Republic of Macedonia INFORMATIVE INVENTORY REPORT 1990 – 2015

2017

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

MACEDONIAN ENVIRONMENTAL INFORMATION CENTER
MINISTRY OF ENVIRONMENT AND PHYSICAL PLANNING

Republic of Macedonia
INFORMATIVE INVENTORY REPORT
1990 – 2015

Submission under the
Convention on Long-Range Transboundary Air Pollution
(CLRTAP)

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LIST OF ABBREVIATIONS

2W	Two wheelers
AE-DEM	**A**ir **E**missions **D**ata **E**xchange **M**odule
CARDS	**C**ommunity **A**ssistance for **R**econstruction **D**evelopment and **S**tabilization
CPAPRM	**C**adastre of **p**olluters and **a**ir **p**ollutants in **R**epublic of **M**acedonia
CRF	**C**ommon **R**eporting **F**ormat
EB	Executive body
EEA	**E**uropean **E**nvironment **A**gency
EMEP	Cooperative Programme for **M**onitoring and **E**valuation of the Long-range Transmission of Air **P**ollutants in **E**urope
ETC/ACC	**E**uropean **T**opic **C**entre on **A**ir and **C**limate **C**hange
ERT	Expert review team
EU	**E**uropean **U**nion
GHGs	**G**reen**h**ouse **G**ase**s**
GPG	**G**ood **P**ractice **G**uidance (of the IPCC)
HDVs	Heavy-duty vehicles
HM	**H**eavy **M**etals
IPCC	**I**ntergovernmental **P**anel on **C**limate **C**hange
KCA	Key Category Analysis
LDTs	Light-duty trucks
LE	Law on environment
LHV	**L**ow **H**eating **V**alue
LPS	**L**arge **P**oint **S**ource
MAFWS	Ministry of agriculture, forestry and water supply
ME	Ministry of economy
MEIC	**M**acedonian **E**nvironmental **I**nformative **C**entre
MEPP	**M**inistry of **E**nvironment and **P**hysical **P**lanning
MOI	Ministry of **I**nterior
MS	Member State
NAPFUE	**N**omenclature for **A**ir **P**ollution of **Fue**ls
NEAP	**N**ational **E**nvironmental **A**ction **P**lan
NFR	**N**omenclature **F**or **R**eporting

PCs	Passenger cars
POPs	**P**ersistent **O**rganic **P**ollutant**s**
QA/QC	**Q**uality **A**ssurance / **Q**uality **C**ontrol
RM	**R**epublic of **M**acedonia
SNAP	**S**elected **N**omenclature for **A**ir **P**ollution
SSO	State statistical office
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
UNFCCC	**U**nited **N**ations **F**ramework **C**onvention on **C**limate **C**hange
CORINAIR	CORe INventory AIR emissions
ERT	Emission review team
EAF	Electric Arc Furnace
WWTP	Waste Water treatment plants

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EXECUTIVE SUMMARY

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 (EB) of the LRTAP convention are set down in Article 27-d of the Law on ambient air quality (LAAQ)[1].

As a party to the UNECE/LRTAP convention and its protocols 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, 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 is compiled according to the Revised 2014 Reporting guidelines (ECE/EB.AIR.125) under the UNECE/CLTRAP convention and its protocols which define the standards for the national emission inventory[2].

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 emission factors used per Nomenclature for reporting (NFR) source category. In this report subchapters on source-specific uncertainty analysis, QAA/QC, recalculations and planned improvements are included. The chapter projections gives information on the current situation and planned activities regarding this obligation set down in the current 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 2015.

1.1. Summary of the main differences in the inventory since the last submission

This report contains emissions of the whole time series 1990-2015. In the submissions before 2004, 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 2016 and 2017 emission inventory submission and Informative Inventory Reports (IIR) in those years, 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) which was finalized in January 2017.

Within the framework of this project, Finland (Finnish Meteorological Institute) was the lead partner and Umweltbundesamt 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 of the capacities for performing emission inventories and dispersion modeling.

One of the mandatory results of Component 2 is an updated and improved Air emission inventory and the preparation of the Inventory Informative Report (IIR) for the year 2014, which was submitted in 2016 to UNECE/LRTAP for the first time. Due to the fact that the inventory and report submitted in

[1]Law on Ambient Air Quality (Official Gazette of RM No. 67/2004, 92/2007, 83/2009, 35/10, 47/11, 100/12, 163/13)

[2]http://www.ceip.at/fileadmin/inhalte/emep/2014_Guidelines/ece.eb.air.125_ADVANCE_VERSION_reporting_guidelines_2013.pdf

2016 and 2017 have been prepared together with experienced inventory experts of EU member state, the quality of preparation of the inventory and IIR has improved significantly. Namely, the expert missions 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 (Key Category Analysis - KCA) as well as trend analysis calculations and introduce and enhance the implementation of QA/QC system in the preparation of the inventory.

In particular, in the present IIR, a general and category-specific uncertainty assessment for the main pollutants (SO_2, NO_x, NMVOC, NH_3 and$PM_{2.5}$) has been included for the first time, as well as implementation of QA/QC system, recalculations and planned improvements on category level.

1.2. Explanation of significant changes in emission trends

The report presents trend analysis in the country for the period 1990 – 2015. The evaluation of the status of the emission trends is based on emission inventories and key source analysis. Generally, the main reason for reduction of the main pollutants is the modernization of the power plants, as well as replacement of heavy fuel oil with natural gas in the heating plants.

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 2014 to 2015 emissions remained quite stable (-6%).

The trend on NMVOC emissions is variable. In the period from 2014 to 2015 emissions decreased by 15%, 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. In the period from 2014 to 2015, emissions slightly decreased by 2%, but the emissions from the key sectors are stable and the reason for reduction is lower fugitive emissions. With regards to CO, the main reason for decreasing trend and reduction of 15% in 2015 compare to 2014 is the higher use of natural gas and briquettes and pellets for residential heating instead of the use of fossil fuels and wood.

Table 1 Emission trends 1990 – 2015 for the main air pollutants and CO

Year	Emission in kt				
	NO_x	NMVOC	SO_2	NH_3	CO
1990	44,14	48,86	109,97	15,80	132,39
1991	36,30	42,71	89,23	14,83	111,52
1992	38,03	44,70	86,34	14,94	123,43
1993	39,44	46,49	88,93	15,26	133,29
1994	35,37	41,44	88,99	15,20	120,85
1995	38,02	44,04	95,10	14,99	125,23
1996	35,98	43,72	89,05	13,95	123,08
1997	36,83	44,82	93,01	13,53	126,30
1998	41,35	44,61	107,84	13,23	129,33
1999	39,15	45,49	98,37	13,41	132,43
2000	42,60	47,64	106,55	13,49	145,00
2001	39,58	40,04	108,52	12,74	113,22

Year	Emission in kt				
	NO_x	NMVOC	SO_2	NH_3	CO
2002	38,48	39,05	97,78	12,12	114,85
2003	34,38	38,72	95,56	12,06	116,43
2004	36,20	39,10	96,64	12,16	121,51
2005	37,10	37,63	97,35	11,58	114,89
2006	36,87	39,42	94,54	12,00	118,58
2007	39,82	39,69	99,69	11,64	113,71
2008	38,88	43,39	101,45	11,79	125,76
2009	39,14	43,81	96,39	11,10	134,49
2010	38,36	36,45	91,26	11,34	115,09
2011	40,78	39,01	102,02	11,68	121,20
2012	40,27	38,49	96,65	10,85	115,81
2013	38,39	36,98	83,06	10,65	102,89
2014	29,47	34,08	83,59	10,90	96,78
2015	27,61	28,81	76,41	10,66	82,02
Trend 1990-2015	***-14%***	***-41,04%***	***-30,52%***	***-32,54%***	***-38,05%***

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 1.A.4 Other Sectors (residential heating) has not changed much due to the fact that biomass is still the main fuel used in household heating. The main reason for decreasing trend and reduction of around 40% in 2015 compared to 1990, is the higher use of natural gas and briquettes and pellets for residential heating instead of the use of fossil fuels and wood.

Table 2 Emission trends for particulate matter 1990-2015

Year	Emissions			
	PM10 [kt]	PM2.5[kt]	TSP [kt]	BC [kt]
1990	32,49	48,01	57,36	2,96
1991	28,46	42,11	49,97	2,59
1992	34,76	50,35	59,03	3,26
1993	31,12	44,77	52,51	2,89
1994	29,10	42,38	49,95	2,62
1995	29,36	42,98	50,86	2,65
1996	32,21	46,92	55,55	2,97
1997	31,29	45,55	53,50	2,83
1998	35,66	52,02	61,71	3,25
1999	31,00	44,93	53,49	2,80
2000	29,89	43,42	53,79	2,68
2001	18,12	27,53	33,92	1,43
2002	18,69	28,02	33,96	1,64
2003	28,96	41,84	49,94	2,58
2004	31,50	45,57	54,68	2,84
2005	28,17	41,48	50,59	2,56
2006	27,18	39,48	47,60	2,41

Year	Emissions			
	PM10 [kt]	PM2.5[kt]	TSP [kt]	BC [kt]
2007	21,38	31,67	38,64	1,83
2008	25,00	36,21	44,52	2,17
2009	19,79	28,38	36,00	1,69
2010	24,33	34,56	43,01	2,15
2011	28,92	41,79	52,95	2,56
2012	27,61	39,96	50,24	2,48
2013	27,12	39,88	50,61	2,46
2014	23,82	34,40	42,85	2,12
2015	18,89	28,00	35,16	1,65
Trend 1990–2015	***-41,69%***	***-41,86%***	***-38,70%***	***-44,15%***

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.

Table 3 Emission trends for heavy metals 1990-2015

Year	Emissions		
	Cd [Mg]	Pb [Mg]	Hg [Mg]
1990	0,38	109,39	0,62
1991	0,35	86,77	0,57
1992	0,33	96,84	0,52
1993	0,30	91,17	0,50
1994	0,27	87,60	0,42
1995	0,36	95,60	0,44
1996	0,41	95,97	0,49
1997	0,32	99,61	0,52
1998	0,36	102,06	0,59
1999	0,31	97,70	0,53
2000	0,31	100,20	0,54
2001	0,31	96,38	0,56
2002	0,31	103,55	0,59
2003	0,23	95,15	0,44
2004	0,23	25,97	0,43
2005	0,16	23,34	0,31
2006	0,16	8,18	0,31

Year	Emissions		
	Cd [Mg]	Pb [Mg]	Hg [Mg]
2007	0,17	8,89	0,33
2008	0,17	6,24	0,32
2009	0,16	5,57	0,29
2010	0,16	6,20	0,30
2011	0,18	6,90	0,34
2012	0,16	5,41	0,30
2013	0,14	4,14	0,25
2014	0,15	4,84	0,26
2015	0,14	4,61	0,25
Trend 1990–2015	***-64,70%***	***-95,79%***	***-59,56%***

With regards to PCDD/F and PAHs the trends are variable, but still decreasing trend can be noticed from 2011 onwards. The largest source of emissions for these pollutants is the energy sector (mainly residential heating) with a share of 75% and 89% respectively. With regards to PAHs the emissions are more or less stable during the whole reporting period, bearing in mind that biomass is still major fuel used for domestic heating. However, a decline in biomass fuel consumption and incline of natural gas fuel combustion in the latest year results in lower emissions of these pollutants in 2015 compared to 2014.

Table 4 Emission trends for POPs 1990-2015

Year	Emissions			
	PCDD/F [g – I TEQ]	PAHs [t]	HCB [kg]	PCB [kg]
1990	16,49	12,24	44,30	187,54
1991	14,51	10,81	39,23	177,69
1992	14,74	11,67	25,84	177,56
1993	15,23	12,78	24,20	131,34
1994	13,79	11,97	25,05	123,06
1995	13,96	12,10	18,64	237,83
1996	13,47	11,88	19,72	266,61
1997	14,00	11,93	27,90	150,21
1998	15,35	12,20	29,35	178,05
1999	15,31	12,40	53,99	128,32
2000	17,60	14,48	38,33	104,83
2001	14,62	11,44	34,16	93,30
2002	15,67	11,49	52,70	92,52
2003	16,25	12,83	42,99	49,31
2004	16,32	12,96	8,53	38,09
2005	15,18	12,18	7,58	4,24
2006	16,30	12,95	11,71	4,63

Year	Emissions			
	PCDD/F [g – I TEQ]	PAHs [t]	HCB [kg]	PCB [kg]
2007	15,12	11,51	10,15	4,88
2008	16,45	13,32	10,40	4,36
2009	16,86	14,10	7,44	3,81
2010	17,86	14,88	9,56	4,26
2011	17,84	14,58	9,93	4,69
2012	16,73	14,18	7,28	3,87
2013	13,44	11,53	6,55	3,05
2014	15,99	13,67	4,93	9,73
2015	13,50	11,32	4,56	11,45
Trend 1990–2015	***-18,15%***	***-7,52%***	***-89,70%***	***-93,89%***

The main inconsistency of the trends origin from the Transport sector due to the use of different calculation methodology (Tier 1 for the calculation of emissions in the period 1990-2013 and Tier 2 for the calculation of emissions in the period 2014-2015) as the assumed high uncertainty of the used mileage data per vehicle category for which we do not have detail scientific research evidence, as well as different categorization of the vehicles over the years in the statistical publications and MOI database.

1.3. Priorities for improvement

This report includes improvements made in response to the findings of the Stage 3 in-depth Review under the LRTAP convention, carried out in June 2016[3]. These improvements include clarification of notation keys and time series consistencies. More information on these improvements per category can be found in the sectoral chapters. The major improvement was done in the Transport sector where available car fleet data form MOI for 2014 and 2015 have been used for calculation of traffic emission, by use of Tier 2 method. Most of the recommendations in the stage 3 review report refer to this particular sector, mainly on SO_2 emission calculation in 1.A.3.c and 1.A.2.gii. Furthermore, emissions in following NFR sectors have been calculated for the first time bearing in mind recommendations given in the stage III review report: 1.A.5.b, 1.B.2.d, 5.D, 3.D.a.2 and 3.D.a.3, while 2.D.3.i and 2.G NFR categories have been separated.

Nonetheless, due to limitation of staff and lack of activity data, there are still a lot of issues to be improved in future. Due to the fact that emissions from the Transport sector have been calculated using the Tier 2 method only for the last two years, the major priority is establishment of Copert V model for calculation of emissions coming from this sector for the whole reporting period. 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. Some improvements have been already made for this reporting round, but there is steel need for further improvement. Establishment of better QA/QC procedures will enable better cross checking of data and better data quality. Training on implementation of all QA/QC procedures were carried out during the last expert missions in the frame of the Component 2 of the Twining project. During this year SOP for preparation of the inventory and implementation of QA/QC procedures will be prepared and used for the check of the data quality in the next reporting round.

[3]UNECE/CEIP/S3.RR/2016/Macedonia19/10/2016

1.4. Information on recalculation – main reasons for recalculations

The most important recalculations carried out for the present submission include: 1.A.3.bi, 1.A.3.bii, 1.A.3.biii and 1.A.3.biv. Emissions for the years 2014-2015 were recalculated, using higher tier level. This recalculation was carried out because detailed data on the vehicle fleet for these years was provided by MOI.

- In Energy sector emissions for the year 2014 were recalculated, using final activity data from the energy balance. This recalculation did not result in some major changes.
- In some 3.B and 3.D category, emissions for the whole reporting were recalculated, due to missing linkage in the excel calculation sheets.
- In the category 2.D NFRs were recalculated due to the comments and recommendations given by the MS experts for the improvement of the activity data.

Detailed information on the recalculations per category can be found in the sector chapters.

1.5. Explanation of differences between reported national totals

National totals are reported for the entire territory, based on fuel sold. There are no differences in national totals reported in the NFR tables.

1.6. Clarification of the reason for differences in reported national totals for the entire territory with NECD reports

As Republic of Macedonia is not a Member of the European Union, it does not report emissions under the EU's National Emissions Ceiling Directive (NECD). However, the NEC directive is transposed in the national legislation and national totals for NOx, NMVOC, SOx and NH_3 with national emission ceilings.

2. INTRODUCTION

2.1. National Inventory background

International commitments

Reporting of emission data to the Executive Body (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 (PM), various HM and POPs.

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. For Republic of Macedonia, status of ratification to LRTAP Convention and its Protocols is shown below:

- Convention on Long-Range Transboundary Air Pollution (LRTAP) (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 with the date of effect of 30.12.1997.
  - 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 sulfur 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 sulfur 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, negotiations 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 sulfur 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.

Status of ratification of the protocols under CLRTAP are presented in the table below.

Table 5 Status of ratification of the protocols under CLRTAP

Tools of UNECE Convention on Long-Range Transboundary Air Pollution (LRTAP)		Parties	entered into force	Signed (S) / Ratified (R) / Succession (d) / Accession (a) by Macedonia
1979	Geneva Convention on Long-Range Transboundary Air Pollution		16.03.1983	30 Dec 1997 (d)[4]
1984	Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP)	47	28.01.1988	10 Mar 2010 (a)
1985	Helsinki Protocol on the Reduction of Sulfur Emissions or their Transboundary Fluxes by at least 30 per cent	25	02.09.1987	10 Mar 2010 (a)
1988	Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes	35	14.02.1991	10 Mar 2010 (a)
1991	Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes	24	29.09.1997	10 Mar 2010 (a)
1994	Oslo Protocol on Further Reduction of Sulfur Emissions	29	05.08.1998	5 Jun 2014 (a)
1998	Aarhus Protocol on Heavy Metals	31	29.12.2003	1 Nov 2010 (a)
	Aarhus Protocol on Heavy Metals, as **amended on 13 December 2012**			
1998	Aarhus Protocol on Persistent Organic Pollutants (POPs)	33	23.10.2003	1 Nov 2010 (a)
	Aarhus Protocol on Persistent Organic Pollutants, **as amended on18 December 2009**[5]			
1999	Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone	31	17.05.2005	5 Jun 2014 (a)
	Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, **as amended on 4 May 2012**[6]			

In the context of air pollution and Climate Change the Republic of Macedonia has ratified also the following conventions:

- United National Framework Convention on Climate Change (UNFCCC) (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 Republic of Macedonia on 28.04.1998.

[4]https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-1&chapter=27&clang=_en

[5]http://www.unece.org/fileadmin/DAM/env/lrtap/full%20text/ece.eb.air.104.e.pdf

[6]http://www.unece.org/fileadmin/DAM/env/documents/2013/air/eb/ECE.EB.AIR.114_ENG.pdf

- Kyoto Protocol under the United Nations Framework Convention on Climate Change the Republic of Macedonia. The Protocol was ratified by means of the Law on Ratification („Official Gazette of RM" No. 49/04).

- Stockholm Convention on Persistent Organic Pollutants. 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). 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). 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 trans-boundary 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).

At its thirty-second session[7] (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.

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

[7]http://www.unece.org/index.php?id=33605#/

National legislation

In accordance with the Law on ambient air quality Article 27-g (2)[8], the Air Pollutant Emissions inventory for the territory of Republic of Macedonia is performed through:

1) Calculation of emission quantities of pollutants in the air in 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 fulfill the requirements toward the 1979 Convention on Long-Range trans-boundary 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.

Practical implementation and development of the inventory work

In 2005 Republic of Macedonia via the Ministry of Environment and Physical Planning (MEPP) established a National Methodology for Air pollutants emission inventory. This was part of the implementation of the EMEP Program, 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) Program. The objective of the project was to establish an air pollutant emission inventory and reporting system for 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, the consulting company TEHNOLAB Ltd authorized by the MEPP, has prepared the first Air pollutant emission Inventory and Informative Inventory Report (IIR) which covered information on air pollutant emissions for year 2004[9] and has been based EMEP/EEA Guidebook[10] for 2006 (in the further text GB 2006). The history of the development of the inventory is described below.

For the 2005, 2006, 2007, 2009 inventory years, according to the requirements of CLRTAP, MEPP has updated the air pollutant emission data only for the three main SNAP[11] sectors (1, 2 and 3), without submitting an 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 tons per year for all types of activities, as well as other data to be delivered to the Environmental Monitoring Program of Europe (EMEP)"[12].

In 2010, MEPP engaged the second time TEHNOLAB Ltd, a consulting company, to prepare a complete Air pollutant emission inventory and IIR for year 2008 emissions[13].

In 2011 air pollutant emissions data (only for the three main SNAP sectors (1, 2 and 3)) for 2009 were updated without submission of an IIR Report.

[8]Law on Environment (Official Gazette of RM No.53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 187/13, 42/14 and 44/15);

[9] CLRTAP- Macedonia's Informative Inventory Report, 2004, MEPP, March 2006

[10] EMEP/CORINAIR Emission Inventory Guidebook - 2006

[11]SNAP Selected Nomenclature on Air Pollutants

[12]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 EMEP (Official Gazette of RM no.142/2007)

[13]CLRTAP- Macedonia's Informative Inventory Report, 2008, MEPP, March 2010

Republic of Macedonia, in 2011 participated in Stage 3 in depth review[14] of Air Emission Inventories, and replied promptly and timely on the questions sent by the 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 pollutant emission inventory in accordance with GB 2009[15]. Hence, recommendations from Stage 3 review were taken into account in the Inventory submissions in the following years.

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

In 2013, the air pollutant emission inventory for 2011 was extended for the first time to cover emissions of 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 trans-boundary Air Pollution in accordance with the requirements of the particular protocols.

In 2014 and 2015 the air pollutant emission inventory for all pollutants was prepared, meaning calculation for the missing years and recalculation for the previously reported years was carried out, including calculation of the emissions in the baseline years of 1980 (SOx), 1987 (NOx), 1988 (NMVOC) and 1990 (POPs) due to improved activity data, as well as in accordance with the updated version of the EMEP/EEA Emission Inventory Guidebook 2013[16] for most of the source categories.

The IIR submitted in 2016 covered information on anthropogenic emissions of air pollutants for 2014 for all pollutants, the entire time series starting from 1990, and it includes documentation of methods, data sources, completeness of the Inventory, quality assurance and quality control (QA/QC) activities carried out, as well as sectorial methodologies for emission estimations by category (NFR). Emission data, activity data and emission factors are presented in separate chapters of this IIR. NFR 14-2 tables are used to report the emissions.

In 2016, Republic of Macedonia again participated in a Stage 3 in depth review of Air Emission Inventories. Based on this review, additional improvements were made in the inventory. The present IIR, submitted in 2017, describes these improvements and for the first time contains a quantitative uncertainty assessment. Furthermore in most of the categories updated emission factors from the EMEP/EEA Emission Inventory Guidebook 2016[17] have been used.

The overall view of the gradual improvement of the inventory work is presented in the following table.

[14]http://www.ceip.at/fileadmin/inhalte/emep/pdf/2011/MK_Stage3_Review_Report_2011.pdf;

[15] EMEP/EEA air pollutant emission inventory guidebook - 2009

[16] EMEP/EEA air pollutant emission inventory guidebook - 2013

[17] EMEP/EEA air pollutant emission inventory guidebook - 2016

Table 5 Development of the inventory work in Macedonia

Year	Inventory	Pollutant	Time series	Based on	Implemented by	Submission			
						NFR07	NFR09	NFR 14	IIR
2005	• National Methodology for Air pollutants emission inventory • Establishment of an emission inventory and reporting system	Basic pollutants/ SNAP sector 1,2,3	2003	EMEP/CORINAIR Emission Inventory Guidebook - 3rd edition October 2002 UPDATE Emission measurments	MOEPP	X			
2006	First Air pollutant emission Inventory accoriding CORINAIR methodology and Informative Inventory Report (IIR)	Basic pollutants /all sectors	2004	EMEP/CORINAIR Emission Inventory Guidebook - 3rd edition October 2002 UPDATE Emission measurements	ETC/ACC[18] (EMEP Program)TEHNOLAB Ltd	X			X
2007	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 EMEP	Basic pollutants	2005		MEPP	X			
2008 and 2009	Update	Basic pollutants SNAP sector 1, 2 and 3	On yearly base according the rule n-2	EMEP/CORINAIR Emission Inventory Guidebook - 3rd edition October 2002 UPDATE Emission measurements	MEPP		X		
2010	Air pollutant emission Inventory and IIR	Basic pollutants	2008		TEHNOLAB Ltd		X		X
2011	Stage 3 in depth review Update	Basic pollutants SNAP sector 1, 2 and 3		EMEP/EEA GB 2009	MEPP & TEHNOLAB Ltd		X		

[18]European Topic Centre on Air and Climate Change

Year	Inventory	Pollutant	Time series	Based on	Implemented by	Submission			
						NFR07	NFR09	NFR 14	IIR
2012	Inventory and preparation of the report	All including heavy metals (HM)	Full time series		MEPP & TEHNOLAB Ltd		X		X
2013	• Air pollutant emission Inventory • Emissions for the baseline years 1980 (SOx), 1987 (NOx), 1988 (NMVOC) and 1990 (POPs)	All + HM including PM2.5, PM10, dioxins and furans		EMEP/EEA GB 2009	MOEPP		X		
2014 2015	Recalculation including baseline years	All with exception of BC	Baseline years + 2012 and 2013	EMEP/EEA Emission Inventory Guidebook -2009, 2013	MEPP			X	
2016	• Recalculation of all pollutants, time series starting from 1990 • documentation of methods, data sources, completeness of the Inventory, QA/QC, sectorial methodologies for emission estimations by category (NFR)	All with exeption of BC	1990 - 2014	EMEP/EEA Emission Inventory Guidebook -2009, 2013	MEPP Twinning			X	X
2017	• Introduction of uncertainty trend analysis and key source analysis as well as QA/QC procedures implemented and improved, most of the Stage 3 review comments implemented	All + BC	1990-2015	EMEP/EEA Emission Inventory Guidebook -2009, 2013 and 2016	MEPP Twinning			X	X

2.2. Institutional arrangements

According to the article 40 of the Law on environment (LE)[19] the Macedonian Environmental Informative Center (MEIC), a department within the Ministry of Environment and Physical Planning (MEPP) is the Single National Entity (SNE) 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.

[19] Law on Environment (Official Gazette of RM No.53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 187/13, 42/14 and 44/15);

Data needed for the preparation of the inventory are provided by either industrial operators, State statistical office (SSO), Ministry of Economy (MOE), Ministry of defense (MOD), 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 2016 with MOI on detailed vehicles fleet data.

The other ministries / institutions mentioned above are delivering the data on voluntary basis and upon our requirements. The plant operators are reporting the data due to their obligation under PRTR and national sub legislation.

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

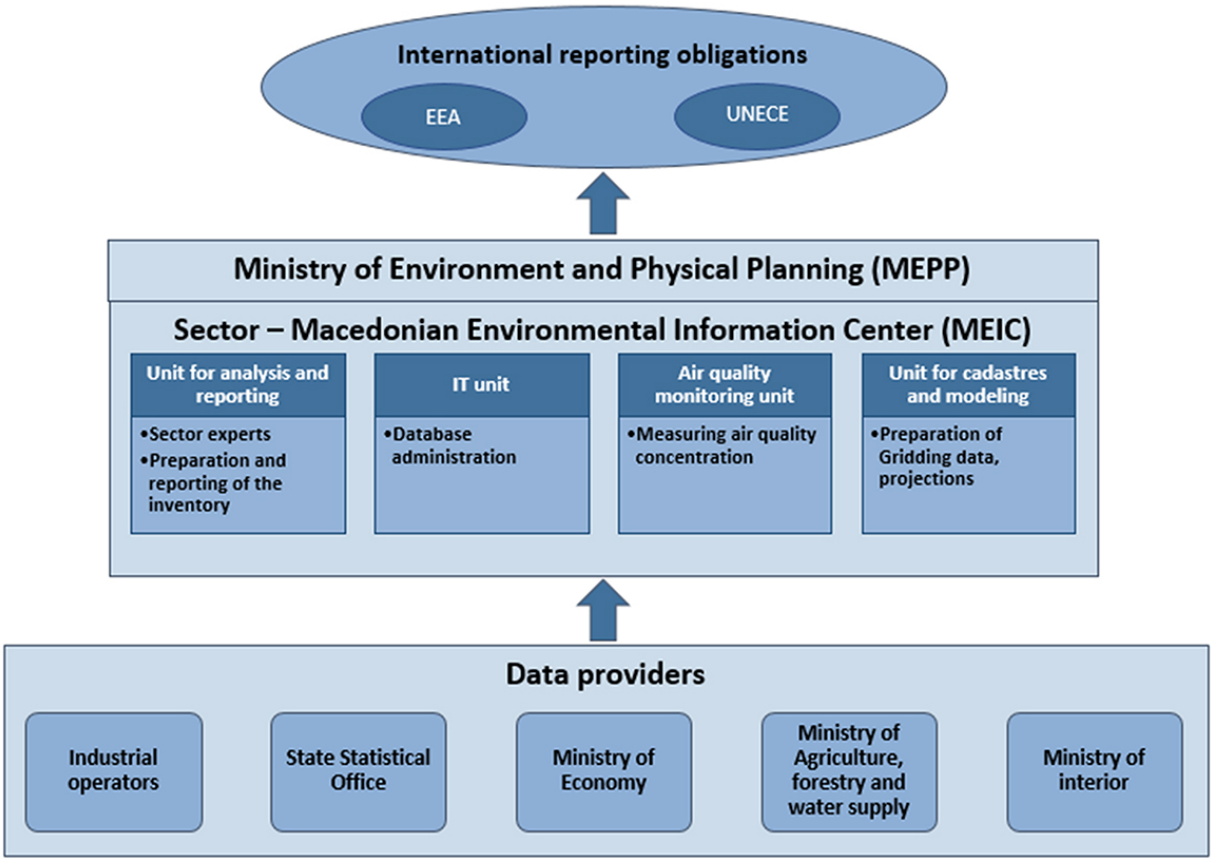

Figure 1 Institutional arrangements

2.3. Inventory preparation process

The preparation of the Inventory includes the following stages:

a) Planning

b) Preparation

c) Data management

d) Reporting

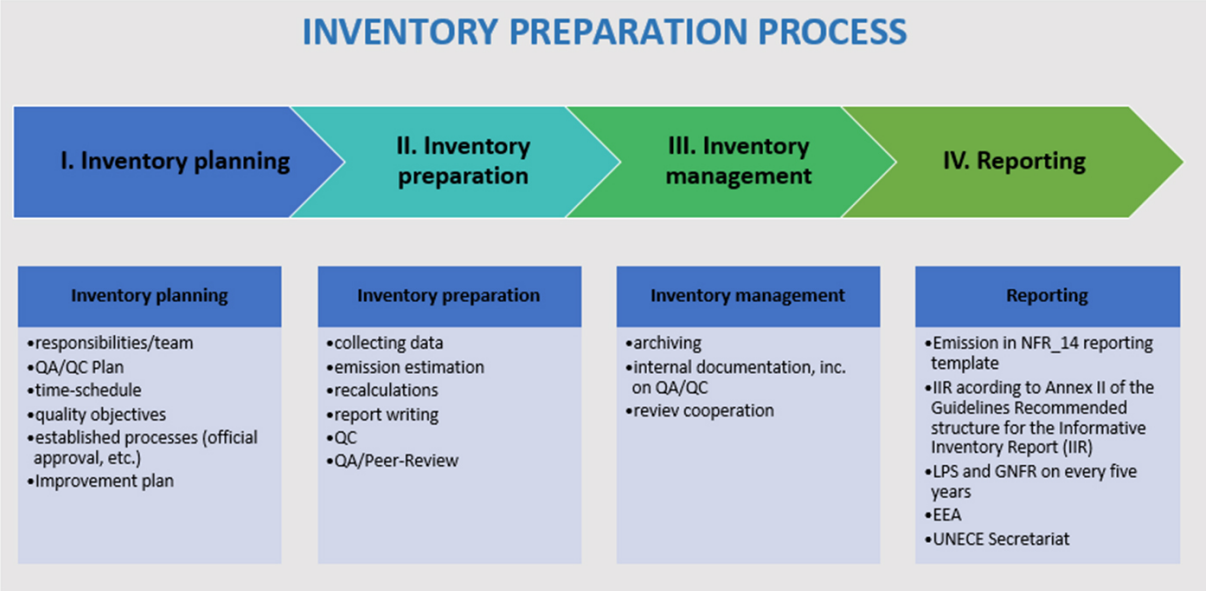

Figure 2 Scheme of inventory preparation process

a) Inventory planning

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. Currently 6 people are involved in the inventory work, but for only two of them the preparation of the emission inventory is primary task. Five of them are distributed as key experts and deputy experts between sectors, but due to the fact that preparation of the inventory is not their main task, they need further training in order to be independent in the preparation of the sector inventory, which is currently done with the support of expert acting as a Component 2 leader. The IT expert is responsible for update of the NFR reporting tool, KCA, Trend analysis and NFR reporting table on yearly base. Further improvement and safe sustainability of the inventory will be entirely ensured by increasing of the trained staff and dedication of the experts to inventory work as their primary task. A document for the timeline of the inventory preparation have been prescribed and has been used by the experts within preparation of this inventory round.

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 were followed and were of great use regarding the improvements made in the NFR, this IIR and improvements in general.

Furthermore, in the course of the Twinning Project, trainings on gap filling methods, uncertainty analysis and use of QA/QC procedures in the preparation process were delivered. Still, more training on specific categories (waste, transport, industry and solvents) have been provided by experts from Umweltbundesamt Austria and SYKE-Finland, specialized in those certain sectors, in the course of an expert missions carried out in the period March 2016 – January 2017. The experts provided mission reports and explanations for improvement which are already included in this Informative Inventory Report.

- **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 1990-2015;
- Publications published by SSO in different areas (Transport, Industry in the Republic of Macedonia, Industry and Energy, Livestock, Agriculture and Forestry);
- Energy Balance of the Republic of Macedonia by Ministry of economy
- Measurements data from the operators
- International web page databases (FAO, Eurostate and etc.).

c) Data management and processing

Emission factors and activity data for different source categories are collected and calculated in separate NFR excel tables, for the period from 1990 to 2015. NFR tables are categorized in separate folders (ENERGY, INDUSTRY and SOLVENT PRODUCT USE, AGICULTURE, WASTE, TRANSPORT, NATURAL SOURCES).

During each inventory preparation cycle, evaluation and update of selected emission factors of previous years is conducted, if there is an available updated version of EMEP/EEA Guidebook. Change of the emission factors due to the revision of the EMEP/EEA Guidebook from 2016 and more detailed expert analysis in agriculture sector, for example, are in details described in the Recalculations chapter.

QA/QC activities include 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 in the selection of the methodology used in the calculation of emissions and selection of emission factors for each source, is driven by availability of activity data. The availability of data and possible time series inconsistencies are described for each source category in the sectoral chapters, further below. Mainly the problem is coming from the fact that data coming from the Statistical publications are not detailed enough, and the fact that the last Census was carried out in 2002. Additionally, compared to the other European countries, we have started with preparation of whole time series emission inventory for all pollutants only in 2014. This effects in use of different methodology in the older statistical yearbook, and higher use of data gap filling methods that result with trend inconsistency in some sectors, as well as higher uncertainty.

Taking into account such difficulties in the collection of data on activity rates, as well as the fact that Republic of Macedonia does not yet have national emission factors with exception of those provided for the major industries, Tier 1 methodologies and the corresponding emission factors from GB 2009, GB 2013 and GB 2016 were used to estimate emissions from most sources in this Inventory.

Calculation of emissions with use of Tier 2 method was carried out in the following sources: NFRs 1.B.1.a (Fugitive emission from solid fuels), 2.A.3 (Glass production), 2.D.3.g (Chemical products) and 2H2 (Food and beverages industry). 1.A.3.b for 2014-2015 and in 5.A, for the whole reporting period. Implied emission factors (IEFs) have been used in NFR categories 1.A.1.a (Public electricity and heat production) and 2.C.2 (Ferroalloys production). These factors were calculated based on emissions reported in the previous years and fuel used/production. The factors are used in case when these plants do not report measured data or the reported data are not calculated on yearly base.

With regard to the specification of emission factors for certain number of emission sources, mainly for point sources (Facilities), data from the manual monthly and yearly emissions measurements of pollutant, measurements done with automated systems, carried out at the various facilities, has been used (see chapter References).[20]

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

d) Reporting

For reporting of emissions, data from separated calculated sheets tables per NFR, containing EFs, activity data and calculated emissions per pollutant, were linked to the NFR table for reporting. This was carried out with the help of a NFR Reporting Tool, which was developed within the EU Twinning project and implemented by an IT expert from MEPP. The NFR Reporting Tool transposes columns to rows, includes data analysis and provides emission trends. NFR Reporting tool is linked with the NFR_14 reporting template and reporting towards UNECE and EEA is carried out within the given deadline.

During the preparation of the current submission of Informative Inventory Report in 2017, 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 emission inventory guidebook - 2009;
- EMEP/EEA air pollutant emission inventory guidebook — 2013;

EMEP/EEA air pollutant emission inventory guidebook — 2016;

The structure of the above mentioned guidelines was followed by the authors, in order to achieve transparency, consistency, completeness, comparability and accuracy of reported emission data. This IIR as the previous one, was reported after the given deadline, namely at the end of April due to the experts engagement within the Twining project. It is planned from the next year to respect the given reporting deadline also for the IIR.

2.4. Methods and data sources

2.4.1. Methodology

The methodology of the Macedonian air pollutant emission inventory is based on the UNECE CLRTAP Reporting Guidelines and the EMEP/EEA Emission Inventory Guidebook 2013, targeting on transparency, completeness, consistency, comparability and accuracy of emissions data.

The calculation of emissions is based on activity data (AD), which represents the magnitude or volume of an activity generating emissions, while an emission factor (EF) is the mass of emissions per unit of activity. Activity data is either available from official statistics, from the industry of from special studies, inquiries or e.g. from the literature. Default emission factors presented in the Guidebook have been used in the calculation of emissions. In the future there is a need to develop national emission factors that would more accurately correspond to the Macedonian conditions.

2.4.2. 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, or also from the industry and inquiries carried out by MEIC. For particular sub-sectors and source categories,

[20] Questionnaire for emissions in environment from stationary sources_National Cadastre 2015

more detailed data are required than those published in official statistical reports, such as disaggregated energy balance, vehicle fleet etc. Table 7 presents the official activity data sources in relation to the NFR sectors.

Table 6 Activity data sources

NFR Sector	Data source	Data provider
Energy	Energy balance 2009-2014, Energy statistics Questionnaire for emissions in environment -2015	Ministry of economy MEPP State statistical office
Transport	State Statistical Office of the Republic of Macedonia, Transport and other communications, 2007-2015, Statistical Yearly reports 1990-2015 MOI car fleet database	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, 2010-2015 Statistical Yearly reports 1990-2015 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, Data on treated communal water 1990-2015	State statistical office Public enterprise “Drisla” landfill EUROSTATE Public enterprise Proakva Ohrid
Natural sources	State Statistical Office of the Republic of Macedonia, Forestry, 2000 – 2014, http://www.stat.gov.mk/Publikacii/5.4.8.02.pdf Data on fires (burned area, burned forests)	State statistical office Public enterprise Macedonian forests

2.5. Key Categories

Following the encouragement from the last Stage 3 review, the update of the Key Category Analysis (KCA) was prepared on NFR subcategory basis for all pollutants and therefore is fully consistent with the analysis done by CEIP. Additionally to the level assessment, for the first time a trend analysis was carried out as recommended in the Stage 3 review carried out last year.

According to the UNECE CLRTAP Reporting Guidelines sources contributing to an accumulated 80% to total emissions are defined as key sources.

Furthermore, the section on emission trends (see chapter 3) has been included to the Macedonian IIR. 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 "EMEP/EEA air pollutant emission inventory guidebook 2016". 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 8.

Table 7 Key categories for all air pollutants

Pollutant	Key categories 2015 (sorted from high to low contribution from left to right)										Total %
NOx	1A1a	1A3biii	1A3bi	1A2a							81.1%
NMVOC	1A4bi	5A	2D3a	2D3e	3B1a	1B2av	1A3bv	1B1a	3Da1	1A3bi	81.5%
SO_2	1A1a										91.0%
NH_3	3Da2a	3B1a	3Da3	1A4bi	3Da1	3B3					80.4%
PM2.5	1A4bi	2C2	1A1a								89.8%
PM10	1A4bi	1A1a	2C2	3Da1							86.8%
TSP	1A4bi	1A1a	2C2	2D3b							88.1%
CO	1A4bi	1A3bi									80.2%
Pb	2C1	1A2a	1A1a	1A4bi							88.5%
Cd	1A1a	1A4bi	1A2a	2C1							84.1%
Hg	1A1a	2C1	1A2a								82.5%
As	1A1a	2C1									93.7%
Cr	2C1	1A1a	1A3biii								81.7%
Cu	1A4bi	1A2a	5C1biii	2C7a	1A2gvii	1A1a	2G				82.0%
Ni	1A1a	1A2gviii	1A4ai								81.2%
Se	1A1a										97.2%
Zn	5C2	1A4bi	2C1	1A2a							89.4%
DIOX	1A4bi	2C1									84.8%
PAH	1A4bi										89.1%
HCB	2C3										96.3%
PCBs	2C7a	2C1									83.5%

In the process of key categories identification each pollutant was analyzed separately. The results of the level and trend assessment for each pollutant are presented in Table 9 to Table 27.

Table 8 Key source categories for emissions of NO_X in Gg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A1a	Public electricity and heat production			16.40	59.4%	59.4%
1A3biii	R.T., Heavy duty vehicles			2.61	9.5%	68.9%
1A3bi	R.T., Passenger cars			1.70	6.2%	75.0%
1A2a	Iron and Steel			1.68	6.1%	81.1%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A1a	Public electricity and heat production	23.77	16.40	0.107	22.1%	22.1%
1A3bi	R.T., Passenger cars	5.28	1.70	0.090	18.7%	40.8%
1A2gvii	Mobile Combustion in Manufacturing Industries and Construction	3.72	1.04	0.078	16.1%	56.9%
1A2a	Iron and Steel	1.83	2.01	0.040	8.2%	65.1%
1A3biii	R.T., Heavy duty vehicles	3.00	2.61	0.031	6.3%	71.4%
1A2b	Non-ferrous Metals	0.72	0.00	0.024	5.0%	76.4%
1A4bi	Residential: stationary	0.84	0.92	0.018	3.8%	80.2%

Table 9 Key source categories for emissions of NMVOC in Gg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A4bi	Residential: stationary			8.61	29.9%	29.9%
5A	Solid waste disposal on land			3.77	13.1%	43.0%
2D3a	Domestic solvent use including fungicides			2.07	7.2%	50.2%
2D3e	Degreasing			1.76	6.1%	56.3%
3B1a	Dairy cattle			1.61	5.6%	61.9%
1B2av	Distribution of oil products			1.35	4.7%	66.6%
1A3bv	R.T., Gasoline evaporation			1.20	4.2%	70.8%
1B1a	Coal Mining and Handling			1.19	4.1%	74.9%
3Da1	Inorganic N-fertilizers			1.09	3.8%	78.7%
1A3bi	R.T., Passenger cars			0.83	2.9%	81.5%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A3bi	R.T., Passenger cars	11.83	0.10	0.362	27.1%	27.1%
1A4bi	Residential: stationary	9.58	10.67	0.174	13.1%	40.2%
5A	Solid waste disposal on land	1.49	3.74	0.170	12.8%	52.9%
2D3d	Coating applications	4.44	3.79	0.153	11.4%	64.4%
2D3a	Domestic solvent use including fungicides	2.03	2.07	0.052	3.9%	68.2%
2D3e	Degreasing	1.72	1.76	0.044	3.3%	71.5%
3B1a	Dairy cattle	1.59	1.65	0.040	3.0%	74.5%
1B2av	Distribution of oil products	1.18	1.20	0.038	2.9%	77.4%
1A3biv	R.T., Mopeds & Motorcycles	1.00	0.03	0.033	2.4%	79.8%
1A3bv	R.T., Gasoline evaporation	1.10	1.21	0.032	2.4%	82.3%

Table 10 Key source categories for emissions of SO_2 in Gg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A1a	Public electricity and heat production			69.51	91.0%	91.0%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A2a	Iron and Steel	1.40	4.96	0.076	49.4%	49.4%
1A1a	Public electricity and heat production	102.15	76.90	0.028	17.9%	67.3%
1A2b	Non-ferrous Metals	2.10	0.00	0.027	17.7%	85.0%

Table 11 Key source categories for emissions of NH_3 in Gg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
3Da2a	Animal manure			2.41	22.6%	22.6%
3B1a	Dairy cattle			2.10	19.7%	42.3%
3Da3	Urine and dung deposited by grazing animals			1.24	11.6%	53.9%
1A4bi	Residential: stationary			1.00	9.4%	63.3%
3Da1	Inorganic N-fertilizers			0.94	8.8%	72.1%
3B3	Swine			0.89	8.3%	80.4%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
3Da3	Urine and dung deposited by grazing animals	2.93	1.24	0.103	19.1%	19.1%
3B4gi	Laying Hens	1.76	0.60	0.102	18.9%	38.0%
3B1a	Dairy cattle	2.07	2.14	0.098	18.1%	56.1%
3B2	Sheep	0.92	0.30	0.045	8.4%	64.5%
3Da1	Inorganic N-fertilizers	0.91	0.99	0.045	8.4%	72.9%
3B3	Swine	0.84	0.78	0.045	8.3%	81.1%

Table 12 Key source categories for emissions of CO in Gg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A4bi	Residential: stationary			57.44	70.0%	70.0%
1A3bi	R.T., Passenger cars			8.35	10.2%	80.2%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A3bi	R.T., Passenger cars	46.34	9.41	0.401	41.1%	41.1%
1A4bi	Residential: stationary	64.13	71.15	0.348	35.8%	76.9%
1A2a	Iron and Steel	1.50	5.19	0.085	8.7%	85.6%

Table 13 Key source categories for emissions of TSP in Gg

Level Assessment 2015				
NFR Code	**NFR sector**	**2015**	**%**	**%cum**
1A4bi	Residential: stationary	11.47	32.6%	32.6%
1A1a	Public electricity and heat production	8.70	24.7%	57.4%

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
2C2	Ferroalloys Production			6.52	18.6%	75.9%
2D3b	Road paving with asphalt			4.28	12.2%	88.1%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
2C2	Ferroalloys Production	24.52	9.94	0.395	44.3%	44.3%
1A4bi	Residential: stationary	12.74	14.21	0.170	19.1%	63.3%

Table 14 Key source categories for emissions of PM2.5 in Gg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A4bi	Residential: stationary			10.61	56.2%	56.2%
2C2	Ferroalloys Production			3.96	21.0%	77.1%
1A1a	Public electricity and heat production			2.38	12.6%	89.8%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
2C2	Ferroalloys Production	14.71	6.00	0.418	45.5%	45.5%
1A4bi	Residential: stationary	11.78	13.14	0.342	37.3%	82.7%

Table 15 Key source categories for emissions of PM10 in Gg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A4bi	Residential: stationary			10.89	38.9%	38.9%
1A1a	Public electricity and heat production			5.88	21.0%	59.9%
2C2	Ferroalloys Production			5.56	19.9%	79.8%
3Da1	Inorganic N-fertilizers			1.97	7.0%	86.8%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
2C2	Ferroalloys Production	20.84	8.45	0.404	44.7%	44.7%
1A4bi	Residential: stationary	12.10	13.50	0.235	26.0%	70.7%
1A1a	Public electricity and heat production	8.63	6.50	0.052	5.7%	76.4%
3Da1	Inorganic N-fertilizers	2.06	1.97	0.047	5.2%	81.6%

Table 16 Key source categories for emissions of Pb in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
2C1	Iron and Steel Production			2.15	46.6%	46.6%
1A2a	Iron and Steel			0.74	16.1%	62.7%
1A1a	Public electricity and heat production			0.60	13.1%	75.8%
1A4bi	Residential: stationary			0.58	12.7%	88.5%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A3bi	R.T., Passenger cars	89.09	0.00	19.35	47.5%	47.5%

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
2C1	Iron and Steel Production	4.07	2.29	10.19	25.0%	72.5%
1A2a	Iron and Steel	0.19	0.73	3.77	9.3%	81.7%

Table 17 Key source categories for emissions of Cd in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A1a	Public electricity and heat production			0.07	54.5%	54.5%
1A4bi	Residential: stationary			0.02	15.4%	69.8%
1A2a	Iron and Steel			0.01	7.4%	77.2%
2C1	Iron and Steel Production			0.01	6.9%	84.1%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A1a	Public electricity and heat production	0.11	0.08	0.743	50.9%	50.9%
1A4bi	Residential: stationary	0.02	0.03	0.265	18.2%	69.0%
1A2a	Iron and Steel	0.00	0.01	0.191	13.1%	82.1%

Table 18 Key source categories for emissions of Hg in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A1a	Public electricity and heat production			0.12	46.3%	46.3%
2C1	Iron and Steel Production			0.05	18.6%	64.9%
1A2a	Iron and Steel			0.04	17.6%	82.5%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A1a	Public electricity and heat production	0.17	0.13	0.468	42.2%	42.2%
1A2a	Iron and Steel	0.01	0.04	0.389	35.1%	77.3%
2C1	Iron and Steel Production	0.09	0.05	0.107	9.7%	87.0%

Table 19 Key source categories for emissions of As in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A1a	Public electricity and heat production			0.58	70.7%	70.7%
2C1	Iron and Steel Production			0.19	22.9%	93.7%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A1a	Public electricity and heat production	0.84	0.64	0.130	50.5%	50.5%
2C1	Iron and Steel Production	0.35	0.20	0.056	21.9%	72.4%
1A2a	Iron and Steel	0.01	0.02	0.038	14.7%	87.2%

Table 20 Key source categories for emissions of Cr in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
2C1	Iron and Steel Production			2.10	62.0%	62.0%
1A1a	Public electricity and heat production			0.37	10.8%	72.9%
1A3biii	R.T., Heavy duty vehicles			0.30	8.8%	81.7%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2014**	**TA**	**%**	**%cum**
2C1	Iron and Steel Production	3.98	2.24	0.307	46.0%	46.0%
1A3biii	R.T., Heavy duty vehicles	0.00	0.28	0.122	18.4%	64.3%
1A3bi	R.T., Passenger cars	0.01	0.29	0.120	18.0%	82.3%

Table 21 Key source categories for emissions of Cu in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A4bi	Residential: stationary			0.13	20.5%	20.5%
1A2a	Iron and Steel			0.10	15.5%	36.0%
5C1biii	Clinical waste			0.08	12.2%	48.2%
2C7a	Copper production			0.06	10.2%	58.4%
1A2gvii	Mobile Combustion in Manufacturing Industries and Construction			0.05	8.7%	67.1%
1A1a	Public electricity and heat production			0.05	7.8%	74.9%
2G	Other product manufacture and use			0.04	7.1%	82.0%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A3bi	R.T., Passenger cars	0.30	0.01	0.447	27.5%	27.5%
1A2a	Iron and Steel	0.03	0.10	0.278	17.2%	44.7%
1A4bi	Residential: stationary	0.14	0.16	0.190	11.7%	56.4%
1A3biii	R.T., Heavy duty vehicles	0.12	0.01	0.165	10.2%	66.6%
1A2gvii	Mobile Combustion in Manufacturing Industries and Construction	0.19	0.05	0.132	8.1%	74.7%
1A3bii	R.T., Light duty vehicles	0.06	0.00	0.088	5.4%	80.2%

Table 22 Key source categories for emissions of Ni in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A1a	Public electricity and heat production			0.80	35.4%	35.4%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction			0.65	28.7%	64.0%
1A4ai	Commercial/Institutional: Stationary			0.39	17.1%	81.2%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A4ai	Commercial/Institutional: Stationary	0.10	0.59	0.298	29.2%	29.2%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0.69	0.27	0.265	26.0%	55.2%
1A1a	Public electricity and heat production	1.21	0.85	0.171	16.8%	72.0%

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.34	0.13	0.102	10.0%	82.0%

Table 23 Key source categories for emissions of Se in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A1a	Public electricity and heat production			1.80	97.2%	97.2%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A2a	Iron and Steel	0.00	0.01	0.006	26.0%	26.0%
5C2	Open burning of waste	0.02	0.02	0.005	20.8%	46.8%
1A1a	Public electricity and heat production	2.63	1.99	0,004	17.9%	64.6%
1A2b	Non-ferrous Metals	0.00	0.00	0.002	9.1%	73.8%
2C1	Iron and Steel Production	0.02	0.01	0.002	8.8%	82.6%

Table 24 Key source categories for emissions of Zn in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
5C2	Open burning of waste			5.14	45.8%	45.8%
1A4bi	Residential: stationary			1.87	16.7%	62.5%
2C1	Iron and Steel Production			1.87	16.7%	79.2%
1A2a	Iron and Steel			1.15	10.2%	89.4%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A2a	Iron and Steel	0.37	1.14	0.128	26.0%	26.0%
5C2	Open burning of waste	6.67	5.12	0.125	25.4%	51.4%
1A4bi	Residential: stationary	2.10	2.32	0.075	15.3%	66.7%
2C1	Iron and Steel Production	3.54	1.99	0.054	11.0%	77.8%
1A2b	Non-ferrous Metals	0.48	0.00	0.042	8.7%	86.4%

Table 25 Key source categories for emissions of DIOX in g I-TEQ

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A4bi	Residential: stationary			10,05	74,5%	74,5%
2C1	Iron and Steel Production			1,40	10,4%	84,8%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A2a	Iron and Steel	0.29	1.10	0.080	26.0%	26.0%
1A4bi	Residential: stationary	11.22	12.45	0.078	25.4%	51.4%
2C1	Iron and Steel Production	2.66	1.50	0.070	22.7%	74.0%
1A2b	Non-ferrous Metals	0.47	0.00	0.035	11.2%	85.3%
1A2a	Iron and Steel	0.29	1.10	0.080	26.0%	26.0%

Table 26 Key source categories for emissions of PAHs in Mg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
1A4bi	Residential: stationary			10.08	89.1%	89.1%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
1A2a	Iron and Steel	0.27	0.83	0.056	47.8%	47.8%
1A4bi	Residential: stationary	11.25	12.48	0.030	25.9%	73.7%
2C1	Iron and Steel Production	0.42	0.24	0.016	13.7%	87.4%

Table 27 Key source categories for emissions of HCB in kg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
2C3	Aluminum production			4.40	96,3%	96,3%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
2C3	Aluminum production	44.21	4.76	0.336	66.2%	66.2%
1A4bi	Residential: stationary	0.09	0.11	0.162	31.9%	98.1%

Table 28 Key source categories for emissions of PCB in kg

Level Assessment 2015						
NFR Code	**NFR sector**			**2015**	**%**	**%cum**
2C7a	Copper production			8.40	73.3%	73.3%
2C1	Iron and Steel Production			1.17	10.2%	83.5%
Trend Assessment 1990-2015						
NFR Code	**NFR sector**	**1990**	**2015**	**TA**	**%**	**%cum**
2C1	Iron and Steel Production	2.21	1.25	1.48	36.4%	36.4%
1A2a	Iron and Steel	0.24	0.92	1.32	32.6%	69.0%
1A4bi	Residential: stationary	0.98	1.07	1.15	28.4%	97.4%

2.6. 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).

