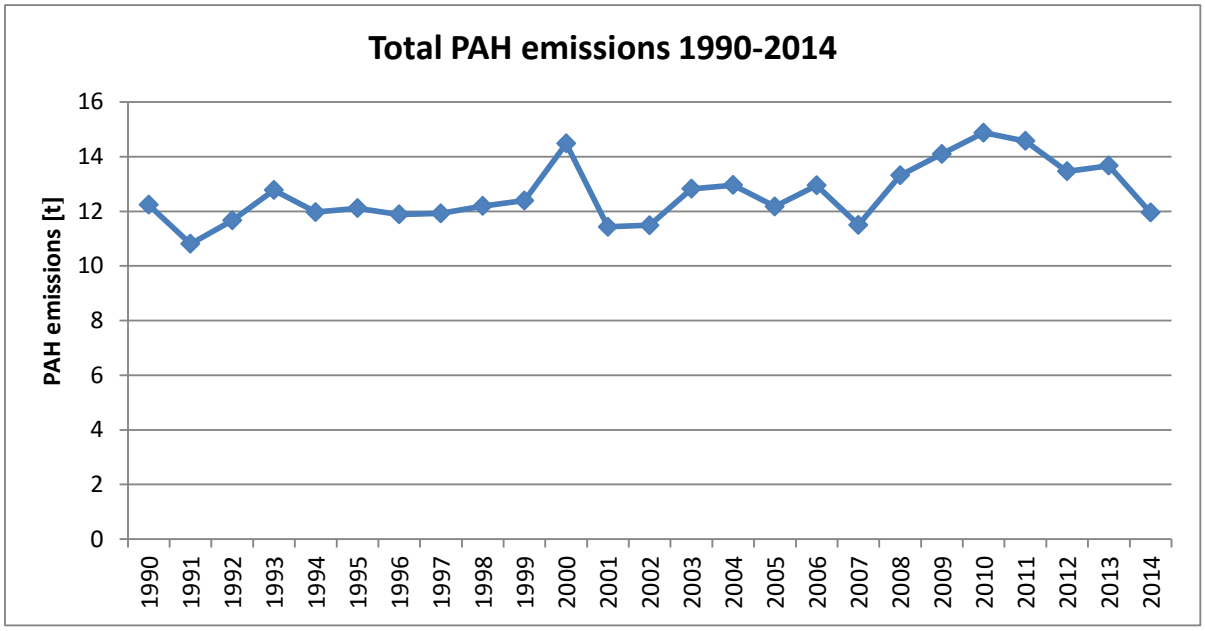

Figure 28 National total PAH emissions 1990-2014

Main emission sources in Macedonia

The most important emission source in 2014 of PAH is NFR sector 1 Energy. Within the Energy sector the main contributor in 2014 is 1A4 Other Sectors (residential heating) with a share of 89% (92% in 1990). Also 1A2 Manufacturing Industries is contributing with a share of 8% (4% in 1990) in the national total emissions.

PAH emissions from NFR sectors 1B Fugitive Emissions and 2 Industrial Processes and Product use are minor sources.

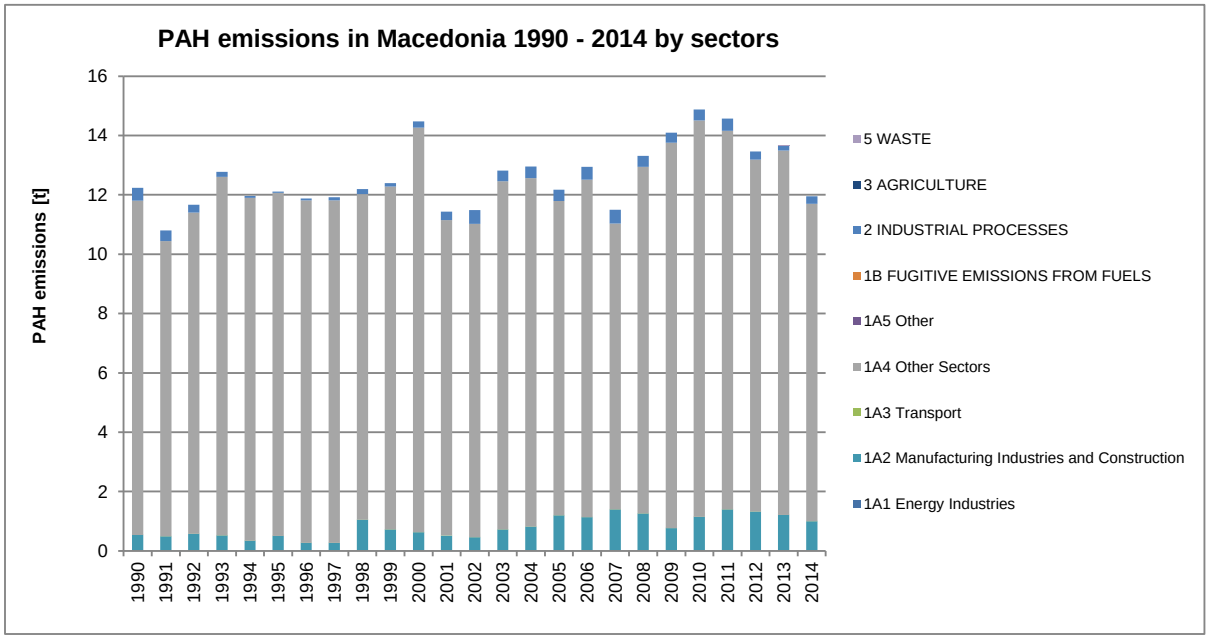

Figure 29 PAH emissions in Macedonia 1990-2014 by sectors

3.4.2. Dioxin and Furan emissions (PCDD/F)

National total dioxin/furan emissions amounted to 16 g in 1990; emissions have decreased since then, and in the year 2014 emissions were down by 14% to 14 g in the period 1990-2014. The most important reductions could be observed in sector 2 Industrial Processes and Other Product Use (Metal Production), especially in iron and steel production. This production has not been stable due to variations of the price of steel and due to the fact that also fugitive emissions have been reduced significantly. Between 2013 and 2014 total dioxin/furan emissions decreased by 9% mainly due to a fall of emissions from residential heating. The consumption of biomass has been reduced in 2014 compared to 2013 due to warmer winter. Additionally the consumption of wood briquettes and pellets has been increased.

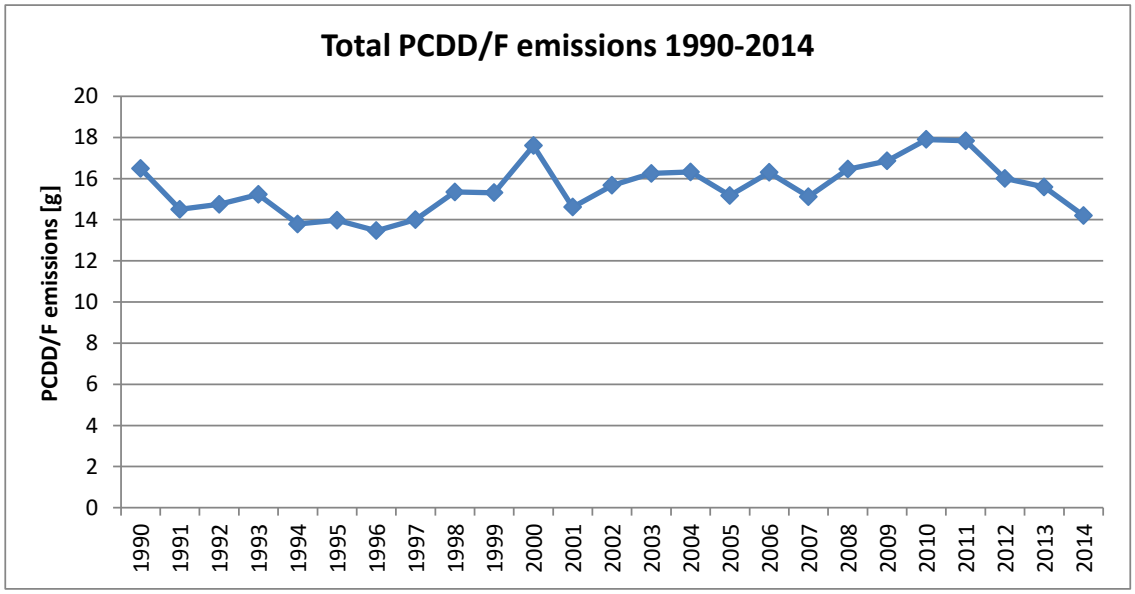

Figure 30 National total PCDD/F emissions 1990-2014

Main emission sources in Macedonia

The most important emission source in 2014 of PCDD/F is NFR sector 1 Energy. Within the Energy sector the main contributor in 2014 is 1A4 Other Sectors (mainly residential heating) with a share of 76% (68% in 1990). Also 1A2 Manufacturing Industries is contributing with a share of 9% (6% in 1990) in the national total emissions. NFR category 2 Industrial Processes and Product use (Metal Production) is also a main contributor with 11% (21%) to national total PCDD/F emissions.

Dioxin/furan emissions from NFR sectors 1B Fugitive Emissions and 5 Waste are minor sources.

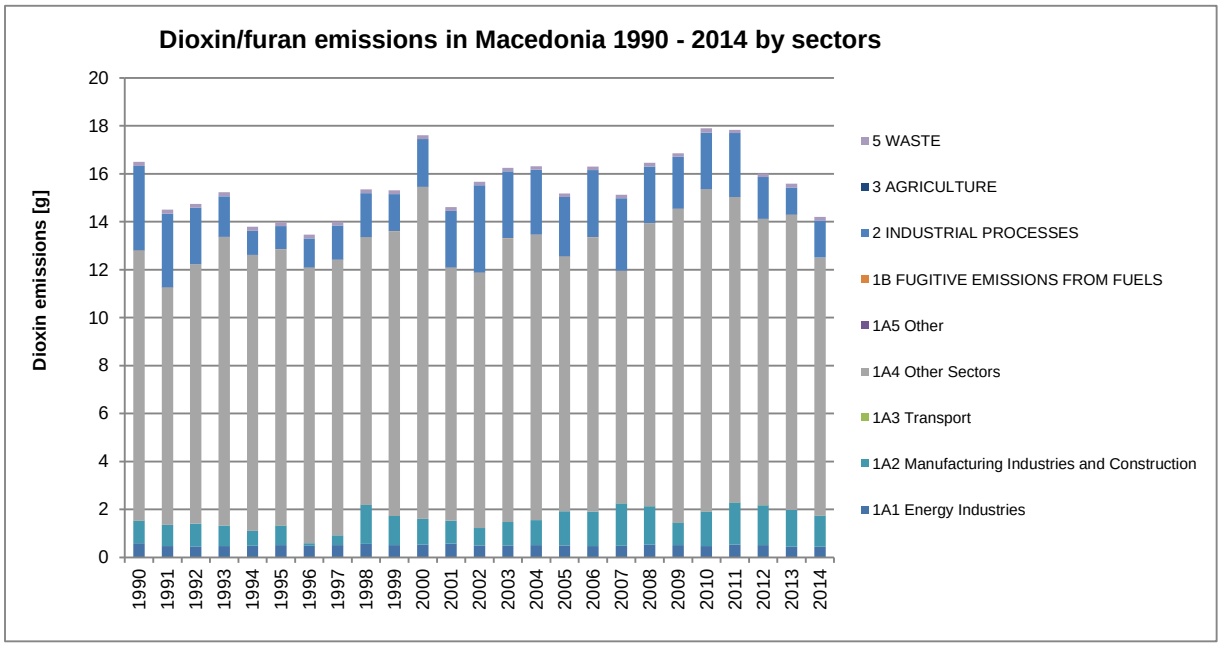

Figure 31 Dioxin/furan emissions in Macedonia 1990-2014 by sectors

3.4.3. Hexachlorobenzene (HCB) emissions

National total HCB emissions amounted to 44 kg in 1990; emissions have decreased steadily since then and in the year 2014 emissions were down by 89% to 5 kg in the period 1990-2014. The most important reductions could be observed in sector 2 Industrial Processes and Other Product Use (Aluminum Production). Between 2013 and 2014 total HCB emissions decreased by 25% also due to fall of emissions from aluminum production.

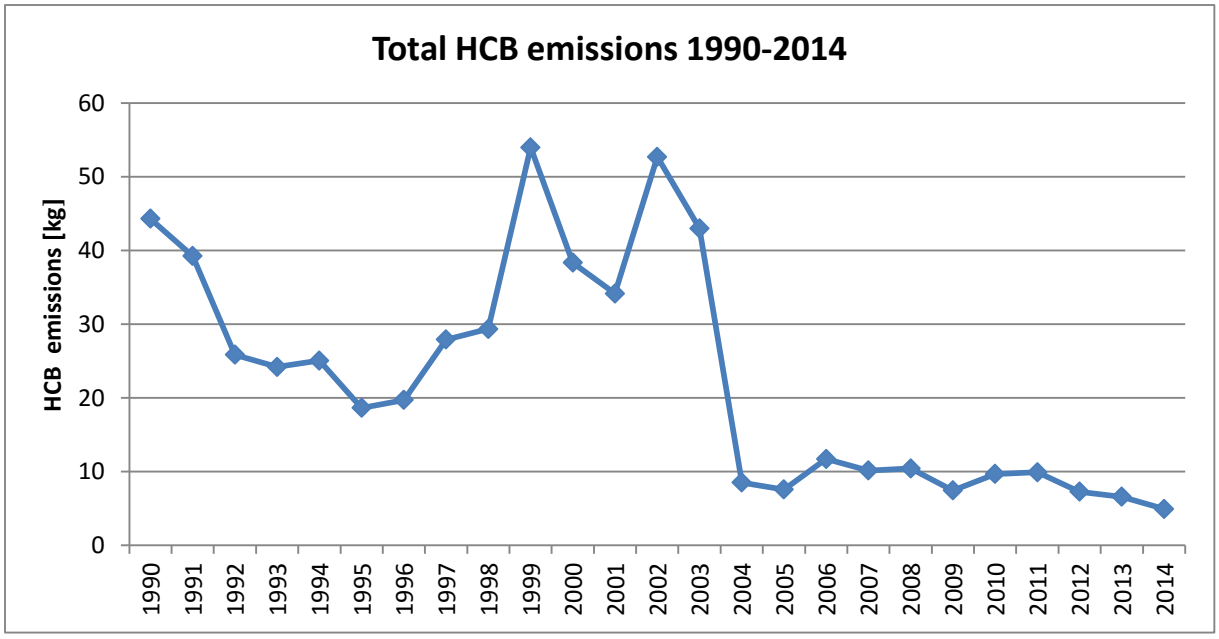

Figure 32 National total HCB emissions 1990-2014

Main emission sources in Macedonia

The most important emission source in 2014 of HCB is NFR sector 2 Industrial Processes and Product Use. With a share of 97% (100% in 1990) in the national total emissions almost all HCB is emitted from this source and therefore dominiating the trend. Within this sector emissions are exclusively emitted from NFR sector 2C3 Aluminium Production.

HCB emissions from NFR sectors 1 Energy and 5 Waste are minor sources.

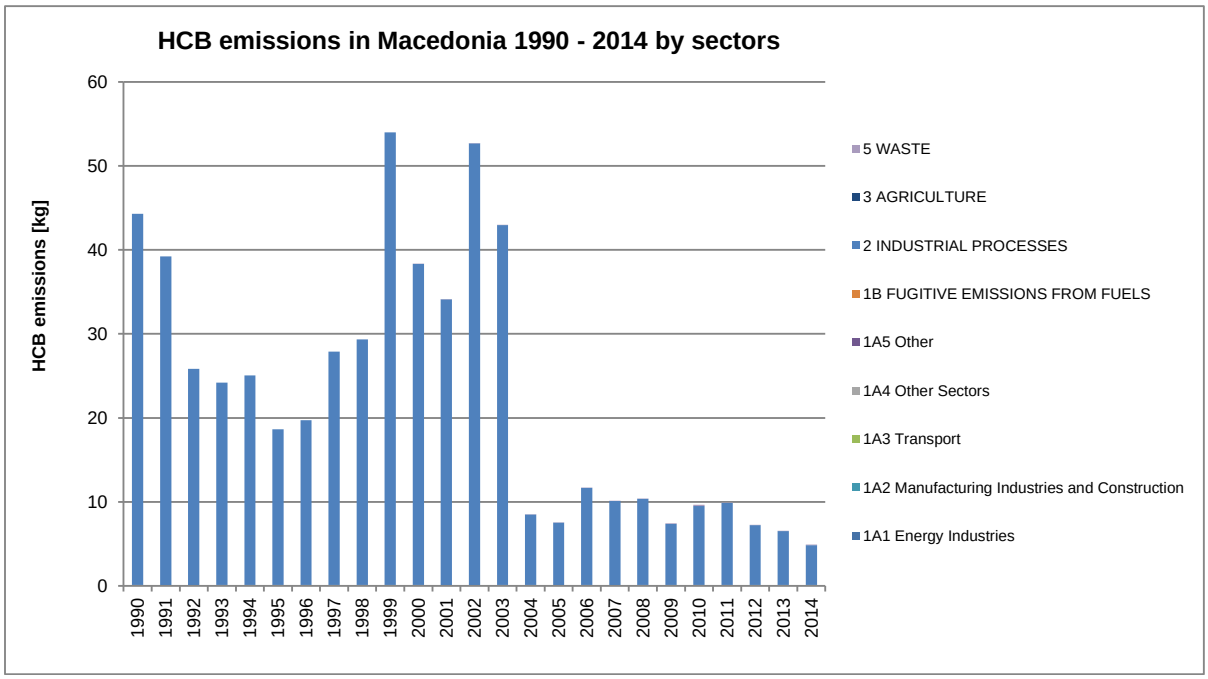

Figure 33 HCB emissions in Macedonia 1990-2014 by sectors

3.4.4. Polychlorinated biphenyl (PCB) Emissions

National total PCB emissions amounted to 187.5 kg in 1990; emissions have decreased steadily since then and in the year 2014 emissions were down by 98% to 3.2 kg in the period 1990-2014. The most important reductions could be observed in sector 2 Industrial Processes and Other Product Use (Lead Production). Between 2013 and 2014 total PCB emissions remained quite stable (-0.5%).

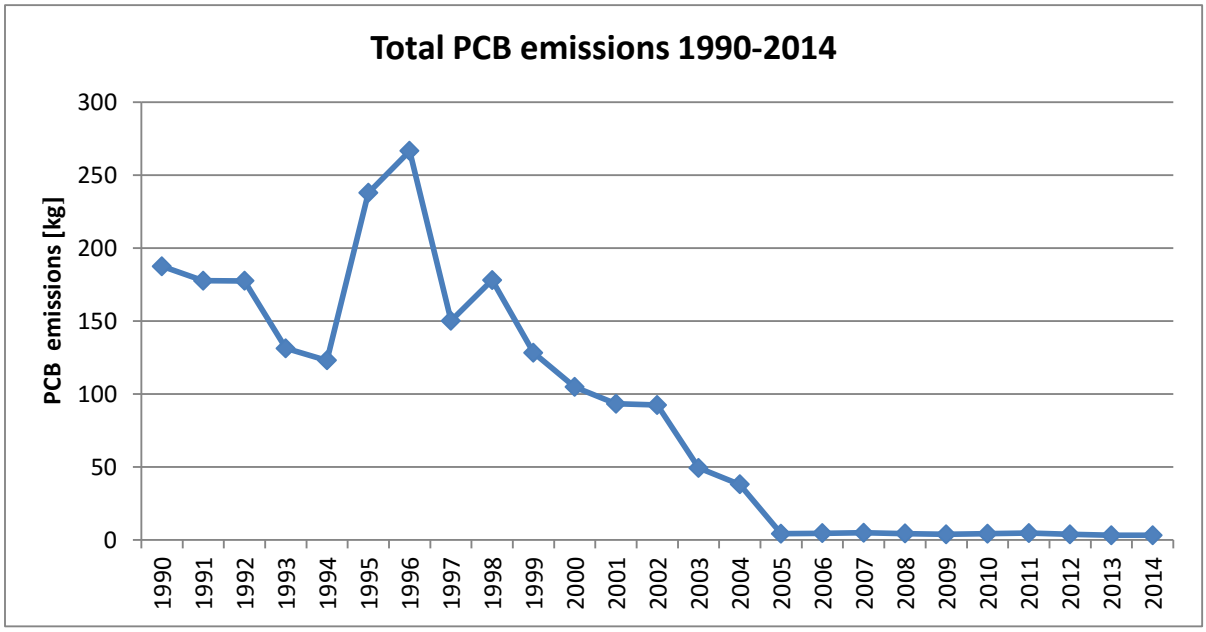

Figure 34 National total PCB emissions 1990-2014

Main emission sources in Macedonia

The most important emission source in 2014 of PCB is NFR sector 2 Industrial Processes and Product Use. Within this sector the main contributor is 2C5 Lead Production with a share of 39% (99% in 1990) in the national total PCB emissions. The main source was the smelter company in Veles that has stopped production in 2003. Further emission sources in 2014 are NFR sectors 1A2 Manufacturing Industries (Iron and Steel Production) and 1A4 Other Sectors (mainly residential heating).

PCB emissions from NFR sector 5 Waste is a minor source.

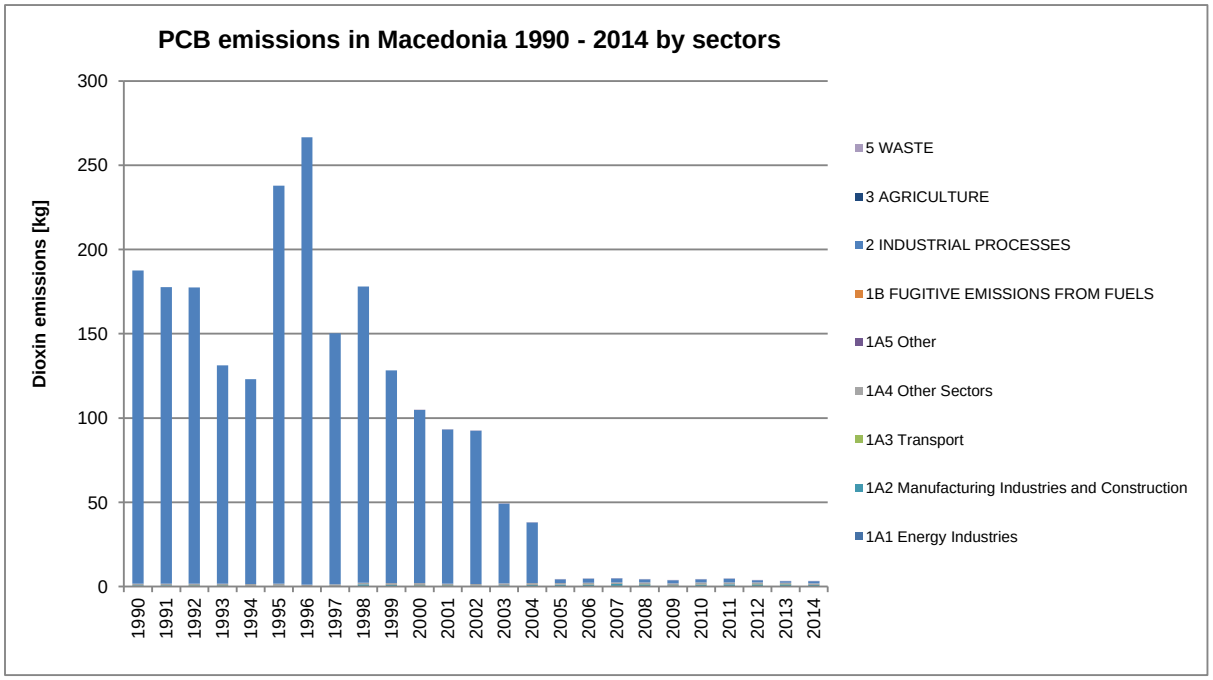

Figure 35 PCB emissions in Macedonia 1990-2014 by sectors

4. ENERGY (NFR SECTOR 1)

4.1. Sector overview

The chapter gives an overview of category 1.A Stationary combustion activity. The energy sector is the most important sector considering major air pollutants air emissions in the Republic of Macedonia. Emissions from this sector arise from fuel combustion (NFR sector 1. A) and fugitive emissions from fuels (NFR sector 1. B).

Completeness

The completed and not completed NFRs are presented in the following tables:

Table 33 NFR categories included in Energy sector for 2014

NFR category	Completeness
1 A 1 a Public electricity and heat production	√
1 A 1 b Petroleum refining	√
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	√
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	√
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	√
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	√
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	√
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other (Please specify in your IIR)	√
1 A 2 f ii Mobile Combustion in manufacturing industries and construction: (Please specify in your IIR)	√
1 A 3 a i (i) International aviation (LTO)	√
1 A 3 b i Road transport: Passenger cars	√
1 A 3 b ii Road transport: Light duty vehicles	√
1 A 3 b iii Road transport:, Heavy duty vehicles	√
1 A 3 b iv Road transport: Mopeds & motorcycles	√
1 A 3 b v Road transport: Gasoline evaporation	√
1 A 3 b vi Road transport: Automobile tyre and brake wear	√
1 A 3 b vii Road transport: Automobile road abrasion	√
1 A 3 c Railways	√
1 A 4 a i Commercial / institutional: Stationary	√
1 A 4 b i Residential: Stationary plants	√
1 A 4 b ii Residential: Household and gardening (mobile)	√
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	√
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	√
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	√
1 B 2 a iv Refining / storage	√
1 B 2 a v Distribution of oil products	√
1 B 2 c Venting and flaring	√
A 3 d ii National navigation (Shipping)	

NFR category	Completeness
Memo Items	
1 A 3 a i (ii) International aviation (Cruise)	√
1 A 3 a ii (ii) Civil aviation (Domestic, Cruise)	√
1A3 Transport (fuel used)	√

Table 34 NFR categories not included in Energy sector for 2014

NFR category	Notation key used
1 A 1 c Manufacture of solid fuels and other energy industries	NO
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	NE
1 A 3 d i (ii) International inland waterways	NO
1 A 3 e Pipeline compressors	NE
1 A 4 a ii Commercial / institutional: Mobile	NE
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	NE
1 A 5 a Other stationary (including military)	NE
1 A 5 b Other, Mobile (including military, land based and recreational boats)	NE
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	NO
1 B 1 c Other fugitive emissions from solid fuels	NO
1 B 2 a i Exploration, production, transport	NO
1 B 2 b Natural gas	NO
1 B 3 Other fugitive emissions from geothermal energy production , peat and other energy extraction not included in 1 B 2	NE
Memo Items	
1 A 3 d i (i) International maritime navigation	NO

Methodology

In general the methodology is following the EMEP Tier 1 methodology using default emission factors from the Guidebooks 2009/2013 and activity data from energy statistics. Plant specific emission data is considered for reporting of NOX, SO2, CO and TSP within the following sectors:

1.A.1.a 7 power plants

1.A.1.b 1 refinery

1.A.2.f 1 cement plant

Activity data is mainly taken from the national energy statistics which is published annually at the website of the state statistical office (http://www.stat.gov.mk/)[35]. Fuel consumption for 1A1a has been provided by plant operators [12-16]. Complete energy statistics is only available for the years 1998-2010 and from 2012 onwards. For some of the missing years and for specific categories, energy consumption is particularly available from other sources (national reports, older printed versions of statistics). For some years activity data has been gap filled as described in the sector specific chapters. Until the year 2012 energy statistics does only provide 'diesel and other gasoil' together but from the year 2013 onwards separate data for road diesel and gasoil is available.

Emission factors are mostly taken from the GB 2009 and particularly taken from the latest available Guidebook version 2013. At current the default (medium range) emission factors have been selected in all cases. Implied emission factors have been used for source category 1A1a.

With regards to LHV this values have been taken from energy balance [36] or operators reports ifthey were reported. For coal mined in the country LHV- 6,7 -7,7 TJ/10^3 t has been used, for biomass

– 10,902 TJ/10^3 m^3, for heavy fuel - 40 TJ/10^3, for diesel- 43 TJ/10^3t, for wood wastes, wood briquettes and pellets – 3, 8 TJ/10^3 t, for coke -29,92 TJ/10^3 t , forother imported coal - 8,29 TJ/10^3t , for natural gas -33,888 TJ/10^6 m^3 n, LPG – 46 TJ/10^3t and petroleum coke – 31,8 TJ/10^3 t.

4.2. Public electricity and heat production-NFR 1A1a

This category includes emissions from thermal public power and district heating plants. At current all power plants are owned by the state and no private companies are involved in this sector.

Public electricity production is dominated by two large plants which are using lignite as a major fuel and fuel oil as a supporting fuel while natural gas is not widely used for power generation. District heating plants are mainly operated using natural gas. At current, biofuels are not used for power or district heat generation. In 2014 only seven public plants were operating. Emissions from non-public district heat generation (industrial auto producers) are considered in the respective sub categories of 1.A.2 or 1.A.4.a.

Coal plants do not have any secondary abatement technologies to reduce NO_X, SO_2 or TSP emissions but since 2013 low NO_X burners have been installed in the major coal burning plant which reduced NO_X-emissions significantly.

Methodological issues

For the years 2008 onwards NO_X, SO_2, CO and TSP measured emissions from the seven power and district heating plants are considered. At current emissions of these plants are based on periodical (monthly) measurements which are carried out by accredited laboratories. Yearly emissions are calculated by means of flue gas concentrations and flue gas volumes and reported by the operators to the Ministry of Environment. At current no continuous measurement equipment is installed in any of these facilities. For lignite and fuel oil the NO_X, SO_2, CO and TSP emissions 1990 to 2007 are estimated by means of calculated implied emission factors which are derived from average 2009-2012 emissions and fuel consumption provided by plant operators. For natural gas 1990 to 2007 emissions are calculated with default Tier1 emission factors from the Guidebook 2009 [6].

Other pollutants (NH_3, heavy metals and POPs) are estimated by means of the EMEP 2009 default emission factors and fuel consumption. PM10 and PM2.5 emissions are derived from TSP emissions by applying the share of the Guidebook emissions factors. The share of PM10 on TSP is 68% and the share of PM2.5 is 27%.

Activity data

Activity data have been provided by the plant operators. Activity data on coal consumption for 1990 have been taken from the hard copy energy balance and replaced with figure used in the previous reporting round.

The lignite originates from inland mines and has a sulphur content of about 0.7% and very high water content up to 60%. Therefore the NCV of lignite is only about 6 MJ/kg. Residual fuel oil (also called ‘Mazut’) has a sulphur content of 1% but in the early 1990s it is to be estimated that the sulphur content was up to 3%.

The following table shows activity data for category 1.A.1.a by type of fuel.

Table 35 Activity data for source category 1.A.1.a Public electricity and heat production by type of fuel

Year	Lignite (TJ)	Natural gas (TJ)	Residual fuel oil (TJ)
1990	58359	1000	2516
1991	45655	-	3090
1992	44356		2656
1993	45442		3037
1994	47507		2434
1995	49958		2986
1996	47675		3051
1997	49362		3301
1998	55194		2602
1999	50091		2640
2000	51991	715	6345
2001	56387	673	3800
2002	48716	641	4286
2003	49091	345	2902
2004	49291	69	2936
2005	48711	52	3031
2006	45153	197	5152
2007	45697	895	6588
2008	52597	1 627	1270
2009	50442	744	2267
2010	46386	1 475	2330
2011	53111	1 570	1431
2012	50549	974	1594
2013	28463	1 522	1310
2014	44158	1 633	1671

Emission factors

Emission factors for this source category is presented in the following table:

Table 36 Emission factors for source category Public electricity and heat production 1.A.1.a by type of fuel

Pollutant	Unit	Lignite	Natural gas	Heavy fuel oil
NO_X	g/GJ	389	89	389
NMVOC	g/GJ	1,4	2,6	2,3
SO_2	g/GJ	1678	0,3	1678
NH_3	g/GJ	NE	NE	NE
PM2,5	g/GJ	57,4	0,9	57,4
PM10	g/GJ	141,8	0,9	141,8
TSP	g/GJ	210	0,89	210
CO	g/GJ	43	2,5	43
Pb	mg/GJ	15	0,0015	4,56
Cd	mg/GJ	1,8	0,00025	1,3

Pollutant	Unit	Lignite	Natural gas	Heavy fuel oil
Hg	mg/GJ	2,9	0,1	0,341
As	mg/GJ	14,3	0,12	3,98
Cr	mg/GJ	9,1	0,00076	2,55
Cu	mg/GJ	1	0,000076	5,31
Ni	mg/GJ	9,7	0,00051	255
Se	mg/GJ	45	0,0112	2,06
Zn	mg/GJ	8,8	0,0015	87,8
PCDD/ PCDF (dioxins/ furans)	ng I-TEQ/GJ	10	0,5	2,5
benzo(a) pyren	µg/GJ	1,3	0,56	
benzo(b) fluoranthen	µg/GJ	37	0,84	4,5
benzo(k) fluoranthen	µg/GJ	29	0,84	4,5
Indeno (1,2,3-cd) pyren	µg/GJ	2,1	0,84	6,92

Emission measurments

For the period 2008-2014 emission measurement data for NO_X, SO_2, TSP and CO have been taken into accont. These data were used for identification of implied emission factors.

Implied emission factors

The following table shows NO_X, SO_2, TSP and CO implied emission factors for category 1.A.1.a by type of fuel for the years 2009 to 2012 and the mean value which has been used to calculate emissions from lignite and fuel oil 1990 to 2007.

