1990 -2017

INFORMATIVE INVENTORY REPORT

Republic of North Macedonia

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Submission under the

Convention on Long-Range Transboundary Air Pollution (CLRTAP)

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LIST OF ABBREVIATIONS

2W	**T**wo **W**heelers
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
CPAPRNM	**C**adastre of **p**olluters and **a**ir **p**ollutants in **R**epublic of **N**orth **M**acedonia
CRF	**C**ommon **R**eporting **F**ormat
EB	**E**xecutive **B**ody
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	**E**xpert **R**eview **T**eam
EU	**E**uropean **U**nion
GHGs	**G**reen**h**ouse **G**ase**s**
GPG	**G**ood **P**ractice **G**uidance (of the IPCC)
HDVs	**H**eavy-**D**uty **V**ehicles
HM	**H**eavy **M**etals
IPCC	**I**ntergovernmental **P**anel on **C**limate **C**hange
KCA	**K**ey **C**ategory **A**nalysis
LDTs	**L**ight-**D**uty **T**ruck**s**
LE	**L**aw on **E**nvironment
LHV	**L**ow **H**eating **V**alue
LPS	**L**arge **P**oint **S**ource
MAFWS	**M**inistry of **A**griculture, **F**orestry and **W**ater **S**upply
ME	**M**inistry of **E**conomy
MEIC	**M**acedonian **E**nvironmental **I**nformative **C**entre
MEPP	**M**inistry of **E**nvironment and **P**hysical **P**lanning
MOI	**M**inistry of **I**nterior
MS	**M**ember **S**tate
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	**P**assenger **C**ar**s**
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	**S**tate **S**tatistical **O**ffice
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	**COR**e **IN**ventory **AIR** emissions
EAF	**E**lectric **A**rc **F**urnace
WWTP	**W**aste **W**ater **T**reatment **P**lants
CAA	**C**ivil **A**viation **A**gency
NEIT	**N**ational **E**mission **I**nventory **T**eam

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Republic of North 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 North 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 North 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 4-8 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, QA/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 2017.

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

This report contains emissions of the whole time series 1990-2017. 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 (IIRs) in those years, the Ministry of Environment and Physical Planning (MEPP) was supported by austrian 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. Starting from 2018 reporting has been done by the national expert emission inventory team. However, compare to the previous IIR, the quality control of the inventory has been improved in general.

[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

1.2. Explanation of significant changes in emission trends

The report presents trend analysis in the country for the period 1990 – 2017. 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, reduse use of coal for electricity production, as well as closure of installations or reduced production in the sector industry.

A decreasing trend is noticed for NOx and SOx emissions from 2011, which is a result of the shorter operation of the power plant REK Oslomej from 12 to several mounts per year, and a decrease in coal consumption including gasification of the one heating plant. 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 reduction of emissions, especially in 2016, is due to the reduced amount of burnt coal in REK Bitola and reduced operation of REK Oslomej. From 2017 to 2016 emissions of these supstances are redused by 8% for NOx and 13 % for SOx due to the lower coal and heavy fuel consuption consumption as well as reduced operation of power plant REK Oslomej..

The trend on NMVOC emissions is variable. In the period from 2016 to 2017 emissions decreased by only 3%, due to slightly lower emissions from the residential sector.

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 2016 to 2017, emissions slightly decreased by 2%, and the reason for decrease is coming from the domestic solid fuel combustion. With regards to CO, the main reason for decreasing trend and reduction of 13% in 2017 compare to 2016 is decrese in emissions coming from combustion of fuels in industry as well in households and administrative capacities.

Table 1 Emission trends 1990 – 2017 for the main air pollutants and CO

Year	Emission in kt				
	NO_x	NMVOC	SO_2	NH_3	CO
1990	44,14	47,88	109,97	15,80	132,39
1991	36,30	42,06	89,23	14,83	111,52
1992	38,03	44,22	86,34	14,94	123,43
1993	39,44	46,21	88,93	15,26	133,29
1994	35,37	41,23	88,99	15,20	120,85
1995	38,02	43,90	95,10	14,99	125,23
1996	35,98	43,60	89,05	13,95	123,08
1997	36,83	44,73	93,01	13,53	126,30
1998	41,35	44,49	107,84	13,23	129,33
1999	38,92	45,36	98,04	13,41	132,33
2000	42,53	47,53	106,45	13,49	144,97
2001	39,53	39,98	108,45	12,74	113,19
2002	37,82	38,97	96,86	12,12	114,59
2003	34,14	38,66	95,22	12,06	116,33
2004	36,03	39,06	96,40	12,16	121,44
2005	36,94	37,38	97,13	11,57	114,66
2006	36,79	38,98	94,47	11,92	117,53
2007	39,65	39,20	99,49	11,57	112,71
2008	38,74	42,91	101,28	11,74	125,03
2009	38,98	43,43	96,20	11,06	133,88
2010	38,25	36,22	91,13	11,30	114,53
2011	40,66	38,68	101,89	11,61	120,36
2012	39,79	34,22	96,39	10,31	89,32
2013	38,13	34,46	82,90	10,33	90,15
2014	28,96	28,42	83,40	10,28	62,21
2015	27,43	29,56	77,03	10,34	64,59
2016	26,62	29,60	64,75	10,36	65,43
2017	24,48	28,58	56,06	11,20	56,91
Trend 1990-2017	***-8%***	***-3%***	***-13%***	***8%***	***-13%***

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 60% in 2016 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 as well as reduced dust coming form the electricity production due to the reduced coal consumption over the reporting period.

Table 2 Emission trends for particulate matter 1990-2017

Year	Emissions			
	PM10 [kt]	PM2.5 [kt]	TSP [kt]	BC [kt]
1990	32,49	48,02	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	46,93	55,55	2,97
1997	31,29	45,55	53,50	2,83
1998	35,66	52,02	61,72	3,25
1999	30,96	44,89	53,42	2,78
2000	29,88	43,41	53,77	2,68
2001	18,11	27,53	33,91	1,42
2002	18,59	27,88	33,78	1,58
2003	28,93	41,81	49,89	2,56
2004	31,48	45,55	54,65	2,82
2005	28,07	41,38	50,48	2,55
2006	26,67	38,98	47,11	2,40
2007	20,89	31,18	38,15	1,82
2008	24,64	35,86	44,16	2,16
2009	19,50	28,09	35,70	1,67
2010	24,06	34,36	42,91	2,14
2011	28,52	41,47	52,70	2,55
2012	22,40	34,67	44,75	1,99
2013	24,47	37,25	47,95	2,24
2014	17,44	27,90	36,05	1,47
2015	15,66	24,75	31,80	1,31
2016	13,47	21,97	31,28	1,13
2017	9,20	16,12	24,91	0,73
Trend 1990–2017	***-27%***	***-32%***	***-20%***	***-35%***