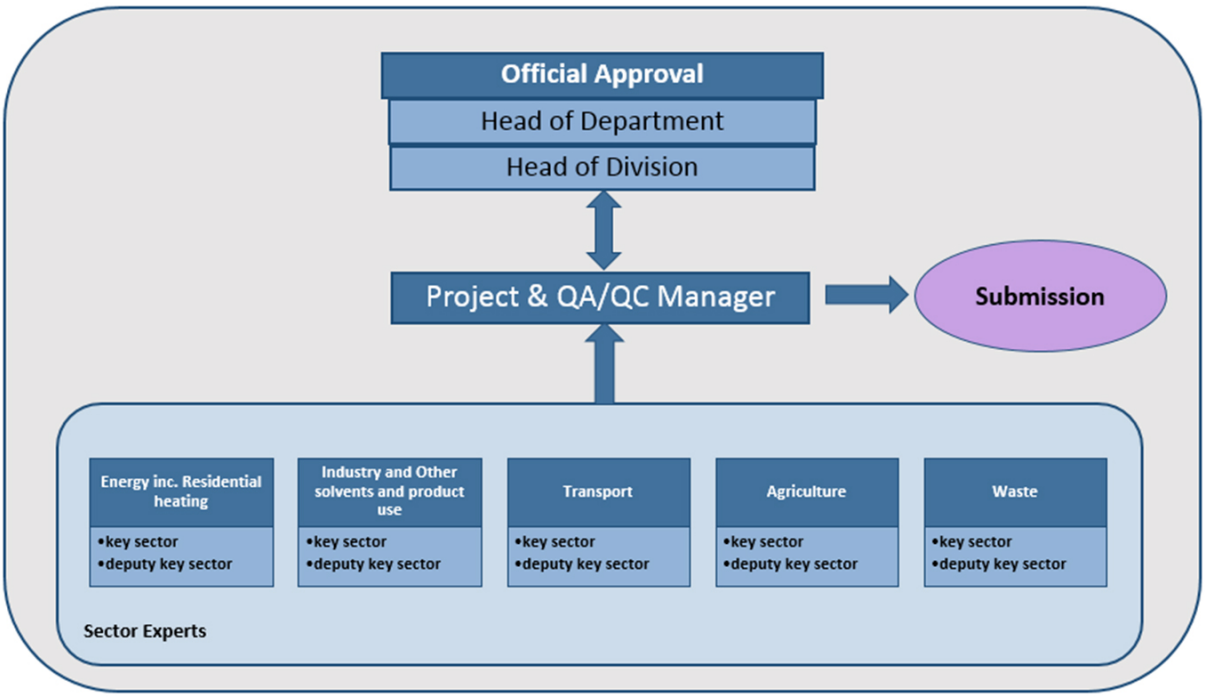

Figure 3 Roles in inventory preparation and submission

The sector experts are responsible for selection of methods, collection of input data, emissions calculation as well as QC at sector level. The project 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, implementation and maintaining of a QA/QC plan, review coordination within the team, as well as for key category analysis and of Review communication. The update of uncertainty analysis, KCA, trend assessment and recalculations files is done by QA/QC Manager with support of the IT expert.

QA/QC Plan and quality objectives

A QA/QC plan is currently being developed. The plan will lay 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, such as:

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

Progress in transparency and completeness as well as timeliness is analyzed annually. The analysis is carried out by counting the total number of data records, as well as those reported as “not estimated” and “included elsewhere” (for all air pollutants). Then the share of “NE” and “IE” to total data records is determined. The results of this year’s analysis and a comparison with the previous submission is shown in Table below. As shown, completeness has been improved since last submission, since activity data for some sectors were made available.

The timeliness parameter of the IIR 2016 was set to 95%, as the IIR report was submitted after the official deadline of 15th March defined in the CLRTAP Reporting Guidelines (ECE/EP.AIR/125), due to engagement of the experts in the Twinning project that helped in the improvement of the Macedonian emission inventory. Submission of emission data, i.e. NFR Tables to CEIP was however done in time on 15th February.

For next year's submission it is planned to submit both, NFR tables and IIR by the set deadlines of the UNECE CLRTAP Reporting Guidelines.

Table 29 Completeness Analysis 2017

Sector	Submission 2016		Submission 2017			Plan Submission 2018		
	1990	2014	1990	2014	2015	1990	2015	2015
Transparency (IE)	98%	*98%*	98%	98%	98%	98%	98%	98%
Completeness (NE)	80%	*85%*	86%	86%	88%	88%	88%	90%
Completeness (IIR)	*~ 180 pages*		*~ 250 pages*			*~ 270 pages*		
Timeliness (Submission)	95%*		95%*			*100%*		

Accuracy, consistency and comparability were checked in the course of the EMEP/EEA Reviews. Recommendations from the Stage 3 reviews (2011, 2016), have been almost fully implemented as presented in Table 214 of 9.2.2.

The QA/QC plan has been prepared, and the following QA/QC activities were carried out in order to ensure the quality of the inventory:

Table 30 Annual time schedule

Task	Description	Responsibility	Deadline
AD collection and QC input data for all sectors	Requesting input data	*Sector expert*	*April 30*
	Quality control (QC) input data	*Sector expert*	*June 30*
Review results	Implementation of review recommendations	*Sector expert*	*October 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	*Deputy 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 – updating of methodological issues	*Sector expert*	*February 15*
Preparation of "Informative Inventory Report"	Compilation of a draft IIR report	*QA/QC expert*	*February 28*
	Provide the IIR report for Peer-Review; revision of the IIR pursuant to comments received or inclusion of recommendations in planned improvements (both from reviews and internal comments)	*Head of Division*	*March 1*
QC IIR	QC of IIR (requirements fulfilled, completeness, etc.)	*QA/QC expert*	*March 10*
Approval of submission	Official approval of the IIR report	*Head of Unit*	*March15*
UNECE Submission	Submission of the IIR	*NRC*	*March 15*

*These deadlines for preparation and reporting of the emission inventory and the IIR will be respected from next year onwards. During 2016 and 2017 we have reported IIR with delay of 1,5 month due to our engagement in the Twining project.

2.6.1. Quality control procedures

QC activities are an important component in the annual inventory preparation process. The basic aim is to ensure the 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 and data processing. The completeness of the inventory is checked to meet the current situation of sources in the country and the pollutants likely to be emitted. Documentation/archiving of the inventory is applicable to all source categories. Category-specific quality checks relate to input data, emission data and emission factors.

QA/QC activities include:

- Plausibility check of data received from operators (category-specific);
- Analysis of time series data;
- If anything is unclear, questions for clarification are sent to the data provider (category-specific);
- Assessment of needs 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 finalization of the IIR report, before official approval and submission, the whole report is checked by the QA/QC manager or some other expert appointed for:

- Completeness of reporting per sector (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;

2.6.2. Quality assurance procedures

QA measures are taken in addition to QC after the finalization of the inventory and are done by experts not closely involved with the national inventory compilation ("independent third-party review"). A basic review of the draft IIR takes place before the final submission. The aim is to get feedback on reporting and methodologies, and to define areas of improvement. Issues from these reviews are either addressed immediately in the draft version, or collected in the improvements list (see 9.2.2). The IIR report itself is annually sent for approval by the Head of division and one expert that have not been included in the preparation process, fifteen days before submission.

Additionally this IIR has been prepared with the support of the emission inventory experts from Umweltbundesamt Austria, which have made review of the prepared text of the report. In the course of this, some improvements were made and some added to the planned improvements list. Please refer to chapter 9.2.1 and 9.2.2.

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 Stage 3 review of the Macedonian Inventory was carried out in 2016. The findings have been addressed in the current inventory to the extent possible.

2.6.3. 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, and 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.

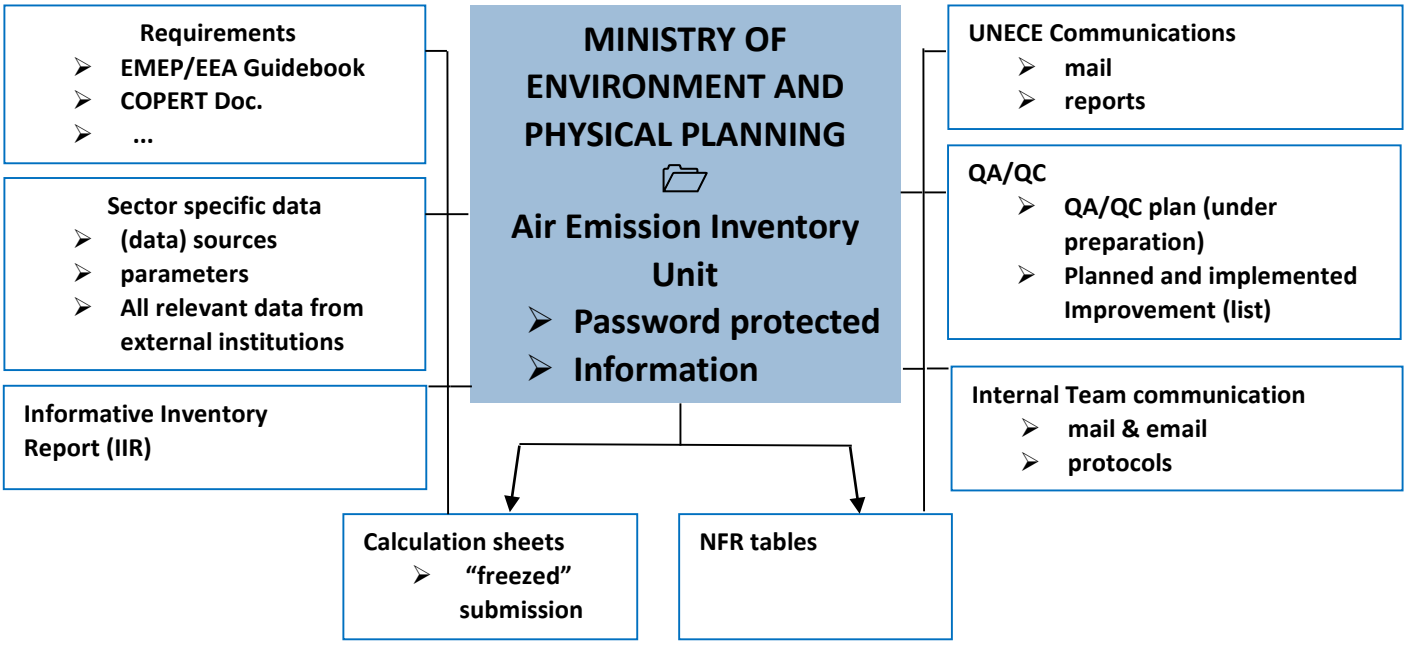

Figure 4 Archiving system

2.6.4. Continuous improvement

The Macedonian inventory is subject to continuous improvement.

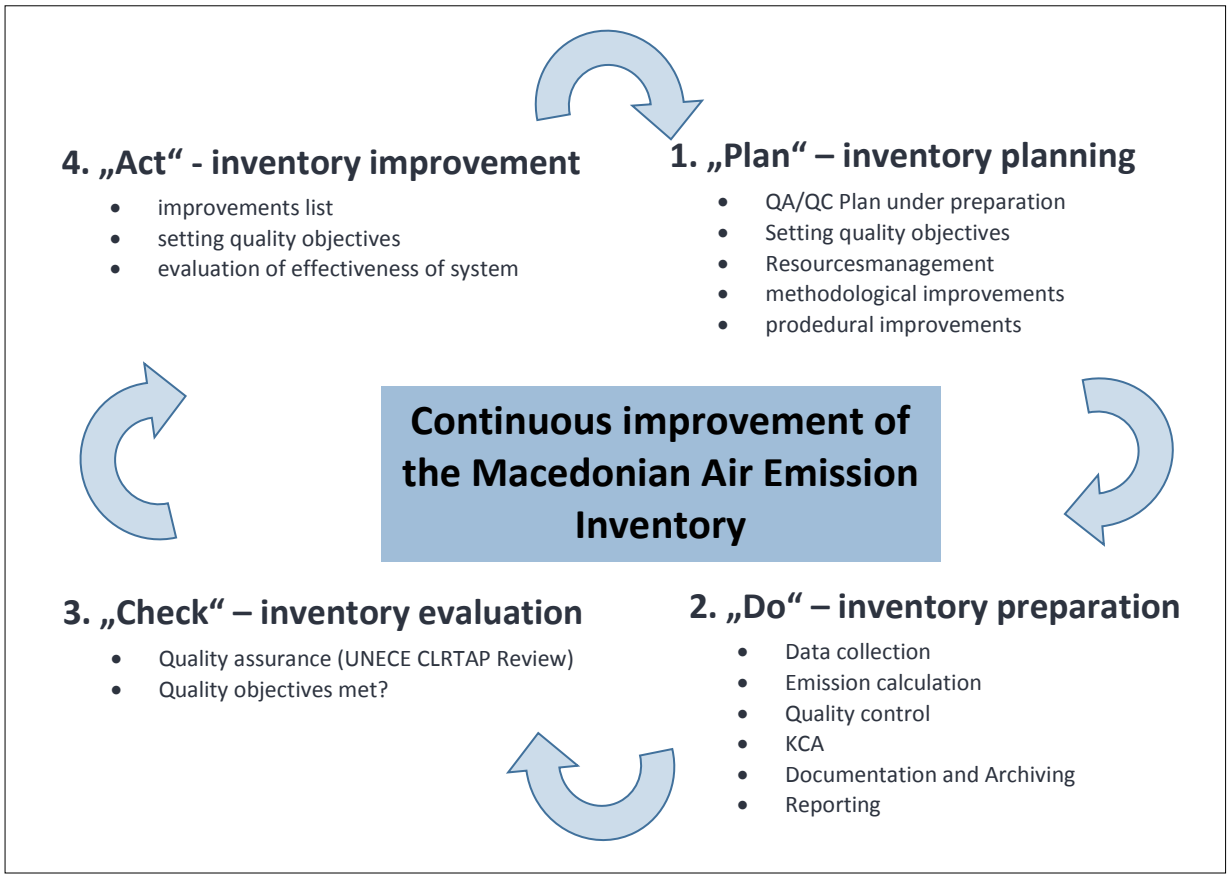

Figure 5 Improvement Cycle

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, prioritization, and timeline for implementation of the measures as well as a documentation field for the status of implementation (“finished”).

During an internal inventory team meeting the improvements needed are discussed and prioritized based on KCA and UCA results.

2.7. General uncertainty evaluation

For this year’s IIR, for the first time, an uncertainty assessment of the main pollutants (SO_2, NO_x, NMVOC, NH_3 and$PM_{2.5}$) has been carried out. The assessment was carried out for the base year 1990 and for the year 2015.

The method for the assessment of uncertainty is described in the “EMEP/EEA air pollutant emission inventory guidebook 2016” (EEA 2016)”. For the Macedonian uncertainty analysis, the Tier 1 method was implemented for the main pollutants. By using the error propagation method, the uncertainties

for a specific source category can be estimated. By combining these uncertainties an overall uncertainty can be calculated. In order to estimate the overall uncertainty per pollutant, an uncertainty value for each activity data and emission factor in every sector had to be estimated. This assessment was based on guidance stated in Table 32 for activity and Table 33 for emission factors.

Table 31 Rating definitions for emission factors

Data source	Error range
The national (official) statistics	-
An update of last year's statistics, using gross economic growth factors	0-2%
IEA energy statistics	OECD: 2-3% non-OECD: 5-10%
UN data bases	5-10%
Default values, other sectors and data sources	30-100%

Source: Table 3-1 Rating definitions, Chapter 5 of the EMEP/EEA emission inventory guidebook 2016.

Table 32 Rating definitions for emission factors

Rating	Definition	Typical Error Range
A	An estimate based on a large number of measurements made at a large number of facilities that fully represent the sector	10 to 30%
B	An estimate based on a large number of measurements made at a large number of facilities that represent a large part of the sector	20 to 60%
C	An estimate based on a number of measurements made at a small number of representative facilities, or an engineering judgement based on a number of relevant facts	50 to 200%
D	An estimate based on single measurements, or an engineering calculation derived from a number of relevant facts	100 to 300%
E	An estimate based on an engineering calculation derived from assumptions only	order of magnitude

Source: Table 3-2 Rating definitions, Chapter 5 of the EMEP/EEA emission inventory guidebook 2016.

2.7.1. Results

The quantitative assessment was performed with the Tier 1 method for the pollutants SO_2, NO_x, NMVOC, NH_3 and $PM_{2.5}$, for the year 2015 and the respective level and trend uncertainties. The results of the uncertainty analysis are presented in following tables.

Table 33 Result of overall uncertainty estimation for the main pollutants SO_2, NO_x, NMVOC, NH_3 and $PM_{2.5}$

Pollutants	Emissions 2015	Level uncertainty 2015	Trend uncertainty 1990 - 2015
SO_2	76,4 kt	18,8%	4,6%
NO_X	27,6 kt	14,7%	3,7%
NMVOC	28,8 kt	31,3%	13,2%
NH_3	10,5 kt	98,3%	23,5%
$PM_{2.5}$	18,9 kt	73,3%	18,1%

A more detailed presentation of the uncertainties on sectoral level is given in the following tables below.

Table 34 Uncertainty estimation of SO_2 emissions 1990 and 2015.

Member State:	MK												
Reporting year:	2017												
NRF sector	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions	Comments (optional)
		Mg	Mg	%	%	%	%	%	%	%	%	%	
	SO2	Input data	Input data	input data Note A	input data Note A	(E^2+F^2)^(1/2)	(G*D)^2/Summe(D)^2	Note B	D/Summe(C)	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2	
1 A 1 a	SO2	102.1	69.5	5.0	20.0	20.62	351.70	-0.01	0.63	-0.26	4.47	20.04	
1 A 1 b	SO2	0.8	NO	5.0	20.0	20.62							
1 A 2 a	SO2	1.4	5.0	10.0	20.0	22.36	2.16	0.04	0.05	0.74	0.65	0.96	
1 A 2 b	SO2	2.1	0.0	10.0	20.0	22.36	0.00	-0.01	0.00	-0.26	0.00	0.07	
1 A 2 c	SO2	0.0	0.0	10.0	20.0	22.36	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 2 d	SO2	0.3	0.0	10.0	20.0	22.36	0.00	0.00	0.00	-0.04	0.00	0.00	
1 A 2 e	SO2	0.2	0.0	10.0	20.0	22.36	0.00	0.00	0.00	-0.02	0.00	0.00	
1 A 2 g 8	SO2	0.7	0.6	10.0	20.0	22.36	0.03	0.00	0.01	0.03	0.08	0.01	
1 A 3 a	SO2	0.0	0.0	10.0	20.0	22.36	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 3 b	SO2	0.7	0.6	10.0	20.0	22.36	0.03	0.00	0.01	0.03	0.08	0.01	
1 A 3 d	SO2	0.0	0.0	10.0	20.0	22.36	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 4 a	SO2	0.2	0.2	10.0	20.0	22.36	0.00	0.00	0.00	0.02	0.03	0.00	
1 A 4 b	SO2	0.4	0.3	20.0	20.0	28.28	0.01	0.00	0.00	0.00	0.07	0.00	
1 A 4 c	SO2	0.2	0.1	10.0	20.0	22.36	0.00	0.00	0.00	-0.02	0.01	0.00	
1 B 2 a	SO2	0.8	-	10.0	20.0	22.36	0.00	0.00	0.00	-0.10	0.00	0.01	
1 B 2 c	SO2	0.0	NO	20.0	20.0	28.28							
5 C	SO2	0.0	0.0	10.0	200.0	200.25	0.00	0.00	0.00	0.00	0.00	0.00	
Total Uncertainties						Uncertainty in total inventory %:	**18.81**				Trend uncertainty %:	**4.59**	

Table 35 Uncertainty estimation of NO_x emissions 1990 and 2015

Member State:	MK												
Reporting year:	2017												
NRF sector	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions	Comments (optional)
		Mg	Mg	%	%	%	%	%	%	%	%	%	
	NOX	Input data	Input data	input data Note A	input data Note A	(E^2+F^2)^(1/2)	(G*D)^2/Summe(D)^2	Note B	D/Summe(C)	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2	
1 A 1 a	NOX	23.8	16.4	5.0	20.0	20.62	150.00	0.03	0.37	0.69	2.63	7.38	
1 A 1 b	NOX	0.3	NO	5.0	20.0	20.62							
1 A 2 a	NOX	1.8	1.7	10.0	40.0	41.23	6.28	0.01	0.04	0.48	0.54	0.52	
1 A 2 b	NOX	0.7	0.0	10.0	40.0	41.23	0.00	-0.01	0.00	-0.39	0.01	0.15	
1 A 2 c	NOX	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 2 d	NOX	0.1	0.0	10.0	40.0	41.23	0.00	0.00	0.00	-0.03	0.00	0.00	
1 A 2 e	NOX	0.9	0.4	10.0	40.0	41.23	0.34	0.00	0.01	-0.13	0.13	0.03	
1 A 2 g 7	NOX	3.7	1.0	10.0	40.0	41.23	2.42	-0.03	0.02	-1.16	0.33	1.47	
1 A 2 g 8	NOX	1.1	1.0	10.0	40.0	41.23	2.39	0.01	0.02	0.34	0.33	0.22	
1 A 3 a	NOX	0.3	0.4	10.0	40.0	41.23	0.37	0.00	0.01	0.19	0.13	0.05	
1 A 3 b	NOX	8.9	4.7	10.0	40.0	41.23	50.00	-0.02	0.11	-0.74	1.52	2.85	
1 A 3 c	NOX	0.4	0.1	10.0	40.0	41.23	0.02	0.00	0.00	-0.13	0.03	0.02	
1 A 3 d	NOX	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 4 a	NOX	0.1	0.2	10.0	40.0	41.23	0.09	0.00	0.00	0.15	0.06	0.03	
1 A 4 b	NOX	0.8	0.8	20.0	40.0	44.72	1.49	0.01	0.02	0.21	0.48	0.28	
1 A 4 c	NOX	0.5	0.3	10.0	40.0	41.23	0.16	0.00	0.01	-0.03	0.09	0.01	
1 B 2 a	NOX	0.3	-	10.0	40.0	41.23	0.00	0.00	0.00	-0.17	0.00	0.03	
1 B 2 c	NOX	0.0	NO	20.0	40.0	44.72							
2 G	NOX	0.0	0.0	20.0	40.0	44.72	0.00	0.00	0.00	-0.01	0.01	0.00	
3 B 1	NOX	0.0	0.0	5.3	40.0	40.35	0.00	0.00	0.00	0.01	0.01	0.00	
3 B 2	NOX	0.0	0.0	10.2	40.0	41.28	0.00	0.00	0.00	0.00	0.00	0.00	
3 B 3	NOX	0.0	0.0	6.1	40.0	40.46	0.00	0.00	0.00	0.00	0.00	0.00	
3 B 4	NOX	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	-0.01	0.00	0.00	
3 D a	NOX	0.3	0.4	50.0	40.0	64.03	0.98	0.01	0.01	0.23	0.68	0.52	
5 C	NOX	0.1	0.0	10.0	200.0	200.25	0.10	0.00	0.00	0.04	0.01	0.00	
Total Uncertainties						Uncertainty in total inventory %:	**14.65**				Trend uncertainty %:	**3.68**	

Table 36: Uncertainty estimation of NMVOC emissions 1990 and 2015.

Member State:	MK												
Reporting year:	2017												
NRF sector	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions	Comments (optional)
		Mg	Mg	%	%	%	%	%	%	%	%	%	
	NMVOC	Input data	Input data	input data Note A	input data Note A	(E^2+F^2)^(1/2)	(G*D)^2/Summe(D)^2	Note B	D/Summe(C)	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2	
1 A 1 a	NMVOC	0.1	0.1	5.0	200.0	200.06	0.22	0.00	0.00	0.06	0.01	0.00	
1 A 1 b	NMVOC	0.0	NO	5.0	200.0	200.06							
1 A 2 a	NMVOC	0.2	0.5	10.0	200.0	200.25	14.08	0.01	0.01	1.72	0.16	2.99	
1 A 2 b	NMVOC	0.2	0.0	10.0	200.0	200.25	0.00	0.00	0.00	-0.53	0.00	0.28	
1 A 2 c	NMVOC	0.0	0.0	10.0	200.0	200.25	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 2 d	NMVOC	0.0	0.0	10.0	200.0	200.25	0.00	0.00	0.00	-0.07	0.00	0.00	
1 A 2 e	NMVOC	0.1	0.1	10.0	200.0	200.25	0.19	0.00	0.00	0.12	0.02	0.01	
1 A 2 g 7	NMVOC	0.4	0.1	10.0	40.0	41.23	0.02	0.00	0.00	-0.10	0.03	0.01	
1 A 2 g 8	NMVOC	0.1	0.1	10.0	40.0	41.23	0.03	0.00	0.00	0.05	0.03	0.00	
1 A 3 a	NMVOC	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 3 b	NMVOC	14.8	2.4	10.0	40.0	41.23	11.75	-0.13	0.05	-5.16	0.69	27.06	
1 A 3 c	NMVOC	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	-0.01	0.00	0.00	
1 A 3 d	NMVOC	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 4 a	NMVOC	0.0	0.1	10.0	40.0	41.23	0.01	0.00	0.00	0.03	0.01	0.00	
1 A 4 b	NMVOC	10.5	9.2	20.0	40.0	44.72	206.17	0.06	0.19	2.51	5.35	34.95	
1 A 4 c	NMVOC	0.1	0.0	10.0	40.0	41.23	0.00	0.00	0.00	-0.01	0.01	0.00	
1 B 1 a	NMVOC	1.3	1.2	10.0	20.0	22.36	0.85	0.01	0.02	0.16	0.34	0.14	
1 B 2 a	NMVOC	1.4	1.4	10.0	20.0	22.36	1.10	0.01	0.03	0.21	0.39	0.20	
1 B 2 c	NMVOC	0.0	NO	20.0	20.0	28.28							
2 A 3	NMVOC	0.0	NO	10.0	40.0	41.23							
2 C 1	NMVOC	0.1	0.1	2.0	125.0	125.02	0.09	0.00	0.00	-0.02	0.00	0.00	
2 D	NMVOC	10.3	4.6	20.0	125.0	126.59	415.74	-0.03	0.09	-3.69	2.69	20.81	
2 G	NMVOC	0.5	0.3	20.0	40.0	44.72	0.18	0.00	0.01	-0.03	0.16	0.03	
2 H	NMVOC	1.2	0.6	20.0	40.0	44.72	0.88	0.00	0.01	-0.09	0.35	0.13	
3 B 1	NMVOC	2.6	2.4	5.3	40.0	40.35	11.51	0.02	0.05	0.71	0.37	0.65	
3 B 2	NMVOC	0.4	0.1	10.2	40.0	41.28	0.03	0.00	0.00	-0.09	0.04	0.01	
3 B 3	NMVOC	0.1	0.1	6.1	40.0	40.46	0.03	0.00	0.00	0.05	0.02	0.00	
3 B 4	NMVOC	1.6	0.5	10.0	40.0	41.23	0.46	-0.01	0.01	-0.40	0.14	0.18	
3 D a	NMVOC	1.1	1.1	50.0	40.0	64.03	5.84	0.01	0.02	0.34	1.57	2.59	
5 A	NMVOC	1.5	3.8	50.0	125.0	134.63	311.28	0.06	0.08	7.40	5.46	84.66	
5 C	NMVOC	0.0	0.0	10.0	125.0	125.40	0.01	0.00	0.00	0.01	0.00	0.00	
Total Uncertainties						Uncertainty in total inventory %:	31.31				Trend uncertainty %:	13.22	

Table 37 Uncertainty estimation of NH_3 emissions 1990 and 2015

Member State:	MK												
Reporting year:	2017												
NRF sector	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions	Comments (optional)
		Mg	Mg	%	%	%	%	%	%	%	%	%	
	NH3	Input data	Input data	input data Note A	input data Note A	(E^2+F^2)^(1/2)	(G*D)^2/Summe(D)^2	Note B	D/Summe(C)	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2	
1 A 2 g 7	NH3	0.0	0.0	10.0	125.0	125.40	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 3 b	NH3	-	0.1	10.0	125.0	125.40	1.43	0.01	0.01	0.79	0.09	0.63	
1 A 3 c	NH3	0.0	0.0	10.0	125.0	125.40	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 4 b	NH3	1.1	1.0	20.0	125.0	126.59	146.42	0.02	0.06	2.12	1.79	7.69	
1 A 4 c	NH3	0.0	0.0	10.0	125.0	125.40	0.00	0.00	0.00	0.00	0.00	0.00	
1 B 2 a	NH3	0.0		10.0	40.0	41.23	0.00	0.00	0.00	0.00	0.00	0.00	
2 A 3	NH3	0.0	NO	10.0	40.0	41.23							
3 B 1	NH3	3.1	2.9	5.3	125.0	125.11	1,198.04	0.05	0.18	6.67	1.38	46.33	
3 B 2	NH3	0.9	0.3	10.2	125.0	125.42	12.32	-0.02	0.02	-2.50	0.27	6.31	
3 B 3	NH3	0.8	0.9	6.1	125.0	125.15	111.89	0.02	0.06	2.63	0.48	7.13	
3 B 4	NH3	2.4	0.7	10.0	125.0	125.40	66.38	-0.06	0.04	-7.18	0.61	51.93	
3 D a	NH3	7.3	4.6	50.0	200.0	206.16	8,129.82	-0.02	0.29	-3.49	20.51	432.99	
Total Uncertainties						Uncertainty in total inventory %:	98.32				Trend uncertainty %:	23.52	

Table 38 Uncertainty estimation of $PM_{2.5}$ emissions 1990 and 2015

Member State:	MK												
Reporting year:	2017												
NRF sector	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions	Comments (optional)
		Mg	Mg	%	%	%	%	%	%	%	%	%	
	PM2.5	Input data	Input data	input data Note A	input data Note A	(E^2+F^2)^(1/2)	(G*D)^2/Summe(D)^2	Note B	D/Summe(C)	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2	
1 A 1 a	PM2.5	3.5	2.4	5.0	125.0	125.10	248.86	0.01	0.07	1.34	0.52	2.07	
1 A 1 b	PM2.5	0.0	NO	5.0	40.0	40.31							
1 A 2 a	PM2.5	0.2	0.6	10.0	40.0	41.23	1.85	0.02	0.02	0.62	0.27	0.45	
1 A 2 b	PM2.5	0.3	0.0	10.0	40.0	41.23	0.00	0.00	0.00	-0.19	0.00	0.03	
1 A 2 c	PM2.5	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 2 d	PM2.5	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	-0.03	0.00	0.00	
1 A 2 e	PM2.5	0.1	0.0	10.0	40.0	41.23	0.01	0.00	0.00	0.00	0.01	0.00	
1 A 2 g 7	PM2.5	0.2	0.1	10.0	125.0	125.40	0.19	0.00	0.00	-0.27	0.03	0.08	
1 A 2 g 8	PM2.5	0.1	0.1	10.0	125.0	125.40	0.29	0.00	0.00	0.16	0.04	0.03	
1 A 3 a	PM2.5	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 3 b	PM2.5	0.0	0.3	10.0	40.0	41.23	0.32	0.01	0.01	0.29	0.11	0.10	
1 A 3 c	PM2.5	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 3 d	PM2.5	0.0	0.0	10.0	40.0	41.23	0.00	0.00	0.00	0.00	0.00	0.00	
1 A 4 a	PM2.5	0.0	0.1	10.0	125.0	125.40	0.17	0.00	0.00	0.19	0.03	0.04	
1 A 4 b	PM2.5	11.8	10.6	20.0	125.0	126.59	5,054.01	0.12	0.33	14.42	9.23	293.12	
1 A 4 c	PM2.5	0.0	0.0	10.0	125.0	125.40	0.02	0.00	0.00	-0.02	0.01	0.00	
1 B 1 a	PM2.5	0.0	0.0	10.0	200.0	200.25	0.14	0.00	0.00	0.08	0.02	0.01	
1 B 2 a	PM2.5	0.0	-	10.0	200.0	200.25	0.00	0.00	0.00	-0.02	0.00	0.00	
2 A 1	PM2.5	0.1	0.0	2.0	200.0	200.01	0.04	0.00	0.00	-0.11	0.00	0.01	
2 A 2	PM2.5	0.0	0.0	5.0	200.0	200.06	0.00	0.00	0.00	-0.06	0.00	0.00	
2 A 3	PM2.5	0.0	NO	10.0	200.0	200.25							
2 A 5	PM2.5	0.0	0.0	10.0	200.0	200.25	0.18	0.00	0.00	0.08	0.02	0.01	
2 C 1	PM2.5	0.1	0.1	2.0	40.0	40.05	0.02	0.00	0.00	-0.01	0.01	0.00	
2 C 2	PM2.5	14.7	4.0	5.0	40.0	40.31	71.59	-0.14	0.12	-5.62	0.86	32.37	
2 C 3	PM2.5	0.0	0.0	2.0	40.0	40.05	0.00	0.00	0.00	0.00	0.00	0.00	
2 C 5	PM2.5	0.0	NE	5.0	40.0	40.31							
2 C 6	PM2.5	0.0	NO	5.0	40.0	40.31							
2 D	PM2.5	0.0	0.1	20.0	40.0	44.72	0.08	0.00	0.00	0.13	0.11	0.03	
2 G	PM2.5	0.7	0.2	20.0	40.0	44.72	0.28	-0.01	0.01	-0.24	0.19	0.09	
3 B 1	PM2.5	0.1	0.1	5.3	200.0	200.07	0.62	0.00	0.00	0.17	0.02	0.03	
3 B 2	PM2.5	0.0	0.0	10.2	200.0	200.26	0.02	0.00	0.00	-0.06	0.01	0.00	
3 B 3	PM2.5	0.0	0.0	6.1	200.0	200.09	0.02	0.00	0.00	0.04	0.00	0.00	
3 B 4	PM2.5	0.1	0.0	10.0	200.0	200.25	0.18	0.00	0.00	-0.27	0.02	0.07	
3 D a	PM2.5	0.1	0.1	50.0	200.0	206.16	0.69	0.00	0.00	0.18	0.17	0.06	
5 A	PM2.5	0.0	0.0	50.0	200.0	206.16	0.00	0.00	0.00	0.00	0.00	0.00	
5 C	PM2.5	0.1	0.1	10.0	200.0	200.25	0.33	0.00	0.00	0.08	0.02	0.01	
Total Uncertainties						Uncertainty in total inventory %:	**73.35**				Trend uncertainty %:	**18.13**	

2.7.2. Background information

ENERGY

For the calculation of the energy balance, the methodology ''Energy Statistics Methodology, Eurostat F4, 1998'' is used. The Energy balance is prepared in accordance with Regulation No 1099/2008 on energy statistics.

Energy balance 2016

The data for the whole year 2015 and nine months of 2016, the quantity of fuels (electricity, natural gas, oil and petroleum products and coal) has been taken from the State Statistical Office (SSO).

In the preparation of the balance of network energy (electricity and gas), for the year 2017 and the last four months of 2016, predictions and forecasts of consumption and losses in the systems were used. The data was obtained from the operators and anticipated needs of large customers, as well as forecasts for production of electricity generators.

The data for crude oil and petroleum products, and coal (coke, lignite and coal) was obtained from manufacturers, importers of energy (traders and/or large consumers).

Households

The estimates in the survey on energy consumption in households during 2014, are generally in the form of totals and averages. The scope of estimation is the total number of households in Republic of Macedonia divided between the eight statistical regions. The estimation procedures of SECH data were performed by weighting the probabilities of a sample selection, with a certain adjustment for non-response to the survey and calibrating the weight, according to population estimates from the regional demographic distributions by sex and five-year age groups, as well as the estimated number of

households in the regions. Calculations were performed in SAS 9.1 using the CALMAR module for calibrating weights. The non-response rate in SECH 2014 is 6.5% and the refusal rate is 3.6%. Because of calculations of the sample and rounding up calculated results to one number, sometimes deviations are possible in the total of the results, obtained by summing up individual items. The survey results effect the activity data on biomass consumption for 2015 within the energy balance.

Transport

Data sources for road transport statistics are the regular monthly and annual reports submitted by business entities, whose main activity according to National Classification of Activities is road transport. Data on the number of registered road motor vehicles, type of vehicles and year of production, vehicle by type of fuel, road traffic accidents and data on cross-border traffic of passengers and vehicles, are taken from the Ministry of Internal Affairs. Data on road network are taken from the Agency for State Roads, while the data on local road network are obtained from the units of local self-government (municipalities). Regular cross-border passenger traffic is performed on the basis of regular international travel documents for passengers and vehicles, without restriction on final destination. Small-scale border traffic of passengers is performed on the basis of bilateral agreements with neighboring countries, only in areas covered by the agreements.

Industry

The State Statistical Office of the Republic of Macedonia, in cooperation with the regional statistical offices, has collected data included in this chapter from the existing records of the enterprises and their units distributed in the field of industry. This data is covered in the Monthly Industrial Report and the Annual Industrial Report. The data from the Monthly Industrial Report are the basis for calculating the indices of the production, stocks and the employees. The data on the industrial production in natural indicators are collected by the Annual Industrial Report. The coverage goes until 1999 in the Monthly Industrial Report and until 1998 in the Annual Industrial Report; data on industry were collected according to the Uniform Classification of Economic Activities (UCEA); since 1999 and 2001 in the Annual Industrial Report and the Monthly Industrial Report, respectively, data are collected according to the National Classification of Activities NKD Rev.1. In 2010, in the Annual Industrial Report for 2009, the National Classification of Activities NKD Rev.2 and the National Nomenclature of Industrial Products NNIP 2008, were implemented. All business entities with 10 and more employees in main, auxiliary or supporting manufacturing activities are included.

Agriculture

The estimates in the Livestock Survey are in the forms of totals and ratios. The domain of estimates is the whole country and the eight regions. Sample selection weights were used in the estimation procedures of the 2015 Livestock Survey, with certain adjustments made regarding the survey non-response rate. The errors are calculated as relative errors. All calculations were made with the SAS statistical software package. The non-response rate in the Livestock Survey 2015 was 5.3%. The following table shows the calculated relative errors of the main categories of livestock in the survey for 2015.

Table 39 Relative errors of livestock survey 2015

Relative errors	Cattle	Pigs	Sheep	Poultry	Goats
Republic of Macedonia	5.3	6.1	10.2	7.7	9.4

WASTE

Municipal waste is waste collected by, or on behalf of municipal authorities. It consists of waste from the households, including the massive waste, similar waste from commercial and trade industries, official buildings, institutions and small business, waste from gardens, street waste, the content of waste containers and the waste from market cleaning. The definition excludes waste from the municipal sewage networks, and the waste from construction and demolition. The data presented here were obtained through the regular annual statistical survey on municipal waste, which was carried out in 2009 (reference year 2008) for the first time, in accordance with the national legislation and European standards. Reporting units are the municipal enterprises in Republic of Macedonia. Data on the total amount of collected municipal waste, as well as data on the treatment of collected municipal waste, have been obtained on the basis of the reports filled in by the reporting units. On the basis of the obtained data and the data on the number of population, an estimation has been made of the total generated municipal waste on the territory of the Republic of Macedonia. The obtained indicator of the annual amount of municipal waste per person in kg is a ratio of the total annual amount of generated municipal waste and the total population estimated for the reference year (as at 01.01. in the reference year).

2.8. General assessment of completeness

Notation keys are used according to the revised 2014 Reporting guidelines (ECE/EB.AIR.125) (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 2009/2013/2016 .

Table 40 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 provide in the IIR 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.

2.8.1. Sources not estimated (NE)

Table 41 Number of "not estimated" (NE) per sector and pollutant in 2015

Gas	Energy	Fugitives	IPPU	Agriculture	Waste	Other
NOx(as NO_2)	**5**	**1**	**1**	**1**	**1**	**1**
NMVOC	**5**	**1**	**1**	**1**	**1**	**1**
SOx(as SO_2)	**6**	**1**	**1**	**1**	**1**	**1**
NH_3	**7**	**1**	**1**	**1**	**1**	**1**
PM2.5	**6**	**1**	**1**	**1**	**1**	**1**
PM10	**6**	**1**	**1**	**1**	**1**	**1**
TSP	**5**	**1**	**1**	**1**	**1**	**1**
CO	**11**	**1**	**1**	**1**	**1**	**1**
Pb	**5**	**1**	**1**	**1**	**1**	**1**
Cd	**5**	**1**	**1**	**1**	**1**	**1**
Hg	**5**	**1**	**1**	**1**	**1**	**1**
As	**5**	**1**	**1**	**1**	**1**	**1**
Cr	**6**	**1**	**1**	**1**	**1**	**1**
Cu	**5**	**1**	**1**	**1**	**1**	**1**
Ni	**5**	**1**	**1**	**1**	**1**	**1**
Se	**5**	**1**	**1**	**1**	**1**	**1**
Zn	**5**	**1**	**1**	**1**	**1**	**1**
PCDD/ PCDF	**5**	**1**	**1**	**1**	**1**	**1**

Gas	Energy	Fugitives	IPPU	Agriculture	Waste	Other
PAHs	**5**	**1**	**1**	**1**	**1**	**1**
HCB	**6**	**1**	**1**	**1**	**1**	**1**
PCBs	**6**	**1**	**1**	**1**	**1**	**1**
Reasons for NE	**lack of activity data or lack of default emission factors in the EMEP/EEA Guidebook**					
Plans how to report in future	Please refer to Table 214					

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 within the statistical yearbooks over the years or the fact that there are no available emission factors in the EMEP/EEA Guidebooks.

2.8.2. Sources included elsewhere (IE)

Table 42 Number of "included elsewhere" (IE) per sector and pollutant in 2015

Gas	Energy	Fugitives	IPPU	Agriculture	Waste	Other
NOx(as NO_2)	**0**	**0**	**0**	**3**	**0**	**0**
NMVOC	**0**	**0**	**0**	**3**	**0**	**0**
SOx (as SO_2)	**0**	**0**	**0**	**1**	**0**	**0**
NH_3	**0**	**0**	**0**	**1**	**0**	**0**
PM2.5	**0**	**0**	**0**	**1**	**0**	**0**
PM10	**0**	**0**	**0**	**1**	**0**	**0**
TSP	**0**	**0**	**0**	**1**	**0**	**0**
CO	**0**	**0**	**0**	**0**	**0**	**0**
Pb	**0**	**0**	**0**	**0**	**0**	**0**
Cd	**0**	**0**	**0**	**0**	**0**	**0**
Hg	**0**	**0**	**0**	**0**	**0**	**0**
As	**0**	**0**	**0**	**0**	**0**	**0**
Cr	**0**	**0**	**0**	**0**	**0**	**0**
Cu	**0**	**0**	**0**	**0**	**0**	**0**
Ni	**0**	**0**	**0**	**0**	**0**	**0**
Se	**0**	**0**	**0**	**0**	**0**	**0**
Zn	**0**	**0**	**0**	**0**	**0**	**0**
PCDD/ PCDF	**0**	**0**	**0**	**0**	**0**	**0**
PAHs	**0**	**0**	**0**	**0**	**0**	**0**
HCB	**0**	**0**	**0**	**0**	**0**	**0**
PCBs	**0**	**0**	**0**	**0**	**0**	**0**
Reasons for IE	**lack of detailed activity data**					
Plans how to report in future	Please refer to Table 214					

The notation key "included elsewhere" (IE) is used in those source categories for which activity data are not available in the required details in the statistical yearbooks but have been included in other source categories.

For both categories, MEPP has already made list of responsible institutions for data collection and will organize separate meetings with them during this year, in order to reduce the use of the NE and IE notation keys and make the national inventory more complete. Emissions in the following NFR sectors 1A5b, 1B2D, 5D, 3Da2 and 3Da3 that have not been included last year, are included in this reporting round.

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 1990-2015 are presented in the following table.

Table 43 Emission trends 1990 – 2015 for the main air pollutants and CO

Year	Emission in kt				
	NO_x	NMVOC	SO_2	NH_3	CO
1990	44,14	48,86	109,97	15,80	132,39
1991	36,30	42,71	89,23	14,83	111,52
1992	38,03	44,70	86,34	14,94	123,43
1993	39,44	46,49	88,93	15,26	133,29
1994	35,37	41,44	88,99	15,20	120,85
1995	38,02	44,04	95,10	14,99	125,23
1996	35,98	43,72	89,05	13,95	123,08
1997	36,83	44,82	93,01	13,53	126,30
1998	41,35	44,61	107,84	13,23	129,33
1999	39,15	45,49	98,37	13,41	132,43
2000	42,60	47,64	106,55	13,49	145,00
2001	39,58	40,04	108,52	12,74	113,22
2002	38,48	39,05	97,78	12,12	114,85
2003	34,38	38,72	95,56	12,06	116,43
2004	36,20	39,10	96,64	12,16	121,51
2005	37,10	37,63	97,35	11,58	114,89
2006	36,87	39,42	94,54	12,00	118,58
2007	39,82	39,69	99,69	11,64	113,71
2008	38,88	43,39	101,45	11,79	125,76
2009	39,14	43,81	96,39	11,10	134,49
2010	38,36	36,45	91,26	11,34	115,09
2011	40,78	39,01	102,02	11,68	121,20
2012	40,27	38,49	96,65	10,85	115,81
2013	38,39	36,98	83,06	10,65	102,89
2014	29,47	34,08	83,59	10,90	96,78
2015	27,61	28,81	76,41	10,66	82,02
Trend 1990-2015	-14%	-41,04%	-30,52%	-32,54%	-38,05%

3.1.1. NOx emissions

Emission trend

In 1990 national total NOx emissions amounted to 44 kt. Since then, the emissions decreased by 14% and in 2015 emissions were on the level of about 27,61 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 1.A.1.a 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 months, and the decrease of coal consumption up to 60%. 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. For the period 2014 to 2015 emissions are quite stable (- 6%).

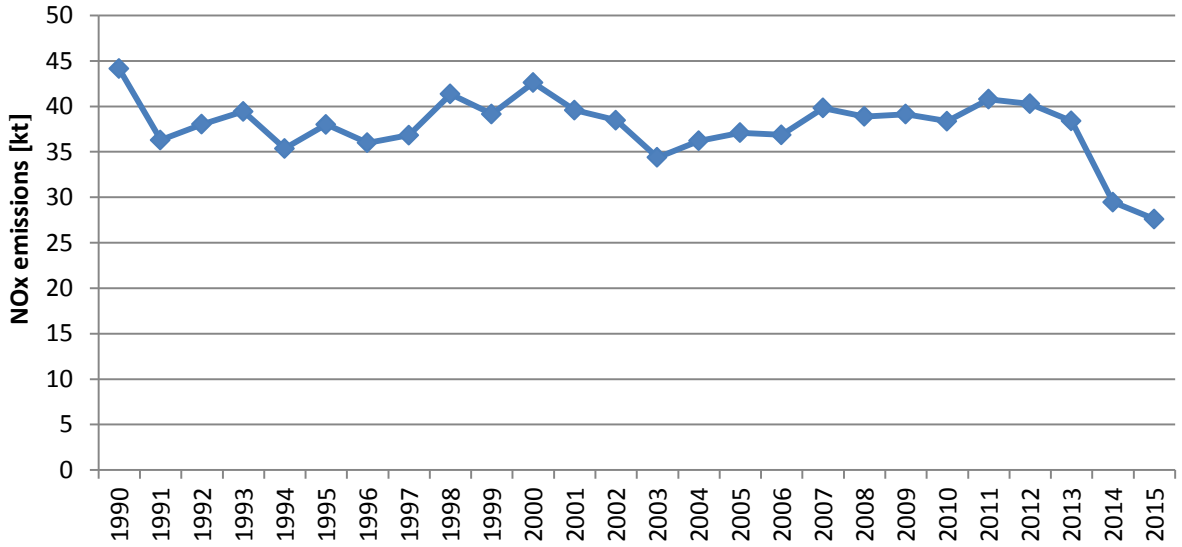

Figure 6 National total NOx emissions 1990-2015

The target value for NOx according to Gothenburg Protocol for the year 2010 is 39 kt. Republic of Macedonia met that target value in 2013, and starting from this year the emissions trend is decreasing. The country is in compliance with the Protocol in controlling the nitrogen oxides or their trans-boundary fluxes. Meaning that NOx emissions in 2015 are less than the NOx emissions reported for 1987.

Main emission sources in Macedonia

Almost all NOx emissions are coming from the sector Energy, where the major sources of total emissions changed compared to 1990, due to growing importance of NFR sector 1.A.3 Transport. The main emission sources in 2015 are NFR source categories 1.A.3 Transport and 1.A.1 Energy Industries, which contributed with 19% (22% in 1990) and 59% (55% in 1990) respectively, of the national total NOx emissions. From NFR source category 1.A.2 Manufacturing Industries also 15% (19% in 1990) of total NOx emissions are stemming.

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

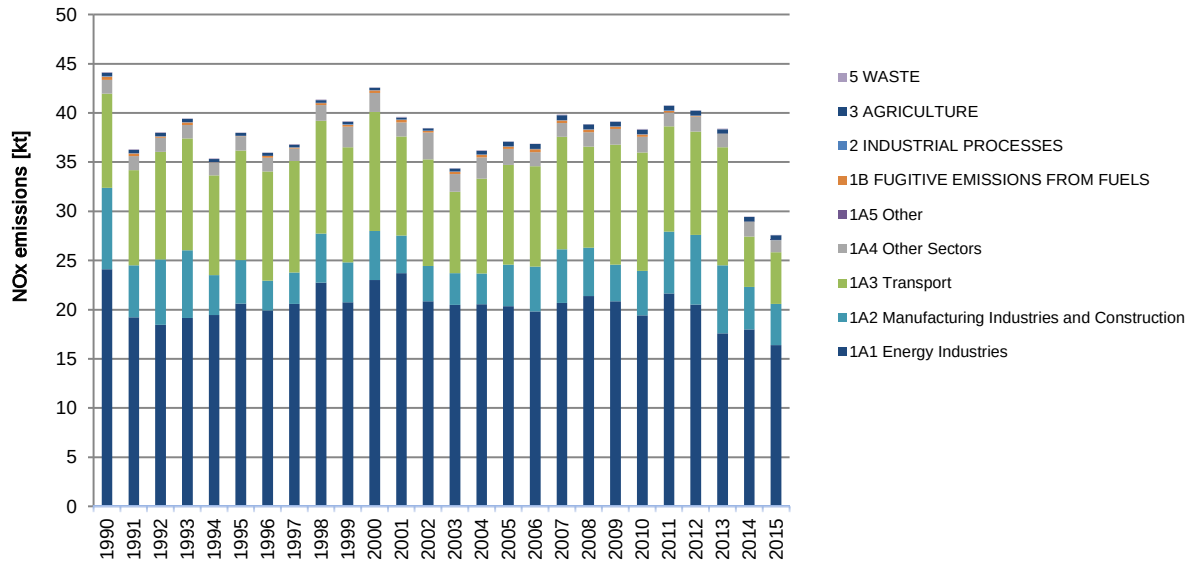

Figure 7 NOx emissions in Macedonia 1990-2015 by sectors

3.1.2. NMVOC emissions

Emission trend

In 1990 national total NMVOC emissions amounted to about 49 kt. Emissions were down by 41% compared to 2015 and amounted to around 29 kt. Reasons for the decrease are mainly due to declining emissions from Transport and Solvent Use. From 2014 to 2015 emissions decreased by 15%, also due to a reduced use of solvents as well as slightly lower emissions from the residential sector.