Table 37 Implied Emission factors for source category Public electricity and heat production 1.A.1.a by type of fuel

Year	IEF NO_X (g/GJ)	IEF SO_2 (g/GJ)	IEF TSP (g/GJ)	IEF CO (g/GJ)
2009	374,42	1 827,26	241,57	33,13
2010	411,71	1 562,94	171,77	33,88
2011	411,34	1 736,47	213,54	44,27
2012	359,25	1 584,72	213,57	61,00
Mean	389,00	1 678,00	210,00	43,00

Planned improvements

No planned improvements.

Recalculations

Implied emission factor has been used for the whole time series for the following pollutants: NOx, SO_2, TSP and CO. For 1990 activity data on coal consumption has been provided from the chapter energy balance in the Statistical yearbook and has been replaced with the previous reported figure taken from GAINS model.

4.3. Petroleum refining – NFR 1A1b

This chapter presents the entire consumption of fuels in the oil industry. Main representative of this sector was only one company "OKTA AD – Skopje". In 1982, with the commissioning of the processing plants, OKTA AD – Skopje becomes the only crude oil refinery in the country. In January 2013 production in OKTA ended, after which the company entered a transformation process from an inflexible and non-efficient heavy industry into a fast growing, client-oriented, logistics services trade

company. OKTA has developed a retail network of 25 petrol stations across the country, where it supplies high quality products and services to the end consumers.

Methodological issues

The Tier 1 approach for process emissions from combustion uses the general equation:

$E_{pollutant} = AR_{fuel\ consumption} \times EF_{pollutant}$

$E_{pollutant}$ annual emission of pollutant

$EF_{pollutant}$ emission factor of pollutant

$AR_{fuel\ consumption}$ activity rate by fuel consumption

This equation is applied at the national level, using annual national total fuel use (disaggregated by fuel type (refinery gas and heavy fuel oil).

Activity data

Data on the consumption of fuels in this sector for the period 2000-2014 have been collected by the operator itself. An request for providing data for the period 1990-1999 has been sent to the company but these data were not received.

Data for 1990-1999 were calculated using the surrogate method. The estimate were related to the two trends in crude oil consumption by the refinery.

Table 38 Activity data for source category 1.A.1.b Petroleum refining by type of fuel

Year	Refinery gas (TJ)	Residual fuel oil (TJ)
1990	1711	1680
1991	1356,2	1331
1992	797,2	782
1993	1432,4	1406
1994	201,4	198
1995	168,0	165
1996	979,6	961
1997	534,2	524
1998	1061,8	1042
1999	1076,8	1057
2000	1467,4	1070,73
2001	1424,9	1108,95
2002	911,8	869,52
2003	1102,6	1140,30
2004	1173,8	1180,85
2005	1373,3	1035,27
2006	1522,1	1002,13
2007	1550,6	1228,2778
2008	1483,0	1304,25
2009	1368,1	1339,40
2010	1293,8	1920,79
2011	723	1815,33
2012	235,68	990,27
2013	67,89	383,56
2014		107,47

Emission factors

The emission factors for refinery gas has been taken from GB 2013 [5] Table 4-2 Tier 1 emission factors for source category 1.A.1.b. refinery gas and emission factors for heavy fuel oil from GB 2013 Table 4-4 Tier 2 emission factors for source category 1.A.1.b. process furnaces using residual oil.

Table 39 Emission factors fo source category 1A1b Petroleum refining

Pollutant	Unit	Refinery gas	Heavy fuel oil
NO_X	g/GJ	63	142
NMVOC	g/GJ	2,58	2,3
SO_2	g/GJ	0.281	485
NH_3	g/GJ		1
PM2,5	g/GJ	0,89	9
PM10	g/GJ	0,89	15
TSP	g/GJ	0,89	20
CO	g/GJ	39,3	15
Pb	mg/GJ	1,79	4,6
Cd	mg/GJ	0,712	1,2
Hg	mg/GJ	0,086	0,3
As	mg/GJ	0,343	3,98
Cr	mg/GJ	2,74	14,8
Cu	mg/GJ	2,22	11,9
Ni	mg/GJ	3,6	1030
Se	mg/GJ	0,42	2,1
Zn	mg/GJ	25,2	49,3
"PCDD/ PCDF (dioxins/ furans)"	ng I-TEQ/GJ	-	2,5
benzo(a) pyren	µg/GJ	0,669	
benzo(b) fluoranthen	µg/GJ	1,14	3,7
benzo(k) fluoranthen	µg/GJ	0,631	-
Indeno (1,2,3-cd) pyren	µg/GJ	0,631	-

Planned improvements

No planned improvements.

Recalculations

Recalculation in 2013 is made due to the use of final consumption data from the energy balance, The recalculation for 1990 is made due to the fact that source of activity data have been changed (national statistical data have been used for this reporting round).

4.4. Manufacturing industries and construction – NFR 1A2

This category includes emissions from manufacturing industries. Several industrial branches consist of only a single or a few industrial plants with rather small capacities. Many plants had phases of nonoperation or high fluctuation in their production due to the economic changes since the early 1990s.

For all other categories the Tier1 methodology has been selected by using default emission factors from the GB 2009 [6].

Methodological issues

The Tier 1 approach for process emissions from industrial combustion installations uses the general equation:

$$E_{pollutants} = \sum AR_{fuel\ consumption} \times EF_{fuel,pollutnat}$$

$E_{Pollutant}$ = emissions of pollutant (kg),

$AR_{fuel\ consumption}$ = fuel used in the industrial combustion (TJ) for each fuel,

$EF_{fuel,pollutant}$ = an average emission factor (EF) for each pollutant for each unit of fuel type used (kg/TJ).

Activity data

Complete energy statistics is only available for the years 1991, 1993, 1995, 1996, 1998-2014. The missing years 1990, 1992, 1994 and 1997 have been linearly interpolated or gap-filled by means of production statistics.

The activity data for the following category are presented in Tables 40-45:

- 1.A.2.a — Iron and steel
- 1.A.2.b — Non-ferrous metals
- 1.A.2.c — Chemicals
- 1.A.2.d — Pulp, paper and print
- 1.A.2.e — Food processing, beverages and tobacco
- 1.A.2.f — Other

Table 40 Activity data for source category 1.A.2.a – Stationary combustion in manufacturing industries and construction: Iron and steel

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
1990			1395,926	3104,251
1991			2133,226	1184,316
1992			2451,098	1610,82
1993			1963,745	1290,54
1994			960,3717	631,14
1995			2100,154	655,996
1996				33,744
1997			272,3442	178,98
1998	0,294		5165,955	1793,497
1999	0,526		3443,079	1414,101
2000		26,93758	2285,072	1698,71
2001	0,083736	815,651	1912,153	780,1264
2002		959,6427	1378,295	1076,008
2003	2,595816	1119,32	2882,068	1195,541
2004	2,219004	1225,525	3299,994	1040,671
2005	130,4188	1272,347	4851,748	1963,107
2006	111,2014	1310,301	5060,46	2739,465
2007	50,74402	1321,856	6819,795	3588,004
2008	14,57006	1201,376	5930,518	2968,651
2009	1,549116	1094,23	2636,009	2530,209
2010	83,736	1079,216	4446,214	2977,233

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
2011	47,29337	1598,382	6163,09	4014,444
2012	110,699	437,1438	5846,866	3543,205
2013	6,48954	609,8074	5220,06	3366,229
2014	5,527314	754,3067	5282,484	2113,038

Table 41 Activity data for source category 1.A.2.b Stationary combustion in manufacturing industries and construction: Iron and steel

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
1990			2298	631
1991			1826,964	277,653
1992			1830,27	591,1085
1993			1833,576	904,564
1994			1685,519	861,8515
1995			1537,461	819,139
1996				26,015
1997			919,528	82,2985
1998			1839,056	138,582
1999			1754,216	699,846
2000			2045,964	770,8317
2001			1918,81	374,0068
2002			1246,117	614,8734
2003			595,991	8,834148
2004				12,97908
2005				21,81323
2006				32,02902
2007				42,41228
2008				32,19649
2009				26,2931
2010				35,00165
2011				38,64416
2012				42,28668
2013	9			43,29151
2014	1,0902	37,95077891		3,025277

Table 42 Activity data for source category 1.A.2.c Stationary combustion in manufacturing industries and construction: Chemicals

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
1990				169
1991				165,573
1992			0,42527	612,721
1993			0,85054	1059,869
1994			0,746996	1136,4
1995			0,643452	1212,93
1996			2,540328	32,838
1997			2,256664	88,5425

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
1998			1,973	144,247
1999				39,692
2000				
2001		37,5178		0,083736
2002		40,37278		1,590984
2003		32,71471		0,711756
2004		25,96352		5,987124
2005		22,63831		5,44284
2006		13,80467		7,578108
2007		10,24434		5,400972
2008		9,035172		3,600648
2009		5,978664		4,354272
2010		4,903848		8,457336
2011		2,451924		42,76816
2012				77,07899
2013	0,382			72,68285
2014		35,90285		66,23732

Table 43 Activity data for source category 1.A.2.d Stationary combustion in manufacturing industries and construction: Pulp, paper and print

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
1990			337,1813	12,8941
1991			0,44376	16,884
1992			0,22188	12,4005
1993				7,917
1994				7,7605
1995				7,604
1996			56,10707	196,994
1997			28,77704	169,954
1998	1,901		1,447	142,914
1999	0,526			2,863
2000	0,502416			0,376812
2001	0,83736			0,293076
2002	0,669888			1,925928
2003	0,20934			1,25604
2004	1,004832			1,130436
2005	1,297908			0,251208
2006	0,879228			0,293076
2007	0,83736			0,125604
2008	0,921096			0,20934
2009	0,753624			0,376812
2010	1,842192	6,583248		0,251208
2011	1,214172	15,28681	0,146538	8,917884

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
2012	0,586152	23,99036	0,293076	17,58456
2013	0,460548	15,15622	0,20934	16,37039
2014	0,31813	15,04326	0.904537	18.13565

Table 44 Activity data for source category 1.A.2.e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
1990			172,3139	1610,597
1991			34,495	223,436
1992			32,26252	414,356
1993			30,03004	605,276
1994			21,8182	588,646
1995			13,60637	572,016
1996			3,202307	137,396
1997			17,10065	546,9
1998	15,54		30,999	956,404
1999	18,407		31,05	115,082
2000	13,18842		27,80035	1614,472
2001	12,30919	33,588	13,23029	155,0791
2002	9,671508	58,64465	17,62643	172,4124
2003	4,1868	58,87976	22,44125	201,7619
2004	5,86152	51,35605	15,74237	154,7441
2005	12,39293	43,42928	15,5749	136,8665
2006	7,53624	56,42784	4,144932	160,8987
2007	3,181968	53,13622	8,959752	117,2304
2008	5,568444	60,15611	7,661844	123,5943
2009	2,470212	57,26754	6,322068	146,6217
2010	7,410636	62,20498	0,795492	190,9599
2011	28,63771	139,3313	3,433176	510,7059
2012	49,86479	216,4576	6,07086	830,4518
2013	116,9792	217,8811	5,568444	705,9363
2014	205,9133	200,9358	3,92653	663,6458

Table 45 Activity data for category source category 1.A.2giii Stationary combustion in manufacturing industries and construction: Other

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]	Clinker [tonnes]
1990	66,60538		110,8883	2666,445	491902
1991	66,61725		111,1813	2727,26	465375
1992	66,5935		110,5954	2605,63	396496
1993	66,641		110,0094	2484	413444
1994	66,546		122,5078	2116,5	375914
1995	66,736		135,0063	1749	365121
1996	66,356		32,1626	6040,328	396015

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]	Clinker [tonnes]
1997	67,116		592,8778	2495,243	475252
1998	65,596		668,367	2990,737	346867
1999	68,636	152,862	517,3887	1999,75	427080
2000	66,609	262,511	634,3643	2540,039	614162
2001	34,81	204,082	649,0153	2743,566	716963
2002	29,986	266,2	686,5682	2922,048	739492
2003	38,4199	29,32	1084,274	2731,35	602569
2004	29,32638		1705,716	1349,179	643258
2005	29,4332		1781,248	4627,66	694922
2006	4,898556		1885,137	1349,179	801302
2007	29,32638		1750,728	1451,279	882834
2008	23,48795		1822,425	1349	843765
2009	16,70533	10,0442	1752,379	1488,677	478404
2010	22,19004	126,8029	2386,236	1925,877	588978
2011	110,9388	242,1364	2130,342	1828,516	687986
2012	136,0982	133,3791	1929,546	1645,066	645482
2013	96,89335	127,0221	2009,455	1061,103	577845
2014	135,0613	137,8233	679,4522	972,7662	518198

Activity data for category 1A2gvii for diesel fuel are presented in Table 46, The activity data for the period 1990-2002 were calculated using surrogate data (off-road vehicles in industry), Activity data for the years 2004, 2008 and 2010 were taken from the IIR reported for those years [9,10,12], Data for 2013 and 2014 are available from the energy balance due to the fact that source category diesel for transport has been introduced, Activity data for the years 2009 and 2011-2012 were calculated as average of the previous two years.

Table 46 Activity data for source category 1A2gvii Mobile Combustion in manufacturing industries and construction: for diesel fuel

Year	Heavy Fuels [TJ]	Year	Heavy Fuels [TJ]
1990	4879	2003	549
1991	3520	2004	507
1992	4707	2005	429
1993	4925	2006	459
1994	2074	2007	528
1995	2408	2008	558
1996	2074	2009	789
1997	1796	2010	1020
1998	1624	2011	1378
1999	1316	2012	1737
2000	1050	2013	2300
2001	1156	2014	1173
2002	680		

Emission factors

Tier 1 emission factors [5] have been used for calculation of emissions in separate categories. Emission factors for different type of fuels are presented in Tables 47-50.

Table 47 Emission factors for source category 1A2 Stationary combustion in manufacturing industries and constructionfor biomass

Pollutant	Value	Unit	References
NOx	91	g/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
NMVOC	300	g/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
SOx	11	g/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
PM2.5	140	g/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
PM10	143	g/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
TSP	150	g/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
CO	570	g/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
Pb	27	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
Cd	13	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
Hg	0.56	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
As	0.19	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
Cr	23	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
Cu	6	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
Ni	2	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
Se	0.5	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
Zn	512	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
PCDD/ PCDF	100	ng I-Teq/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
benzo(a) pyren	10	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
benzo(b) fluoranthen	16	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
benzo(k) fluoranthen	5	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
Indeno (1.2.3-cd) pyren	4	mg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
HCB	5	µg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2
PCBs	0.06	µg/GJ	GB 2013 Table 3-5 emission factor for source category 1.A.2

Table 48 Emission factors for source category 1A2 Stationary combustion in manufacturing industries and construction for gaseous fuel

Pollutant	Value	Unit	References
NOx	74	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
NMVOC	23	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
SOx	0.67	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
PM2.5	0.78	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
PM10	0.78	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
TSP	0.78	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
BC	4	% of PM2.5	GB 2013 Table 3-3 emission factor for source category 1.A.2
CO	29	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
Pb	0.011	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
Cd	0.0009	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2

Pollutant	Value	Unit	References
Hg	0.54	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
As	0.1	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
Cr	0.013	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
Cu	0.0026	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
Ni	0.013	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
Se	0.058	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
Zn	0.73	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
PCDD/ PCDF	0.52	ng I-Teq/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
benzo(a) pyren	0.72	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
benzo(b) fluoranthen	2.9	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
benzo(k) fluoranthen	1.1	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2
Indeno (1.2.3-cd) pyren	1.08	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.2

Table 49 Emission factors for source category 1A2 Stationary combustion in manufacturing industries and constructionfor solid fuel

Pollutant	Value	Unit	References
NOx	173	g/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
NMVOC	88,8	g/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
SOx	900	g/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
PM2.5	108	g/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
PM10	117	g/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
TSP	124	g/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
BC	6,4	% of PM2.5	GB 2013 Table 3-2 emission factor for source category 1.A.2
CO	931	g/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
Pb	134	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
Cd	1,8	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
Hg	7,9	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
As	4	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
Cr	13,5	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
Cu	17,5	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
Ni	13	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
Se	1,8	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
Zn	200	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
PCDD/ PCDF	203	ng I-Teq/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
benzo(a) pyren	45,5	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
benzo(b) fluoranthen	58,9	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
benzo(k) fluoranthen	23,7	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
Indeno (1.2.3-cd) pyren	18,5	mg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
HCB	0,62	µg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
PCBs	170	µg/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2

Table 50 Emission factors for source category 1A2 Stationary combustion in manufacturing industries and constructionfor liquid fuel

Pollutant	Value	Unit	References
NOx	513	g/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
NMVOC	25	g/GJ	GB 2013 Table 3-2 emission factor for source category 1.A.2
SOx	47	g/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
PM2.5	20	g/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
PM10	20	g/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
TSP	20	g/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
BC	56	% of PM2.5	GB 2013 Table 3-4 emission factor for source category 1.A.2
CO	66	g/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
Pb	0,08	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
Cd	0,006	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
Hg	0,12	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
As	0,03	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
Cr	0,2	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
Cu	0,22	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
Ni	0,008	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
Se	0,11	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
Zn	29	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
PCDD/ PCDF	1,4	ng I-Teq/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
benzo(a) pyren	1,9	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
benzo(b) fluoranthen	15	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
benzo(k) fluoranthen	1,7	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2
Indeno (1.2.3-cd) pyren	1,5	mg/GJ	GB 2013 Table 3-4 emission factor for source category 1.A.2

The emission factors for clinker production are presented in Table 58.

Table 51 Emission factors for category 1A2 Stationary combustion in manufacturing industries and construction: Other for clinker

Pollutant	Value	Unit	References
NOx	1241	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
NMVOC	18	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
SOx	374	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
CO	1455	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
Pb	0,098	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
Cd	0,008	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
Hg	0,049	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
As	0,0265	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
Cr	0,041	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
Cu	0,0647	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
Ni	0,049	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.

Pollutant	Value	Unit	References
Se	0,0253	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
Zn	0,424	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
PCB	103	µg/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
PCDD/ PCDF	4,1	ng I-TEQ/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
benzo(a) pyren	0,000065	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
benzo(b) fluoranthen	0,00028	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
benzo(k) fluoranthen	0,000077	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
Indeno (1.2.3-cd) pyren	0,000043	g/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.
HCB	4,6	µg/t clinker	GB 2013 Table 3-24 emission factor for source category 1.A.2.f.

With regards to the source category 1.A.2.gii, the emission factors for diesel fuels are presented in table 52.

Table 52 Emission factors for source category 1.A.2.gii Mobile Combustion in manufacturing industries and construction: for diesel fuel

Pollutant	Value	Unit	References
NOx	32792	g/tonne	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
NMVOC	3385	g/tonne	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
NH_3	8	g/tonne	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
PM2.5	2086	g/tonne	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
PM10	2086	g/tonne	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
TSP	2086	g/tonne	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
CO	10722	g/tonne	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
Cd	0,01	mg/kg	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
Cr	1,16	mg/kg	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
Cu	39,5	mg/kg	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
Ni	0,07	mg/kg	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
Se	0,01	mg/kg	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
Zn	1	mg/kg	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
benzo(a) pyren	30	µg/kg	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
benzo(b) fluoranthen	50	µg/kg	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery

Planned improvement

No planned improvements.

Recalculations

In subsector 1A2 the recalculation was performed for the year 1990 due to change of data source explained before. The final data for source category diesel for transport for 2013 were available in

October 2015 and the emissions for 2013 in this source category were calculated in this year's submission. Furthermore, the emission factors from GB 2013 [5] have been used in this year emission calculations from the source category 1A2gvii. The methodology for calculation of activity data have been changed due to available surrogate data for number of work vehicles.

4.5. Transport

4.5.1. Road transport –NFR 1A3

This chapter covers the emissions from road transport. It provides the methodology, emission factors as well as relevant activity data necessary for calculation of the exhaust emissions for the following categories of road vehicles:

- passenger cars (NFR code 1.A.3.b.i)
- light commercial vehicles (1) (< 3.5 t) (NFR code 1.A.3.b.ii)
- heavy-duty vehicles (2) (> 3.5 t) and buses (NFR code 1.A.3.b.iii)
- mopeds and motorcycles (NFR code 1.A.3.b.iv)

The preparation of the road transport inventory was the most difficult part of the emission calculation, compared to other sectors due to the lack of activity data, as well the weak support of the existent scientific institutions in the country. The estimated emissions from this category are calculated with the highest uncertainty due to the lack of details on vehicles fleet data during the inventory preparation, which have been received after the reporting deadline.

4.5.1.1. Road transport – NFR 1A3bi,bii,biii,biv

Methodology

The simplified Tier 1 methodology [5] for emission calculation has been used: fuel quantity (expressed in heat units) is multiplied by the appropriate emission factor which depends on the type of the fuel and type of technology of combustion in stationary sources, and the type of mobile equipment and machinery, respectively.

The Tier 1 approach for exhaust emissions uses the following general equation:

$$E_i = \sum_j \left(\sum_m \left(FC_{j,m} \times EF_{i,j,m} \right) \right)$$

Where:

Ei = emission of pollutant i [g],

FCj,m = fuel consumption of vehicle category j using fuel m [kg],

EFi,j,m = fuel consumption-specific emission factor of pollutant i for vehicle category j and fuel m [g/kg].

The emission data for the period 1990-2000 has been taken directly from NFR tables reported in 2013. There are no detail background data on the type of fuel consumption, nor the EF used for the this reporting period.

Therefore within the Twinning project an attempt was made for recalculation of historical emissions 1990-2003. A different approach was used, which took into account the statistical number of vehicle data by category, data on national yearly fuel type consumption in traffic sector as well as mileage data received by Mechanical faculty from Skopje. The specific FC/km was taken from a former road transport model by a Finnish expert for BC in the year 2006. However, this approach resulted in major discrepancies of emissions between reported data 1990-2003 and calculated data for the period 2004-2014. In order not to apply two different methodologies for the time series and the fact that MEPP received detail car fleet data from MOI in February, it was decided to use the same approach (as used so far) for the whole reporting period and install and implement COPRERT model

for calculations of transport emissions before the next reporting round which will lower the uncertainty of the current methodology. Therefore the quantities of fuels consumed in road transport (total fuel consumption) have been obtained through expert calculations, i.e. estimates. Total fuel quantities, taken from the Energy Balance of the Republic of Macedonia as part of Statistical yearbook [35] have been distributed to the relevant SNAP subgroups in percentage, depending (as stated above) on the number and type of vehicles in the Republic of Macedonia.

Activity data

Fuel consumption data were taken from Statistical yearbook –chapter Energy balance 1990-2014 [35]. Data on number of vehicles were taken from Statistical yearbook for the period 1990-2002 [35] and publication Transport and other communication for the period 2003-2014 [39]. The data on mileage was received from the Faculty for Mechanical Engineering in Skopje.

Table 53 Activity data for source category 1A3b Road transport for period 1990-2013

NFR	1A3bi	1A3bi	1A3bii	1A3biii	1A3biv
Year	Liquied fuels	Gas fuel	Liquied fuels	Liquied fuels	Liquied fuels
1990	7647	2064	1553	3054	101
1991	6331	1396,6	2148,1	4293,3	121
1992	7097	1565,6	2544,1	5084,8	181,8
1993	7353,6	1622,2	2652,8	5302,1	198,9
1994	6674	1472,3	2300,1	4597,1	96,1
1995	7250,3	1599,4	2579,2	5154,9	152,6
1996	7202,5	1588,8	2556,6	5109,8	179
1997	7333,9	1617,8	2614,7	5225,9	227,7
1998	7320,6	1614,9	2649	5294,4	236,2
1999	7350,6	1621,5	2640,6	5277,5	232,2
2000	7597,3	1675,9	2739,8	5475,9	246,9
2001	6115,9	1395,2	2198,5	4466,2	50,5
2002	6599	1395,2	2410,2	4819	76,6
2003	6188	1395,2	2260,1	4518,8	71,8
2004	6324,3	1395,2	2005,2	3991,3	91,5
2005	6034,5	1249,3	2229,9	4460	100,6
2006	5685,8	1489,4	1868,6	4982,6	135,1
2007	6150,6	1987,7	2156,3	5763,2	152,8
2008	5943	1953	1656,9	4390,4	339,3
2009	6477,3	1987,7	2971,0	5972,4	342,1
2010	7456,4	2634	3980	8045	92,5
2011	7272,1	1599,6	3464,3	6986,6	93,7
2012	6300,4	1543,1	3553,6	7178,4	83,3
2013	6847,1	1693	4168,3	8433,1	87,4
2014	6587,3	1873,4	4474,4	9070,7	79,2

Table 54 Activity data for source category 1A3b Road transport for 2014

NFR code	Fuel	Fuel consumption [TJ]

NFR code	Fuel	Fuel consumption [TJ]
1A3bi	Gasoline	4173,46
	Diesel	2413,81
	LPG	1873,40
1A3bii	Gasoline	48,77
	Diesel	4425,59
1A3biii	Gasoline	9070,69
	Diesel	79,21
1A3biv	Gasoline	9070,69

Emission factors

Default emission factors for the basic pollutants, lead and particulates were taken from GB 2009 – Tier 1 emission factors [6]. Emission factors for HM were taken from IIR 2010 [10]. In the Table 55 Emission factors used for estimation of emissions grouped by sub-sectors are presented. Emission factor for lead was used for calculation of emissions starting from 2008 onwards.

Table 55 Emission factor for source category 1A3 Road Transport

NFR code	Fuel	NOx	NMVOC	SOx	NH_3	TSP	CO	As
	Unit	g/kg fuel	g/kg fuel	ppm	g/kg fuel	g/kg fuel	g/kg fuel	/
1A3bi	Gasoline	14,50	14,00	40	0,173	0,037	132,00	/
	Diesel	11,00	1,10	8	0,018	1,70	4,70	/
	LPG	15,00	10,00	/	0,173	/	68,00	/
1A3bii	Gasoline	24,00	14,00	40	0,14	0,03	155,00	/
	Diesel	15,00	1,75	8	0,014	2,80	11,00	/
1A3biii	Diesel	37,00	1,60	8	0,015	1,20	8,00	/
1A3biv	Gasoline	9,50	114,00	40	0,063	2,70	490,00	/
1A3bi	Gasoline	1,70	0,05	0,07	0,01	1,00	0,017	0,01
	Diesel	1,70	0,05	0,07	0,01	1,00	0,0325	0,01
	LPG	1,70	0,05	0,07	0,01	1,00	/	0,01
1A3bii	Gasoline	/	/	/	/	/	0,017	0,01
	Diesel	1,70	0,05	0,07	0,01	1,00	0,0325	0,01
1A3biii	Diesel	1,70	0,05	0,07	0,01	1,00	0,0325	0,01
1A3biv	Gasoline	1,70	0,05	0,07	0,01	1,00	0,017	0,01

Planned improvements

The emission calculation software COPERT for 1 A 3 b Road Transport is planned to be used within the Inventory System in order to improve the present methodology (Tier 1) for Road Transport. Due to the availability of the detailed registration data for 2014 (data on historical years has not been yet received), MEPP will apply for a TAEIX expert missions for training in regard to the use of COPERT model.

Recalculation

For the year of 2013 only preliminary activity data from the energy balance could be taken into consideration. However, for the preparation of this report the final definitive activity data from the energy balance have been used. Activity data tooked in the previous reporting from GAINS model have been replaced with national data.

4.5.1.2. Gasoline evaporation (from vehicles) –NFR 1A3bv

This chapter provides the methodology, emission factors and relevant activity data to enable evaporative emissions of NMVOCs from gasoline vehicles (NFR code 1A3bv) to be calculated. The

term 'evaporative emissions' refers to the sum of all fuel-related NMVOC emissions not deriving from fuel combustion.

Most evaporative emissions of VOCs emanate from the fuel systems (tanks, injection systems and fuel lines) of petrol vehicles. Evaporative emissions from diesel vehicles are considered to be negligible due to the presence of heavier hydrocarbons and the relatively low vapour pressure of diesel fuel and can be neglected in the calculations.

Methodological issues

The Tier 1 approach for calculating evaporative emissions uses the general equation from EMEP/EEA Guidebook 2013:

$$E_{\mathrm{VOC}} = \sum_j N_j \times EF_{VOC,j} \times 365$$

Where:

$\mathbf{E}_{VOC}$ = the emissions of VOC (g/year);

N_j = the number of vehicles in category j.

$EF_{voc,j}$= the emission factor of VOC for vehicle category j (g/vehicle/day).

j = the vehicle category (passenger cars. light-duty vehicles and two-wheel vehicles. i.e.[5]

Activity Data

The number of vehicles in category PCs and TWs are taken directly from the statistical yearbooks for the period 1990-2004 [35] and Publication transport and communication for the period 2005-2014[38]. The LDVs were calculated gathering subcategories (fright cars. special vehicles).

Table 56 Activity data for source category 1.A.3.v Gasoline evaporation

Year	Passenger cars (PCs)	Light-duty vehicles (LDVs)	Two-wheel vehicles (TWVs)
1990	196282	4500	1523
1991	212340	4729	1489
1992	238032	5601	2238
1993	246638	5841	2448
1994	223845	5065	1183
1995	243175	5678	1879
1996	241572	5629	2203
1997	245979	5757	2803
1998	245532	5832	2907
1999	246537	5814	2858
2000	254811	6032	3040
2001	263294	6312	3654
2002	261609	5872	2379
2003	254999	5532	1746
2004	195915	4340	1203
2005	198088	4139	1484
2006	186812	3804	3132
2007	207218	3962	4396
2008	203234	4212	8319
2009	216380	4674	8684

Year	Passenger cars (PCs)	Light-duty vehicles (LDVs)	Two-wheel vehicles (TWVs)
2010	227184	4663	7457
2011	217016	4363	7510
2012	199329	4096	7965
2013	213808	4311	7681
2014	215175	4128	8180

Emission factors

For the calculation of emissions for emission parameters from 1990-2014 the used emission factors were taken from the GB 2009 [6]. NMVOC emission factors for gasoline fuelled road vehicles, when daily temperature range is around 10 to 25 °C, were taken into account. This emission factor was chosen due to the fact that calculated average annual temperature for 2014 was 13.7 °C, according to the automatic meteorological station under responsibility of HMA – Hidro Meteorologicaal Administration.

These emission factors are given in Table 57 below.

Table 57 Evaporative emissions emission factors source category 1A3bv Gasoline evaporation for gasoline fuelled road vehicles — when daily temperature range is around 10 to 25 °C

Pollutant	Vehicle type	Value	Unit	References
NMVOC	Gasoline PCs	14,8	g/vehicle/day	GB 2009 1.A.3.b.v Gasoline evaporation. Table 3-2. pg. 9 evaporative emissions emission factors for gasoline fuelled road vehicles — when daily temperature range is around 10 to 25 °C.
NMVOC	Gasoline LDVs	22,6	g/vehicle/day	GB 2009 1.A.3.b.v Gasoline evaporation. Table 3-2. pg. 9 evaporative emissions emission factors for gasoline fuelled road vehicles — when daily temperature range is around 10 to 25 °C.
NMVOC	Two-wheel vehicles	3,0	g/vehicle/day	GB 2009 1.A.3.b.v Gasoline evaporation. Table 3-2. pg. 9 evaporative emissions emission factors for gasoline fuelled road vehicles — when daily temperature range is around 10 to 25 °C.

4.5.1.3. Road vehicle tire and brake wear NFR 1A3bvi and road surface wear – NFR 1A3bvii

This chapter covers the emissions of particulate matter (PM) which are due to road vehicle tire and brake wear (NFR code 1.A.3.b.vi) and road surface wear (NFR code 1.A.3.b.vii). PM emissions from vehicle exhaust are not included. The focus is on primary particles — in other words, those particles emitted directly as a result of the wear of surfaces — and not those resulting from the resuspension of previously deposited material [5].

Methodological issues

In order to calculate emissions of TSP, PM10 or PM2.5 from (i) brake and tire wear combined and (ii) road surface wear equation can be used. This equation can be used to estimate emissions for a defined spatial and temporal resolution by selecting appropriate values for the fleet size and the activity (mileage). Emission factors are given as a function of vehicle category alone. Total traffic generated emissions for each of the NFR codes can be estimated by summating the emissions from individual vehicle categories.

$$TE = \sum_j N_j \times M_j \times EF_{i,j}$$

where:

TE = total emissions of TSP, PM10 or PM2.5 for the defined time period and spatial boundary [g]

N_j = number of vehicles in category j within the defined spatial boundary

M_j = average mileage driven per vehicle in category j during the defined time period [km]

$EF_{i,j}$ = mass emission factor for pollutant i and vehicle category j [g/km]

The indices are:

i = TSP, PM10, PM2.5

j = vehicle category (two-wheel vehicle, passenger car, light-duty truck, heavy-duty vehicle).

Two-wheel vehicles correspond to mopeds and motorcycles. Passenger cars are small or larger family cars used mainly for the carriage of people. Light-duty trucks include vans for the carriage of people or goods. Heavy-duty vehicles correspond to trucks. urban buses and coaches [5].