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 1990-2017

Year	Emissions		
	Cd [Mg]	Pb [Mg]	Hg [Mg]
1990	0,384	109,392	0,621
1991	0,350	86,769	0,569
1992	0,332	96,840	0,524
1993	0,300	91,171	0,499
1994	0,267	87,599	0,416
1995	0,363	95,604	0,439
1996	0,407	95,967	0,493
1997	0,318	99,609	0,522
1998	0,361	102,057	0,594
1999	0,312	97,658	0,527
2000	0,311	100,190	0,538
2001	0,307	96,374	0,562
2002	0,307	103,443	0,589
2003	0,233	95,115	0,442
2004	0,226	25,946	0,428
2005	0,164	23,313	0,309
2006	0,163	8,177	0,310
2007	0,167	8,867	0,334
2008	0,170	6,217	0,324
2009	0,164	5,546	0,288
2010	0,164	6,183	0,303
2011	0,177	6,881	0,343
2012	0,156	5,164	0,297
2013	0,137	4,055	0,253
2014	0,133	4,377	0,251
2015	0,130	4,379	0,254
2016	0,131	2,429	0,210
2017	0,126	2,212	0,192
Trend 1990–2017	***-0,671***	***-0,980***	***-0,691***

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 68% and 84% 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 2017 compared to 2016.

Table 4 Emission trends for POPs 1990-2017

Year	Emissions			
	PCDD/F [g – I TEQ]	PAHs [t]	HCB [kg]	PCB [kg]
1990	16,49	12,23	44,30	187,54
1991	14,51	10,80	39,23	177,69
1992	14,74	11,66	25,84	177,56
1993	15,23	12,77	24,20	131,33
1994	13,79	11,97	25,05	123,05
1995	13,96	12,09	18,64	237,82
1996	13,47	11,88	19,72	266,61
1997	14,00	11,92	27,90	150,21
1998	15,35	12,19	29,35	178,05
1999	15,29	12,39	53,99	128,32
2000	17,60	14,48	38,33	104,83
2001	14,61	11,43	34,16	93,29
2002	15,60	11,49	52,70	92,51
2003	16,22	12,82	42,99	49,31
2004	16,30	12,96	8,53	38,09
2005	15,17	12,18	7,58	4,23
2006	16,29	12,95	11,71	4,63
2007	15,11	11,50	10,15	4,87
2008	16,43	13,31	10,40	4,36
2009	16,84	14,10	7,44	3,80
2010	17,85	14,88	9,56	4,26
2011	17,83	14,57	9,93	4,69
2012	12,33	9,72	7,24	7,85
2013	11,47	9,45	6,53	9,82
2014	9,92	7,62	4,87	9,21
2015	10,48	8,28	4,54	18,17
2016	9,17	7,72	5,52	19,04
2017	7,99	6,37	6,67	25,12
Trend 1990–2017	***-0,52%***	***-0,48%***	***-0,85%***	***-0,87%***

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 2014-2017) 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

Due to the fact that emissions from the Transport sector have been calculated using the Tier 2 method only for the last three 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 national experts have alrady recived two days training for use of COPERT V model. The second priority is use of Tier 2 in 1A4 sector due to the fact the combustion in households and administrative capacities is one of the major emission sources for several pollutants especially for particulate mater. QA/QC procedures are continiusly implemented. During this reporting round deputy experts have made control checks of emission calcualtions . In this manner the quality control of the data has been significantly improved.

1.4. Information on recalculation – main reasons for recalculations

- In Energy sector emissions for the year 2017 (and even several years before) were recalculated, using final activity data from the energy balance and disaggregated activity data regarding fuel consumption. This recalculation did not result in some major changes.However due to aviability of separate LHV for solid fuels recalculations were made in 1A2 and 1A4 NFR sector up to 2013, which resalted with bigger changes.
- In the solvent sector NFRs were recalculated in some cases up to 2006 due to the comments and recommendations given by the MS experts for the improvement of the historical activity data given during the Twining project.

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 we are not a Member of the European Union, we are not obliged to report emissions under the EU's National Emissions Ceiling Directive (NECD). However, the NEC directive 2001/81/EC has been transposed in the national legislation and national totals for NOx, NMVOC, SOx and NH_3 with national emission ceilings.

The new NEC Directive (2016/2284/EU) on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/ECwill be transposed in the Law on ambient air quality within an technical project which is programed in IPA 2 program, that is planned to start in 2019. However due to regular preparation of the National emission inventory on yearly base, gridded data starting LPS data from 2017, and IIR on yearly basewe can say that several obligation from the new NEC directive are already implemented in our country.

INTRODUCTION

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 North 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 North 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 North 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 North Macedonia
1979	Geneva Convention on Long-Range Transboundary Air Pollution		16.03.1983	30 Dec 1997 (d)3
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 20094			
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[5]			

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

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

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

In the context of air pollution and Climate Change the Republic of North 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 North Macedonia on 28.04.1998.
  - Kyoto Protocol under the United Nations Framework Convention on Climate Change the Republic of North 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 North 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 North 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 North 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).
- Minamata convention on mercury. The convention has been signed on 24.07.2014

At its thirty-second session[6] (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.

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

National legislation

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

1) Calculation of emission quantities of pollutants in the air in Republic of North 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 of the LAAQ.

Practical implementation and development of the inventory work

In 2005 Republic of North 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 North 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 North 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[7] and has been based EMEP/EEA Guidebook[8] 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[9] sectors (1, 2 and 3), without submitting an IIR Report.

In 2007 Republic of North 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)“[10].

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[11].

[7] CLRTAP- Macedonia’s Informative Inventory Report, 2004, MEPP, March 2006

[8] EMEP/CORINAIR Emission Inventory Guidebook - 2006

[9]SNAP Selected Nomenclature on Air Pollutants

[10]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)

[11]CLRTAP- Macedonia’s Informative Inventory Report, 2008, MEPP, March 2010

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.

Republic of North Macedonia, in 2011 participated in Stage 3 in depth review[12] 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[13]. 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[14] 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 North 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 IIR, submitted in 2017 and 2018, 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[15] have been used. The present IIR contains improved actitivity data and the editing has also been improved.

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

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

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

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

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

Table 6 Development of the inventory work in North 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[16] (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		

[16]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[17] implemented	All + BC	1990-2015	EMEP/EEA Emission Inventory Guidebook - 2009, 2013 and 2016	MEPP Twinning			X	X
2018	• Data quality improvement, introduction of new QA/QC precedures	Emission inventory experts	1990-2016	EMEP/EEA Emission Inventory Guidebook - 2009, 2013 and 2016	MEPP			X	X
2019	• Data quality improvement, introduction of new QA/QC precedures	Emission inventory experts	1990-2017	EMEP/EEA Emission Inventory Guidebook - 2009, 2013 and 2016	MEPP			X	X

2.2. Institutional arrangements

According to the article 40 of the Law on environment (LE) the Macedonian Environmental Informative Center (MEIC), a department within the Ministry of Environment and Physical Planning (MEPP) is the

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

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.