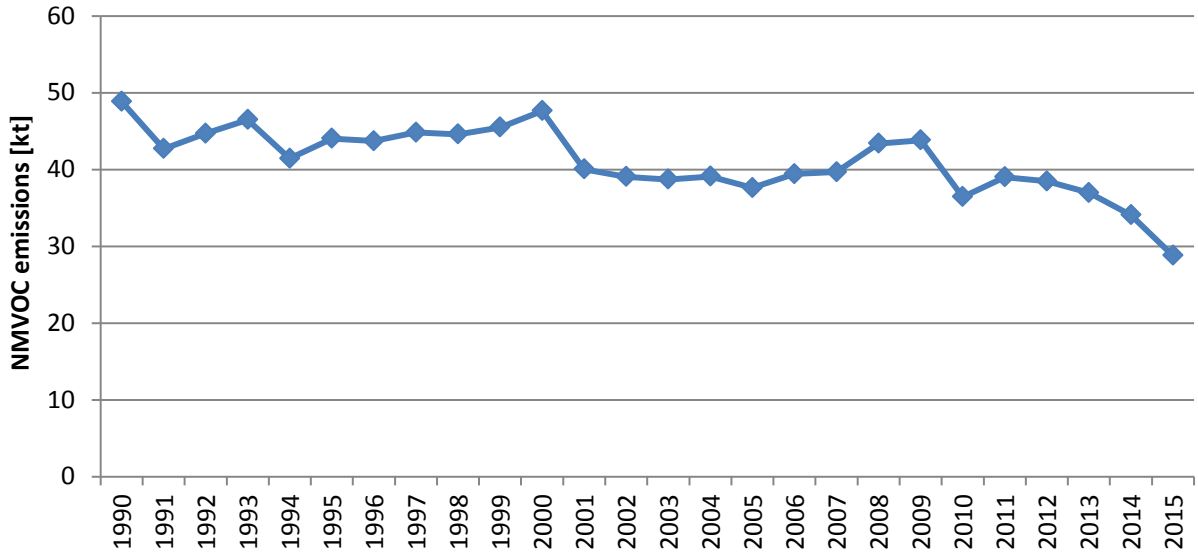

Figure 8 National total NMVOC emissions 1990-2015

Target value for NMVOC according to Gothenburg Protocol for year 2010 is 30 kt NMVOC. Emissions in 2015 are below the target value. The country is also 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 reduced by more 30% in 2015.

Main emission sources in Macedonia

NMVOC emissions are emitted from different source. The key category source in 2015 are NFR source categories 1.A.4 Other Sectors (mainly residential heating) which contributed with 31% (23% in 1990), to the national total NMVOC emissions. From NFR source category 1.A.3 Transport, 19% (31% in 1990) of total NMVOC emissions are stemming. Waste, Agriculture, Industry including solvent use are contributing with around 13%, 15% and 19%, respectively, while fugitive emissions and transport with around 8%.

NFR sectors 1.A.1.a, 1.A.1.b and 1.A.5.b are minor sources of NMVOC emissions.

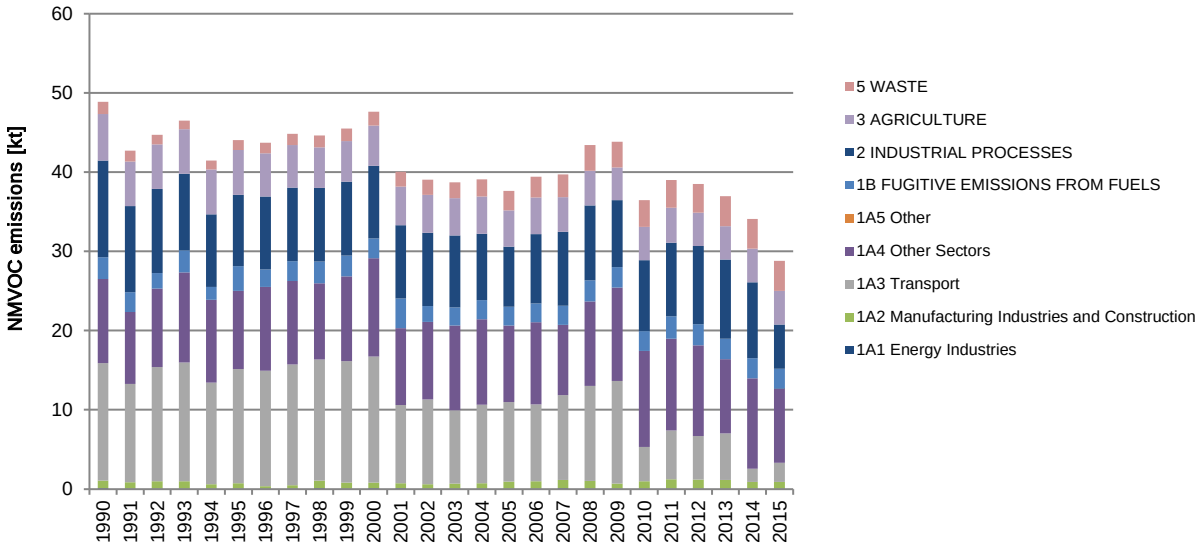

Figure 9 NMVOC emissions in Macedonia 1990-2015 by sectors

3.1.3. SO_2 emissions

Emission trend

In 1990 national total SO_2 emissions amounted to 110 kt. 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, the decrease of emissions is due to the lower capacity of work of the second by capacity power plant REK Oslomej (from 12 to 5 months), and decrease of coal consumption up to 60%. Lower SO_2 emissions in 2013 compared to 2012 are result to modernization of the boilers in the major power plant REK Bitola. From 2014 to 2015 emissions are reduced (- 8,59%) due to the reduced consumption of coal and heavy fuel oil in the power plants, and reduced emissions coming from consumption of fuels for households heating.

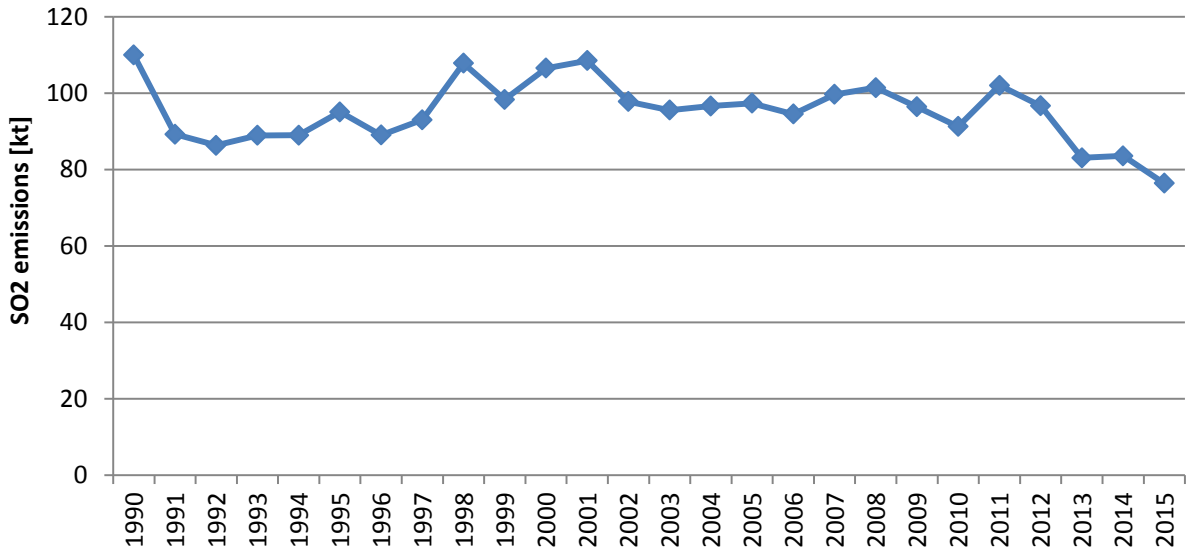

Figure 10 National total SO_2 emissions 1990-2015

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

The country is in non-compliance with the 1985 Protocol on reduction of sulfur emissions, or their transboundary transmission by at least 30 percent, due to the fact that emissions since 1980 have not been reduced by 30% up to now. Due to the fact that the major source of this pollutant is power production, compliance with the oldest protocol on sulfur is expected to be achieved with installation of a desulfurization unit in the Power plant REK Bitola. According to the agreement with Energy community, the compliance with SOx emission limit values, which will also mean compliance with the protocol, should be reached with implementation of desulfurization unit which is currently planned to be implemented by the end of the year according to NERP (which was in April this year) adopted by the Government.

Main emission sources in Macedonia

Almost all SO_2 emissions are resulting from Energy sector. So, the main emission source in 2015 is NFR source category 1.A.1 Energy Industries (Public electricity and heat production), which contributed with 91% (94% in 1990) to the national total SO_2 emissions. About 7% (4% in 1990) of total emissions are stemming from NFR source category 1.A.2 Manufacturing Industries.

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

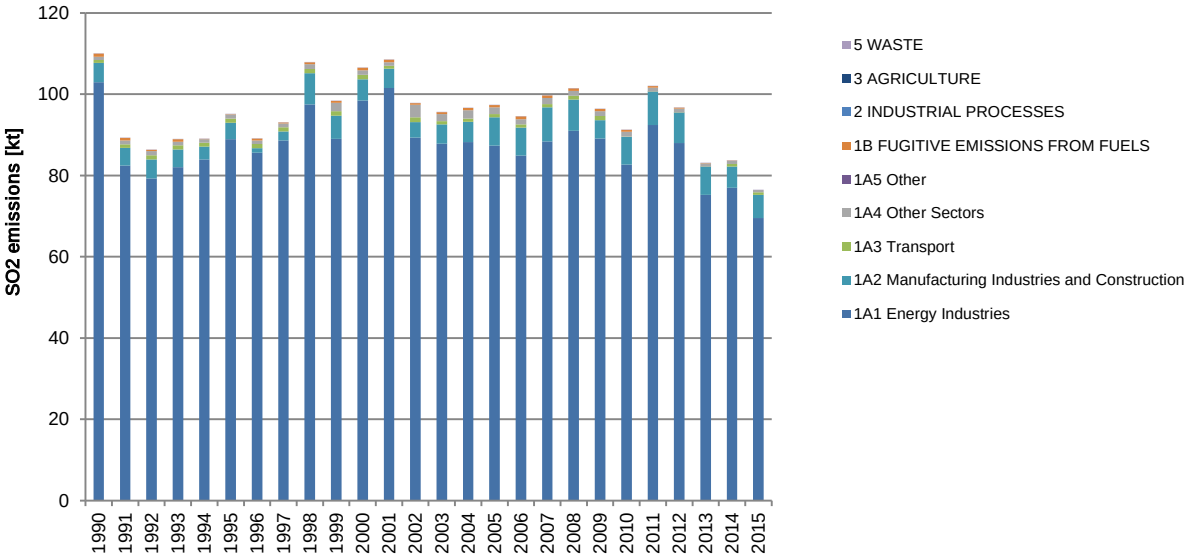

Figure 11 SO_2 emissions in Macedonia 1990 – 2015 by sectors

3.1.4. NH_3 emissions

Emission trend

In 1990 national total NH_3 emissions, amounted to 15 kt. Emissions were down by 36% compared to 2015 and amounted to 10,66 kt. Reasons for the decline are mainly decreasing emissions from Agriculture (Manure Management) related to decreasing livestock numbers. From 2014 to 2015 emissions slightly decreased by 2%.

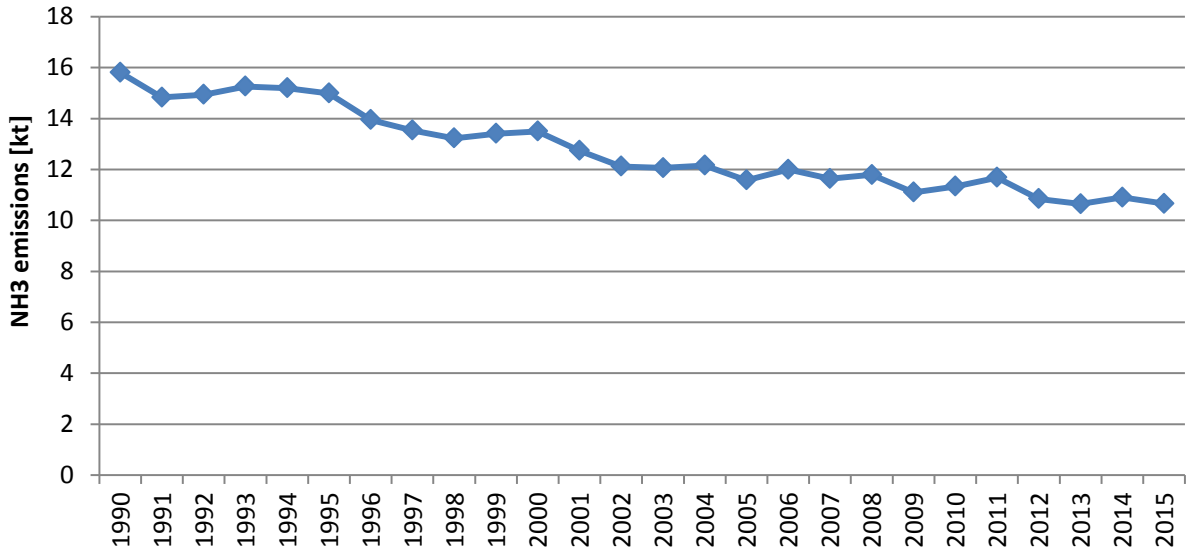

Figure 12 National total NH_3 emissions 1990-2015

Emissions of NH_3 are well below the respective ceiling. Emissions in 2015 were 11% 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 87,66% (92% in 1990) to national total NH_3 emissions. Within Agriculture sector NH_3 is almost exclusively emitted by source category 3.B Manure Management (51% in 2014) and emissions from cattle have the highest contribution (31,03%).

About 9,40% (7% in 1990) of the total emissions are stemming from NFR source category 1.A.4 Other Sectors (residential heating).

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

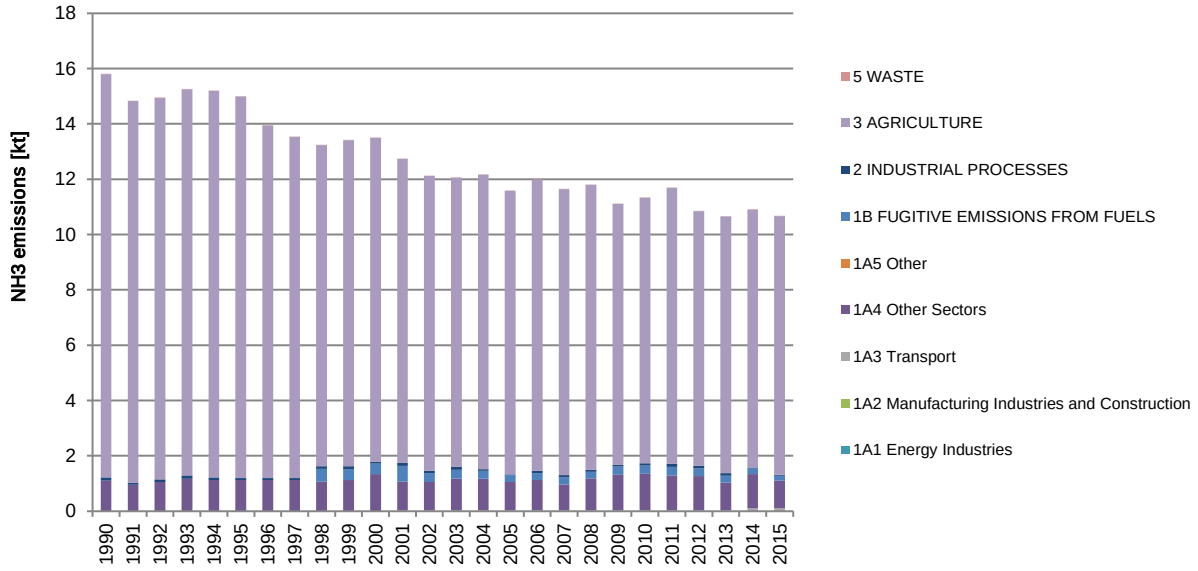

Figure 13 NH_3 emissions in Macedonia 1990-2015 by sectors

3.1.5. CO emissions

Emission trend

In 1990 the national total CO emissions amounted to 132,39 kt. The decrease in 2001, compared to 2000, is attributed to lower fuel consumption in 1.A.4 sector. Emissions decreased by 38,05% compared to 2015 and amounted to 132,39 kt. The reason for the decrease is mainly due to declining emissions from the Transport sector (road transport). From 2014 to 2015 emissions decreased by 15,25% mainly due to lower wood consumption in the residential heating, due to the fact that there is trend of decreased use of biomass and solid fuel, while the consumption of natural gas and pellets is increased, especially in the last few years.

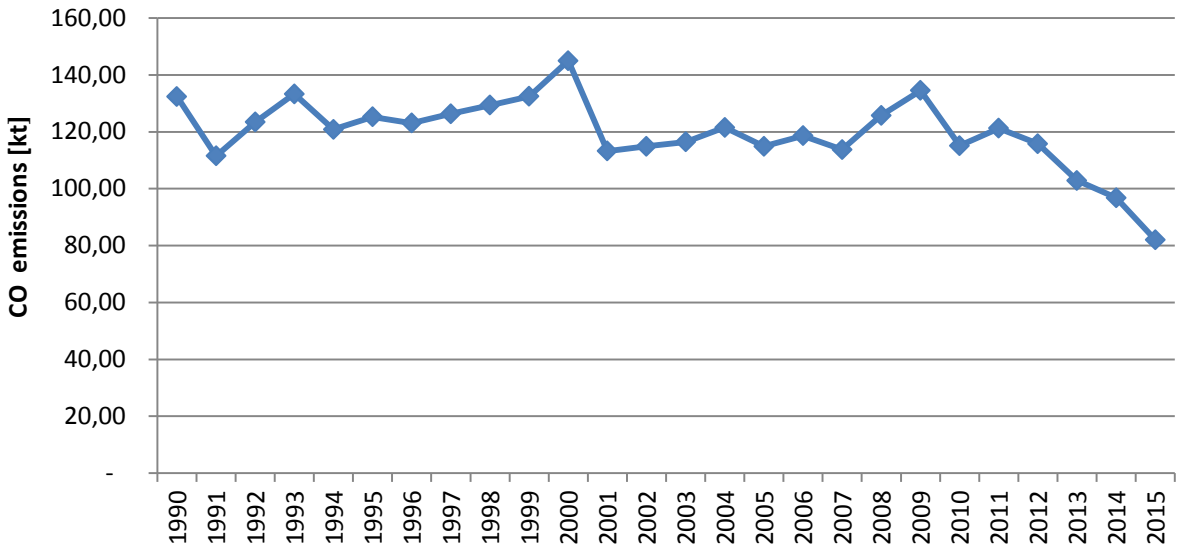

Figure 14 National total CO emissions 1990-2015

Main emission sources in Macedonia

Almost all CO emissions are resulting from the Energy sector. So, the main emission sources in 2015 are NFR sectors 1.A.4 Other Sectors (residential heating) and 1.A.3 Transport, contributing with 72,58% (51% in 1990) and 13,29% (39% in 1990) to the national total CO emissions. Further smaller emission sources in 2015 are 1.A.2 Manufacturing Industries, 5 Waste and 1.A1 Energy Industries with shares of 7,56%, 3,15% and 2,33%, respectively.

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

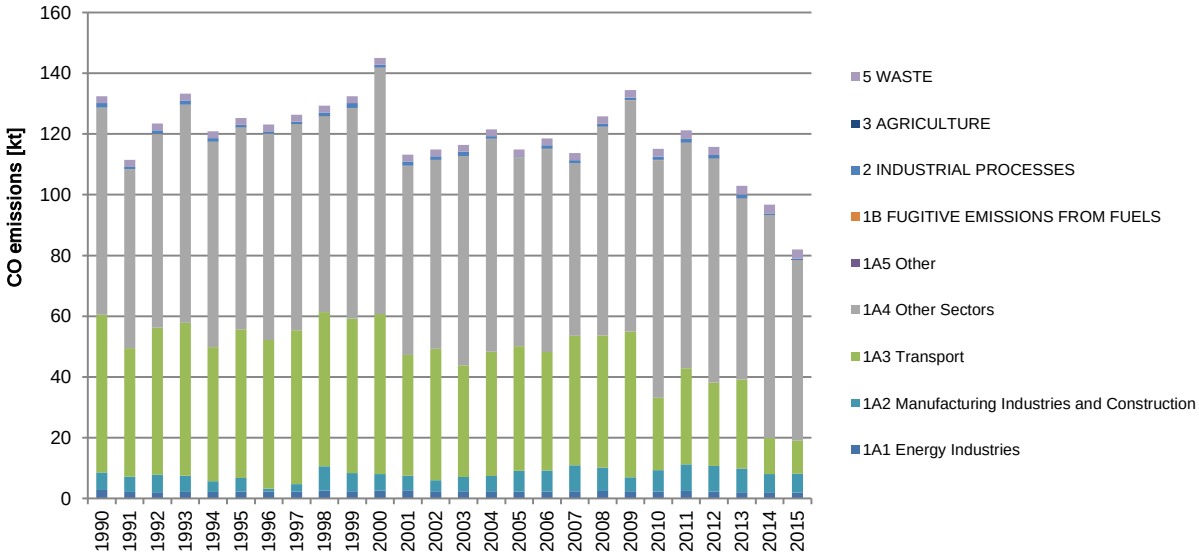

Figure 15 CO emissions in Macedonia 1990-2015 by sectors

3.2. Emission Trends for Particulate Matter

Particulate Matter emissions in Macedonia mainly originate 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 44 Emission trends for particulate matter 1990-2015

Year	Emissions			
	PM10 [kt]	PM2.5[kt]	TSP [kt]	BC [kt]
1990	32,49	48,01	57,36	2,96
1991	28,46	42,11	49,97	2,59
1992	34,76	50,35	59,03	3,26
1993	31,12	44,77	52,51	2,89
1994	29,10	42,38	49,95	2,62
1995	29,36	42,98	50,86	2,65
1996	32,21	46,92	55,55	2,97
1997	31,29	45,55	53,50	2,83
1998	35,66	52,02	61,71	3,25
1999	31,00	44,93	53,49	2,80
2000	29,89	43,42	53,79	2,68
2001	18,12	27,53	33,92	1,43
2002	18,69	28,02	33,96	1,64
2003	28,96	41,84	49,94	2,58
2004	31,50	45,57	54,68	2,84
2005	28,17	41,48	50,59	2,56
2006	27,18	39,48	47,60	2,41
2007	21,38	31,67	38,64	1,83
2008	25,00	36,21	44,52	2,17
2009	19,79	28,38	36,00	1,69
2010	24,33	34,56	43,01	2,15
2011	28,92	41,79	52,95	2,56
2012	27,61	39,96	50,24	2,48
2013	27,12	39,88	50,61	2,46
2014	23,82	34,40	42,85	2,12
2015	18,89	28,00	35,16	1,65
Trend 1990–2015	***-41,69%***	***-41,86%***	***-38,70%***	***-44,15%***

3.2.1. PM10 emissions

Emission trend

In 1990, national total PM10 emissions amounted to 48 kt. Emissions decreased by 41,69% compared to 2015, and were at the level of 23,8 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 Ferrosilicon 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 biomass consumption from residential heating. The ferroalloys production has decreased due to the fact that the installation producing ferrosilicon has worked with limited capacity starting at the end of 2014 and during 2015, due to the fact that this installation did not fulfill the obligation in the IPPC license for installation of filter for reduction of dust emissions. Furthermore

BAT for dust emission reduction have been installed in the installation for ferronickel production in 2013.

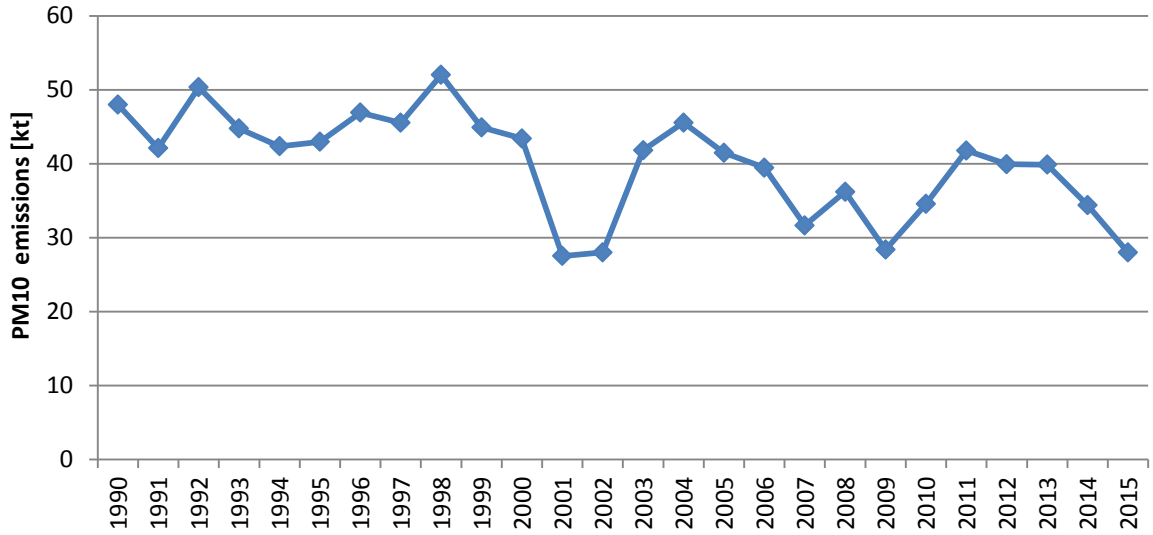

Figure 16 National total PM10 emissions 1990-2015

Main emission sources in Macedonia

The main emission sources for PM10 in 2015 are NFR sectors 1.A.4 Other Sectors (residential heating), with a share of 39% (25% in 1990) in total PM10 emissions, 2 Industrial Processes and Product Use (mainly 2C2 Ferroalloys Production) with 26% (47% in 1990) and 1A1 Energy Industries with 21% (18% in 1990). With a share of 7% in 2015(9% 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.

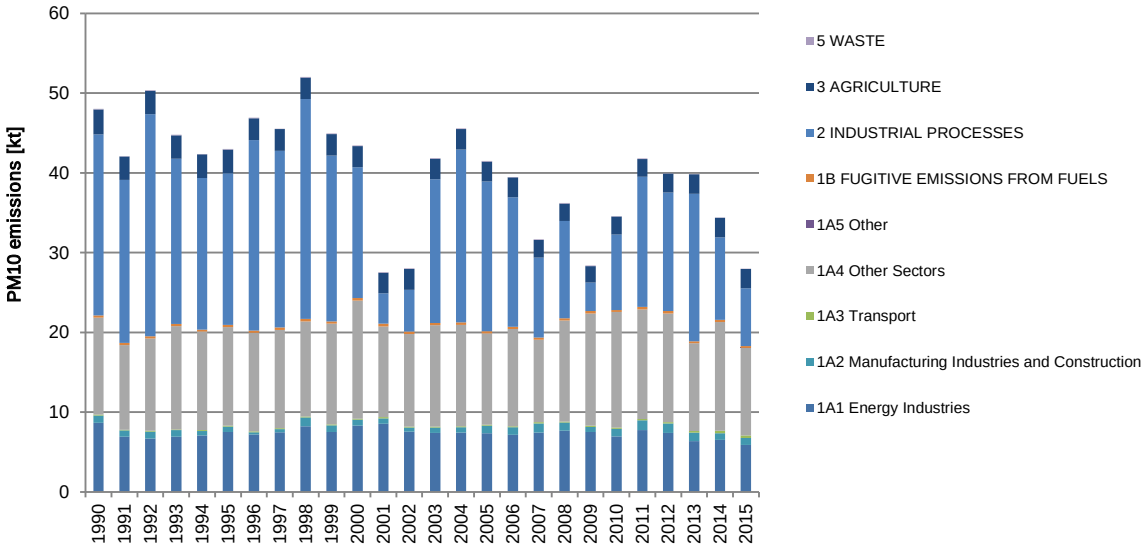

Figure 17 PM10 emissions in Macedonia 1990-2015by sectors

3.2.2. PM2.5 emissions

Emission trend

In 1990, national total PM2.5 emissions amounted to 32 kt. Emissions decreased by 42% compared to 2015 and amounted to 19 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.

The reasons for decreasing trend in the last three years is due to the reasons explained in the subchapter for PM10.

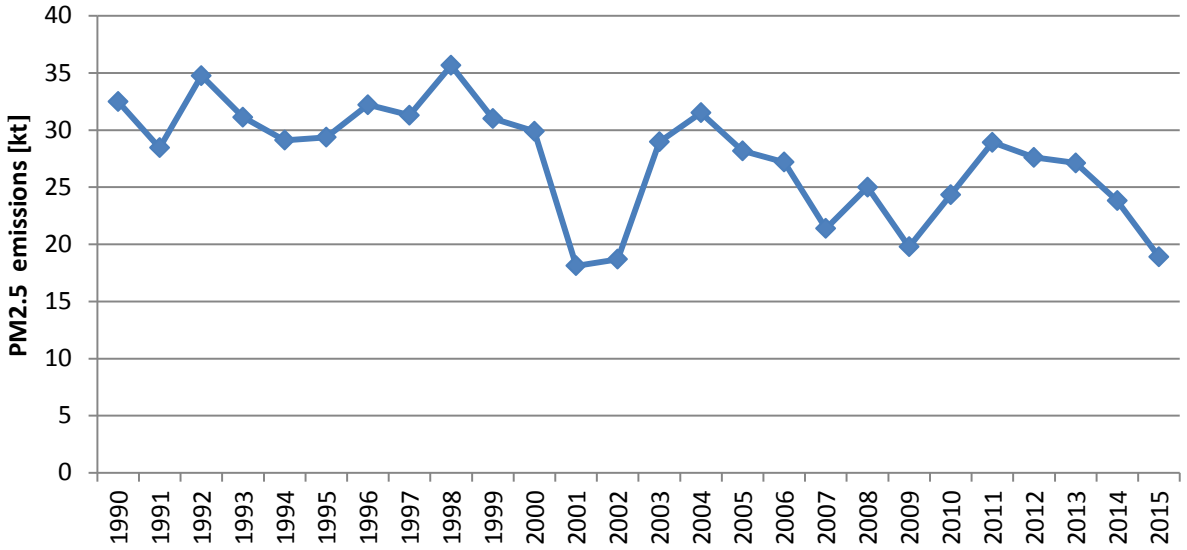

Figure 18 National total PM2.5 emissions 1990-2015

Main emission sources in Macedonia

Same as for PM10, the main emission sources for PM2.5 in 2015 are NFR sectors 1.A.4 Other Sectors (residential heating) with a share of 57% (36% in 1990) in total PM10 emissions, 2 Industrial Processes and Product Use (mainly 2.C.2 Ferroalloys Production) with 24% (48% in 1990) and 1A1 Energy Industries with 13% (11% in 1990).

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

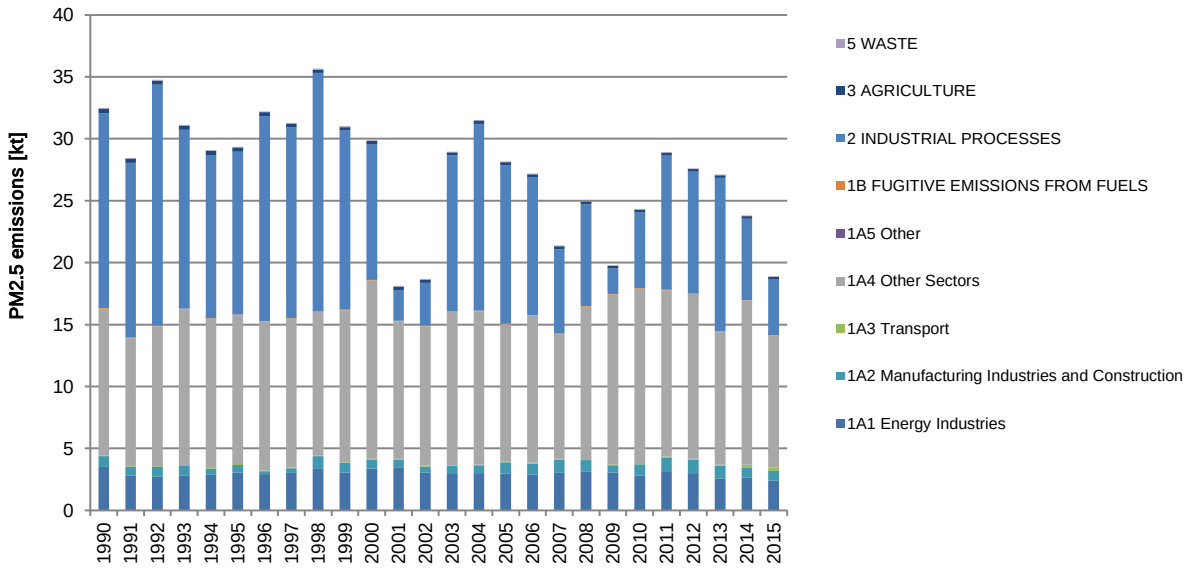

Figure 19 PM2.5 emissions in Macedonia 1990-2015 by sectors

3.2.3. TSP emissions

Emission trend

In 1990, national total TSP emissions amounted to about 43 kt. Emissions decreased by 39% compared to 2015 and amounted to about 35 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 for low emissions from Ferroalloys Production is 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.

The reasons for decreasing trend in the last three years is due to the reasons explained in the subchapter for PM10.

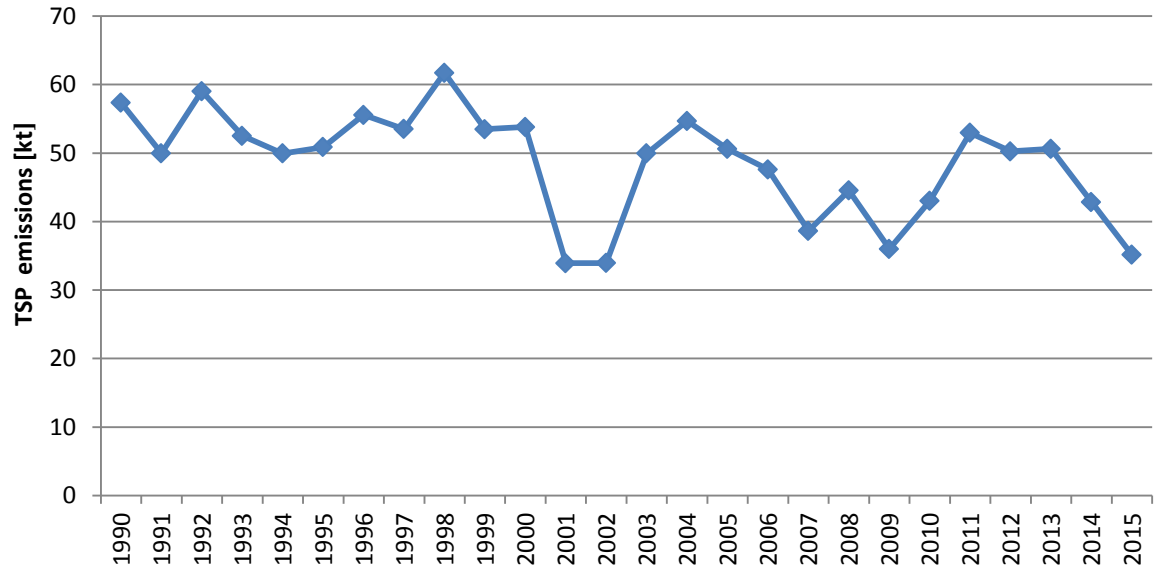

Figure 20 National total TSP emissions 1990-2015

Main emission sources in Macedonia

The main emission sources for TSP in 2015 are NFR sectors 2 Industrial Processes and Other Product Use (mainly NFR sector 2C2 Ferroalloys Production) with a share of 35% (50% in 1990) in total TSP emissions, 1.A.4 Other Sectors (residential heating) with 33% (22% in 1990) and 1.A.1 Energy Industries with 25% (22% in 1990).

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

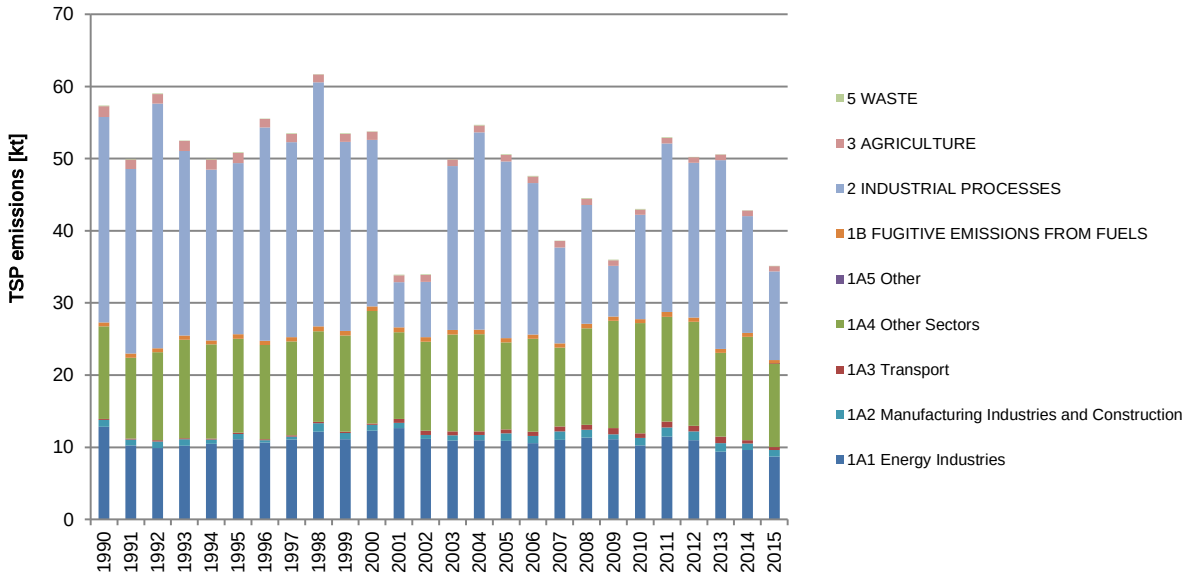

Figure 21 TSP emissions in Macedonia 1990-2015 by sectors

3.2.4. BC emissions

Emission trend

The calculations on black carbon emissions have been introduced for the first time. Default emission factors given in the EMEP/EEA Guidebook have been used for NFR sectors. In 1990, national total BC emissions amounted to about 3 kt. Emissions decreased by 44% compared to 2015 and amounted to about 1,7 kt. The main reason for the decrease is due to a decline of emissions of PM2.5. The trend has similar pathway as that one for PM due the fact that for BC emissions are calculated as given contribution in PM2.5 expressed in %.

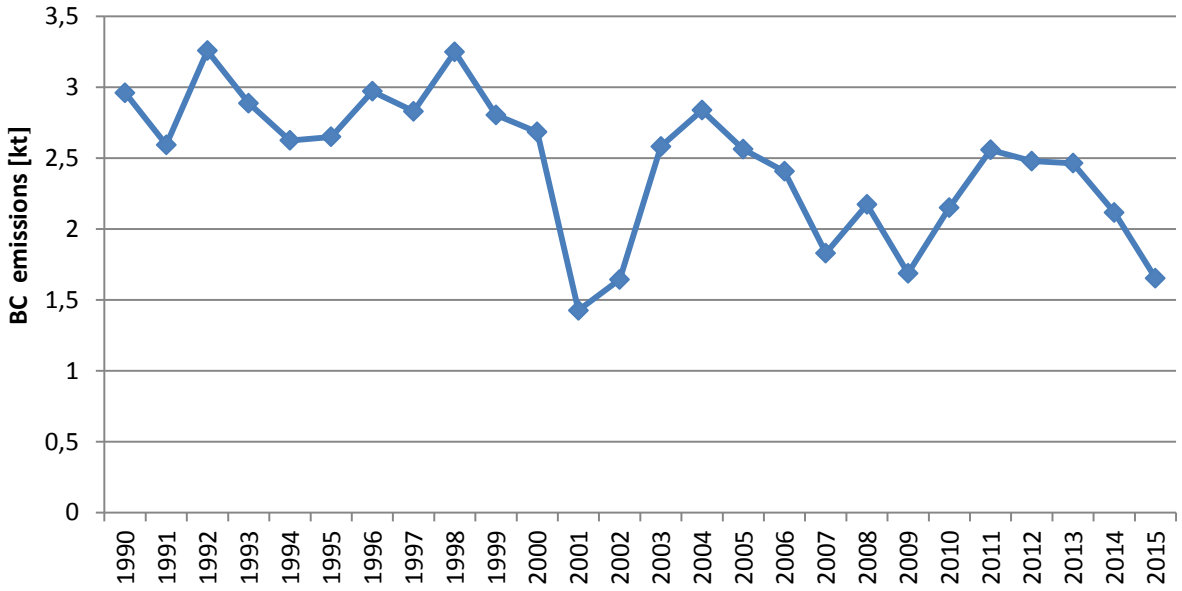

Figure 22 National total BC emissions 1990-2015

Main emission sources in Macedonia

As expected, the main emission sources for BC are those for PM2.5. In 2015 the NFR sectors 1A4 Other Sectors (residential heating) contribute with a share of 66% (40% in 1990) in total PM10 emissions, 2 Industrial Processes and Product Use (mainly 2C2 Ferroalloys Production) with 25% (50% in 1990) and 1A2Energy Industries with 8 % both in 1990 and 2015.

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

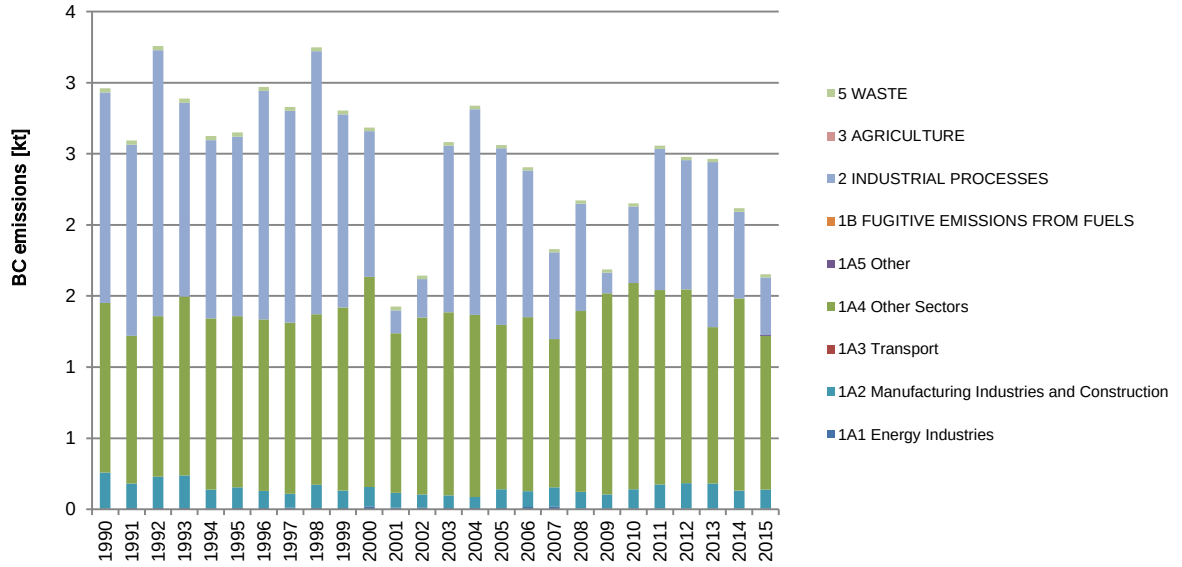

Figure 22 BC emissions in Macedonia 1990-2015 by sectors

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 45 Emission trends for heavy metals 1990-2015

Year	Emissions		
	Cd [kt]	Pb [kt]	Hg [kt]
1990	0,38	109,39	0,62
1991	0,35	86,77	0,57
1992	0,33	96,84	0,52
1993	0,30	91,17	0,50
1994	0,27	87,60	0,42
1995	0,36	95,60	0,44
1996	0,41	95,97	0,49
1997	0,32	99,61	0,52
1998	0,36	102,06	0,59
1999	0,31	97,70	0,53
2000	0,31	100,20	0,54
2001	0,31	96,38	0,56
2002	0,31	103,55	0,59
2003	0,23	95,15	0,44
2004	0,23	25,97	0,43
2005	0,16	23,34	0,31
2006	0,16	8,18	0,31
2007	0,17	8,89	0,33
2008	0,17	6,24	0,32
2009	0,16	5,57	0,29
2010	0,16	6,20	0,30
2011	0,18	6,90	0,34
2012	0,16	5,41	0,30
2013	0,14	4,14	0,25
2014	0,15	4,84	0,26
2015	0,14	4,61	0,25
Trend 1990–2015	***-64,70%***	***-95,79%***	***-59,56%***

Republic of Macedonia in 2015 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

Emission trend

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 1990-2015. The most important reductions could be observed in sectors 1.A/3 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.

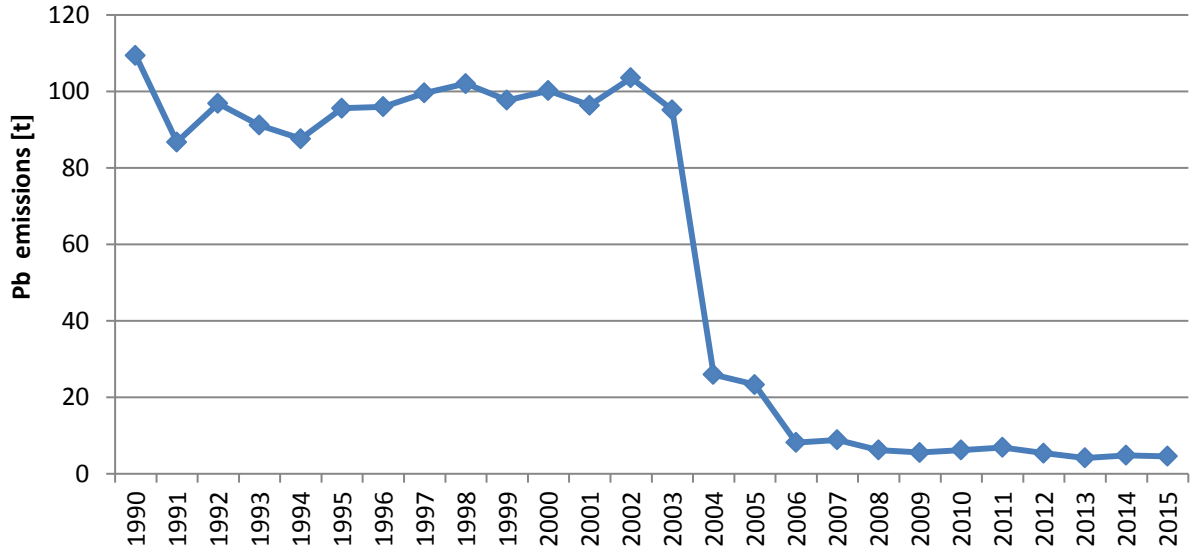

Figure 234 National total Pb emissions 1990-2015

Main emission sources in Macedonia

The most important emission sources of Pb in 2015 are NFR sectors 2 Industrial Processes and Product Use and 1 Energy with shares in national total emissions of 52% and 13% in 1A1a, 18% in 1.A.2 and 16% in 1.A/4. In 1990 the situation was different, where the key sector was use of leaded petrol in transport sector which led to contribution of NFR 1.A.3 with 84%. While the energy sector, meaning 1.A.1, 1.A.2 and 1.A.4 contribute with around 1 %. Within NFR sector 2 Industrial Processes and Product Use, all Pb emissions result from 2.C Metal Production (2.C.1 Iron and Steel Production) with a share of 14% in 1990 and 52% in 2015, due to the fact that leaded petrol was eliminated in 2004. The reduction of 96% compare to 1990 is due to the elimination of the use of leaded petrol. However, due to the fact that EF used for calculation of Pb emissions up to 2004 are not documented, there is a high uncertainty of estimation of lead emissions in 1.A.3 transport, so these emissions should be recalculated with the use of COPERT model.

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

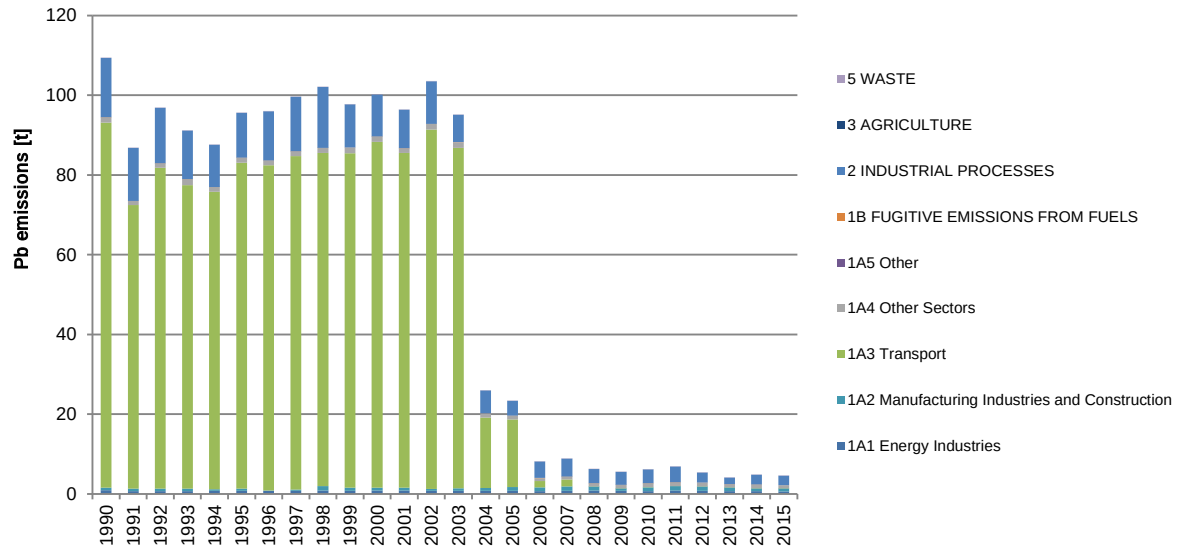

Figure 245 Pb emissions in Macedonia 1990-2015by sectors

3.3.2. Cadmium (Cd) emissions

Emission trend

National total Cd emissions amounted to 0.38t in 1990; emissions have decreased steadily and in the year 2015 emissions were estimated to be 0,14 t, which means they were down by 68% compared to 1990-. 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 2014 and 2015, emissions slightly decreased by 7% mainly due to lower fugitive emissions (NFR sector 1B).

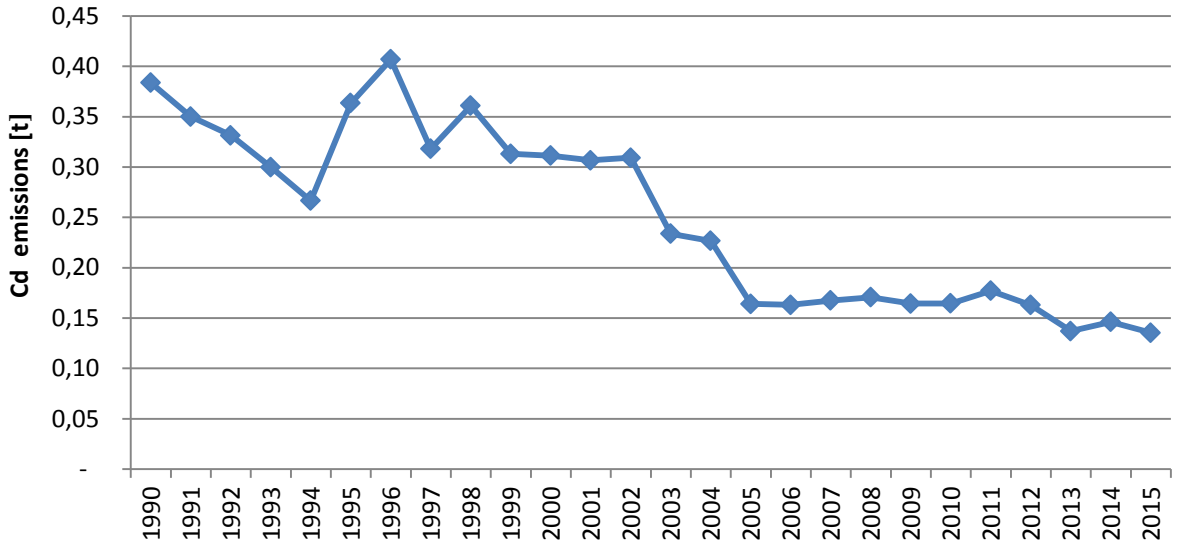

Figure 256 National total Cd emissions 1990-2014

Main emission sources in Macedonia

The most important emission source in 2015 of Cd is NFR sector 1 Energy. Within the Energy sector the main contributors in 2015 are 1.A.1 Energy Industries, with a share of 54% (29% in 1990), 1A4 Other Sectors Energy with 16% (6% in 1990) and 1.A.2 Manufacturing Industries with 10% (2%), in the

national total emissions. NFR category 2 Industrial Processes and Product use, is also contributing with 11% (60%) to the national total Cadmium emissions.