Activity Data

The activity data on the number of vehicles for the category Passenger cars and Motorcycles have been taken from the publication Transport and othe communication for the period 2003-2014 [38] and chapter transport from the statistical yearbook for the period 1990-2002 [35], the number of Heavy duty (HDV) vehicles have been calculated as sum of numbers of Buses + Goods vehicles + Road tractors. Light duty vehicles (LDV) is not available at the moment. In former years there was however a category called “commercial vehicles” and later “freight cars” which represent LDVs. From the last available year the share was taken to calculate LDVs as a part of the total “goods vehicles”. The category “goods vehicles” plus “road tractors” now correlates with former “special vehicles”. Yearly mileages per vehicle category were provided by the Mechanical Faculty of Skopje.

Table 58 Activity data for the source categories 1A3bvi Road vehicle tire and brake wear and 1A3bvii Road surface wear

Year	2W x Mileage [km]	PCs x Mileage [km]	LDTs x Mileage [km]	HDVs x Mileage [km]
1990	5596151	1623758097	364624335	357046031
1991	5473324	1756600415	383221612	379976496
1992	8223466	1969141086	453867724	434940721
1993	8996382	2040332747	473265390	466679239
1994	4346903	1851778276	410458384	416094438
1995	6905315	2011681586	460129592	474896809
1996	8097643	1998418463	456104105	474355532
1997	10302550	2034879739	466462083	479719096
1998	10683017	2031178729	472582705	485673143
1999	10503269	2039495446	471076090	496449478
2000	11171332	2107943013	488778815	543737410
2001	13430164	2178121470	511472201	599046084
2002	8741739	2164182878	475831344	629308392
2003	6417000	2109498000	448265000	654650000
2004	4140000	1774428000	358100000	615340000
2005	5169000	1800211000	346780000	675610000

Year	2W x Mileage [km]	PCs x Mileage [km]	LDTs x Mileage [km]	HDVs x Mileage [km]
2006	10323000	1724960000	319505000	706385000
2007	14118000	1915348000	327040000	821205000
2008	25875000	1874564000	329716982	813077500
2009	27282000	2009790000	367222156	896444016
2010	23277000	2205249000	381681101	946292282
2011	25119000	2223648000	370832622	936272203
2012	25416000	2141113000	352826216	892923288
2013	24270000	2458887000	402735024	1028991603
2014	25887000	2633300000	431162836	1107184651

Emission factors

Tables 59 and 60 summarizes the emission factors used for the calculation of particulate emissions in the whole reporting period.

Table 59 Emission factors for source category 1A3bvi Road vehicle tyre

Pollutant	Vehicle type	Value	Unit	References
TSP	Two-wheelers	0,0083	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
PM10	Two-wheelers	0,0064	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
PM2.5	Two-wheelers	0,0034	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
TSP	Passenger cars	0,0182	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
PM10	Passenger cars	0,0138	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
PM2.5	Passenger cars	0,0074	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
TSP	Light duty trucks	0,0286	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
PM10	Light duty trucks	0,0216	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
PM2.5	Light duty trucks	0,0177	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
TSP	Heavy duty vehicles	0,0777	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
PM10	Heavy duty vehicles	0,0590	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14
PM2.5	Heavy duty vehicles	0,0316	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14

Table 60 Emission factors for the source category 1A3bvii Road surface wear

Pollutant	Vehicle type	Value	Unit	References
TSP	Two-wheelers	0,006	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
PM10	Two-wheelers	0,003	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
PM2.5	Two-wheelers	0,0016	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
TSP	Passenger cars	0,015	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
PM10	Passenger cars	0,0075	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
PM2.5	Passenger cars	0,0041	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
TSP	Light duty trucks	0,015	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
PM10	Light duty trucks	0,0075	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
PM2.5	Light duty trucks	0,0041	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
TSP	Heavy duty vehicles	0,076	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
PM10	Heavy duty vehicles	0,038	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14
PM2.5	Heavy duty vehicles	0,0205	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tyre and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14

4.5.2. Aviation

These subcategories 1A3ai(ii) and 1A3aii(ii) have been reported for first time.

4.5.2.1. International aviation LTO – NFR 1A3ai(i)

Methodological issues

The approach is based on the number of flights which are available in the BC's transport statistics. There the number of flights are divided into “international LTOs” (regular + charter) and “other operations”. “Other operations” have a share of 9% of total LTOs in 2014 and it is assumed that these flights are operated by private jets running internationally on kerosene.

Activity Data

The Number of LTO were taken from the publication Transport and communications [39] for the period 2005-2014. For the previous year the surrogate method has been used. The estimates of the activity data were related to the passenger numbers.

Table 61 Activity data for source category 1A3ai(i) International aviation LTO civil (number of LTO)

Year	Number of LTO	Year	Number of LTO
1990	11986	2003	12170
1991	11297	2004	11986
1992	10539	2005	13204
1993	14581	2006	13509

Year	Number of LTO	Year	Number of LTO
1994	14351	2007	14174
1995	14305	2008	14323
1996	12307	2009	12800
1997	11067	2010	12721
1998	13249	2011	11873
1999	24156	2012	11284
2000	23168	2013	12380
2001	11664	2014	13968
2002	12767		

Emission factors

The calculationof emissions for emission parameters from 1990-2014 were used emission factors taken from GB 2013. The used emission factors are presented in Table 62.

Table 62 Emission factors for source category 1A3ai(i) International aviation LTO civil

Pollutant	Value	Unit	References
NOx	26	kg/LTO	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (LTO (kg/LTO) — average fleet (B767))
NMVOC	0,2	kg/LTO	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (LTO (kg/LTO) — average fleet (B767))
SOx	1,6	kg/LTO	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (LTO (kg/LTO) — average fleet (B767))
PM2.5	0,15	kg/LTO	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (LTO (kg/LTO) — average fleet (B767))
CO	6,1	kg/LTO	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (LTO (kg/LTO) — average fleet (B767))

4.5.2.2. International aviation cruise (civil) – NFR 1A3ai(ii)

The aircraft data of the national flight authority shows a relatively new fleet composition -> Tier 1 emission factors of average fleet are feasible.

Methodological issues

The total fuel consumption was calculated as sum from gasoline consumption and LTO fuel. The LTO fuel consumption is calculated according this equation:
LTO fuel = number of LTOs x fuel consumption per LTO (1617 kg/LTO)

Activity Data

The activity data for aviation gasoline consumption have been taken from the Energy statistics 2000-2010 [36] for the period 2005-2010, and statistical yearbook chapter energy balance for period 2011-2014. For the previous year the surrogate method has been used. The estimates of the activity data were related to the passenger numbers.

Table 63 Activity data for fuel consumption for source category 1A3ai(ii) International aviation cruise (civil)

Year	Total fuel (t)	Year	Total fuel (t)
1990	352	2003	277
1991	332	2004	163
1992	310	2005	49
1993	428	2006	81
1994	422	2007	102
1995	420	2008	153
1996	362	2009	155
1997	325	2010	117
1998	389	2011	82
1999	710	2012	68
2000	493	2013	129
2001	423	2014	85
2002	775		

Emission factors

Emission factors taken from GB 2013 [5](Cruise (kg/tonne) — average fleet (B767)). These emission factors are given in Table 64 below.

Table 64 Emission factors for 1A3ai(ii) International aviation cruise (civil)

Pollutant	Value	Unit	References
Nox	12,8	kg/t fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (Cruise (kg/tonne) — average fleet (B767))
NMVOC	0,5	kg/t fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (Cruise (kg/tonne) — average fleet (B767))
Sox	1	kg/t fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (Cruise (kg/tonne) — average fleet (B767))
PM2.5	0,2	kg/t fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (Cruise (kg/tonne) — average fleet (B767))
CO	1,1	kg/t fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-3. pg. 9 (Cruise (kg/tonne) — average fleet (B767))

4.5.2.3. Domestic aviation cruise – NFR 1A3aii(ii)

Methodological issues

The cruse fuel is calculated according this equation:
Cruise fuel = total fuel consumption — LTO fuel consumption

The LTO fuel consumption is calculated according this equation:
LTO fuel = number of LTOs x fuel consumption per LTO (1617 kg/LTO)

Activity Data

The activity data for calculation of total fuel consumption are taken from the energy balance from the Statistical yearbooks 1990-1999 [35] as well as from the publication Energy statistics 2000-2010 [36]. Data on jet fuel and aviation gasoline consumption are available starting from 2005. For the

period 1990-2004 the surrogate method has been used. The estimates of the activity data were related to the passenger numbers. The sources of number of LTO have been discussed in the previous chapter. Table 65 provides the Tier 1 calculated activity data.

Table 65 Activity data for source category 1A3aii(ii) Domestic aviation cruise (civil)

Year	Fuel consumption (t)	Year	Fuel consumption (t)
1990	20647	2003	15973
1991	19461	2004	8882
1992	18156	2005	6433
1993	25117	2006	4670
1994	24722	2007	6861
1995	24642	2008	6121
1996	21201	2009	2772
1997	19065	2010	6867
1998	22823	2011	3652
1999	41611	2012	8488
2000	28265	2013	10108
2001	25104	2014	11946
2002	46843		

Emission factors

Emission factors were taken from GB 2013 for all reporting period. These emission factors are given in Table 66 below.

Table 66 Emission factors for NFR-1A3aii(ii)

Pollutant	Value	Unit	References
Nox	4	kg/tonne fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-4. pg. 20
CO	1200	kg/tonne fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-4. pg. 20
NMVOC	19	kg/tonne fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-4. pg. 20
TSP	0	kg/tonne fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-4. pg. 20
PM10	0	kg/tonne fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-4. pg. 20
PM2.5	0	kg/tonne fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-4. pg. 20
SO_2	1	kg/tonne fuel	GB 2013 1.A.3.a. 1.A.5.b Aviation. Table 3-4. pg. 20

4.5.3. Railways-NFR 1A3c

This chapter covers emissions from rail transport and concerns the movement of goods or people by rail. Railway locomotives generally are one of three types: diesel, electric or less frequently, steam.

Diesel locomotives either use only diesel engines for propulsion or in combination with an on-board alternator or generator to produce electricity which powers their traction motors (diesel-electric). These locomotives fall in three categories:

- shunting locomotives;
- rail-cars;
- line-haul locomotives;

Methodology

The Tier 1 approach for railways is a fuel-based methodology and uses the general equation:

$$\mathbf{E}_i = \sum_m \mathbf{FC}_m \times \mathbf{EF}_{i,m}$$

where:

E_i = emissions of pollutant i for the period concerned in the inventory (kg or g)

FC_m = fuel consumption of fuel type m for the period and area considered (tonnes)

EF_i = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

m = fuel type (diesel,gas oil) [5].

Activity Data

The activity data for the diesel oil consumption for the period 1990, 1999-2014 have been taken from the chapter Energy balance from the Statistical yearbooks for that period [35]. For the period 1991-1998 an approach has been develop to complete lacking years in the time series by use of passenger km used as surrogate data.

Table 67 Activity data for diesel fuel consumption in source category 1A3c Railways

Year	Diesel fuel consumption [t]	Year	Diesel fuel consumption [t]
1990	7300	2003	2000
1991	5932	2004	2138
1992	3233	2005	2607
1993	1958	2006	3597
1994	1987	2007	3736
1995	1928	2008	3701
1996	3559	2009	3634
1997	4182	2010	3580
1998	4449	2011	3734
1999	3957	2012	3169
2000	4212	2013	2616
2001	3373	2014	2616
2002	2328		

Emission factors

The calculation of emissions for emission parameters from 1990-2014 were used emission factors taken from GB. 2013 [5]. These emission factors are given in Table 68 below.

Table 68 Emission factors for source category 1A3 Railways

Pollutant	Value	Unit	References
Nox	52,4	kg/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
CO	10,7	kg/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
NMVOC	4,65	kg/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
NH_3	0,007	kg/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
TSP	1,52	kg/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
PM10	1,44	kg/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
PM2.5	1,37	kg/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8

Pollutant	Value	Unit	References
Cd	0,01	g/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Cr	0,05	g/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Cu	1,7	g/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Ni	0,07	g/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Se	0,01	g/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Zn	1	g/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Benzo(a)pyrene	0,03	g/tonne fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Benzo(b)fluoranthene	0,05	g/tonne fuel	GB 2013 . 1.A.3.c Railways. Table 3-1. pg. 8

4.5.4. National navigation – NFR 1A3dii

Emissions from fuels used by vessels of all flags that depart and arrive in the same country (excludes fishing) includes small leisure boats. Republic of Macedonia has three natural lakes, but the lake tourist boat transport is made on Ohrid lake with four boats. Emissions from fuel consumption.

There is no international/maritime navigation (bunkers fuels) – so the source category International maritime bunkers is reported as “NO”.

Methodological issues

The Tier 1 approach for navigation uses the general equation to be applied for the different NFR codes:

$$E_i = \sum_m \left(FC_m \times EF_{i,m}\right)$$

where:

E_i = emission of pollutant i in kilograms;

FC_m = mass of fuel type m sold in the country for navigation (tonnes);

EF_i = fuel consumption-specific emission factor of pollutant i and fuel type m [kg/tonne];

m = fuel type (bunker fuel oil, marine diesel oil, marine gas oil, gasoline).

The FCm x EF product is summed over the four types of fuel used to provide total emissions from navigation.

For the calculation of sulphur emissions it is recommended to take the BC’s country specific sulphur percentage in diesel oil for the different years, compare it with the default percentage in the GB 2013 and change the default SOx EF with a relative factor [5].

Activity Data

The activity data on diesel consumption in lake transport have been provided from the “Kapetanija Ohrid” within the frames of the Ministry of Transport and Communications for 2011. Within the Twinning project the data gaps were filled by using the number of boats and passenger km in lake transport. All data were taken from the Statistical yearbook – chapter transport [35]. Data on sulfur content was reported by the Ministry of Economy.

Table 69 Activity data for diesel fuel oil consumption for soure category 1A3dii National navigation

Year	Diesel fuel oil consumption [t]	Year	Diesel fuel oil consumption [t]
1990	87,93	2003	12,93
1991	15,65	2004	6,26
1992	10,96	2005	19,06
1993	7,08	2006	21,57

1994	10,00	2007	72,34
1995	21,71	2008	174,22
1996	8,71	2009	164,28
1997	6,47	2010	111,06
1998	25,52	2011	57,85
1999	18,03	2012	61,18
2000	21,85	2013	41,38
2001	7,96	2014	50,43
2002	26,47		

Emission factors

For the calculation of emissions for emission parameters from 1990-2014 the used emission factors were taken from GB 2013 [5] These emission factors are given in Table 70 below.

Table 70 Emission factors for ships using marine diesel oil/marine gas oil for source category 1A3dii National navigation

Pollutant	Value	Unit	References
NOx	78,5	kg/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
CO	7,4	kg/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
NMVOC	2,8	kg/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
SOx	20	kg/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
TSP	1,5	kg/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
PM10	1,5	kg/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
PM2.5	1,4	kg/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
Pb	0,13	g/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
Cd	0,01	g/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
Hg	0,03	g/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
As	0,04	g/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
Cr	0,05	g/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
Cu	0,88	g/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
Ni	1	g/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
Se	0,1	g/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
Zn	1,2	g/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International

Pollutant	Value	Unit	References
			navigation. national navigation. national fishing. Table 3-2. pg. 14
PCB	0,038	mg/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
PCDD/F	0,13	µg I-TEC/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14
HCB	0,08	mg/tonne fuel	GB 2013 . 1.A.3.d.i. 1.A.3.d.ii. 1.A.4.c.iii International navigation. national navigation. national fishing. Table 3-2. pg. 14

Planned improvements

In February this year MOI has sent vehicle fleet data for 2014 to MEPP. In March 2016 MEPP signed a Memorandum of understanding with MOI. MEPP is planning to use COPERT model for calculating transport emissions in future.

MEPP will contact the national aviation institution responsible for recording flight movements for international LTO analyses if the flight movements given in the yearly Energy Balance of the national statistics only contain IFR flights (jet kerosene) or also VFR flights (aviation gasoline, used for smaller piston engines.

Recalcualtions

Regarding road transport, in the previous reporting preliminary activity data from energy sector were used for 2013 emissions, however, in this reporting final definitive activity data have been used. Additionally regarding the 1990 emissions coming from the road transport, in the previous reporting activity data – fuel consumption have been taken from Gains model. For this reporting round national activity data have been used.

Regarding NFRs 1A3bv, 1A3biv, and 1A3bvi an improvement was made of the categorization of vehicles reported in the statistical yearbook as fright cars, special vehicles and road tractors in LHV and HDV category.

Compared to 2013 NFR sectors 1A3ai(ii) 1A3aii(ii) subsectors were reported for the first time. For the national navigation emission factors from GB 2013 [5] were used in this reporting roind compared to last year's submission when emission factors from the GB 2009 were used. No recalculations has been performed in Railways sector.

4.6. Small Combustion and Non-road mobile sources and machinery – NFR 1A4

This category includes emissions from commercial/institutional, residential and agricultural fuel combustion which is mainly for heating and hot water generation purpose.

Methodological issues

The Tier1 methodology has been selected by using default emission factors from the Guidebook 2009. The Tier 1 approach for process emissions from small combustion installations uses the general equation:

$$E_{pollutants} = \sum AR_{fuel\ consumption} \times EF_{fuel,pollutnat}$$

where:

$E_{\text{pollutant}}$ = the emission of the specified pollutant,

$AR_{\text{fuelconsumption}}$ = the activity rate for fuel consumption,

$EF_{\text{pollutant}}$ = the emission factor for this pollutant [5].

4.6.1. Commercial/Institutional – stationary combustion – NFR 1A4ai

Within the Commercial/Institutional sector mainly liquid fuels are used. The amount of biomass and coal has been reduced over the year while contribution of natural gas in overall combustion has increased.

Activity data

Activty data for this sector has been taken from the Statistical yearbooks – chapter energy balance for the period 1990 -2014 [35]. For the period activity data were taken from the GHGs inventory.

Table 71 Activity data for the source category 1A4ai Commercial/Institutional – stationary combustion

Year	Biomass [TJ]	Coal [TJ]	Gaseous Fuels [TJ]	Liquid Fuels [TJ]
1990		144		387
1991		144		
1992		243		
1993		152		
1994		152		
1995		152		
1996		152		
1997		152		
1998	712	152		2640
1999	712	607		5649
2000	848	58		1702
2001		33		1202
2002	0	196		15928
2003	311	246		5812
2004	325	656		4180
2005	209	203	22	5141
2006	436	63	26	3016
2007	334	223	30	3811
2008	562	53	29	3338
2009	592	53	33	3650
2010	562	53	79	3189
2011	253	47	83	2144
2012	448	88	91	2501
2013	196	62	109	2476
2014	279	12	198	2275

Emission factors

Emission factors are taken from EB 2013. Emission factors for different type of fuels are -presented in tables 72-75.

Table 72 Emission factors for biomass for source category 1A4ai Commercial/Institutional – stationary combustion

Pollutant	Value	Unit	References
NOx	150	g/GJ	GB 2009 Table 3-10 emission factor for source category

Pollutant	Value	Unit	References
			1.A.4.a.i.
NMVOC	146	g/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
SOx	38,4	g/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
PM2.5	149	g/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
PM10	150	g/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
TSP	156	g/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
CO	1600	g/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
Pb	24,8	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
Cd	1,8	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
Hg	0,7	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
As	1,4	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
Cr	6,5	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
Cu	4,6	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
Ni	2	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
Se	0,5	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
Zn	144	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
PCB	0,06	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
PCDD/ PCDF	326	ng I-TEQ/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
benzo(a) pyren	44,6	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
benzo(b) fluoranthen	64,9	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
benzo(k) fluoranthen	23,4	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
Indeno (1.2.3-cd) pyren	22,3	mg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.
HCB	6	µg/GJ	GB 2009 Table 3-10 emission factor for source category 1.A.4.a.i.

Table 73 Emission factors for solid fuels for source category 1A4ai Commercial/Institutional – stationary combustion

Pollutant	Value	Unit	References
NOx	173	g/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.

Pollutant	Value	Unit	References
NMVOC	88,8	g/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
SOx	900	g/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
PM2.5	108	g/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
PM10	117	g/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
TSP	124	g/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
CO	931	g/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
Pb	134	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
Cd	1,8	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
Hg	7,9	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
As	4	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
Cr	13,5	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
Cu	17,5	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
Ni	13	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
Se	1,8	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
Zn	200	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
PCB	170	µg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
PCDD/ PCDF	203	ng I-TEQ/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
benzo(a) pyren	45,5	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
benzo(b) fluoranthen	58,9	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
benzo(k) fluoranthen	23,7	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
Indeno (1.2.3-cd) pyren	18,5	mg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.
HCB	0,62	µg/GJ	GB 2013 Table 3-7 emission factor for source category 1.A.4.a.i.

Table 74 Emission factors for gaseous fuels for source category 1A4ai Commercial/Institutional – stationary combustion

Pollutant	Value	Unit	References
NOx	70	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
NMVOC	2,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.

Pollutant	Value	Unit	References
SOx	0,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
PM2.5	0,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
PM10	0,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
TSP	0,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
CO	25	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
Pb	0,984	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
Cd	0,515	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
Hg	0,234	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
As	0,0937	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
Cr	0,656	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
Cu	0,398	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
Ni	0,984	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
Se	0,0112	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
Zn	13,6	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
PCDD/ PCDF	2	ng I-TEQ/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
benzo(a) pyren	0,562	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
benzo(b) fluoranthen	0,843	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
benzo(k) fluoranthen	0,843	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.
Indeno (1.2.3-cd) pyren	0,843	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i.

Table 75 Emission factors for biomass for source category 1A4ai Commercial/Institutional – stationary combustion

Pollutant	Value	Unit	References
NOx	100	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
NMVOC	10	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
SOx	140	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
PM2.5	16,5	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
PM10	21,5	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.

Pollutant	Value	Unit	References
TSP	27,5	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
CO	40	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
Pb	16	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
Cd	0,3	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
Hg	0,1	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
As	1	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
Cr	12,8	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
Cu	7,2	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
Ni	260	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
Zn	8	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
PCDD/ PCDF	10	ng I-TEQ/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
benzo(a) pyren	5,2	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
benzo(b) fluoranthen	6,2	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
benzo(k) fluoranthen	4	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.
Indeno (1.2.3-cd) pyren	2,2	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i.

4.6.2. Residential – stationary combustion – NFR 1A4bi

Within the Residential sector mainly solid biomass is used while liquid fuels, solid fuels and natural gas have minor importance.

A new survey 'Energy consumption in households. 2014' from has been conducted in 2015 by the *State Statistical Office* and published in 2016 [38]. For this survey a representative sample of 3500 households was selected.

Beside other information the report provides information about construction age, average area of dwellings and heated area, type of insulation and finally the total energy consumption of the approximately 559 thousands households.

The following table presents energy consumption of households in 2014.

Table 76 Consumption and Number of households using the type of energy

Type of energy	Consumption	Number of households using the type of energy
Electricity	3 118 365 (MWh)	559 187
Fuel wood	1 328 979 (m^3)	345 658
Wood of fruit trees and other plant residues	31 243 (m^3)	27 242
Wood residues. wood briquettes and pellets	19 404 (t)	8 078

Coal	4 462 (t)	2 555
LPG	5 585 (t)	87 739
Natural gas	49 460 (Nm^3)	N/A
Heating oil	4 822 (m^3)	3 6 33
Derived heat	317 082 (MWh)	46 590
Wood mass consumed for other purposes (for food in winter. producing brandy. etc.)	149 366	N/A

Activity data

The outcome of the survey shows that biomass consumption is a factor of 2.5 higher than the final energy consumption published in official energy statistics. Therefore, the activity data for biomass has been adjusted by multiplying the energy consumption from energy statistics by this factor for whole reporting period.

Since energy statistics is not available for 1991 to 1997 for this source category, the consumption of biomass, liquid fuels and coal has been gap filled by backward linear trend interpolation of 1998-2010 energy statistics.

Table 77 Activity data for source category 1A4bi Residential:Stationary

Year	Biomass [TJ]	Coal [TJ]	Gaseous Fuels [TJ]	Liquid Fuels [TJ]
1990	19,518	186		397
1991	17,288	333		863
1992	17,758	323		921
1993	15,814	313		980
1994	13,688	304		1038
1995	14,961	294		1097
1996	16,774	284		1156
1997	16,024	275		1214
1998	16,024	213		1225
1999	16,024	276		1316
2000	16,024	235		1394
2001	15,273	177		1435
2002	16,028	227		1513
2003	19,040	228		1577
2004	14,811	248		1657
2005	14,654	249		1700
2006	16,315	305		1775
2007	16,271	228		1907
2008	14,629	128		1828
2009	15,688	85		1912
2010	13,280	95		1872
2011	16,335	44		1827
2012	18,250	47	435	1470
2013	18,759	55	468	771
2014	17,953	82		562

Emission factors

For biomass the default emission factors of the Guidebook 2013 (table 3-17. Conventional stoves) have been selected for NO_X, NMVOC, SO_2, CO, NH_3, TSP, PM10 and PM2.5.

For all other fuels and heavy metals and POPs the default emission factors of the Guidebook 2009 [6] have been selected. Emission factors for different type of fuels are presented in the four following tables.

Table 78 Emission factors for biomass for source category 1A4bi Residential:Stationary

Pollutant	Value	Unit	References
NOx	74,5	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
NMVOC	925	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
SOx	20	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
NH_3	3,8	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
PM2.5	695	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
PM10	695	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
TSP	730	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
CO	5300	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
Pb	40	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
Cd	1,4	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
Hg	0,5	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
As	1	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
Cr	2,9	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
Cu	8,6	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
Ni	4,4	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
Se	0,5	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
Zn	130	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
PCB	0,06	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
PCDD/ PCDF	700	ng I-TEQ/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
benzo(a) pyren	210	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
benzo(b) fluoranthen	220	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
benzo(k) fluoranthen	130	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
Indeno (1.2.3-cd) pyren	140	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i
HCB	6	µg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i

Table 79 Emission factors for coal for source category 1A4bi Residential:Stationary

Pollutant	Value	Unit	References
NOx	110	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
NMVOC	484	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
SOx	900	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
NH_3	0,3		
PM2.5	398	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
PM10	404	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
TSP	444	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
CO	4600	g/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
BC	6,4	% of PM2.5	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
Pb	130	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
Cd	1,5	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i

Pollutant	Value	Unit	References
Hg	5,1	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
As	2,5	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
Cr	11,2	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
Cu	22,3	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
Ni	12,7	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
Se	1	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
Zn	220	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
PCB	170	µg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
PCDD/ PCDF	800	ng I-TEQ/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
benzo(a) pyren	230	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
benzo(b) fluoranthen	330	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
benzo(k) fluoranthen	130	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
Indeno (1.2.3-cd) pyren	110	mg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i
HCB	0,62	µg/GJ	GB 2013 Table 3-3 emission factor for source category 1.A.4.b.i

Table 80 Emission factors for natural gas for source category 1A4bi Residential:Stationary

Pollutant	Value	Unit	References
NOx	57	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
NMVOC	10,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
SOx	0,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
PM2.5	0,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
PM10	0,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
TSP	0,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
CO	31	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
Pb	0,984	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
Cd	0,515	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
Hg	0,234	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
As	0,0937	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
Cr	0,656	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
Cu	0,398	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
Ni	0,984	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
Se	0,0112	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
Zn	13,6	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
PCDD/ PCDF	0,5	ng I-TEQ/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
benzo(a) pyren	0,562	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
benzo(b) fluoranthen	0,843	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
benzo(k) fluoranthen	0,843	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i
Indeno (1.2.3-cd) pyren	0,843	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i

Table 81 Emission factors for natural gas for source category 1A4bi Residential:Stationary

Pollutant	Value	Unit	References
NOx	68	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
NMVOC	15,5	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
SOx	140	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
PM2.5	3,7	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
PM10	3,7	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
TSP	6	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
CO	46	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
Pb	15,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
Cd	1,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
Hg	0,03	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
As	0,9	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
Cr	15,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
Cu	7,9	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
Ni	240	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
Zn	8,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
PCDD/ PCDF	10	ng I-TEQ/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
benzo(a) pyren	22	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
benzo(b) fluoranthen	25,7	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
benzo(k) fluoranthen	12,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i
Indeno (1.2.3-cd) pyren	14,8	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i

4.6.3. Residential: Household and gardening (mobile)– NFR 1A4bii

The emissions of this subsector come from mobile combustion (the combustion of fuel to power the equipment) used in residential areas: households and gardening land-based mobile machinery.

The species for which it is the more important are SO_2, NOx, CO2 PM, CO and non-methane volatile organic compounds (NMVOCs). The emissions of CO_2 and SO_2 are predominantly fuel-based and independent of engine technology/type of equipment.

Methodology

For the Tier 1 approach emissions are estimated using the equation:

$E_{pollutants} = \sum_{fueltype} FC_{fueltype} \times EF_{pollutants,fueltype}$ Where:

Epollutant = the emission of the specified pollutant,

FCfuel type = the fuel consumption for each fuel (diesel, LPG, four-stroke gasoline and two-stroke gasoline) for the source category

EFpollutant = the emission factor for this pollutant for each fuel type[5].

Activity data

Activity data for this source have been taken from the NFR tables reported in 2013. Regarding the source of activity data in the IIR 2010 [10] it was emphasized that all activity data were taken from Energy balances. Due to the fact that energy balances for the period 1990-2000 contain only data on

total petroleum products, an expert judgment has been used for determination of gasoline consumed in this category.

Due to the lack of background information on the implemented expert judgment as well as no available surrogate data on number of the off road machinery used in the households and gardening no calculation of the activity data from 2001 onwards has been applied.

Table 82 Activity data for source category 1A4bii Residential: Household and gardening (mobile)

Year	Gasoline consumption [TJ]
1990	48,62
1991	29,9
1992	56,1
1993	31,8
1994	31,8
1995	38,8
1996	38,4
1997	38,0
1998	38,2
1999	35,2
2000	34,4

Emission factors

Emission factors are taken from EB 2009. For the HM default emissions, factors from the guidebook have been used. With regards to other pollutants, EF are calculated as averages between EF for gasoline: two strike and gasoline: four strike engines. Emission factors used in calculation of emissions coming from this sector are -presented in table 83.

Table 83 Emission factors for source category 1A4bii Residential: Household and gardening (mobile)

Pollutant	Value	Unit	References
NOx	4941	g/tonne fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
NMVOC	129899,5	g/tonne fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
SOx	40,0	ppm	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
NH_3	3,5	g/tonne fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
TSP	1959,5	g/tonne fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
CO	695580,5	g/tonne fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
Pb	0,00013	kg/l fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.20
Cd	0,01	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.
Cr	0,05	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.

Pollutant	Value	Unit	References
Cu	1,70	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.
Ni	0,07	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.
Se	0,01	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.
Zn	1	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.

4.6.4. Agriculture/Forestry/Fishing: Stationary – NFR 1A4ci

Within the agriculture and forestry sector mainly liquid fuels (Residual fuel oil, gasoil and LPG) are used, while solid biomass and coal (lignite) have minor importance.

Activity data

The activity data have been taken from the Statistical yearbooks – energy sector for the whole reporting period [35].

Table 84 Activity data for source category 1A4ci Agriculture/Forestry/Fishing: Stationary

Year	Biomass [TJ]	Coal [TJ]	Gaseous Fuels [TJ]	Liquid Fuels [TJ]
1990		32,78208		1302
1991		33,41493		1545,235
1992		33,08283		1321,978
1993		33,31204		943,5977
1994		33,3377		890,333
1995		33,57047		984,7882
1996		33,51847		1124,645
1997		33,67497		874,6727
1998		0,022415		828,8763
1999		0,063526		959,1264
2000		1,90485		1260,63
2001		0,37485		998,088
2002		0,00765		570,7749
2003	14,07214	1,3617		456,596
2004	18,07457	1,84365		1507,755
2005	22,03457	0,80		967,457
2006	20,394	0,25		801,649
2007	19,06457	0,25		512,99
2008	27,56	0,59		549,712
2009	41,20	0,11		387,043
2010	42,09	0,11		729,323
2011	49,10	0,11		628,144
2012	51,46614	0,08415	32,64	598,216
2013	86,92398	36,3069	48,874	502,6442
2014	77,81994	33,5835		485,0583

Emission factors

The emission factors for all fuels have the same tables in Commercial/institutional tables 1.A.4.a.i chapter, with the exception of the value for NMVOC (15.5/10) regarding the liquid fuels table.

4.6.5. Agriculture/Forestry/Fishing: Off-road vehicles and other machinery – NFR 1A4cii

Activity data

The activity data for the period have been taken from the energy balance in the frame of Statistical yearbooks for the reporting period [35]. Regarding the missing activity data, the number of off road vehicles used in agriculture sector (taken form the chapter agriculture in the statistical yearbook) has been used as surrogate data for estimation of the fuel consumption.

Table 85 Activity data for source category 1A4cii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

Year	Diesel [TJ]	LPG [TJ]	Gasoline[TJ]
1990	9558		2441
1991	12917		1326
1992	11276		909
1993	7651		1046
1994	7364		842
1995	8305		772
1996	9482		884
1997	6932		1130
1998	7346		294
1999	8149		692
2000	11598		985
2001	9574		813
2002	5325		452
2003	4260		362
2004	14066		1195
2005	1865		393
2006	711		620
2007	674		339
2008	140	24	341
2009	610	17	336
2010	540	15	351
2011	564	16	394
2012	3762	14	379
2013	5710	19	368
2014	6007	20	390

Emission factors

Emission factors for calculation of emissions in this sector have been taken from the GB 2013 [5] and are presented in the following table.