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. MOI during 2018 has provided activity data per vechicle category for the period 2006-2016. However due to limited time, tier 2 calculation methodology has been implemented only for 2016 data in this reporting round.

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 under the Law on ambient air quality.

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.

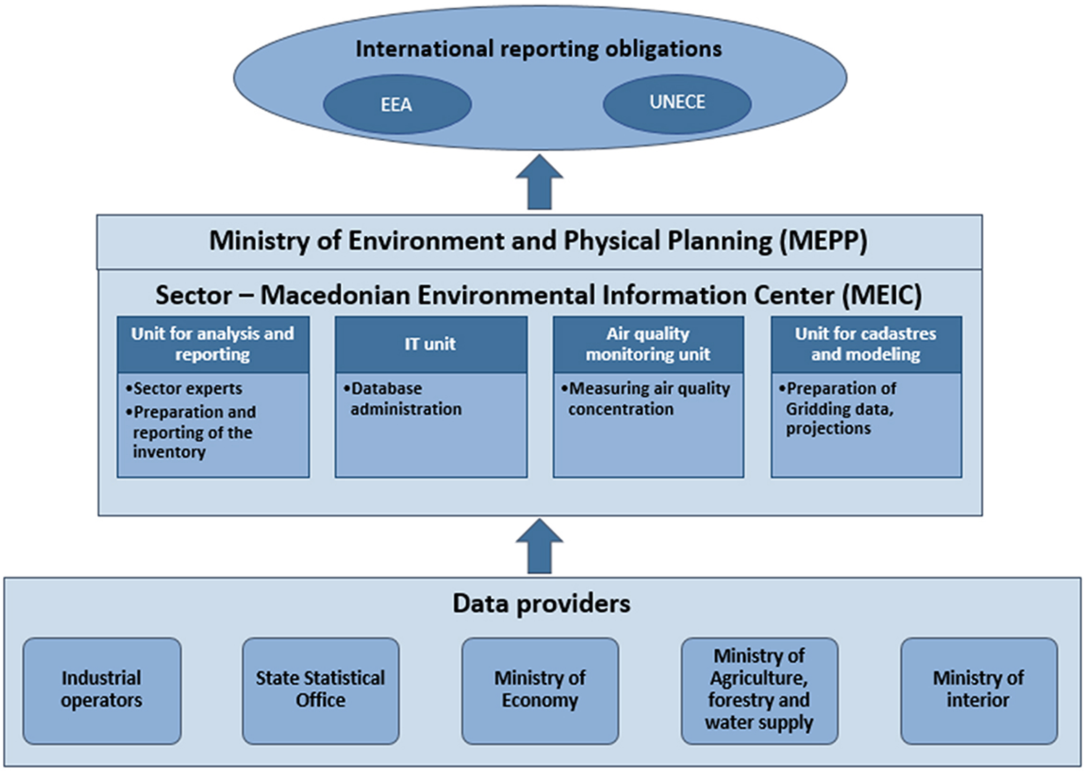

Figure 1 Institutional arrangements

2.3. Inventory preparation process

The preparation of the Inventory includes the following stages:

a) Planning

b) Preparation

c) Data management

d) Reporting

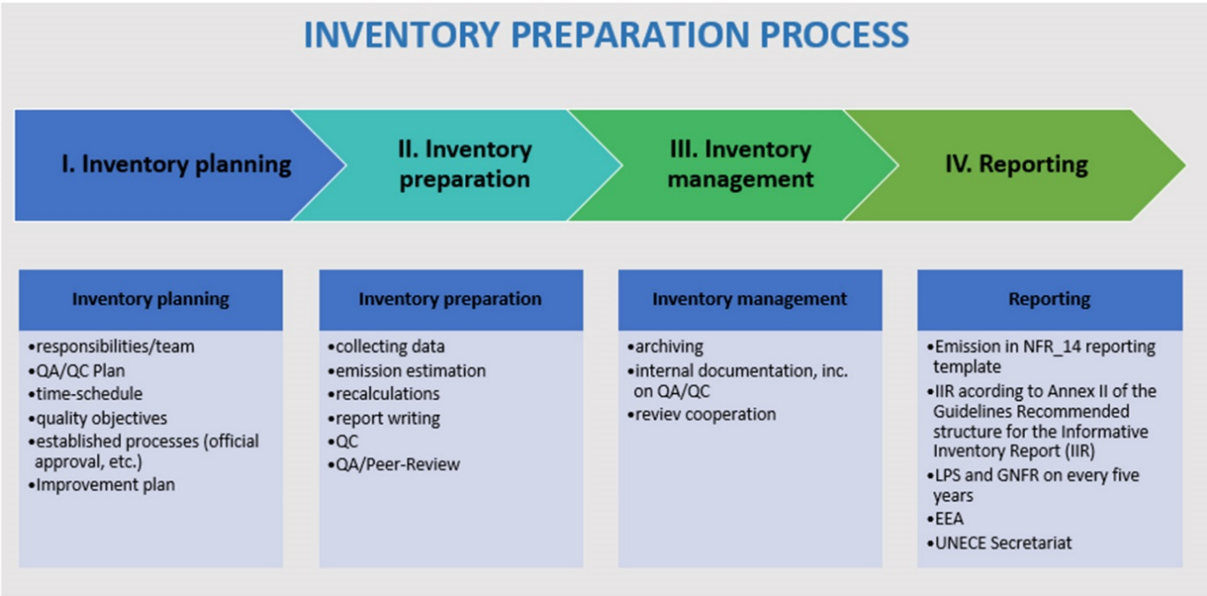

Figure 2 Scheme of inventory preparation process

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 7 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 Energy expert acting as emission inventory coordinator. 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.

An expert mission on Improvment of the QA/QC procedures in the emission inventory process Within the project ”Capacity building on climate change mitigation and adaptation for western balkan” Program for 2017, financed by the Austrian government, has been held in December 2017. During the mission a Work flow matrix for preparation of IIR and emission inventory has been developed and it is planned to be implemented for the next reporting round.

In the last reporting round deputy experts per sectors have checked more detail activity data and emissions calculations done by the nominated key experts per sector according the work flow matrix.

- **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 North 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 North Macedonia 1990-2017;
- Publications published by SSO in different areas (Transport, Industry in the Republic of North Macedonia, Industry and Energy, Livestock, Agriculture and Forestry);
- Energy Balance of the Republic of North Macedonia by Ministry of economy
- Measurements data from the industrial operators and waste inceneration plants
- International web page databases (FAO, Eurostate and etc.).
- MAKSTAT database of the SSO

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 2016. 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. No changes emission factors were done during this reporting round.

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 North 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 2.H.2 (Food and beverages industry). 1.A.3.b for 2014-2016 and in 5.A and 5.D, for the whole reporting period. Implied emission factors (IEFs) have been used in NFR categories 1.A.1.a (Public electricity and heat production), 2.A.1 (Cement production) 2.C.1 (Metal 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 approved by MEPP.