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

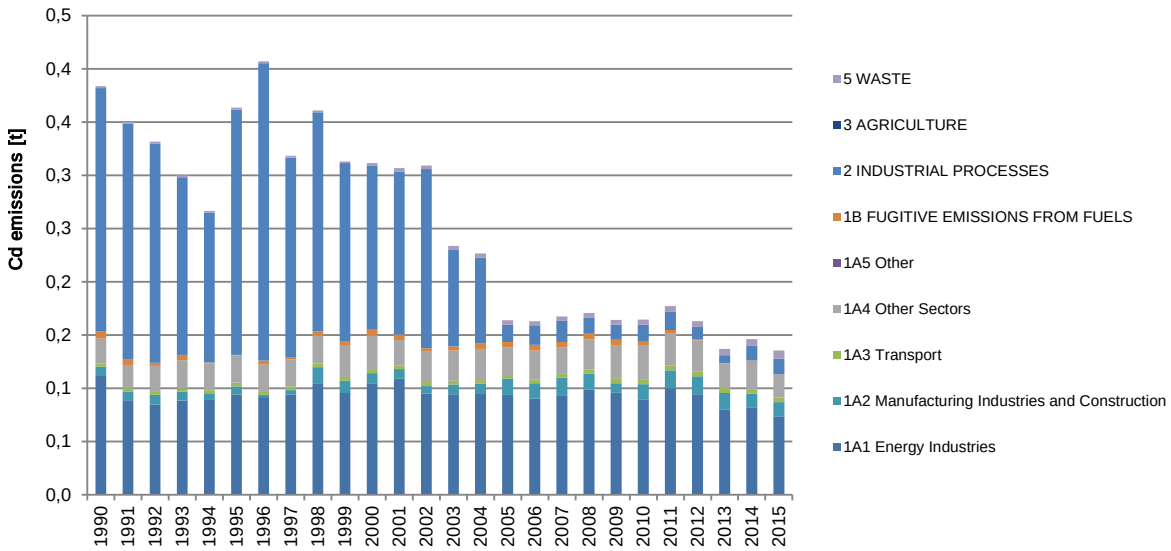

Figure 267 Cd emissions in Macedonia 1990-2015by sectors

3.3.3. Mercury (Hg) emissions

Emission trend

National total Hg emissions amounted to 0,62 t in 1990; emissions have decreased steadily, and in the year 2015 emissions (0,25t) were down by 60%, to compare to 1990 emissions. 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 2014 and 2015 total Pb emissions slightly decreased by 2,5%.

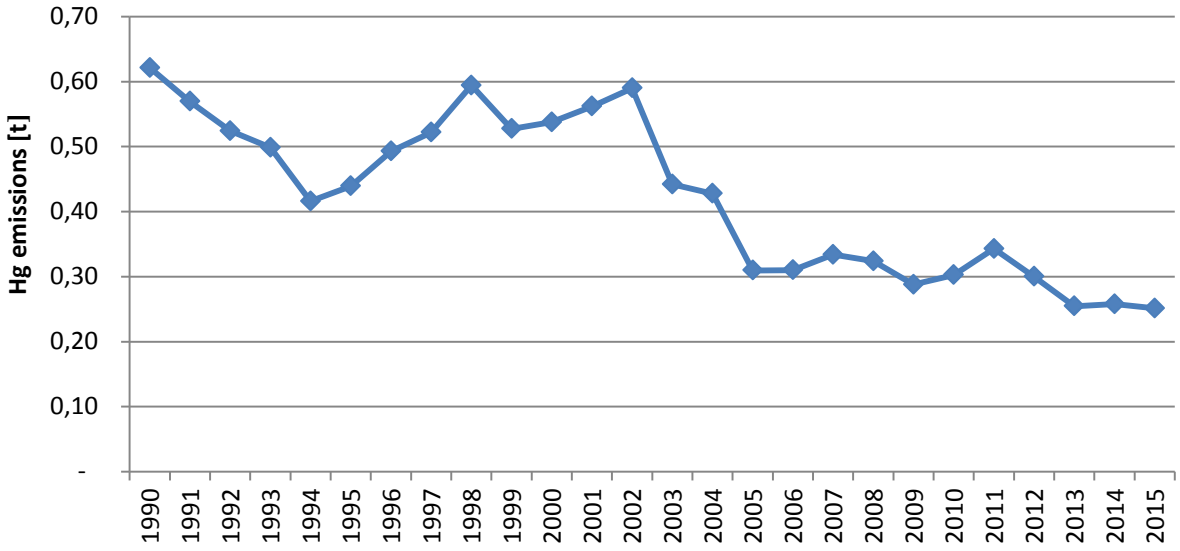

Figure 278 National total Hg emissions 1990-2015

Main emission sources in Macedonia

The most important emission source in 2015 of Hg is NFR sector 1 - Energy. Within the Energy sector, the main contributors in 2015 are 1.A.1 Energy Industries with a share of 46% (28% in 1990) and 1.A.4 Other Sectors Energy, with 19% (3% in 1990) in the national total emissions. NFR category 2 Industrial Processes and Product use is also a main contributor with 19% (64%) to the national total mercury emissions. In 2015, also 13% of total mercury emissions are stemming from sector 5 Waste while this sector have minor contribution in 1990.

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

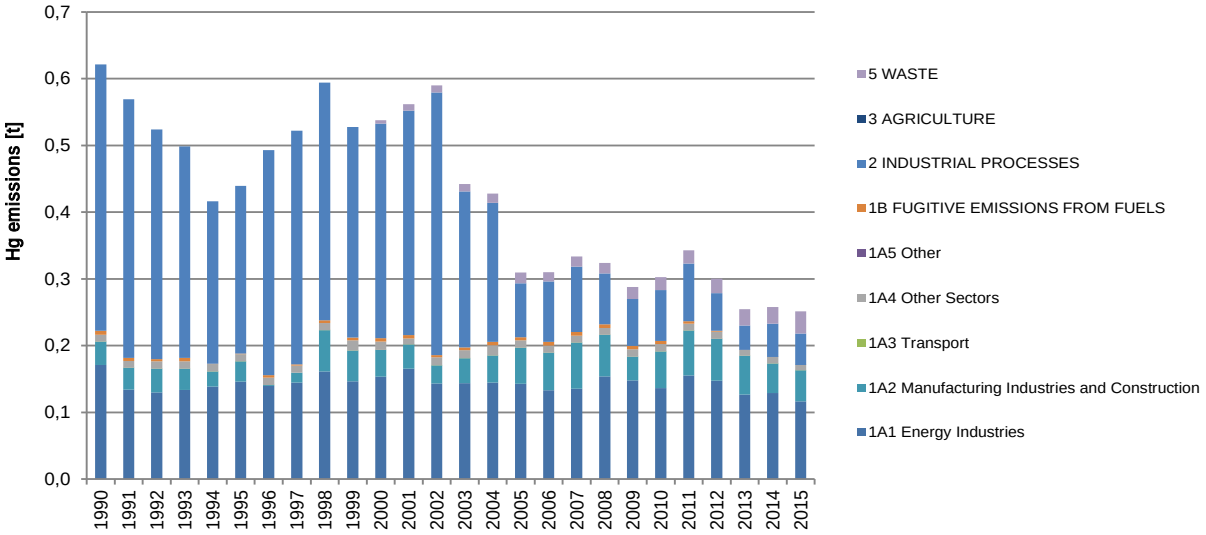

Figure 289 Hg emissions in Macedonia 1990-2015by sectors

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 46 Emission trends for POPs 1990-2015

Year	Emissions			
	PCDD/F [g – I TEQ]	PAH [t]	HCB [kg]	PCB [kg]
1990	16,49	12,24	44,30	187,54
1991	14,51	10,81	39,23	177,69
1992	14,74	11,67	25,84	177,56
1993	15,23	12,78	24,20	131,34
1994	13,79	11,97	25,05	123,06
1995	13,96	12,10	18,64	237,83
1996	13,47	11,88	19,72	266,61
1997	14,00	11,93	27,90	150,21
1998	15,35	12,20	29,35	178,05
1999	15,31	12,40	53,99	128,32
2000	17,60	14,48	38,33	104,83
2001	14,62	11,44	34,16	93,30
2002	15,67	11,49	52,70	92,52

Year	Emissions			
	PCDD/F [g – I TEQ]	PAH [t]	HCB [kg]	PCB [kg]
2003	16,25	12,83	42,99	49,31
2004	16,32	12,96	8,53	38,09
2005	15,18	12,18	7,58	4,24
2006	16,30	12,95	11,71	4,63
2007	15,12	11,51	10,15	4,88
2008	16,45	13,32	10,40	4,36
2009	16,86	14,10	7,44	3,81
2010	17,86	14,88	9,56	4,26
2011	17,84	14,58	9,93	4,69
2012	16,73	14,18	7,28	3,87
2013	13,44	11,53	6,55	3,05
2014	15,99	13,67	4,93	9,73
2015	13,50	11,32	4,56	11,45
Trend 1990–2015	-18,15%	-7,52%	-89,70%	-93,89%

We can conclude from the figures presented in the previous table that Republic of Macedonia in 2015 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-4 emissions

Emission trend

National total PAH-4 emissions amounted to 12 t in 1990; emissions have been quite stable since then, and in the year 2015 emissions were nearly at 1990 levels to 12 t amounted to 11,3 t which reflect with only 7,65% reduction. The most important reductions could be observed in the sector for residential heating. Between 2014 and 2015, total PAH-4 emissions decreased by 17%, because of decreased emissions from residential heating, due to warmer weather which resulted with lower wood consumption.

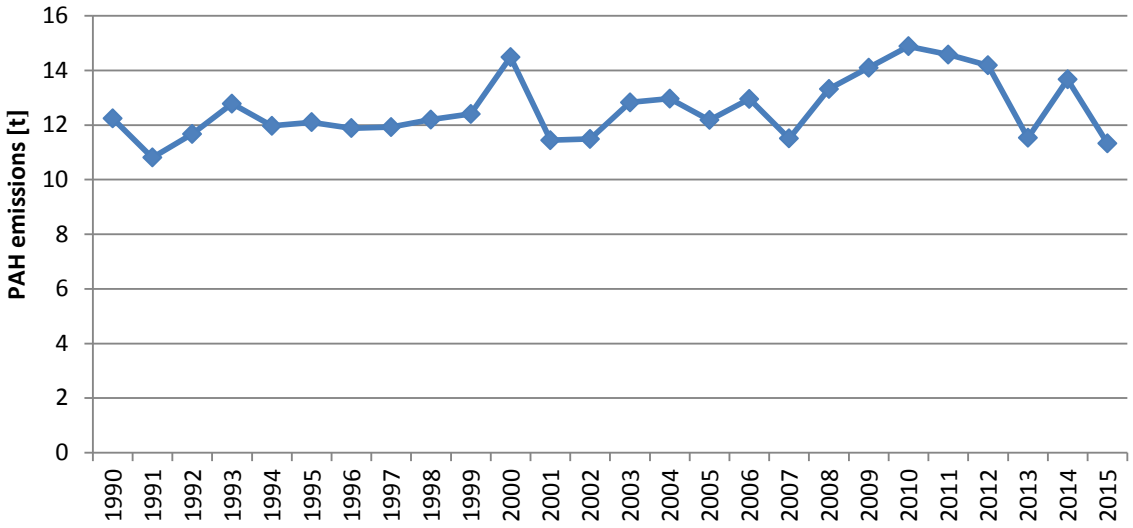

Figure 30 National total PAH emissions 1990-2015

Main emission sources in Macedonia

The most important emission source in 2015 of PAH is NFR sector 1 - Energy. Within the Energy sector the main contributor in 2015 is 1.A.4 Other Sectors (residential heating), with a share of 89% (92% in 1990). Furthermore, 1.A.2 Manufacturing Industries is contributing with a share of 9% (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.

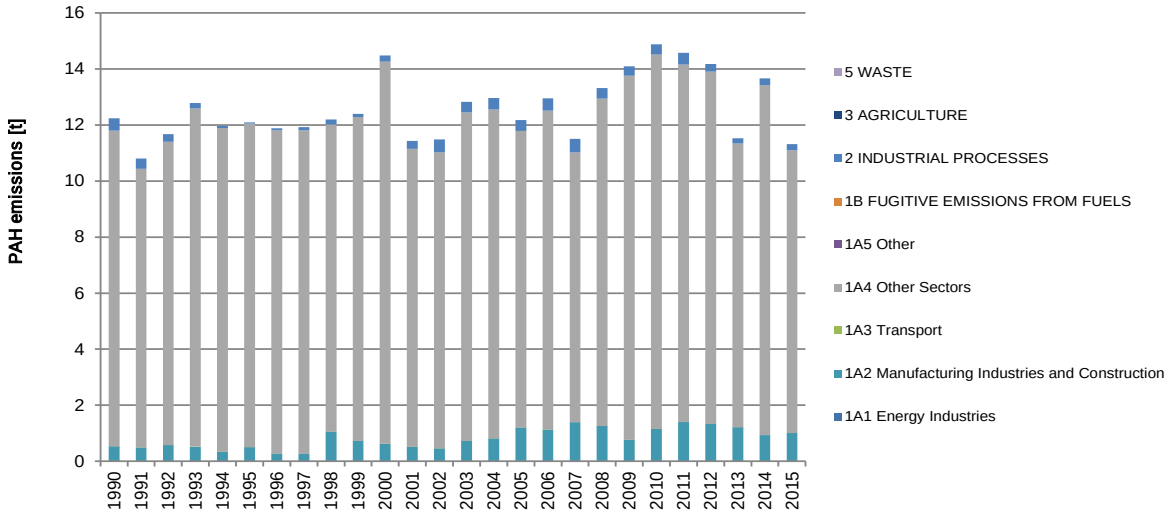

Figure 31 PAH-4 emissions in Macedonia 1990-2015 by sectors

3.4.2. Dioxin and Furan emissions (PCDD/F)

Emission trend

National total dioxin/furan emissions amounted to 13,5g-I-TEQ in 1990; emissions have decreased since then, and in the year 2015 emissions were down by 18% to 13,5g-I-TEQ in the period 1990-2015. 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 2014 and 2015, total dioxin/furan emissions decreased by 15,5%, mainly due to a fall of emissions from residential heating. The consumption of biomass has been reduced in 2015 compared to 2014 due to lower biomass and solid fuel consumption. Additionally the consumption of wood briquettes and pellets has been increased.

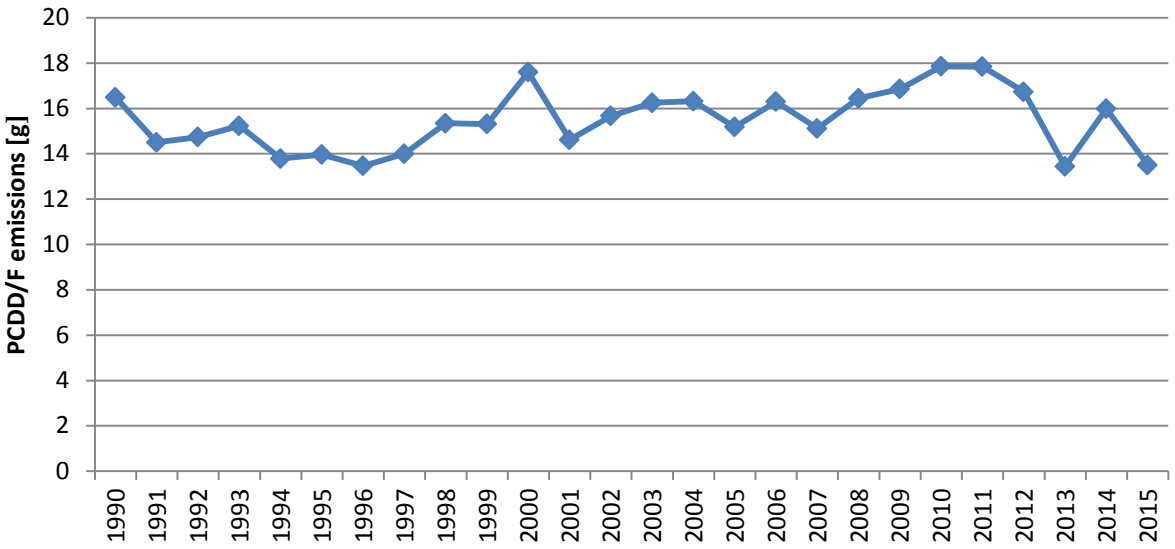

Figure 292 National total PCDD/F emissions 1990-2015

Main emission sources in Macedonia

The most important emission source in 2015 of PCDD/F is NFR sector 1 - Energy. Within the Energy sector the main contributor in 2015 is 1.A.4 Other Sectors (mainly residential heating), with a share of 75% (68% in 1990). Furthermore, 1.A.2 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 1.B Fugitive Emissions and 5 Waste are minor sources.

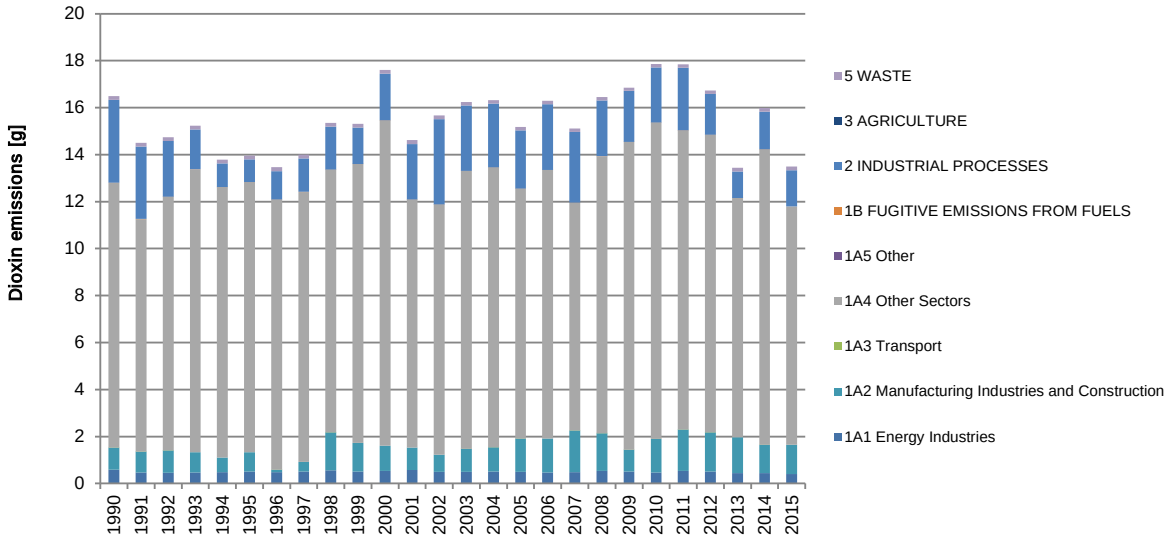

Figure 303 Dioxin/furan emissions in Macedonia 1990-2015 by sectors

3.4.3. Hexachlorobenzene (HCB) emissions

Emission trend

National total HCB emissions amounted to 44 kg in 1990; emissions have decreased steadily since then and in the year 2015 emissions were down by 90% to 4,6 kg in the period 1990-2015. The emission peaks in 1999 and 2002 are due to higher activities of secondary aluminum production. The significant

emission reduction between 2003 and 2004, is also caused by the aluminum production. From then onwards the emission level remained quite stable. The most important reductions could be observed in sector 2 Industrial Processes and Other Product Use (Aluminum Production). Between 2014 and 2015, total HCB emissions decreased by 7,4% also due to fall of emissions from aluminum production.

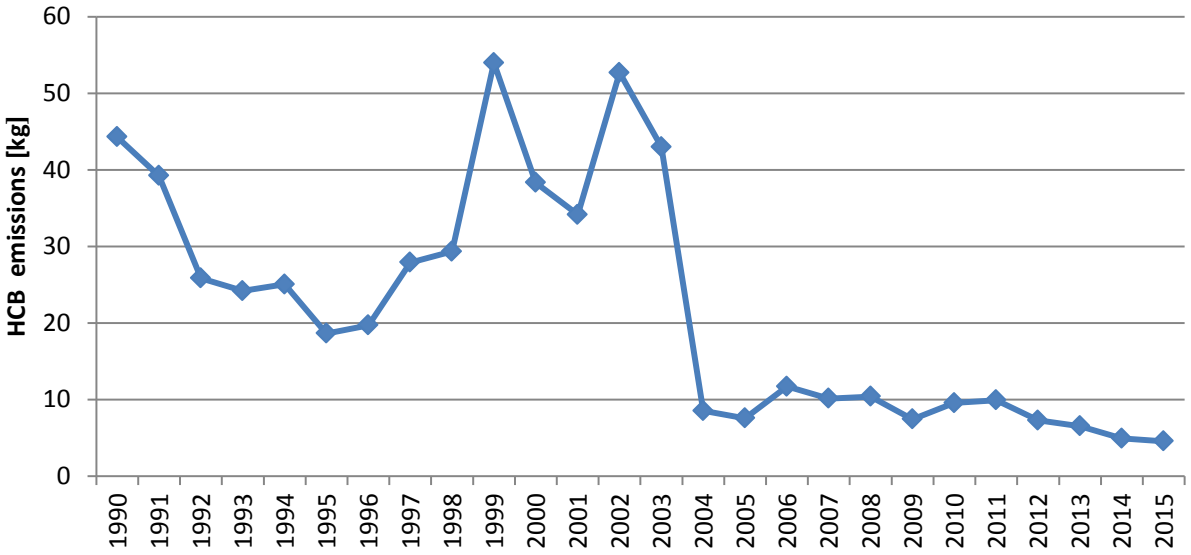

Figure 314 National total HCB emissions 1990-2015

Main emission sources in Macedonia

The most important emission source in 2015 of HCB is NFR sector 2 Industrial Processes and Product Use. With a share of 96% (100% in 1990) in the national total emissions almost all HCB is emitted from this source and therefore dominating the trend. Within the category emissions are exclusively emitted from NFR sector 2.C.3 Aluminum Production.

HCB emissions from other sectors are minor sources.

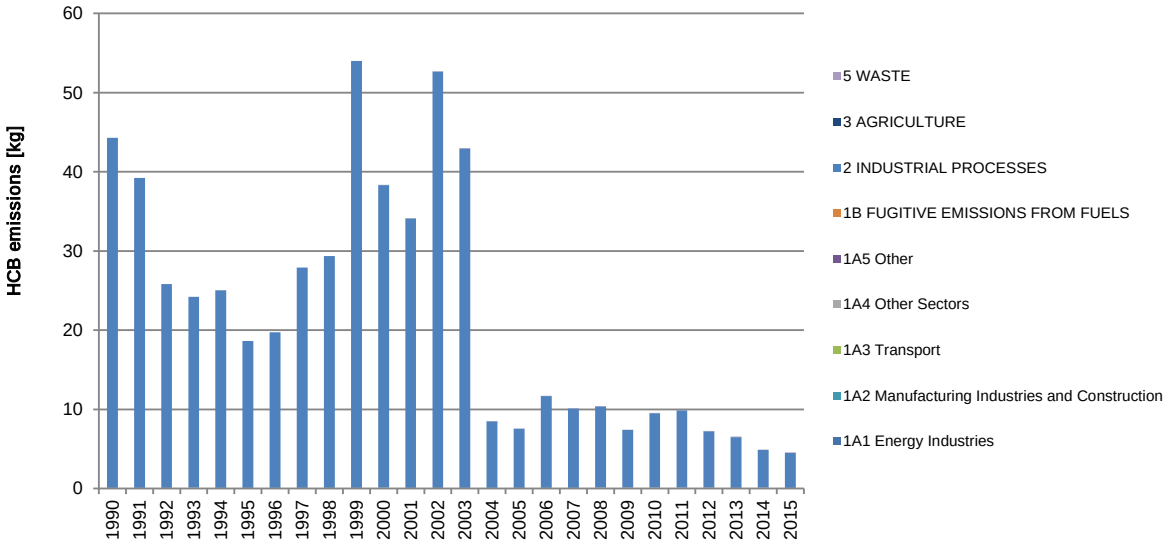

Figure 325 HCB emissions in Macedonia 1990-2015 by sectors

3.4.4. Polychlorinated biphenyl (PCB) Emissions

Emission trend

National total PCB emissions amounted to 187,5 kg in 1990; emissions have decreased steadily since then and in the year 2015 emissions were down by 94% to 11,4 kg in the period 1990-2015. The emission decrease between 1996 and 1997 is due to a decreased activity in secondary zinc production. Between 2004 and 2005, emissions decreased sharply because the smelter company in Veles has stopped production in 2003. Until then, the emission level remained quite stable. The most important reductions could be observed in sector 2 Industrial Processes and Other Product Use (Lead Production). Between 2014 and 2015, the total PCB emissions are reduced by 18%.

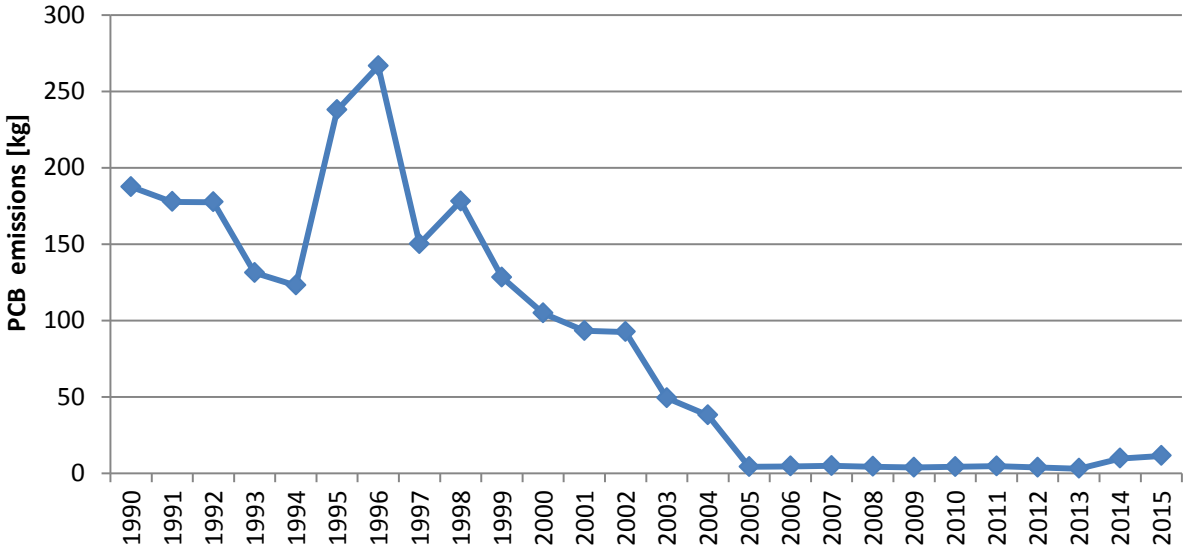

Figure 336 National total PCB emissions 1990-2015

Main emission sources in Macedonia

The most important emission source in 2015 of PCB is NFR sector 2 Industrial Processes and Product Use. Within this sector, the main contributor is 2.C.5 Lead Production, with a share of 83% (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 2015 are NFR sectors 1.A.2 Manufacturing Industries (Iron and Steel Production) and 1.A.4 Other Sectors (mainly residential heating) with share of 8%.

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

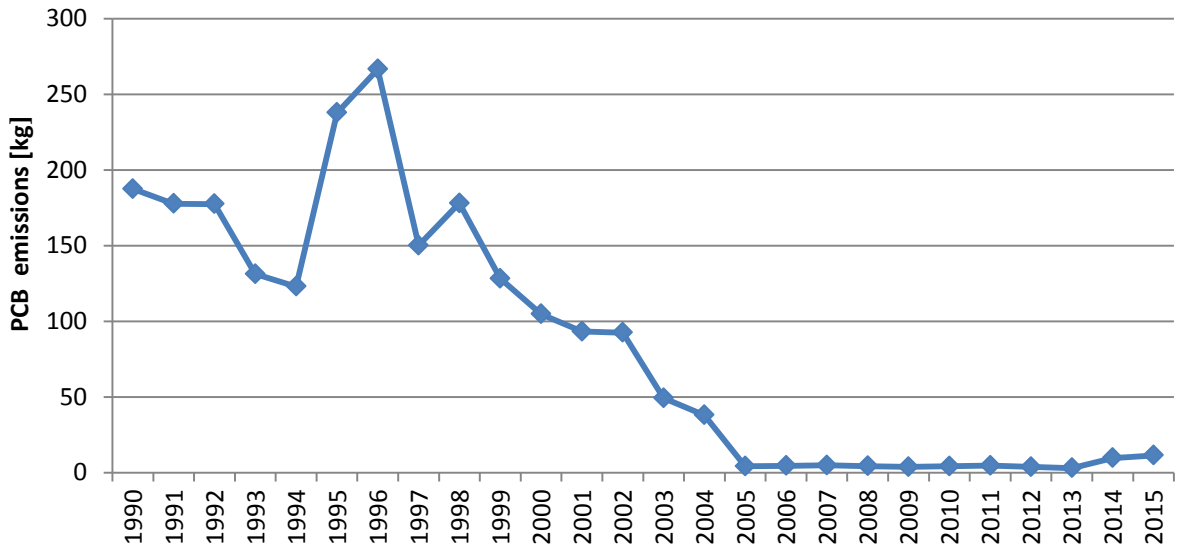

Figure 347 PCB emissions in Macedonia 1990-2015by sectors

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 47 NFR categories included in Energy sector for 2015

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 (civil)	√
1 A 3 a i (ii) Domestic aviation LTO (civil)	√
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 tire 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	√
1A5bOther, Mobile (including military, land based and recreational boats)	√
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	√
1 B 2 d Other fugitive emissions from energy production	√
A 3 d ii National navigation (Shipping)	√
Memo Items	

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

Table 48 NFR categories not included in Energy sector for 2015

NFR category	Notation key used
1 A 1 c Manufacture of solid fuels and other energy industries	NO
1 A 3 a ii (ii) Domestic aviation cruse (, civil)	NO
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 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
1 A 3 a ii (ii) Domestic aviation cruse (civil)	NO

Methodology

In general, the methodology is following the EMEP Tier 1 methodology, using default emission factors from the Guidebooks 2009/2013/2016 and activity data from energy statistics. Plant specific emission data is considered for reporting of NO_X, SO_2, 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[21] . Fuel consumption for 1.A.1.a has been provided by plant operators. 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' summarized together but for the year 2013 and 2014, separate data for road diesel and gasoil is available. In the energy balance for 2015, again fuel data are summarized under one category 'diesel and other gasoil'.

Emission factors are mostly taken from the GB 2009/2013 and particularly taken from the latest available Guidebook version 2016. At current, the default (medium range) emission factors have been selected in all cases. Implied emission factors have been used for source category 1.A.1.a.

[21] http://www.stat.gov.mk/

With regards to LHV, these values have been taken from energy balance[22], or operators reports if they were reported. For coal mined in the country LHV- 6,7 -7,7 TJ/10^3 t has been used, for imported coal – 8,29 TJ/10^3t, for biomass – 10,902 TJ/10^3 m^3, for heavy fuel – 40 TJ/10^3t, for heating oil and other gasoil –42,5 TJ/10^3t, for diesel– 43 TJ/10^3t, for wood wastes, wood briquettes and pellets – 17,615 TJ/10^3 t, for coke –26,795 TJ/10^3t , for other imported coal– 8,29 TJ/10^3 , for natural gas –33,588 TJ/10^6 m^3n, LPG – 46 TJ/10^3t and petroleum coke – 31,82 TJ/10^3t.

4.2. Public electricity and heat production-NFR 1.A.1.a

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 2015, 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.

4.2.1. 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 from 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 from 1990 to 2007 emissions are calculated with default Tier 1 emission factors from the Guidebook 2016.

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 sulfur 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 sulfur content of 1% but in the early 1990s it is to be estimated that the sulfur content was up to 3%.

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

[22] Ministry of Economy, Energy Balance of the Republic of Macedonia,(Official gazette of RM num. 192/2014);

Table 49 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	NO	3090
1992	44356	NO	2656
1993	45442	NO	3037
1994	47507	NO	2434
1995	49958	NO	2986
1996	47675	NO	3051
1997	49362	NO	3301
1998	55194	NO	2602
1999	50091	NO	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
2015	39816	3258	1606

Quantity of fuels consumption in the 1.A.1.a, shown in the table was used as activity data for calculation of emissions for all pollutants in the period 1990-2007. Data on fuel consumption is reported by the installation in the format prescribed in the secondary legislation. Starting from 2008 onwards, emission measurements for the basic pollutants (SOx, NOx, TSP and CO) are presented. In cases when the facility do not deliver emission measurements data, or the quality check of the emission measurement data is low (for example in cases when the calculated yearly emissions are lower compared to the quantity of fuel consumed), emissions for the basic pollutants are calculated when implied emission factors are multiplied with the quantity of fuel consumed reported by the installations.

Emission factors

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

Table 50 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
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	NE
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
PCB	ng WHOTEG/GJ	3.3	NE	NE
HCB	µg/GJ	6,7	NE	NE

Emission factors for the basic pollutants NOx, SOx, CO and particulates are implied emission factors, while for the other pollutants emission factors are taken from GB 2016, Table 3-, Tier 1 emission factors for source category 1.A.1.a, using brown coal, (page 17 of GB 2016), using other gaseous fuels (page 18 of GB 2016) and using heavy fuel oil (page 19 of GB 2016).

Emission measurements

For the period 2008-2015 emission measurement data for NO_X, SO_2, TSP and CO have been taken into account. These data were used for identification of implied emission factors. Data for the yearly emission measurements are reported by the operators in a template prescribed in the national sub legislation until 15th March each year. For 2015, emission measurements for 6 out of 7 plants were used. After the quality check of reported emission measured data, additional request for explanation is sent to the facilities in case of dumps and jumps of emissions, compared to the previous years. Data on emission measurements from REK Bitola were not taken into account. Instead, emissions for basic pollutants were calculated with implied emission factors due to the fact that this installation did not made emission measurements for each month in 2015.

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 51 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

4.2.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 5%; the emission factor uncertainty for NOx and SOx was estimated to be 20% (rating A, cf. chapter 1.7), 200% for NMVOC (rating D) and 125% for PM2.5 (rating C).

4.2.3. Source-specific QA/QC and verification

Quality check of these data is made by the advisor for emission data, within the division for analysis and reporting, before they are used in the national inventory. As recommended by ERT an improved quality checks for the use of 2015 data reported by the plants in the inventory was done, and this is documented. Additionally, emissions in this category were checked with the calculated emissions in the Annex VI_LCP_emissions template.

4.2.4. Source-specific recalculations including changes made in response to the review process

During the 2016 Stage 3 review, it was pointed out that according to the NFR reporting table 2014, HCB and PCB from the energy industry were reported as NA. The correction was made for PCB emissions, which were reported properly in this submission.

4.2.5. Source-specific planned improvements including those in response to the review process

Calculation of HCB emissions using the updated EF from the latest guidebook is planned to be carried out for the next reporting round, due to the fact that insertion of the EF for this pollutant has been overseen.

4.3. Petroleum refining – NFR 1.A.1.b

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.

4.3.1. 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. No production was carried out in 2015. The company became customer-oriented, logistics and trading company, providing uninterrupted and reliable supply of fuel to the country. Request for providing data for the period 1990-1999 has been sent to the company, but these data have not been reported until now.

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 52 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	NO	107,47
2015	NO	NO

Emission factors

The emission factors for refinery gas has been taken from GB 2013, 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 53 Emission factors for source category 1.A.1.b- 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	-

4.3.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 5%; the emission factor uncertainty for NOx and SOx was estimated to be 20% (rating A, cf. chapter 1.7), 200% for NMVOC (rating D) and 40% for PM2.5 (rating B).

4.3.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR. Data reported by the operator were cross checked with data reported in the energy balance.

4.3.4. Source-specific recalculations including changes made in response to the review process

No recalculations were made in this category.

4.3.5. Source-specific planned improvements including those in response to the review process

No planned improvements.

4.4. Manufacturing industries and construction– NFR 1.A.2

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.

4.4.1. Methodological issues

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

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

$E_{Pollutant}$ = 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 – stationary combustion

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 categories are presented in Tables 55-60:

- 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 54 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	NO	NO	1395,926	3104,251
1991	NO	NO	2133,226	1184,316
1992	NO	NO	2451,098	1610,82
1993	NO	NO	1963,745	1290,54
1994	NO	NO	960,3717	631,14
1995	NO	NO	2100,154	655,996
1996	NO	NO		33,744
1997	NO	NO	272,3442	178,98
1998	0,294	NO	5165,955	1793,497
1999	0,526	NO	3443,079	1414,101
2000	NO	26,93758	2285,072	1698,71
2001	0,083736	815,651	1912,153	780,1264
2002	NO	959,6427	1378,295	1076,008
2003	2,595816	1119,32	2882,068	1195,541

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
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
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	5410,196	1981,182
2015	6,48669	657,63	5516,203	1315,227

Table 55 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	NO	NO	2298	631
1991	NO	NO	1826,964	277,653
1992	NO	NO	1830,27	591,1085
1993	NO	NO	1833,576	904,564
1994	NO	NO	1685,519	861,8515
1995	NO	NO	1537,461	819,139
1996	NO	NO		26,015
1997	NO	NO	919,528	82,2985
1998	NO	NO	1839,056	138,582
1999	NO	NO	1754,216	699,846
2000	NO	NO	2045,964	770,8317
2001	NO	NO	1918,81	374,0068
2002	NO	NO	1246,117	614,8734
2003	NO	NO	595,991	8,834148
2004	NO	NO	NO	12,97908
2005	NO	NO	NO	21,81323
2006	NO	NO	NO	32,02902
2007	NO	NO	NO	42,41228
2008	NO	NO	NO	32,19649
2009	NO	NO	NO	26,2931
2010	NO	NO	NO	35,00165
2011	NO	NO	NO	38,64416
2012	NO	NO	NO	42,28668
2013	9	NO	NO	43,29151
2014	1,090	37,950	NO	2,846268
2015	NO	NO	NO	41,00704

Table 56 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	NO	NO	NO	169
1991	NO	NO	NO	165,573
1992	NO	NO	0,42527	612,721
1993	NO	NO	0,85054	1059,869
1994	NO	NO	0,746996	1136,4
1995	NO	NO	0,643452	1212,93
1996	NO	NO	2,540328	32,838
1997	NO	NO	2,256664	88,5425
1998	NO	NO	1,973	144,247
1999	NO	NO	NO	39,692
2000	NO	NO	NO	
2001	NO	37,5178	NO	0,083736
2002	NO	40,37278	NO	1,590984
2003	NO	32,71471	NO	0,711756
2004	NO	25,96352	NO	5,987124
2005	NO	22,63831	NO	5,44284
2006	NO	13,80467	NO	7,578108
2007	NO	10,24434	NO	5,400972
2008	NO	9,035172	NO	3,600648
2009	NO	5,978664	NO	4,354272
2010	NO	4,903848	NO	8,457336
2011	NO	2,451924	NO	42,76816
2012	NO	NO	NO	77,07899
2013	0,382	NO	NO	72,68285
2014	NO	35,90285	NO	65,2251
2015	NO	36,43887	NO	68.,08714

Table 57 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	NO	NO	337,1813	12,8941
1991	NO	NO	0,44376	16,884
1992	NO	NO	0,22188	12,4005
1993	NO	NO	NO	7,917
1994	NO	NO	NO	7,7605
1995	NO	NO	NO	7,604
1996	NO	NO	56,10707	196,994
1997	NO	NO	28,77704	169,954
1998	1,901	NO	1,447	142,914
1999	0,526	NO	NO	2,863
2000	0,502416	NO	NO	0,376812
2001	0,83736	NO	NO	0,293076
2002	0,669888	NO	NO	1,925928

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
2003	0,20934	NO	NO	1,25604
2004	1,004832	NO	NO	1,130436
2005	1,297908	NO	NO	0,251208
2006	0,879228	NO	NO	0,293076
2007	0,83736	NO	NO	0,125604
2008	0,921096	NO	NO	0,20934
2009	0,753624	NO	NO	0,376812
2010	1,842192	6,583248	NO	0,251208
2011	1,214172	15,28681	0,146538	8,917884
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	17, 74865
2015	0,283452	15,23901	0,226317	20,15844

Table 58 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	NO	NO	172,3139	1610,597
1991	NO	NO	34,495	223,436
1992	NO	NO	32,26252	414,356
1993	NO	NO	30,03004	605,276
1994	NO	NO	21,8182	588,646
1995	NO	NO	13,60637	572,016
1996	NO	NO	3,202307	137,396
1997	NO	NO	17,10065	546,9
1998	15,54	NO	30,999	956,404
1999	18,407	NO	31,05	115,082
2000	13,18842	NO	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	655,6439
2015	131,8807	203,4392	4,00503	708,521

Table 59 Activity data for category source category 1.A.2.giii- Stationary combustion in manufacturing industries and construction: Other

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]	Clinker [tonnes]
1990	66,60538	NO	110,8883	2666,445	491902
1991	66,61725	NO	111,1813	2727,26	465375
1992	66,5935	NO	110,5954	2605,63	396496
1993	66,641	NO	110,0094	2484	413444
1994	66,546	NO	122,5078	2116,5	375914
1995	66,736	NO	135,0063	1749	365121
1996	66,356	NO	32,1626	6040,328	396015
1997	67,116	NO	592,8778	2495,243	475252
1998	65,596	NO	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	NO	1705,716	1349,179	643258
2005	29,4332	NO	1781,248	4627,66	694922
2006	4,898556	NO	1885,137	1349,179	801302
2007	29,32638	NO	1750,728	1451,279	882834
2008	23,48795	NO	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	147,2365	136.,6032	73,49527	1015.,77	518198
2015	73,35922	142,639	272,8614	2467,986	553232

Activity data – mobile combustion

Activity data for category 1.A.2.gvii for diesel fuel is presented in Table 61. 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. Data for 2013 and 2014 is available from the energy balance due to the fact that source category diesel for transport has been introduced. For 2015, data from the category diesel and other gasoil has been used. Activity data for the years 2009 and 2011-2012 were calculated as average of the previous two years.

Table 60 Activity data for source category 1.A.2.gvii - 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

Year	Heavy Fuels [TJ]	Year	Heavy Fuels [TJ]
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	2015	1365

Emission factors – stationary combustion

Tier 1 emission factors have been used for calculation of emissions in separate categories. Emission factors for different type of fuels are presented in Tables 62-65.

Table 61 Emission factors for source category 1.A.2 -Stationary combustion in manufacturing industries and construction for biomass

Pollutant	Value	Unit	References
NOx	91	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
NMVOC	300	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
SOx	11	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
PM2.5	140	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
PM10	143	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
BC	28	% of PM2.5	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
TSP	150	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
CO	570	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
Pb	27	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
Cd	13	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
Hg	0.56	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
As	0.19	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
Cr	23	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
Cu	6	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
Ni	2	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
Se	0.5	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
Zn	512	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
PCDD/ PCDF	100	ng I-Teq/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
benzo(a) pyren	10	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
benzo(b) fluoranthen	16	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
benzo(k) fluoranthen	5	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
Indeno (1.2.3-cd) pyren	4	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
HCB	5	µg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18
PCBs	0.06	µg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 18

Table 62 Emission factors for source category 1.A.2 -Stationary combustion in manufacturing industries and construction for gaseous fuel

Pollutant	Value	Unit	References
NOx	74	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
NMVOC	23	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
SOx	0.67	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
PM2.5	0.78	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
PM10	0.78	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
TSP	0.78	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
BC	4	% PM2.5	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
CO	29	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
Pb	0.011	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16

Pollutant	Value	Unit	References
Cd	0.0009	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
Hg	0.54	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
As	0.1	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
Cr	0.013	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
Cu	0.0026	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
Ni	0.013	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
Se	0.058	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
Zn	0.73	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
PCDD/ PCDF	0.52	ng I-Teq/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
benzo(a) pyren	0.72	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
benzo(b) fluoranthen	2.9	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
benzo(k) fluoranthen	1.1	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16
Indeno (1.2.3-cd) pyren	1.08	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 16

Table 63 Emission factors for source category 1.A.2- Stationary combustion in manufacturing industries and construction for solid fuel

Pollutant	Value	Unit	References
NOx	173	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
NMVOC	88,8	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
SOx	900	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
PM2.5	108	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
PM10	117	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
TSP	124	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
BC	6,4	% of PM2.5	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
CO	931	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
Pb	134	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
Cd	1,8	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
Hg	7,9	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
As	4	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
Cr	13,5	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
Cu	17,5	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
Ni	13	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
Se	1,8	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
Zn	200	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
PCDD/ PCDF	203	ng I-Teq/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
benzo(a) pyren	45,5	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
benzo(b) fluoranthen	58,9	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
benzo(k) fluoranthen	23,7	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
Indeno (1.2.3-cd) pyren	18,5	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
HCB	0,62	µg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16
PCBs	170	µg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 15-16

Table 64 Emission factors for source category 1.A.2-Stationary combustion in manufacturing industries and construction for liquid fuel

Pollutant	Value	Unit	References
NOx	513	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
NMVOC	25	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
SOx	47	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
PM2.5	20	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
PM10	20	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
TSP	20	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17

Pollutant	Value	Unit	References
BC	56	% of PM2.5	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
CO	66	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
Pb	0,08	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
Cd	0,006	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
Hg	0,12	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
As	0,03	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
Cr	0,2	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
Cu	0,22	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
Ni	0,008	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
Se	0,11	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
Zn	29	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
PCDD/ PCDF	1,4	ng I-Teq/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
benzo(a) pyren	1,9	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
benzo(b) fluoranthen	15	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
benzo(k) fluoranthen	1,7	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17
Indeno (1.2.3-cd) pyren	1,5	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.2, page 17

The emission factors for clinker production are presented in Table 66.

Table 65 Emission factors for category 1.A.2- Stationary combustion in manufacturing industries and construction: Other for clinker

Pollutant	Value	Unit	References
NOx	1241	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
NMVOC	18	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
SOx	374	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
CO	1455	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
Pb	0,098	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
Cd	0,008	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
Hg	0,049	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
As	0,0265	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
Cr	0,041	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
Cu	0,0647	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
Ni	0,049	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
Se	0,0253	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
Zn	0,424	g/tclinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
PCB	103	µg/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
PCDD/ PCDF	4,1	ng I-TEQ/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
benzo(a) pyren	0,000065	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
benzo(b) fluoranthen	0,00028	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
benzo(k) fluoranthen	0,000077	g/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
Indeno (1.2.3-cd) pyren	0,000043	g/tclinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31
HCB	4,6	µg/t clinker	GB 2016 Table 3-24 emission factor for source category 1.A.2.f., page 31

Emission factors – mobile combustion

Concerning the source category 1.A.2.gvii, the emission factors for diesel fuels are presented in table 66.

Table 66 Emission factors for source category 1.A.2.gvii - 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/tone	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/tone	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
BC	56	%P2.5	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	0,05	mg/kg	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
Cu	1,7	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

4.4.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10 %. For the categories 1.A.2.a - 1.A.2.e, as well as 1.A.2.gviii, the emission factor uncertainty for SOx was estimated to be 20% (rating A, cf. chapter 1.7). For NOx, including category 1.A.2.gvii was estimated to be 40% (rating B, cf. chapter 1.7). For NMVOC for the categories 1.A.2.a - 1.A.2.e , the EF uncertainty is estimated to be 200% (rating D, cf. chapter 1.7) and for the category 1.A.2.gvii, it was estimated to be 40 % (rating B, cf. chapter 1.7). For the categories 1.A.2.a - 1.A.2.e for PM2.5, the EF is estimated to be 40% (rating B, cf. chapter 1.7), and for 1.A.2.gvii and 1.A.2.gviii is estimated to be 125% (rating C cf. chapter 1.7).

4.4.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

4.4.4. Source-specific recalculations including changes made in response to the review process

Recalculations for 2014 were performed, due to the use of final data (from the energy balance) for fuel consumption. Compared to the previous IIR, SOx emissions are now being calculated for the category 1.A.2.gvii, as recommended in the last Stage 3 Review Report. For calculating SOx emissions of mobile machinery in industry, the content of sulfur used in the category 1.A.3.dii has been implemented. The ERT noted that incorrect EFs were used for estimation of Cr and Cu emissions in the category NFR 1.A.2.g.vii, leading to NFR 1.A.2.g.vii category becoming a key source for Cu. The proper EFs have been used in this submission.

Some activity data which were listed in the previous IIR Tables 40 – 45, showed gaps in historical years, especially in the early 1990's. ERT encouraged us to explain the situation in the IIR, as it is important

to know if a fuel was not used, or if data on the use is not available, to facilitate assessing the completeness and consistency of the inventory. Data gaps in those tables were fulfilled in this IIR with proper notation keys. Recalculations of the emissions were done only due to the use of final energy consumption data for 2014.

Furthermore, following a recommendation from the stage 3 review report, the emission factors for Cr and Cu in Table 65 (IIR 2016) were corrected, to be in line with the GB 2013.

4.4.5. Source-specific planned improvements including those in response to the review process

Update of EF from GB 2016 in cases where EF from the older Guidebook versions are still used.

4.5. Transport

4.5.1. Road transport –NFR 1.A.3

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 for the period 1990-2013 during the inventory preparation.

4.5.1.1. Road transport – NFR 1.A.3.bi,bii,biii,biv

4.5.1.1.1. Methodology

The simplified Tier 1 methodology for emissions calculation from the road transport for the period 1990-2013 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:

E_i = emission of pollutant i [g],

$FC_{j,m}$ = fuel consumption of vehicle category j using fuel m [kg],

$EF_{i,j,m}$ = 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 is no detail background data on the type of fuel consumption, or the EF used for this reporting period.

The Tier 2 methodology or emissions calculation included in the EEA Guidebook 2013, has been used for calculation of the emission from road transport for the years 2014 and 2015. The Tier 2 approach allows to estimate the emission for a given vehicles fleet, when the information concerning the

number of vehicles classified by categories, fuel and emission standards is known. The calculation includes emissions from passenger cars, light duty vehicles, heavy-duty vehicles and busses, motorcycles and gasoline evaporation from vehicles.

The Tier 2 approach considers the fuel used by different vehicle categories and their emission standards that are 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 2 approach for exhaust emissions uses the following general equation:

The emission E for a certain pollutant i and a vehicles category j is calculated as following:

$$E_{i,j} = \sum_k (N_{j,k} \cdot M_{j,k} \cdot EF_{i,j,k})$$

where:

$N_{j,k}$ = number of vehicles in the fleet of category j and technology k.

$M_{j,k}$ = average annual distance driven per vehicle of category j and technology k.

$EF_{i,j,k}$ = technology-specific emission factor of pollutant i for vehicle category j and technology k.

Concerning the annual average mileage of a vehicle category, the data available from the national statistics are referred to the total annual mileage of a certain vehicle, without considering the different regimes of circulation (urban, interurban, highway).

The data of the vehicle stock has been delivered from the official National Car Registry of Macedonia managed by the Ministry of interior (MOI). The data for the driven kilometer per type of vehicle has been calculated.

The emission factors are available for CO, NH_3, NMVOC, NOx, lead, benzo(a)pyrene and Particulate Matter(PM). Concerning particulate matter, the guidebook assumes that the amount of total suspended particles is equivalent to the PM10 one. The Tier 2 emission factors are stated in units of grams per vehicle-kilometer, and for each vehicle technology are given in the table 3.17 of the EEA Guidebook 2013.

Sulfur dioxide emissions are estimated by assuming that all sulfur in the fuel is transformed completely into SO_2, using the formula:

$$E_{SO_2,m} = (2 \cdot k_{S,m} \cdot FC_m)$$

where:

$K_{S,m}$= weight related sulfur content in fuel of type *m*

FCm = *fuel consumption of fuel m*

The typical sulfur content of fuel was retrieved from the table 3.13 of the EEA Guidebook 2013, Road Transport.