Table 86 Emission for source category 1A4cii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

Pollutant	Value	Unit	References
NOx	35043	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
NMVOC	3366	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
PM2.5	1738	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
PM10	1738	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
TSP	1738	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
CO	10939	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
Cd	0,01	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
Cr	0,05	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
Cu	1,70	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
Ni	0,07	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
Zn	1	mg/GJ	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
benzo(a) pyren	30	µg/GJ	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture
benzo(b) fluoranthen	50	µg/GJ	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture

Table 87 Emission factors for LPG source category 1A4cii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

Pollutant	Value	Unit	References
NOx	61093	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii
NMVOC	6720	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii
PM2.5	225	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii
PM10	225	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii
TSP	225	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii
CO	4823	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii

Planned improvements

No planned improvements in the 1A4 sector.

Recalculations

The consumption of the main fuel, biomass, has been recalculated for the whole time series. Information from the new survey 'Energy consumption in households, 2014' [37] that has been conducted in 2015 by the State Statistical Office and published in 2016 was used for re-estimation of the biomass consumption.

Activity data for fuel consumption from the final energy balance for 2013 has been used.

4.7. Fugitive emission from fuels - NFR 1 B

Fugitive emission arise from coal mining, production, distribution, storage and distribution of oil products.

4.7.1. Coal mining and handling – NFR 1B1a

Methodological issues

This is one of the small number of subcategories for which Tier 2 method was used.

$E_{pollutants} = \sum_{tehnologies} AR_{production,tehnology} \times EF_{tehnology,pollutant}$

where:

$E_{pollutant}$ = the emission of the specified pollutant,

$AR_{fuelconsumption}$ = the production rate the source category, for specific technology,

$EF_{pollutant}$ = the emission factor for this technology and this pollutant [5]

Activity data

Data on coal mined has been taken from the Statistical Yearbook of the Republic of Macedonia – chapter on Industrial production for the whole reporting period [35].

Table 88 Activity data for source category 1B1a Fugitive emission from solid fuels: Coal mining and handling

Year	Coal mined [Mg]	Year	Coal mined [Mg]
1990	6643409	2003	7271202
1991	6978171	2004	7296136
1992	6472920	2005	6882862
1993	6917774	2006	6653474
1994	6859762	2007	6569220
1995	7249237	2008	7669103
1996	7145667	2009	7395915
1997	7442876	2010	6583074
1998	8144653	2011	7902084
1999	7277623	2012	7309546
2000	7513998	2013	6633560
2001	8142082	2014	6681752
2002	7571202		

Emission factors

Tier 2 emission factors has been used in the calculations starting from 2015, due to the fact that all coal mines are categorized as open mines.

Table 89 Emission factors for 1B1a Fugitive emission from solid fuels: Coal mining and handling

Pollutant	Value	Unit	References
NMVOC	0,2	kg/Mg	Table 3-2 Tier 2 emission factors for source category 1.B.1.a Coal mining and handling, Open cast mining
PM10	0,039	kg/Mg	Table 3-2 Tier 2 emission factors for source category 1.B.1.a Coal mining and handling, Open cast mining
PM2.5	0,06	kg/Mg	Table 3-2 Tier 2 emission factors for source category 1.B.1.a Coal mining and handling, Open cast mining

Pollutant	Value	Unit	References
TSP	0,082	kg/Mg	Table 3-2 Tier 2 emission factors for source category 1.B.1.a Coal mining and handling, Open cast mining

4.7.2. Fugitive emissions oil:Refining/storage –NFR 1B2aiv

Emissions of NMVOCs to the atmosphere occur in nearly every element of the oil products distribution chain. The vast majority of emissions occur due to the storage and handling of gasoline due to their much higher volatility compared to other fuels such as gasoil, kerosene, etc.

Methodological issues

The Tier 1 approach for the refining industry uses the general equation:

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

This equation is applied at national level, using the total refined oil production as production statistics. It is also possible to use the crude oil throughput as production statistics [5].

Activity data

The activity data on crude oil input are taken from the energy balance in the frames of the Statistical Yearbook of the Republic of Macedonia [35] for the whole reporting period and are presented in the following table.

Table 90 Activity data for source category 1B2aiv Fugitive emissions oil:Refining/storage

Year	Crude oil input [Mg]	Year	Crude oil input [Mg]
1990	1216491	2003	78749
1991	964033	2004	975262
1992	566701	2005	946747
1993	1018201	2006	1067096
1994	143148	2007	1050007
1995	119437	2008	1061736
1996	696341	2009	972532
1997	379759	2010	853000
1998	754775	2011	705144
1999	765412	2012	259606
2000	1043104	2013	59676
2001	1012872	2014	7274
2002	648137		

Emission factors

Emission factors for emission estimations in this sector are presented in the following table and are directly taken from GB 2013 [5].

Table 91 Emission factors for source category 1B2aiv Fugitive emissions oil:Refining/storage

Pollutant	Value	Unit	References
NOx	0,24	kg/Mg crude oil	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
NMVOC	0,2	kg/Mg crude oil	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
SOx	0,62	kg/Mg crude oil	GB 2013 Table 3-1 emission factor for source category

Pollutant	Value	Unit	References
			1.B.2.a.iv
NH_3	0,0011	kg/Mg crude oil	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
PM2.5	0,0043	kg/Mg crude oil	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
PM10	0,0099	kg/Mg crude oil	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
TSP	0,016	kg/Mg crude oil	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
CO	0,09	kg/Mg crude oil	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
Pb	0,0051	g/MG crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
Cd	0,0051	g/MG crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
Hg	0,0051	g/MG crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
As	0,0051	g/MG crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
Cr	0,0051	g/MG crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
Cu	0,0051	g/MG crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
Ni	0,0051	g/MG crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
Se	0,0051	g/MG crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
Zn	0,0051	g/MG crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv
PCDD/ PCDF	0,0057	µg/Mg crude oil input	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.iv

4.7.3. Distribution of oil products – NFR 1B2v

This chapter is about the distribution of oil products, in particular (but not limited to) gasoline distribution.

Methodological issues

The Tier 1 approach for process emissions from combustion uses the general equation:

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

$E_{pollutant}$ = the emission of certain pollutant

$AR_{production}$ = activity rate by fuel gasoline sold

$EF_{pollutant}$ = emission factor for the selected pollutant [5].

Activity data

The oil products taken into account in this source category are as follows: The activity data regarding distributed oil products are calculated as the difference between produced and imported products reduced by the quantity of exported oil products. Activity data for the produced oil products were

taken from the publication Industry in the Republic of Maceonia for the period 2005-2014 [40] and the Industry chapter within the Statistical yearbooks of the Republic of Macedonia [35] for the previous period. Activity data on the imported and exported oil products are taken from External trade chapter within the Statistical yearbooks of the Republic of Macedonia [35] for the whole reporting period. The quantity of distributed oil is presented in the following table.

Table 92 Activity data for source category 1B2av Distribution of oil products

Year	Distributed oil (Mg)	Year	Distributed oil (Mg)
1990	592133	2003	338459
1991	457295	2004	383553
1992	278185	2005	402385
1993	597143	2006	409568
1994	117255	2007	454633
1995	828450	2008	456165
1996	334711	2009	447263
1997	459252	2010	516450
1998	484508	2011	566686
1999	514251	2012	572365
2000	394487	2013	626447
2001	959035	2014	598267
2002	178107		

The emission factor from GB 2013 [5] has been used for calculations.

Table 93 Emission factors for for source category 1B2av Distribution of oil products for NMVOC

Pollutant	Value	Unit	References
NMVOC	2	kg/Mg oil	GB 2013 Table 3-1 emission factor for source category 1.B.2.a.v

4.7.4. Venting and flaring – 1B2c

Methodological issues

The Tier 1 approach for process emissions from combustion uses the general equation:

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

This equation is applied at national level, using annual totals for venting and flaring [5].

Activity data

The activity data for this source category are taken for the years 2004, 2008 and 2010 from the previous informative reports ([7],[9],[10]) which were originally obtained from the refinery. For the period 1990-1999 the activity data were taken from the reported data for the this period in the 2013 reporting round (there is no pointed source where this data are coming from). For the other years a gap filling method has been implemented by using data on quantity of crude oil processed as surrogate data. The consumption of refinery feed has been requested from the refinery but these data were not reported.

Table 94 Activity data for source category 1B2c Venting and flaring

Year	Refinery feed [TJ]	Year	Refinery feed [TJ]
1990	325	2003	156
1991	186	2004	201

1992	109	2005	188
1993	196	2006	212
1994	28	2007	209
1995	23	2008	211
1996	134	2009	193
1997	73	2010	165
1998	146	2011	140
1999	148	2012	52
2000	188	2013	12
2001	201	2014	1
2002	129		

Emission factors

Emission factors are taken from the IIR 2010 [10] expressed in TJ.

Table 95 Emission factors for source category 1B2c Venting and flaring

Pollutant	Value	Unit	References
NOx	100	g/GJ refinery feed	IIR 2010 Table 72 page 74
NMVOC	5	g/GJ refinery feed	IIR 2010 Table 72 page 74
SOx	15	g/GJ refinery feed	IIR 2010 Table 72 page 74
CO	24	g/GJ refinery feed	IIR 2010 Table 72 page 74

Planned improvments

No planned improvements in 1B sector.

Recalcualtions

Recalculation in NFR sectors due to use of activity data for fuel consumption from the final energy balance for 2013. No recalculation in 1B1a has been performed. Emissions in the source category 1Baiv has been reported for the first time for 1990 base year emissions. The activity data for calculation of emissions coming from the subsector 1Baiv received by the company has been replaced with the figure from the final energy balance data for 2013. Activity data for 1Bav were replaced due to the available data on import and export statistics of oil products. Emissions coming from 1Bc sector were calculated with use of gap filing method and use of quantity of crude oil as surrogate data.

5. INDUSTRIAL PROCESSES (NFR SECTOR 2)

5.1. Sector overview

This chapter includes information on the estimation (calculation) of the emissions of NEC gases, CO, particle matter (PM), heavy metals (HM) and persistent organic pollutant (POP) as well as activity data and their references and emission factors reported under NFR category Industrial Processes (taken from EMEP Guidebooks 2009/2013) for the period from 1990-2014.

This category comprises emissions from the following sub categories: Mineral Products, Chemical Industry, Metal Production and Other products and solvents used.

Only process related emissions are considered in this Sector. Emissions due to fuel combustion in manufacturing industries are allocated in NFR Category 1 A 2 Fuel Combustion – Manufacturing Industries and Construction.

Some categories in this sector like those categorized as chemical production are not occurring (NO) in Macedonia, as there is no such production. For some categories emissions have not been estimated (NE) or are included elsewhere (IE).

5.2. General description

Completeness

Table 96 NFR categories covered in Industrial processes sector for 2010

NFR sector	Completeness
2 A 1 Cement production	√
2 A 2 Lime production	√
2 A 5 Asphalt roofing	√
2 A 6 Road paving with asphalt	√
2 A 7 a Quarrying and mining of minerals other than coal	√
2 A 7 b Construction and demolition	√
2A 7 c Storage. handling and transport of mineral products	√
2 C 1 Iron and steel production	√
2 C 2 Ferroalloys production	√
2 C 3 Aluminum production	√
2 C 5 b Lead production	√
2 D 2 Food and drink	√
2 D 3 Wood processing	√
2 A 3 Limestone and dolomite use	NE
2 A 4 Soda ash production and use	NE
2 A 7 d Other Mineral products	NE
2 B 1 Ammonia production	NO
2 B 2 Nitric acid production	NO
2 B 3 Adipic acid production	NO
2 B 4 Carbide production	NO
2 B 5 a Other chemical industry	NE
2 B 5 b Storage. handling and transport of chemical products	NE
2 C 5 a Copper production	NO
2 C 5 c Nickel production	NO

NFR sector	Completeness
2 C 5 d Zinc production	NO
2 C 5 e Other metal production	NE
2 C 5 f Storage. handling and transport of metal products	NE
2 D 1 Pulp and paper	NE
2 E Production of POPs	NO
2 F Consumption of POPs and heavy metals (e.g. electrician and scientific equipment)	NE
2 G Other production. consumption. storage. transportation or handling of bulk products	NE

Methodology

The Tier 1 approach for process emissions from production uses the general equation:

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

$E_{pollutant}$ = the emission of certain pollutant

$AR_{production}$ = the activity rate (data) for the production

$EF_{pollutant}$ = emission factor for the selected pollutant [5].

5.3. Mineral products – NFR 2A

5.3.1. Cement production – 2A1

In the Republic of Macedonia there is only one installation (factory) for cement production named Cementarnica USJE AD Skopje.

Methodological issues

The Tier 1 approach for process emissions from cement uses the general equation:

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

where:

$E_{pollutant}$ = the emission of a pollutant (kg),

$AR_{production}$ = the annual production of cement (in Mg),

$EF_{pollutant}$ = is the emission factor of the relevant pollutant (in kg pollutant / Mg cement produced)[

Activity Data

The activity data for the whole reporting period was recived from the operator itself [5].

Table 97 Activity data for source category 2A1 cement production

Year	Clinker produced (t)	Year	Clinker produced (t)
1990	491900	2003	602570
1991	465380	2004	643260
1992	396500	2005	694920
1993	413440	2006	801300
1994	375910	2007	882830
1995	365120	2008	843770
1996	396020	2009	478400
1997	475250	2010	588980
1998	346870	2011	687990
1999	427080	2012	645480
2000	614160	2013	577850

Year	Clinker produced (t)	Year	Clinker produced (t)
2001	716960	2014	518200
2002	739490		

Emission factors

For calculation (estimation) of emissions for PM2.5, PM10 and TSP for the period 1990-2014 emission factors were taken from GB 2013 [5].

These emission factors are given in table below:

Table 98 Emission factors for source category 2A1 cement production

Pollutant	Value	Unit	References
PM10	234	g/Mg clinker	GB 2013 2.A.1 Cement production. Table 3-1. pg. 10
PM2.5	130	g/Mg clinker	GB 2013 2.A.1 Cement production. Table 3-1. pg. 10
TSP	260	g/Mg clinker	GB 2013 2.A.1 Cement production. Table 3-1. pg. 10

5.3.2. Lime production – NFR 2A2

Methodological issues

For estimation of emission from lime production Tier 1 method is used, where lime produced was taken as activity data.

Activity Data

The activity data for the period 1990 – 1999 have been taken from Statistical Yearbook - chaper industry [35], while activity data for the period 2000-2013 were taken from the International Mineral yearbook. No data were available for 2008 and 2014.

Table 99 Activity data for source category 2A2 Lime production

Year	Lime produced (t)	Year	Lime produced (t)
1990	37452	2003	500
1991	29194	2004	500
1992	33872	2005	15009
1993	24904	2006	12704
1994	14097	2007	7517
1995	12538	2008	NE
1996	9707	2009	2713
1997	4344	2010	2700
1998	964	2011	2700
1999	4264	2012	2700
2000	1000	2013	2700
2001	500	2014	
2002	500		

Emission factors

For the calculation (estimation) of emissions for PM2.5. PM10 and TSP for the period 1990-2013 emission factors were taken from GB 2013 [5].

These emission factors are given in Table 100 below.

Table 100 Emission factors for source category 2A2 Lime production

Pollutant	Value	Unit	References
PM10	3500	g/Mg lime	GB 2013 2.A.2 Lime production, Table 3-1, pg. 8
PM2.5	700	g/Mg lime	GB 2013 2.A.2 Lime production, Table 3-1, pg. 8
TSP	9000	g/Mg lime	GB 2013 2.A.2 Lime production, Table 3-1, pg. 8

5.3.3. Glass production – NFR 2A3

The glass production in Macedonia was ongoing in the installation "Staklara" during the nineties. Currently there are small installations in which glass is not produced but it is only processed.

Methodological issues

Tier 2 method has been implemented for estimation of emissions coming from this source category bearing in mind data that were available for flat glass and glass wool produced.

$$E_{pollutants} = \sum_{tehnologies} AR_{production,tehnology} \times EF_{production,tehnology}$$

where:

$AR_{production,tehnology}$ = the production rate within the source category, using this specific technology,

$EF_{pollutant}$ = the emission factor for this technology and this pollutant [5].

Activity Data for source category 2A3 Flat glass production

The activity data for both flat glass production and glass wool production are presented below. The activity data for flat glass production for the period 1990-1992 are taken from the statistical yearbooks for that period [35].

Table 101 Activity data for 2A3 Flat glass production

Year	Flat glass produced [t]	Year	Flat glass produced [t]
1990	448	2003	NO
1991	32	2004	NO
1992	179	2005	NO
1993	NO	2006	NO
1994	NO	2007	NO
1995	NO	2008	NO
1996	NO	2009	NO
1997	NO	2010	NO
1998	NO	2011	NO
1999	NO	2012	NO
2000	NO	2013	NO
2001	NO	2014	NO
2002	NO		

Emission factors

For the estimation of emission parameters from 1990-1992 the used emission factors were taken from GB 2013 [5]. These emission factors are given in Table 102 below.

Table 102 Emission factors for source category 2A3 Flat glass production

Pollutant	Value	Unit	References
PM10	130	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
PM2.5	120	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
TSP	100	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Pb	0.4	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Cd	0.068	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Hg	0.003	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
As	0.08	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Cr	0.08	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Cu	0.007	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Ni	0.74	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Se	0.15	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Zn	0.37	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16

Activity Data for source category 2A3 glass wool production

The activity data for glass wool production were taken from Statistical yearbooks- chapter industry for the period 1990-1998 [35].

Table 103 Activity data for source category 2A3 glass wool production

Year	Glass wool produced [t]	Year	Glass wool produced [t]
1990	2739	2003	NO
1991	1176	2004	NO
1992	1828	2005	NO
1993	444	2006	NO
1994	1332	2007	NO
1995	3043	2008	NO
1996	1454	2009	NO
1997	961	2010	NO
1998	960	2011	NO
1999	NO	2012	NO
2000	NO	2013	NO
2001	NO	2014	NO
2002	NO		

Emission factors

For the estimation of emission parameters for the period 1990-1998 coming from this source category, the used emission factors were taken from GB 2013 [5].

These emission factors are given in Table 104 below.

Table 104 Emission factors for Glass wool production

Pollutant	Value	Unit	References
NMVOC	500	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-5. Glass wool production pg. 19
NH_3	1400	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-5. Glass wool production pg. 19
PM2.5	520	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-5. Glass wool production pg. 19

PM10	590	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-5. Glass wool production pg. 19
TSP	670	g/Mg glass	GB 2013 2.A.3 Glass production. Table 3-5. Glass wool production pg. 19

5.3.4. Quarrying and mining of minerals other than coal – NFR 2A5a

This subchapter elaborates quarrying and mining of minerals other than coal and it does not include emissions from the combustion of fuels in the plant or transport machinery.

Methodological issues

Tier 1 method is used for calculation of emissions coming from this sector. The quantity of different minerals (like marble, talk, silica, gypsum, etc.) was summarized for calculation of activity data per reporting year [5].

Activity Data

The activity data for mineral produced are taken from the Statistical yearbook for the period 1990-2004 [35], while activity data for the period 2005-2014 are taken from the statistical Industry in the Republic of Macedonia publication [40].

Table 105 Emission factors for minerals produced for source category 2A5 Quaring and mining the minerals other than coal

Year	Mineral produced [t]	Year	Mineral produced [t)]
1990	6117811	2003	739786
1991	5730999	2004	347795
1992	5299552	2005	2827908
1993	5246466	2006	4605478
1994	4817372	2007	4473612
1995	5215134	2008	4598850
1996	5233110	2009	3766500
1997	5528418	2010	5659141
1998	5158798	2011	5606998
1999	4658946	2012	6042327
2000	4917560	2013	6179618
2001	3488792	2014	6109330
2002	2855005		

Emission factors

For estimation of emissions for PM2.5. PM10 and TSP the used emission factors were taken from GB 2013. These emission factors are given in Table 106 below.

Table 106 Emission factors for minerals produced for 2A5 source category Quarrying and mining of minerals other than coal

Pollutant	Value	Unit	References
TSP	102	g/Mg mineral	GB 2013 2.A.5.a Quarrying and mining of minerals other than coal. Table 3-1. pg. 5
PM10	50	g/Mg mineral	GB 2013 2.A.5.a Quarrying and mining of minerals other than coal. Table 3-1. pg. 5
PM2.5	5.0	g/Mg mineral	GB 2013 2.A.5.a Quarrying and mining of minerals other than coal. Table 3-1. pg. 5

5.3.5. Construction and demolition – NFR 2A5b

This subchapter elaborates emissions from construction and demolition works. This activity mainly results in emissions of particulates, but other pollutants may also be emitted, depending on the materials used in the work. At construction sites, construction materials are used to construct items including buildings and infrastructure. At demolition sites, a building, infrastructure or other constructions are torn down, resulting in a lot of rubbish.

Methodological issues

Tier 1 method has been applied for estimation of emissions coming from this source category where the activity data refer to floor area in m^2 of the building constructed or demolished.

Activity Data

Activity data on constructed dwellings and number of demolished dwellings are taken from Statistical yearbooks - Chapter Industry, Energy and Construction. There are only data for area of constructed dwellings, as well as number of demolished dwellings. The area of demolished dwellings is calculated when the number of constructed dwellings per year is multiplied with an average dwelling area of 65 m^2. Summarized data are presented in the following table

Table 107 Activity data for constructed and demolished area for source category 2.A.5.b Construction and demolition

Year	kg/m^2/year	Year	kg/m^2/year
1990	1810252	2003	952813
1991	1532878	2004	1021573
1992	1375918	2005	961766
1993	1203495	2006	1016189
1994	1017799	2007	892385
1995	949006	2008	817091
1996	927963	2009	858076
1997	843602	2010	920066
1998	793938	2011	958890
1999	940300	2012	967773
2000	897868	2013	924887
2001	957742	2014	803889
2002	871894		

Emission factors

Emisson factors for the particulates PM2.5. PM10 and TSP are taken from GB 2013 [5]. These emission factors are given in Table 108 below.

Table 108 Emission factors for source category 2.A.5.b Construction and demolition

Pollutant	Value	Unit	References
TSP	0,162	kg/m^2/year	GB 2013 2.A.5.b Construction and demolition. Table 3-1. pg. 6
PM10	0,0812	kg/m^2/year	GB 2013 2.A.5.b Construction and demolition. Table 3-1. pg. 6
PM2.5	0,00812	kg/m^2/year	GB 2013 2.A.5.b Construction and demolition. Table 3-1. pg. 6

5.3.6. Storage, handling and transport of mineral products – NFR 2A5c

The source category refers to emissions from storage, handling and transport of mineral products

Methodological issue

In a Tier 2 approach, the emissions from storage, handling and transport of mineral products need to be estimated separately. For this activity only one 'technology' (the 'Tier 2 default') is available. Therefore, the equation describing the approach is the same as for Tier 1, where the activity data refer to the activity rate for the storage and handling of mineral products [5].

Activity data

Data on transported mineral by road and railway transport were taken from the statistical publication Transport and communications for the period 2009-2014 [39]. The historical data for the quantity of transported minerals in road transport were taken from the Statistical yearbook – chapter Transport for the period 1990-2008 [35], while regarding the railway transport the content of transported minerals in the transported goods in railway transport were estimated.

Table 109 Activity data for source category 2A5c Storage, handling and transport of mineral products

Year	Products transported [t]	Year	Products transported [t]
1990	246717	2003	8006331
1991	143309	2004	10497726
1992	96043	2005	8475328
1993	152750	2006	16441405
1994	49973	2007	4813390
1995	57838	2008	1965897
1996	34404	2009	7058289
1997	106462	2010	2820746
1998	189443	2011	3330100
1999	152301	2012	3499387
2000	48708	2013	3407267
2001	575864	2014	5564332
2002	685869		

Emission factors

For estimation of emissions for praticulates, PM2.5, PM10 and TSP, the emission factors were taken from GB 2009. Currently there are no available activity data with used emission factors from the newest Guidebook version. Used emission factors are given in the table below [6].

Table 110 Emission factors for source category A.5.c Storage. handling and transport of mineral products.

Pollutant	Value	Unit	References
TSP	10	g/Mg product	GB 2009 2.A.5.c Storage. handling and transport of mineral products. Table 3-2. pg. 6
PM10	5	g/Mg product	GB 2009 2.A.5.c Storage. handling and transport of mineral products. Table 3-2. pg. 6
PM2.5	0.5	g/Mg product	GB 2009 2.A.5.c Storage. handling and transport of mineral products. Table 3-2. pg. 6

Planned improvements

Emission factors from GB 2013 to are used for 2.A.5.c Storage, handling and transport of mineral products. Currently the emissions from the source category Construction and demolition refer only

to the area of constructed and demolished dwellings and are underestimates. It is planned for the reporting in future to gather activity data for other type of constructed and demolished buildings.

Recalculations

Recalculation was performed in the source category Glass production due to the in-depth analysis of the type glass production process over the years. It was concluded that emissions from this process occurred only when the installation "Staklara" operated in the period 1990-1998. The emissions from the current glass production are accounted only in 1A2 sector. The notation key NO is used for the period 1999-2014. Emissions from sectors 2A2 and 2A5c have been estimated due to available activity data.

5.4. Chemical Industry – NFR 2B

The following NFR source categories:

- 2B1 Ammonia production
- 2B2 Nitric acid production
- 2B3 Adipic acid production and
- 2B4 Carbide production.

In the inventory these are reported as NO due to the fact that in Macedonia this kind of production does not exist.

The NFR categories: 2B10a Other chemical industry and 2B10b Storage handling and transport of chemical products in national inventory are reported as NE due to the lack of official activity data.

5.5. Metal Production – NFR 2C

In this source category activity data, emission factors and implemented methodology is presented for the following NFR source categories: 2C1, 2C2, 2C3, 2C5,2C6 and 2C7c.

5.5.1. Iron and steel production – NFR 2C1

In the nineties in the Republic of Macedonia there was one integrated steel plant for iron and steel where primary iron and steel was produced, as well as ingots using hot and cold rolling mills.

Due to the disintegration of Former Yugoslavia and Macedonia becoming an independent country, this factory has disintegrated over the years to a number od smaller installation with different ownership. Currently in the Republic of Macedonia there are two installations that have this type of production. The first one, Makstil AD Skopje for steel production uses an electric arc furnace (EAF), and produces ingots using hot rolling mills. The second one, ArcelorMittal produces only ingots using cold rolling mill.

Activity Data

Activity data for the reporting period 1990-2004 have been taken from the statistical yearbooks chapter Industry [35], and for the period 2005-2014 form the publications Industry in the Republic of Macedonia 2005-2014 [39].

Table 111 Activity data for source category 2C1 Iron and steel production

Year	Products [t]	Year	Products [t]
1990	885015	2003	760538
1991	755634	2004	833328
1992	548462	2005	807782
1993	353822	2006	905272
1994	140045	2007	982650

1995	83407	2008	766310
1996	128117	2009	705567
1997	230274	2010	759924
1998	347846	2011	862827
1999	237409	2012	564054
2000	437934	2013	363887
2001	583379	2014	498459
2002	960178		

Emission factors

For the estimation of emissions for pollutnats, emission factors were taken from GB 2013 [5] Used emission factors are given in the table below.

Table 112 Emission factors for source category 2C1 Iron and steel production

Pollutant	Value	Unit	References
NMVOC	150	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
TSP	300	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
PM10	180	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
PM2.5	140	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
Pb	4,6	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
Cd	0,02	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
Hg	0,1	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
As	0,4	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
Cr	4,5	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
Cu	0,07	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
Ni	0,14	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
Se	0,02	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
Zn	4	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
PCDD/F	3	µg I-TEQ/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
PAHs (Total)	0,48	g/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
HCB	0,03	mg/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24
PCBs	2,5	mg/Mg steel	GB 2013 2.C.1 Iron and steel production. Table 3-1. pg. 24

5.5.2. Ferroalloys production – NFR 2C2

Ferroalloys are master alloys containing iron and one or more non-ferrous metals as alloying elements. The ferroalloys are usually classified in two groups: bulk ferroalloys and special ferroalloys. Bulk ferroalloys are used in steel production and steel or iron foundries exclusively, while the use of special ferroalloys is far more versatile.

Depending on the raw material that is used (primary or secondary raw material) the production of ferroalloys can be carried out as a primary or secondary process [5].

In the country there are three major installations for production of ferroalloys namely, ferrosilicon, ferronickel and ferrosiliconmanganse. The installation Skopski Leguri which produces ferrosilicomanganese started operation in 2007 and stopped in 2012. The other two installations Jugohrom AD Feroalloys produces ferrosilicon and FENi INDUSTRY produced ferronickel. This sector significantly contributes to the national total amount of emission of particulates.

Methodological issue

Emissions coming from this sector have been calculated as a sum of ferrosilicon produced, multiplied with implied emission factors, and ferronickel and ferrosilicamangan produced, multiplied with emission factors taken from GB 2013 [5].

Activity Data

The activity data for ferrosilicon have been taken from the Statistical yearbooks - chapter Industry, Energy and Construction for period 1990-2004 [35] and publication Industry in the Republic of Macedonia [39] for the period 2005 – 2014 while data for ferronickel for the period 2005-2014 came from the operator [19,24].

Table 113 Activity data for the source category 2C2 Ferroalloy production

Year	Total Alloy produced [t]	Year	Total Alloy produced [t]
1990	85148	2003	67283
1991	77442	2004	83160
1992	107866	2005	106590
1993	78357	2006	108920
1994	72134	2007	175719
1995	72735	2008	170252
1996	92638	2009	60458
1997	85908	2010	133347
1998	106661	2011	184310
1999	78009	2012	146970
2000	58520	2013	165803
2001	8779	2014	163489
2002	15085		

Emission factors

For calculation of PM2.5, PM10 and TSP from 1990-2014 coming from ferronickel and ferrosilicamanganise production GB 2013 [5] emission factors have been used.

Table 114 Emission factors for source category 2C2 Ferroalloys production

Pollutant	Value	Unit	References
PM10	850	g/Mg alloy produced	GB 2013 2.C.2 Ferroalloys production. Table 3-1. pg. 6
PM2.5	600	g/Mg alloy produced	GB 2013 2.C.2 Ferroalloys production. Table 3-1. pg. 6
TSP	1000	g/Mg alloy produced	GB 2013 2.C.2 Ferroalloys production. Table 3-1. pg. 6

For the estimation of emissions coming from the ferrosilicium production due to the big difference of the calculated emissions with the use of EF and emission measurments data, as well as no implementation of BAT in this installation, EF for TSP has been taken from IIR 2008 [8], while EF for PM10 and PM2.5 have been calculated as 0,85% and 0,60% of TSP Emission factor value, for PM10 and PM2.5 respectively.

Table 115 Emission factors for 2C2 Ferroalloys production – production of ferrosilicium

Pollutant	Value	Unit
PM10	244,8	kg/Mg alloy produced
PM2.5	172,8	kg/Mg alloy produced

TSP	288	kg/Mg alloy produced

Emission measurements

For the period 2012-2015 TSP emission measurements coming from ferrosilicon production were taken into account, while PM10 and PM2.5 emissions coming from this installation were calculated using the emission factors presented in Table 115.

5.5.3. Aluminum production – NFR 2C3

Primary aluminum is produced by means of electrolytic reduction of alumina. This chapter covers the complete process of primary aluminum production, from the production of alumina from bauxite to the shipment of the aluminum from the facilities. For secondary aluminum production, it covers the whole process starting from the melting of scrap. In the Republic of Macedonia there is no primary aluminum production.

Activity Data

The activity data were taken from the Statistical Yearbooks 1990-2014 [35]. Type of activity data used for emission estimation are presented in the following list.

1990 – 1998 Pressed aluminum products and aluminum alloy products

1999 – 2005 Aluminum and aluminum alloys

2005 – 2014 Sum of unwrought aluminum, alloyed in ingot

Aluminum alloyed bars, rods, profiles

Aluminum tubes and pipes, non-alloyed

Table 116 Activity data for source category 2C3 Aluminum production

Year	Aluminum and aluminium products [t]	Year	Aluminum and aluminum products [t]
1990	8841	2003	8573
1991	7829	2004	1679
1992	5150	2005	1489
1993	4819	2006	2316
1994	4991	2007	2005
1995	3709	2008	2053
1996	3924	2009	1457
1997	5561	2010	1880
1998	5850	2011	1953
1999	10777	2012	1424
2000	7641	2013	1280
2001	6809	2014	952
2002	10516		

Emission factors

The emission factors used in this source category are presented in the following table.

Table 117 Emission factors for source category 2C3 Secondary Aluminum production production

Pollutant	Value	Unit	References
TSP	2	kg/Mg aluminium	GB 2013 2.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15
PM10	1,4	kg/Mg	GB 2013 2.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15

		aluminium	
PM2.5	0,55	kg/Mg aluminium	GB 2013 2.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15
PCDD/F	35	µg I-TEQ/Mg aluminium	GB 2013 2.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15
HCB	5	g/Mg aluminium	GB 2013 2.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15

5.5.4. Lead production – NFR 2C5

This subchapter presents information on atmospheric emissions during primary and secondary lead production. The primary lead production in the country was conducted in the smelter company in the town of Veles which operated until 2003.

Methodological issues

To estimate (calculate) emissions from lead production, the general equation has been adopted:

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

where:

$E_{pollutant}$ = the emission of a specified pollutant

$AR_{production}$ = the annual lead production

$EF_{pollutant}$ = is the emission factor of the this pollutant [5]

Activity data

Statistical data foe production of crude lead were taken as primary lead production and the production of refined lead as secondary production.