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).[18]

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 2018, the below listed guidelines were followed:

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

[18] Questionnaire for emissions in environment from stationary sources_National Cadastre 2017

- 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 in the beginning of April due to the experts engagement in other duties. 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 2016, targeting on transparency, completeness, consistency, comparability and accuracy of emissions data. In cases where we are limited with activity data, emission factors from EMEP/EEA Emission Inventory Guidebook 2013 and 2009 have been used.

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, 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 7 Activity data sources

NFR Sector	Data source	Data provider
Energy	Energy balance 2009-2017, Energy statistics Questionnaire for emissions in environment –final energy balance for 2016, and preliminary balance for 2017	Ministry of economy MEPP State statistical office
Transport	State Statistical Office of the Republic of North Macedonia, Transport and other communications, 2007-2015, MAK STAT database for 2016-2017 data- http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/ Statistical Yearly reports 1990-2017	Ministry of Interior State statistical office

	MOI car fleet database 2014-2017	
Industrial Processes	Industry in the Republic of North Macedonia, 2002-2007,2003-2003-2008,2004-2009,2005-2010,2006-2011,2007-2012,2008-2013,2009-2014, 2010-2015, MAK STAT database for 2016-2017 data http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/ Statistical Yearly reports 1990-2017 Questionnaire for emissions in environment -2017	State statistical office MEPP
Solvent and Other Product Use	Industry in the Republic of North Macedonia, 2002-2007,2003-2003-2008,2004-2009,2005-2010,2006-2011,2007-2012,2008-2013,2009-2014, MAK STAT database for 2016 data- http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/ Statistical Yearly reports 1990-2017 Questionnaire for emissions in environment -2017 Data required from SSO for 2017 activity data	State statistical office MEPP
Agriculture	State Statistical Office of the Republic of North Macedonia, Field crops, orchards and vineyards, 2007-2017, http://www.stat.gov.mk/PrikaziPoslednaPublikacija.aspx?id=5 Statistical Yearly reports 1990-2017 State Statistical Office of the Republic of North Macedonia, Livestock, 2007-2015, MAK STAT database for 2016 data-2017 http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/ State Statistical Office of the Republic of North Macedonia, Forestry, 2000–2015, MAK STAT database for 2016-2017 data- http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/ 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 1990-2017 Feasibility study on drisla landfill, book 1of 2, General overview, Final report, August, 2011 “Drisla” landfill web page - http://drisla.mk/page_detail.asp?lID=3&ID=25 , Drisla, Yearly environmental reports, 2013, 2014, 2015, 2016,2017 Data on treated communal water 1990-2017 reported by 5 waste water treatment plants.	State statistical office Public enterprise “Drisla” landfill EUROSTATE Public enterprise Proakva Ohrid
Natural sources	State Statistical Office of the Republic of North Macedonia, Forestry, 2000–2014, http://www.stat.gov.mk/Publikacii/5.4.8.02.pdf Data on fires (burned area, burned forests) reported by Macedonian forest fires 1990-2016-2017	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. The trend analysis was carried out as recommended in the Stage 3 review carried out last year for thr first time and also carried out durin this 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 8 presents the key sources for all reported pollutants.

Table 8 Key categories for all air pollutants

Pollutant	Key categories 2017 (sorted from high to low contribution from left to right)											Total %
NOx	1A1a	1A3biii	1A2gviii	1A3bi								80,4%
NMVOC	1A4bi	5A	2D3d	2D3a	2D3e	1B2av	3B1a	1A3bv	3Da1	1B1a	3B1b	80,2%
SO_2	1A1a											87,7%
NH_3	3Da2a	3B1a	1A4bi	3Da3	3B3	3B1b						81,1%
PM2,5	1A4bi	1A1a	1A2gviii									83,1%
PM10	1A4bi	1A1a	3Da1	2D3b								83,0%
TSP	2D3b	1A1a	1A4bi	1A4bii								83,4%
CO	1A4bi	1A3bi	1A3biii	1A2gviii	5A							83,3%
Pb	1A1a	2C1	1A2gviii	1A2a	1A4bi							85,9%
Cd	1A1a	2C1	1A4bi	5C1biii								82,3%
Hg	1A1a	5C1biii	1A2gviii	1A2a								86,3%
As	1A1a											90,1%
Cr	1A3bi	1A3biii	1A1a									82,1%
Cu	5C1biii	1A4bi	1A2gviii	1A2a	1A2gvii	1A1a	2G	2C7a				84,2%
Ni	1A1a	1A4ai	1A2gviii									80,4%
Se	1A1a											98,5%
Zn	5C2	1A4bi	2C1	1A2gviii								82,2%
DIOX	1A4bi	2C1	1A2gviii									85,0%
PAH	1A4bi											84,0%
HCB	2C3											97,9%
PCBs	2C5	2C7a										91,6%

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 the following Table 9.

Table 9 Key source categories for emissions of NO_X in Gg

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
1A1a	Public electricity and heat production	NO_X	11,73	47,9%
1A3biii	R.T., Heavy duty vehicles	NO_X	4,55	18,6%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	NO_X	1,75	7,2%
1A3bi	R.T., Passenger cars	NO_X	1,65	6,8%

Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A3biii	R.T., Heavy duty vehicles	3,00	4,55	0,213	28,7%	28,7%
1A1a	Public electricity and heat production	23,77	11,73	0,107	14,4%	43,1%
1A3bi	R.T., Passenger cars	5,28	1,65	0,094	12,7%	55,8%
1A2gvii	Mobile Combustion in Manufacturing Industries and Construction	3,72	0,82	0,091	12,3%	68,1%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	1,06	1,75	0,086	11,6%	79,7%
1A2b	Non-ferrous Metals	0,72	0,03	0,027	3,7%	83,4%

Table 10 Key source categories for emissions of NMVOC in Gg

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
1A4bi	Residential: stationary	4,58	16,1%	16,1%
5A	Solid waste disposal on land	3,78	13,3%	29,4%
2D3d	Coating applications	3,28	11,5%	40,9%
2D3a	Domestic solvent use including fungicides	2,08	7,3%	48,2%
2D3e	Degreasing	1,76	6,2%	54,4%
1B2av	Distribution of oil products	1,72	6,0%	60,4%
3B1a	Dairy cattle	1,59	5,6%	66,0%
1A3bv	R.T., Gasoline evaporation	1,13	4,0%	69,9%
3Da1	Inorganic N-fertilizers	1,09	3,8%	73,8%
1B1a	Coal Mining and Handling	1,01	3,6%	77,3%
3B1b	Non-dairy cattle	0,83	2,9%	80,2%

Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A3bi	R.T., Passenger cars	11,83	0,68	0,375	33,1%	33,1%
5A	Solid waste disposal on land	1,49	3,78	0,171	15,0%	48,1%
1A4bi	Residential: stationary	9,58	4,58	0,066	5,8%	53,9%
2D3d	Coating applications	3,78	3,28	0,061	5,4%	59,3%

Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1B2av	Distribution of oil products	1,18	1,72	0,060	5,3%	64,5%
2D3a	Domestic solvent use including fungicides	2,03	2,08	0,051	4,5%	69,1%
2D3e	Degreasing	1,72	1,76	0,044	3,8%	72,9%
3B1a	Dairy cattle	1,59	1,59	0,038	3,4%	76,3%
1A3biv	R.T., Mopeds & Motorcycles	1,00	0,05	0,032	2,8%	79,1%
1A3bv	R.T., Gasoline evaporation	1,10	1,13	0,028	2,5%	81,6%

Table 11 Key source categories for emissions of SO2 in Gg

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
1A1a	Public electricity and heat production	49,19	87,7%	87,7%

Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A1a	Public electricity and heat production	102,15	49,19	0,101	31,1%	31,1%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,66	2,94	0,091	28,1%	59,2%
1A2a	Iron and Steel	1,40	2,36	0,058	17,8%	77,0%
1A2b	Non-ferrous Metals	2,10	0,00	0,037	11,5%	88,5%

Table 12 Key source categories for emissions of NH_3 in Gg

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
3Da2a	Animal manure	2,48	22,1%	22,1%
3B1a	Dairy cattle	2,07	18,5%	40,6%
1A4bi	Residential: stationary	1,53	13,7%	54,3%
3Da3	Urine and dung deposited by grazing animals	1,24	11,0%	65,4%
3B3	Swine	0,94	8,4%	73,8%
3B1b	Non-dairy cattle	0,82	7,3%	81,1%

Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
3Da3	Urine and dung deposited by grazing animals	2,93	1,24	0,106	20,3%	20,3%
1A4bi	Residential: stationary	1,11	1,53	0,094	18,0%	38,3%
3B4gi	Laying Hens	1,76	0,57	0,086	16,5%	54,8%
3B1a	Dairy cattle	2,07	2,07	0,077	14,7%	69,5%
3B2	Sheep	0,92	0,29	0,046	8,7%	78,2%
3B3	Swine	0,84	0,94	0,044	8,4%	86,7%

Table 13 Key source categories for emissions of CO in Gg

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
1A4bi	Residential: stationary	30,57	53,7%	53,7%

Level Assessment 2017						
NFR Code	NFR sector			2017	%	%cum
1A3bi	R.T., Passenger cars			6,74	11,8%	65,6%
1A3biii	R.T., Heavy duty vehicles			4,74	8,3%	73,9%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction			2,78	4,9%	78,8%
5A	Solid waste disposal on land			2,56	4,5%	83,3%
Trend Assessment 1990-2017						
NFR Code	NFR sector	1990	2017	TA	%	%cum
1A3bi	R.T., Passenger cars	46,34	6,74	0,539	42,2%	42,2%
1A3biii	R.T., Heavy duty vehicles	2,74	4,74	0,146	11,4%	53,7%
1A4bi	Residential: stationary	64,13	30,57	0,123	9,6%	63,3%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,32	2,78	0,108	8,5%	71,8%
5A	Solid waste disposal on land	1,27	2,56	0,082	6,5%	78,2%
1A2a	Iron and Steel	1,50	2,49	0,075	5,9%	84,1%

Table 14 Key source categories for emissions of TSP in Gg

Level Assessment 2017						
NFR Code	NFR sector			2017	%	%cum
2D3b	Road paving with asphalt			6,46	25,9%	25,9%
1A1a	Public electricity and heat production			6,22	25,0%	50,9%
1A4bi	Residential: stationary			6,09	24,5%	75,4%
1A4bii	Residential: Household and gardening (mobile)			2,00	8,0%	83,4%
Trend Assessment 1990-2017						
NFR Code	NFR sector	1990	2017	TA	%	%cum
2C2	Ferroalloys Production	24,52	0,03	0,981	47,1%	47,1%
2D3b	Road paving with asphalt	1,21	6,46	0,549	26,3%	73,4%
1A4bii	Residential: Household and gardening (mobile)	0,01	2,00	0,185	8,9%	82,3%

Table 15 Key source categories for emissions of PM2.5 in Gg

Level Assessment 2017						
NFR Code	NFR sector			2017	%	%cum
1A4bi	Residential: stationary			5,63	61,3%	61,3%
1A1a	Public electricity and heat production			1,68	18,3%	79,5%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction			0,33	3,6%	83,1%
Trend Assessment 1990-2017						
NFR Code	NFR sector	1990	2017	TA	%	%cum
2C2	Ferroalloys Production	14,71	0,02	1,592	49,3%	49,3%
1A4bi	Residential: stationary	11,78	5,63	0,884	27,4%	76,6%
1A1a	Public electricity and heat production	3,50	1,68	0,265	8,2%	84,8%

Table 16 Key source categories for emissions of PM10 in Gg

Level Assessment 2017				
NFR Code	NFR sector	2017	%	%cum
1A4bi	Residential: stationary	5,79	35,9%	35,9%
1A1a	Public electricity and heat production	4,23	26,2%	62,1%
3Da1	Inorganic N-fertilizers	1,97	12,3%	74,4%
2D3b	Road paving with asphalt	1,38	8,6%	83,0%

Trend Assessment 1990-2017						
NFR Code	NFR sector	1990	2017	TA	%	%cum
2C2	Ferroalloys Production	20,84	0,03	1,288	48,5%	48,5%
1A4bi	Residential: stationary	12,10	5,79	0,319	12,0%	60,6%
1A1a	Public electricity and heat production	8,63	4,23	0,246	9,3%	69,9%
2D3b	Road paving with asphalt	0,26	1,38	0,240	9,0%	78,9%

Table 17 Key source categories for emissions of Pb in Mg

Level Assessment 2017				
NFR Code	NFR sector	2017	%	%cum
1A1a	Public electricity and heat production	0,43	19,6%	19,6%
2C1	Iron and Steel Production	0,42	18,8%	38,4%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,39	17,8%	56,2%
1A2a	Iron and Steel	0,35	15,7%	71,9%
1A4bi	Residential: stationary	0,31	14,0%	85,9%

Trend Assessment 1990-2017						
NFR Code	NFR sector	1990	2017	TA	%	%cum
1A3bi	R.T., Passenger cars	89,09	0,05	39,10	44,7%	44,7%
1A1a	Public electricity and heat production	0,89	0,43	9,27	10,6%	55,3%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,06	0,39	8,78	10,0%	65,3%
1A2a	Iron and Steel	0,19	0,35	7,670	8,8%	74,1%
2C1	Iron and Steel Production	4,07	0,42	7,466	8,5%	82,6%