Activity data

Fuel consumption data were taken from Statistical yearbook – chapter Energy balance 1990-2015[23]. Data on number of vehicles were taken from Statistical yearbook for the period 1990-2002 and

[23] State Statistical Office of the Republic of Macedonia, Statistical Yearbook of the Republic of Macedonia, 1990-2015;

publication Transport and other communication for the period 2003-2015[24]. The data on mileage was received from the Faculty for Mechanical Engineering in Skopje.

Table 67 Activity data for source category 1.A.3.b - 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	7226,3	547,7	2211,0	7114,1	51,6
2015	7474,9	543,4	2803,6	7547,2	60,4

Table 68 Activity data for source category 1.A.3.b Road transport for 2015

NFR code	Fuel	Fuel consumption [TJ]
1A3bi	Gasoline	4387.08
	Diesel	3087.83
	LPG	543.43
1A3bii	Gasoline	680.25
	Diesel	2123.39
1A3biii	Gasoline	239.03
	Diesel	7547,20
1A3biv	Gasoline	60.37

[24] State Statistical Office of the Republic of Macedonia,Transport and other communications, 2007-2015 http://www,stat,gov,mk/Publikacii/8,4,8,03,pdf

Emission factors

Default emission factors for the basic pollutants, lead and particulates were taken from GB 2009 –Tier 1 emission factors. Emission factors for HM were taken from IIR 2010 . In the Table 70, 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.

Compared to the previous IIR the EF for SOx emissions has been revised as recommended in the last Stage 3 Review Report. For SOx emissions the country specific sulfur content of diesel in road transport is being used now.

Sulfur dioxide emissions are estimated by assuming that all sulfur in the fuel is transformed completely into SO_2, using the formula:

$$E_{SO_2,m} = (2 \cdot k_{S,m} \cdot FC_m)$$

where:

$K_{S,m}$= weight related sulfur content in fuel of type m

FC_m = fuel consumption of fuel m

Table 69 Emission factor for source category 1.A.3.b - Road Transport used for calculation of emissions in the period 1990-2013 by use of Tier 1 methodology

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

Table 70 Emission factor for source category 1.A.3.bi Road Transport: Passenger cars used for calculation of emissions in the period 2014-2015 by use of Tier 2 methodologies

Fuel type	g/km	CO	NH_3	NMVOC	NO_x	Pb	PM2.5	B(a)P
gasoline	EURO 0	24,60	0,002	2,16	2,66	0,0000182	0,0022	0,00000048
gasoline	EURO 1	4,07	0,0922	0,48	0,46	0,0000182	0,0022	0,0000003
gasoline	EURO 2	2,04	0,1043	0,22	0,24	0,0000182	0,0022	0,00000032
gasoline	EURO 3	1,80	0,0342	0,10	0,09	0,0000182	0,0011	0,00000032
gasoline	EURO 4	0,63	0,0342	0,05	0,06	0,0000182	0,0011	0,00000032
gasoline	EURO 5	0,63	0,0123	0,05	0,06	0,0000182	0,0014	0,00000032
gasoline	EURO 6	0,63	0,0123	0,05	0,06	0,0000182	0,0014	0,00000032
diesel	EURO 0	0,69	0,001	0,16	0,71	0,0000182	0,2209	0,00000174
diesel	EURO 1	0,41	0,001	0,06	0,69	0,0000182	0,0842	0,00000174
diesel	EURO 2	0,30	0,001	0,07	0,72	0,0000182	0,0548	0,00000174
diesel	EURO 3	0,09	0,001	0,03	0,77	0,0000182	0,0391	0,00000174
diesel	EURO 4	0,09	0,001	0,01	0,58	0,0000182	0,0314	0,00000174
diesel	EURO 5	0,04	0,0019	0,01	0,61	0,0000182	0,0021	0,00000174
diesel	EURO 6	0,05	0,00	0,01	0,50	0,0000182	0,0015	0,00000174

Fuel type	g/km	CO	NH_3	NMVOC	NO_x	Pb	PM2.5	B(a)P
other	EURO 0	6,83	0,002	1,05	2,36	1,82E-05	0,0022	1,00E-08
other	EURO 1	3,57	0,088	0,72	0,41	1,82E-05	0,0022	1,00E-08
other	EURO 2	2,48	0,1007	0,34	0,18	0,0000182	0,0022	0,00000001
other	EURO 3	1,79	0,0338	0,12	0,09	0,0000182	0,0011	0,00000001
other	EURO 4	0,62	0,0338	0,10	0,06	1,82E-05	0,0011	1,00E-08
other	EURO 5	0,62	0,0338	0,10	0,06	1,82E-05	n.a.	n.a.
other	EURO 6	0,62	0,0338	0,10	0,06	1,82E-05	n.a.	n.a.

Table 71 Emission factor for source category 1.A.3.bii - Road Transport: Light duty vehicles, used for calculation of emissions in the period 2014-2015 by use of Tier 2 methodology

Type	Technology	CO	NH3	NMVOC	NO_x	Pb	PM2.5	B(a)P
Gasoline <3.5t	Conventional	25,5	0,0025	3,44	3,09	2,82E-06	0,0023	4,80E-07
Gasoline <3.5t	Euro1	8,82	0,0758	0,614	0,563	3,31E-06	0,0023	3,20E-07
Gasoline <3.5t	Euro2	5,89	0,091	0,304	0,23	3,31E-06	0,0023	3,20E-07
Gasoline <3.5t	Euro3	5,05	0,0302	0,189	0,129	3,31E-06	0,0011	3,20E-07
Gasoline <3.5t	Euro4	2,01	0,0302	0,128	0,064	3,31E-06	0,0011	3,20E-07
Gasoline <3.5t	Euro5	1,3	0,0123	0,096	0,064	3,31E-06	0,0014	3,20E-07
Gasoline <3.5t	Euro6	1,3	0,0123	0,096	0,064	3,31E-06	0,0012	3,20E-07
Diesel <3.5 t	Conventional	1,34	0,0012	0,133	1,66	4,65E-06	0,356	2,85E-06
Diesel <3.5 t	Euro1	0,577	0,0012	0,141	1,22	4,17E-06	0,117	6,30E-07
Diesel <3.5 t	Euro2	0,577	0,0012	0,149	1,22	4,17E-06	0,117	6,30E-07
Diesel <3.5 t	Euro3	0,473	0,0012	0,094	1,03	4,17E-06	0,0783	6,30E-07
Diesel <3.5 t	Euro4	0,375	0,0012	0,035	0,831	4,17E-06	0,0409	6,30E-07
Diesel <3.5 t	Euro5	0,075	0,0019	0,035	1,18	4,17E-06	0,001	6,30E-07
Diesel <3.5 t	Euro6	0,075	0,0019	0,035	0,953	4,17E-06	0,0009	6,30E-07

Table 72 Emission factor for source category 1.A.3.biii - Road Transport: Heavy duty vehicles used for calculation of emissions in the period 2014-2015 by use of Tier 2 methodology

Type	Technology	CO	NH_3	NMVOC	NOx	Pb	PM2.5	B(a)P
		g/km	g/km	g/km	g/km	g/km	g/km	g/km
Gasoline >3.5 t	Conventional	59,5	0,0019	5,25	6,6	5,84E-06	**0,057**	4,80E-07
Diesel <=7.5 t	Conventional	1,85	0,0029	1,07	4,7	6,47E-06	0,333	9,00E-07
Diesel <=7.5 t	HD Euro I - 91/542/EEC I	0,657	0,0029	0,193	3,37	5,43E-06	0,129	9,00E-07
Diesel <=7.5 t	HD Euro II - 91/542/EEC II	0,537	0,0029	0,123	3,49	5,22E-06	0,061	9,00E-07
Diesel <=7.5 t	HD Euro III - 2000	0,584	0,0029	0,115	2,63	5,47E-06	0,0566	9,00E-07
Diesel <=7.5 t	HD Euro IV - 2005	0,047	0,0029	0,005	1,64	5,17E-06	0,0106	9,00E-07

Type	Technology	CO	NH_3	NMVOC	NOx	Pb	PM2.5	B(a)P
Diesel <=7.5 t	HD Euro V - 2008	0,047	0,011	0,005	0,933	5,17E-06	0,0106	9,00E-07
Diesel <=7.5 t	HD Euro VI	0,047	0,011	0,005	0,18	5,17E-06	0,0005	9,00E-07
Diesel 7.5 - 16 t	Conventional	2,13	0,0029	0,776	8,92	9,48E-06	0,3344	9,00E-07
Diesel 7.5 - 16 t	HD Euro I - 91/542/EEC I	1,02	0,0029	0,326	5,31	8,36E-06	0,201	9,00E-07
Diesel 7.5 - 16 t	HD Euro II - 91/542/EEC II	0,902	0,0029	0,207	5,5	8,05E-06	0,104	9,00E-07
Diesel 7.5 - 16 t	HD Euro III - 2000	0,972	0,0029	0,189	4,3	8,39E-06	0,0881	9,00E-07
Diesel 7.5 - 16 t	HD Euro IV - 2005	0,071	0,0029	0,008	2,65	7,85E-06	0,0161	9,00E-07
Diesel 7.5 - 16 t	HD Euro V - 2008	0,071	0,011	0,008	1,51	7,85E-06	0,0161	9,00E-07
Diesel 7.5 - 16 t	HD Euro VI	0,071	0,011	0,008	0,291	7,85E-06	0,0005	9,00E-07
Diesel 16 - 32 t	Conventional	1,93	0,0029	0,486	10,7	1,31E-05	0,418	9,00E-07
Diesel 16 - 32 t	HD Euro I - 91/542/EEC I	1,55	0,0029	0,449	7,52	1,14E-05	0,297	9,00E-07
Diesel 16 - 32 t	HD Euro II - 91/542/EEC II	1,38	0,0029	0,29	7,91	1,11E-05	0,155	9,00E-07
Diesel 16 - 32 t	HD Euro III - 2000	1,49	0,0029	0,278	6,27	1,13E-05	0,13	9,00E-07
Diesel 16 - 32 t	HD Euro IV - 2005	0,105	0,0029	0,01	3,83	1,06E-05	0,0239	9,00E-07
Diesel 16 - 32 t	HD Euro V - 2008	0,105	0,011	0,01	2,18	1,06E-05	0,0239	9,00E-07
Diesel 16 - 32 t	HD Euro VI	0,105	0,011	0,01	0,422	1,06E-05	0,0012	9,00E-07
Diesel >32 t	Conventional	2,25	0,0029	0,534	12,8	1,54E-05	0,491	9,00E-07
Diesel >32 t	HD Euro I - 91/542/EEC I	1,9	0,0029	0,51	9,04	1,36E-05	0,358	9,00E-07
Diesel >32 t	HD Euro II - 91/542/EEC II	1,69	0,0029	0,326	9,36	1,33E-05	0,194	9,00E-07
Diesel >32 t	HD Euro III - 2000	1,79	0,0029	0,308	7,43	1,36E-05	0,151	9,00E-07
Diesel >32 t	HD Euro IV - 2005	0,121	0,0029	0,012	4,61	1,26E-05	0,0268	9,00E-07
Diesel >32 t	HD Euro V - 2008	0,121	0,011	0,012	2,63	1,26E-05	0,0268	9,00E-07
Diesel >32 t	HD Euro VI	0,121	0,011	0,012	0,507	1,26E-05	0,0013	9,00E-07

Table 73 Emission factor for source category 1.A.3.biii - Buses used for calculation of emissions in the period 2014-2015 by use of Tier 2 methodology

Type	EURO class	CO	NH_3	NMVOC	NO_x	Pb	PM2.5	B(a)P
		g/km	g/km	g/km	g/km	g/km	g/km	g/km
Urban Buses Standard	Conventional	5,71	0,0029	1,99	16,5	1,90E-05	0,909	9,00E-07
Urban Buses Standard	HD Euro I - 91/542/EEC I	2,71	0,0029	0,706	10,1	1,61E-05	0,479	9,00E-07
Urban Buses Standard	HD Euro II - 91/542/EEC II	2,44	0,0029	0,463	10,7	1,55E-05	0,22	9,00E-07

Type	EURO class	CO	NH_3	NMVOC	NO_x	Pb	PM2.5	B(a)P
+ Urban Buses Standard	HD Euro III - 2000	2,67	0,0029	0,409	9,38	1,62E-05	0,207	9,00E-07
Urban Buses Standard	HD Euro IV - 2005	0,223	0,0029	0,022	5,42	1,54E-05	0,0462	9,00E-07
Urban Buses Standard	HD Euro V - 2008	0,223	0,0029	0,022	3,09	1,54E-05	0,0462	9,00E-07
Urban Buses Standard	HD Euro VI	0,223	0,0029	0,022	0,597	1,54E-05	0,0023	9,00E-07

Table 74 Emission factor for source category 1A3biv - Road Transport: Mopeds & motorcycles used for calculation of emissions in the period 2014-2015 by use of Tier 2 methodology

Capacity	EURO class	CO	NH_3	NMVOC	NOx	Pb	PM2.5	B(a)P
		g/km	g/km	g/km	g/km	g/km	g/km	g/km
<50	Conventional	14,7	0,001	8,28	0,056	0,000011	0,176	9,6E-08
<50	Mop - Euro 1	5,65	0,001	1,96	0,2	0,000011	0,0425	6,4E-08
<50	Mop - Euro 2	3,5	0,001	1,665	0,17	0,000011	0,0165	6,4E-08
<50	Mop - Euro 3	2,25	0,001	1,15	0,17	0,000011	0,011	6,4E-08
<250	Conventional	28,55	0,0019	6,015	0,146	1,08E-06	0,087	3,2E-07
<250	Mop - Euro 1	14,95	0,0019	3,45	0,2365	1,01E-06	0,039	3,2E-07
<250	Mop - Euro 2	9,185	0,0019	1,3395	0,2105	9,7E-07	0,01775	3,2E-07
<250	Mop - Euro 3	2,88	0,0019	0,6355	0,237	8,82E-07	0,00655	3,2E-07
<750	Conventional	25,7	0,0019	1,68	0,233	1,23E-06	0,014	3,2E-07
<750	Mop - Euro 1	13,8	0,0019	1,19	0,477	1,19E-06	0,014	3,2E-07
<750	Mop - Euro 2	7,17	0,0019	0,918	0,317	1,19E-06	0,0035	3,2E-07
<750	Mop - Euro 3	3,03	0,0019	0,541	0,194	1,19E-06	0,0035	3,2E-07
>750	Conventional	21,1	0,0019	2,75	0,247	1,48E-06	0,014	3,2E-07
>750	Mop - Euro 1	10,1	0,0019	1,5	0,579	1,53E-06	0,014	3,2E-07
>750	Mop - Euro 2	7,17	0,0019	0,994	0,317	1,53E-06	0,0035	3,2E-07
>750	Mop - Euro 3	3,03	0,0019	0,587	0,194	1,53E-06	0,0035	3,2E-07

4.5.1.1.2. Source-specific uncertainties and time-series consistency

Tier 2 approach upgrade has been used to calculate the emissions of the transport sector for the years 2014 and 2015, while the calculation of the emissions for previous years is done by use of Tier 1 method which brings inconsistency in this sector.

Acquired data for the fleet composition in Republic of Macedonia is available only for the years 2014 and 2015. The data was not quality checked and controlled and it needed further analysis and calculations. The National Car Registry of Macedonia database is obsolete and does not quite meet the quality standards. There are many gaps and inconsistences.

Since the calculation method of the traffic emissions has been upgraded from Tier 1 to Tier 2 for 2014 and 2015, there is a difference in the emissions in the sector 1.A.3.bii and 1.A.3.biii. This is due to the different classification of the vehicle categories in the data gained from the National Statistical Office and the data acquired from the National Car Registry of Macedonia. The statistical methodology of the vehicle fleet used by the two different data holders is not in compliance. Anyhow, this does not affect the total emissions.

The estimation of the mileage may entail some degree of uncertainty. Nevertheless, the magnitude of the mileage amount estimated for each category of vehicles on national level is comparable with information retrieved in other countries in Europe.

The activity data uncertainty was estimated to be 10 % (rating C, cf. chapter 1.7); the emission factor uncertainty for NOx, NMVOC and PM2.5 was estimated to be 20 % (rating A, cf. chapter 1.7), for SO_2 and was estimated to be 40% (rating B) and NH_3 for (125% rating C).

4.5.1.1.3. Source-specific QA/QC and verification

The activity data has been a subject to QA/QC procedures. The consumption of fuel each year has been cross checked with the previous year and compared. The calculation of the emissions using Tier 2 approach was cross checked by using reverse process to calculate the emissions from the total fuel quantities, taken from the Energy Balance of the Republic of Macedonia as part of Statistical yearbook. This amount 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.

Calculation excel sheets were developed within the Twining project for calculations of emissions in 1.A.3bi, bii, biii, and biv NFR categories by use of Tier 2 methodology for the latest years 2014 and 2015. EF from GB 2016 were inserted in the excel calculation sheet and rechecked. Calculated emissions per NFR category by use of vehicles numbers and mileage were crosschecked with fuel consumption data from the energy balance in road transport sector.

4.5.1.1.4. Source-specific recalculations including changes made in response to the review process

The ERT noted that the trend of SOx, IEFs for NFR 1.A.3.b (between 1990 and 2014) does not follow the development of the sulfur content of road fuels over time. It was recommended that the Party should review its current assumption across the time series and to use country specific information on the sulfur content of the relevant fuel types. Only recalculation of emissions for 2014 were carried out, and calculation of SOx emissions in 2015, using national specific information. With regards to the comment on use of inappropriate notation key for PM10/PM2.5 and POPs emissions from NFRs 1.A.3.b.i-iv emissions, the emissions for these pollutants were calculated only for the last two years.

4.5.1.1.5. Source-specific planned improvements including those in response to the review process

Compared to the previous IIR, also POPs (PCB, PCDD, PCDF) emissions will be included as recommended in the last Stage 3 Review Report. The emission calculation software COPERT for 1.A.3.b Road Transport is planned to be used within the Inventory System in the following submissions, in order to improve the present methodology and lower the uncertainty of the current calculations for Road Transport, especially for the period 1990-2013, for which Tier 1 methodology has been used. Due to the availability of the detailed registration data for 2014 and 2015 (data on historical years has not been yet received), MEPP will apply for a TAEIX expert missions for training concerning the use of COPERT model. Additionally, it is planned for the following submissions to calculate emissions on POPs, PM2.5 and PM10 and recalculate SOx emissions for the complete reporting period.

4.5.1.2. Gasoline evaporation (from vehicles) –NFR 1.A.3.b.v

This chapter provides the methodology, emission factors and relevant activity data to enable evaporative emissions of NMVOCs from gasoline vehicles (NFR code 1.A.3.bv) 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 negligible, due to the presence of heavier hydrocarbons and the relatively low vapor pressure of diesel fuel and can be neglected in the calculations.

4.5.1.2.1. Methodological issues

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

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

Where:

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 and Publication transport and communication for the period 2005-2014, and MOI database for 2015. The LDVs were calculated gathering subcategories (fright cars. special vehicles).

Table 75 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
2010	227184	4663	7457
2011	217016	4363	7510
2012	199329	4096	7965
2013	213808	4311	7681
2014	215175	4128	8180
2015	209231	7069	10077

Emission factors

For the calculation of emissions for emission parameters from 1990-2015, the used emission factors were taken from the GB 2009. NMVOC emission factors for gasoline fueled road vehicles, when daily temperature range is around 10 to 25 °C, were taken into account. This emission factor was chosen because calculated average annual temperature for 2014 was 13.7 °C, according to the automatic meteorological station under responsibility of HMA – Hydro Meteorological Administration.

These emission factors are presented in Table 76 below.

Table 76 Evaporative emissions emission factors source category 1.A.3.bv - Gasoline evaporation for gasoline fueled 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 fueled 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 fueled 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 fueled road vehicles — when daily temperature range is around 10 to 25 °C.

4.5.1.2.2. Source-specific uncertainties and time-series consistency

No specific uncertainty calculations are performed in this category. Time series inconstancy may occur only in the category - Light-duty vehicles (LDVs), due to use of different categorization of vehicles and their distribution between LDVs and HDVs categories in the statistical yearbooks over the years and within the MOI database.

4.5.1.2.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR. Linkage between excel sheet for vehicles numbers and calculation sheet for this category was implemented.

4.5.1.2.4. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

4.5.1.2.5. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

4.5.1.3. Road vehicle tire and brake wear NFR 1.A3.b.vi and road surface wear – NFR 1.A.3.b.vii

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 re-suspension of previously deposited material.

4.5.1.3.1. 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, an 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.

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 communication" for the period 2003-2014, and from the chapter Transport from the Statistical yearbook for the period 1990-2002, and from MOI database for 2015. The number of Heavy-duty (HDV) vehicles have been calculated as the sum of the numbers of Buses + Goods vehicles + Road tractors. Information on the number of Light duty vehicles (LDV) is not available at the moment. In the previous years there was, however, a category called "commercial vehicles" in the Statistical yearbook for the period and later "freight cars" which represent LDVs. For the last available year 2002 the published shares were taken to calculate LDVs as a part of the total "goods vehicles". The category "goods vehicles" plus "road tractors" now correlates to the former "special vehicles". Yearly mileages per vehicle category were provided by the Mechanical Faculty of Skopje.

Table 77 Activity data for the source categories 1.A.3.bvi - Road vehicle tire and brake wear and 1.A.3.b.vii 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

Year	2W x Mileage [km]	PCs x Mileage [km]	LDTs x Mileage [km]	HDVs x Mileage [km]
2003	6417000	2109498000	448265000	654650000
2004	4140000	1774428000	358100000	615340000
2005	5169000	1800211000	346780000	675610000
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
2015	30231000	2727403000	795305000	567040000

Emission factors

Tables 78 and 79 summarizes the emission factors used for the calculation of particulate emissions in the complete reporting period.

Table 78 Emission factors for source category 1.A.3.b.vi - Road vehicle tire

Pollutant	Vehicle type	Value	Unit	References
TSP	Two-wheelers	0,0083	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire and brake wear. 1.A.3.b.vii Road surface wear Table 3-1 pg 14

Table 79 Emission factors for the source category 1.A.3.bvii 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 tire and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14

Pollutant	Vehicle type	Value	Unit	References
PM10	Two-wheelers	0,003	g km-1 vehicle-1	GB 1.A.3.b.vi Road vehicle tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire 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 tire and brake wear. 1.A.3.b.vii Road surface wear Table 3-2 pg 14

4.5.1.3.2. Source-specific uncertainties and time-series consistency

No specific uncertainty calculations are performed in this category. Time series inconstancy may occur only in the category - Light-duty vehicles (LDVs) due to use of different categorization of vehicles and their distribution between LDVs and HDVs categories in the statistical yearbooks over the years and within the MOI database.

4.5.1.3.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR. Linkage between excel sheet for vehicles numbers and calculation sheet for this category was implemented.

4.5.1.3.4. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

4.5.1.3.5. Source-specific planned improvements including those in response to the review process

No planned improvement in this category.

4.5.2. Aviation

Methodological issues, activity data and emission factors can be found below distinguished by domestic and international landing and take-off (LTO) and cruise. Planned improvements, QA/QC, Recalculations and Uncertainties for the whole sector 1.A.3.a are shown at the end of this chapter.

4.5.2.1. International aviation LTO –NFR 1.A.3.ai(i)

4.5.2.1.1. 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 private jets running internationally on kerosene operate these flights.

Activity Data

The Number of LTO were taken from the publication Transport and communications for the period 2005-2015. For the previous year, the surrogate method has been used. The estimates of the activity data were related to the passenger numbers.

Table 80 Activity data for source category 1.A.3.ai(i) - International aviation LTO civil (number of LTO)

Year	Number of LTO	Year	Number of LTO	Year	Total fuel(t)
1990	11986	2000	23168	2010	12721
1991	11297	2001	11664	2011	11873
1992	10539	2002	12767	2012	11284
1993	14581	2003	12170	2013	12380
1994	14351	2004	11986	2014	13968
1995	14305	2005	13204	2015	15585
1996	12307	2006	13509		
1997	11067	2007	14174		
1998	13249	2008	14323		
1999	24156	2009	12800		

Emission factors

The calculation of emissions for emission parameters from 1990-2015 were used emission factors taken from GB 2013. The used emission factors are presented in Table 81.

Table 81 Emission factors for source category 1.A.3.ai(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 1.A.3.ai(ii)

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

4.5.2.2.1. 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 has been taken from the Energy statistics 2000-2010[25] for the period 2005-2010, and from the Statistical yearbooks chapter energy balance for period

[25] State Statistical Office of the Republic of Macedonia, Energy statistics 2000-2010, Skopje, March 2012, http://www,stat,gov,mk/PrethodniSoopstenijaOblast,aspx?id=64&rbrObl=21;

2011-2015. For the period 2000-2004 surrogate method has been used to calculate the consumption related to the passenger numbers. The data is available in the Statistical year books in the Transport chapter for the period 1990 – 2004, as for the period 2005-2015, the data is taken from the special publication Transport and other services.

In the previous IIR the incorrect numbers were presented for international cruise in the table below, although the calculation was correct. This remark has been taken into acount in the present IIR according to a finding in the last Stage 3 Review Report.

Table 82 Activity data for fuel consumption for source category 1.A.3.ai(ii)International aviation cruise (civil)

Year	Total fuel (t)	Year	Total fuel(t)	Year	Total fuel(t)
1990	20 647	2000	28265	2010	6867
1991	19461	2001	25104	2011	3652
1992	18156	2002	46843	2012	8488
1993	25117	2003	15973	2013	10108
1994	24722	2004	8882	2014	11946
1995	24642	2005	6433	2015	13419
1996	21201	2006	4670		
1997	19065	2007	6861		
1998	22823	2008	6121		
1999	41611	2009	2772		

Emission factors

Emission factors taken from GB 2013(Cruise (kg/t) — average fleet (B767)). These emission factors are given in Table 84 below.

Table 83 Emission factors for 1.A.3.ai(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/t) — 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/t) — 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/t) — 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/t) — 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/t) — average fleet (B767))

4.5.2.3. Domestic aviation cruise – NFR 1.A.3.aii(ii)

4.5.2.3.1. 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 is taken from the Energy balance from the Statistical yearbooks 1990-1999, as well as from the publication Energy statistics 2000-2010 . Data on

jet fuel and aviation gasoline consumption are available starting from 2005. For the period 1990-2004, 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 85 provides the Tier 1 calculated activity data.
In the previous IIR the incorrect numbers were presented for domestic cruise (in the table below), although the calculation was correct. This has been changed in the present IIR according to a finding in the last Stage 2 Review Report. Domestic Cruise is not occurring (NO) in Macedonia as there are no flight movements with kerosene within the country. All flight movements with kerosene are international.

Table 84 Activity data for source category 1.A.3.aii(ii) Domestic aviation cruise (civil)

Year	Fuel consumption (t)	Year	Fuel consumption (t)	Year	Fuel consumption (t)
1990	NO	2000	NO	2010	NO
1991	NO	2001	NO	2011	NO
1992	NO	2002	NO	2012	NO
1993	NO	2003	NO	2013	NO
1994	NO	2004	NO	2014	NO
1995	NO	2005	NO	2015	NO
1996	NO	2006	NO		
1997	NO	2007	NO		
1998	NO	2008	NO		
1999	NO	2009	NO		

Emission factors

Emission factors were taken from GB 2013 for all reporting period. These emission factors are given in Table 85 below.

Table 85 Emission factors for NFR - 1.A.3.aii (ii)

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

4.5.2.3.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10 % (rating C, cf. chapter 1.7); the emission factor uncertainty for NOx, NMVOC and PM2.5 was estimated to be 40 % (rating B, cf. chapter 1.7), for SO_2 and was estimated to be 20% (rating A).

4.5.2.3.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR. Info sheet was inserted in the excel calculation files, and data on fuel consumption were linked with energy balance.

4.5.2.3.4. Source-specific recalculations including changes made in response to the review process

In the 2016 Stage 3 review, the ERT noted that incorrect labeling has been used between NFR categories 1.A.3.aii(ii) and 1.A.3.ai(ii). Based on the recommendations by the ERT, the correct labeling and location of the activity data in the proper tables was implemented in this submission.

4.5.2.3.5. Source-specific planned improvements including those in response to the review process

It is planned to check with the national aviation institution on whether the flight movements given in the national statistics only contain flights using jet kerosene or also flights using aviation gasoline as well as to receive explanation for jumps and deeps in the passenger numbers

4.5.3. Railways-NFR 1.A.3.c

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;

4.5.3.1. 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 (tons)

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

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

Activity Data

The activity data for the diesel oil consumption for the period 1990, 1999-2015 was taken from the chapter Energy balance from the Statistical yearbooks for the related period. For the period 1991-1998, an approach has been developed to complete lacking years in the time series by use of passenger km used as surrogate data.

Table 86 Activity data for diesel fuel consumption in source category 1.A.3.c - Railways

Year	Diesel fuel consumption [t]	Year	Diesel fuel consumption [t]	Year	Diesel fuel consumption [t]
1990	7300	2000	4212	2010	3580
1991	5932	2001	3373	2011	3734
1992	3233	2002	2328	2012	3169
1993	1958	2003	2000	2013	2616
1994	1987	2004	2138	2014	2616
1995	1928	2005	2607	2015	1877
1996	3559	2006	3597		
1997	4182	2007	3736		
1998	4449	2008	3701		
1999	3957	2009	3634		

Emission factors

The calculation of emissions for emission parameters from 1990-2015 were used emission factors taken from GB 2013. These emission factors are given in Table 87 below.

Table 87 Emission factors for source category 1.A.3- Railways

Pollutant	Value	Unit	References
NOx	52,4	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
CO	10,7	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
NMVOC	4,65	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
NH_3	0,007	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
TSP	1,52	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
PM10	1,44	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
PM2.5	1,37	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Cd	0,01	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Cr	0,05	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Cu	1,7	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Ni	0,07	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Se	0,01	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Zn	1	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Benzo(a)pyrene	0,03	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Benzo(b)fluoranthene	0,05	g/t fuel	GB 2013 . 1.A.3.c Railways. Table 3-1. pg. 8

4.5.3.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10 % (rating C, cf. chapter 1.7); the emission factor uncertainty for NOx, NMVOC and PM2.5 was estimated to be 40 % (rating B, cf. chapter 1.7), for NH_3 was estimated to be 125% (rating D).

4.5.3.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR. Info sheet was inserted in the excel calculation file and data on fuel consumption were linked with energy balance.

4.5.3.4. Source-specific recalculations including changes made in response to the review process

SOx emissions from this NFR were calculated as recommended by the ERT. No recalculations were carried out for the other pollutants, only 2014 emissions were recalculated with using final consumption data instead of preliminary data from the national energy balance.

4.5.3.5. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

4.5.4. Other, Mobile (including military, land based and recreational boats)– NFR 1.A.5.b

Emissions from fuels used in the Military has been for a first time reported in this submission only for 2015. For the previous year it is assumed that they are included elsewhere, namely within the category 1.A.3.biii.

4.5.4.1. Methodological issues

See chapter 4.4.1

Activity Data

The activity data on diesel consumption were obtained from the Ministry of defense. Reported data for the year 2015, are presented in the following table.

Table 88 Activity data for diesel fuel oil consumption for source category 1.A.5.b - Other, Mobile for 2015

Type of fuel	Diesel fuel oil consumption [L]	Diesel fuel oil consumption [t]
ED	708450	592,97
MB-95	94500	79,10
Total	802950	672,07

Diesel fuel consumption has been reported in L and converted in tons by use of diesel density of 0,837kg/m^3.

Emission factors

See table 66.

4.5.4.1. Source-specific uncertainties and time-series consistency

No specific uncertainty analysis is done for this category.

4.5.4.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

4.5.4.3. Source-specific recalculations including changes made in response to the review process

Emissions in this category were reported for the first time.

4.5.4.4. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

4.5.5. Railways-NFR 1.A.3.c

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;

4.5.5.1. 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 (tons)

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

m = fuel type (diesel, gas oil).

Activity Data

The activity data for the diesel oil consumption for the period 1990, 1999-2015 have been taken from the chapter Energy balance from the Statistical yearbooks for that period. For the period 1991-1998, an approach has been developed to complete lacking years in the time series by use of passenger km used as surrogate data.

Table 89 Activity data for diesel fuel consumption in source category 1.A.3.c - Railways

Year	Diesel fuel consumption [t]	Year	Diesel fuel consumption [t]	Year	Diesel fuel consumption [t]
1990	7300	2000	4212	2010	3580
1991	5932	2001	3373	2011	3734
1992	3233	2002	2328	2012	3169
1993	1958	2003	2000	2013	2616
1994	1987	2004	2138	2014	2616
1995	1928	2005	2607	2015	1877
1996	3559	2006	3597		
1997	4182	2007	3736		
1998	4449	2008	3701		
1999	3957	2009	3634		

Emission factors

The calculation of emissions for emission parameters from 1990-2015 were used emission factors taken from GB 2013. These emission factors are given in Table 91 below.

Table 90 Emission factors for source category 1.A.3 - Railways

Pollutant	Value	Unit	References
NOx	52,4	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
CO	10,7	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
NMVOC	4,65	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
NH_3	0,007	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
TSP	1,52	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
PM10	1,44	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
PM2.5	1,37	kg/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Cd	0,01	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Cr	0,05	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Cu	1,7	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Ni	0,07	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Se	0,01	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Zn	1	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Benzo(a)pyrene	0,03	g/t fuel	GB 2013. 1.A.3.c Railways, Table 3-1. pg. 8
Benzo(b)fluoranthene	0,05	g/t fuel	GB 2013 . 1.A.3.c Railways. Table 3-1. pg. 8

4.5.5.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10 % (rating C, cf. chapter 1.7); the emission factor uncertainty for NOx, NMVOC and PM2.5 was estimated to be 40 % (rating B, cf. chapter 1.7), for NH_3 was estimated to be 125% (rating D).

4.5.5.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR. Info sheet was inserted in the excel calculation file and data on fuel consumption were linked with energy balance.

4.5.5.4. Source-specific recalculations including changes made in response to the review process

SOx emissions from this NFR were calculated as recommended by the ERT. No recalculations were carried out for the other pollutants, only 2014 emissions were recalculated with using final consumption data instead of preliminary data from the national energy balance.

4.5.5.5. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

4.6. Small Combustion and Non-road mobile sources and machinery – NFR 1.A.4

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

4.6.1. Methodological issues

The Tier 1 methodology has been selected by using default emission factors from the Guidebook 2009/2016. 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:

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

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

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

4.6.2. Source-specific uncertainties and time-series consistency

Source-specific uncertainties are described below per category, taken into account the uncertainty of the activity data and emission factors for 1.A.4.a, 1.A.4.b and 1.A.4.c. The jumps and deeps in the emissions in this sector are mainly due correlation of fuel consumption with the temperature as well as change of methodology in the energy balances over the years.

4.6.3. Source-specific QA/QC and verification

Info sheets were added in the excel calculation files. Data on fuel consumption were linked with the excel file - energy balance. Furthermore, trend graphs on fuel consumption were created in order to locate jumps and deeps in the trend period.

4.6.4. Source-specific recalculations including changes made in response to the review process

Some activity data, which were listed in the previous IIR 2004, 2008 and 2010, showed gaps in previous years, especially in the early 1990's. ERT encouraged us to explain the situation in the IIR as it is important to know if a fuel was not used or if data on the use is not available, to facilitate assessing

the completeness and consistency of the inventory. Data gaps in those tables in this IIR were fulfilled with proper notation keys. Recalculations of the emissions were carried out only due to the use of final energy consumption data for 2014.

4.6.5. Source-specific planned improvements including those in response to the review process

Calculation of emissions in the category 1.A.4.aii when activity data are made available and use of updated EF from GB 2016 in the following categories: 1.A.4.ai, 1.A.4.bi and 1.A.4.cii.

4.6.6. Commercial/Institutional – stationary combustion – NFR 1.A.4.ai

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.

4.6.6.1. Methodological Issues

Activity data

Activity data for this sector has been taken from the Statistical yearbooks – chapter energy balance for the period 1990 -2015. For the period 1990-1998, activity data were taken from the GHGs inventory.

Table 91 Activity data for the source category 1.A.4.ai Commercial/Institutional – stationary combustion

Year	Biomass [TJ]	Coal [TJ]	Gaseous Fuels [TJ]	Liquid Fuels [TJ]
1990	NO	144	NO	387
1991	NO	144	NO	NO
1992	NO	243	NO	NO
1993	NO	152	NO	NO
1994	NO	152	NO	NO
1995	NO	152	NO	NO
1996	NO	152	NO	NO
1997	NO	152	NO	NO
1998	712	152	NO	2640
1999	712	607	NO	5649
2000	848	58	NO	1702
2001	NO	33	NO	1202
2002	NO	196	NO	15928
2003	311	246	NO	5812
2004	325	656	NO	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

Year	Biomass [TJ]	Coal [TJ]	Gaseous Fuels [TJ]	Liquid Fuels [TJ]
2015	235	16	222	1481

Emission factors

Emission factors are taken from GB 2013. Emission factors for different type of fuels are -presented in tables 93-94.

Table 92 Emission factors for biomass for source category 1.A.4.ai - Commercial/Institutional – stationary combustion

Pollutant	Value	Unit	References
NOx	150	g/GJ	GB 2009 Table 3-10 emission factor for source category 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.
BC	28	% PM2.5	GB 2016 Table 3-8 emission factor for source category 1.A.4.a.i, page 41
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 93 Emission factors for solid fuels for source category 1.A.4.ai -Commercial/Institutional – stationary combustion

Pollutant	Value	Unit	References
NOx	173	g/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
NMVOC	88,8	g/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
SOx	900	g/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
PM2.5	108	g/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
PM10	117	g/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
BC	6,4	%PM2.5	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
TSP	124	g/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
CO	931	g/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
Pb	134	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38

Pollutant	Value	Unit	References
Cd	1,8	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
Hg	7,9	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
As	4	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
Cr	13,5	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
Cu	17,5	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
Ni	13	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
Se	1,8	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
Zn	200	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
PCB	170	µg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
PCDD/ PCDF	203	ng I-TEQ/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
benzo(a) pyren	45,5	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
benzo(b) fluoranthen	58,9	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
benzo(k) fluoranthen	23,7	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
Indeno (1.2.3-cd) pyren	18,5	mg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38
HCB	0,62	µg/GJ	GB 2016 Table 3-7 emission factor for source category 1.A.4.a.i, page 38

Table 94 Emission factors for gaseous fuels for source category 1.A.4.ai - 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, page 26
NMVOC	2,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
SOx	0,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
PM2.5	0,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
BC	4	%PM2.5	GB 2016 Table 3-8 emission factor for source category 1.A.4.a.i, page 39
PM10	0,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
TSP	0,5	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
CO	25	g/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
Pb	0,984	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
Cd	0,515	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
Hg	0,234	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
As	0,0937	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
Cr	0,656	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
Cu	0,398	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
Ni	0,984	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
Se	0,0112	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
Zn	13,6	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
PCDD/ PCDF	2	ng I-TEQ/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
benzo(a) pyren	0,562	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
benzo(b) fluoranthen	0,843	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
benzo(k) fluoranthen	0,843	mg/GJ	GB 2009 Table 3-8 emission factor for source category 1.A.4.a.i, page 26
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, page 26

Table 95 Emission factors for liquid fuels for source category 1.A.4.ai - 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, page 27
NMVOC	10	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
SOx	140	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
PM2.5	16,5	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
BC	56	% PM2.5	GB 2016 Table 3-8 emission factor for source category 1.A.4.a.i, page 40
PM10	21,5	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
TSP	27,5	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
CO	40	g/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
Pb	16	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
Cd	0,3	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
Hg	0,1	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
As	1	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
Cr	12,8	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
Cu	7,2	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
Ni	260	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
Zn	8	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
PCDD/ PCDF	10	ng I-TEQ/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
benzo(a) pyren	5,2	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
benzo(b) fluoranthen	6,2	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
benzo(k) fluoranthen	4	mg/GJ	GB 2009 Table 3-9 emission factor for source category 1.A.4.a.i, page 27
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, page 27

4.6.6.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10 % (rating C, cf. chapter 1.7); the emission factor uncertainty for SO_2 was estimated to be 20 % (rating A, cf. chapter 1.7), for SOx and NMVOC was estimated to be 40% (rating B) and for PM2.5.(125% rating C).

4.6.6.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

4.6.6.3. Source-specific recalculations including changes made in response to the review process

During the 2016 stage 3 review, the ERT asked why emissions from category 1.A.4.aii were not reported. It was check with the statistical office whether activity data from this source has been accounted for elsewhere, but we did not receive any answer on this issue. Therefore, for this submission for the emissions in this category NE notation key has been used. Recalculations were done for 2014 emissions within the category 1.A.4.ai due to use of final consumption data for this year.

4.6.6.4. Source-specific planned improvements including those in response to the review process

Plan to check possibility to gather activity data in frame of survey, made by National statistical office and report emissions in following submissions. Use of updated EF for GB 2016 in the category 1.A.4.ai.

4.6.7. Residential – stationary combustion – NFR 1.A.4.bi

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[26]. 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 96 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

4.6.7.1. Methodological Issues

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 the complete reporting period.

Since Energy statistics data were 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 97 Activity data for source category 1.A.4.bi - Residential: Stationary

Year	Biomass [TJ]	Coal [TJ]	Gaseous Fuels [TJ]	Liquid Fuels [TJ]
1990	15,814	186	NO	397
1991	13,688	333	NO	863
1992	14,961	323	NO	921
1993	16,774	313	NO	980
1994	16,024	304	NO	1038
1995	16,024	294	NO	1097
1996	16,024	284	NO	1156
1997	16,024	275	NO	1214

[26] State Statistical Office of the Republic of Macedonia,Energy consumption in households, 2014, Skopje, December, 2016

1998	15,273	213	NO	1225
1999	16,028	276	NO	1316
2000	19,040	235	NO	1394
2001	14,811	177	NO	1435
2002	14,654	227	NO	1513
2003	16,315	228	NO	1577
2004	16,271	248	NO	1657
2005	14,629	249	NO	1700
2006	15,688	305	NO	1775
2007	13,280	228	NO	1907
2008	16,335	128	NO	1828
2009	18,250	85	NO	1912
2010	18,759	95	NO	1872
2011	17,953	44	NO	1827
2012	17,739	47	NO	1470
2013	14,315	55	0,390	771
2014	17,739	37	1,661	430
2015	14,315	33	2,556	485

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, heavy metals, and POPs, the default emission factors of the Guidebook 2009 have been selected. Emission factors for different type of fuels are presented in the four following tables.

Table 98 Emission factors for biomass for source category 1.A.4.bi - 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, page 29
NMVOC	925	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
SOx	20	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
NH_3	3,8	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
PM2.5	695	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
PM10	695	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
TSP	730	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
CO	5300	g/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
Pb	40	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
Cd	1,4	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
Hg	0,5	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
As	1	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
Cr	2,9	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
Cu	8,6	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
Ni	4,4	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
Se	0,5	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
Zn	130	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
PCB	0,06	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
PCDD/ PCDF	700	ng I-TEQ/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29

Pollutant	Value	Unit	References
benzo(a) pyren	210	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
benzo(b) fluoranthen	220	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
benzo(k) fluoranthen	130	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
Indeno (1.2.3-cd) pyren	140	mg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29
HCB	6	µg/GJ	GB 2009 Table 3-6 emission factor for source category 1.A.4.b.i, page 29

Table 99 Emission factors for coal for source category 1.A.4.bi - Residential: Stationary

Pollutant	Value	Unit	References
NOx	110	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
NMVOC	484	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
SOx	900	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
NH_3	0,3		GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
PM2.5	398	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
BC	6,4	% PM2.5	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
PM10	404	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
TSP	444	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
CO	4600	g/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
BC	6,4	% of PM2.5	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
Pb	130	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
Cd	1,5	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
Hg	5,1	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
As	2,5	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
Cr	11,2	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
Cu	22,3	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
Ni	12,7	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
Se	1	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
Zn	220	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
PCB	170	µg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
PCDD/ PCDF	800	ng I-TEQ/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
benzo(a) pyren	230	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
benzo(b) fluoranthen	330	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
benzo(k) fluoranthen	130	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
Indeno (1.2.3-cd) pyren	110	mg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34
HCB	0,62	µg/GJ	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 34

Table 100 Emission factors for natural gas for source category 1.A.4.bi - 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,page 22
NMVOC	10,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
SOx	0,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
PM2.5	0,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
BC	5,4	% PM2.5	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 35
PM10	0,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
TSP	0,5	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
CO	31	g/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22

Pb	0,984	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
Cd	0,515	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
Hg	0,234	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
As	0,0937	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
Cr	0,656	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
Cu	0,398	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
Ni	0,984	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
Se	0,0112	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
Zn	13,6	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
PCDD/ PCDF	0,5	ng I-TEQ/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
benzo(a) pyren	0,562	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
benzo(b) fluoranthen	0,843	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
benzo(k) fluoranthen	0,843	mg/GJ	GB 2009 Table 3-4 emission factor for source category 1.A.4.b.i,page 22
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,page 22

Table 101 Emission factors for liquid fuels for source category 1.A.4.bi -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, page 23
NMVOC	15,5	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
SOx	140	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
PM2.5	3,7	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
BC	8,5	% PM2.5	GB 2016 Table 3-3 emission factor for source category 1.A.4.b.i, page 35
PM10	3,7	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
TSP	6	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
CO	46	g/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
Pb	15,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
Cd	1,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
Hg	0,03	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
As	0,9	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
Cr	15,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
Cu	7,9	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
Ni	240	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
Zn	8,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
PCDD/ PCDF	10	ng I-TEQ/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
benzo(a) pyren	22	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
benzo(b) fluoranthen	25,7	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
benzo(k) fluoranthen	12,5	mg/GJ	GB 2009 Table 3-5 emission factor for source category 1.A.4.b.i, page 23
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, page 23

4.6.7.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10 % (rating C, cf. chapter 1.7); the emission factor uncertainty for SO_2 was estimated to be 20 % (rating A, cf. chapter 1.7), for SOx and NMVOC was estimated to be 40% (rating B) and for PM2.5 and NH_3 (125% rating C).

4.6.7.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

4.6.7.3. Source-specific recalculations including changes made in response to the review process

No recommendations were given by ERT for this category. Recalculations were done for 2014 emissions due to use of final consumption data for this year.

4.6.7.4. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

4.6.8. Residential: Household and gardening (mobile) – NFR 1.A.4.bii

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.

4.6.8.1. Methodological Issues

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.

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 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.

Table 102 Activity data for source category 1.A.4.bii - Residential: Household and gardening (mobile)

Year	Gasoline consumption [TJ]	Year	Gasoline consumption [TJ]	Year	Gasoline consumption [TJ]
1990	48,62	2000	34,4	2010	34
1991	29,9	2001	34,4	2011	34
1992	56,1	2002	34,4	2012	34
1993	31,8	2003	34	2013	34
1994	31,8	2004	34	2014	34
1995	38,8	2005	34	2015	34
1996	38,4	2006	34		
1997	38,0	2007	34		
1998	38,2	2008	34		

1999	35,2	2009	34		

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 103.

Table 103 Emission factors for source category 1.A.4.bii - 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.19
Cd	0,01	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
Cr	0,05	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
Cu	1,70	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
Ni	0,07	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
Se	0,01	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
Zn	1	mg/kg fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19

4.6.8.1. Source-specific uncertainties and time-series consistency

See chapter 3.6.7.1.

4.6.8.2. Source-specific QA/QC and verification

No specific QA/QC and verification were done in the sector.

4.6.8.3. Source-specific recalculations including changes made in response to the review process

During the 2016 stage 3 review, the ERT pointed out emissions from NFR 1.A.4.b.ii, are currently estimated only for the period 1991 - 2000. The ERT recognized the challenge faced by the Party, due to insufficient information available from the earlier inventories to enable deriving a full time series of emissions. During the review, the ERT provided suggestions on how to proceed (use of emissions calculated in 2000 for the upcoming years or use household number as surrogate data) to provide emission. We have agreed to use the suggestion with surrogate data, however due to limitation of time we have kept same emissions from 2000 for the period 2001-2015.

ERT also noted that TSP emissions were reported until 2000 (while PM2.5/PM10 only reported in 1995. It was clarified that copy/paste mistake was done and emissions for PM2.5/PM10 were reported as NE for reporting period while for TSP emissions as explained above emissions estimated in 2000 were reported constant for the upcoming years.

4.6.8.4. Source-specific planned improvements including those in response to the review process

Calculation of emissions in this category by use of households number as surrogate data.

4.6.9. Agriculture/Forestry/Fishing: Stationary – NFR 1.A.4.ci

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.

4.6.9.1. Methodological Issues

Activity data

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

Table 104 Activity data for source category 1.A.4.ci - Agriculture/Forestry/Fishing: Stationary

Year	Biomass [TJ]	Coal [TJ]	Gaseous Fuels [TJ]	Liquid Fuels [TJ]
1990	NO	32,78208	NO	1302
1991	NO	33,41493	NO	1545,235
1992	NO	33,08283	NO	1321,978
1993	NO	33,31204	NO	943,5977
1994	NO	33,3377	NO	890,333
1995	NO	33,57047	NO	984,7882
1996	NO	33,51847	NO	1124,645
1997	NO	33,67497	NO	874,6727
1998	NO	0,022415	NO	828,8763
1999	NO	0,063526	NO	959,1264
2000	NO	1,90485	NO	1260,63
2001	NO	0,37485	NO	998,088
2002	NO	0,00765	NO	570,7749
2003	14,07214	1,3617	NO	456,596
2004	18,07457	1,84365	NO	1507,755
2005	22,03457	0,80	NO	967,457
2006	20,394	0,25	NO	801,649
2007	19,06457	0,25	NO	512,99
2008	27,56	0,59	NO	549,712
2009	41,20	0,11	NO	387,043
2010	42,09	0,11	NO	729,323
2011	49,10	0,11	NO	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	NO	485,0583
2015	90,1552	35,57239	NO	207,1407

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.

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

4.6.10.1. Methodological Issues

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. 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 105 Activity data for source category 1.A.4.cii - Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

Year	Diesel [TJ]	LPG [TJ]	Gasoline[TJ]
1990	9558	NO	2441
1991	12917	NO	1326
1992	11276	NO	909
1993	7651	NO	1046
1994	7364	NO	842
1995	8305	NO	772
1996	9482	NO	884
1997	6932	NO	1130
1998	7346	NO	294
1999	8149	NO	692
2000	11598	NO	985
2001	9574	NO	813
2002	5325	NO	452
2003	4260	NO	362
2004	14066	NO	1195
2005	1865	NO	393
2006	711	NO	620
2007	674	NO	339
2008	140	NO	341
2009	610	NO	336
2010	540	NO	351
2011	564	NO	394
2012	3762	NO	379
2013	5710	NO	368
2014	6007	NO	390
2015	6477	NO	372

Emission factors

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

Table 106 Emission for source category 1.A.4.cii - 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, page 19
NMVOC	3366	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
PM2.5	1738	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
PM10	1738	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
TSP	1738	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19

Pollutant	Value	Unit	References
CO	10939	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
Cd	0,01	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
Cr	0,05	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
Cu	1,70	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
Ni	0,07	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
Zn	1	mg/GJ	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
benzo(a) pyren	30	µg/GJ	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
benzo(b) fluoranthen	50	µg/GJ	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19

Table 107 Emission factors for LPG source category 1.A.4.cii - Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

Pollutant	Value	Unit	References
NOx	61093	g/t	GB 2016 Table 3-1 emission factor for source category 1.A.4.c.ii, page 24-25
NMVOC	6720	g/t	GB 2016 Table 3-1 emission factor for source category 1.A.4.c.ii, page 24-25
PM2.5	225	g/t	GB 2016 Table 3-1 emission factor for source category 1.A.4.c.ii, page 24-25
PM10	225	g/t	GB 2016 Table 3-1 emission factor for source category 1.A.4.c.ii, page 24-25
TSP	225	g/t	GB 2016 Table 3-1 emission factor for source category 1.A.4.c.ii, page 24-25
CO	4823	g/t	GB 2016 Table 3-1 emission factor for source category 1.A.4.c.ii, page 24-25

Table 108 Emission factors for gasoline for source category 1.A.4.cii - Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

Pollutant	Value	Unit	References
NOx	7117	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
NMVOC	17602	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
PM2.5	157	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
PM10	157	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
TSP	157	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
CO	770368	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
Cd	0,01	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
Cr	0,05	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
Cu	1,70	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
Ni	0,07	mg/kg	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
Zn	1	mg/GJ	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
benzo(a) pyren	40	µg/GJ	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
benzo(b) fluoranthen	40	µg/GJ	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20

4.6.10.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10 % (rating C, cf. chapter 1.7); the emission factor uncertainty for SO2 was estimated to be 20 % (rating A, cf. chapter 1.7), for SOx and NMVOC was estimated to be 40% (rating B) and for PM2.5 and NH3 (125% rating C).