Table 118 Activity data for source category 2C5 Lead production

Year	Lead, Primary (t)	Lead, Secondary (t)	Year	Lead, Primary (t)	Lead, Secondary (t)
1990	28585*	21858*	2003	19000**	6357****
1991	33938*	19265*	2004		3591****
1992	27860*	23341*	2005		34*****
1993	23575*	21881*	2006		46*****
1994	20569*	20965*	2007		18*****
1995	24007*	22490*	2008		21*****
1996	29259*	23584*	2009		39*****
1997	30508*	26046*	2010		
1998	29242*	28415*	2011		
1999	27086*	19738*	2012		
2000	19000**	17137***	2013		
2001	19000**	13543***	2014		
2002	19000**	11934****			

List of data source:

*Statistical yearbooks - Crude Lead (=Primary Lead) and Refined Lead (=Secondary Lead)

**http://minerals.usgs.gov/minerals/pubs/commodity/lead/lead_myb03.pdf

****http://www.bgs.ac.uk/mineralsuk/statistics/europeanStatistics.html

****Statiistical yearbooks- Regenerated secondary raw materials of lead and lead alloys

Emission factors

Emission factors for primary lead production and secondary lead production are taken from GB 2009 [6]. These emission factors are presented in the following two tables.

Table 119 Emission factors for source category 2C5 Primary Lead production

Pollutant	Value	Unit	References
TSP	500	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-2. pg. 12
PM10	400	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-2. pg. 12
PM2.5	200	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-2. pg. 12
Pb	13	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-2. pg. 12
Cd	0,067	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-2. pg. 12
Hg	0,93	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-2. pg. 12
As	0,015	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-2. pg. 12
PCDD/F	0,5	µg I-TEQ/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-2. pg. 12

Table 120 Emission factors for source category 2C5 Secondary Lead production

Pollutant	Value	Unit	References
TSP	500	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-9. pg. 16
PM10	400	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-9. pg. 16
PM2.5	200	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-9. pg. 16
Pb	430	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-9. pg. 16
Cd	1,1	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-9. pg. 16
Hg	0	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-9. pg. 16
PCBs	3,2	g/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-9. pg. 16
PCDD/F	8	µg I-TEQ/Mg lead	GB 2009 2.C.5.b Lead production. Table 3-9. pg. 16

5.5.5. Zinc production –NFR 2C6

Zinc is produced from various primary and secondary raw materials. Primary zinc is produced from ores which contain 85 % zinc sulphide (by weight) and 8–10 % iron sulphide, with the total zinc concentration about 50 %. A secondary zinc smelter is defined as: any plant or factory in which zinc-bearing scrap or zinc-bearing materials, other than zinc-bearing concentrates (ores) derived from a mining operation, are processed. In practice, primary smelters often also use zinc scrap or recycled dust as input material. The primary zinc production in the country was conducted in the smelter company in town of Veles which operated until 2003.

Activity Data

The activity data has been taken from the Statistical yearbook – chapter Industry, energy and construction for the period 1990-2014*[35] as well as from the following website http://minerals.usgs.gov/minerals/pubs/commodity/zinc/zinc_myb05.pdf**. In the statistical publications the activity data for the Primary Zinc production were defined as Crude Zinc and for Secondary Zinc production as Refined Zinc.

Table 121 Activity data for source category 2C6 zinc production

Year	Primery Zinc (t)	Secondary zink (t)	Year	Primiry Zinc (t)
1990	56734*	17383*	2003	28000**
1991	56081*	17244*	2004	25000**

1992	52728*	14526*	2005	NO
1993	51931*	3315*	2006	NO
1994	41984*	4532*	2007	NO
1995	44081*	34526*	2008	NO
1996	59416*	37853*	2009	NO
1997	59693*	3116*	2010	NO
1998	58865*	8594*	2011	NO
1999	53304*	4017*	2012	NO
2000	52000**		2013	NO
2001	52000**		2014	NO
2002	56000**			

Emission factors

Emission factors for primary lead production and secondary lead production are taken from GB 2009 [6]. These emission factors are presented in the following two tables.

Table 122 Emission factors for source category 2C6 primary Zinc production

Pollutant	Value	Unit	References
TSP	110	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.1. pg. 11
PM10	85	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.1. pg. 11
PM2.5	66	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.1. pg. 11
Pb	17	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.1. pg. 11
Cd	2,4	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.1. pg. 11
Hg	5	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.1. pg. 11
Zn	40	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.1. pg. 11
PCBs	0,9	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.1. pg. 11
PCDD/F	5	µg I-TEQ/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.1. pg. 11

Table 123 Emission factors for source category 2C6 Secondary Zinc production

Pollutant	Value	Unit	References
TSP	80	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
PM10	65	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
PM2.5	50	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
Pb	5,3	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
Cd	2,8	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
Hg	0,0065	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
As	0,48	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
Zn	40	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
PCBs	3,6	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
PCDD/F	5	µg I-TEQ/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12

5.5.6. Other metal production – NFR 2C7c

This category covers silver production in the reporting period 1990-1998.

Methodological issues

Tier 1 method was used for calculation of emissions in this source category. This activity does not occur after the year 1998.

Activity Data

Activity data for this source category are taken from the Statistical yearbooks for the period 1990-1998 [35].

Table 124 Activity data for source category 2Ac7

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
Silver produced [t]	15	19	16	9	13	13	21	28	32

Emission factors

The emission factor on TSP has been taken from GB 2013 [5].

Table 125 Emission factors for Other Metals production

Pollutant	Value	Unit	References
TSP	0,8	g/Mg metal produced	GB 2013 2.C.7.c Other metal production. Table 3.1. pg. 5

Plan improvments

In the future Tier 2 method form GB 2013 for the calculation of emissions in source category 2.C.1 Iron and steel production is planned to be used.

MEPP will discuss with the State Statistical Office the possibility for this institution to start collecting data on the quantity of secondary lead produced.

Recalculations

For the sector of lead production notation key NE has been used for the period 2010-2014 due to the fact that there is no available data of the quantity of lead produced. The quantity of lead battery produced have been used as activity data for emission calculations in the previous inventories submission.

In the source category 2C1 recalculation is made with regards of the used activity data. Namely, quantity of steel produced in cold rolling mill has been used as activity data. In the previous submission activity data referred to all kind of products made in cold rolling mill (zinc coated, plastic coating etc.) that results with overestimated emissions. For the source category 2.C.2 Ferroalloys production recalculations were made due to the updated data on ferronickel alloy produced received from the ferronickel producer itself. It was confirmed that the data published in the Statistical yearbook refer only to the amount of nickel in the alloy.

5.6. Other products and solvents used – NFR 2D

In this source category activity data, emission factors and implemented methodology are presented for the following NFR source categories: 2D3, 2D3b, 2D3c, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h, 2G, 2H1, 2H2 and 2I.

5.6.1. Domestic solvent use including fungicides NFR 2D3a

Methodological issues

The Tier 1 mehod has been applied. This method assumes an averaged or typical technology and abatement implementation in the country and includes an integrated emission factor and emission factors for sub-processes within the source category. It is applied at a national level, using the population.

Activity Data

The activity data – number of population for this source category have been taken from Statistical yearbooks – chapter Population for the period 1990-2008 [35] and Assessment of the population according age and gender, by municipality and by statistical region (NTEC 3- 2007-2014) [42]. It should be emphasized that the last census in the country was carried out in 2002, and therefore the data for the period 2003-2014 are estimated population numbers.

Table 126 Activity data for the source category 2D3a Domestic solvents use including fungicides

Year	Population number	Year	Population number
1990	2028000	2003	2026773
1991	2033964	2004	2032544
1992	2056000	2005	2036855
1993	2066000	2006	2040228
1994	1945932	2007	2043559
1995	1966000	2008	2046898
1996	1983000	2009	2050671
1997	1996869	2010	2055044
1998	2007523	2011	2058539
1999	2017142	2012	2061044
2000	2026350	2013	2064032
2001	2034882	2014	2069172
2002	2020547		

Emission factors

The emission factor for calculation of NMVOC emissions coming from this sector are presented in the following table.

Table 127 Emission factors for the source category 2D3a Domestic solvents use including fungicides

Pollutant	Value	Unit	References
NMVOC	1	kg/person/year	GB 2009 3.D.2 Domestic solvent use including fungicides. Table 3-1. pg. 6

5.6.2. Road paving with asphalt NFR 2D3b

Asphalt is commonly referred to as bitumen, asphalt cement, asphalt concrete or road oil and is mainly produced in petroleum refineries. In some countries the laid mixed product is also referred to as 'asphalt' but it is also known as 'macadam'.

This section covers emissions from asphalt paving operations as well as subsequent releases from the paved surfaces [5].

Methodological issues

To estimate emissions from road paving with asphalt, the following general equation has been applied:

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

where:

$E_{pollutant}$ = the emission of the specified pollutant,

$AR_{produtions}$ = the activity rate (data) for the road paving with asphalt,

$EF_{pollutant}$ = the emission factor for this pollutant [5].

Activity data

Activity data have been gathered by the operators themselves. The activity data for this sector may be underestimated doe to incomplete statistical data on asphalt production [35] as well as change of ownership and close down of some of the asphalt production companies [25-34]. The activity data are presented in the following table.

Table 128 Activity data for source category source category 2D3b Road paving with asphalt

Year	Asphalt produced (t)	Year	Asphalt produced (t)
1990	86320	2003	124492
1991	74296	2004	149323
1992	44067	2005	180559
1993	65194	2006	130847
1994	84729	2007	101508
1995	87814	2008	170049
1996	98545	2009	232001
1997	53600	2010	274654
1998	101563	2011	356596
1999	136540	2012	336725
2000	327937	2013	389163
2001	137305	2014	336545
2002	119651		

Emission factors

Emission factors for estimation of emissions in this source category are presented in the following table.

Table 129 Emission factors for source category source category 2D3b Road paving with asphalt

Pollutant	Value	Unit	References
NMVOC	16	g/Mg asphalt	GB 2013 2.D.3.b Road paving with asphalt. Table 3.1. pg. 8
TSP	14000	g/Mg asphalt	GB 2013 2.D.3.b Road paving with asphalt. Table 3.1. pg. 8
PM10	3000	g/Mg asphalt	GB 2013 2.D.3.b Road paving with asphalt. Table 3.1. pg. 8
PM2.5	400	g/Mg asphalt	GB 2013 2.D.3.b Road paving with asphalt. Table 3.1. pg. 8

5.6.3. Asphalt roofing NFR 2D3c

The source category 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.

Methodological issues

To estimate (calculate) emissions from the asphalt roofing, the following general equation has been adopted:

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

where:

$E_{pollutant}$ = the emission of the specified pollutant,

$AR_{prodution}$ = the activity rate (data) for the rasphalt roofing,

$EF_{pollutant}$ = the emission factor for this pollutant [5].

Activity Data

For the period 1990-1999 activity data have been taken from the Statistical Yearbooks – chapter Industry, Energy ansd Construction[35]. For the period 2005-2014 activity data have been taken from the publication Industry in the Republic Macedonia [40], while due to the lack of data for the period 2002-2004 the gap filling interpolation method has been used.

The activity data for this source category is presented in the following table.

Table 130 Activity data for source category 2D3c Asphalt roofing

Year	Asphalt roofing products (t)	Year	Asphalt roofing products (t)
1990	12572	2003	11668
1991	12593	2004	12458
1992	5325	2005	11305
1993	4067	2006	9773
1994	5901	2007	9998
1995	8873	2008	9489
1996	5992	2009	16407
1997	6442	2010	13201
1998	5489	2011	16516
1999	13429	2012	15324
2000	13075	2013	12520
2001	12525	2014	14221
2002	12104		

Due to use of change of methodology of statistical data gathered over the years the list of different type of data used are presented below.

Type of activity data for the whole reporting period

1990 – 1999
Roof patch, Bitumen paper and jute;
Bituminous products for building;

2005 – 2014
Roofing or water-proofing felts of roofing cardboard based on bitumen in rolls;
Roofing or water-proofing felts of metal foil based on bitumen in rolls;
Bituminous paper in rolls;
Bituminous bands of glass voal in rolls;
Bituminous plastic bands in rolls;
Bituminous emulsions;
Other bituminous mixtures based on natural asphalt, bitumen and other (ex. bitumen whale).

Emission factors

Emission factors used for this source category are presented in the following table:

Table 131 Emission factors for source category 2D3c Road paving with asphalt

Pollutant	Value	Unit	References
CO	9,5	g/Mg shingle	GB 2013 2.D.3.c Asphalt roofing. Table 3.1. pg. 7
NMVOC	130	g/Mg shingle	GB 2013 2.D.3.c Asphalt roofing. Table 3.1. pg. 7
TSP	1600	g/Mg shingle	GB 2013 2.D.3.c Asphalt roofing. Table 3.1. pg. 7

PM10	400	g/Mg shingle	GB 2013 2.D.3.c Asphalt roofing. Table 3.1. pg. 7
PM2.5	80	g/Mg shingle	GB 2013 2.D.3.c Asphalt roofing. Table 3.1. pg. 7

5.6.4. Coating application – NFR 2D3d

Methodology

NMVOC emissions in this source category are estimated according to the GB 2013 [5].

Activity data

The quantity of paint produced for the period 2005-2014 is taken from the publications Industry in the Republic of Macedonia [40] and the data for the imported-exported paints are taken from the publication Commodity international exchange in the Republic of Macedonia for the period 2006-2013 [41]. The activity data for year 2014 includes only data on imported paint due to the fact that data on imported paints was not available during the period of preparation of this report. Data for the period 1990-2004 have been calculated using the method of extrapolation. Namely, the number of the population has been used as surrogate data for the estimation of the quantity of paint applied in the category decorative application and the index of industrial production as surrogate data for the extrapolation of activity data in the sources Industrial application and Other industrial application.

Table 132 Activity data for source category 2D3d Coating application

Year	Industrial application	Decorative application	Other industrial application
	Paint [kg]	Paint [kg]	Paint [kg]
1990	7822932	674542	5314404
1991	6477388	769676	5330032
1992	5453961	926769	5387778
1993	4695860	928872	5413983
1994	4202795	735225	5099343
1995	3753096	471423	5151932
1996	3873195	789641	5196480
1997	3935166	892270	5232824
1998	4112248	915188	5260743
1999	4005330	698899	5285950
2000	4145517	766101	5310080
2001	4017006	874148	5332438
2002	3804104	1052564	5294873
2003	3982897	1054953	5311188
2004	3896764	835021	5326311
2005	2498588	535412	3034000
2006	4185176	896824	5082000
2007	4729118	1013382	5742500
2008	4850588	1039412	5890000
2009	3704235	793765	4498000
2010	4060412	870088	4930500
2011	4633069	992801	5625870
2012	5578693	1195434	6774127
2013	5591353	1198147	6789500

Year	Industrial application	Decorative application	Other industrial application
	Paint [kg]	Paint [kg]	Paint [kg]
2014	66294	14206	80500

Emission factors

Emission factors for Tier 1 method from GB 2013 are presented in the following table:

Table 133 Emission factors for source category 2D3d Coating application

Pollutant	Value	Unit	References
NMVOC (Decorative coating application)	150	g/kg paint applied	GB 2013 Table 3-1 Tier 1 emission factors for source category 2.D.3.d Decorative coating application
NMVOC (Industrial coating application)	400	g/kg paint applied	GB 2013 Table 3-2 Tier 1 emission factors for source category 2.D.3.d Industrial coating application
NMVOC (Other coating application)	500	g/kg paint applied	GB 2013 Table 3-3 Tier 1 emission factors for source category 2.D.3.d Other coating application

5.6.5. Degreasing - NFR 2D3e

Degreasing is a process of 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.

Methodological issues

The Tier 1 mehod has been applied. This method assumes an averaged or typical technology and abatement implementation in the country and include an integrated emission factor and emission factors for sub-processes within the source category. It is applied at a national level, using the population data.

Activity Data

Activity data for the source category 2D3e Degresing are presented in Table 126 in subchapter 5.6.1.

Emission factors

Emission factor For the calculation of NMVOC emissions is given below.

Table 134 Emission factor for source category 2D3d Degreasing

Pollutant	Value	Unit	References
NMVOC	0,85	kg/inhabitant/year	Informative Inventory Report of Republic of Serbia for 2013 page [48] which refers to GB 2006

5.6.6. Dry cleaning – NFR 2D3e

Dry cleaning refers to any process of removal of contamination from furs, leather, down leathers, textiles or other objects made of fibers using organic solvents. The most significant pollutants from dry cleaning are non-methane volatile organic compounds [5].

Methodological issues

(NMVOCs), including chlorinated solvents The Tier 1 method has been applied. This method assumes an averaged or typical technology and abatement implementation in the country and includes an

integrated emission factor and emission factors for sub-processes within the source category. It is applied at a national level, using the population.

Activity Data

Due to the lack of data on textile treatment, the activity data considered in this source category is population number. Population data for the source category 2D3e Degreasing are presented in Table 126 in subchapter 5.6.1.

Emission factors

Emission factor For the calculation of NMVOC emissions is given below.

Table 135 Emission factor for the source category 2D3e Dry Cleaning

Pollutant	Value	Unit	References
NMVOC	0,3	kg/inhabitant/year	GB 2013 2.D.3.f Dry cleaning. pg. 6

5.6.7. Chemical products – NFR 2G3g

This subchapter covers emissions from:

- polyurethane and polystyrene foam processing;
- asphalt blowing;
- tyre production;
- speciality organic chemical industry;
- manufacture of paints, inks and glues;
- fat, edible and non-edible oil extraction;
- industrial application of adhesives.

Methodological issues

The following equation form Tier 2 approach has been use for calculating emissions from chemical products:

$$E_{pollutant} = \sum_{tehnologies} AR_{use,tehnology} \times EF_{tehnology,pollutant}$$

Where:

$AR_{use,tehnology}$ = the use of specific chemical products;

$EF_{tehnology,pollutants}$ = the emission factor for this tehnology and this pollutants [5].

Activity Data

The activity data for this source category have been taken from the Statistical yearbook- chapter Industry, energy and construction for the period 1990-2004 [35] and publication Industry in the Republic of Macedonia for the period 2005-2014 [39]. The activity data are presented in the following table.

Table 136 Activity data for source category 2D3g Chemical products

Year	Polyesther /kg	Polyurethane /kg	Polystirene /kg	Shoos/pairs	Leather thanning/kg	Paints. Inks and glues/kg	Rubber Procesing/ kg
1990	16450000			6638000			
1991	12440000			4049000			
1992	11150000		364000	3667000	10797000		1355000
1993	4466000		382000	2308000	10197000		1145000

Year	Polyesther /kg	Polyurethane /kg	Polystirene /kg	Shoos/pairs	Leather thanning/kg	Paints. Inks and glues/kg	Rubber Procesing/ kg
1994	8628000		455000	1529000	9177000		978000
1995	9904000			1122000			
1996	3212000		302000	1231000	11062000		383000
1997	3820000		363000	1509000	7491000		371000
1998	2642000		547000	1790000	4908000		417000
1999				2488000			
2000				2129000			
2001				1073000			
2002				1521000			
2003				1799000			
2004				1785000			
2005		1095000		1540000		6068000	
2006		1405000		1739000		5252000	
2007		1129000		1949000		4982000	
2008		1239000		2196000		4604000	
2009		1133000		3074000		3972000	
2010		1033000		2846000		3495000	
2011		1059000		3302000		750000	
2012		1118000		3256000		388000	
2013		1166000		4314000		208000	
2014		697000		3855000		161000	

Emission factors

The emission factors used for calculation of emission from GB 2013 for different type of activities are presented in the following table.

Table 137 Emission factors for source category 2D3g Chemical Products

Pollutant	Value	Unit	References
NMVOC	50	g/kg polyester monomer used	GB 2013 2.D.3.g Chemical products. Table 3-2. pg. 17
NMVOC	120	g/kg polyurethane foam procesed	GB 2013 2.D.3.g Chemical products. Table 3-3. pg. 17
NMVOC	60	g/kg polystirene	GB 2013 2.D.3.g Chemical products. Table 3-4. pg. 18
NMVOC	8	g/kg rubber produced	GB 2013 2.D.3.g Chemical products. Table 3-5. pg. 18
NMVOC	11	g/kg products (paints. inks. glues)	GB 2013 2.D.3.g Chemical products. Table 3-11. pg. 21
NMVOC	0,045	kg/pairs of shoss	GB 2013 2.D.3.g Chemical products. Table 3-13. pg. 22
NH_3	0,68	g/kg raw hid (leather tanning)	GB 2013 2.D.3.g Chemical products. Table 3-14. pg. 23

5.6.8. Printing NFR – 2D3h

Printing involves the use of inks which may contain a proportion of organic solvents, therefore NMVOC emissions are expected from this process.

Methodological issues

The simplified Tier 1 methodology for calculation of NMVOC emissions coming from this sector has been used, namely, the quantity of ink used was multiplied with the appropriate emission factor.

Activity data

Data on ink consumption in the printing industry has been asked from the SSO for the whole time series due to the fact that these data were not published in the statistical publications. Due to the fact that these data were not published so far, MEPP received a request by the SSO not to publish these activity data in the report. Therefore these activity data are not presented in this report.

Emission factors

Emission factor for NMVOC has been taken from GB 2013 and is presented in Table 138.

Table 138 Emission factors for source category 2D3h Printing

Pollutant	Value	Unit	References
NMVOC	500	g/kg ink	GB 2013 Table 3-1 Tier 1 emission factors for source category 2.D.3.h Printing

5.6.9. Other solvent and product use – NFR 2D3i and 2G

NMVOC emissions are expected from this sector. Emissions from the following activities have been calculated in this source category:

- 060404 Fat, edible and non-edible oil extraction;
- 060406 Preservation of wood;
- 060602 Use of tobacco and
- 060603 Use of shoes

The calculated emissions has been reported in the NFR 2G while for the NFR category 2D3i, the notation key IE has been used.

Activity data

The activity data on tobacco and pairs of shoes have been taken from the Statistical yearbooks - chapter Industry, energy and construction for the period 1990-2004 [35] and publication Industry in the Republic of Macedonia for the period 2005-2014 [40]. Consumption of creosote has been calculated with the formula 75 kg creosote/m ^{3} wood (where kg of wood preservative used was taken from the Statistical yearbooks. Regarding the activity Fat, edible and non-edible oil extraction statistics on different vegetable oil types have been used for estimation of seed quantity.

The activity data are presented in the following table.

Table 139 presents quantities used as activity data for calculation of the emissions from this source category.

Table 139 Activity data for the source category 2D3i and 2G Other solvent and product use

Year	Tobacco	Creosite	Fat. edible and non-edible oil extraction-seed	Pair of shoes
1990	26481	2765878	38303	6638000
1991	16576	1789766	39190	4049000
1992	22297	1949659	32975	3667000
1993	25964	1322008	30218	2308000

Year	Tobacco	Creosite	Fat. edible and non-edible oil extraction-seed	Pair of shoes
1994	21143	981327	47598	1529000
1995	16152	844494	30990	1122000
1996	13980	651086	54763	1231000
1997	14904	362120	52515	1509000
1998	23297	302723	47063	1790000
1999	29005	270176	28165	2488000
2000	18991	38073	39048	2129000
2001	26110	21097	38388	1073000
2002	20547	23524	71910	1521000
2003	25689	4552	64698	1799000
2004	15317	34444	61148	1785000
2005	5798	18855	59138	1540000
2006	20634	19787	63578	1739000
2007	18237	6694	61973	1949000
2008	16767	17656	76303	2196000
2009	14858	12474	75020	3074000
2010	19944	7014	78368	2846000
2011	24796	6984	82848	3302000
2012	21108	2688309	80805	3256000
2013	23745	1255185	77008	4314000
2014	27720	4186908	83258	3855000

Emission factors

The Emission factors have been taken from GB 2013 [5] and are presented in the following table.

Table 140 Emission factors for source category 2D3i and 2G Other solvents and product use

Pollutant	Activity	Value	Unit	References
NOx	Tobacco combustion	1,8	kg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
NMVOC	Tobacco combustion	4,84	kg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
NH_3	Tobacco combustion	4,15	kg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
PM2.5	Tobacco combustion	27	kg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
PM10	Tobacco combustion	27	kg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
TSP	Tobacco combustion	27	kg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
CO	Tobacco	55,1	kg/ton	GB 13 Table 3-14 Tier 2 emission factors for source

Pollutant	Activity	Value	Unit	References
	combustion		tobacco	category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
Cd	Tobacco combustion	5,1	mg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
Hg	Tobacco combustion	0,1	mg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
As	Tobacco combustion	0,16	mg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
Cr	Tobacco combustion	0,35	mg/ton tobacco	GB 13 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product
NMVOC	Wood preservation. Creosote preservative type	105	g/kg creosote	GB 13 Table 3-5 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Wood preservation. Creosote preservative type
benzo(a) pyren	Wood preservation. Creosote preservative type	1,05	mg/kg creosote	GB 13 Table 3-5 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Wood preservation. Creosote preservative type
benzo(b) fluoranthen	Wood preservation. Creosote preservative type	0,533	mg/kg creosote	GB 13 Table 3-5 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Wood preservation. Creosote preservative type
benzo(k) fluoranthen	Wood preservation. Creosote preservative type	0,533	mg/kg creosote	GB 13 Table 3-5 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Wood preservation. Creosote preservative type
Indeno (1.2.3-cd) pyren	Wood preservation. Creosote preservative	0,533	mg/kg creosote	GB 13 Table 3-5 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Wood preservation. Creosote preservative type
NMVOC	Treatment of vehicles	0,2	kg/person/ year	GB 13 Table 3-10 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Treatment of vehicles
NMVOC	Manufacturing of shoes	0,06	kg/pair of shoes	GB 13 Table 3-15 Tier 2 emission factor for source category 2.D.3.i. 2.G Other solvent and product use. Other. Use of Shoes
NMVOC	Fat. edible and non-edible oil extraction	1,57	g/kg seed	GB 13 Table 3-4 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use.
PM2.5	Fat. edible and non-edible oil extraction	0,6	g/kg seed	GB 13 Table 3-4 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use.
PM10	Fat. edible and	0,9	g/kg seed	GB 13 Table 3-4 Tier 2 emission factors for source

Pollutant	Activity	Value	Unit	References
	non-edible oil extraction			category 2.D.3.i. 2.G Other solvent and product use.
TSP	Fat. edible and non-edible oil extraction	1,1	g/kg seed	GB 13 Table 3-4 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use.

5.6.10. Food and beverages industry - NFR 2H2

This source category addresses NMVOC emissions from food and beverages manufacturing, except emissions from vegetable oil extraction.

Methodological issues

The Tier 2 approach has been applied. Both the activity data and the emission factors have been stratified according to the different techniques that occur in the country.

The following equation form Tier 2 approach has been use for calculating emissions from food and beverage industry:

$$E_{pollutant} = \sum_{tehnologies} AR_{production,tehnology} \times EF_{tehnology,pollutant}$$

Where:

$AR_{production,tehnology}$ = the production rate within this source category;

$EF_{tehnology,pollutants}$ = the emission factor for this tehnology and this pollutants [5].

Activity Data

The activity data for this source category has been taken from the Statistical yearbook- chapter Industry, energy and construction for the period 1990-2004 [35] and publication Industry in the Republic of Macedonia for the period 2005-2014 [40]. The activity data are presented in the following table.

Table 141 Activity data for source category 2H2 Food and beverage industry

Year	spirits/hL	beer/hL	wine/hL	Animal Feed/t	Margarine and solid cooking fat/t	Sugar/t	Meat. fish and poultry/t	Cakes. bisquits and breakfast cereals/t	Bread/t
1990	13100	958224	1296900	180625	1972	13904	11855	13063	102392
1991	16165	928043	1572000	167137	1972	8624	10921	13328	86892
1992	21708	860843	2111000	140320	1972	8140	8121	15112	99149
1993	21708	951854	2274000	143034	1972	6677	7128	12602	85379
1994	23710	724974	2347290	126146	1972	6351	33787	12583	85014
1995	26920	620201	2665080	126583	1972	7205	29375	12308	84901
1996	40040	622223	3963960	130248	1972	17993	29368	11824	84382
1997	31800	600092	3148200	105754	1972	35183	27800	11426	83817
1998	24790	578212	2454210	97947	1972	40354	25971	11657	82740
1999	30070	652165	2976930	97946	1972	43039	26512	12296	81184
2000	27820	659829	2754180	97995	1972	31923	27470	11408	78632
2001	43900	622181	4346100	75003	1972	18004	26041	10995	74689
2002	37960	637894	3758040	68382	1972	36614	27471	10828	68425
2003	28350	680217	2806650	61474	1972	33334	29835	10454	58606

Year	spirits/hL	beer/hL	wine/hL	Animal Feed/t	Margarine and solid cooking fat/t	Sugar/t	Meat. fish and poultry/t	Cakes. bisquits and breakfast cereals/t	Bread/t
2004	12424	717496	516000	55235	1972	27810	29839	10113	43115
2005	10548	675325	948489	77025	1734	36815	28264	8051	45654
2006	11831	669648	703005	73497	1903	19325	28041	8030	44774
2007	11237	695140	613188	80137	1916	35927	27228	10998	54757
2008	7929	702382	984684	54873	1877	43731	25065	14048	50408
2009	6652	635926	1133998	46104	1877	23472	25362	14678	47272
2010	9929	631370	923925	50796	2479	37998	26472	15323	56041
2011	6151	611843	792444	49002	2328	30423	28391	25440	56967
2012	9672	633621	939788	48672	2228	21414	35751	29645	57295
2013	10529	621005	1251759	32316	2355	22916	35398	28092	54115
2014	9749	641124	747211	33222	2339	12085	32533	31851	49656

Emission factors

The emission factors for estimation of NMVOC emissions are presented in the following table.

Table 142 Emission factors for source category 2H2 Food and beverages industry

Pollutant	Value	Unit	References
NMVOC	15	kg/hL alcohol (spirits)	GB 2013 2.H.2 Food and beverages industry. Table 3-28. pg. 20
NMVOC	35	g/hL beer	GB 2013 2.H.2 Food and beverages industry. Table 3-27. pg. 19
NMVOC	80	g/hL wine	GB 2013 2.H.2 Food and beverages industry. Table 3-24. pg. 18
NMVOC	1	kg/Mg animal feed	GB 2013 2.H.2 Food and beverages industry. Table 3-22. pg. 17
NMVOC	10	kg/Mg product (Margarine and solid cooking fats)	GB 2013 2.H.2 Food and beverages industry. Table 3-21. pg. 17
NMVOC	10	kg/Mg sugar	GB 2013 2.H.2 Food and beverages industry. Table 3-20. pg. 17
NMVOC	0.3	kg/Mg product (meat. fish and poultry)	GB 2013 2.H.2 Food and beverages industry. Table 3-19. pg. 16
NMVOC	1	kg/Mg product (Cakes. biscuits and breakfast cereals)	GB 2013 2.H.2 Food and beverages industry. Table 3-18. pg. 16
NMVOC	4.5	kg/Mg bread	GB 2013 2.H.2 Food and beverages industry. Table 3-11. pg. 13

5.6.11. Wood processing – NFR 2I

This source category is only important for particulate emissions. The emissions from this source category however are less than 1 % of the national emissions for particulates. Namely, in 2014 the contribution from this source in the total TSP emissions is 0.043%

Methodological issues

The simplified Tier 1 methodology for emission calculation has been used. Namely the quantity of activity data is multiplied with the appropriate emission factor.

Activity data

The input data for this source category is the quantity of different type of final products. This data have been taken from the Statistical Yearbooks of the Republic of Macedonia for the period 1990-2024 [35] and the publication Industry in the Republic of Macedonia for the period 2005-2014[40].

Table 143 Activity data for source category 2I Wood processing

Year	Wood processed [Mg]	Year	Wood processed [Mg]
1990	66889	2003	19913
1991	52422	2004	24263
1992	46790	2005	15509
1993	44454	2006	21866
1994	40402	2007	11183
1995	29144	2008	15591
1996	27210	2009	6695
1997	23188	2010	10671
1998	17048	2011	8719
1999	22568	2012	16115
2000	18173	2013	18752
2001	16882	2014	18079
2002	10015		

Emission factors

Emission factor for estimation of TSP have been taken from GB 2009 [6] and they are presented in Table 133.

Table 144 Emission factors for source category 2I Wood processing

Pollutant	Value	Unit	References
TSP	1	kg/Mg wood products	GB 2013 Table 3.1 Tier 1 emission factors for source category 2.I Wood processing

Planned improvements

Overall, further Improvements of the activity data used in section 2.D-2.L Other solvent and product use are planned to be conducted during two expert missions within component 2 of the undergoing Twinning project.

Recalculations

Activity data in the sector Wood production - 2I has been recalculated to the fact that unprocessed wood has been also taken into account in the previous submission. The activity data used for Coating application – 2D3d did not consider imported paint since this data was not available until the date of inventory submission. The publication External trade referring to 2013 data was published in June 2015. The emissions in pulp and paper section are considered not occurring due to the fact that a detailed analysis has been conducted showing no pulp processing in the country. Previously the quantity of paper produced has been taken as activity data. In the sector Food and beverages industry-2H2_there is a small difference of reported emissions due to the change of emission factor for bread production from 5000 to 4500 g/Mg. The figures in fields for Degreasing and Dry cleaning NMVOC emission were switched in the correct order. For the sector Other product and solvents use Tier 2 emission factors from GB 2013 have been used. Regarding sector Chemical products the availability of activity data has been improved. Recalculation in the sector Asphalt roofing was made

due to the in depth analysis of activity data used for calculation of emission in this sector. It was concluded that some data of asphalt products should not be taken into consideration in this sector.