Table 18 Key source categories for emissions of Cd in Mg

Level Assessment 2017				
NFR Code	NFR sector	2017	%	%cum
1A1a	Public electricity and heat production	0,05	41,7%	41,7%
2C1	Iron and Steel Production	0,03	26,4%	68,2%
1A4bi	Residential: stationary	0,01	8,5%	76,6%
5C1biii	Clinical waste	0,01	5,7%	82,3%

Trend Assessment 1990-2017						
NFR Code	NFR sector	1990	2017	TA	%	%cum
2C1	Iron and Steel Production	0,02	0,03	0,664	37,1%	37,1%

Trend Assessment 1990-2017						
1A1a	Public electricity and heat production	0,11	0,05	0,411	23,0%	60,1%
2C5	Lead Production	0,03	0,00	0,197	11,0%	71,1%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,00	0,01	0,126	7,1%	78,2%
1A2a	Iron and Steel	0,00	0,00	0,093	5,2%	83,4%

Table 19 Key source categories for emissions of Hg in Mg

Level Assessment 2017						
NFR Code	**NFR sector**			**2017**	**%**	**%cum**
1A1a	Public electricity and heat production			0,08	43,7%	43,7%
5C1biii	Clinical waste			0,04	20,0%	63,7%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction			0,02	11,7%	75,3%
1A2a	Iron and Steel			0,02	11,0%	86,3%
Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A1a	Public electricity and heat production	0,17	0,08	0,528	36,6%	36,6%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,00	0,02	0,371	25,7%	62,3%
1A2a	Iron and Steel	0,01	0,02	0,297	20,6%	82,9%

Table 20 Key source categories for emissions of As in Mg

Level Assessment 2017						
NFR Code	**NFR sector**			**2017**	**%**	**%cum**
1A1a	Public electricity and heat production			0,41	90,1%	90,1%
Trend Assessment 1990-2016						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A1a	Public electricity and heat production	0,84	0,41	0,799	41,9%	41,9%
2C1	Iron and Steel Production	0,35	0,00	0,758	39,7%	81,6%

Table 21 Key source categories for emissions of Cr in Mg

Level Assessment 2017						
NFR Code	**NFR sector**			**2017**	**%**	**%cum**
1A3bi	R.T., Passenger cars			0,47	32,9%	32,9%
1A3biii	R.T., Heavy duty vehicles			0,44	30,8%	63,7%
1A1a	Public electricity and heat production			0,26	18,4%	82,1%
Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
2C1	Iron and Steel Production	3,98	0,03	2,721	49,3%	49,3%
1A3bi	R.T., Passenger cars	0,01	0,47	1,085	19,7%	69,0%
1A3biii	R.T., Heavy duty vehicles	0,00	0,44	1,022	18,5%	87,5%

Table 22 Key source categories for emissions of Cu in Mg

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
5C1biii	Clinical waste	0,09	18,8%	18,8%
1A4bi	Residential: stationary	0,07	14,3%	33,0%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,06	12,2%	45,2%
1A2a	Iron and Steel	0,05	9,8%	55,0%
1A2gvii	Mobile Combustion in Manufacturing Industries and Construction	0,04	9,2%	64,2%
1A1a	Public electricity and heat production	0,03	7,2%	71,4%
2G	Other product manufacture and use	0,03	7,0%	78,4%
2C7a	Copper production	0,03	5,8%	84,2%

Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A3bi	R.T., Passenger cars	0,30	0,01	0,555	26,1%	26,1%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,02	0,06	0,289	13,6%	39,7%
1A2a	Iron and Steel	0,03	0,05	0,214	10,1%	49,8%
1A3biii	R.T., Heavy duty vehicles	0,12	0,01	0,183	8,6%	58,4%
1A2gvii	Mobile Combustion in Manufacturing Industries and Construction	0,19	0,04	0,163	7,6%	66,0%
1A3bii	R.T., Light duty vehicles	0,06	0,00	0,118	5,6%	71,6%
2G	Other product manufacture and use	0,14	0,03	0,114	5,4%	76,9%
2C1	Iron and Steel Production	0,06	0,01	0,100	4,7%	81,7%

Table 23 Key source categories for emissions of Ni in Mg

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
1A1a	Public electricity and heat production	0,51	31,4%	31,4%
1A4ai	Commercial/Institutional: Stationary	0,51	31,1%	62,5%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,29	17,9%	80,4%

Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A4ai	Commercial/Institutional: Stationary	0,10	0,51	0,791	58,0%	58,0%
1A1a	Public electricity and heat production	1,21	0,51	0,127	9,3%	67,3%
2C1	Iron and Steel Production	0,12	0,11	0,115	8,4%	75,7%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0,34	0,07	0,083	6,1%	81,8%

Table 24 Key source categories for emissions of Se in Mg

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
1A1a	Public electricity and heat production	1,29	98,5%	98,5%

NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A1a	Public electricity and heat production	2,63	1,29	0,020	45,0%	45,0%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,00	0,01	0,008	17,4%	62,4%
1A2a	Iron and Steel	0,00	0,00	0,005	11,9%	74,3%
1A3biii	R.T., Heavy duty vehicles	0,00	0,00	0,004	7,8%	82,2%

Table 25 Key source categories for emissions of Zn in Mg

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
5C2	Open burning of waste	5,17	57,5%	57,5%
1A4bi	Residential: stationary	1,00	11,1%	68,7%
2C1	Iron and Steel Production	0,64	7,1%	75,8%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,58	6,5%	82,2%

Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
5C2	Open burning of waste	6,67	5,17	0,386	37,2%	37,2%
2C1	Iron and Steel Production	3,54	0,64	0,255	24,6%	61,8%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,05	0,58	0,121	11,7%	73,5%
1A2a	Iron and Steel	0,37	0,54	0,077	7,4%	80,9%

Table 26 Key source categories for emissions of DIOX in g I-TEQ

Level Assessment 2017				
NFR Code	**NFR sector**	**2017**	**%**	**%cum**
1A4bi	Residential: stationary	5,35	67,0%	67,0%
2C1	Iron and Steel Production	0,83	10,4%	77,4%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,60	7,6%	85,0%

Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,07	0,60	0,147	27,6%	27,6%
2C1	Iron and Steel Production	2,66	0,83	0,117	21,9%	49,5%
1A2a	Iron and Steel	0,29	0,53	0,100	18,8%	68,3%
1A2b	Non-ferrous Metals	0,47	0,00	0,058	11,0%	79,3%
2C3	Aluminium production	0,31	0,05	0,027	5,0%	84,3%

Table 27 Key source categories for emissions of PAHs in Mg

Level Assessment 2017						
NFR Code	**NFR sector**			**2017**	**%**	**%cum**
1A4bi	Residential: stationary			5,35	84,0%	84,0%
Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
1A4bi	Residential: stationary	11,25	5,35	0,152	38,9%	38,9%
1A2gviii	Other Stationary Combustion in Manufacturing Industries and Construction	0,13	0,46	0,119	30,4%	69,3%
1A2a	Iron and Steel	0,27	0,39	0,077	19,6%	88,9%