4.6.10.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

4.6.10.3. Source-specific recalculations including changes made in response to the review process

During the 2016 stage 3 review, the ERT pointed out that the emission factor table used for gasoline activity data has been omitted in the IIR. This omission was corrected in the present IIR.

4.6.10.4. Source-specific planned improvements including those in response to the review process

Update of EF from older versions with updated EF from GB 2016.

4.6.11. Agriculture/Forestry/Fishing: Off-road vehicles and other machinery – NFR 1.A.4.ciii

As there is no commercial fishing industry in Macedonia, emissions from 1.A.4.ciii (national fishing) are not occurring (NO). It is assumed that the fuel consumption of the few private working boats used for fishing are included in 1.A.3,d domestic navigation.

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 1.B.1.a

4.7.1.1. 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:

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

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

$EF_{\text{pollutant}}$ = the emission factor for this technology and this pollutant

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.

Table 109 Activity data for source category 1.B.1.a - Fugitive emission from solid fuels: Coal mining and handling

Year	Coal mined[Mg]	Year	Coal mined[Mg]	Year	Coal mined[Mg]
1990	6643409	2000	7513998	2010	6583074
1991	6978171	2001	8142082	2011	7902084
1992	6472920	2002	7571202	2012	7309546
1993	6917774	2003	7271202	2013	6633560
1994	6859762	2004	7296136	2014	6681752
1995	7249237	2005	6882862	2015	5927749
1996	7145667	2006	6653474		

1997	7442876	2007	6569220		
1998	8144653	2008	7669103		
1999	7277623	2009	7395915		

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 110 Emission factors for1.B.1.a - Fugitive emission from solid fuels: Coal mining and handling

Pollutant	Value	Unit	References
NMVOC	0,2	kg/Mg	GB 2016 Table 3-2 Tier 2 emission factors for source category 1.B.1.a Coal mining and handling, Open cast mining, page 10
PM10	0,039	kg/Mg	GB 2016 Table 3-2 Tier 2 emission factors for source category 1.B.1.a Coal mining and handling, Open cast mining, page 10
PM2.5	0,06	kg/Mg	GB 2016 Table 3-2 Tier 2 emission factors for source category 1.B.1.a Coal mining and handling, Open cast mining, page 10
TSP	0,082	kg/Mg	GB 2016 Table 3-2 Tier 2 emission factors for source category 1.B.1.a Coal mining and handling, Open cast mining, page 10

4.7.1.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10 %; the emission factor uncertainty for NOx was estimated to be 20 % (rating A, cf. chapter 1.7) and 200% for PM2.5. (rating D).

4.7.1.2. Source-specific QA/QCand verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

4.7.1.3. Source-specific recalculations including changes made in response to the review process

No recalculations were performed in this category.

4.7.1.4. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

4.7.2. Fugitive emissions oil: Refining/storage –NFR 1.B.2.aiv

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.

4.7.2.1. 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.

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 for the whole reporting period and are presented in the

following table. For 2015 no crude oil input was reported. Therefore emissions in this category did not occur.

Table 111 Activity data for source category 1.B.2.aiv - Fugitive emissions oil: Refining/storage

Year	Crude oil input [Mg]	Year	Crude oil input[Mg]	Year	Crude oil input[Mg]
1990	1216491	2000	1043104	2010	853000
1991	964033	2001	1012872	2011	705144
1992	566701	2002	648137	2012	259606
1993	1018201	2003	78749	2013	59676
1994	143148	2004	975262	2014	7274
1995	119437	2005	946747	2015	NO
1996	696341	2006	1067096		
1997	379759	2007	1050007		
1998	754775	2008	1061736		
1999	765412	2009	972532		

Emission factors

Emission factors for emission estimations in this sector are presented in the following table and are directly taken from GB 2016.

Table 112 Emission factors for source category 1.B.2.aiv- Fugitive emissions oil: Refining/storage

Pollutant	Value	Unit	References
NOx	0,24	kg/Mg crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
NMVOC	0,2	kg/Mg crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
SOx	0,62	kg/Mg crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
NH_3	0,0011	kg/Mg crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
PM2.5	0,0043	kg/Mg crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
PM10	0,0099	kg/Mg crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
TSP	0,016	kg/Mg crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
CO	0,09	kg/Mg crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
Pb	0,0051	g/MG crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
Cd	0,0051	g/MG crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
Hg	0,0051	g/MG crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
As	0,0051	g/MG crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
Cr	0,0051	g/MG crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
Cu	0,0051	g/MG crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
Ni	0,0051	g/MG crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
Se	0,0051	g/MG crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
Zn	0,0051	g/MG crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14
PCDD/ PCDF	0,0057	µg/Mg crude oil input	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.iv page 14

4.7.2.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10%; the emission factor uncertainty for NMVOC and SOx was estimated to be 20% (rating A, cf. chapter 1.7), and 40% for NO_x and NH_3 (rating B), and 200% for EF uncertainty for PM2.5 (rating D).

4.7.2.3. Source-specific QA/QC and verification

Crosschecking of data reported by the operator and data reported in Energy balance is carried out.

4.7.2.4. Source-specific recalculations including changes made in response to the review process

The ERT noted that the NFR tables contain some zero-values. The ERT recommendation to replace the zero-values by the actual emissions instead of plain zero (0) values or to use the appropriate notation keys was implemented.

4.7.2.5. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

4.7.3. Distribution of oil products – NFR 1.B.2.v

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

4.7.3.1. 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.

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 Republic of Macedonia for the period 2005-2015[27], and the Industry chapter within the Statistical yearbooks of the Republic of Macedonia 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, for the whole reporting period. The quantity of distributed oil is presented in the following table.

[27]State Statistical Office of the Republic of Macedonia, Industry in the Republic of Macedonia, 2002-2015)http://www,stat,gov,mk/PublikaciiPoOblast,aspx?id=8&rbrObl=19

Table 113 Activity data for source category 1.B.2.a.v- Distribution of oil products

Year	Distributed oil (Mg)	Year	Distributed oil (Mg)	Year	Distributed oil (Mg)
1990	592133	2000	394487	2010	516450
1991	457295	2001	959035	2011	566686
1992	278185	2002	178107	2012	572365
1993	597143	2003	338459	2013	626447
1994	117255	2004	383553	2014	598267
1995	828450	2005	402385	2015	675630
1996	334711	2006	409568		
1997	459252	2007	454633		
1998	484508	2008	456165		
1999	514251	2009	447263		

The emission factor from GB 2016 has been used for calculations.

Table 114 Emission factors for source category 1.B.2.a.v- Distribution of oil products for NMVOC

Pollutant	Value	Unit	References
NMVOC	2	kg/Mg oil	GB 2016 Table 3-1 emission factor for source category 1.B.2.a.v page 12

4.7.3.1. Source-specific uncertainties and time-series consistency

See chapter 3.7.2.1.

4.7.3.2. Source-specific QA/QC and verification

Comparison of data reported under this category with data reported under 1.B.a.iv

4.7.3.3. Source-specific recalculations including changes made in response to the review process

No recalculations were performed in this category.

4.7.3.4. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

4.7.4. Venting and flaring – 1.B.2.c

4.7.4.1. 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.

Activity data

The activity data for this source category for the years 2004, 2008 and 2010, has been taken from the previous informative reports, which were originally obtained from the refinery. For the period 1990-1999, the activity data were taken from the reported data in 2013 reporting round (there is no presented source where this data is 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 the data was not reported. No production process was carried out in 2015 so the emissions in this category are not occurring.

Table 115 Activity data for source category 1.B.2.c - Venting and flaring

Year	Refinery feed [TJ]	Year	Refinery feed [TJ]	Year	Refinery feed [TJ]
1990	325	2000	188	2010	165
1991	186	2001	201	2011	140
1992	109	2002	129	2012	52
1993	196	2003	156	2013	12
1994	28	2004	201	2014	1
1995	23	2005	188	2015	NO
1996	134	2006	212		
1997	73	2007	209		
1998	146	2008	211		
1999	148	2009	193		

Emission factors

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

Table 116 Emission factors for source category 1B2cVenting 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

4.7.4.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 20%; the emission factor uncertainty for NMVOC was estimated to be 20% (rating A, cf. chapter 1.7), and 40% for NOx (rating B).

4.7.4.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR. Data were crosschecked with activity data from the category 1.B.a.iv

4.7.4.4. Source-specific recalculations including changes made in response to the review process

No recalculations were performed in this category.

4.7.4.5. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

4.7.5. Other fugitive emissions from energy production – 1.B.2.d

Within the previous reporting round, emissions under NFR 1.B.2.d were reported as “NA” except NH_3, Hg and As which are reported as “NE”. The ERT encourages us to check if the activity exists in our country, and to estimate and report occurring emissions, or to correct the notation key to “NO” in case the source does not exist in the country. The result of the investigations was that the source occur in the country, since geothermal energy is used for energy production. Therefore, emissions for NH_3, Hg and As were calculated for the period 2005-2015, where data on geothermal energy consumption were available.

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 the national level, using annual national statistics on the extraction of geothermal energy from the earth.

The Tier 1 emission factors assume an averaged or typical technology and abatement implementation in the country and integrate all different sub-processes within the geothermal energy extraction process.

Activity data

The activity data for this source category for the period 1998-2015 expressed in m^3 are taken from the Energy balance. Data are converted in Gcal which are expressed in GWh by use of conversion factor taken from the Energy balance for Republic of Macedonia, where it is stated that 1 Gcal = 1,16 $*10^{-3}$ GWh.

Table 117 Activity data for source category 1.B.2.d - Other fugitive emissions from energy production

Year	Geothermal energy [MWh electricity produced]	Year	Geothermal energy [MWh electricity produced]	Year	Geothermal energy [MWh electricity produced]
1990	NE	2000	181751	2010	141326
1991	NE	2001	269512	2011	148889
1992	NE	2002	151114	2012	129343
1993	NE	2003	153373	2013	117210
1994	NE	2004	136983	2014	92420
1995	NE	2005	115561	2015	84884
1996	NE	2006	116846		
1997	NE	2007	124244		
1998	217375	2008	115379		
1999	178608	2009	141326		

Emission factors

Emission factors are taken from the GB 2016, expressed in MWh electricity produced.

Table 118 Emission factors for source category 1.B.2.d -Other fugitive emissions from energy

Pollutant	Value	Unit	References
NH_3	2100	g/MWh electricity produced	GB 2016 Table 3-4 emission factor for source category 1.B.2.d page 5
Hg	0,44	g/MWh electricity produced	GB 2016 Table 3-4 emission factor for source category 1.B.2.d page 5
As	0,025	g/MWh electricity produced	GB 2016 Table 3-4 emission factor for source category 1.B.2.d page 5

4.7.5.1. Source-specific uncertainties and time-series consistency

No specific uncertainties were calculated for this category.

4.7.5.2. Source-specific QA/QC and verification

Info sheet was added to the calculation sheet and consumption data form energy balance were linked.

4.7.5.3. Source-specific recalculations including changes made in response to the review process

Emission in the category 1.B.2.d were reported for the first time in this reporting round as recommended by ERT. The ERT stated that emissions under NFR 1.B.2.d are reported as “NA” except

NH3, Hg and As which are reported as “NE”. The ERT encouraged the Party to check if the activity exists in the country and to estimate and report occurring emission. Emissions were calculated and chapter has been added for this category.

4.7.5.4. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

5. INDUSTRIAL PROCESSES AND PRODUCT USE (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 2009/2013/2016) for the period from 1990-2015.

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 119 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	√
2. A.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
2.C.5.d Zinc production	NO

NFR sector	Completeness
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.

5.3. Mineral products – NFR 2.A

5.3.1. Cement production – 2.A.1

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

5.3.1.1. 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 received from the operator itself.

Table 120 Activity data for source category 2.A.1 - Cement production

Year	Clinker produced (t)	Year	Clinker produced (t)	Year	Clinker produced (t)
1990	491900	2000	614160	2010	588980
1991	465380	2001	716960	2011	687990
1992	396500	2002	739490	2012	645480
1993	413440	2003	602570	2013	577850
1994	375910	2004	643260	2014	518200
1995	365120	2005	694920	2015	553232
1996	396020	2006	801300		
1997	475250	2007	882830		
1998	346870	2008	843770		
1999	427080	2009	478400		

Emission factors

For calculation (estimation) of emissions for PM2.5, PM10 and TSP for the period 1990-2014 emission factors were taken from GB 2016.

These emission factors are given in the table below:

Table 121 Emission factors for source category 2.A.1 cement production

Pollutant	Value	Unit	References
PM10	234	g/Mg clinker	GB 2016 2.A.1 Cement production. Table 3-1. pg. 10
PM2.5	130	g/Mg clinker	GB 2016 2.A.1 Cement production. Table 3-1. pg. 10
TSP	260	g/Mg clinker	GB 2016 2.A.1 Cement production. Table 3-1. pg. 10

5.3.1.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 2%; the emission factor uncertainty was estimated to be 200% (rating D, cf. chapter 1.7), based on expert judgment.

There has been one cement plant operating over the whole time series. Emissions follow the changes production. Currently, changes in abatement technology are not taken into account, but it is planned to do this in the future.

5.3.1.2. Source-specific QA/QC and verification

Standard QA/QC procedures are carried out for this source category, i.e. activity data are checked for plausibility and time-series consistency; emission data are checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.3.1.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.3.1.4. Source-specific planned improvements including those in response to the review process

It is planned to apply a Tier 2 method in the future, taking into account the abatement technology installed at the cement plant.

5.3.2. Lime production – NFR 2.A.2

5.3.2.1. 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, was taken from Statistical Yearbook - chapter industry, while activity data for the period 2000-2013, was taken from the International Mineral yearbook[28]. No data were available for 2008 and 2014. According to the MS expert comments, data on hydraulic lime can be taken into account. Therefore, available data for 2014 and 2015 from the Statistical publication Industry in the Republic of Macedonia was used as activity data.

Table 122 Activity data for source category 2.A.2 - Lime production

Year	Lime produced (t)	Year	Lime produced (t)	Year	Lime produced (t)
1990	37452	2000	1000	2010	2700
1991	29194	2001	500	2011	2700

[28] http://minerals.usgs.gov/minerals/pubs/country/europe.html#mk

Year	Lime produced (t)	Year	Lime produced (t)	Year	Lime produced (t)
1992	33872	2002	500	2012	2700
1993	24904	2003	500	2013	2700
1994	14097	2004	500	2014	10836
1995	12538	2005	15009	2015	8003
1996	9707	2006	12704		
1997	4344	2007	7517		
1998	964	2008	NE		
1999	4264	2009	2713		

Emission factors

For the calculation (estimation) of emissions for PM2.5, PM10 and TSP for the period 1990-2015 emission factors were taken from GB 2016.

These emission factors are given in Table 123 below.

Table 123 Emission factors for source category 2.A.2 - Lime production

Pollutant	Value	Unit	References
PM10	3500	g/Mg lime	GB 20162.A.2Lime production, Table 3-1, pg. 8
PM2.5	700	g/Mg lime	GB 20162.A.2 Lime production, Table 3-1, pg. 8
TSP	9000	g/Mg lime	GB 20162.A.2 Lime production, Table 3-1, pg. 8

5.3.2.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 5%; the emission factor uncertainty was estimated to be 200% (rating D), based on expert judgement.

The activity data time series, as taken from the statistical yearbook, shows some inconsistencies; data is not available for 2008.

5.3.2.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.3.2.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category. Hydraulic lime data for 2014 and 2015 was used as activity data due to the recommendation given by the MS solvent and industry expert.

5.3.2.4. Source-specific planned improvements including those in response to the review process

No improvements are planned in this category.

5.3.3. Glass production – NFR 2.A.3

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.

5.3.3.1. 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.

Activity Data for source category 2.A.3 - 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.

Table 124 Activity data for 2.A.3 - Flat glass production

Year	Flat glass produced [t]	Year	Flat glass produced [t]	Year	Flat glass produced [t]
1990	448	2000	NO	2010	NO
1991	32	2001	NO	2011	NO
1992	179	2002	NO	2012	NO
1993	NO	2003	NO	2013	NO
1994	NO	2004	NO	2014	NO
1995	NO	2005	NO	2015	NO
1996	NO	2006	NO		
1997	NO	2007	NO		
1998	NO	2008	NO		
1999	NO	2009	NO		

Emission factors

For the estimation of emission parameters from 1990-1992, the used emission factors were taken from GB 2016. These emission factors are given in Table 125 below.

Table 125 Emission factors for source category 2.A.3 Flat glass production

Pollutant	Value	Unit	References
PM10	120	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-2.Flat glass production pg. 16
PM2.5	100	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
TSP	130	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Pb	0.4	g/Mg glass	GB 20162.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Cd	0.068	g/Mg glass	GB 20162.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Hg	0.003	g/Mg glass	GB 20162.A.3 Glass production. Table 3-2. Flat glass production pg. 16
As	0.08	g/Mg glass	GB 20162.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Cr	0.08	g/Mg glass	GB 20162.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Cu	0.007	g/Mg glass	GB 20162.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Ni	0.74	g/Mg glass	GB 20162.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Se	0.15	g/Mg glass	GB 20162.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Zn	0.37	g/Mg glass	GB 20162.A.3 Glass production. Table 3-2. Flat glass production pg. 16

Activity Data for source category 2.A.3 - Glass wool production

The activity data for glass wool production was taken from Statistical yearbooks - chapter industry for the period 1990-1998.

Table 126 Activity data for source category 2.A.3 - Glass wool production

Year	Glass wool produced [t]	Year	Glass wool produced [t]	Year	Glass wool produced [t]
1990	2739	2000	NO	2010	NO
1991	1176	2001	NO	2011	NO
1992	1828	2002	NO	2012	NO
1993	444	2003	NO	2013	NO
1994	1332	2004	NO	2014	NO
1995	3043	2005	NO	2015	NO
1996	1454	2006	NO		
1997	961	2007	NO		
1998	960	2008	NO		
1999	NO	2009	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 2016.

These emission factors are given in Table 127 below.

Table 127 Emission factors for Glass wool production

Pollutant	Value	Unit	References
NMVOC	500	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-5.Glass wool production pg. 19
NH_3	1400	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-5. Glass wool production pg. 19
PM2.5	520	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-5. Glass wool production pg. 19
PM10	590	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-5. Glass wool production pg. 19
TSP	670	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-5. Glass wool production pg. 19

5.3.3.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10%; the emission factor uncertainty was estimated to be 40% for NMVOC and NH_3 and 200% for PM2.5, based on expert judgement.

This time series ends in 1998, as the production of flat glass and glass wool ceased by that time.

5.3.3.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.3.3.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.3.3.4. Source-specific planned improvements including those in response to the review process

No improvements are planned in this category.

5.3.4. Quarrying and mining of minerals other than coal – NFR 2.A.5.a

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.

5.3.4.1. Methodological issues

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

Activity Data

The activity data for mineral produced are taken from the Statistical yearbook for the period 1990-2005, while activity data for the period 2005-2015 are taken from the statistical publication for industry.

Table 128 Emission factors for minerals produced for source category 2.A.5 Quarrying and mining the minerals other than coal

Year	Mineral produced [t]	Year	Mineral produced [t)]	Year	Mineral produced [t)]
1990	6117811	2000	4917560	2010	5659141
1991	5730999	2001	3488792	2011	5606998
1992	5299552	2002	2855005	2012	6042327
1993	5246466	2003	739786	2013	6179618
1994	4817372	2004	347795	2014	6109330
1995	5215134	2005	2827908	2015	6295363
1996	5233110	2006	4605478		
1997	5528418	2007	4473612		
1998	5158798	2008	4598850		
1999	4658946	2009	3766500		

Emission factors

For estimation of emissions for PM2.5, PM10 and TSP the used emission factors were taken from GB 2016. These emission factors are given in Table 129 below.

Table 129 Emission factors for minerals produced for 2.A.5 source category - Quarrying and mining of minerals other than coal

Pollutant	Value	Unit	References
TSP	102	g/Mg mineral	GB 2016 2.A.5.a Quarrying and mining of minerals other than coal. Table 3-1. pg. 5
PM10	50	g/Mg mineral	GB 2016 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 2016 2.A.5.a Quarrying and mining of minerals other than coal. Table 3-1. pg. 5

5.3.4.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10%; the emission factor uncertainty was estimated to be 200% (rating D), based on expert judgment.

5.3.4.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.3.4.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.3.4.4. Source-specific planned improvements including those in response to the review process

No improvements are planned in this category.

5.3.5. Construction and demolition – NFR 2.A.5.b

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.

5.3.5.1. 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 is 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 130 Activity data for constructed and demolished area for source category 2.A.5.b Construction and demolition

Year	m^2/year	Year	m^2/year	Year	m^2/year
1990	1810252	2000	897868	2010	920066
1991	1532878	2001	957742	2011	958890
1992	1375918	2002	871894	2012	967773
1993	1203495	2003	952813	2013	924887
1994	1017799	2004	1021573	2014	803889
1995	949006	2005	961766	2015	752207
1996	927963	2006	1016189		
1997	843602	2007	892385		
1998	793938	2008	817091		
1999	940300	2009	858076		

Emission factors

Emission factors for the particulates PM2.5, PM10 and TSP are taken from GB 2016. These emission factors are given in Table 131 below.

Table 131 Emission factors for source category 2.A.5.b - Construction and demolition

Pollutant	Value	Unit	References
TSP	0,29	kg/m^2/year	GB 2016 2.A.5.b Construction and demolition. Table 3-1. pg. 6
PM10	0,086	kg/m^2/year	GB 2016 2.A.5.b Construction and demolition. Table 3-1. pg. 6
PM2.5	0,0086	kg/m^2/year	GB 2016 2.A.5.b Construction and demolition. Table 3-1. pg. 6

5.3.5.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10%; the emission factor uncertainty was estimated to be 200% (rating D), based on expert judgment.

5.3.5.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.3.5.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.3.5.4. Source-specific planned improvements including those in response to the review process

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 types of constructed and demolished buildings.

5.3.6.Storage, handling and transport of mineral products – NFR 2.A.5.c

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

5.3.6.1. Methodological issue

In a Tier 2 approach, the emissions from storage, handling and transport of mineral products needs 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.

Activity data

Data on transported mineral by road and railway transport were taken from the statistical publication Transport and communications for the period 2009-2015. 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, while regarding the railway transport the content of transported minerals in the transported goods in railway transport were estimated.

Table 132 Activity data for source category 2.A.5.c - Storage, handling and transport of mineral products

Year	Products transported [t]	Year	Products transported [t]	Year	Products transported [t]
1990	246717	2000	48708	2010	2820746
1991	143309	2001	575864	2011	3330100
1992	96043	2002	685869	2012	3499387
1993	152750	2003	8006331	2013	3407267
1994	49973	2004	10497726	2014	5564332
1995	57838	2005	8475328	2015	4142405
1996	34404	2006	16441405		
1997	106462	2007	4813390		
1998	189443	2008	1965897		
1999	152301	2009	7058289		

Emission factors

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

Table 133 Emission factors for source category 2.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

5.3.6.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10%; the emission factor uncertainty was estimated to be 200% (rating D), based on expert judgment.

5.3.6.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.3.6.4. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.3.6.5. Source-specific planned improvements including those in response to the review process

No improvements are planned in this category.

5.4. Chemical Industry – NFR 2B

The following NFR source categories:

- 2.B.1 - Ammonia production
- 2.B.2 - Nitric acid production
- 2.B.3 - Adipic acid production and
- 2.B.4 - 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: 2.B.10.a - Other chemical industry and 2.B.1.0b - 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 2.C

In this source category activity data, emission factors and implemented methodology is presented for the following NFR source categories: 2.C.1, 2.C.2, 2.C.3, 2.C.5, 2.C.6 and 2.C.7.c.

5.5.1. Iron and steel production – NFR 2.C.1

In the nineties in 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 of smaller installation with different ownership. Currently in Republic of Macedonia, two installations 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.

5.5.1.1. Methodological Issues

Activity Data

Activity data for the reporting period 1990-2004 have been taken from the statistical yearbooks chapter Industry, and for the period 2005-2015 from the publications Industry in the Republic of Macedonia 2002-2015.

Table 134 Activity data for source category 2.C.1 - Iron and steel production

Year	Products[t]	Year	Products [t]	Year	Products [t]
1990	885015	2000	437934	2010	759924
1991	755634	2001	583379	2011	862827
1992	548462	2002	960178	2012	564054
1993	353822	2003	760538	2013	363887
1994	140045	2004	833328	2014	498459
1995	83407	2005	807782	2015	466847
1996	128117	2006	905272		
1997	230274	2007	982650		
1998	347846	2008	766310		
1999	237409	2009	705567		

Table 135 Activity data for type of steel in 2015

Year	Name of Products	[t]
2015	Liquid steel	123968
	Hot rolled sheet	190879
	Cold rolled sheet	152000

Emission factors

For the estimation of emissions for pollutants, emission factors were taken from GB 2016. Used emission factors are given in the table below.

Table 136 Emission factors for source category 2.C.1 - Iron and steel production, steel making, electric arc furnace, abated by fabric filter

Pollutant	Value	Unit	References
NMVOC	130	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
TSP	30	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
PM10	24	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
PM2.5	2.5	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
Pb	1.5	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
Cd	0,12	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
Hg	0,076	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
As	0,0081	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
Cr	0.105	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
Cu	0,02	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
Ni	0,41	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
Se	2.3	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
Zn	3	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
PCDD/F	0,48	µgI-TEQ/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
PAHs (Total)	2,5	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43

Pollutant	Value	Unit	References
HCB	130	mg/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43
PCBs	30	mg/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-19. pg. 43

Table 137 Emission factors for source category 2.C.1 - Iron and steel production, rolling mills, cold rolling mills

Pollutant	Value	Unit	References
TSP	96	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-21. pg. 45

Table 138 Emission factors for source category 2.C.1 - Iron and steel production, rolling mills, hot rolling mills

Pollutant	Value	Unit	References
NMVOC	7	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-22. pg. 45
TSP	9	g/Mg steel	GB 2016 2.C.1 Iron and steel production. Table 3-22. pg. 45

5.5.1.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 2%; the emission factor uncertainty was estimated to be 125% for NMVOC and 40% for PM2.5, based on expert judgment.

5.5.1.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.5.1.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.5.1.4. Source-specific planned improvements including those in response to the review process

In the stage 3 review in 2016, the expert review team recommended applying Tier 2 methods for the Electric Arc Furnace (EAF), and for the hot and cold rolling mills. It is planned to apply these methods; however, for earlier years, activity data do not distinguish between EAF, hot and cold rolling mills (the rolling mills use more steel than the amount produced in the EAF).

5.5.2. Ferroalloys production – NFR 2.C.2

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.

In the country there are three major installations for production of ferroalloys namely, ferrosilicon, ferronickel and ferrosilicon manganese. The installation Skopski Leguri which produces ferrosilicon manganese started operation in 2007 and stopped in 2012. The other two installations Jugohrom AD Ferroalloys produces ferrosilicon and FENi INDUSTRY produced ferronickel.

Jugohrom ALZAR DOOEL is one of the biggest industrial polluters in Republic of Macedonia. Jugohrom installed a filter facility for taking the gases emitted from the several electric furnaces. The installation has an IPPC environmental permit with adjustment plan, according which the installation should install a filter facility for all electric furnaces until 01 April 2014. This deadline given by the government of Republic of Macedonia was postponed until October 2016. The second deadline has not been reached

either and that was the reason why the State environmental Inspectorate closed the installation for a period of 6 months, starting from November 2016, with an approval of the Ministry of environment and physical planning, until the requirement for installation of filter facility is not fulfilled.

FENI Industry is one of the biggest installation in the sector Ferroalloys Production. In the period 2012-2013 this installation installed ESF (electrostatic filter) in 2 (two) biggest emission points (rotary kilns). The installation also installed scrubbers for reduction of emission gases from 2 electric furnaces and with this the requirements given the IPPC environmental permit for this installation have been fulfilled.

This sector significantly contributes to the national total amount of emission of particulates.

5.5.2.1. Methodological issue

Emissions coming from this sector have been calculated as a sum of ferrosilicon produced, multiplied with implied emission factors, and ferronickel and ferrosilicon manganese produced, multiplied with emission factors taken from GB 2016.

Activity Data

The activity data for ferrosilicon have been taken from the Statistical yearbooks - chapter Industry, Energy and Construction for period 1990-2004, and publication Industry in the Republic of Macedonia for the period 2005 – 2015 while data for ferronickel for the period 2005-2015 was received by the operator.

Table 139 Activity data for the source category 2.C.2 -Ferroalloy production

Year	Total Alloy produced [t]	Year	Total Alloy produced [t]	Year	Total Alloy produced [t]
1990	85148	2000	58520	2010	133347
1991	77442	2001	8779	2011	184310
1992	107866	2002	15085	2012	146970
1993	78357	2003	67283	2013	165803
1994	72134	2004	83160	2014	163489
1995	72735	2005	106590	2015	130970
1996	92638	2006	108920		
1997	85908	2007	175719		
1998	106661	2008	170252		
1999	78009	2009	60458		

Emission factors

For calculation of PM2.5, PM10 and TSP from 1990 to 2015 coming from ferronickel and ferrosilicon manganese production, GB 2013 emission factors have been used.

Table 140 Emission factors for source category 2.C.2 - 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 ferrosilicon production, due to the big difference of the calculated emissions with the use of EF and emission measurements data, as well as no implementation of BAT in this installation, EF for TSP has been taken from IIR 2008, 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 141 Implied emission factors for 2.C.2 Ferroalloys production – production of ferrosilicon

Pollutant	Value	Unit
PM10	244,8	kg/Mg alloy produced
PM2.5	172,8	kg/Mg alloy produced
TSP	288	kg/Mg alloy produced

Table 142 Implied mission factors for 2.C.2 Ferroalloys production – production of ferrosilicon for 2015

Pollutant	Value	Unit
PM10	139.14	kg/Mg alloy produced
PM2.5	118.3	kg/Mg alloy produced
TSP	83.5	kg/Mg alloy produced

Emission measurements

For the period 2012-2014, 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 the Table above. For 2015, since no measurements were delivered by the company (there is only activity data), TSP, PM10 and PM2,5 emissions coming from ferrosilicon production were calculated using the emission factors presented in Table 141. These emission factors are calculated from the emission of TSP and calculation of emission factors for PM10 and PM2.5 from 2014.

5.5.2.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 5%; the emission factor uncertainty was estimated to be 40% (rating B), based on expert judgement. The inconsistency of the time-series may appear because implied emission factors were used for the historical data, and for the period 2012-2014 measurement data was used.

5.5.2.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR. Data received by the operator in the excel template which is consistent with the national legislation are checked by MEPP, after they are received by the operator. Concerning jumps, dips or lack of emission data, the operator is contacted with official letter for the reasons of jumps and deeps of the measured emission or lack of required data.

5.5.2.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.5.2.4. Source-specific planned improvements including those in response to the review process

No improvements are planned in this category.

5.5.3. Aluminum production – NFR 2.C.3

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 Republic of Macedonia, there is no primary aluminum production.

5.5.3.1. Methodological Issues

Activity Data

The activity data were taken from the Statistical Yearbooks 1990-2015. 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 – 2015 Sum of unwrought aluminum, alloyed in ingot

Aluminum alloyed bars, rods, profiles

Aluminum tubes and pipes, non-alloyed

Table 143 Activity data for source category 2.C.3 - Aluminum production

Year	Aluminum and aluminum products[t]	Year	Aluminum and aluminum products[t]	Year	Aluminum and aluminum products[t]
1990	8841	2000	7641	2010	1880
1991	7829	2001	6809	2011	1953
1992	5150	2002	10516	2012	1424
1993	4819	2003	8573	2013	1280
1994	4991	2004	1679	2014	952
1995	3709	2005	1489	2015	879
1996	3924	2006	2316		
1997	5561	2007	2005		
1998	5850	2008	2053		
1999	10777	2009	1457		

Emission factors

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

Table 144 Emission factors for source category 2.C.3 - Secondary Aluminum production

Pollutant	Value	Unit	References
TSP	2	kg/Mg aluminum	GB 20162.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15
PM10	1,4	kg/Mg aluminum	GB 20162.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15
PM2.5	0,55	kg/Mg aluminum	GB 20162.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15
PCDD/F	35	µgI-TEQ/Mg aluminum	GB 20162.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15
HCB	5	g/Mg aluminum	GB 20162.C.3 Aluminum production. Secondary production. Table 3-4. pg. 15

5.5.3.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 2%; the emission factor uncertainty was estimated to be 40% (rating B), based on expert judgement.

5.5.3.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.5.3.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.5.3.4. Source-specific planned improvements including those in response to the review process

No improvements are planned in this category.

5.5.4. Lead production – NFR 2.C.5

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.

5.5.4.1. 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

Activity data

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

Table 145 Activity data for source category 2.C.5 - 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	NO	3591****
1992	27860*	23341*	2005	NO	34*****
1993	23575*	21881*	2006	NO	46*****
1994	20569*	20965*	2007	NO	18*****
1995	24007*	22490*	2008	NO	21*****
1996	29259*	23584*	2009	NO	39*****
1997	30508*	26046*	2010	NO	NE
1998	29242*	28415*	2011	NO	NE
1999	27086*	19738*	2012	NO	NE
2000	19000**	17137***	2013	NO	NE
2001	19000**	13543***	2014	NO	NE
2002	19000**	11934****	2015	NO	NE

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. These emission factors are presented in the following two tables.

Table 146 Emission factors for source category 2.C.5 -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 147 Emission factors for source category 2.C.5 -Secondary Lead production

Pollutant	Value	Unit	References
TSP	500	g/Mg lead	GB 20092.C.5.b Lead production. Table 3-9. pg. 16
PM10	400	g/Mg lead	GB 20092.C.5.b Lead production. Table 3-9. pg. 16
PM2.5	200	g/Mg lead	GB 20092.C.5.b Lead production. Table 3-9. pg. 16
Pb	430	g/Mg lead	GB 20092.C.5.b Lead production. Table 3-9. pg. 16
Cd	1,1	g/Mg lead	GB 20092.C.5.b Lead production. Table 3-9. pg. 16
Hg	0	g/Mg lead	GB 20092.C.5.b Lead production. Table 3-9. pg. 16
PCBs	3,2	g/Mg lead	GB 20092.C.5.b Lead production. Table 3-9. pg. 16
PCDD/F	8	µg I-TEQ/Mg lead	GB 20092.C.5.b Lead production. Table 3-9. pg. 16

5.5.4.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 5 %; the emission factor uncertainty was estimated to be 40 % (rating B), based on expert judgement.

5.5.4.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.5.4.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.5.4.4. Source-specific planned improvements including those in response to the review process

MEPP discussed with the State Statistical Office the possibility for this institution to start collecting data on the quantity of secondary lead produced. Furthermore, EF will be updated with the EF from GB 2016.

5.5.5. Zinc production–NFR 2.C.6

Zinc is produced from various primary and secondary raw materials. Primary zinc is produced from ores, which contain 85% zinc sulfide (by weight) and 8–10% iron sulfide, 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.

5.5.5.1. Methodological Issues

Activity Data

The activity data has been taken from the Statistical yearbook – chapter Industry, energy and construction for the period 1990-2015*, 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 148 Activity data for source category 2.C.6 - Zinc production

Year	Primary Zinc (t)	Secondary zinc (t)	Year	Primary 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**	NO	2013	NO
2001	52000**	NO	2014	NO
2002	56000**	NO	2015	NO

Emission factors

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

Table 149 Emission factors for source category 2.C.6 - Primary Zinc production

Pollutant	Value	Unit	References
TSP	110	g/Mg zinc	GB 20132.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 150 Emission factors for source category 2.C.6 - Secondary Zinc production

Pollutant	Value	Unit	References
TSP	80	g/Mg zinc	GB 20132.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

5.5.5.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 5 %; the emission factor uncertainty was estimated to be 40 % (rating B), based on expert judgment.

5.5.5.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.5.5.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.5.5.4. Source-specific planned improvements including those in response to the review process

No improvements are planned in this category.

5.5.6. Other metal production – NFR 2.C.7.c

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

5.5.6.1. 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.

Table 151 Activity data for source category 2.C.7.c – Other Metals production

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.

Table 152 Emission factors for 2.C.7.c - 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

5.5.6.1. Source-specific uncertainties and time-series consistency

This category includes TSP emissions only. Uncertainties have not yet been estimated for TSP emissions.

5.5.6.2. Source-specific QA/QC and verification

No QA/QC procedures were carried out for this source category, since is no longer occurring in the Republic of Macedonia.

5.5.6.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.5.6.4. Source-specific planned improvements including those in response to the review process

Updated emission factors for TSP and EF for SOx will be used in the next reporting round.

5.6. Other products and solvents used – NFR 2.D

In this source category activity data, emission factors and implemented methodology are presented for the following NFR source categories: 2.D.3, 2.D.3.b, 2.D.3.c, 2.D.3.d, 2.D.3.e, 2.D.3.f, 2.D.3.g, 2.D.3.h, 2.G, 2.H.1, 2.H.2 and 2.I.

5.6.1. Domestic solvent use including fungicides NFR 2.D.3.a

This category covers the use of fungicides in agriculture. The share of NMVOC emissions from this category of total NMVOC emissions in 2015 was 7,19%.

5.6.1.1. Methodological issues

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

The activity data – number of population for this source category have been taken from Statistical yearbooks – chapter Population for the period 1990-2008, and Assessment of the population according age and gender, by municipality and by statistical region (NTEC 3- 2007-2014)[29]. It should be emphasized that the last census in the country was carried out in 2002, and therefore the data for the period 2003-2015 are estimated population numbers.

Table 153 Activity data for the source category 2.D.3.a Domestic solvents use including fungicides

Year	Population number	Year	Population number	Year	Population number
1990	2028000	2000	2026350	2010	2055044
1991	2033964	2001	2034882	2011	2058539
1992	2056000	2002	2020547	2012	2061044
1993	2066000	2003	2026773	2013	2064032
1994	1945932	2004	2032544	2014	2069172
1995	1966000	2005	2036855	2015	2071278
1996	1983000	2006	2040228		
1997	1996869	2007	2043559		
1998	2007523	2008	2046898		
1999	2017142	2009	2050671		

[29] Assessment of the population according age and gender, by municipality and by statistical region (NTEC 3- 2007-2014) http://www,stat,gov,mk/PublikaciiPoOblast,aspx?id=11&rbrObl=2

Emission factors

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

Table 154 Emission factors for the source category 2.D.3.a - 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

5.6.1.1. Source-specific uncertainties and time-series consistency

The activity data uncertainty for 2.D was estimated to be 20% according to expert judgement; the emission factor uncertainty was estimated to be 125% (rating C) for NMVOC and 40% (rating B) for PM2.5 based on EMEP Guidebook.

Population number is taken from statistical publications, but there is uncertainty of these activity data due to the fact that population census has been carried out only three times in 1991, 1994 and 2002, while for the other years estimated numbers were used.

5.6.1.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.6.1.3. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.6.1.4. Source-specific planned improvements including those in response to the review process

The historical data on population number will be reviewed due to the comments given by the MS solvent expert within the mission report, where the source on population shows different data on population number. These data will be revised for the next reporting period.

5.6.2. Road paving with asphalt NFR 2.D.3.b

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'.

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

NMVOC emissions and particles are released to the air from this activity and the contribution of this sector in the total NMVOC in 2015 is 0,016% and in TSP is 12,17%. Due to the non-completeness of the activity data, the emissions of these pollutants and the contribution of this sector in the national total may be underestimated.

5.6.2.1. 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,

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

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

Activity data

The operators themselves have gathered activity data. Data from 85% of all asphalt production companies in 2015 delivered data on produced asphalt. Summarized data on national asphalt produced were used as activity data for estimation of emissions in this sector. The activity data for this sector may be underestimated, especially for the historical years, due to incomplete statistical data on asphalt production, as well as change of ownership and close down of some of the asphalt production companies. The activity data are presented in the following table.

Table 155 Activity data for source category 2.D.3.b - Road paving with asphalt

Year	Asphalt produced (t)	Year	Asphalt produced (t)	Year	Asphalt produced (t)
1990	86320	2000	327937	2010	274654
1991	74296	2001	137305	2011	356596
1992	44067	2002	119651	2012	336725
1993	65194	2003	124492	2013	389163
1994	84729	2004	149323	2014	336545
1995	87814	2005	180559	2015	305856
1996	98545	2006	130847		
1997	53600	2007	101508		
1998	101563	2008	170049		
1999	136540	2009	232001		

Emission factors

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

Table 156 Emission factors for source category 2.D.3.b - Road paving with asphalt

Pollutant	Value	Unit	References
NMVOC	16	g/Mg asphalt	GB 20162.D.3.b Road paving with asphalt. Table 3.1. pg. 8
TSP	14000	g/Mg asphalt	GB 20162.D.3.b Road paving with asphalt. Table 3.1. pg. 8
PM10	3000	g/Mg asphalt	GB 20162.D.3.b Road paving with asphalt. Table 3.1. pg. 8
PM2.5	400	g/Mg asphalt	GB 20162.D.3.b Road paving with asphalt. Table 3.1. pg. 8
BC	5,7	% PM2.5	GB 2016 2.D.3.b Road paving with asphalt. Table 3.1. pg. 8

5.6.2.2. Source-specific uncertainties and time-series consistency

The inconsistency of the emissions in this sector comes from the fact that incomplete statistical data on asphalt production, as well as change of ownership and close down of some of the asphalt production companies. No specific uncertainty analysis was done for this category.

5.6.2.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.6.2.4. Source-specific recalculations including changes made in response to the review process

No recalculations were carried out in this category.

5.6.2.5. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

5.6.3. Asphalt roofing NFR 2.D.3.c

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. Asphalt roofing contributes to NMVOC emissions by a share of 0,004% in 2015.

5.6.3.1. Methodological issues

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

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

where:

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

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

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

Activity Data

For the period 1990-1999 activity data have been taken from the Statistical Yearbooks – chapter Industry, Energy and Construction. For the period 2005-2015, activity data have been taken from the publication Industry in the Republic Macedonia, 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 157 Activity data for source category 2.D.3.c - Asphalt roofing

Year	Asphalt roofing products (t)	Year	Asphalt roofing products (t)	Year	Asphalt roofing products (t)
1990	12572	2000*	13075	2010	13201
1991	12593	2001*	12525	2011	16516
1992	5325	2002*	12104	2012	15324
1993	4067	2003*	11668	2013	12520
1994	5901	2004*	12458	2014	14221
1995	8873	2005	11305	2015	9924
1996	5992	2006	9773		
1997	6442	2007	9998		
1998	5489	2008	9489		
1999	13429	2009	16407		

*based on extrapolation

Due to a change of methodology in the collection of statistical data over the years, the list of different type of data collected in 1990-1999 and 2005-2015 are presented below. Data for the years 2000-2005 are not covered by the statistics but are calculated by use of interpolation.

Type of data available in the national statistics for 1990-1999 and 2005-2015

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

2005 – 2014
Roofing or waterproofing felts of roofing cardboard based on bitumen in rolls;
Roofing or waterproofing 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 158 Emission factors for source category 2.D.3.c - Road paving with asphalt

Pollutant	Value	Unit	References
CO	9,5	g/Mg shingle	GB 20162.D.3.c Asphalt roofing. Table 3.1. pg. 7
NMVOC	130	g/Mg shingle	GB 20162.D.3.c Asphalt roofing. Table 3.1. pg. 7
TSP	1600	g/Mg shingle	GB 20162.D.3.c Asphalt roofing. Table 3.1. pg. 7
PM10	400	g/Mg shingle	GB 2016 2.D.3.c Asphalt roofing. Table 3.1. pg. 7
PM2.5	80	g/Mg shingle	GB 2016 2.D.3.c Asphalt roofing. Table 3.1. pg. 7
BC	0,013	% PM2.5	GB 2016 2.D.3.c Asphalt roofing. Table 3.1. pg. 7

5.6.3.1. Source-specific uncertainties and time-series consistency

No pecific uncertainty analysis was done for this category. The inconsistency in this sector is due to use of different sources for the activity data in different period.

5.6.3.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.6.3.3. Source-specific recalculations including changes made in response to the review process

During the 2016 stage 3 review, the ERT pointed out that for the parameters NOx, Pb, Cd, Hg, PCDD/F, Benzo(a)pyrene, Benzo(a)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene and HCB the notation key NA was used, although these emissions may be applicable according to the GB 2013. Therefore, the notation keys were changed to NE in the current submission.

5.6.3.4. Source-specific planned improvements including those in response to the review process

The comments and questions on the completeness of the activity data in this category given in the Twinning mission report No. 24/2016 will be taken into account for the further improvements of activity data in this sector.

5.6.4. Coating application – NFR 2.D.3.d

Coating applications in Macedonia include emissions from quantity of paint applied in the industrial applications, other industrial applications and domestic application and this category is source of NMVOC emissions with contribution of around 11% in 2014 where the imported paints is taken into account.

5.6.4.1. Methodological Issues

NMVOC emissions in this source category are estimated according to the GB2013.

Activity data

The quantity of paint produced in the period 2005-2015 is taken from the publications Industry in the Republic of Macedonia, and the data for the imported-exported paints are taken from the publication

External trade in the Republic of Macedonia for the period 2006-2015[30] . For the year 2015, only data on produced paint were available for use. 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 159 Activity data for source category 2.D.3.d - Coating application

Year	Industrial application	Decorative application	Other industrial application
	Paint [kg]	Paint [kg]	Paint [kg]
1990	8.530.459	5.743.495	843.430
1991	7.063.220	5.760.386	962.383
1992	5.947.231	5.822.794	1.158.808
1993	5.120.566	5.851.115	1.161.438
1994	4.582.906	5.511.071	919.306
1995	4.092.535	5.567.905	589.455
1996	4.223.497	5.616.051	987.347
1997	4.291.073	5.655.329	1.115.671
1998	4.484.171	5.685.503	1.144.328
1999	4.367.582	5.712.745	873.886
2000*	4.520.448	5.738.823	957.913
2001*	4.380.314	5.762.986	1.093.012
2002*	4.148.157	5.722.388	1.316.099
2003*	4.343.121	5.740.021	1.319.086
2004*	4.249.198	5.756.365	1.044.089
2005	2.724.567	3.308.403	669.465
2006	4.563.695	5.541.629	1.121.365
2007	5.156.831	6.261.867	1.267.107
2008	5.289.288	6.422.707	1.299.654
2009	4.039.256	4.904.811	992.503
2010	4.427.645,927	5.376.427	1.087.936
2011	5.052.096,027	6.134.688	1.241.372
2012	6.083.243,990	7.386.796	1.494.740
2013	6.097.049,391	7.403.560	1.498.132
2014	5.997.370,109	7.282.521	1.473.640
2015	42.206,543	51.251	10.371

*based on extrapolation

Emission factors

Emission factors for Tier 1 method from GB 2016 are presented in the following table:

[30] State Statistical Office of the Republic of Macedonia, Commodity international exchange in the Republic of Macedonia, 2006-2014,http://www,stat,gov,mk/PublikaciiPoOblast,aspx?id=14&rbrObl=23;

Table 160 Emission factors for source category 2.D.3.d - Coating application

Pollutant	Value	Unit	References
NMVOC(Decorative coating application)	150	g/kg paint applied	GB 2016Table 3-1Tier 1 emission factors for source category 2.D.3.d Decorative coating application
NMVOC (Industrial coating application)	400	g/kg paint applied	GB 2016Table 3-2 Tier 1 emission factors for source category 2.D.3.d Industrial coating application
NMVOC (Other coating application)	200	g/kg paint applied	GB 2016Table 3-3 Tier 1 emission factors for source category 2.D.3.d Other coating application

5.6.4.1. Source-specific uncertainties and time-series consistency

No specific uncertainty analysis was done for this category.

5.6.4.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.6.4.3. Source-specific recalculations including changes made in response to the review process

During the 2016 stage 3 review, the ERT posed questions related to the lower emissions in the latest year in this category as well as wrong number for the EF in the IIR for the subcategory other coating application. Following the recommendations by the ERT, the explanation is included in the text above and the EF for the subcategory other coating application has been corrected.

Recalculations in this category were done for the year 2014, due to the update the activity data for this year with the export and production amounts of paint and recalculation of NMVOC emissions from coating application for that year, but also for the previous years, due to dislocation of the activity data between subcategories.

5.6.4.1. Source-specific planned improvements including those in response to the review process

No planned improvements in this category.

5.6.5. Degreasing - NFR 2.D.3.e

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, fiberglass, printed circuit boards and other products are treated by the same process. NMVOC emissions occur from decreasing and contribute approximately to 6% of total emissions.

5.6.5.1. Methodological issues

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 data.

Activity Data

Population has been used as activity data for the source category 2.D.3.e - Degreasing. The time series of population is presented in subchapter 5.6.1.1. Population data were taken from the statistical yearbooks for the period 1990-2006, as well as from Statistical publications “Assessment of the population according gender and age, distributed among municipalities and statistical regions” for the period 2007-2015.

Emission factors

Emission factor for the calculation of NMVOC emissions is presented below.

Table 161 Emission factor for source category 2.D.3.e- Degreasing

Pollutant	Value	Unit	References
NMVOC	0,85	kg/inhabitant/year	Informative Inventory Report of Republic of Serbia for 2013[31] which refers to GB 2006

5.6.5.1. Source-specific uncertainties and time-series consistency

No specific uncertainty was carried out for this sector. There is a drop in emissions in 1994 and a smaller one in 2002, probably because census was conducted in those years, and for the other years only population assessment was conducted.

5.6.5.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.6.5.3. Source-specific recalculations including changes made in response to the review process

No recalculations were made in this category.

5.6.5.4. Source-specific planned improvements including those in response to the review process

The historical data on population number will be reviewed due to the comments given by the MS solvent expert within the mission report, where the source on population from the other sources, such as https://en.wikipedia.org/wiki/Demographics_of_the_Republic_of_Macedonia do not present such fluctuations. This data will be revised for the next reporting period.

5.6.6. Dry cleaning – NFR 2.D.3.f

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.

5.6.6.1. Methodological issues

The calculation in this category is based on the volume of solvents, including chlorinated organic chlorinated solvents using Tier 1 method. 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. Population data for the source category 2.D.3.e – Degreasing, is presented in sub chapter 3.13.1.1.

Emission factors

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

[31] The Republic of Serbia Informative Inventory Report to LRTAP Convention, Belgrade, 2012

Table 162 Emission factor for the source category 2.D.3.f- Dry Cleaning

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

5.6.6.1. Source-specific uncertainties and time-series consistency

An EF by population does not reflect country-specific circumstances, real conditions and habits of use, and gives increasing emissions when the population grows. In case population is estimated, this brings additional uncertainty to the emission levels.

5.6.6.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.6.6.3. Source-specific recalculations including changes made in response to the review process

Based on the recommendation by the ERT during the 2016 stage 3 review, a calculation error in the reporting file was corrected. Namely due to typing error the EF of 0,31 was corrected to 0,3. This typing error also had minor influence of the emissions.

5.6.6.4. Source-specific planned improvements including those in response to the review process

The historical data on population number will be reviewed due to the comments given by the MS solvent expert within the mission report where the source on population shows different data compared to the source[32], where there is no such fluctuations. This data will be revised for the next reporting period in order to decide which one is the more reliable source.

5.6.7. Chemical products – NFR 2.D.3.g

This subchapter covers emissions from:

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

Emissions from manufacturing of chemical products include NMVOCs and NH_3. The chemical production in the country is variable, because after the fall of ex-Yugoslavia, the economy in our country experienced several shocks that damaged the local economy. The economy began to recover in 1995 and recovered only after 2001. This situation had influenced the trend series emissions coming from the chemicals production branch.

5.6.7.1. Methodological issues

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

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

Where:

[32] https://en.wikipedia.org/wiki/Demographics_of_the_Republic_of_Macedonia

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

$EF_{tehnology,pollutants}$ = the emission factor for this technology and this pollutants.

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 and publication Industry in the Republic of Macedonia for the period 2005-2015. The activity data are presented in the following table.