6. AGRICULTURE (NFR 3)

6.1. Sector overview

The Agriculture sector is a major source category for ammonia emissions. 99% of the total national emissions of NH_3 are emitted from the agricultural sector.

In Macedonian inventory emissions from sourcecategories 3B animal husbandry and manure management and 3.D.a.1 Inorganic N-fertilizers are reported.

In sector manure management, emissions such as organic and nitrous compounds are included.

6.2. General description

Methodology

In general, a simple Tier 1 methodology is used, multiplying activity data for each source category with an applied emission factor. The methodology of selection of emission factors in the manure management source category is described in details below.

Completeness

In the table 132 NFR categories covered in the Agriculture sector for 2014 are presented the categories which are not included in this sector and for which appropriate notation keys are used.

Table 145 NFR categories covered in Agriculture sector for 1990-2014

NFR category	Completeness
3B1a Manure management - Dairy cattle	√
3B1b Manure management - Non-dairy cattle	√
3B2 Manure management – Sheep	√
3B3 Manure management - Swine	√
3B4d Manure management – Goats	√
3B4e Manure management – Horses	√
3B4gi Manure management - Laying hens	√
3B4gii Manure management - Broilers	√
3B4giii Manure management - Turkeys	√
3B4giv Manure management - Other poultry	√
3Da1 Inorganic N-fertilizers (includes also urea application)	√
3B4f Manure management - Mules and asses	NE
3B4a Manure management – Buffalo	IE
3B4h Manure management - Other animals (please specify in IIR)	NO
3Da2a Animal manure applied to soils	IE
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	IE
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	NE

NFR category		Completeness
3De	Cultivated crops	NE
3Df	Use of pesticides	NO
3F	Field burning of agricultural residues	NO
3I	Agriculture other (please specify in the IIR)	NO
3B4h	Manure management - Other animals (please specify in IIR)	NO

3.B.4.f: Mules and asses: No data were received for number of mules and asses in the reporting period upon request sent to the state statistical office.

3.B.4.a: Buffalos: only historic data are available. Buffalos are included in the other cattle category (3.B.1.b) as buffalos are bovines and no data for buffalo is available from 2007 onwards (-> time series consistency). The NH_3 EF for buffalos and other cattle (solid) is very similar. Report buffalos as IE for all years (and explain in IIR).

3.B.4.h:Other animals: The inventory includes all animals provided in the statistical review of Macedonia. Therefore, no additional animal categories are relevant for Macedonia.

3.D.a.2.a: Animal manure applied to soils: Emissions are included in sector 3.B as calculations follow the tier 1 approach. Therefore, the notation key IE is used for this sector.

3.D.a.2.b: Sewage sludge applied to soils: This source is not estimated (NE). Activities (tons of sewage sludge annually spread). The posibillites to estimated emissions in this sector will be discussed with national experts for the next reporting.

3.D.a.2.c: Other organic fertilizers applied to soils (including compost): The notation key is NA.

3.D.a.3: Urine and dung deposited by grazing animals: Emissions are included in sector 3.B as calculations follow the Tier 1 approach. Therefore notation key IE is used.

3.D.a.4: Crop residues applied to soils is NA

3.D.b: Emissions from Indirect emissions from managed soils are not available

3.D.c: Farm-level agricultural operations including storage, handling and transport of agricultural products: In this category PM and TSP emissions from agricultural soils should be reported. Data are not available.

3.D.d: Off-farm storage, handling and transport of bulk agricultural products is not estimated

3.D.e: Cultivated crops is not estimated

3.D.f: Use of pesticides: Only if HCB is used as pesticide. HCB is forbidden under the Stockholm Convention on Persistent Organic Pollutants, so this NFR does not occur

3.F: Field burning is permitted by law and there are no data on illegal field burning activities available. “NO” for source category 3F “Field burning”.

3.I: Agriculture other, does not occur.

6.3. Manure management NFR 3B

Methodological issues

The Tier 1 default approach following the GB 2013/2009 has been used.

Emission factors have been obtained from EMEP/EEA Air Pollutant GB 2013 [5]. Separate default Tier 1 EFs are provided for slurry- and litter-based manure management systems to be multiplied with the animal numbers of the appropriate livestock categories. The manner of data filing as well as analysis of provided information for the selection of proper emission factors for different substances is presented below.

Activity data and background information on the activity data

The input data in this sub-sector is the number of registered heads of each domestic animal species. All activity data is derived from the Statistical Yearbooks for period 1990-2006 [35] and Publication Livestock prepared by the State Statistical Office for the period 2007-2014 [43]. The numbers per livestock category are presented in Table 146. Number of different categories of poultry are presented in Table 147.

Table 146 Domestic livestock population and its trend 1990–2014

Year	Dairy	Non-diary	Total Swine	Fattening pigs	Sows	Sheep	Goats	Horses
1990	122.318	166.458	178.537	154.359	24.178	2.297.115	252.904	66.282
1991	120.476	163.361	170.975	145.973	25.002	2.250.549	245.466	65.155
1992	121.097	165.001	173.006	147.479	25.527	2.351.408	238.027	64.576
1993	121.614	159.835	184.920	151.605	33.315	2.458.648	230.589	61.748
1994	122.006	160.351	171.571	138.809	32.762	2.466.099	223.151	61.797
1995	122.419	161.835	175.063	143.672	31.391	2.319.905	215.712	61.733
1996	129.223	166.403	192.396	161.365	31.031	1.813.895	208.274	66.479
1997	130.519	159.817	184.293	148.802	35.491	1.631.034	200.836	65.869
1998	122.551	145.807	196.838	164.150	32.688	1.315.176	193.397	59.847
1999	126.536	144.336	226.047	190.933	35.114	1.288.733	185.959	57.152
2000	126.371	139.229	204.135	173.006	31.129	1.250.686	178.520	56.486
2001	128.218	137.653	189.293	160.794	28.499	1.285.099	171.082	45.638
2002	127.135	132.437	196.223	164.056	32.167	1.233.830	163.644	41.775
2003	118.325	142.217	179.050	143.557	35.493	1.239.330	156.205	42.883
2004	118.872	136.496	158.231	131.992	26.239	1.432.369	148.767	40.391
2005	115.485	133.174	155.753	128.940	26.813	1.244.000	141.329	39.651
2006	120.682	135.157	167.116	137.102	30.014	1.248.801	133.890	40.553
2007	121.005	132.761	255.146	209.641	45.505	817.536	126.452	31.065
2008	125.004	128.469	246.874	210.106	36.768	816.604	133.017	30.936
2009	109.858	142.662	193.840	164.796	29.044	755.356	94.017	29.418
2010	119.060	140.827	190.552	161.346	29.206	778.404	75.708	26.658
2011	136.926	128.373	196.570	171.412	25.158	766.631	72.777	25.415
2012	123.392	127.848	176.920	152.256	24.664	732.338	63.585	21.676
2013	128.677	109.656	167.492	140.768	26.724	731.828	75.028	20.682
2014	126.762	114.345	165.053	141.542	23.511	740.457	81.346	19.371
Trend 90–14	*3.6%*	*-31.3%*	*-7.6%*	*-8.3%*	*-2.8%*	*-67.8%*	*-67.8%*	*-70.8%*

Table 147 Domestic livestock population and its trend 1990–2014

Year	Laying hens	Broilers	Livestock category – Population size [heads] *			
			Ducks	Geese	Turkeys	Total Poultry
1990	5.515.140	101.653	58.888	15.264	38.036	5.728.981
1991	4.392.197	80.955	46.898	12.156	30.291	4.562.497
1992	4.136.947	76.251	44.172	11.449	28.531	4.297.350
1993	4.228.758	77.943	45.153	11.703	29.164	4.392.721
1994	4.510.147	83.129	48.157	12.482	31.105	4.685.021
1995	4.697.726	86.587	50.160	13.001	32.398	4.879.873
1996	3.235.355	59.633	34.546	8.954	22.313	3.360.801
1997	3.152.343	58.103	33.659	8.724	21.741	3.274.570
1998	3.214.141	59.242	34.319	8.895	22.167	3.338.764
1999	3.102.875	57.191	33.131	8.587	21.399	3.223.184
2000	3.574.763	65.889	38.170	9.893	24.654	3.713.369
2001	2.647.004	48.789	28.263	7.326	18.255	2.749.637
2002	2.407.615	44.376	25.707	6.663	16.604	2.500.966
2003	2.327.131	42.893	24.848	6.441	16.049	2.417.362
2004	2.623.573	48.357	28.013	7.261	18.094	2.725.298
2005	2.519.329	46.435	26.900	6.972	17.375	2.617.012
2006	2.488.827	45.873	26.575	6.888	17.165	2.585.327
2007	2.115.866	80.742	35.131	11.004	21.151	2.263.894
2008	2.173.346	9.717	22.656	4.082	16.254	2.226.055
2009	2.041.098	34.949	23.658	3.182	15.003	2.117.890
2010	1.951.276	27.235	6.982	4.652	4.707	1.994.852
2011	1.853.176	11.862	68.743	4.225	6.253	1.944.259
2012	1.715.180	30.698	15.670	4.495	10.254	1.776.297
2013	1.623.130	548.617	13.558	7.143	9.102	2.201.550
2014	1.884.289	26.492	13.790	5.687	9.621	1.939.879
Trend 90–14	*-65.8%*	*-73.9%*	*-76.6%*	*-62.7%*	*-74.7%*	*-66.1%*

During the preparation of the inventory for submission in 2016 an intense data requirement analysis was performed. The aim was to fill the gaps in the existing data sets in order to provide a complete time series 1990-2014.

In 2007 a new census was introduced [45], leading to more accurate animal numbers. The census was conducted by the end of the year and comprises a representative sample of 5000 farms (90000 farms in total). Most of farms are individual farms; less than 200 farms are business entities.

There is a general problem of time series consistency in Macedonia. In 2007 a new method was introduced leading to more reliable data. The 2007 census is interview based (-> interviewers personally visit all farms in BC) and provides a full coverage of the country. The next full coverage census will take place in 2017.

The annual animal accountings in the years between are based on samples of about 5000 farms. In generally it is distinguished between individual farms and business entities (less than 200 registered).

The annual accountings were made as of the 31st of December until the year 2014, but from this year onwards they are made as of the 20th of November.

A solution could not be found on how to improve inconsistency between these two datasets (1990-2006 and from 2007 onwards), especially for sheep, goats and pigs the time series shows significant inconsistencies.

Actually, the Ministry of Agriculture and the Statistics Office have an ongoing project with the aim of improving the livestock statistics by using animal data (cattle, swine) of the Veterinarian Register.

The overall livestock population continuously decreased, especially for sheep, goats and horses as well as poultry.

Goat and sheep numbers decreased by about 68% between 1990 and 2014. Goats decreased because in the last century husbandry of goats was forbidden as it would curb the formation of karst. The main reason for the decline in sheep numbers is that most of the sheep herds are owned by small individual businesses, which were not profitable anymore. Horse numbers also show a decreasing trend since 1990. Horses were used for means of locomotion in the past in rural areas, but the purpose of horses changed and more and more people are now living in the cities and less horses are needed.

Cattle numbers

For 1990-2006 national statistics include dairy, other cows and heifers in calve in one category "cows". Activity data for dairy cows was not made available until this reporting period.

Regarding the relatively small number of calves and young cattle compared to the cattle older than 2 years (including dairy cattle that the share dairy/Non-Dairy is in line with the data of neighbouring countries of that region and that the marked is very volatile) – many calves are imported.

There is no specific tradition in animal breeding in Macedonia. The quality of the genetic pool of the domestic livestock is not good enough for high yield and quality production. Thus, for the replacement of animals in milk, meat and pork production predominantly young animals are imported from abroad (-> no domestic breed is taken).

The small calve number in the official statistics is due to the fact that (especially male calves) are slaughtered very early (between 2 and 12 months). In the veterinarian register all born animals have to be registered within a period of 7 days. This is the reason why the livestock balances show a significant higher number of calves than outlined in the official statistics.

Goat numbers

No official goat numbers are published before 2007. Within a meeting with experts of the statistical office data for the period 2000-2007 from the MAKSTAT data base were provided. For the years before an official request has been made for the use of non-published data, and only 1999 data has been provided. For the derivation of consistent time series of goats for 1990-1998 the average shares of the years 2007-2014 have been used.

Pig numbers

Pig statistics from 1990-2006 are not fully consistent with the official numbers from 2007 onwards. For the years 1990 to 2006 the fattening pig number has been derived from the difference of sow number (including boars) and total swine number 1990-2006.

Poultry number

Before 2007 only total poultry number is available. An official request has been made for the use of non-published data of laying hens 1990-2006. Data were received by the statistical office and used in the calculations.

For the derivation of consistent time series of broilers, geese, ducks and turkeys for 1990-2006 the average shares of the years 2007-2010 have been used. The time series of laying hens has been validated with annual total egg production and annual egg numbers per hen.

Sheep

Activity data for the whole time series are available in the official statistics. There are time series inconsistencies in animal numbers and milk production 1995-1996 and 2006-2007. No solution could be found. Inconsistencies are due to different methodologies of accounting.

Mules and asses

Regarding information from the Veterinary institute horses do not include mules and assess. No data on mules and assess were made available in the reporting period.

Emission factors

Table 148 and 149 provides for each livestock category emission factors taken from the EMEP EEA GB 2013 (updated in July). These factors have been used for the estimation of NO_X. NMVOC and NH_3 emissions. For cattle the average mean of both EF for NMVOC (EF with and EF without silage feeding) has been used.

Table 148 NH_3, NOx and NMVOC emission factors for source category 3B Manure managament

NFR code	Pollutants		
	NH_3	NO_x	NMVOC
	kg AAP-1 a-1	kg AAP-1 a-1	kg AAP-1 a-1
3B1a Dairy cattle	28,7	0,154	12,992
3B1b Non-dairy cattle	9,2	0,094	6,252
3B2 Sheep	1,4	0,005	0,169
3B3 Swine-fattening pigs	6,7	0,001	0,551
3B3 Swine-sows	15,8	0,004	1,704
3B4d Goats	1,4	0,005	0,542
3B4e Horses	14,8	0,131	7,781
3B4gi Laying hens	0,48	0,003	0,165
3B4gii Broilers	0,22	0,001	0,108
3B4giii Turkeys	0,95	0,005	0,489
Reference	GB 2013 updated July 2015 - Table 3.1 Default Tier 1 EF (EF NH_3) for calculation of NH_3 emissions from manure management. Figures are annually averaged emission kg AAP-1 a -1 NH_3. as defined in subsection 3.3.1 of the present chapter.	GB 2013 updated July 2015 - Table 3.2 Default Tier 1 EF for NO	GB 2013 updated July 2015 - Table 3-3 Default Tier 1 EF for NMVOC

Table 149 NH_3, NOx and NMVOC emission factors for source category 3B Manure managament

NFR code	TSP	PM10	PM2.5	Reference

	kg/capita	kg/capita	kg/capita	
3B1a Dairy cattle	1,38	0,63	0,41	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B1b Non-dairy cattle	0,59	0,27	0,18	GB 2013 updated July 2015 - Table 3,3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B2 Sheep	0,139	0,0556	0,0167	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B3 Swine-fattening pigs	0,75	0,34	0,06	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B3 Swine-sows	1,53	0,69	0,12	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B4d Goats	0,139	0,0556	0,0167	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B4e Horses	0,48	0,22	0,14	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B4gi Laying hens	0,119	0,119	0,023	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B4gii Broilers	0,069	0,069	0,009	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B4giii Turkeys	0,52	0,52	0,07	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).

During the inventory preparation for submission in 2016 first investigations on management practices commonly applied in the Macedonian agriculture have been made. On the basis of expert judgments and information of big IPPC installations within pig and poultry husbandry a distinction between slurry and solid systems could be made for each animal category.

The following expert judgment (REF) has been provided:

Cattle husbandry

The cattle husbandry is mostly in traditional holdings – 97% of all farms in Macedonia are small scale farms with up to 20 cows. In the past 25 years the number of bigger holdings is decreasing and at the moment there are only few farms with more than 100 dairy cows. The typical systems used in dairy cattle husbandry are small stalls with solid manure system, tied housing system with no outdoor loafing areas. Some of the bigger farms (more than 50 cattle) have changed from tied stall to free stall system, solid manure and outdoor loafing areas. The milking system is mechanical with separate milking parlour in the bigger farms. The other category of cattle which has a major part in the cattle husbandry in Macedonia is the cow-calf system (suckling cows). Where the cows are kept free on pasture and mountains and the breeders are using only the calves for meat production. This type of breeding is strictly traditional with the local breed Busha. In the milking sector dominating breed is Holstein Friesian, with small percentage of Simmental breed and the rest of the cattle breeds are within negligible numbers. Although there are several attempts in the past decade for establishing bigger farms. there is no visible trend for creating dairy farms with large number of animals in Macedonia. Based on this expert judgement we decided to use the EMEP/EEA default NH_3 and NO Tier 1 EFs for solid systems for all cattle categories.

Pasturing of cattle

Pastured system is mostly present in the cow-calf system. explained above. The rest of the farmers are rarely using pasture for dairy cattle and dairy cattle is kept indoors during the whole year. There are some practices where the cows from the whole village are pastured on the same pasture during the summer months of the year. However, there are no exact numbers available for presenting the percentage of farms that are using pasture in their management.

Based on this expert judgement and discussions with agriculture experts it was decided to apply the solid NH_3 and NO EFs for all cattle.

Swine

For IPPC installations (big pig farms) the following information was provided by the national IPPC experts: the number of animal places, the animal number produced per farm for 2014 and the number of days the animals are alive before being slaughtered for 2014.

Based on these data it was possible to calculate the annual average animal population held in these 7 big pig farms. The result was that about 30% of BC's pigs (mostly fattening pigs) were held in these farms in 2014. From the previous meeting we know that these farms use liquid systems.

Now it had to be clarified which kind of systems are usually applied for the rest of pigs held in smaller business entities and individual farms.

Additional information from the veterinary agency that also the small pig farms usually practice liquid manure systems; the manure is stored in septic tanks. Farmers have an agreement with someone else that uses a tank truck to collect the manure or use the manure for fertilization of their own agricultural land.

The assessment of the veterinary agency of Macedonia was confirmed by national experts of the Ministry of Agriculture. Based on this expert judgement we decided to use the EMEP/EEA default NH_3 and NO EFs for liquid systems for all swine categories.

Poultry

In Macedonia only laying hens are kept in big poultry farms. Broilers are mainly imported from abroad. Data from IPPC investigations (big poultry farms) showed that the solid factor is the appropriate for all hens (conservative approach). This approach was confirmed by the national experts of the Ministry of Agriculture within an expert meeting during the mission.

EMEP/EEA Tier 1 NH_3 and NO_X emission factors of all other animal categories do not distinguish between solid and liquid systems.

NMVOC emission factors

Default Tier 1 emission factors distinguish between feeding with and without silage for dairy cows. other cattle, sheep, goats, horses and mules and asses (GB 2013[5]. Table 3-3).

The following information from the Veterinary institute has been received on the feeding with silage.

"Feeding with silage is quite common in Macedonia among farm animals. Especially during the winter period - to my knowledge (there is no exact data analysis for the time period) at least half of the year the farmers are using silage as feed. The composition of silage is dominantly consisted of maize, alfalfa, clover and grains. This type of feed is especially used for cattle feeding."

According to the information received the following was decided:

- For cattle to use the average mean of both EF with, and EF without silage feeding
- For all other animals to use the EF without silage feeding

6.4. Crop production and Agricultural Soils - NFR 3D

Methodological issues

Due to existing data gaps on fertilizer type level. Tier 1 methodology has been used.

The approach to use a 3-years average for mineral fertilizers was confirmed by MAFWS as fertilizers listed in the official imported/export statistics are not applied on the fields accordingly. Wholesalers and big farmers buy fertilizers when the prices are good. Fertilizers are stored. There is no relevant fertilizer production in the country, therefore the use of imported amounts is a good basis for emission calculation.

Activity data

Time series inorganic N-fertilizers are incomplete and inconsistent. From 2002 to 2010 data are based on FAO. from 2009 to 2014 data from import/export statistics have been taken. These data were recived from the Ministry of agriculture, forestry and water supply. For the years before 2002 only an incomplete dataset is available.

There is no reporting obligation for wholesalers in BC. There are no numbers of sold fertilizer amounts available. Anyhow, all kind of fertilizers have to be registered for permission in the country; hardcopies are available for each type of fertilizer including the shares of fertilizer substances (but no amounts!). As there are hundreds of different kinds of fertilizers registered, the manual evaluation would be very time consuming and there are no resources available. As a result, no information on N contents could be obtained.

Anyhow, an estimate can be made as following:

Fertilizers listed in the import/export balance with unknown substances are:

- liquid mineral fertilizers, organic fertilizers, foliaric fertilizers

(-> following Austrian experts foliaric N-fertilizers might be used in regions with low precipitation!)

For foliaric fertilizers. liquid fertilizers and organic fertilizers only amounts from import statistics but no N contents are available in Macedonia. As a first approach emissions are calculated using average N content and average EF of all applied fertilizers.

Information on the low numbers of calcium ammonium nitrate fertilizers from 1997-2002 and the use of MAP. DAP. NKK fertilizers before 2001 could not be given.

Soil ph could be clarified. The European Soil Bureau. Research Report No. 9 outlines different soil types and complexes in ha (%). An evaluation of this information resulted in the assessment that all relevant soils have a low soil ph =< 7.0. This assessment was confirmed by the national experts of the Ministry of Agriculture.

In the following table the quantities of applied N fertilizers is shown.

Table 150 Activity data for source category NFR 3Da1 Inorganic fertilizers

Year	kg kg-1 fertilizer-N applied	Year	kg kg-1 fertilizer-N applied
1990	1124002	2003	860310.695
1991	1065502	2004	845942.87
1992	890002	2005	906904.85
1993	841252	2006	965538.225
1994	882803	2007	875386.53
1995	498524.68	2008	959214.64
1996	767468.56	2009	1207483.92
1997	653342.56	2010	1084643.25
1998	743111.56	2011	993640
1999	809078.56	2012	1083658
2000	590690.56	2013	1182682
2001	563141.56	2014	1313309
2002	476740.9		

Emission factors

In the following table the emission factors applied for source category 3.D.a.1 are shown. All emission factors are taken from the GB 2013 [5].

Table 151 Emissions factors for source category NFR 3Da1 Inorganic fertilizers

Pollutant	Value	Unit	References
NOx	0,026	kg kg-1 fertilizer-N applied	Table 3-1 emission factor for source category 3.D.a.1
NMVOC	0,86	kg/ha	Table 3-1 emission factor for source category 3.D.a.1
NH_3	0,081	kg kg-1 fertilizer-N applied	Table 3-1 emission factor for source category 3.D.a.1
PM10	1,56	kg/ha	Table 3-1 emission factor for source category 3.D.a.1
PM2.5	0,06	kg/ha	Table 3-1 emission factor for source category 3.D.a.1

6.5. Field burning of agricultural residues - NFR 3F

Field burning activities were discussed with agriculture experts. Field burning is not permitted by law and there are no data on illegal field burning activities available.

Therefore the source category 3F “Field burning”is reported as not occurring (“NO”). Anyhow, the current estimates for sector 5C2 “Open burning of waste” (average amount of waste burned for arable farmland of 25kg/ha) should be kept as it is liable that open burning of small-scale (agricultural) waste happens in BC.

Recalculations

Recalculation in following source categories: 3B1a. 3B3. 3B4gi. 3B4gii.3B4giii have been carried out due to change of emission factors. Emission factors have been selected after in depth analysis of the current situation of manure management and type of feeding done by MS expert within the currently ongoing Twining project.

The number of fattening pigs was derived from the difference between total pig number and sows. Updated activity data for source category swine caused change in NO_x, NH_3, TSP, PM10, PM2.5 and TSP emissions in 2013 and 1990 reported last year.

Buffalos are included in other cattle category (3.B.1.b) as buffalos are bovines and no data for buffalo is available from 2007 onwards (-> time series consistency).

The reason for recalculation in the source category 3.D.a.1 is a change of activity data which results in a change of methodology. namely application of approach to use a 3-years average for mineral fertilizers.

Planned improvements

Emissions of source category Sewage sludge applied to soils are planned to be calculated when information on amounts annually spread on fields (including N-contents) are made available. No planned improvements in in the source category 3.D.a.1.

7. WASTE (NFR 5)

7.1. Sector overview

The chapter includes calculation of NOx, SO_2, CO, NMVOC, Particulates, heavy metals and persistent organic compounds (POPs). Emissions addressed in this chapter include emissions from the next subcategories:

5A Solid waste disposal on land

5C1biii Clinical waste incineration

5C2 Open burning of waste

For calculation of emissions coming from this category Tier 1 emission factors have been used. Explanations of the source of activity data, methodology used and emission factors are presented below.According to information from the statistical office more than 99% of municipal solid waste is landfilled. Generally in the country there is only clinic a waste incinerator operating from 2000. Other type of waste incineration as well as cremation process do not occur. Open burning of waste covers the volume reduction by open burning of small-scale (agricultural) waste. It does not include stubble burning, or forest fires. The open burning of rubber tires or waste oil on farms has also not been included. Agricultural wastes that might be burned are crop residues (e.g. cereal crops, peas, beans, soya, sugar beet, oil seed rape, etc.), wood, prunings, slash, leaves. plastics and other general wastes. Straw and wood are often used as the fuel for the open burning of agricultural wastes.

Regarding waste water treatment, there are few waste treatment plants in the municipalities in the country that do not operate continuously and no data for the quantity of treated water has been requested up to now. Regarding the Industrial wastewater handling, the some installations subjected under the IPPC licence system are obligated to install waste water treatment. Emissions from this NFR categories have not been estimated until now.

Methodology

Tier 1 approach was used, using the given default Emission factors from the GB 2013 [5].

Completeness

The completeness in this sector is presented in the following table.

Table 152 NFR categories not included in Waste sector for 2014

NFR category		Completeness
5A	Biological treatment of waste - Solid waste disposal on land	√
5C1biii	Clinical waste incineration	√
5C2	Open burning of waste	√
5B1	Biological treatment of waste - Composting	NE
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	NA
5C1a	Municipal waste incineration	NO
5C1bi	Industrial waste incineration	NO
5C1bii	Hazardous waste incineration	NO
5C1biv	Sewage sludge incineration	NO
5C1bv	Cremation	NO
5C1bvi	Other waste incineration (please specify in the IIR)	NA
5D1	Domestic wastewater handling	NE
5D2	Industrial wastewater handling	NE

NFR category		Completeness
5D3	Other wastewater handling	NA
5E	Other waste (please specify in IIR)	NO

7.2. Solid waste disposal on land (NFR 5A)

Within this category the emissions arising from solid waste disposal shall be accounted for, whereby municipal and industrial waste shall be considered. But it has to be taken into account that only waste which still undergoes biological or chemical degradation is relevant. So, inert waste (like construction waste) shall not be included.

Methodological issues

NMVOC and particulate emissions were estimated using tier 1 method by multiplying amount of landfilled municipal solid waste and emission factors. For the first time these emissions have been calculated using Tier 1 emission factors of the GB 2013 [5].

Activity Data

The activity data represent the amount of landfilled waste. Due to lack of data on industrial waste and its composition only municipal solid waste has been taken into account. The data from 2000 to 2014 are taken from Eurostat, whereby it has been checked that they are consistent with national statistics. National statistics on municipal solid waste are only available for 2014 and 2010 [35], so, in order to have a time series without gaps the data from Eurostat have been used. According to information from the statistical office more than 99% of municipal solid waste is landfilled.

As activity data from 1990 to 2007 are not available, they were extrapolated based on the annual relative change in population. Quantity of solid waste generated for the period 1990–2014 is presented in the following table:

Table 153 Activtity data for source category 5A Solid waste disposal on land

Year	Comunal waste [Mg]	Year	Comunal waste [Mg]
1990	704631	2003	706965
1991	706710	2004	708984
1992	714450	2005	710491
1993	717942	2006	711670
1994	678510	2007	712833
1995	685580	2008	714000
1996	691560	2009	726000
1997	696431	2010	721000
1998	700166	2011	735000
1999	703537	2012	786000
2000	706763	2013	793000
2001	709752	2014	765000
2002	704787		

Emission Factors

The emission factors used are as outlined in the GB 2013 for source category 5A.

Table 154 Emission factors for source category 5A Biological treatment of waste

Pollutant	Value	Unit	Reference
NMVOC	1,56	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.A Biological treatment of waste – Solid waste disposal on land
TSP	0,463	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.A Biological treatment of waste – Solid waste disposal on land
PM10	0,219	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.A Biological treatment of waste – Solid waste disposal on land
PM2.5	0,33	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.A Biological treatment of waste – Solid waste disposal on land

For NO_x and SO_x, heavy metals except Hg and POPs the notation key NA was used. For NH_3, Hg and CO the notation key NE was used – as outlined in the GB 2013.

7.3. Clinical Waste incineration - NFR 5C

Methodological issues

Emissions from this source category are estimated according to GB – 2013. The guideline outlines simple methodology where the amount of clinical waste incinerated is multiplied with Tier 1 emission factors.

Activity data

The activity data for source category 5C Clinical waste are from annual report of company "Drisla" [46] where clinical waste incineration is operating. The company started with operation in 2000. Data for the period 2000-2012 were taken from the Drisla landfill website, while data for the period 2013-2014 were requested from the landfill operator itself.

Table 155 Quantity of clinical waste incinerated in the period 2000–2014

Year	Clinical waste [Mg]	Year	Clinical waste [Mg]
2000	0,1150	2007	0,3023
2001	0,1369	2008	0,5340
2002	0,1546	2009	0,4490
2003	0,1732	2010	1,5210
2004	0,2231	2011	0,3559
2005	0,2521	2012	0,4448
2006	0,2748	2013	0,7273
		2014	0,7117

Emission Factors

The emission factors used are as outlined in the GB 2013 and presented in the following table.

Table 156 Emission factors for source category 5c1dii Clinical waste incineration

Pollutant	Value	Unit	References
NOx	3,18	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
NMVOC	1,23	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
NH_3	0,11	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
PM10	4,19	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
PM2.5	4,51	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
TSP	4,64	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
BC	42	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
CO	55,83	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Pb	0,49	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Cd	0,1	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Cr	0,01	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Cu	0,2	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Se	0,07	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
PCDD/ PCDF (dioxins/ furans)	10	mg I-Teq/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
benzo(a) pyren	2,33	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
benzo(b) fluoranthen	4,63	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
benzo(k) fluoranthen	5,68	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator

7.4. Open burning of waste - NFR 5C2

Methodological issues

The simpler methodology involves the use of a single emission factor for each pollutant representing the emission per mass of waste burned, combined with activity statistics:

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

This requires a prior knowledge of the weight of agricultural waste produced per hectare of forestry, orchard and farmland. It is assumed that open burning of agricultural waste (except stubble burning) is mainly practised in forestry, orchard and arable farming; emissions from open burning for other

types of farming are likely to be less significant and are assumed to be negligible. The average amount of waste burned for arable farmland is therefore 5.C.2 Open burning of waste GB 2013/2009 estimated to be 25 kg/hectare. This approach has been used for estimation of activity data.

Activity data

Data on arable farmland taken from the statistical office and calculated waste burned are presented in the following table.Data on arable farmled are taken from State Statistical Office of the Republic of Macedonia, Field crops, orchards and vineyards, 2007-2014 [44].

Table 157 Activity data for source category 5C2 Open burning of waste

Year	Arable farmland [hectare]	Waste [kg]
1990	667000	16675
1991	664000	16600
1992	662000	16550
1993	663000	16575
1994	661000	16525
1995	656000	16400
1996	658000	16450
1997	647000	16175
1998	635000	15875
1999	633000	15825
2000	598000	14950
2001	612000	15300
2002	577000	14425
2003	569000	14225
2004	560000	14000
2005	546000	13650
2006	537000	13425
2007	529000	13225
2008	521000	13025
2009	513000	12825
2010	504000	12600
2011	511000	12775
2012	510000	12750
2013	509000	12725
2014	511579	12789

Emission Factors

The emission factors used are as outlined in the GB 2013 [5] for source category 5C2.

Table 158 Emission factors for source category 5C2 Open burning of waste

Pollutant	Value	Unit	References
Nox	3,18	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
NMVOC	1,23	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning

Pollutant	Value	Unit	References
Sox	0,11	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
PM2.5	4,19	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
PM10	4,51	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
TSP	4,64	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
BC	42	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
CO	55,83	kg/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Pb	0,49	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Cd	0,1	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Cr	0,01	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Cu	0,2	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Se	0,07	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
"PCDD/ PCDF (dioxins/ furans)"	10	mg I-Teq/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
benzo(a) pyren	2,33	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
benzo(b) fluoranthen	4,63	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
benzo(k) fluoranthen	5,68	g/Mg	GB 2013 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning

7.5. Waste water treatment - NFR 5D

Explanation of the problems for emissions estimations

Waste water handling has so far not been included in the air emission inventory, which should be changed. Although it is expected to be a minor source, but waste water exists and causes emissions. Therefore, data available for Sector 5D Waste water handling were checked, if they could be reported in 2016. Data for waste water from households and industries are available until 2012, although the source of data could not be verified. Looking at the statistical yearbook of Macedonia it seems that the data available in chapter 10.02 Water management, the produced wastewater from mining and other industries should be used.