Table 28 Key source categories for emissions of HCB in kg

Level Assessment 2017						
NFR Code	**NFR sector**			**2017**	**%**	**%cum**
2C3	Aluminium production			6,53	97,9%	97,9%
Trend Assessment 1990-2016						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
2C3	Aluminium production	44,21	6,53	0,124	77,9%	77,9%
1A4bi	Residential: stationary	0,09	0,05	0,031	19,6%	97,5%

Table 29 Key source categories for emissions of PCB in kg

Level Assessment 2017						
NFR Code	**NFR sector**			**2017**	**%**	**%cum**
2C5	Lead Production			19,46	77,5%	77,5%
2C7a	Copper production			3,54	14,1%	91,6%
Trend Assessment 1990-2017						
NFR Code	**NFR sector**	**1990**	**2017**	**TA**	**%**	**%cum**
2C5	Lead Production	69,95	19,46	3,00	86,0%	86,0%

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 North Macedonia consists of seven experts, partly having double roles. The project manager is also responsible for the QA/QC procedures, and compiles the emissions for one sector and support industry and solvent expert (see Figure below).

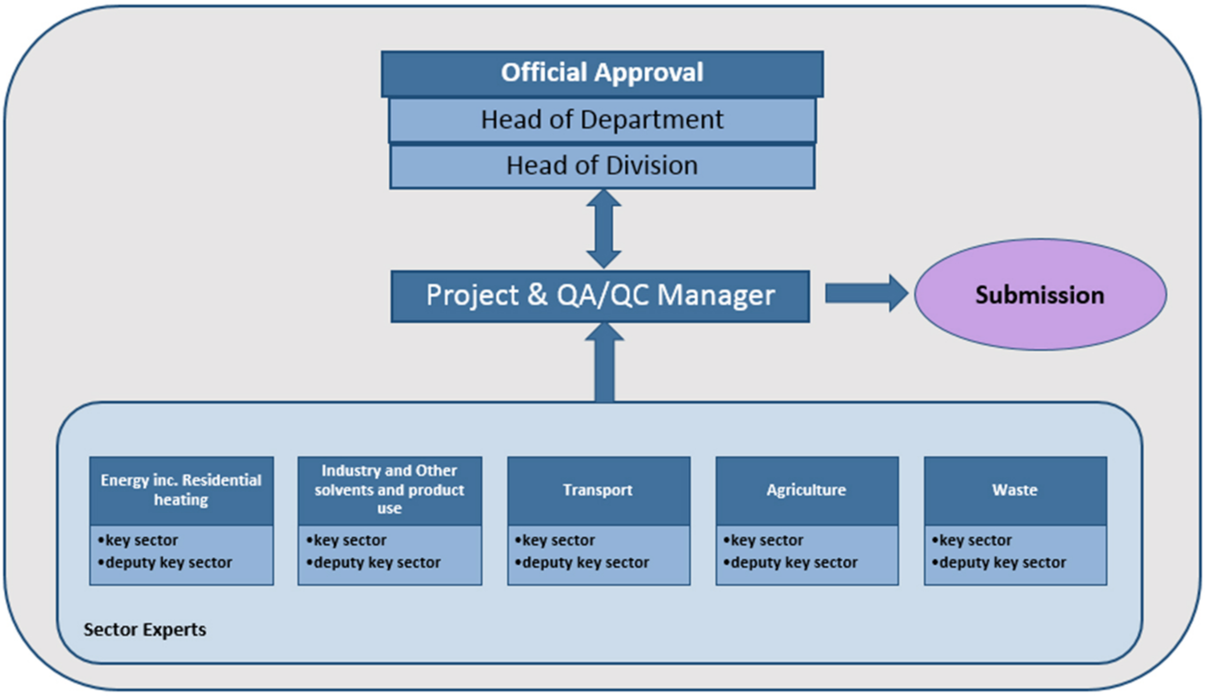

Figure 3 Roles in inventory preparation and submission

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.

2.6.1. 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 conataning 2017 emission data 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 other work overload. 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 30 Completeness Analysis 2019

Sector	Submission 2018		Submission 2019			Plan Submission 2020		
	1990	2016	1990	2016	2017	1990	2018	2019
Transparency (IE)	98%	98%	98%	98%	98%	98%	98%	98%
Completeness (NE)	86%	86%	88%	88%	90%	88%	90%	90%
Completeness (IIR)	*~ 268 pages*		*~ 273 pages*			*~ 290 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 217 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 31 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*	*March 15*
UNECE Submission	Submission of the IIR	*NRC*	*March 15*

*These deadlines for preparation and reporting of the IIR will be respected from next year onwards. During this reporting round we postponed submission of the IIR until end of April due to the work load in the Ministry.

2.6.2. 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;

2.6.3. 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 air quality expert that have not been included in the preparation process, one week before submission.

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. Most of the findings were addressed in the IIR prepared last year but some findings has also been addressed in the current inventory to the extent possible.

2.6.4. 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.

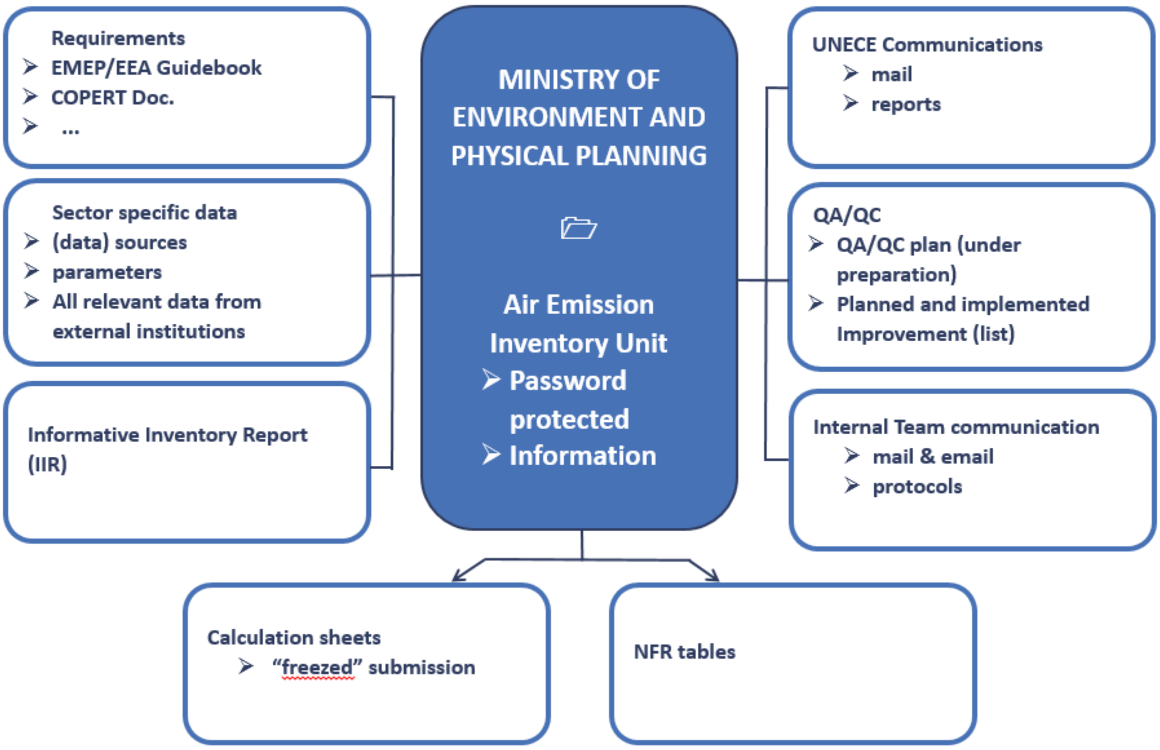

Figure 4 Archiving system

2.6.5. Continuous improvement

The Macedonian inventory is subject to continuous improvement.