Table 163 Activity data for source category 2.D.3.g - Chemical products

Year	Polyester/ kg	Polyurethane/ kg	Polystyrene/ kg	Shoos/pairs	Leather tanning/kg	Paints. Inks and glues/kg	Rubber Processing/ kg
1990	16450000	NO	NO	6638000	NO	NO	NO
1991	12440000	NO	NO	4049000	NO	NO	NO
1992	11150000	NO	364000	3667000	10797000	NO	1355000
1993	4466000	NO	382000	2308000	10197000	NO	1145000
1994	8628000	NO	455000	1529000	9177000	NO	978000
1995	9904000	NO	378500*	1122000	10119500*	NO	680500*
1996	3212000	NO	302000	1231000	11062000	NO	383000
1997	3820000	NO	363000	1509000	7491000	NO	371000
1998	2642000	NO	547000	1790000	4908000	NO	417000
1999	NO	NO	NO	2488000	NO	NO	NO
2000	NO	NO	NO	2129000	NO	NO	NO
2001	NO	NO	NO	1073000	NO	NO	NO
2002	NO	NO	NO	1521000	NO	NO	NO
2003	NO	NO	NO	1799000	NO	NO	NO
2004	NO	NO	NO	1785000	NO	NO	NO
2005	NO	1095000	NO	1540000	NO	6068000	NO
2006	NO	1405000	NO	1739000	NO	5252000	NO
2007	NO	1129000	NO	1949000	NO	4982000	NO
2008	NO	1239000	NO	2196000	NO	4604000	NO
2009	NO	1133000	NO	3074000	NO	3972000	NO
2010	NO	1033000	NO	2846000	NO	3495000	NO
2011	NO	1059000	NO	3302000	NO	750000	NO
2012	NO	1118000	NO	3256000	NO	388000	NO
2013	NO	1166000	NO	4314000	NO	208000	NO
2014	NO	697000	NO	3855000	NO	161000	NO
2015	NO	NO	NO	2226000	NO	878000	NO

*data for chemical products in 1995 is based on Interpolation between the previous year and the next year. The value is the average of the previous year and the next year. For the other years, it is expected that no production occur.

Emission factors

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

Table 164 Emission factors for source category 2.D.3.g Chemical Products

Pollutant	Value	Unit	References
NMVOC	50	g/kg polyester monomer used	GB 20162.D.3.g Chemical products. Table 3-2. pg. 17
NMVOC	120	g/kg polyurethane foam processed	GB 20162.D.3.g Chemical products. Table 3-3. pg. 17
NMVOC	60	g/kg polystyrene	GB 20162.D.3.g Chemical products. Table 3-4. pg. 18
NMVOC	8	g/kg rubber produced	GB 20162.D.3.g Chemical products. Table 3-5. pg. 18
NMVOC	11	g/kg products (paints. inks. glues)	GB 20162.D.3.g Chemical products. Table 3-11. pg. 21
NMVOC	0,045	kg/pairs of shoes	GB 20162.D.3.g Chemical products. Table 3-13. pg. 22
NH_3	0,68	g/kg raw hid (leather tanning)	GB 20162.D.3.g Chemical products. Table 3-14. pg. 23

5.6.7.1. Source-specific uncertainties and time-series consistency

No source-specific uncertainties were done for the sector; the emissions vary due to the unstable economy over the years.

5.6.7.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR. Comparing manufacture of polystyrene, leather tanning and rubber processing, it looks like there are gaps in the statistics, as all these three activities have operated only in the above-mentioned years, which would be quite a coincident. Therefore, gap filing for 1995 has been carried out.

5.6.7.3. Source-specific recalculations including changes made in response to the review process

In accordance with the questions on activity data missing by ERT and comments given by the MS experts within the Twining mission report num. 24/2016, gap filling and use of NO notation key has been used for the empty fields of the Table num. 136 in the previous IIR.

5.6.7.4. Source-specific planned improvements including those in response to the review process

It is planned to check the availability of data on other chemical products for future reporting (Textile finishing, Leather tanning and Pharmaceutical products manufacturing) and report emissions in the following submission.

5.6.8. Printing NFR – 2.D.3.h

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

5.6.8.1. Methodological issues

The simplified Tier 1 methodology for calculation of NMVOC emissions 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 required from the SSO for the time series 1990-2015, since this data was not published in the statistical publications. Because the data has not been published so far, MEPP received a request by the SSO not to publish the activity data in the report. Therefore, this activity data is not presented in this report.

Emission factors

Emission factor for NMVOC has been taken from GB 2016 and is presented in table below.

Table 165 Emission factors for source category 2.D.3.h Printing

Pollutant	Value	Unit	References
NMVOC	500	g/kg ink	GB 2016 Table 3-1 Tier 1 emission factors for source category 2.D.3.h Printing

5.6.8.1. Source-specific uncertainties and time-series consistency

No source specific uncertainty was done for this sector.

5.6.8.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR

5.6.8.3. Source-specific recalculations including changes made in response to the review process

During the 2016 stage 3 review, the ERT pointed out that the IEF for the period of 1999-2013 differs from the Tier 1 EF of 500 g/kg ink. Based on the recommendation by the ERT, correction of emissions that appeared due to the field scrolling of the formula in the excel calculation sheet was done.

5.6.8.1. Source-specific planned improvements including those in response to the review process

No planned improvements in this sector.

5.6.9. Other solvent and product use – NFR 2.D.3.i and 2.G

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 2.G while for the NFR category 2.D.3.i, the notation key IE has been used.

5.6.9.1. Methodological Issues

Activity data

The activity data on tobacco and pairs of shoes has been taken from the Statistical yearbooks - chapter Industry, energy and construction for the period 1990-2004, and from the publication of the "Industry in the Republic of Macedonia", for the period 2005-2015. 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 166 Activity data for the source category 2.D.3.i and 2.G - Other solvent and product use (Source Statistical yearbooks (1990-2004) and Industry in the Republic of Macedonia (2005-2015)

Year	Tobacco	Creosote	Fat, edible and non-edible oil extraction-seed	Pairs of shoes
1990	26481	2765878	38303	6638000
1991	16576	1789766	39190	4049000
1992	22297	1949659	32975	3667000

Year	Tobacco	Creosote	Fat, edible and non-edible oil extraction-seed	Pairs of shoes
1993	25964	1322008	30218	2308000
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	18283	80805	3256000
2013	23745	674	77008	4314000
2014	10241	108	83258	3876811
2015	8214	4709	102678	3876811

Emission factors

The Emission factors have been taken from GB 2016 and are presented in the following table.

Table 167 Emission factors for source category 2.D.3.i and 2.G - Other solvents and product use

Pollutant	Activity	Value	Unit	References
NOx	Tobacco combustion	1,8	kg/ton tobacco	GB 16 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 16 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 16 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 16 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 16 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 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion

Pollutant	Activity	Value	Unit	References
BC	Tobacco combustion	0,45	% of PM2.5	GB 16 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 combustion	55,1	kg/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
Cd	Tobacco combustion	5,4	mg/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
Ni	Tobacco combustion	2,7	g/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
Zn	Tobacco combustion	2,7	g/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
Cu	Tobacco combustion	5,4	g/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
PCDD/F	Tobacco combustion	0,1	Mg I-TEQ/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
benzo(a) pyren	Tobacco combustion	0,111	g/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
benzo(b) fluoranthen	Tobacco combustion	0,045	g/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
benzo(k) fluoranthen	Tobacco combustion	0,045	g/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
Indeno (1.2.3-cd) pyren	Tobacco combustion	0,045	g/ton tobacco	GB 16 Table 3-14 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Tobacco combustion
NMVOC	Wood preservation. Creosote preservative type	105	g/kg creosote	GB 16 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 16 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	0,53	mg/kg creosote	GB 16 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	0,53	mg/kg creosote	GB 16 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

Pollutant	Activity	Value	Unit	References
Indeno (1.2.3-cd) pyren	Wood preservation. Creosote preservative	0,53	mg/kg creosote	GB 16 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 16 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 16 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 16 Table 3-4 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Fat, edible and non-edible oil extraction
PM2.5	Fat. edible and non-edible oil extraction	0,6	g/kg seed	GB 16 Table 3-4 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Fat, edible and non-edible oil extraction
PM10	Fat. edible and non-edible oil extraction	0,9	g/kg seed	GB 16 Table 3-4 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Fat, edible and non-edible oil extraction
TSP	Fat. edible and non-edible oil extraction	1,1	g/kg seed	GB 16 Table 3-4 Tier 2 emission factors for source category 2.D.3.i. 2.G Other solvent and product use. Fat, edible and non-edible oil extraction

5.6.9.1. Source-specific uncertainties and time-series consistency

No specific source uncertainty is done for the sector. Time series minor inconsistency is expected because recalculation of the activity data on tobacco combustion and manufacturing of shoes was done only for the last two reporting years.

5.6.9.2. Source-specific recalculations including changes made in response to the review process

During the 2016 stage 3 review, the ERT pointed out that emissions from NFR 2.D.3.i are reported as "IE" under NFR 2.G Other Product use. The ERT recommended to study closer which activities should be reported under NFRs 2.D.3.i and NFR 2.G, e.g. by using the Mapping table linking categories of different reporting formats, and to adjust the structure of the inventory in the next submission. Based on the recommendation by the ERT, NFRs 2.D.3.i and NFR 2.G were calculated and reported separately. Additionally, in Table 140 of the IIR 2016, it was stated that the EFs for tobacco combustion are taken from Guidebook 2013. The ERT compared the EFs shown in Table 140 from IIR 2016 to EFs in Guidebook 2013, and found that there was a discrepancy between them. The reference for the proper guidebook and EF for tobacco combustion and wood preservation were corrected for this submission. This was also a reason for recalculations of the emissions in this submission. Furthermore, the country has investigated if activity data for the use of fireworks is available in the country's statistics but no available data was found.

5.6.9.3. Source-specific planned improvements including those in response to the review process

Based on the recommendation given by the MS industry stipulated in the Twining mission report 24/2016, expert activity data on use of shoes and use of tobacco will be recalculated for the next reporting round, bearing in mind that the import and export data should be taken into account. This report does not include emissions from the following activities in the inventory: SNAP 060401 Glass wool induction, 060402 Mineral wool induction, 060405 Application of glues and adhesives, 060409 Vehicle de-waxing. Therefore, NMVOC emissions from NFR 2.D.3.i might be underestimated. A meeting with SSO was held in the beginning of this year to discuss the needed missing data and the possibility to collect this type of data will be investigated.

5.6.10. Food and beverages industry - NFR 2.H.2

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

5.6.10.1. 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 used 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 technology and this pollutants.

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 and publication Industry in the Republic of Macedonia for the period 2005-2015. The data on wine production for the period 1990-2004 on wine and spirits was presented in total and therefore a proportion was used to divide this type of product. Additionally, data on wine production was officially required from the Ministry of agriculture, forestry and water supply, but they responded that they do not have such data available. The animal feed is decreasing because of the decrease of the number of animals (see Agriculture chapter). The production of sugar varies during the reported period, because there is only one major company dealing with sugar production. The company stopped with operation in 2015, so this process is not occurring for this year. The activity data is presented in the following table.

Table 168 Activity data for source category 2.H.2 - Food and beverage industry (Source Statistical yearbook (year) (1990-2004) and Industry in the Republic of Macedonia (2005-2015)

Year	spirits/hL	beer/hL	wine/hL	Animal Feed/t	Margarine and solid cooking fat/t	Sugar/t	Meat. fish and poultry/t	Cakes. biscuits 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
2004	12424	717496	516000	55235	1972	27810	29839	10113	43115

Year	spirits/hL	beer/hL	wine/hL	Animal Feed/t	Margarine and solid cooking fat/t	Sugar/t	Meat. fish and poultry/t	Cakes. biscuits and breakfast cereals/t	Bread/t
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
2015	10261	642633	1085681	28646	2303	NO	29588	34162	48990

Emission factors

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

Table 169 Emission factors for source category 2.H.2 - 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

5.6.10.1. Source-specific uncertainties and time-series consistency

A quantitative uncertainty analysis has not yet been carried out to the Macedonian inventory but it is scheduled for the future. Source category specific information on uncertainties will be added when the results are available. The trends of the food production is variable due to the change of the methodology in the statistics, as well as due to the unstable regime of the major food installations.

5.6.10.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.6.10.3. Source-specific recalculations including changes made in response to the review process

No recalculations were done in this sector since no recommendations were given by the ERT. The explanation of the trends of the food products required by the MS solvent expert were included in the text above.

5.6.10.4. Source-specific planned improvements including those in response to the review process

Updated emission factors from GB 2016 will be used in the emission calculations in the next reporting round.

5.6.11. Wood processing – NFR 2.I

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 2015 the contribution from this source in the total TSP emissions is 0,045%.

5.6.11.1. 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. These data has been taken from the Statistical Yearbooks of the Republic of Macedonia for the period 1990-2015 and the publication Industry in the Republic of Macedonia for the period 2005-2015.

Table 170 Activity data for source category 2.I - Wood processing

Year	Wood processed [Mg]	Year	Wood processed [Mg]	Year	Wood processed [Mg]
1990	66889	2000	18173	2010	10671
1991	52422	2001	16882	2011	8667
1992	46790	2002	10015	2012	16082
1993	44454	2003	19913	2013	9210
1994	40402	2004	24263	2014	14203
1995	29144	2005	15509	2015	15866
1996	27210	2006	21866		
1997	23188	2007	11183		
1998	17048	2008	15591		
1999	22568	2009	6695		

Emission factors

Emission factor for estimation of TSP have been taken from GB 2009 and they are presented in the table below.

Table 171 Emission factors for source category 2.I Wood processing

Pollutant	Value	Unit	References
TSP	1	kg/Mg wood products	GB 2016 Table 3.1 Tier 1 emission factors for source category 2.I Wood processing

5.6.11.1. Source-specific uncertainties and time-series consistency

No source specific uncertainty was done for this sector.

5.6.11.2. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data was checked for plausibility and time-series consistency; emission data was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

5.6.11.3. Source-specific recalculations including changes made in response to the review process

Activity data in the sector Wood production – 2.I has been recalculated for the period 2011-2016, because unprocessed wood has been also taken into account in the previous submission. This correction was made due to the comments given by the MS expert within the Twining project.

5.6.11.4. Source-specific planned improvements including those in response to the review process

In response to the comments given by the MS industry expert, correction of the historical data will be carried out because currently the emissions in this sector are overestimated.

6. AGRICULTURE (NFR 3)

6.1. Sector overview

The Agriculture sector is a major source category for ammonia emissions. 87,65% of the total national emissions of NH_3 are emitted from the agricultural sector.

In the Macedonian inventory emissions from source categories 3.B Animal husbandry and manure management, 3.D.a.1 Inorganic N-fertilizers, 3.D.a.2 Animal Manure applied to soils and 3.D.a.3 Urine and dung deposited by grazing animals were 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 below NFR categories covered in the Agriculture sector for 2015 are presented, which are not included in this sector and for which appropriate notation keys are used.

Table 172 NFR categories covered in Agriculture sector for 1990-2015

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	√
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	√
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	NE
3Dd	Off-farm storage. handling and transport of bulk agricultural products	NA
3De	Cultivated crops	NE

NFR category		Completeness
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 (NE).

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.

3.B.4.h: Other animals: The inventory includes all animals provided in the statistical review of Macedonia. No additional animal categories are relevant for Macedonia (NO).

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. NH_3 emissions of source category 3.D.a.2.a animal manure applied to soils have been reported from submission 2017 onwards.

3.D.a.2.b: Sewage sludge applied to soils: This source is not estimated (NE). Activities (tons of sewage sludge annually spread) are not available. The possibilities to estimate emissions in this sector will be discussed with national experts for the next reporting.

3.D.a.2.c: The EMEP/EEA Guidebook 2013 does not provide methodologies and emission factors for this source category. Thus, for Other organic fertilizers applied to soils (including compost) the notation key NA is reported.

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. NH_3 emissions of source category 3.D.a.3 Urine and dung deposited by grazing animals have been reported from submission 2017 onwards.

3.D.a.4: The EMEP/EEA Guidebook 2013 does not provide methodologies and emission factors for this source category. Thus, emissions from Crop residues applied to soils are reported as NA.

3.D.b: The EMEP/EEA Guidebook 2013 does not provide methodologies and emission factors for calculating emissions resulting from the deposition of N emitted from managed soils. Thus, for indirect emissions from managed soils NA is reported.

3.D.c: Farm-level agricultural operations including storage, handling and transport of agricultural products: In this category PM and TSP emissions from soil cultivation and crop harvesting should be reported. Data are not available (NE).

3.D.d: The EMEP/EEA Guidebook 2013 does not provide methodologies and emission factors for this source category. Thus, for Off-farm storage, handling and transport of bulk agricultural products NA is reported.

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 is reported for source category 3F - Field burning.

3.I: Agriculture other, does not occur (NO).

6.3. Manure management NFR 3.B

6.3.1. Methodological issues

The Tier 1 default approach following the GB 2013 and the GB 2016 has been used.

Emission factors for NOx, NMVOC and PM have been obtained from EMEP/EEA Air Pollutant GB 2013. 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. Based on a recommendation of the Stage 3 CLRTAP Review 2016, Macedonia applied the new Tier 1 methodology for calculating NH_3 emissions based on the EMEP EEA GB 2016. Separate emission factors for housing, storage and yard (reported under 3.B), animal manure application and grazing (reported under 3.D) are now available in the latest GB version. 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.

6.3.1.1. 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 and Publication Livestock prepared by the State Statistical Office for the period 2007-2015[33]. The numbers per livestock category are presented in Table 172. Number of different categories of poultry are presented in Table 173.

Table 173 Domestic livestock population and its trend 1990–2015

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

[33] State Statistical Office of the Republic of Macedonia, Livestock, 2007-2014, http://www,stat,gov,mk/PrikaziPoslednaPublikacija,aspx?id=5;

Year	Dairy	Non-diary	Total Swine	Fattening pigs	Sows	Sheep	Goats	Horses
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	114.845	165.053	141.542	23.511	740.457	81.346	19.371
2015	124.194	129.248	195.443	174.586	20.857	733.510	88.064	18.784
Trend 1990-2015	2%	-22%	22%	13%	-14%	-68%	-65%	-72%

Table 174 Domestic livestock population and its trend 1990–2015

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
2015	1.423.841	311.809	15.814	2.094	7.587	1.761.145
Trend 1990–2015	-74%	207%	-73%	-86%	-80%	-69%

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 1990-2015.

Official data sets of the period 1990 – 2006 and from 2007 onwards are not fully consistent. In 2007, a new census was introduced[34], leading to more accurate animal numbers.

The 2007 census was interview based (interviewers personally visited all farms) 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. The total farm number of Macedonia is about 90000. In general, it is distinguished between individual farms (which reflect the vast majority of 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 2015 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.

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 neighboring 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.

Dairy cattle

Increased production of milk is responsible for the increased husbandry of dairy cattle (+3.2% from 1990 to 2015).

Non-dairy cattle

Reduced rentability of beef production is responsible for the decrease of Non-dairy cattle numbers by 22% between 1990 and 2015 due to the reduced number of heifers in calf and other cattle.

Pig numbers

Pig statistics from 1990-2006 are not fully consistent with the official numbers from 2007 onwards. A consistent time series had to be established. 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.

[34] Census of agriculture, 2007, Individual agricultural holdings grouped by total available land, by regions, 2008, Skopje;

In Macedonia total swine production increased by 16,4% between 1990 and 2015, mainly due to increased production of fattening pigs.

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. The main reason for the decline in sheep numbers (-68%) is that most of the sheep herds are owned by small individual businesses which are not profitable anymore.

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 for 1990-1998 the average shares of the years 2007-2015 have been used. Goat numbers decreased by -65% between 1990 and 2015, because in the last century husbandry of goats was forbidden as it would curb the formation of karst.

Horses

Horse numbers show a decreasing trend since 1990 (-72%). In the past horses were used for means of locomotion 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.

Mules and asses

Regarding information from the veterinary institute, horse category does not include mules and assess. No data on mules and assess were made available in the reporting period (NE).

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.

Total poultry number decreased by 69% from 1990 to 2015mainly due to declining numbers of laying hens as a result of a reduced egg production in Macedonia.

Animal manure management system distribution

During the inventory preparation for submission in 2016, first investigations on management practices commonly applied in the Macedonian agriculture have been made. Based on 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 now 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 parlor

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 judgment 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 judgment 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 national IPPC experts provided the following information: 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 this data, it was possible to calculate the annual average animal population held in these seven 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. The situation in 2015 is similar so no changes to the distribution of type of system is changed.

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.

National experts of the Ministry of Agriculture confirmed the assessment of the veterinary agency of Macedonia. Based on this expert judgment 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). The national experts of the Ministry of Agriculture within an expert meeting confirmed this approach 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.

6.3.1.2. Emission factors

Table 148provides for each livestock category emission factors taken from the EMEP EEA GB 2013 (updated July 2015 version) and for NH_3 from EMEP EEA GB 2016. These factors have been used for the estimation of NO_X NMVOC and NH_3 emissions. For NMVOC and cattle, the average mean of both EFs (NMVOC EF with and EF without silage feeding) has been used (for details see description below). EF for NMVOC are same in EMEP EEA GB 2013 and 2016.

Table 175 NH_3 emission factors for source categories 3.B - Manure management and 3.D - Agricultural Soils

NFR code	NH_3		
	Housing, storage, yard	Manure application*	Grazing**
	kg AAP-1 a-1	kg AAP-1 a-1	kg AAP-1 a-1
3B1a Dairy cattle	16,9	8,8	2,9
3B1b Non-dairy cattle	6,2	2,2	0,8
3B2 Sheep	0,4	0,2	0,8
3B3 Swine-fattening pigs	4,0	2,7	0,0
3B3 Swine-sows	9,0	6,0	0,0
3B4d Goats	0,4	0,2	0,8
3B4e Horses	7,0	1,7	6,1
3B4gi Laying hens	0,32	0,15	0,0
3B4gii Broilers	0,15	0,07	0,0
3B4giii Turkeys	0,56	0,39	0,0
3B4giv Other poultry (ducks)	0,45	0,23	0,0
3B4giv Other poultry (geese)	0,30	0,05	0,0
Reference	GB 2016 - Table 3.2 Default Tier 1 EF ($EFNH_3$) for calculation of NH_3 emissions from manure management		

*reported under source category 3.D.a.2

** reported under source category 3.D.a.3

Table 176 NOx and NMVOC emission factors for source category 3B Manure management

NFR code	Pollutants	
	NO_x	NMVOC
	kg AAP-1 a-1	kg AAP-1 a-1
3B1a Dairy cattle	0,154	12,992
3B1b Non-dairy cattle	0,094	6,252
3B2 Sheep	0,005	0,169
3B3 Swine-fattening pigs	0,001	0,551
3B3 Swine-sows	0,004	1,704
3B4d Goats	0,005	0,542
3B4e Horses	0,131	7,781
3B4gi Laying hens	0,003	0,165
3B4gii Broilers	0,001	0,108
3B4giii Turkeys	0,005	0,489
3B4giv Other poultry (ducks)	0,004	0,489
3B4giv Other poultry (geese)	0,001	0,489
Reference	GB 2013 updated July 2015 - Table 3.2 Default Tier 1 EF for NO	GB 2016- Table 3-3 Default Tier 1 EF for NMVOC

Emissions of particulate matter (PM) occurring from animal husbandry were calculated with the EMEP/EEA Tier 1 methodology provided in the EMEP/EEA Guidebook 2013 (updated version July 2015). The Tier 1 methodology multiplies average animal numbers with the particular default emission factors listed in the following table:

Table 177 TSP, PM_{10} and $PM_{2.5}$ emission factors for source category 3.B - Manure management

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).
3B4giv Other poultry (ducks)	0,14	0,14	0,02	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).
3B4giv Other poultry (geese)	0,24	0,24	0,03	GB 2013 updated July 2015 - Table 3.3 Default Tier 1 estimates of EF for particle emissions from animal husbandry (housing).

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. 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), 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

6.3.2. Source-specific uncertainties and time-series consistency

For the first time a quantitative uncertainty, analysis has been carried out for the Macedonian air pollutant emission inventory and was submitted in 2017. The 2015 Livestock Survey derived uncertainties of activity data, with certain adjustments made regarding the survey non-response rate. The errors are calculated as relative errors. All calculations were made with the SAS statistical software package. Uncertainties of emission factors were based on the GB 2013 and assumption of experts.

The following table presents combined uncertainties for emissions as well as uncertainties for activity data and the EFs for sector *3.B Manure Management* according to GB 2013.

Table 178 Uncertainties of activity data, emission factors and emissions for NFR 3.B

Categories		NH_3 Emissions	NOx Emissions	NMVOC Emissions	PM2.5 Emissions	EF NH_3	EF NO_x	EF NMVOC	EF PM2.5
3.B.1	Cattle	+/-125.1	+/-40.3	+/-40.3	+/-200.1	+/-125%	+/-40%	+/-40%	+/-200%
3.B.2	Sheep	+/-125.4	+/-41.3	+/-41.3	+/-200.3	+/-125%	+/-40%	+/-40%	+/-200%
3.B.3	Swine	+/-125.1	+/-40.5	+/-40.5	+/-200.1	+/-125%	+/-40%	+/-40%	+/-200%
3.B.4	Other Livestock	+/-125.4	+/-41.2	+/-41.2	+/-200.2	+/-125%	+/-40%	+/-40%	+/-200%
	Activity Data				**Relative errors**				
	Animal Population – Cattle				+/- 5.3%				
	Animal Population – Sheep				+/-10.2%				
	Animal Population – Swine				+/-6.1%				
	Animal Population – other Livestock				+/-10.0%				

**Note: uncertainties of emissions are combined uncertainties*

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. Statistical methods have been used for improvement of time consistency already described above.

Concerning the time series consistency, there is a dip in the number of broilers and jumps in between 2013 and 2015. According to the opinion of the Statistical office, the number of broilers in the business farm is variable while the number of broilers in the individual farms is mostly constant. The dips and jumps are due to the opening of new farms, which may be connected with the market prices. Concerning the jump in pig's number in 2007 and 2008, we have asked the MAFWS for the reason but no explanation was provided.

6.3.3. Source-specific QA/QC and verification

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

Activity data

- Consistency of time series: plausibility checks of dips and jumps for which requests on reasons are send to relevant institutions;
- Comparison with time series of previous year. Explanation of revisions are done only if jumps or dips appeared;
- Consistency checks of sub-categories with totals like in case of poultry with sum of

Emission factors

- Default EFs were used

Results (emissions)

- Assessment of recalculation differences: plausibility checks, explanation
- Documentation in calculation sheets and IIR.
- Livestock emission excel sheet contains sheets for cross checking of animal number with production of milk, eggs and number of helfers and calves in the case of cattle numbers.

6.3.4. Source-specific recalculations including changes made in response to the review process

Recalculations have been carried out, because the revised default Tier 1 methodology for NH_3 emissions, provided in the new EMEP/EEA GB 2016, has been applied. The Tier 1 methodology includes separate default EFs for housing, storage & yard, manure application and grazing.

Due to correction of a linkage error, recalculations for NMVOC for the whole time series have been carried out.

6.3.5. Source-specific planned improvements including those in response to the review process

The EMEP/EEA GB 2016 offers updated Tier 1 emission factors. It is planned to implement the new factors for NOx, and PM-emissions in the next reporting round.

6.4. Crop production and Agricultural Soils- NFR 3.D

6.4.1. Inorganic N-fertilizers (NFR 3.D.a.1)

6.4.1.1. 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/exported 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

From 2002 to 2010, activity data are based on FAO. Data from import/export statistics is available from 2009 onwards. These data were received 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 amounts could be obtained from this data source.

Based on a recommendation of the Stage 3 Review 2016 Macedonia moved to Tier 2 methodology in submission 2017 by using the N contents for different types of fertilizer as provided in the Stage 3 Review Report 2016, category issue 2:

- AS - Ammonium sulphate, 0.21 kg N per kg fertilizer.
- AN - Ammonium nitrate, 0.34 kg N per kg fertilizer.
- CAN - Calcium ammonium nitrate, 0.27 kg N per kg fertilizer.
- U - Urea, 0.46 kg N per kg fertilizer.

- MAP, 0.11 kg N per kg fertilizer.
- DAP, 0.18 kg N per kg fertilizer.
- NPK > 10 kg, 0.15 kg N per kg fertilizer
- NPK< 10 kg, 0.15 kg N per kg fertilizer

For other fertilizers emissions are calculated by using average N content and average EF of all applied fertilizers.

Soil P_h 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. The national experts of the Ministry of Agriculture confirmed this assessment.

According to the IPCC 2006 Guidelines, cool climates have an average temperature below 15 °C. The average temperature in Macedonia for 2015 is 11.4 degrees.

In the following table the quantities of applied N fertilizers is shown.

Table 179 Activity data for source category NFR 3.D.a.1 - Inorganic N-fertilizers

	t N applied per year									
Year	Ammonium sulphate	Ammonium nitrate	Calcium ammonium nitrate	Urea	MAP	DAP	NPK > 10 kg	NPK< 10 kg	Other N-fertilizers	3 years average Total N/t
1990	412	3,696	1,007	5,100	0	20	304	0	0	10540
1991	412	3,696	1,007	5,000	0	20	304	0	0	10440
1992	412	3,696	1,007	4,600	0	20	304	0	0	10040
1993	412	3,696	1,007	4,117	0	20	304	0	0	9557
1994	412	3,696	1,007	3,804	0	20	304	0	0	9244
1995	429	3,654	708	3,168	0	20	304	0	0	8283
1996	431	4,009	462	3,025	0	20	304	0	0	8252
1997	434	4,069	144	2,657	0	20	304	0	0	7629
1998	420	3,910	126	3,097	0	20	304	0	0	7878
1999	420	3,139	54	3,266	0	20	304	0	0	7204
2000	420	2,618	54	3,220	0	20	304	0	0	6636
2001	420	1,825	54	3,005	0	20	304	0	0	5628
2002	607	3,168	45	2,260	0	20	304	0	0	6405
2003	751	4,689	617	2,410	0	19	555	0	0	9042
2004	630	6,530	1,657	2,348	0	22	1,540	0	0	12727
2005	317	6,476	3,205	2,610	1	24	3,023	2	0	15658
2006	46	6,916	3,515	2,520	61	27	3,775	3	0	16863
2007	42	7,173	4,190	2,373	77	23	4,159	3	0	18041
2008	42	7,248	3,438	2,628	77	18	3,765	3	0	17217
2009	30	4,516	4,277	3,291	35	18	3,814	3	53	16036
2010	27	4,873	4,811	3,618	19	17	3,586	4	82	17037
2011	13	2,693	6,068	3,708	18	14	4,009	3	100	16627
2012	13	2,693	6,296	3,314	0	5	4,742	1	92	17157
2013	0	0	5,731	3,634	0	0	5,673	0	63	15102
2014	0	823	5,641	3,986	0	0	6,119	0	116	16685
2015	0	3,090	4,340	3,858	0	0	4,996	0	147	16431

* the 3-years average is used for all fertilizer types

Emission factors

In the following tables the emission factors applied for source category 3.D.a.1 are shown. All emission factors are taken from the GB 2013 and the GB 2016.

Table 180 NH_3 Emissions factors for source category NFR 3.D.a.1-Inorganic fertilizers

Fertilizer type	Value	Unit	References
AS	0,09	kg NH_3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
AN	0,015	kg NH_3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
CAN	0,008	kg NH_3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
U	0,155	kg NH_3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
MAP	0,05	kg NH_3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
DAP	0,05	kg NH_3 kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
NPK	0,05	kg NH_3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1

The emission factors for the respective N-fertilizers are taken for soils with normal pH and cool climate as described above.

Table 181 NOx, NMVOC and PM Emissions factors for source category NFR 3.D.a.1 - Inorganic fertilizers

Pollutant	Value	Unit	References
NOx	0,026	kg kg-1 fertilizer-N applied	GB 2016 Table 3-1 emission factor for source category 3.D.a.1
NMVOC	0,86	kg/ha	GB 2016 Table 3-1 emission factor for source category 3.D.a.1
PM10	1,56	kg/ha	GB 2016 Table 3-1 emission factor for source category 3.D.a.1
PM2.5	0,06	kg/ha	GB 2016 Table 3-1 emission factor for source category 3.D.a.1

6.4.2. Animal manure applied to soils (NFR 3.D.a.2)

This source category covers NH_3 emissions from animal manure applied to agricultural soils.

6.4.2.1. Methodological issues

The Tier 1 methodology according the EMEP/EEA GB 2016 has been applied.

Activity data and background information on the activity data

The input data is the number of registered heads of each domestic animal species. All activity data is derived from the Statistical Yearbooks for period 1990-2006 and Publication Livestock, prepared by the State Statistical Office for the period 2007-2015. The numbers per livestock category are presented in Table 172. Numbers of different categories of poultry were presented in Table 173. For further information, please refer to chapter 3.B Manure Management.

Emission factors

In Table 174 in chapter 3.B Manure Management, for each livestock category the NH_3 emission factors for animal manure applied to soils, taken from EMEP/EEA GB 2016, are shown.

6.4.3. Urine and dung deposited by grazing animals (NFR 3.D.a.3)

This source category covers NH_3 emissions from urine and dung deposited by grazing animals.

6.4.3.1. Methodological issues

The Tier 1 default approach following the EMEP/EEA GB 2016 has been applied.

Activity data and background information on the activity data

The input data is the number of registered heads of each domestic animal species. All activity data is derived from the Statistical Yearbooks for period 1990-2006, and Publication Livestock prepared by the State Statistical Office for the period 2007-2015. The numbers per livestock category are presented in Table 172. Number of different categories of poultry are presented in Table 173. For further information, please refer to chapter 3.B Manure Management.

Emission factors

In Table 174 in chapter 3.B - Manure Management for each livestock category the NH_3 emission factors for grazing, taken from EMEP/EEA GB 2016, are shown.

6.4.4. Source-specific uncertainties and time-series consistency

For the first time a quantitative uncertainty analysis has been carried out for the Macedonian air pollutant emission inventory and was submitted in 2017. Uncertainties of activity data and emission factors were based on the EMEP/EEA GB 2013.

The following table presents uncertainties for emissions, as well as for activity data and the EFs for sector *3.D Agricultural Soils* according to EMEP/EEA 2013.

Table 182 Uncertainties of emissions, emission factors and activity data

Categories		NH_3 Emissions	NOx Emissions	NMVOC Emissions	PM2.5 Emissions	EF NH_3	EF NOx	EF NMVOC	EF PM2.5
3.D.a	Inorganic N-fertilizers	+/- 206.2%	+/- 64.0%	+/- 64.0%	+/- 206.2%	+/- 200.0%	+/- 40.0%	+/- 40.0%	+/- 200.0%
Activity Data									
Inorganic N-fertilizers - amount				+/- 50%					

**Note: uncertainties of emissions are combined uncertainties*

Emissions from the whole period have been calculated; however, the sources on activity data are different. Namely in the period 2009-2015, data are received from the State inspectorate under Ministry of agriculture, forestry and water supply. For the period 1990-2008, data are taken from FAO; however, there are dips and jumps in the use of some fertilizers like ammonia nitrate for which MAFWS will be contact for further explanation of this inconsistency.

6.4.5. Source-specific QA/QC and verification

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

Activity data

Activity data from different sources like (FAO and MAFWS) for the period 2009-2011 was performed. Last year data were compared with 2015 data.

An Excel sheet called Fertilizers_final.xls was prepared by the MS expert in which graphs for different type of fertilizers are shown are checked for dips and jumps. Furthermore, comparison with time series of previous year is done and the data providers are asked on dips or jumps, that was not the case in this year.

Emission factors

Default Emission factors were used, but country specific parameters (e.g. N contents of fertilizers) were also compared with defaults and values reported by other countries (e.g. Serbia, Austria and Croatia).

Results (emissions)

Comparison of emissions calculated with Tier 1 and Tier 2 method was done. Use of tier 2 method result with lower emissions starting from 2001 onwards.

6.4.6. Source-specific recalculations including changes made in response to the review process

The reason for recalculations of NH_3 emissions in the source category 3.D.a.1 is due to the change of methodology. The Tier 2 methodology for calculating NH_3 emissions has been applied. Recalculations of NO_x emissions, have been carried out due to the correction of a linkage error for the activity data.

Furthermore, NH_3 emissions from 3.D.a.2 - Animal Manure applied to soils and 3.D.a.3 - Urine and dung deposited by grazing animals have been reported for the first time within source category 3D Agricultural Soils.

6.4.7. Source-specific planned improvements including those in response to the review process

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.

6.5. Field burning of agricultural residues - NFR 3.F

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 3.F “Field burning“ is reported as not occurring (“NO”). Anyhow, the current estimates for sector 5.C.2 “Open burning of waste” (average amount of waste burned for arable farmland of 25 kg/ha) should be kept as it is liable that open burning of small-scale (agricultural) waste happens in BC.

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:

5.A - Solid waste disposal on land

5.C.1.biii - Clinical waste incineration

5.C.2 - Open burning of waste

5.D.1 - Domestic wastewater handling

As during the stage 3 review in 2016, it was recommended to change to Tier 2 method for the category 5.A, this recommendation have been followed. Additionally, emissions for category 5.D.1 have been calculated using a Tier 1 approach.
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 clinical 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, pruning, 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 only three Waste Water treatment plants (WWTP) operating in Macedonia. For the plant in Ohrid, activity data are available for the whole time series. Emissions have been estimated based on these activity data. However, as data for the other plants is currently not available, the emissions are underestimated.

Regarding the Industrial wastewater handling, the some installations subjected under the IPPC license system are obligated to install waste water treatment. Emissions from this NFR category 5.D.2 have not been estimated until now.

7.1.1. Methodology

Tier 1 approach was used, using the given default Emission factors from the GB2016.

Completeness

The completeness in this sector is presented in the following table.

Table 183 NFR categories not included in Waste sector for 2015

NFR category		Completeness
5.A	Biological treatment of waste - Solid waste disposal on land	√
5.C.1.biii	Clinical waste incineration	√
5.C.2	Open burning of waste	√
5.B.1	Biological treatment of waste - Composting	NE
5.B.2	Biological treatment of waste - Anaerobic digestion at biogas facilities	NA
5.C.1.a	Municipal waste incineration	NO
5.C.1.bi	Industrial waste incineration	NO
5.C.1.bii	Hazardous waste incineration	NO

NFR category		Completeness
5.C.1.biv	Sewage sludge incineration	NO
5.C.1.bv	Cremation	NO
5.C.1.bvi	Other waste incineration (please specify in the IIR)	NA
5.D.1	Domestic wastewater handling	√
5.D.2	Industrial wastewater handling	NE
5.D.3	Other wastewater handling	NA
5.E	Other waste (please specify in IIR)	NO

7.1.2. Source-specific uncertainties and time-series consistency

Activity data for the whole time series and background information on these are hardly available, for which reason the uncertainty is expected to be rather high. Especially getting data on waste disposal is hard, as these data are required back to 1950, a time when Macedonia was still part of Yugoslavia. For further information, see the respective chapter below. Uncertainties of emissions, emission factors and activity data for 5.A and 5.C are presented below.

Time series consistency is ensured as recalculations are carried out for the whole time series and not only for specific years.

7.1.3. Source-specific QA/QC and verification

The results of this year's calculations have been compared with last year, and the reasons for any major differences clarified. Calculation sheets were checked for any errors in formulas or links. Data or information received from third parties was reviewed and archived to ensure transparency.

The recommendations of the stage 3 review were taken in consideration and improvements made:

- request for country specific data to statistical office and installations
- change to Tier 2 approach for 5.A
- estimation of emissions from 5.D.1
- review of notation key use.

7.1.4. Source-specific recalculations including changes made in response to the review process

Recalculation were made for the following sectors, the resulting differences and justifications are described in the respective sub-chapters.

5.A - Biological treatment of waste - Solid waste disposal on land

5.D.1 - Domestic Waste Water Handling

7.1.5. Source-specific planned improvements including those in response to the review process

The stage 3 review recommended establishing a national data reporting system for waste amounts in coordination with the National Statistical Office. This recommendation is taken seriously but takes some time to be set up and implemented.

In addition, wastewater treatment plants shall be asked again to send whole time series activity data to be able to calculate emissions from category 5.D.1, since currently the emissions in this sector are underestimated. The activity data concerning industrial wastewater treated will be available from the PRTR software BUBE that is operational starting from this year onwards.

A TAEIX study visit to an EU country is planned to be held during this year on strengthening the capacities for future establishment of a national data reporting system for waste amounts in coordination with the National Statistical Office. Key sector expert, deputy expert and representative from National Statistical Office will take participation in this planned TAEIX mission.

7.2. Solid waste disposal on land (NFR 5.A)

Within this category the emissions arising from solid waste disposal shall be accounted for, whereby municipal and industrial waste shall be considered. However, it has to be taken into account that only waste which still undergoes biological or chemical degradation is relevant. Therefore, inert waste (like construction waste) shall not be included.

7.2.1. Methodological issues

NMVOC, CO and NH_3were estimated using tier 2 method, 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 2 emission factors following the guidance of 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

7.2.2. Activity Data

As for Tier 2 method, since activity data on waste landfilled is required back to 1950, extrapolation was necessary based on population and GDP data. Data on municipal solid waste generation per person is available for the years 2003 until 2015 (source: Eurostat statistics and EEA report[35]). The hereby available information provided data on waste generation from 2003 to 2014. For the data from 1990-2003 the average annual change between 2003 and 2015 was applied, and then the value for 1990 (which is 97 kg per person), was kept constant until 1950.

Total municipal solid waste generation was calculated by multiplying with population data. Data on population is available in the Statistical Yearbooks of Macedonia, although before 1990 data were interpolated between decades. According to information from the statistical office more than 99% of municipal solid waste is landfilled, for that reason it was assumed that 100% of municipal solid waste was deposited on uncategorized landfills.

In order to determine the waste fraction, information published in an EEA study “Municipal Waste Management in FYROM (2013), page 7-8” was used. The shares are kept constant for the whole time series (1950 to 2015) due to a lack of better data, although, it can be assumed that in 1950 the waste composition was different.

Table 184 Type of waste, percentage and considerations in FOD model

Type of waste	Percentage	Consideration in FOD model as:
Biodegradable (organic) waste	26%	Food
Wood	2,7%	Wood
Paper and cardboard	11,9%	Paper
Plastics	9,6%	Plastics, other inert
Glass	3,5%	Plastics, other inert
Metals	2,6%	Plastics, other inert
Composite packaging	2,2%	Plastics, other inert
Other waste (complex products, inert materials, other categories)	7,5%	Plastics, other inert
Textiles	2,9%	Textile
Hazardous household waste	0,2%	Not considered
Fine mixed particle (<10mm)	30,9%	Plastics, other inert

[35] EEA, Municipal Waste Management in FYROM (2013), page 7-8

It has been possible to collect data on industrial waste, but only for the year 2014. The following table shows which waste types have been considered. In order to estimate industrial waste amounts back to 1950, GDP was used. National GDP data are available from 1994 to 2013. Before 1994, GDP for former Yugoslavia were found and used.[36] Industrial waste * by category, tons.

Table 172 Type of waste, and quantity in tons

Type of waste	Quantity [t]
Waste from households and similar waste – non-hazardous	5.131,38
Mixed and undifferentiated materials – nonhazardous	9.643,95
Waste from sorting materials – non-hazardous	167,65
Deposition	729,54
Waste from combustion	3.005,33
Soil waste	9.827,26
Waste from excavation	71.027,10
Industrial waste disposition	945.761,30
Paper and cardboard waste	483.859,40
Rubber waste	1.650,89
Plastics waste	8.792,21
Wood waste	1.398,89
Textile waste	721,05
Animal waste and mixed food waste	2.408,00
Agricultural waste	3.427,89
Animal manure and urine	86.099,50
TOTAL	1.633.651,33

Table 185 Activity data for source category 5.A - Solid waste disposal on land for the period 1990-2002

Year	Municipal Waste in Gg	Industrial Waste in Gg	Total Waste in Gg	Methane Emission in m³
1990	760	197	956.970	55.880.395
1991	659	208	866.923	56.799.402
1992	540	222	762.066	57.288.296
1993	456	236	692.189	57.303.851
1994	477	235	711.155	57.013.027
1995	552	250	802.077	56.816.648
1996	574	267	840.913	56.979.209
1997	602	283	885.602	57.269.171
1998	635	301	935.614	57.703.436
1999	680	319	999.662	58.295.947
2000	769	339	1.108.203	59.095.131
2001	822	359	1.180.774	60.271.499
2002	842	377	1.218.358	61.657.934

[36] GDP per capita of Former Yugoslavia by Angus Maddison (https://www.quandl.com/data/MADDISON/GDPPC_YUG_NEW-GDP-Per-Capita-of-Former-Yugoslavia-New-Estimate) accessed 28.11.2016

Table 186 Activity data for source category 5.A - Solid waste disposal on land for the period 2002-2015

Year	Municipal Waste in Gg	Industrial Waste in Gg	Total Waste in Gg	Methane Emission in m³
2003	399	875	1.273.595	63.105.610
2004	463	914	1.376.957	64.676.555
2005	572	1004	1.575.993	66.499.410
2006	589	1090	1.678.902	68.886.318
2007	606	1214	1.819.752	71.554.400
2008	714	1350	2.064.464	74.645.308
2009	726	1350	2.075.591	78.427.384
2010	721	1423	2.144.393	82.054.979
2011	735	1511	2.245.923	85.797.193
2012	787	1519	2.306.024	89.753.957
2013	793	1634	2.426.435	93.688.590
2014	765	1634	2.398.807	97.918.081
2015	786	1634	2.419.833	101.872.360

7.2.2.1. Emission Factors

As for the emission calculations the IPCC waste model was applied, the default parameters and factors were used as set in the excel for Southern European Countries with dry temperature.

Table 187 Parameter used for methane calculation of different waste types for source category 5.A -Biological treatment of waste

Parameter	Food	Garden	Paper	Wood	Textiles	Industrial
DOC	0,15	0,2	0,4	0,43	0,24	0,150
DOCf	0,500	0,500	0,500	0,500	0,500	0,500
Methane generation rate constant (k)	0,060	0,050	0,040	0,020	0,040	0,050
Half-life time (t1/2, years):	11,6	13,9	17,3	34,7	17,3	13,9
exp1 exp(-k)	0,94	0,95	0,96	0,98	0,96	0,95
Process start in deposition year. Month M	13,00	13,00	13,00	13,00	13,00	13,00
exp(-k*((13-M)/12))	1,00	1,00	1,00	1,00	1,00	1,00
Fraction to CH_4	0,500	0,500	0,500	0,500	0,500	0,500

The methane correct factor is set to 0,6, as the landfills are treated as uncategorized. All municipal and industrial waste is landfilled, other treatments are not relevant. No methane recovery occurs.

NMVOC, CO and NH_3 were estimated based on the landfill gas emitted. Therefore methane emission have been converted to landfill gas in m³ by consideration of the CH_4 concentration in the landfill gas and by taking into account the absolute density of CH_4. Based on that NMVOC, CO and NH_3 were calculated.

Table 188 Data for conversion of methane emissions to NMVOC, CO and NH_3 emissions for category 5A Biological treatment of waste

Parameter	CH_4	NMVOC	CO	NH_3
Relative density	0,555	0,555	0,967	-
Absolute density [kg/Nm³] bei 30°C	0,650	0,72	1,13	-
Concentration in landfill gas [%] (Cd, Hg, Pb, NMVOC, NH_3 in mg/m³)	55	300	2	10

The emission factors used to calculate emission from particulate matter are as outlined in the GB 2016 for source category 5.A.

Table 189 Emission factors for source category 5.A- Biological treatment of waste

Pollutant	Value	Unit	Reference
NMVOC	1,56	kg/Mg	GB 2016 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 2016Table 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 2016Table 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 2016Table 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 2016.

7.2.3. Source-specific uncertainties and time-series consistency

For the first time a quantitative uncertainty analysis has been carried out for the Macedonian air pollutant emission inventory and was submitted in 2017. Uncertainties of activity data and emission factors have been estimated by using Tier 1 methodology of the EMEP/EEA GB 2013.

Table 190 Uncertainties of emissions, emission factors and activity data for 5.A

Categories	NMVOC Emissions	PM2.5 Emissions	EF NMVOC	EF PM2.5
5.A Solid waste disposal on land	+/- 134.6%	+/- 206.2%	+/- 125.0%	+/- 200.0%
Activity data				
Amount of landfilled waste		+/- 50.0%		

7.2.4. Source-specific QA/QC and verification

The calculation has been checked by waste management experts and the used parameters and factors have been discussed. Therefore, the 4-eye principle was applied. Internal documentation was written to allow for transparency and reproduction in the following years.

The results have been compared to emission estimates from other countries, to check if the range of magnitude is right.

7.2.5. Source-specific recalculations including changes made in response to the review process

Major recalculation occurred for the sector 5.A, as the method was changed to Tier 2, which is a completely new approach as the First Order decay method was applied. Activity data were also reviewed and updated including industrial waste.

Table 191 Comparison of emission data reported for the NFR 5.A in 2016 and in 2017

Year	NMVOC in Mg		Year	NMVOC in Mg	
	2016 submission	2017 submission		2016 submission	2017 submission
1990	1.099,22	1,4929	2003	1.102,87	1,9868
1991	1.102,47	1,3524	2004	1.106,02	2,1481
1992	1.114,54	1,1888	2005	1.108,37	2,4585

Year	NMVOC in Mg		Year	NMVOC in Mg	
	2016 submission	2017 submission		2016 submission	2017 submission
1993	1.119,99	1,0798	2006	1.110,20	2,6191
1994	1.058,48	1,1094	2007	1.112,02	2,8388
1995	1.069,50	1,2512	2008	1.113,84	3,2206
1996	1.078,83	1,3118	2009	1.132,56	3,2379
1997	1.086,43	1,3815	2010	1.124,76	3,3453
1998	1.092,26	1,4596	2011	1.146,60	3,5036
1999	1.097,52	1,5595	2012	1.226,16	3,5974
2000	1.102,55	1,7288	2013	1.237,08	3,7852
2001	1.107,21	1,8420	2014	1.193,40	3,7421
2002	1.099,47	1,9006	2015	-	3,7749

7.2.6. Source-specific planned improvements including those in response to the review process

The review recommendation to apply a higher Tier method was followed. Currently the given default factors as set in the FOD model have been used, if country specific data become available they will be used.

7.3. Clinical Waste incineration - NFR 5.C

7.3.1. Methodological issues

Emissions from this source category are estimated according to GB–2016. The guideline outlines simple methodology where the amount of clinical waste incinerated is multiplied with Tier 1 emission factors.

7.3.1.1. Activity data

The activity data for source category 5.C - Clinical waste are from annual report of company “Drisla” where clinical waste incineration is operating. The company started with operation in 2000. Data for the period 2000-2015 were taken from the Drisla landfill website.

Table 192 Quantity of clinical waste incinerated in the period 2000–2015

Year	Clinical waste[Mg]	Year	Clinical waste [Mg]
2000	0,1149	2008	0,3589
2001	0,2319	2009	0,4163
2002	0,2486	2010	0,4584
2003	0,2551	2011	0,4700
2004	0,3227	2012	0,5013
2005	0,3756	2013	0,5666
2006	0,3270	2014	0,5729
2007	0,3550	2015	0,7749

7.3.1.2. Emission Factors

The emission factors used are as outlined in the GB 2016 and presented in the following table.

Table 193 Emission factors for source category 5.c.1.dii - Clinical waste incineration

Pollutant	Value	Unit	References
NOx	2,3	kg/Mg waste	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
NMVOC	0,7	kg/Mg waste	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
TSP	17	kg/Mg waste	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
BC	2,3	% of TSP	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
CO	0,19	g/Mg waste	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Pb	62	g/Mg waste	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Cd	8	g/Mg waste	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Cr	2	g/Mg waste	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Cu	98	g/Mg waste	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
PCB	0,02	g/Mg waste	GB 2016 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)	40	mg I-Teq/Mg waste	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
Total 4 PAHs	0,04	g/Mg waste	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator
HCB	0,1	g/Mg waste	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration. uncontrolled rotary kiln incinerator

7.3.2. Source-specific uncertainties and time-series consistency

In the NFR sector 5.C the activity data uncertainty was estimated to be 10 %; the emission factor uncertainty was estimated to be 200 % (rating D), based on expert judgment for SO_x, NO_x 125% (rating C) for NMVOC. No uncertainty analysis were done for the other pollutants.

7.3.3. Source-specific QA/QC and verification

Standard QA/QC procedures were carried out for this source category, i.e. activity data were checked for plausibility and time-series consistency; emission data were checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

7.3.4. Source-specific recalculations including changes made in response to the review process

Official activity data from the official website of the landfill Drisla for the period 2000-2015 on incinerated clinical waste were taken into account in this reporting round[37]. For the previous submission, calculations were made according Drisla reports on the amount of incinerated medical waste per medical installation, because activity data taken from the official website of the landfill were higher. In addition to this EF from 2016 GB instead of 2013 GB were applied.

7.3.5. Source-specific planned improvements including those in response to the review process

No planned improvements.

7.4. Open burning of waste- NFR 5.C.2

7.4.1. 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 practiced 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. The activity data were calculated when the agriculture area expressed in hectares was multiplied with the factor 25 and divided by 1000 which equals to the waste burned in kg.

7.4.1.1. Activity data

Data on arable farmland taken from the statistical office and calculated waste burned are presented in the following table. Data on arable farmland are taken from State Statistical Office of the Republic of Macedonia, Field crops, orchards and vineyards, 2007-2015[38].