It was also attempted to gain data on how much people are connected to waste water treatment. The data from Eurostat provide values for several years, in the range of 5-7%. Another information was found in the SOER country profile for Macedonia (see below), mentioning that “Sixty percent of dwellings are connected to a public sewage system. 21 % have septic tanks and another 19 % have only a system of uncontrolled wastewater discharge “. According to the BC experts, this number

seems right concerning the connection to the sewage system, but when it comes to the connection to waste water treatment plants, the percentages provided by EUROSTAT seem reliable. Still, this information is not sufficient to decide on how many people are using latrines or sceptic tanks, which serve as activity data for NH_3 emissions. For this reason, NH_3 emissions from 5D cannot be calculated with the available data. But in order to also report on NMVOC emissions from 5D, the amount of wastewater from households and industries is needed.

Recalculations

For the sector Solid waste disposal on land for this reporting round, emission factors from EMEP guidebook 2013 have been used. Additionally as due to a lack of data on industrial waste and its composition, only municipal solid waste has been taken into account.

Data for the Clinical waste incineration have been taken from the landfill operator “Drisla” for this reporting due to fact that Drisla landfill data account as more reliable and complete than the data gathered by MEPP from the clinical waste producers.

No recalculations were performed in the 5C2 sector.

Planned improvements

Estimation of emissions in Waste water treatment source category.

Further analysis of industrial waste data, gathering relevenat data on industrial waste and its composition in order to improve and complete activity data are needed for calculations of emissions in the sector Solid waste disposal on land - 5A.

8. NATURAL SOURCES

8.1. Sector overview

This chapter describes emissions from (naturally or man-induced) burning of non-managed and managed forests and other vegetation, excluding agricultural burning of stubble, etc. This includes domestic fires (fuel wood, crop residue, dung and charcoal burning) as well as open vegetation fires (forest, shrub, grass and cropland burning).

In this Inventory Report this chapter shows emissions which originated from open vegetation forest fires.

This sector includes information and description of the methodologies applied for estimating emissions for NMVOC, NH_3, NOx, SOx, PM10, PM2.5, TSP and CO as well as references to activity data and emission factors concerning emissions coming from the forest fires for the period 1990-2014.

8.2. General description

Methodology

Tier 1 approach was used, using the given default Emission factors from the GB 2013 [5].

Completeness

The information on the completeness in this sector is presented in the following tables.

Table 159 Completed/Notcompleted NFRs in sector Natural sources

NFR category	Completeness
11.B Forest fires	√
11.A Volcanoes	NO
11.C Other Natural Sources	NE

8.3. Forest fires – NFR 11B

Methodological issues

The Tier 1 approach for emissions from forest fires uses the general equation:

$$E_{pollutant} = \sum AR_{burned} \times EF_{pollutnat}$$

Where:

$E_{pollutant}$ = is the emission of a certain pollutant.

AR_{burned} =is the total area that has been burned/wood burned

$EF_{pollutant}$ =is the emission factor for this pollutant.

Activity Data

The activity data for this sector are taken from Statistical Yearbooks [35] and State Statistical Office of the Republic of Macedonia, Forestry, 2000 – 2014 [47].

Table 160 Activity data for source category 11B Forest fires

Year	Area burned [ha]	Wood burned [m^3]	Wood burned [kg]
1990		1131	870870
1991		3729	2871330
1992		2	1540
1993		4213	3244010

Year	Area burned [ha]	Wood burned [m^3]	Wood burned [kg]
1994		96612	74391240
1995		54228	41755560
1996		636	489720
1997		4084	3144680
1998		4214	3244780
1999		3856	2969120
2000	4807		
2001	5255		
2002	5482		
2003	1922		
2004	1798		
2005	3093		
2006	3594		
2007	34443		
2008	15046		
2009	1030		
2010	4725		
2011	8702		
2012	19312		
2013	2844		
2014	1150		

Emission factors

Calculation of emission parametars was used and emission factors were taken from the GB 2013.

Table 161 Emission factors for for source category 11B Forest fires

Pollutant	Value	Unit	References
Nox	100	kg/ha area burned	GB 2013 11.B Forest fires. Table 3-1. pg. 9
CO	3000	kg/ha area burned	GB 2013 11.B Forest fires. Table 3-1. pg. 9
NMVOC	300	kg/ha area burned	GB 2013 11.B Forest fires. Table 3-1. pg. 9
SOx	20	kg/ha area burned	GB 2013 11.B Forest fires. Table 3-1. pg. 9
NH_3	20	kg/ha area burned	GB 2013 11.B Forest fires. Table 3-1. pg. 9
PM10	17	g/kg wood burned	GB 2013 11.B Forest fires. Table 3-1. pg. 9
PM2.5	11	g/kg wood burned	GB 2013 11.B Forest fires. Table 3-1. pg. 9
TSP	9	g/kg wood burned	GB 2013 11.B Forest fires. Table 3-1. pg. 9

In the Statistical Yearbook from 2000-2014 [35] there is data for wood burned in m^3. Calculation is made for wood burned in kg using the equation: average density 0.77 kg/m^3 *1000.

Planned improvements

Gathering data for the quantity of wood burned from Macedonian forests for calculation of particulate emissions for the period 2000-2014.

Recalculation

No recalculations were made since last year's submission.

9. RECALCULATIONS AND IMPROVEMENTS

9.1. Recalculations

To ensure time series consistency when improving the Macedonian emission inventory recalculations have been carried out for historical years.

The following section describes the changes made since the previous submission for each sector (e.g. methodological changes, update of activity data, new emission sources).

9.1.1. Explanation of recalculations per sector

As a result of the reporting of the whole time series 1990-2014 in this reporting round, as well as major improvements of the emission inventory made within the activities in the component 2 of the ongoing Twinning project, most of emission sources have been recalculated based on availability of historical activity data, use of extrapolation, use of emission factors from the GB2013 and updated methodology and selection of emission factors according to deeper analysis conducted with the support of MS experts.

Explanations for recalculation per sector are given in respective chapters. The tables indicating recalculations per pollutant can be found in Chapter 9.1.2.

Energy (NFR 1)

Activity data for fuel consumption from the final energy balance for 2013 has been used due to the minor changes in the Energy balance. Updated activity data results in recalculated emissions in the following sectors: 1B1a1, Bav, 1Bc, 1A2gvii and 1Baiv.

Measurement data from power plants and heating plants for the period 2008-2014 have been used in order to reach compliance with the NERP reported to the Energy Community. Implied emission factor has been used for the whole time series for the following pollutants: NOx, SO2, TSP and CO. The consumption of the main fuel biomass in source category 1A4bi has been recalculated for the whole time series due to newly available data from the current survey 'Energy consumption in households. 2014' [38]. Additionally recalculation in the 1A2 sector have been done when available statistical data have been replaced with IIASA data used in the previous submission. In 1B sector emissions from source category NFR 1B2aiv.

Transport (NFR 1A3)

NFR sectors 1A3ai(i). 1A3ai(ii) 1A3aii(ii) in aviation were reported for the first time in this reporting round. Regarding Road transport, for the previous reporting preliminary activity data from energy balance were used, however, in this reporting final definitive activity data from the energy balance have been used.

Update of activity data results with recalculation in emission in the following NFRs 1.A.3.biv. 1.A.3.bv.1A3bvi and 1A3dii.

For the national navigation emission factors from the GB 2013 [5] instead of GB 2009 [6] have been used.

Industrial processes and product use (NFR 2)

Major changes in the sector were made due to the availability of engaged human resources in the Ministry as well as the support provided by the MS expert in the Twining project for detailed analysis of the industrial processes in this sector with special emphasis on the activity data used. Activity data in the following sectors have been updated: 2A5c, 2C1, 2C2, 2C6, 2I, 2D3d and 2D3c.

Emissions for the NFR 2C5 have been calculated for the time period 1990-2009. For the emissions coming from this sector in the period 2010 -2014 it has been decided that emissions should be

reported not estimated due to the fact that quantity of lead accumulators have been reported in the previous reporting rounds.

Emissions from the source category Food and beverages industry-2H2_are slightly revised due to the change of emission factor for bread production from 5000 to 4500 g/Mg taken from the GB 2013 [5].

NMVOC emissions from source category Decreasing and Dry cleaning have been reported in a wrong order in the previous inventory and have now been reported in the right fields.

For the sector Other product and solvents use, Tier 2 emission factors from GB 2013 [5] have been used.

Notation keys NO and NE have been implemented for the source categories glass production and lead production respectively, due to the detailed analysis of the ongoing industrial process in these sectors and available statistical activity data.

Agriculture (NFR 3)

Recalculation in the following source categories: 3B1a. 3B3. 3B4gi. 3B4gii.3B4giii have been carried out due to change of emission factors. Emission factors have been selected after in depth analysis of the current situation of manure management and type of feeding done by MS expert within the currently ongoing Twining project.

The number of fattening pigs was derived from the difference between total pig number and sows. Updated activity data for source category swine caused changes in NOx, NH_3, TSP, PM10, PM2.5 and TSP emissions in the whole time series.

Change of activity data which results due to change of methodology, namely application of approach to use a 3-years average for mineral fertilizers.

Waste (NFR 5)

The update of activity data for the sector Solid waste disposal on land and Clinical waste incineration was used in the calculations, using emission factors from GB 2013 [5] for source category Solid waste disposal on land resulting in changes of emissions for 2013 in Clinical waste incineration category (data source has been changed) as well as for the whole time series for the category source Solid waste disposal on land (previously landfill gas instead of waste quantity).

9.1.2. Recalculations per pollutant

The following tables show the changes of emissions for all air pollutants (reported mandatory by Macedonia) compared to the previous submission (NFR from May 2015). Detailed explanations on the reasons for recalculations are provided in the sectoral chapters. Revisions in the extent by more than 1000 % are due to inclusion of new estimates as well as the fact that the whole time series inventory has been prepared in three reporting years. This was done with support of MS experts within the component 2 of the ongoing Twining project whose knowledge has been used for support in proper selections of available statistical activity data and use of methods for time series consistency.

Table 162 Recalculation difference of NOx compared to submission 2015

NOx emissions [kt]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1A1	Energy Industries	6.95	40%	0.00	0%
1A2	Manufacturing Industries & Construction	1.41	20%	2.27	57%
1A3	Transport	-3.18	-25%	1.91	19%
1A4	Other Sectors	0.21	18%	0.51	52%
1.A.5	Other	NE	NE	NE	NE
1B	Fugitive Emissions	0.29	898%	0.00	3%
2	Industrial Processes and Product Use	-0.35	-88%	0.02	67%
3	Agriculture	-0.43	-79%	-0.40	-84%
5*	Waste	0.00	-1%	0.00	1%
6	Other	0.00	-	0.00	-
	Total emissions	**4.89**	**13%**	**4.31**	**16%**

*Note: High increase is due to change estimation of emissions coming from the NFR 1B2aiv Fugitive emissions oil: Refining / storage

Table 163 Recalculation difference of NMVOC compared to submission 2015

NMVOC emissions [kt]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1A1	Energy Industries	-1.84	-95%	-0.01	-13%
1A2	Manufacturing Industries & Construction	-0.58	-37%	0.46	76%
1A3	Transport	5.99	68%	0.89	18%
1A4	Other Sectors	4.98	89%	6.19	141%
1.A.5	Other	NE	NE	NE	NE
1B	Fugitive Emissions	0.89	47%	1.16	81%
2	Industrial Processes and Product Use	-4.13	-26%	4.28	74%
3	Agriculture	-1.66	-24%	-1.07	-21%
5*	Waste	1.09	>1000%	1.22	>1000%
6	Other	0.00	-	0.00	-
	Total emissions	**4.74**	**11%**	**13.12**	**58%**

*Note: High increase is due to change of the activity data and as well as emission factor in the NFR 5A

Table 164 Recalculation difference of SO_2 compared to submission 2015

SO_2 emissions [kt]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	-7.00	-6%	0.01	0%
1.A.2	Manufacturing Industries & Construction	-11.30	-71%	2.45	53%
1.A.3	Transport	-1.73	-72%	0.02	301%
1.A.4	Other Sectors	0.29	56%	-0.93	-52%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.60	>1000%	0.00	-5%
2	Industrial Processes and Product Use	-5.72	-100%	-0.05	-100%
3	Agriculture	0.00	-	0.00	-
5	Waste	0.00	-17%	0.00	5%
6	Other	0.00	-	0.00	-
	Total emissions	**-24.86**	**-18%**	**1.50**	**2%**

*Note: High increase is due to change estimation of emissions coming from the NFR1B2aiv
Fugitive emissions oil: Refining / storage

Table 165 Recalculation difference of NH_3 compared to submission 2015

NH_3 emissions [kt]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0.00	-	0.00	-
1.A.2*	Manufacturing Industries & Construction	0.00	>1000%	0.00	-
1.A.3	Transport	0.00	0%	-0.26	-89%
1.A.4	Other Sectors	0.66	150%	0.73	150%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.00	-	0.00	-5%
2	Industrial Processes and Product Use	-0.01	-65%	0.00	-
3	Agriculture	-0.93	-6%-	-2.12	-20%
5	Waste	0.00	-	0.00	-
6	Other	0.00		0.00	-
	Total emissions	-0.28	--2%	-1.65	-14%

*Note: High increase is due to the fact that more reliable methodology has been used for estimation of activity data for NFR 1.A.2.g.vii. Moreover EF from EB guidebook 2013 have been used in this reporting round.

Table 166 Recalculation difference of PM2.5 compared to submission 2015

PM2.5 emissions [kt]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	3.51	100%	0.00	0%
1.A.2	Manufacturing Industries & Construction	0.87	100%	0.43	72%
1.A.3	Transport	0.05	100%	0.07	248%
1.A.4	Other Sectors	11.84	100%	7.76	148%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.04	100%	0.00	0%
2	Industrial Processes and Product Use	15.71	100%	0.77	6%
3	Agriculture	0.36	100%	0.00	1%
5	Waste	0.07	100%	0.00	0%
6	Other	NE	NE	NE	NE
	Total emissions	**32.46**	**100%**	**9.03**	**43%**

Note: PM2.5 emissions for the year whole time series have been reported for the first time in submission 2016.

Table 167 Recalculation difference of PM10 compared to submission 2015

PM10 emissions [kt]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	8.66	100%	-0.88	0%
1.A.2	Manufacturing Industries & Construction	0.92	100%	0.46	68%
1.A.3	Transport	0.09	100%	0.12	62%
1.A.4	Other Sectors	12.17	100%	7.96	148%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.45	100%	0.00	99%
2	Industrial Processes and Product Use	22.72	100%	0.67	6%
3	Agriculture	3.10	100%	0.02	5%
5	Waste	0.08	100%	0.00	4%
6	Other	0.00	NE	NE	-
	Total emissions	48.19			25%

Note: PM10 emissions for the year whole time series have been reported for the first time in submission 2016

Table 168 Recalculation difference of TSP compared to submission 2015

TSP emissions [kt]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	12.82	100%	0.00	0%
1.A.2	Manufacturing Industries & Construction	0.97	100%	0.46	68%
1.A.3	Transport	0.14	100%	0.35	62%
1.A.4	Other Sectors	12.83	100%	8.40	148%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.56	100%	0.27	99%
2	Industrial Processes and Product Use	28.24	100%	1.42	6%
3	Agriculture	1.5	100%	0.04	5%
5	Waste	0.08	100%	0.00	4%
6	Other	NE	NE	NE	NE
	Total emissions	**57.12**	**100%**	**10.95**	**25%**

*Note: TSP emissions for the year whole time series have been reported for the first time in submission 2016

Table 169 Recalculation difference of CO compared to submission 2015

CO emissions [kt]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	-4.28	-61%	0.00	0%
1.A.2	Manufacturing Industries & Construction	-9.23	-61%	2.03	35%
1.A.3	Transport	-0.34	-1%	8.02	38%
1.A.4	Other Sectors	40.02	143%	41.54	142%
1.A.5	Other	NE	NE	NE	NE
1.B*	Fugitive Emissions	0.09	>1000%*	0.00	-93%
2*	Industrial Processes and Product Use	1.42	>1000%*	1.17	828%
3	Agriculture	0.00	-	0.00	-
5	Waste	0.00	0%	0.00	0%
6	Other	NE	NE	NE	NE
	Total emissions	**27.68**	**27%**	**52.75**	**89%**

*Note: High increase is due to calculation estimation of emissions coming from the NFR1B2aiv and 2.D.c.3 as well as recalculation of emissions coming from sector 2G due to availability of activity data.

Table 170 Recalculation difference of Pb compared to submission 2015

Pb emissions [t]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	-0.24	-21%	0.00	0%
1.A.2	Manufacturing Industries & Construction	-1.38	-69%	0.36	58%
1.A.3	Transport	0.00	0%	0.00	19%
1.A.4	Other Sectors	-0.15	-17%	0.44	132%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.00	-	0.00	-100%
2	Industrial Processes and Product Use	5.78	70%	-0.93	-36%
3	Agriculture	0.00	-	0.00	-
5	Waste	-0.02	-73%	0.01	23%
6	Other	NE	NE	NE	NE
	Total emissions	**4.22**	**4%**	**-0.11**	**-3%**

Table 171 Recalculation difference of Cd compared to submission 2015

Cd emissions [t]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	-0.03	-20%	0.00	0%
1.A.2	Manufacturing Industries & Construction	-0.04	-81%	0.01	68%
1.A.3	Transport	0.00	0%	0.00	4%
1.A.4	Other Sectors	-0.06	-71%	-0.06	-70%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.19	-	0.00	-5%
2	Industrial Processes and Product Use	0.11	49%	0.00	-35%
3	Agriculture	0.00	-	0.00	-
5	Waste	0.00	-100%	0.00	21%
6	Other	NE	NE	NE	NE
	Total emissions	**-0.02**	**3%**	**-0.06**	**-28%**

Table 172 Recalculation difference of Hg compared to submission 2015

Hg emissions [t]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	-0.05	-5%	0.00	0%
1.A.2	Manufacturing Industries & Construction	-0.08	-8%	0.02	56%
1.A.3	Transport	0.00	0%	0.00	-100%
1.A.4	Other Sectors	0.01	1%	0.00	96%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.23	23%	-0.01	-88%
2	Industrial Processes and Product Use	-0.20	-20%	-0.02	-36%
3	Agriculture	0.00	0%	0.00	-
5	Waste	-0.02	-2%	0.01	26%
6	Other	NE	NE	NE	NE
	Total emissions	**-0.10**	**-10%**	**0.00**	**2%**

Table 173 Recalculation difference of PCDD/ PCDF compared to submission 2015

PCDD/ PCDF emissions [t]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	-0.04	-6%	0.00	0%
1.A.2	Manufacturing Industries & Construction	-1.96	-68%	0.56	58%
1.A.3	Transport	0.00	-	0.00	-
1.A.4	Other Sectors	6.04	115%	6.63	116%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.01	-	-0.01	-100%
2	Industrial Processes and Product Use	-1.62	-31%	-0.60	-35%
3	Agriculture	0.00	-	0.00	-
5	Waste	-0.01	-8%	0.01	4%
6	Other	NE	NE	NE	NE
	Total emissions	**2.41**	**17%**	**6.59**	**73%**

Table 174 Recalculation difference of PAH compared to submission 2015

PAH emissions [t]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0.00	>1000%	0.00	-3%
1.A.2	Manufacturing Industries & Construction	-1.67	-76%	0.42	53%
1.A.3	Transport	0.00	-	0.00	-100%
1.A.4	Other Sectors	8.78	353%	9.51	290%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.01	-	0.00	-
2*	Industrial Processes and Product Use*	2.66	>1000%	0.18	112%
3	Agriculture	0.00	-	0.00	-
5	Waste	0.00	-2%	0.00	-
6	Other	NE	NE	NE	NE
	Total emissions	**7.55**	**161%**	**10.10**	**255%**

*Note: High increase is due to estimation of PAH emissions coming from NFR 2C1 by use of EF from GB 2013. The figure of this estimation has not been missed in the last resubmission in 2014 on purpose

Table 175 Recalculation difference of HCB compared to submission 2015

HCB emissions [kg]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0.00	-	0.00	-
1.A.2	Manufacturing Industries & Construction	-0.25	-99%	0.00	-27%
1.A.3	Transport	0.00	-	0.00	-
1.A.4	Other Sectors	0.06	199%	0.07	200%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.00	-	0.00	-
2	Industrial Processes and Product Use	-1.15	-3%	-0.03	0%
3	Agriculture	0.00	-	0.00	-
5	Waste	-0.04	-100%	0.02	26%
6	Other	NE	NE	NE	NE
	Total emissions	**-1.37**	**-3%**	**0.06**	**1%**

Table 176 Recalculation difference of PCB compared to submission 2015

PCB emissions [kg]		1990		2013	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0.00	-	0.00	-
1.A.2	Manufacturing Industries & Construction	-1.70	-70%	0.86	229%
1.A.3	Transport	0.00	-	0.00	-
1.A.4	Other Sectors	-4.68	-82%	-9.05	-89%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.00	-	0.00	-
2*	Industrial Processes and Product Use	177.58	>1000%	-0.50	-36%
3	Agriculture	0.00	-	0.00	-
5	Waste	-0.01	-100%	0.00	26%
6	Other	NE	NE	NE	NE
	Total emissions	**171.20**	**>1000%**	**-8.70**	**-73%**

*Note: High increase is due to estimation of PCBs emissions coming from NFRs 2C5 and 2C6 sectors. Emissions coming from 2C5 were estimated for first time, while activity data for 2C6 primary production has been recalculated due to analysis of the available statistical data conducted together with MS experts.

9.2. Improvements

9.2.1. Improvements made

The following table shows issues flagged by the CLRTAP stage 3 review 2011, their rating and status of implementation at the time of IIR 2016 submission. Planned improvements at sectoral level are described in the respective sector chapters.

Table 177 Findings from step 3 Review (2011) and improvements made (general issues)

Subject	Source	rating	Improvement made
The inventory is partly in line with the EMEP EEA inventory guidebook and UNECE Reporting Guidelines. The NFR tables are not reported for the complete time series.	CEIP/S3.RR/2010/ FYR of Macedonia § 6	High	NFR tables submitted 2016 cover the complete time series.
The ERT encourages the FYR of Macedonia to report emissions for the whole time series covering all CLRTAP pollutants in the future.	CEIP/S3.RR/2010/ FYR of Macedonia § 7 + § 37	High	Completeness of inventory has been significantly improved. All relevant gases are reported for submission 2016. With regard to covered sources there are still some "NE" reported. but further improvements of completeness are planned.
A Key Category Analysis (KCA) consistent with the EMEP/EEA Guidebook should only include emission sources that contribute to an accumulated 80% of the total emissions by pollutant. The ERT would like to point out that a Tier 2 or 3 methodology should be applied to all sources identified as key categories and thus would apply to all sources listed in tables 2 to 7.	CEIP/S3.RR/2010/ FYR of Macedonia § 10	High	A KCA level assessment (LA) was carried out for 2014. A KCA trend assessment (TA) is planned for future submissions. Concerning effect on methodological choice. currently only T1 calculations are possible due to data constraints. but further methodological improvements will be investigatied.
The ERT encourages the FYR of Macedonia to update the IIR with the latest data consistent with the 2011 CLRTAP submission.	CEIP/S3.RR/2010/ FYR of Macedonia § 11 + § 44	High	The IIR 2016 is consistent with the NFR data submitted on March 14th 2016
The ERT encourages the FYR of Macedonia to present the keys sources as trends and as percentage contribution to total emissions. To clarify this issue. the ERT recommends that the FYR of Macedonia adds in the IIR paragraph “1.5 Key Source analysis” the trend of key sources over the time period. It is also recommends only to include the sources contributing to an accumulated 80% to total emissions in tables 2 to 7.	CEIP/S3.RR/2010/ FYR of Macedonia § 12 + § 45 + § 46	High	An analysis of the trends for all gases (covering all sources) is included in the IIR chapter 3. A KCA trend assessment has so far not been conducted. The tables showing results of the level assessment (LA) show the results only.
Most of the information is provided at aggregated level; however. in each sector more information on assumptions. activity data time series. data sources. emission drivers and Tier of methods used could be	CEIP/S3.RR/2010/ FYR of Macedonia § 13 + § 39	High	The IIR 2016 covers more detailed sector information and show the trends over the complete time series.

Subject	Source	rating	Improvement made
included in the IIR to improve transparency further. The ERT encourages the FYR of Macedonia to show the emission trends over the complete time series and not just for 2004 and 2008.			
The quality control and quality assurance (QC/QA) procedures carried out by the FYR of Macedonia are documented in the IIR. However. the IIR only focuses on the reporting years 2006 (2004) and 2010 (2008). The ERT encourages the FYR of Macedonia to update the IIR with the latest QA/QC procedures consistent with the current reporting year.	CEIP/S3.RR/2010/ FYR of Macedonia § 14	High	Existing QA/QC procedures affect the whole IIR. The IIR 2016 is updated with the latest QA/QC procedures.
Information on recalculations and improvements are covered in very little detail in the IIR. The ERT encourages the FYR of Macedonia to list planned and performed improvements and recalculation by sector. year and pollutant in the IIR as well as highlighting the drivers and prioritisation of improvements.	CEIP/S3.RR/2010/ FYR of Macedonia § 15 + § 41 + § 43	High	This Table 177 shows performed improvements. Table 178 shows planned improvements. Planned improvement are also included in the sectoral chapters as well as chapter 9. Recalculations are calculated for all sectors. years and pollutants.. For reasons of clarity. recalculation information in the IIR are only presented for 1990 and 2013 (per pollutant and sector)
The ERT encourages the FYR of Macedonia to provide the information in the tab 'Additional Info' in the reporting template. especially where ‘NE’ and 'IE' are used in the official submission.	CEIP/S3.RR/2010/ FYR of Macedonia § 16 + § 42	High	This tab is no more included in the current NFR tables template. but information on "NE" and "IE" is given under chapter 2.9.
The FYR of Macedonia does not report emissions of heavy metals and POPs in their 2011 submission. Heavy metals have been reported until 2002. During the stage 3 review the FYR of Macedonia explained that no sufficient activity data are available to either continue reporting heavy metals or report a time series for POPs. The ERT encourages the FYR of Macedonia to further pursue the collection of suitable activity data or use of surrogate data to report emissions for all CLRTAP pollutants.	CEIP/S3.RR/2010/ FYR of Macedonia § 19	High	Heavy metals and POPs are reported in submission 2016.
The FYR of Macedonia reports emissions of TSP but does not report emissions of PM10 or PM2.5. Scaling or conversion factor for PM10 and PM2.5 can be found on the US EPA website. The ERT encourages the FYR of Macedonia to report emissions for PM10 and PM2.5 in the future.	CEIP/S3.RR/2010/ FYR of Macedonia § 20	High	PM10 and PM2.5 are reported in submission 2016.

Subject	Source	rating	Improvement made
Road transport is key source for TSP. NH3 emissions also occur from road transport. The FYR of Macedonia does not report emissions from road transport for TSP and NH3 under 1A3b. although EFs are available in the EMEP/EEA guidebook (for PM2.5 and NH3) and COPERT. The FYR of Macedonia intends to include these emissions in their 2012 submission.	CEIP/S3.RR/2010/ FYR of Macedonia § 21	High	The current submission includes NH3 emissions from road transport.
The FYR of Macedonia reports NOx and SOx emissions from '6 C a Clinical waste incineration (do)' but does not report NMVOC and TSP. The FYR of Macedonia mentioned that these estimates will be included in their 2012 submission.	CEIP/S3.RR/2010/ FYR of Macedonia § 22	High	The current submission includes NMVOC and TSP emissions from waste incineration (now 5.C).
The IIR does not list sources by pollutants that are currently not estimated. The ERT encourages the FYR of Macedonia to add more information why these sources are currently not reported (e.g. lack of activity data. source does not exist in FYR of Macedonia) and whether there are plans to report them in the future.	CEIP/S3.RR/2010/ FYR of Macedonia § 23	High	Macedonia has made an analysis of "NE" and reports in ist submission on the main reason and plans for improvement.
The IIR does not provide explanations for recalculations for the latest CLRTAP submission. The ERT encourages the FYR of Macedonia to provide detailed and complete information on recalculations in the 2012 IIR.	CEIP/S3.RR/2010/ FYR of Macedonia § 24 + § 40	High	Detailed explanations for recalculations are included in the IIR 2016.
The ERT encourages the FYR of Macedonia to provide further information on the methodologies used. activity data and emissions factors used to enable a comparison of the FYR of Macedonia's emissions with other countries.	CEIP/S3.RR/2010/ FYR of Macedonia § 26	High	Information on methodologies. activity data and emission factors used are provided in the IIR 2016.
The IIR covers in good detail the institutional arrangements. the inventory preparation process and the QA/QC. The FYR of Macedonia has implemented a QA/QC plan in accordance with the EMEP/EEA Guidebook. The ERT encourages the FYR of Macedonia to elaborate further on planned improvements. data sources and QA/QC.	CEIP/S3.RR/2010/ FYR of Macedonia § 30	Medi um	Further information on QA/QC was added in the IIR 2016. Procedures will be continuously improved. Specific improvement plans are included in Table 178

9.2.2. Planned improvements

Table 178 Planned improvements

Subject	Source	Rating	Improvement planned	Timeli ne
The ERT notes that the FYR of Macedonia does not submit emission estimates for projections.	CEIP/S3.RR/2010 /FYR of	High	Resubmission of projections data	2018

Subject	Source	Rating	Improvement planned	Timeline
The ERT encourages the party to submit projected emissions for the 'With measures' and 'With additional measures' scenarios together with the associated social economic data for 2010 and 2020 to 2050 if possible.	Macedonia § 8 + § 18 + § 38		is planned for future submissions (see chapter 0)	
The FYR of Macedonia does not perform an uncertainty analyses. The ERT encourages the FYR of Macedonia to report quantitative uncertainty estimates in their IIR in the future.	CEIP/S3.RR/2010 /FYR of Macedonia § 17 + § 47	High	Uncertainty Analysis is planned for future emissions (see chapter 2.8).	2017
A KCA Trend Assessment has so far not been made.	Peer-Review 2016	High	Calculation and inclusion of results in the IIR.	2017
QA/QC Plan. incl. procedures and checklist	Peer-Review 2016	High	Development of a documented QA/QC Plan and subsequent implementation and improvement	2016/2017
Introduction of a data manager and allocation of this function	Peer-Review 2016	High	Definition and allocation of this role as well as training of the expert	2016
Improvement of completeness of the inventory	QA/QC Manager	High	Calculation of emission for categories currently reported as NE	2017
Verification - According to the review GL a comparison with emission data submittted under NEC and UNFCCC has to be done. NEC currently not relevant. but UNFCCC data available. Issue raised during Stage 3 CLRTAP Review 2011.	Peer-Review 2016	medium	compare emission values (indirect GHG)	2018

Table 179 Sectoral improvements planned

NFR Category	Subject	Source	rating	Timeline
1A3	In February this year MOI has sent vichale fleet data for 2014. In March 2016 MEPP has sign Memorandum of understanding with MOI. MEPP is planning to use COPERT model for calculating transport emissions in future.	SE	High	2017
2A5	Emission factors from GB 2013 to be used for 2.A.5.c Storage. handling and transport of mineral products. Currently. the activity data for the sector Construction and demolistion refer to the area of constructed and demolished dwelings. it is planned gathering of activity data for other type of constructed and demolished buildings.	SE	Medium	2017/2018
2D-2L	Overal further Improvement in section 2.D-2.L Other solvent and product use is planned to be conductied during expert mission in the component 2 of the undergoing Twining project.	SE	High	2016/2017
5	Estimation od emissions in Waste water treatment source category. Further analysis of industrial waste data. gathering relevenat data on industrial waste and its composition in order to improve and complete activity data needed for calculations of emissions in the sector Solid waste disposal on land - 5A.	SE	High	2017/2018
6	Gathering data for the quantity of wood burned from Macedonian forests for the period 2000-2014.	SE	Medium	2017
All	Meeeting and discussion with SSO for the possibilities of gathering missing statistical data in the future	SE	High	2017

10. PROJECTIONS

Current situation

Projections for the main pollutants SOx, NOx, NMVOC and NH_3 have been calculated within the National Program for Progressive Reduction of Emission for the period 2012-2020 [49] which has been prepared in the frame of Western Balkan project "Ratification and implementation of the three last protocols under CLRTAP" . This program has been officially published in 2012.

Within this program two scenarios have been developed: The basic scenario which relies on policies and measures planned by the year selected as baseline year. For development of this scenario official documents, applicable legislation and year of fulfillment of individual emission reduction measures have been used.

A second scenario with measures has been developed on the basis of the Strategy for Energy Development in the Republic of Macedonia by 2030, the Energy Balance of the Republic of Macedonia for the period 2012 to 2016, the Environmental Assessment of Strategy, the Strategy for Energy Efficiency Promotion in the Republic of Macedonia by 2020, the Baseline Study on Renewable Energy Sources in the Republic of Macedonia and the National Strategy for Transport and others. These Scenarios were compared with the model scenario developed by CEIP (Centre on Emission Inventories and Projections). No scenario with additional measurements has been developed.