Table 194 Activity data for source category 5.C.2 - 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

[37] http://drisla.mk/page_detail.asp?IID=3&ID=25

[38] State Statistical Office of the Republic of Macedonia, Field crops, orchards and vineyards,2007-2014, http://www,stat,gov,mk/PrikaziPoslednaPublikacija,aspx?id=5

Year	Arable farmland [hectare]	Waste [kg]
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
2015	513564	12839

7.4.1.2. Emission Factors

The emission factors used are as outlined in the GB 2016 for source category 5.C.2.

Table 195 Emission factors for source category 5.C.2 - Open burning of waste

Pollutant	Value	Unit	References
Nox	3,18	kg/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
NMVOC	1,23	kg/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Sox	0,11	kg/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
PM2.5	4,19	kg/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
PM10	4,51	kg/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
TSP	4,64	kg/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
BC	42	% of PM2.5	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
CO	55,83	kg/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Pb	0,49	g/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Cd	0,1	g/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Cr	0,01	g/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Cu	0,2	g/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Se	0,07	g/Mg	GB 2016Table 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 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning

Pollutant	Value	Unit	References
benzo(a) pyren	2,33	g/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
benzo(b) fluoranthen	4,63	g/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
benzo(k) fluoranthen	5,68	g/Mg	GB 2016Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning

7.4.2. Source-specific uncertainties and time-series consistency

See chapter 5.3.2.

7.4.3. Source-specific QA/QC and verification

See chapter 5.3.3.

7.4.4. Source-specific recalculations including changes made in response to the review process

No recalculations were made in this sector.

7.4.5. Source-specific planned improvements including those in response to the review process

No planned improvements.

7.5. Waste water treatment - NFR 5.D

7.5.1. Methodological issues

In Macedonia there are three wastewater treatment plants, they have been contacted to get data plant specific data and especially the amount of domestic wastewater treated in the plants. Based on the data received by one of the plants, emission were calculated based on a Tier 1 approach.

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 5.D cannot be calculated with the available data. However, in order to also report on NMVOC emissions from 5.D, the amount of wastewater from households and industries is needed.

7.5.1.1. Activity data

Activity data on wastewater handled in treatment plant Proakva are presented in the following table:

Table 178 Activity data for source category 5.D.1 - Wastewater treatment

Year	Water treated [m³]	Year	Water treated [m³]
1990	14.506.560	2003	14.979.600
1991	15.137.280	2004	14.506.560
1992	14.191.200	2005	15.452.640
1993	15.452.640	2006	15.294.960
1994	15.137.280	2007	14.348.880
1995	14.191.200	2008	15.137.280
1996	14.664.240	2009	14.664.240

Year	Water treated [m³]	Year	Water treated [m³]
1997	14.979.600	2010	15.294.960
1998	15.610.320	2011	14.979.600
1999	15.768.000	2012	15.768.000
2000	14.348.880	2013	14.033.520
2001	15.294.960	2014	17.680.416
2002	14.191.200	2015	17.680.416

7.5.1.2. Emission Factors

The emission factors applied are the given ones in the EMEP 2016 guidebook, which allowed the calculation of NMOVC emission from domestic wastewater handling. The emission factor used is 15mg NMOVC per m³ wastewater. There is an available emission factor on ammonia but it has not been used for calculation of ammonia emissions, because until now there is no available data on number of people connected to latrines.

7.5.2. Source-specific uncertainties and time-series consistency

In the NFR sector 5.D the activity data uncertainty was estimated to be 10%; the emission factor uncertainty was estimated to be 125% (rating C) for NMVOC. Time series consistency is ensured by applying the same methodology for the whole time series.

7.5.3. Source-specific QA/QC and verification

A waste expert checked the calculation, so a 4-eye principle was applied. Internal documentation ensures that the results can be reproduced and updated new next year.

7.5.4. Source-specific recalculations including changes made in response to the review process

Emissions in this sector were reported for the first time in this reporting round.

7.5.5. Source-specific planned improvements including those in response to the review process

Activity data were received only from one of three wastewater treatment plants. It is expected that all data will be collected for the next submission, because emissions are underestimated in this sector. Data on number of people connected to latrines will be required from the relevant institution.

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 1990-2015.

8.2. General description

Methodology

Tier 1 approach was used, using the given default Emission factors from the GB2016.

Completeness

The information on the completeness in this sector is presented in the following tables.

Table 196 Completed/Not completed 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 11.B

8.3.1. 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.

8.3.1.1. Activity Data

The activity data for this sector are taken from Statistical Yearbooks and State Statistical Office of the Republic of Macedonia, Forestry, 2000 –2015[39], as well on requirement sent to the Public enterprise Macedonian forests.

Table 197 Activity data for source category 11.B Forest fires

Year	Area burned [ha]	Wood burned [m³]	Wood burned [kg]
1990	NE	1131	870870
1991	NE	3729	2871330

[39] State Statistical Office of the Republic of Macedonia, Forestry, 2000 – 2014;http://www,stat,gov,mk/Publikacii/5,4,8,02,pdf

Year	Area burned [ha]	Wood burned [m^3]	Wood burned [kg]
1992	NE	2	1540
1993	NE	4213	3244010
1994	NE	96612	74391240
1995	NE	54228	41755560
1996	NE	636	489720
1997	NE	4084	3144680
1998	NE	4214	3244780
1999	NE	3856	2969120
2000	4807	711782	548072140
2001	5255	88260	67960200
2002	5482	24661	18989186
2003	1922	10987	8459990
2004	1798	4322	3328171
2005	3093	1063	8185510
2006	3594	12978	9993060
2007	34443	617678	475612060
2008	15046	35652	27452425
2009	1030	1551	1194270
2010	4725	2033	1565410
2011	8702	55743	42922341
2012	19312	102160	78663200
2013	2844	15268	11756090
2014	1150	19152	14747040
2015	3165	32494	25020380

8.3.1.2. Emission factors

Calculation of emission parameters was used and emission factors were taken from the GB 2016.

Table 198 Emission factors for source category 11.B Forest fires

Pollutant	Value	Unit	References
Nox	100	kg/ha area burned	GB 201611.B Forest fires. Table 3-1. pg. 9
CO	3000	kg/ha area burned	GB 201611.B Forest fires. Table 3-1. pg. 9
NMVOC	300	kg/ha area burned	GB 201611.B Forest fires. Table 3-1. pg. 9
SOx	20	kg/ha area burned	GB 201611.B Forest fires. Table 3-1. pg. 9
NH_3	20	kg/ha area burned	GB 201611.B Forest fires. Table 3-1. pg. 9
PM10	17	g/kg wood burned	GB 201611.B Forest fires. Table 3-1. pg. 9
PM2.5	11	g/kg wood burned	GB 201611.B Forest fires. Table 3-1. pg. 9
TSP	9	g/kg wood burned	GB 201611.B Forest fires. Table 3-1. pg. 9

In the Statistical Yearbook from 2000-2015[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.

8.3.2. Source-specific uncertainties and time-series consistency

No data available for burned area for the period 1990-1999. Data on wood burned for the period 2000-2014 were submitted for the first time in this IIR.

8.3.3. Source-specific QA/QC and verification

Macedonian Forests Company provided the data that was crosschecked with the data published in the SSO publication Forestry.

8.3.4. Source-specific recalculations including changes made in response to the review process

No recommendations were given for this sector in the stage 3 review report. Only mission data on wood burned for the period 2000-2014 were submitted for the first time in this IIR.

8.3.5. Source-specific planned improvements including those in response to the review process

No planned improvements.

9. RECALCULATIONS AND IMPROVEMENTS

9.1. Recalculations

To ensure time series consistency when improving the Macedonian emission inventory, recalculations have been carried out for the historical years.

The following section summarizes the changes made since the previous submission for each sector (e.g. methodological changes, update of activity data, new emission sources). Detailed information per category can be found in the chapters per sector, above.

9.1.1. Explanation of recalculations per sector

As a result of major improvements of the emission inventory made within the activities in the component 2 of the Twinning project (finalized in end of January 2017), as well as recommendations given by the CLRTAP Stage III review, some of the emission sources have been recalculated. The recalculation was based on the availability of activity data, and some of the emissions in few sectors were estimated for the first time in this reporting round. Recalculations were also carried out because of the updated emission factors from the GB 2016, and use of higher Tier 2 methodology especially in the Transport sector.

Explanations for recalculation per sector are given in the respective chapters. The tables indicating recalculations per pollutant can be found in tables 198-212.

Energy (NFR 1)

In the NFR sectors 1.A.2 - Combustion in manufacturing industries and 1.A.4 - Small combustion, instead of preliminary activity data for 2014 used for the last year reporting round, final fuel consumption data has been used. Emissions in the NFR sectors 1.A.5.b – Other mobile and 1.B.2.d - Other fugitive emissions from energy production, have been calculated for the first time due to available activity data. For the NFR sector 1.A.b.ii - Residential: Household and gardening (mobile) not estimated emissions from 2000 onwards were replaced with last reported emissions for 2000, as recommended by ERT.

Transport (NFR 1.A.3)

Due to availability of detailed car fleet data for 2014 and 2015 from MOI, Tier 2 method has been introduced for the first time. Tier 2 method was used to calculate the emissions coming from road transport, specifically from the following NFR sectors: 1.A.3.b.i,b.ii,b.iii and b.iv, instead of Tier 1 method that has been used for the whole time series in the previous reporting rounds. According to the recommendations given by the stage III review: SO_x emissions coming from NFRs 1.A.2.g.vii, 1.A.3.d.i and 1.A.3.c, PM10/PM2.5 emissions from NFRs 1.A.3.b.i-iv and POPs emissions from NFR 1.A.3.b have been calculated. NFR sectors on aviation emissions for which incorrect labelling of the NFR code for international vs domestic aviation has been used in the spreadsheets and in the IIR, were corrected.

Industrial processes and product use (NFR 2)

The recalculations in this sector were made due to the comments given by the MS solvent expert in the frame of the Twinning project, as well as by the ERT engaged in stage III review of the previous IIR.

There was an overestimation of the estimated emissions in the sectors 2.G - Other product use and in 2.I –Wood production. This was because produced instead of used products data were taken into account as activity data in the NFR 2.G - Other product use, and in 2.I –Wood production, all wooden product instead only those that are covered with creosote.

However, only emissions in the last few years were recalculated due to limitation of time and different available activity data for this sector. The recalculation of the emissions in the whole period is planned for the next reporting round. Recalculations were carried out also in 2.G – Other product use, due to the update of EF provided in the new EMEP/EEA GB 2016 and in 2.D.3.h – Printing, due to the correction of the formula for emission calculations.

Agriculture (NFR 3)

Recalculations in this sector have been carried out because the revised default Tier 1 methodology for NH_3 emissions, provided in the new EMEP/EEA GB 2016, has been applied. The Tier 1 methodology includes separate default EFs for housing, storage & yard, manure application and grazing.

Due to correction of a linkage error, and use of Tier 2 methodology using the N contents recommended by the ERT within the NFR sector 3.D.1 - Inorganic N-fertilizers, recalculations for NMVOC for the whole time series have been carried out.

Waste (NFR 5)

Major recalculation occurred for the sector 5.A - Biological treatment of waste, as the method was changed to Tier 2, which is a completely new approach as the First Order decay method was applied. Activity data were also reviewed and updated, including industrial waste. The recalculation in Clinical waste incineration category was done due to the fact that data source has been changed. Additionally, for the first time emissions coming from the NFR sector 5.D - Wastewater handling were reported.

9.1.2. Recalculations per pollutant

The following tables present 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 sector chapters. Revisions in the extent by more than 1000% are due to inclusion of new estimates in NFRs, which were not reported previously, and use of higher tier methodology or use of final fuel consumption data.

Table 199 Recalculation difference of NOx emissions [kt] compared to submission 2015

NOx emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1A1	Energy Industries	0,00	0%	5,02	39%
1A2	Manufacturing Industries & Construction	0,00	0%	-0,08	-2%
1A3	Transport	0,00	0%	-7,51	-59%
1A4	Other Sectors	0,00	0%	0,12	9%
1.A.5	Other	NE	NE	NE	NE
1B	Fugitive Emissions	0,00	0%	5,02	0%
2	Industrial Processes and Product Use	0,23	0%	-0,03	-63%
3	Agriculture	0,00	208%	0,40	519%
5	Waste	0,00	0%	0,00	-1%
6	Other	0,00	-	0,00	-
	Total emissions	**0,24**	**1%**	**-2,09**	**-7%**

Table 200 Recalculation difference of NMVOC emissions [kt] compared to submission 2015

NMVOC emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1A1	Energy Industries	0,00	0%	0,00	0%
1A2	Manufacturing Industries & Construction	0,00	0%	-0,04	-4%
1A3	Transport	0,00	0%	-3,93	-70%
1A4	Other Sectors	0,00	0%	2,19	24%
1.A.5	Other	NE	NE	NE	NE
1B	Fugitive Emissions	0,00	0%	0,00	0%
2	Industrial Processes and Product Use	0,13	1%	3,20	50%
3	Agriculture	0,52	10%	0,15	4%
5*	Waste	0,39	35%	2,55	211%
6	Other	0,00	-	0,00	-
	Total emissions	**1,04**	**2%**	**4,12**	**14%**

Table 201 Recalculation difference of SO_2emissions [kt] compared to submission 2015

SO_2 emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	0%	0,46	1%
1.A.2	Manufacturing Industries & Construction	0,00	0%	-0,59	-10%
1.A.3*	Transport	0,06	9%	0,61	2034%
1.A.4	Other Sectors	0,00	0%	-0,03	-4%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0,16	26%	0,00	0%
2	Industrial Processes and Product Use	0,00	-	0,00	-
3	Agriculture	0,00	-	0,00	-
5	Waste	0,00	0%	0,00	-4%
6	Other	0,00	-	0,00	-
	Total emissions	**0,22**	**0%**	**0,45**	**1%**

*Note: High increase is due to use of estimation of SOx emissions in Transport sector which were not estimated in the previous reporting round

Table 202 Recalculation difference of NH_3emissions [kt] compared to submission 2015

NH_3 emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-	0,00	-
1.A.2*	Manufacturing Industries & Construction	0,00	0%	0,00	-
1.A.3	Transport	0,00	0%	0,07	232%
1.A.4	Other Sectors	0,00	0%	0,18	17%
1.A.5	Other	NE	NE	NE	NE
1.B*	Fugitive Emissions	0,00	-	0,19	2425588%
2*	Industrial Processes and Product Use	0,11	2866%	0,04	-
3	Agriculture	0,72	5%	0,83	10%
5	Waste	0,00	-	0,00	-

NH_3 emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
6	Other	0,00	-	0,00	-
	Total emissions	**0,83**	**6%**	**1,32**	**14%**

*Note: High increase is due to the fact that emissions from NFR sector 1.B.2.d – were estimated for the first time and emissions for 2G were estimated for 1990.

Table 203 Recalculation difference of PM2.5emissions [kt] compared to submission 2015

PM2.5 emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-	0.00	0%
1.A.2	Manufacturing Industries & Construction	0,00	-	-0.05	-6%
1.A.3	Transport	0,00	-	0.17	171%
1.A.4	Other Sectors	0,00	-	1.92	17%
1.A.5	Other	0,00	-	NE	NE
1.B	Fugitive Emissions	0,00	-	-0.49	0%
2	Industrial Processes and Product Use	0,00	-	0.00	-7%
3	Agriculture	0,00	-	0.00	0%
5	Waste	0,00	-	0.00	1%
6	Other	0,00		1.56	-
	Total emissions	**0,00**	**0%**	**-0.49**	**7%**

Table 204 Recalculation difference of PM10emissions [kt] compared to submission 2015

PM10 emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-	0,00	0%
1.A.2	Manufacturing Industries & Construction	0,00	-	-0,05	-3%
1.A.3	Transport	0,00	-	0,17	-53%
1.A.4	Other Sectors	0,00	-	1,97	17%
1.A.5	Other	0,00	-	NE	NE
1.B	Fugitive Emissions	-0.18	-	0.00	0%
2	Industrial Processes and Product Use	0.01	-	-0,47	-2%
3	Agriculture	0.00	-	0,00	0%
5	Waste	0.00	-	0,00	-2%
6	Other	0.00		0,00	-
	Total emissions	**-0.17**	**0%-**	**1,62**	**3%**

Table 205 Recalculation difference of TSP emissions [kt] compared to submission 2015

TSP emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-	0,00	0%
1.A.2	Manufacturing Industries & Construction	0,00	-	-0,02	-3%
1.A.3	Transport	0,00	-	-0,52	-53%
1.A.4	Other Sectors	0,00	-	2,08	17%
1.A.5	Other	NE	-	NE	NE

TSP emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.B	Fugitive Emissions	0,00	-	0,00	0%
2	Industrial Processes and Product Use	0,23	-	-0,36	-2%
3	Agriculture	0,00	-	0,00	0%
5	Waste	0,00	-	0,00	-2%
6	Other	0,00	0%	0,00	-
	Total emissions	**0,24**	**-**	**1,18**	**3%**

Table 206 Recalculation difference of CO emissions [kt] compared to submission 2015

CO emissions [kt]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	0%	-1,21	-37%
1.A.2	Manufacturing Industries & Construction	0,00	0%	-0,41	-6%
1.A.3	Transport	0,00	0%	-15,62	-57%
1.A.4	Other Sectors	0,00	0%	11,51	19%
1.A.5	Other	NE	NE	NE	NE
1.B*	Fugitive Emissions	0,02	24%	0,00	1888%
2*	Industrial Processes and Product Use	0,00	0%	-0,96	-63%
3	Agriculture	0,00	-	0,00	-
5	Waste	1,27	136%	2,22	311%
6	Other	0,00	-	0,00	-
	Total emissions	**1,29**	**1%**	**-4,48**	**-4%**

*Note: High increase is due to the use of final consumption data from energy balance in 1.B.a.iv - Fugitive emissions oil : Refining / storage

Table 207 Recalculation difference of Pb emissions [t]compared to submission 2015

Pb emissions [t]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	0%	0.00	0%
1.A.2	Manufacturing Industries & Construction	0,00	0%	-0.06	-8%
1.A.3	Transport	0,00	0%	-0.01	-100%
1.A.4	Other Sectors	0,63	89%	0.20	30%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0,00	-	0,00	-
2	Industrial Processes and Product Use	0,87	6%	0,19	8%
3	Agriculture	0,00	-	0,00	-
5	Waste	0,00	0%	-0,01	-17%
6	Other	0,00	-	0,00	-
	Total emissions	**1,51**	**1%**	**0,31**	**7%**

Table 208 Recalculation difference of Cd emissions [t] compared to submission 2015

Cd emissions [t]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	0%	0,00	0%
1.A.2	Manufacturing Industries & Construction	0,00	0%	0,00	-6%
1.A.3	Transport	0,00	0%	0,00	-22%
1.A.4	Other Sectors	0,00	0%	0,00	14%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0,00	-	0,00	-97%
2	Industrial Processes and Product Use	-0,10	-30%	0,00	39%
3	Agriculture	0,00	-	0,00	-
5	Waste	0,00	-	0,00	-16%
6	Other	0,00	-	0,00	-
	Total emissions	-0,10	-20%	0,00	2%

Table 209 Recalculation difference of Hg emissions [t] compared to submission 2015

Hg emissions [t]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	0%	0,00	0%
1.A.2	Manufacturing Industries & Construction	0,00	0%	0,00	-8%
1.A.3	Transport	0,00	0%	0,00	0%
1.A.4	Other Sectors	0,00	0%	0,00	13%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	-0,23	-23%	0,00	-
2	Industrial Processes and Product Use	0,00	0%	0,00	0%
3	Agriculture	0,00	0%	0,00	-
5	Waste	0,00	0%	-0,01	-20%
6	Other	0,00	0%	0,00	-
	Total emissions	**-0,23**	**-23%**	**-0,01**	**-3%**

Table 210 Recalculation difference of PCDD/ PCDF emissions [t] compared to submission 2015

PCDD/ PCDF emissions [t]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	0%	0,00	0%
1.A.2	Manufacturing Industries & Construction	0,00	0%	-0,09	-7%
1.A.3	Transport	0,00	-	0,00	-
1.A.4	Other Sectors	0,00	0%	1,80	17%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0,00	-	0.00	-
2	Industrial Processes and Product Use	0,00	0%	0.09	6%
3	Agriculture	0,00	-	0.00	-
5	Waste	0,00	0%	-0.01	-4%
6	Other	0,00	-	0.00	-
	Total emissions	**0,00**	**0%**	**1.79**	**13%**

Table 211 Recalculation difference of PAHs emissions [t] compared to submission 2015

PAH emissions [t]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	0%	0.00	1%
1.A.2	Manufacturing Industries & Construction	0,00	0%	-0.07	-6%
1.A.3	Transport	0,00	-	0.00	-
1.A.4	Other Sectors	0,00	0%	1.79	17%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0,00	-	0.00	-
2*	Industrial Processes and Product Use*	0,01	1%	-0.01	-79%
3	Agriculture	0,00	-	0.00	-
5	Waste	0,00	0%	0.00	-
6	Other	0,00	-	0.00	-
	Total emissions	**0,01**	**0%**	**1.71**	**15%**

Table 212 Recalculation difference of HCB emissions [kg] compared to submission 2015

HCB emissions [kg]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-	0,00	-
1.A.2	Manufacturing Industries & Construction	0,00	0%	0,00	-4%
1.A.3	Transport	0,00	-	0,00	-
1.A.4	Other Sectors	0,00	0%	0,02	17%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0,00	-	0,00	-
2	Industrial Processes and Product Use	0,00	0%	0,00	0%
3	Agriculture	0,00	-	0,00	-
5	Waste	0,00	-	-0,01	-20%
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**0,00**	**0%**

Table 213 Recalculation difference of PCB emissions [kg] compared to submission 2015

PCB emissions [kg]		1990		2015	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,01	-	0,00	-
1.A.2	Manufacturing Industries & Construction	0,00	0%	-0,08	-8%
1.A.3	Transport	0,00	-	0,00	-
1.A.4	Other Sectors	0,00	0%	0,15	16%
1.A.5	Other	NE	NE	NE	NE
1.B	Fugitive Emissions	0.00	-	0,00	-
2*	Industrial Processes and Product Use	0.04	0%	6,44	517%
3	Agriculture	0.00	-	0,00	-
5	Waste	0.00	-	0,00	-20%
6	Other	0.00	-	0,00	-
	Total emissions	**0.05**	**0%**	**6,51**	**202%**

9.2. Improvements

9.2.1. Improvements made

The following table presents issues flagged by the CLRTAP stage 3 in 2016, as well as gaps in the emission inventory discovered by the MS experts that participated in component 2 of the Twining project, their rating and status of implementation at the time of IIR 2017 submission. Planned improvements at sector level are described in the respective sector chapters.

Table 214 Findings from step 3 Reviews (2011 and 2016) and improvements made (general issues)

Subject	Source	rating	Improvement made
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/ 2016/ Macedonia § 16	High	Currently Tier 2 methodologies are implemented only on limited NFR sectors. For most of the sectors, T1 calculations are possible due to data constraints, but further methodological improvements will be investigated.
The ERT notes that for the key category analysis for some pollutants aggregated sectors are used. Therefore, the analysis does not always compare with the CEIP analysis.	CEIP/S3.RR/ 2016/ Macedonia § 14	High	Fulfilled. A new file for the KCA was established, based on a standardized sector definition (i.e. level of aggregation is currently the same for all pollutants). We are aware about the different importance of sectors for the respective pollutants (e.g. solvents for NMVOC) and we have adapt the aggregation level for the relevant pollutants.
The ERT welcomes the plan and encourages the Party to carry out the improvement not perform an uncertainty analysis as part of the 2016 submission.	CEIP/S3.RR/ 2016/ Macedonia	High	Fulfilled. Uncertainty analysis are part of this IIR. They were prepared within a Twining expert mission.
A KCA Trend Assessment has so far not been made.	Peer-Review 2016	High	Fulfilled. KCA Trend assessment is part of this IIR. It was prepared within an Twining expert mission.
QA/QC Plan. incl. procedures and checklist	Peer-Review 2016	High	QA/QC Plan has been not yet been developed but SOPs on data gathering and emission inventory reporting has been implemented. Furthermore a checklist has been prepared and info sheets of all excel NFR calculation sheets were added.
The ERT welcomes the plan and encourages the Party to report BC on voluntary basis.	CEIP/S3.RR/ 2016/ Macedonia	High	Fulfilled. BC emissions have been included in this IIR for the first time
The ERT encourages us to include information on the existence of abatement technology in the IIR, e.g. that the coal fired plants in the country do not have secondary abatement technology to reduce NO_x, SO_2 or TSP emissions, to further increase the transparency of the inventory.	CEIP/S3.RR/ 2016/ Macedonia	High	Fulfilled. BAT description are incorporated in the chapter Industry.
ERT noted that emissions have not been estimated for NFRs 1.A.2.f, 1.A.3.e.i, 1.A.5.a and 1.B.2.d, and recommends that the Party checks if the activities exist, and estimates and reports the missing emissions.	CEIP/S3.RR/ 2016/ Macedonia	High	Partly Fulfilled. Emissions in the following NFRs 1.A.2.f, 1.A.5.a and 1.B.2.d have been estimated

9.2.2. Planned improvements

In the following, the improvements are listed which were found during the CLRTAP stage 3 reviews in 2011 and 2016 which were not implemented in this reporting round and are planned to be implemented in the future. The improvements are structured as general issues (Table 214) and sector improvements (Table 215). Planned improvements which originate from a peer review in the course of the Twinning project in 2016, as well as improvements planned according to the observations of the gaps by the national emission inventory team (NEIT) are also listed.

Table 215 Planned improvements (general issues)

Subject	Source	Rating	Improvement planned	Timeline
The ERT notes that the FYR of Macedonia does not submit emission estimates for projections. 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.	CEIP/S3.RR/2010 /Macedonia	High	Submission of projections data is planned for future submissions (see chapter 7)	Planned to be implemented in the following submissions
Verification - According to the review, GL a comparison with emission data submitted under NEC and UNFCCC has to be done. NEC currently not relevant. But UNFCCC data available. Issue raised during Stage 3 CLRTAP Review 2011.	CEIP/S3.RR/2010 /Macedonia	Medium	Compare emission values (indirect GHG), it should be made in some project we do not have enough capacities to do this alone without support.	Planned to be implemented in the following submissions
Recalculations to be quantified for the whole time series, currently (i.e. Submission 2016) only for 1990 and 2014	Peer-Review 2016	Low	Depends on possibility to make it but it will be done for future submission	Planned to be implemented in the following submissions

Table 216 Sectoral improvements planned

NFR Category	Subject	Source	rating	Timeline
All	Meeting and discussion with SSO for the possibilities of gathering missing statistical activity data in the future	National emission inventory team	High	2017
1.A.3.b	For 2014 and 2015 data, Tier 2 methodology was applied. MEPP is planning to start with the use COPERT V model for calculating transport emissions in future.	CEIP/S3.RR/2016/Macedonia § 16	High	2017-2018
1.A.3.e.i	ERT noted that emissions have not been estimated for NFRs 1.A.2.f, 1.A.3.e.i, 1.A.5.a and 1.B.2.d and recommends that the Party checks if the activities exist and estimates and reports the missing emissions .MEPP will send requirement to the relevant companion	CEIP/S3.RR/2016/Macedonia § 16	**Low**	**2017**
2H	MEPP has already sent requirement for the historical data for wine production	Twinning mission report No. 24/2016	Medium	2017
2G	Production instead of used products were taken as activity data. Recalculations were done only for the last two years, but	Twinning mission report No. 24/2016	High	2017

NFR Category	Subject	Source	rating	Timeline
	recalculations for the historical years will be done for the next reporting round			
2I	All wooden products were taken into account. Therefore, an overestimation was carried out. Recalculations were done only for the last years (2011-2015), but recalculations for the historical emissions will be done for the next reporting round	Twinning mission report No. 24/2016	High	2017
2.A.5	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 demolition refer to the area of constructed and demolished dwellings. It is planned gathering of activity data for other type of constructed and demolished buildings.	National emission inventory team	Low	2018
5.D	Emissions in 5.D were calculated for the first time in this reporting round, however they are underestimated due to the fact that activity data for this sector are not complete. NET will try to complete the activity data for the future submissions.	National emission inventory team	Medium	2017

10. PROJECTIONS

The need for preparation of national emission projections comes from the:

- Obligation under the Gothenburg protocol (RM is a party to the protocol starting from 2014) projections data for 2020, 2025 and 2030 under the Gothenburg Protocol are requirement under the Article 7 of the Gothenburg Protocol and as outlined in the Guidelines for Reporting Emissions and Projections Data under the Convention, ECE/EB.AIR/125;
- Need to update of the National emission reduction program under NEC directive 2001/81/EC;
- Transposition of the revised NEC directive 2016/2284/EU in the national legislation.

Current situation

Projections for the main pollutants SO_x, NO_x, NMVOC and NH_3 have been calculated within the National Program for Progressive Reduction of Emission for the period 2012-2020[40] 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 document, applicable legislation and year of fulfillment of individual emission reduction measures have been used. Mainly energy strategic documents were taken into account. No serious analyses were made on the strategic documents in the industrial, waste and agriculture sector.

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_3emission projections.

In accordance with the International agreement with Energy community and Decision D/2013/05/MC-EnC, the Ministerial Council provided the possibility for Contracting Parties to use, from 01.01.2018 until 31 December 2027, a national emission reduction plan (NERP) as an alternative to setting the emission limit values of Directive 2001/80/EC for each combustion plant individually. This approach has been chosen by Republic of Macedonia and NERP has been prepared within two TAEIX expert missions in the period October 2014-November 2015. The plan includes emission ceilings for eight plants (Three power plants, two heating plants and one oil refinery, which is currently out of work). The Government in December in 2015 has officially adopted this draft plan. This plan contains emission ceilings for the period 2018 -2027 for the following pollutants NOx, SOx and dust. The plan was send in January 2016 to be checked by Energy community experts and after their comments were accepted and incorporated the by our national working group which will monitor the implementation of the plan, they have been approved by the government and currently the updated plan is pending for approval.

This plan will have impact on the current national emission projections for NOx and SOx for 2020, which means that these projections need to revise. The projections of NOx, SOx and dust in this plan will be taken into account in the process of calculation of 2030 projections for SOx, NOx and PM2.5.

[40] National program for the gradual reduction of the quantities of emissions of the certain pollutants at the level of the Republic of Macedonia for the period 2012 to 2020 (Official gazette of RM no.107/2012)

Regarding the inventory the current inventory has been completed with whole time series for all pollutants for the period 1990-2015 but mainly Tier 1 method has been used for the emission calculations. Within the Twining project "Further strengthening the capacities for effective implementation of the acquis in the field of air quality, 6 expert missions have been used for preparation of framework for future calculation of projections in the following sectors (energy production, energy used in households, transport, industry, waste and agriculture). The recommendations from all experts were summarized in Guidance document for preparation of projections.

After the realization of the expert missions, it became clear that the national human capacities for fulfillment of the obligation for preparation of projections are currently limited. Moreover, involvement of different stakeholders in the process is essential.

The recommendations given in the Twining project under this issue will be used as a basic for preparation of future project that is planned to be implemented within the IPA 2 program.

11. REFERENCES

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ANNEX 1 Nomenclature for reporting format (NFR) - Format for reporting under the UNECE/LRTAP convention for 2015

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 [1] (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		
A_PublicPower	1A1a	Public electricity and heat production	16,403104 89	0,067907 043	69,50701 966	NA	2,382006 859	5,876320 587	8,701510 41	0,005 238 213	1,908206 981	0,604567 046	0,073757 309	0,116339 588	0,576150 479	0,366422 636	0,048344 287	0,795759 164	1,795060 644	0,491396 2	0,402337 072	5,51471E-05	0,001483 152	0,001164 625	9,7464E-05	0,002800 389	NE	0,004062 478	1606,05189	39815, 90416	3258,0 22326	NO	NO	NA	TJ NCV
B_Industry	1A1b	Petroleum refining	NO	NO	NO	NE	NO	NO	NO	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NO	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	1,678269 511	0,539791 031	5,026910 685	NE	0,623475 593	0,673140 884	0,711799 714	0,053 133 336	5,245159 019	0,739458 847	0,010021 976	0,044094 587	0,022171 266	0,074889 534	0,096863 539	0,071742 688	0,010115 227	1,145183 515	1,122621 243	0,25355 15 26	0,344738 478	0,133003 063	0,104049 26	0,835342 327	0,003452 48	0,937754 966	1315,2 26935	5516,2 03393	657,62 9965	6,4866 9	NO	NA	TJ NCV
B_Industry	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0,021036 61	0,001025 176	0,001927 331	NA	0,000820 141	0,000820 141	0,000820 141	0,000 459 279	0,002706 464	3,28056E-06	2,46042E-07	4,92084E-06	1,23021E-06	8,20141E-06	9,02155E-06	3,28056E-07	4,51077E-06	0,001189 204	5,74099E-05	7,79134E-05	0,000615 106	6,9712E-05	6,15106E-05	0,000824 241	NE	NO	41,007 0375	NO	NO	NO	NO	NA	TJ NCV
B_Industry	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0,009505 191	0,001518 965	0,009556 614	NE	0,001151 86	0,001492 296	0,001900 819	0,000 630 262	0,003780 213	0,001089 795	2,04589E-05	2,64857E-05	7,1731E-05	0,000871 989	0,000490 322	0,017703 131	2,11345E-06	0,000571 298	0,000699 82	0,0003540 79	0,000422 246	0,000272 389	0,001497 957	0,002546 671	NE	NE	68,087 14478	NO	36,438 86706	NO	NO	NA	TJ NCV
B_Industry	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0,011533 912	0,000959 591	0,001164 46	NE	0,000479 181	0,000482 068	0,000485 636	0,000 238 926	0,002144 657	3,976E-05	4,22691E-06	1,25947E-05	3,08778E-06	1,38045E-05	1,01357E-05	3,8684E-06	3,65039E-06	0,000786 11	0,000110 434	5,14439E-05	0,000320 286	4,10671E-05	3,55748E-05	0,000448 372	1,55758E-06	3,84909E-05	20,158 4365	0,2263 17	15,239 00995	0,2834 52	NO	NA	TJ NCV
B_Industry	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0,391219 982	0,062311 998	0,038492 024	NA	0,033224 954	0,033656 641	0,034607 842	0,013 139 194	0,131562 84	0,004156 373	0,001726 093	0,000300 373	8,2677E-05	0,003231 673	0,001017 776	0,000324 14	0,000162 886	0,089019 564	0,015098 811	0,0028473 73	0,012974 398	0,001959 033	0,001664 618	0,019445 422	0,000661 887	0,000688 768	708,52 13775	4,0050 3	203,43 91908	131,88 0718	NO	NA	TJ NCV
B_Industry	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	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	IE	IE	IE	IE	TJ NCV
I_Offroad	1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	1,041000 934	0,107458 775	NE	0,000253 965	0,066221 272	0,066221 272	0,066221 272	0,037 083 912	0,340376 068	NO	3,17456E-07	NA	NE	5,205E-08	0,053967 479	0,002222 19	0,000317 456	0,031745 576	NO	0,0009523 67	0,001587 279	NE	NE	0,002539 646	NO	NA	1365,0 59775	NO	NO	NO	NO	NA	TJ NCV
B_Industry	1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	1,035105 482	0,115186 531	0,622602 748	NE	0,081083 904	0,095937 653	0,113127 375	0,027 723 162	0,472158 149	0,077879 74	0,001433 511	0,002481 738	0,003673 882	0,035845 475	0,022935 503	0,645511 432	0,000528 867	0,084558 284	0,104017 306	0,0284859 07	0,036083 652	0,018037 263	0,060962 297	0,143569 119	0,000604 658	0,046390 797	2467,9 86281	272,86 14271	142,63 89726	72,580 66101	NO	0,55323 2	Clinker produced [kt]
H_Aviation	1A3ai(i)	International aviation LTO (civil)	0,40521	0,003117	0,024936	NA	0,002337 75	NA	NA	NA	0,095068 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NA	NE	NA	15585	TJ NCV
H_Aviation	1A3aii(i)	Domestic aviation LTO (civil)	0,000832	0,000032 5	0,000065	NA	0,000013	NA	NA	NA	0,000071 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NA	NE	NA	2,795	TJ NCV
F_RoadTransport	1A3bi	Road transport: Passenger cars	1,701620 809	0,830363 024	0,472142 59	0,095417 874	0,066374 77	0,066374 77	0,066374 77	NE	8,349105 366	4,96123E-05	0,001856 49	NA	NA	0,295519 797	0,008691 759	0,012168 462	0,001738 352	0,173835 175	NA	2,49378E-06	NA	NA	NA	NA	NA	NA	6587,2 73647	NA	1873,3 96	NO	NA	NA	TJ NCV
F_RoadTransport	1A3bii	Road transport: Light duty vehicles	0,415372 39	0,084712 713	0,048228 581	0,003484 715	0,038028 135	0,038028 135	0,038028 135	NE	0,752260 675	1,61335E-06	0,000652 01	NA	NA	0,110841 723	0,003260 051	0,004564 071	0,000652 01	0,065201 014	NA	3,5827E-07	NA	NA	NA	NA	NA	NA	4474,3 57034	NA	NE	NA	NA	NA	TJ NCV
F_RoadTransport	1A3biii	Road transport: Heavy duty vehicles and buses	2,612034 295	0,245802 685	0,095572 575	0,000978 266	0,080702 292	0,080702 292	0,080702 292	NE	1,569973 98	4,25521E-06	0,001755 164	NA	NA	0,298377 87	0,008775 82	0,012286 148	0,001755 164	0,175516 394	NA	2,96867E-07	NA	NA	NA	NA	NA	NA	9070,6 84806	NA	NE	NA	NA	NA	TJ NCV
F_RoadTransport	1A3biv	Road transport: Mopeds & motorcycles	0,006016 103	0,034064 946	0,005869 908	4,53618E-05	0,000395 927	0,000395 927	0,000395 927	NE	0,115325 715	1,65257E-07	0,000140 393	NA	NA	0,023866 77	0,000701 964	0,000982 749	0,000140 393	0,014039 276	NA	6,25958E-09	NA	NA	NA	NA	NA	NA	79,215 6669	NA	NE	NA	NA	NA	TJ NCV
F_RoadTransport	1A3bv	Road transport: Gasoline evaporation	NA	1,199612 358	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	0,047509 1	0,088465 588	0,116694 383	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4119,97 9	10^6 km
F_RoadTransport	1A3bvii	Road transport: Automobile road abrasion	NA	NA	NA	NA	0,026115 792	0,048058 523	0,096117 046	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4119,97 9	10^6 km
I_Offroad	1A3c	Railways	0,098354 8	0,008728 05	0,000075 08	0,000013 139	0,002571 49	0,002702 88	0,002853 04	NA	0,020083 9	NA	0,000018 77	NA	NA	0,000093 85	0,003190 9	0,000131 39	0,000018 77	0,001877	NA	0,0000563 1	0,000093 85	NA	NA	0,000150 16	NA	NA	80,711	NO	NA	NO	NA	NA	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	NO	NO	NA	TJ NCV
G_Shipping	1A3dii	National navigation (shipping)	0,004674 443	0,000166 732	1,00856E-05	NA	8,33659E-05	8,33659E-05	8,93206E-05	NA	0,000440 648	7,74112E-06	5,9547E-07	1,78641E-06	2,38188E-06	2,97735E-06	5,24014E-05	5,9547E-05	5,9547E-06	2,97735E-05	7,74112E-06	NA	NA	NA	NA	NA	4,76376E-06	0,000076 57	2,5605 23082	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 [1] (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 Fuels	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		
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	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	NO	NO	NO	NO	NO	NA	TJ NCV
C_OtherStationaryComb	1A4ai	Commercial/institutional: Stationary	0,201642257	0,051077589	0,231077655	NA	0,061274166	0,069058581	0,079464584	0,02359025	0,455501068	0,031913346	0,001010449	0,000493123	0,001895223	0,020843164	0,012113702	0,385856244	0,000149186	0,044884468	0,095076908	0,0189092 41	0,025373068	0,011801 26	0,008793233	NE	1,01055E-05	0,016853882	1480,601014	16,29919477	222,2121033	234,7169841	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	0,752534305	8,612702701	0,255449504	1,002055615	10,60817012	10,89466 97	11,46971969	1,060389637	57,4360983	0,584464 35	0,020819 49	0,007343 32	0,014835 09	0,049402767	0,12768 5064	0,179741744	0,007190 97	1,872460569	10,05208242	3,0245003 8	3,172791 161	1,871354 193	2,014948 915	10,08359 465	0,085910 374	0,864586613	484,70 16661	33,472 98711	2,5565 84208	14314, 93676	NA	NA	TJ NCV
I_Offroad	1A4bii	Residential: Household and gardening (mobile)	0,001383185	0,635748963	0,000626218	3,440 76E-06	NE	NE	0,003664408	NE	1,229279819	0,10668	0,000008589	NA	NA	0,000042945	0,001460 13	0,000060123	0,000008589	0,000858 9	NA	NE	NE	NE	NA	NA	NA	NA	IE	NA	NA	IE	NA	NA	TJ NCV
C_OtherStationaryComb	1A4ci	Agriculture/Forestry/Fishing: Stationary	0,040391373	0,019532168	0,064476809	NE	0,008602952	0,009967823	0,011513767	0,002535984	0,055828355	0,003542603	7,84342E-05	2,7306E-05	0,000219905	0,002710482	0,001533507	0,053875075	4,57179E-06	0,002692009	0,005017688	0,0014808 42	0,001871 475	0,001040 369	0,000657 414	0,005050 1	NO	0,005415359	207,1407	35,572 39	NO	90,155 2	NE	NA	TJ NCV
I_Offroad	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,229621035	0,028349526	NA	0,000053304	0,011315 43	0,011315 43	0,011315 43	NE	0,353892357	NA	0,000068 49	NA	NA	0,000342 45	0,011643 3	0,000479 43	NA	0,006849	NA	0,0002091 9	0,000338 73	NA	NA	NA	NA	NA	6477	NA	NO	NO	NA	NA	TJ NCV
I_Offroad	1A4ciii	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	NE	NE	NE	NE	NE	NE	NE	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	NE	NE	NO	NO	NO	NE	NA	TJ NCV
I_Offroad	1ASb	Other, Mobile (including military, land based and recreational boats)	0,022392 04	0,002288765	2,76479E-05	NA	0,001407 46	0,001401 936	0,001401 936	0,000785084	0,007236309	NA	6,72069E-09	NA	NA	1,10192E-09	0,001142518	4,70448E-05	6,72069E-06	0,000672069	NO	6,61155E-10	NA	NA	NA	6,61155E-10	NO	NO	NO	NA	NO	NO	NA	28,89897345	TJ NCV
D_Fugitive	1B1a	Fugitive emission from solid fuels: Coal mining and handling	NA	1,185548614	NA	NA	0,035566494	0,231182211	0,486075418	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,927749	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	NA	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	NA	NA	NA	NA	NA	NA	NO	Crude oil produced [Mt]
D_Fugitive	1B2aiv	Fugitive emissions oil: Refining / storage	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	NA	NO	Crude oil refined [Mt]
D_Fugitive	1B2av	Distribution of oil products	NA	1,35126	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	0,67563	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Gas throughput [Mn3]
D_Fugitive	1B2c	Venting and flaring (oil, gas, combined oil and gas)	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	Gas vented flared [TJ]
D_Fugitive	1B2d	Other fugitive emissions from energy production	NE	NE	NE	0,178255613	NE	NE	NE	NE	NE	NE	NE	3,73488E-05	2,12209E-06	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NA	NA	NA	NA	84883,62546	[MWh]
B_Industry	2A1	Cement production	NA	NA	NA	NA	0,0194	0,0259	0,0881	0,000582	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NA	NA	NA	NA	553,232	Clinker produced [kt]
B_Industry	2A2	Lime production	NA	NA	NA	NA	0,0056021	0,0280105	0,072027	2,576 97E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8003	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	0,031476815	0,314768 15	0,642127026	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6,295363	Material quarried [Mt]
B_Industry	2A5b	Construction and demolition	NA	NA	NA	NA	0,006468 98	0,064689802	0,218140 03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	752207	floor space constructed/demolished [M2]
B_Industry	2A5c	Storage, handling and transport of mineral products	NA	NA	NA	NA	0,002071203	0,020712025	0,041424 05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4,142405	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]
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]

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 [1] (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		
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	NE	0,070027 05	NE	NE	0,065358 58	0,084032 46	0,140054 1	0,000 235 291	NE	2,147496 2	0,009336 94	0,046684 7	0,186738 8	2,100811 5	0,032679 29	0,065358 58	0,009336 94	1,867388	1,400541	NE	NE	NE	NE	0,224086 56	1,40054E-05	1,167117 5	NA	NA	NA	NA	NA	466,847	Steel produced [kt]
B_Industry	2C2	Ferroalloys production	NA	NA	NA	NA	3,9647	5,5631	6,5235	0,396 47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	130,97	Ferroalloys produced [kt]
B_Industry	2C3	Aluminium production	NA	NA	NA	NA	0,000483 45	0,001230 6	0,001758	1,111 94E -05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,030765	NA	NA	NA	NA	NA	4,395	NA	NA	NA	NA	NA	NA	0,879	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	0	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	NA	NA	NA	NA	0,000431 11	0,000589 94	0,000726 08	4,311 1E-07	NA	0,24959	0,005218 7	0	0,003176 6	0	0,063532	0,000294 97	NA	NA	0,11345	NA	NA	NA	NA	NA	NA	8,3953	NA	NA	NA	NA	NA	2269	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)	NA	NA	NA	NA	NA	NA	NO	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	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	2,071278	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	2071,278	Population (1000 head)
E_Solvents	2D3b	Road paving with asphalt	NA	0,004893 696	NA	NA	0,122342 4	0,917568	4,281984	0,006 973 517	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	305,856	Asphalt produces[kt]
B_Industry	2D3c	Asphalt roofing	NA	0,001290 12	NA	NA	NA	NA	0,015878 4	NA	0,000942 78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9,924	NA
B_Industry	2D3d	Coating applications	NA	0,026644 387	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	0,10382 8095	Paint applied [kt]
E_Solvents	2D3e	Degreasing	NA	1,760586 3	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	2071,278	Population [1000 head]
E_Solvents	2D3f	Dry cleaning	NA	0,621383 4	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	2071,278	Population [1000 head]
E_Solvents	2D3g	Chemical products	NA	0,109828	NA	0	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	2D3h	Printing	NA	0,043126	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)	NE	0,000655 649	NE	NE	6,160656-05	9,24098E-05	0,000112 945	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	4,94445E-06	2,49577E-06	2,49577E-06	2,49577E-06	1,24318E-05	NE	NE	NA	NA	NA	NA	NA	NA	NA
E_Solvents	2G	Other product use (please specify in the IIR)	0,014785 74	0,272365 851	NE	0,034089 346	0,221786 104	0,221786 104	0,221786 104	0,000 998 037	0,452607 938	NE	4,43572E-05	8,2143E-07	1,31429E-06	2,87501E-06	0,044357 221	NE	NE	NE	8,2143E-07	0,0009117 87	0,000369 644	0,000369 644	0,000369 644	0,002020 718	NE	NE	NA	NA	NA	NA	NA	3885024 ,942	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	0,602926 035	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	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	0,015865 624	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15,8656 2428	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	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	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	0,019125 876	1,613528 448	NA	2,098878 6	0,050919 54	0,078242 22	0,171387 72	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	124,194	Population size (1000 head)
K_AgriLivestock	3B1b	Manure management - Non-dairy cattle	0,012149 312	0,808058 496	NA	0,801337 6	0,023264 64	0,034896 96	0,076256 32	NA	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	129,248	Population size (1000 head)
K_AgriLivestock	3B2	Manure management - Sheep	0,003667 55	0,123963 19	NA	0,293404	0,012249 617	0,040783 156	0,101957 89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	733,51	Population size (1000 head)

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 [1] (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		
K_AgriLivestock	3B3	Manure management - Swine	0,000258014	0,131737214	NA	0,886057	0,012978	0,07375057	0,16285071	NE	NA	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	195,443	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	0,00044032	0,04773068	NA	0,0352256	0,00147066	0,00489635	0,01224089	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	88,064	Population size (1000 head)
K_AgriLivestock	3B4e	Manure management - Horses	0,002460704	0,146158304	NA	0,131488	0,00262976	0,00413248	0,00901632	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	18,784	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 management - Laying hens	0,004271523	0,234933765	NA	0,45562912	0,03274834	0,16943707	0,16943707	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	1423,841	Population size (1000 head)
K_AgriLivestock	3B4gii	Manure management - Broilers	0,000311809	0,033675372	NA	0,04677135	0,00280628	0,02151482	0,02151482	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	311,809	Population size (1000 head)
K_AgriLivestock	3B4giii	Manure management - Turkeys	0,000037935	0,003710043	NA	0,00424872	0,00053109	0,00394524	0,00394524	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	7,587	Population size (1000 head)
K_AgriLivestock	3B4giv	Manure management - Other poultry	0,00006535	0,00875701 2	NA	0,0077445	0,00037 91	0,00271652	0,00271652	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	17,908	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		NA	NA	NA	NA	NA	NO	Population size (1000 head)
L_AgriOther	3Da1	Inorganic N-fertilisers (includes also urea application)	0,42721721 6	1,08739088	NA	0,93747691 9	0,07586448	1,97247648	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	Use of inorganic fertilizers (kg N/yr)
L_AgriOther	3Da2a	Animal manure applied to soils	IE	IE	NA	2,41212823	NA	NA	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
L_AgriOther	3Da2b	Sewage sludge applied to soils	NE	NA	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
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	NA	1,2354026	NA	NA	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
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	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	NE	NE
L_AgriOther	3Dd	Off-farm storage, handling and transport of bulk 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	NA	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		NA	NA	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		NA	NA	NA	NA	NA	NO	Area burned [kha/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		NA	NA	NA	NA	NA	NO	NA
J_Waste	5A	Biological treatment of waste - Solid waste disposal on land	NA	3,77494000 1	NA	0,00101872 4	0,00079854 5	0,00052994 4	0,00112038 3	NA	2,30745485 3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	2,419833334	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		NA	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	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	Waste incinerated [kt]	
J_Waste	5C1biii	Clinical waste incineration	0,00178219 2	0,00054240 6	0,00041842 8	NA	NA	NA	0,01317272 2	0,00030297 3	0,00014722 5	0,04804169 2	0,00619892 8	0,03331923 8	0,00015497 3	0,00154973 2	0,07593686 8	0,00154973 2	NA	NA	0,03099464	NA	NA	NA	NA	3,09946E-08	0,07748666	0,01549732		NA	NA	NA	NA	NA	0,774866	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		NO	NO	NO	NO	NO	NO	Incineration of corpses [Number]

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 [1] (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	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	0,040828338	0,015792093	0,001412301	NE	0,053795829	0,057904341	0,059573424	0,022594248	0,716806953	0,006291159	0,00128391	NE	0,005264031	0,000128391	0,00256782	NE	0,02015	5,13564	0,128391	9,513E-08	7,31174E-08	8,02187E-09	NE	1,76269E-07	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA
J_Waste	5D1	Domestic wastewater handling	NA	0,000265206	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	17680416	Total organic product [m3]
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	NO	NO	NO	NO	NO	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	NE	NA	NA	NA	NA	NE	NA
	NATIONAL TOTAL	**National total for the entire territory (based on fuel sold)**	27,61025743	28,80545505	76,408069	10,661466	18,88955026	27,9918486	35,16355676	1,653140624	82,02422064	4,60527 7579	0,13545 5855	0,25116 7931	0,814444793	3,38582066	0,622962378	2,250722253	1,847352975	11,2063934	13,50126931	,332451703	3,59906 5093	2,03911 512	2,19314 0382	11,3224 3101	4,56314 643	11,4537 8274	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)	0,053676548	0,254963604	0,013419137	NA	NA	NA	NA	NA	16,10296447	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NA	NE	NA	0	TJ NCV
O_AviCruise	1A3aii(i)	Domestic aviation cruise (civil)	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	NE	NA	NA	NE	NA	NO	TJ NCV
P_IntShipping	1A3di(i)	International maritime navigation	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	NO	NO	NO	NO	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)	5,244114484	5,244114484	5,244114484	5,244114484	5,244114484	5,24411484	5,244114484	5,2441 14 84	5,24411 484	5,24411 484	5,24411 484	5,24411 484	5,24411484	5,24411484	5,24411484	5,24411484	5,24411484	5,24411484	5,244114484	,24411484	5,24411 484	5,24411 484	5,24411 484	5,24411 484	5,24411 484	5,24411 484	NE	NE	NE	NE	NE	NE	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	NA	NA	NA	NA	NA	NA	NA	NO	Please specify
N_Natural	11B	Forest fires	0,3165	0,9495	0,0633	0,0633	0,2251834 2	0,27522418	0,4253464 6	NA	9,495	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3165	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	NE	NA	NA	NA	NA	NE	