Total emission projections with measures have been reported in 2013. However, there is a need of recalculation of SOx, NMVOC and NH_3 projections. Regarding SOx, a National emission reduction plan for the energy sector NERP in line with Energy community agreement has been prepared and officially adopted by the Government in December 2015. According to this plan the emission reduction (predicted with model scenario) of SOx should be accomplished in 2018, due to the installation of a desulfurization unit in the major power plant which will lead to differences with the current scenario. In the case of NH_3 major improvements of the inventory have been implemented, for example, the inclusion of emissions from the source category 3Da1 Use of inorganic fertilizers, which result in higher total ammonia emissions. During the period 2012-2015, the emission inventory on NMVOC has been improved.

Planned improvements

As described in the current situation above, projections have to be updated according to the latest developments. So, within the current Twinning project, 10 expert missions have been planned for review and update of the National emission reduction program and emission projections for all sectors of the Macedonian inventory. In the framework of these activates a plan will be prepared for development of projections for the years 2020 - 2030 using emission models. Furthermore, it is planned to include PM2.5 in the improved National emission reduction program.

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ANNEX 1 Nomenclature for reporting format (NFR) - Format for reporting under the UNECE/LRTAP convention for 2014

MK: 15.02.2016: 2014	NFR sectors to be reported		Main Pollutants (from 1990)				Particulate Matter (from 2000)				Other (from 1990)	Priority Heavy Metals (from 1990)			Additional Heavy Metals (from 1990, voluntary reporting)						POPs [b] (from 1990)								Activity Data (from 1990)						
			NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	PM2.5	PM10	TSP	BC	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxins / furans)	PAHs					HCB	PCBs		Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	Other activity (specified)	Other Activity Units
																						Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4												
NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	kt	kt	kt	kt	kt	kt	kt	kt	kt	t	t	t	t	t	t	t	t	t	g I-TEQ	t	t	t	t	t	kg	kg		TJ NCV	TJ NCV	TJ NCV	TJ NCV	TJ NCV		
A_PublicPower	1A1a	Public electricity and heat production	12,95372	0,0699089 95	76,44524	NA	2,6322050 82	6,49825629 7	9,62399983 3	NE	3,24342 7986	0,66998 864	0,08165 6473	0,12879 0752	0,63830261 7	0,40609798 5	0,05302951 9	0,85436681	1,99056303 5	0,53528114 6	0,44583691	1,99444E-05	0,00164 273	0,00128 9467	0,00010 5664	0,00309 7806	NA	NA		1670 ,73	4415 7,8	1632 ,82	NO	NO	NA	TJ NCV
B_Industry	1A1b	Petroleum refining	0,0152605 43	0,0002471 78	0,0521222 76	NE	0,0009672 17	0,00161202 9	0,0021493 72	NE	0,00161 2029	0,00049 4356	0,00012 8962	3,22406 E-05	0,00042772 5	0,00159053 5	0,00127887 6	0,11069266 8	0,00022568 4	0,00529820 2	0,0002686 72	NA	3,97634 E-07	NA	NA	3,97634 E-07	NE	NA		107, 469	NO	NO	NO	NO	NA	TJ NCV
B_Industry	1A1c	Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NA	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NA	NO		NO	NO	NO	NO	NO	NA	TJ NCV
B_Industry	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	2,0541796 05	0,5409177 36	4,8541142 48	NE	0,6141311 69	0,66169010 4	0,6987061 81	NE	5,08247 8232	0,70817 9389	0,00959 3683	0,04239 5606	0,02126980 7	0,07187307 1	0,09294345 7	0,06871005 3	0,00978741 8	1,12115545	1,0762474 07	1,244423594	0,34292 4475	0,12881 5493	0,10091 8428	0,81708 199	0,00330 2776	0,89802 2555		2113 ,04	5282 ,48	754, 307	5,52 731	NO	NA	TJ NCV
B_Industry	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0,0044595 33	0,0012755 6	0,0001796 07	NA	0,0002427 35	0,00024600 6	0,0002536 37	NE	0,00192 1655	3,00949 E-05	1,42249 E-05	2,1467E -05	4,09297E-06	2,6173E-05	7,30543E-06	2,69796E-06	3,07903E-06	0,00067361 9	0,0001329 9	1,66773E-05	6,29324 E-05	1,06357 E-05	8,9397E -06	9,91852 E-05	0,00000 5451	6,5412E -08		3,02 528	NO	37,9 508	1,09 02	NO	NA	TJ NCV
B_Industry	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0,0092805 43	0,0014881 39	0,0092972 8	NE	0,0011209 2	0,00145210 7	0,0018495 31	NE	0,00369 0676	0,00106 0192	1,99035 E-05	2,60113 E-05	6,98276E-05	0,00084830 4	0,00047700 2	0,01722217 1	2,08237E-06	0,00055610 8	0,0006810 43	0,00034446	0,00041 0776	0,00026 4989	0,00145 726	0,00247 7484	NE	NA		66,2 373	NO	35,9 029	NO	NO	NA	TJ NCV
B_Industry	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0,0106022 24	0,0009751 48	0,0016800 38	NE	0,0005166 75	0,00052577	0,0005343 29	NE	0,00265 6666	0,00013 1414	5,88621 E-06	1,76236 E-05	5,72699E-06	2,33509E-05	2,17671E-05	1,27359E-05	4,65466E-06	0,00088070 5	0,0002486 46	1,88063E-05	0,00033 0446	5,38753 E-05	4,52262 E-05	0,00050 8354	2,15146 E-06	0,00015 379		18,1 357	0,90 454	15,0 433	0,31 813	NO	NA	TJ NCV
B_Industry	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0,3747369 16	0,0833353 23	0,0371249	NA	0,0426815 68	0,04333464 6	0,0139165 35	NE	0,17065 392	0,00614 1115	0,00268 8103	0,00033 4474	9,48326E-05	0,00492435 5	0,00145071 8	0,00047079 3	0,00019468	0,12560531	0,0224220 03	0,003498861	0,01348 1154	0,00225 1044	0,00189 198	0,02112 3039	0,00103 2001	0,00067 9865		663, 646	3,92 653	200, 936	205, 913	NO	NA	TJ NCV
B_Industry	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		IE	IE	IE	IE	IE	NA	TJ NCV
I_Offroad	1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	0,8945469 18	0,0923408 55	NE	0,0002182 35	0,0569048 81	0,05690488 1	0,0569048 81	NE	0,29248 9999	NA	2,72794 E-07	NA	NE	1,03767E-06	1,07753730 3	0,00190956	0,00027279 4	0,02727942 5	NO	0,000818383	0,00136 3971	NE	NE	0,00218 2354	NO	NA		1173 ,02	NO	NO	NO	NO	NA	TJ NCV
B_Industry	1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	1,0479355 88	0,1419463 32	0,9467015 47	NE	0,1096380 38	0,12072498 8	0,1321956 49	NE	0,89048 4133	0,10998 7941	0,00182 6866	0,00558 7057	0,00389206 5	0,02259838 7	0,01957074 2	0,26216004 1	0,00129192 3	0,16094506 5	0,1919621 03	0,041997278	0,05481 6477	0,02315 4628	0,03698 2701	0,15695 1083	0,00123 1628	0,11551 4978		972, 766	679, 452	137, 823	135, 061	NO	518.1 98 [kt]	TJ NCV
H_Aviation	1A3ai(i)	International aviation LTO (civil)	0,363168	0,0027936	0,0223488	NA	0,0020952	NA	NA	NA	0,08520 48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NE	NA	NA	NE	NA	NA	TJ NCV
H_Aviation	1A3aii(i)	Domestic aviation LTO (civil)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NE	NA	NA	NE	NA	NA	TJ NCV
F_RoadTransport	1A3bi	Road transport: Passenger cars	2,6037219 99	1,7969278 68	0,0043431 36	0,0244653 18	NA	NA	0,0989393 35	NA	15,5535 8399	0,00343 6867	0,00191 7126	NA	NA	0,25667716	0,00754932 8	0,01056906	0,00150986 6	0,15098656 5	NE	NE	NE	NE	NA	NA	NE	NE		6587 ,27	NA	1873 ,4	NO	NA	NA	TJ NCV
F_RoadTransport	1A3bii	Road transport: Light duty vehicles	1,5704111 11	0,1956286 33	0,0008677 01	0,0015960 64	NA	NA	0,2882110 58	NA	1,30392 803	0,00336 3764	0,00104 029	NA	NA	0,17684936 5	0,00520145 2	0,00728203 3	0,00104029	0,10402903 8	NE	NE	NE	NE	NE	NA	NE	NE		4474 ,36	NA	NE	NA	NA	NA	TJ NCV
F_RoadTransport	1A3biii	Road transport: Heavy duty vehicles and buses	7,8050078 56	0,3375138 53	0,0016875 69	0,0031641 92	NA	NA	0,2531353 9	NA	1,68756 9266	0,00685 575	0,00210 9462	NA	NA	0,35860846 9	0,01054730 8	0,01476623 1	0,00210946 2	0,21094615 8	NE	NE	NE	NE	NE	NA	NE	NE		9070 ,68	NA	NE	NA	NA	NA	TJ NCV
F_RoadTransport	1A3biv	Road transport: Mopeds & motorcycles	0,1710338 26	2,0524059 15	0,0007201 42	0,0011342 24	NA	NA	0,0486096 14	NA	8,82174 4723	0,00030 6061	0,00018 0036	NA	NA	0,03060605 3	0,00090017 8	0,00126024 9	0,00018003 6	0,01800356 1	NE	NE	NE	NE	NE	NA	NE	NE		79,2 157	NA	NE	NA	NA	NA	TJ NCV
F_RoadTransport	1A3bv	Road transport: Gasoline evaporation	NA	1,2053844 88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	TJ NCV
F_RoadTransport	1A3bvi	Road transport: Automobile tyre and brake wear	NA	NA	NA	NA	0,0596060 76	0,11114222 8	0,1465004 27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	4197, 5345	*10^6 km*
F_RoadTransport	1A3bvii	Road transport: Automobile road abrasion	NA	NA	NA	NA	0,0353030 02	0,06513414 9	0,1302682 98	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	4197, 5345	*10^6 km*
I_Offroad	1A3c	Railways	0,1370784	0,0121644	NA	0,0000183 12	0,0035839 2	0,00376704	0,0039763 7	NA	0,02799 12	NA	0,00002 616	NA	NA	0,0001308	0,0044472	0,00018312	0,00002616	0,002616	NA	0,00007848	0,00013 08	NA	NA	0,00020 928	NA	NA		112, 488	NO	NA	NO	NA	NA	TJ NCV

MK: 15.02.2016: 2014	NFR sectors to be reported		Main Pollutants (from 1990)				Particulate Matter (from 2000)				Other (from 1990)	Priority Heavy Metals (from 1990)			Additional Heavy Metals (from 1990, voluntary reporting)						POPs [b] (from 1990)								Activity Data (from 1990)						
																						PAHs													
			NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	PM2.5	PM10	TSP	B C	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxins / furans)	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4	HCB	PCBs	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other NCV	Other activity (specified)	Other Activity Units
NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	kt	kt	kt	kt	kt	kt	kt	kt	kt	t	t	t	t	t	t	t	t	t	g I-TEQ	t	t	t	t	t	kg	kg	TJ NCV	TJ NCV	TJ NCV	TJ NCV	TJ NCV		
G_Shipping	1A3di(ii)	International inland waterways	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	TJ NCV
G_Shipping	1A3dii	National navigation (shipping)	0,003958586	0,000141198	8,27534E-06	NA	7,0599E-05	7,0599E-05	7,56418E-05	NA	0,00037 3166	6,55562 E-06	5,04278 E-07	1,51284 E-06	2,01711E-06	2,52139E-06	4,43765E-05	5,04278E-05	5,04278E-06	2,52139E-05	6,55562E-06	NA	NA	NA	NA	NA	4,03423 E-06	NA	2,16 84	NO	NA	NO	NA	NA	TJ NCV
I_Offroad	1A3ei	Pipeline transport	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NO	NA	NA	NA	NA	NA	TJ NCV
I_Offroad	1A3eii	Other (please specify in the IIR)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NO	NO	NO	NO	NO	NA	TJ NCV
C_OtherStationaryComb	1A4ai	Commercial/Institutional: Stationary	0,285261184	0,065063735	0,339764351	NA	0,080514472	0,092272053	0,107677837	NE	0,55376 8512	0,04507 887	0,00130 8296	0,00056 1416	0,00273094 9	0,03121900 1	0,01794546 9	0,59232138 3	0,00016286 7	0,05506991 7	0,11658032	1,024818039	0,03291 9942	0,01591 2046	0,01144 9758	NE	7,22148 E-06	0,01874 193	2274 ,68	11,6 475	198, 197	279, 364	NO	NA	TJ NCV
I_Offroad	1A4aii	Commercial/Institutional: Mobile	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	IE	NA	IE	IE	NA	NA	TJ NCV
C_OtherStationaryComb	1A4bi	Residential: Stationary	0,803048777	9,1187123	0,318410512	1,058248081	11,221509 91	11,524349 1	12,133606 43	NE	60,8713 4581	0,62401 9514	0,02212 9446	0,00799 2005	0,01582710 4	0,05346099 4	0,13626828 3	0,20235370 6	0,00764039	1,98800953 4	10,653172 52	1,205806909	3,36722 487	1,98290 7698	2,13374 1328	10,6896 8081	0,09075 5502	0,92092 9287	561, 666	81,6 5	NE	1511 7,5	NA	NA	TJ NCV
I_Offroad	1A4bii	Residential: Household and gardening (mobile)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NE	NE	NA	NA	NA	NA	NA	IE	NA	NA	IE	NA	NA	TJ NCV
C_OtherStationaryComb	1A4ci	Agriculture/Forestry /Fishing: Stationary	0,065988763	0,021862329	0,101121592	NA	0,012789996	0,015525321	0,018717447	NE	0,06311 9759	0,00795 8426	0,00015 9586	5,42185 E-05	0,00049608 7	0,00625978 2	0,00352880 4	0,12613114 9	3,95145E-06	0,00477433	0,007394 33	1,002870908	0,00351 4391	0,00212 3128	0,00124 1288	0,00974 9714	NA	0,00467 4906	485, 058	33,5 835	NO	77,8 199	NE	NA	TJ NCV
I_Offroad	1A4ci	Agriculture/Forestry /Fishing: Off-road vehicles and other machinery	0,214500791	0,027218742	NA	0,000049816	0,010505896	0,010505896	0,010505896	NE	0,36297 0731	NA	0,00006 397	NA	NA	0,000319885	0,0108749	0,00044779	NA	0,006397	NA	1,00019581	0,00031 595	NA	NA	NA	NA	NA	285, 557	NA	NO	NO	NA	NA	TJ NCV
I_Offroad	1A4cii	Agriculture/Forestry /Fishing: National fishing	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	IE	NA	NA	NA	NA	NA	TJ NCV
C_OtherStationaryComb	1ASa	Other stationary (including military)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NO	NO	NO	NO	NO	NA	TJ NCV
I_Offroad	1ASb	Other, Mobile (including military, land based and recreational boats)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NO	NA	NO	NO	NA	NA	TJ NCV
D_Fugitive	1B1a	Fugitive emission from solid fuels: Coal mining and handling	NA	1,336349064	NA	NA	0,040090512	0,260588328	0,547903664	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6,681 752	Coal produced [Mt]
D_Fugitive	1B1b	Fugitive emission from solid fuels: Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA	NA	NO	Coal used for transformation [Mt]
D_Fugitive	1B1c	Other fugitive emissions from solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NO	Please specify
D_Fugitive	1B2ai	Fugitive emissions oil: Exploration, production, transport	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NO	Crude oil produced [Mt]
D_Fugitive	1B2aiv	Fugitive emissions oil: Refining / storage	0,001745776	0,0014548	0,004509848	8,0014E-06	3,12782E-05	0,0014548	0	NA	0	0	0,00145 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	0,007 274	Crude oil refined [Mt]
D_Fugitive	1B2av	Distribution of oil products	NA	1,196534	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,598 267	Oil consumed [Mt]
D_Fugitive	1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA	NA	NO	Gas throughput [Mm3]
D_Fugitive	1B2c	Venting and flaring (oil, gas, combined oil and gas)	0,000144 46	7,22298E-06	2,16689E-05	NA	NA	NA	NA	NA	3,46703 E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1,444 5959	Gas vented flared [TJ]
D_Fugitive	1B2d	Other fugitive emissions from energy production	NA	NA	NA	NE	NA	NA	NA	NA	NA	NA	NA	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NE
B_Industry	2A1	Cement production	NA	NA	NA	NA	0,067365 74	0,121258332	0,134731 48	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NA	NA	NA	NA	518,1 98	Clinker produced [kt]
B_Industry	2A2	Lime production	NA	NA	NA	NA	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	Lime produced [kt]
B_Industry	2A3	Glass production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NO	Glass produced [t]
B_Industry	2A5a	Quarrying and mining of minerals other than coal	NA	NA	NA	NA	0,030546665	0,3054665	0,623151616	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6,109 33	Material quarried [Mt]
B_Industry	2A5b	Construction and demolition	NA	NA	NA	NA	0,006527579	0,065277587	0,130230018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	80388 9	floor space constructed/demolished [M2]
B_Industry	2A5c	Storage, handling and transport of mineral products	NA	NA	NA	NA	0,002782166	0,027821 66	0,055643332	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,564 332	Amount [Mt]
B_Industry	2A6	Other mineral products (please specify in the IIR)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Please specify
B_Industry	2B1	Ammonia production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NO	Ammonia produced [kt]

MK: 15.02.2016: 2014	NFR sectors to be reported		Main Pollutants (from 1990)				Particulate Matter (from 2000)				Other (from 1990)	Priority Heavy Metals (from 1990)			Additional Heavy Metals (from 1990, voluntary reporting)						POPs [b] (from 1990)								Activity Data (from 1990)						
			NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	PM2.5	PM10	TSP	B C	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxins / furans)	PAHs					HCB	PCBs		Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other fuels	Other activity (specified)	Other Activity Units
																						Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4										
NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	kt	kt	kt	kt	kt	kt	kt	kt	kt	t	t	t	t	t	t	t	t	t	g I-TEQ	t	t	t	t	t	kg	kg		TJ NCV	TJ NCV	TJ NCV	TJ NCV	TJ NCV		
B_Industry	2B2	Nitric acid production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Nitric acid produced [kt]*
B_Industry	2B3	Adipic acid production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Adipic acid produced [kt]*
B_Industry	2B5	Carbide production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Carbide produced [kt]*
B_Industry	2B6	Titanium dioxide production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NE	*Titanium dioxide produced [kt]*
B_Industry	2B7	Soda ash production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NE	*Soda ash produced [kt]*
B_Industry	2B10a	Chemical Industry: Other (please specify in the IIR)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NA	NA	NA	NA	NA	NE	*Please specify*
B_Industry	2B10b	Storage, handling and transport of chemical products (please specify in the IIR)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NA	NA	NA	NA	NA	NE	*Please specify*
B_Industry	2C1	Iron and steel production	NA	0,0747688 5	NA	NA	0,0697842 6	0,08972262	0,1495377	NA	NA	2,29291 14	0,00996 918	0,04984 59	0,1993836	2,2430655	0,03489213	0,06978426	0,00996918	1,993836	1,495377	NE	NE	NE	NE	0,23926 032	1,49538 E-05	1,24614 75		NA	NA	NA	NA	NA	498,4 59	*Steel produced [kt]*
B_Industry	2C2	Ferroalloys production	NA	NA	NA	NA	5,999	8,451	9,9423529 41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	163,4 89	*Ferroalloys produced [kt]*
B_Industry	2C3	Aluminium production	NA	NA	NA	NA	0,0005236	0,0013328	0,001904	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,03332	NA	NA	NA	NA	NA	4,76	NA		NA	NA	NA	NA	NA	0,952	*Aluminium produced [kt]*
B_Industry	2C4	Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Magnesium produced [kt]*
B_Industry	2C5	Lead production	NA	NA	NA	NA	NE	NE	NE	NA	NA	NE	NE	NE	NE	NA	NA	NA	NA	NA	NE	NA	NA	NA	NA	NA	NA	NE		NA	NA	NA	NA	NA	NE	*Lead produced [kt]*
B_Industry	2C6	Zinc production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Zinc produced [kt]*
B_Industry	2C7a	Copper production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Copper produced [kt]*
B_Industry	2C7b	Nickel production	NO	NO	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Nickel produced [kt]*
B_Industry	2C7c	Other metal production (please specify in the IIR)	NE	NE	NE	NE	NE	NE	NE	NA	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NA	NA	NA	NA	NA	NA	*Please specify*
B_Industry	2C7d	Storage, handling and transport of metal products (please specify in the IIR)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NA	NA	NA	NA	NA	NA	*Amount (kt)*
E_Solvents	2D3a	Domestic solvent use including fungicides	NA	2,069172	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	2069, 172	*Population [1000 head]*
E_Solvents	2D3b	Road paving with asphalt	NA	0,0053847 2	NA	NA	0,134618	1,009635	4,71163	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	336,5 45	*Asphalt produces[kt]*
B_Industry	2D3c	Asphalt roofing	NA	0,0018487 3	NA	NA	NA	NA	0,0227536	NA	0,00135 0995	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	14,22 1	*NA*
B_Industry	2D3d	Coating applications	NA	0,0447485 29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	0,161	*Paint applied [kt]*
E_Solvents	2D3e	Degreasing	NA	1,7587962	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	2069, 172	*Population [1000 head]*
E_Solvents	2D3f	Dry cleaning	NA	0,6414433 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	2069, 172	*Population [1000 head]*
E_Solvents	2D3g	Chemical products	NA	0,2588886	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	*NA*	*NA*
E_Solvents	2D3h	Printing	NA	0,03749	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	*NA*
E_Solvents	2D3i	Other solvent use (please specify in the IIR)	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE		NA	NA	NA	NA	NA	IE	*NA*
E_Solvents	2G	Other product use (please specify in the IIR)	0,049896	0,8053121 53	NA	NA	0,7484899 55	0,74851493 2	0,7485315 83	NA	1,52737 2	NA	0,00014 1372	0,00000 2772	4,4352E-06	0,00000970 2	0,00000415 8	NA	NA	NA	0,0000360 36	,004396253	0,00221 9061	0,00221 9061	0,00221 9061	0,01128 3512	NA	NA		NA	NA	NA	NA	NA	NA	*Please specify*
B_Industry	2H1	Pulp and paper industry	NO	NO	NO	NA	NO	NO	NO	NA	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Pulp production [kt]*
B_Industry	2H2	Food and beverages industry	NA	0,6958041 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	1559, 77	*Bread, Wine, Beer, Spirits production [kt]*
B_Industry	2H3	Other industrial processes (please specify in the IIR)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NA	NA	NA	NA	NA	NE	*NE*
B_Industry	2I	Wood processing	NA	NA	NA	NA	NA	NA	0,0180789	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	18,07 89	*Wood processed kt]*
B_Industry	2J	Production of POPs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*NA*
B_Industry	2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	*NA*
B_Industry	2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NA	NA	NA	NA	NA	NE	*NA*
K_AgriLivestock	3B1a	Manure management - Dairy cattle	0,0195213 48	1,6468919 04	NA	3,6380694	0,0519724 2	0,07986006	0,1749	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	126,7 62	*Population size (1000 head)*
K_AgriLivesto	3B1b	Manure	0,0107484	0,7148849	NA	1,051974	0,0205821	0,03087315	0,0674635	NA	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	114,3	*Population size*

MK: 15.02.2016: 2014	NFR sectors to be reported		Main Pollutants (from 1990)				Particulate Matter (from 2000)				Other (from 1990)	Priority Heavy Metals (from 1990)			Additional Heavy Metals (from 1990, voluntary reporting)						POPs [b] (from 1990)								Activity Data (from 1990)						
																					PCDD/ PCDF (dioxins / furans)	PAHs					HCB	PCBs		Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	Other activity (specified)	Other Activity Units
																						Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4										
NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	PM2.5	PM10	TSP	BC	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	g I-TEQ	t	t	t	t	t	kg	kg		TJ NCV	TJ NCV	TJ NCV	TJ NCV	TJ NCV		
ck		management - Non-dairy cattle	3	4					5																									45	(1000 head)
K_AgriLivestock	3B2	Manure management - Sheep	0,003702285	0,125137233	NA	1,0366398	0,012365632	0,041169409	0,102923523	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	740,457	Population size (1000 head)
K_AgriLivestock	3B3	Manure management - Swine	0,000235586	0,118052386	NA	1,3198052	0,011313844	0,06434687	0,142128323	NA	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	165,053	Population size (1000 head)
K_AgriLivestock	3B4a	Manure management - Buffalo	IE	IE	IE	IE	IE	IE	IE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	Population size (1000 head)
K_AgriLivestock	3B4d	Manure management - Goats	0,000406773	0,044089532	NA	0,1138844	0,001358478	0,004522838	0,011307094	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	81,346	Population size (1000 head)
K_AgriLivestock	3B4e	Manure management - Horses	0,002537601	1,974511E-08	NA	0,2866908	0,002711974	0,00426162	0,009298088	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	19,371	Population size (1000 head)
K_AgriLivestock	3B4f	Manure management - Mules and asses	NE	NE	NA	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	Population size (1000 head)
K_AgriLivestock	3B4gi	Manure mangement - Laying hens	0,005652867	0,310907685	NA	0,9044587	0,043338647	0,224230391	0,224230391	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1884,289	Population size (1000 head)
K_AgriLivestock	3B4gii	Manure mangement - Broilers	0,000026492	0,002861136	NA	0,0052824	0,000238428	0,001827948	0,001827948	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26,492	Population size (1000 head)
K_AgriLivestock	3B4giii	Manure mangement - Turkeys	0,000048105	0,004704669	NA	0,0091399 5	0,000673467	0,00500292	0,005002902	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9,621	Population size (1000 head)
K_AgriLivestock	3B4giv	Manure management - Other poultry	0,000060847	0,009524253	NA	0,0144653 8	0,000446441	0,00329548	0,003295548	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	19,477	Population size (1000 head)
K_AgriLivestock	3B4h	Manure management - Other animals (please specify in IIR)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NO	Population size (1000 head)
L_AgriOther	3Da1	Inorganic N-fertilizers (includes also urea application)	0,034146022	1,0863133	NA	0,106377991	0,0757893	1,9705218	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1313308,5	Use of inorganic fertilizers (kg N/yr)
L_AgriOther	3Da2a	Animal manure applied to soils	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NA	NA	NA	IE	NA
L_AgriOther	3Da2b	Sewage sludge applied to soils	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L_AgriOther	3Da2c	Other organic fertilisers applied to soils (including compost)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L_AgriOther	3Da3	Urine and dung deposited by grazing animals	IE	IE	IE	IE	IE	IE	IE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NA
L_AgriOther	3Da4	Crop residues applied to soils	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L_AgriOther	3Db	Indirect emissions from managed soils	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
L_AgriOther	3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	NA	NA	NA	NA	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA
L_AgriOther	3Dd	Off-farm storage, handling and transport of bulk agricultural products	NE	NE	NA	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA
L_AgriOther	3De	Cultivated crops	NE	NE	NA	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA
L_AgriOther	3Df	Use of pesticides	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NO	NA
L_AgriOther	3F	Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NO	Area burned (k ha/yr)
L_AgriOther	3I	Agriculture other (please specify in the IIR)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NO	NA
J_Waste	5A	Biological treatment of waste - Solid waste disposal on land	NA	1,1934	NA	NE	0,000025245	0,000167535	0,000354195	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	765	Annual deposition of MSW at the SWDS [kt]
J_Waste	5B1	Biological treatment of waste - Composting	NE	NE	NE	NO	NE	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
J_Waste	5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
J_Waste	5C1a	Municipal waste incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	MSW incinerated [kt]
J_Waste	5C1bi	Industrial waste incineration	NO	NO	NO	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NE	NO	NE	NE	NO	NE	NE	NE	NE	NE	NO	NE	NA	NA	NA	NA	NA	NA	Waste incinerated [kt]
J_Waste	5C1bii	Hazardous waste incineration	NO	NO	NO	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NE	NO	NE	NE	NE	NE	NE	NO	NO	NA	NA	NA	NA	NA	NA	Waste incinerated [kt]

MK: 15.02.2016: 2014	NFR sectors to be reported		Main Pollutants (from 1990)				Particulate Matter (from 2000)				Other (from 1990)	Priority Heavy Metals (from 1990)			Additional Heavy Metals (from 1990, voluntary reporting)						POPs [b] (from 1990)								Activity Data (from 1990)						
																						PAHs													
NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	PM2.5	PM10	TSP	B C	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxins / furans)	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4	HCB	PCBs		Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other fuels	Other activity (specified)	Other Activity Units
			kt	kt	kt	kt	kt	kt	kt	kt	kt	t	t	t	t	t	t	t	t	t	g I-TEQ	t	t	t	t	t	kg	kg		TJ NCV	TJ NCV	TJ NCV	TJ NCV	TJ NCV		
J_Waste	5C1biii	Clinical waste incineration	0,001636903	0,000498188	0,000384316	NA	NA	NA	0,012098849	NE	0,00013 5222	0,04412 5214	0,00569 3576	0,03060 2971	0,00014233 9	0,00142339 4	0,06974630 6	0,00142339 4	NA	NA	0,02846788	NA	NA	NA	NA	2,84679 E-08	0,07116 97	0,01423 394		NA	NA	NA	NA	NA	0,711 697	*Waste incinerated [kt]*
J_Waste	5C1biv	Sewage sludge incineration	NO	NO	NO	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NA	*NA*
J_Waste	5C1bv	Cremation	NO	NO	NO	NA	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Incineration of carpses [Number]*
J_Waste	5C1bvi	Other waste incineration (please specify in the IIR)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	*NA*
J_Waste	5C2	Open burning of waste	0,040670531	0,015731054	0,001406842	NA	0,0535879	0,057680532	0,059343164	NE	0,71403 6389	0,00626 6843	0,00127 8948	NA	NA	0,00012789 5	0,00255789 5	NA	NA	NA	0,12789475	7,47623E-08	7,28348 E-08	7,99086 E-09	NA	0	NA	NA		NA	NA	NA	NA	NA	NA	*NA*
J_Waste	5D1	Domestic wastewater handling	NA	NE	NA	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	*Total organic product [Gg DC/yr]*
J_Waste	5D2	Industrial wastewater handling	NA	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	*Total organic product [Gg DC/yr]*
J_Waste	5D3	Other wastewater handling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	*Total organic product [Gg DC/yr]*
J_Waste	5E	Other waste (please specify in IIR)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Please specify*
M_Other	6A	Other (included in national total for entire territory) (please specify in IIR)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NA	NA	NA	NA	NA	NE	*NA*
	NATIONAL TOTAL	**National total for the entire territory (based on fuel sold)**	31,55908113	29,96924834	83,14195468	9,576236126	22,25855091	32,77734484	41,67135604	NE	101,263 9446	4,53034 2405	0,14340 7124	0,26626 6027	0,88265322 6	3,66674368 6	1,55082447 9	2,34212033	2,02499259 4	6,51236834 7	14,20004917	529404498	3,82135 8445	2,15900 2072	2,29006 1634	11,9537 0535	4,92752 5419	3,21909 8817		NA	NA	NA	NA	NA	NA	*NA*
	ADJUSTMENTS (Net total)	Sum of adjustments (negative value) from Annex VII	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NA	*NA*
	NATIONAL TOTAL FOR COMPLIANCE	**National total for compliance assessment (please specify all details in the IIR)**	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NA	*NA*
'MEMO' ITEMS - NOT TO BE INCLUDED IN NATIONAL TOTALS																																				
O_AviCruise	1A3ai(i)	International aviation cruise (civil)	0,047783839	0,226973235	0,011945596	NA	NA	NA	NA	NA	14,3351 5169	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NE	NA	NA	NE	NA	513,6 7627	*TJ NCV*
O_AviCruise	1A3aii(i)	Domestic aviation cruise (civil)	0,001088 31	4,25121E-05	8,50242E-05	NA	1,70048E-05	NA	NA	NA	9,35267 E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NE	NA	NA	NE	NA	3,656 0424	*TJ NCV*
P_IntShipping	1A3di(i)	International maritime navigation	NO	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NO	NO	NA	NO	NA	NA	*TJ NCV*
z_Memo	1ASc	Multilateral operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NA	NA		NO	NO	NO	NO	NO	NA	*NA*
z_Memo	1A3	Transport (fuel used)	12,654379 78	5,6029599 54	0,029875624	0,030378111	0,100658797	0,180114016	0,969716083	NA	27,4803 9518	0,01396 8997	0,00527 3577	1,51284 E-06	2,01711E-06	0,82287436 8	0,02868984 3	0,03411112	0,00487085 6	0,48660653 6	6,55562E-06	0,00007848	0,00013 08	NA	NA	0,00020 928	4,03423 E-06	NA		NE	NE	NE	NE	NA	NA	*NE*
z_Memo	6B	Other not included in national total of the entire territory (please specify in the IIR)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NA	NA		NA	NA	NA	NA	NA	NA	*NA*
N_Natural	11A	Volcanoes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NA	NA	NA	NA	NA	NO	*Please specify*
N_Natural	11B	Forest fires	0,115	0,345	0,023	0,023	NE	NE	NE	NA	3,45	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	1150	Area of forest burned [ha]
N_Natural	11C	Other natural emissions (please specify in the IIR)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NA	NA	NA	NA	NA	NE	