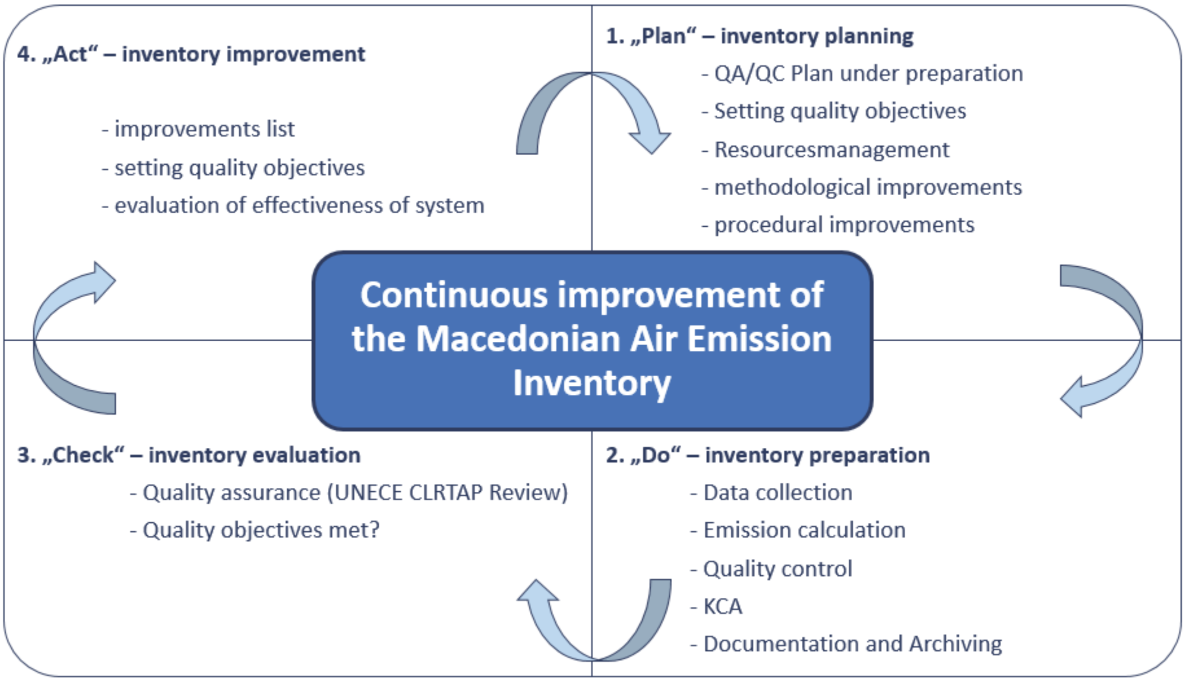

Figure 5 Improvement Cycle

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..

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, as in the previous 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 2017.

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 32 Rating definitions for activity data

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 33 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 2017 and the respective level and trend uncertainties. The results of the uncertainty analysis are presented in following tables.

Table 34 Result of overall uncertainty estimation for the main pollutants SO_2, NO_x, NMVOC, NH_3 and $PM_{2.5}$

Pollutants	Emissions 2017	Level uncertainty 2017	Trend uncertainty 1990 - 2017
SO_2	56,1 kt	18,2%	3,3%
NO_X	24,5 kt	15,7%	3,9%
NMVOC	28,6 kt	41,6%	14,1%
NH_3	11,0 kt	93,0%	24,8%
$PM_{2.5}$	9,2 kt	81,1%	11,7%

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

Table 35 Uncertainty estimation of SO_2 emissions 1990 and 2017

Member State:	MK
Reporting year:	2019

NRF sector	Pollutan	Base year emissio	Year t emissio	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertaint	Contribution to variance by category in year x	Type A sensitivi	Type B sensitivi	Uncertainty in trend in national emissions introduced by emission factor / estimation paramete	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emission
		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	49,2	5,0	20,0	20,62	327,14	-0,03	0,45	-0,52	3,16	10,27
1 A 1 b	SO2	0,8	NO	5,0	20,0	20,62						
1 A 2 a	SO2	1,4	2,4	10,0	20,0	22,36	0,89	0,01	0,02	0,30	0,30	0,18
1 A 2 b	SO2	2,1	0,0	10,0	20,0	22,36	0,00	-0,01	0,00	-0,19	0,00	0,04
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	-0,03	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	2,9	10,0	20,0	22,36	1,38	0,02	0,03	0,47	0,38	0,37
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	0,8	10,0	20,0	22,36	0,11	0,00	0,01	0,09	0,11	0,02
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	0,3	10,0	20,0	22,36	0,02	0,00	0,00	0,04	0,04	0,00
1 A 4 b	SO2	0,4	0,2	20,0	20,0	28,28	0,01	0,00	0,00	0,00	0,05	0,00
1 A 4 c	SO2	0,2	0,1	10,0	20,0	22,36	0,00	0,00	0,00	-0,01	0,01	0,00
1 B 2 a	SO2	0,8	-	10,0	20,0	22,36	0,00	0,00	0,00	-0,07	0,00	0,00
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 %:	18,15				Trend uncertainty %:	3,30

Table 36 Uncertainty estimation of NO_x emissions 1990 and 2017

Member State:	MK
Reporting year:	2019

NRF sector	Pollutan	Base year emissio	Year t emissio	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertaint	Contribution to variance by category in year x	Type A sensitivi	Type B sensitivi	Uncertainty in trend in national emissions introduced by emission factor / estimation paramete	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emission
		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	11,7	5,0	20,0	20,62	97,60	-0,03	0,27	-0,65	1,88	3,96
1 A 1 b	NOX	0,3	NO	5,0	20,0	20,62						
1 A 2 a	NOX	1,8	0,9	10,0	40,0	41,23	2,27	0,00	0,02	-0,11	0,29	0,09
1 A 2 b	NOX	0,7	0,0	10,0	40,0	41,23	0,00	-0,01	0,00	-0,34	0,01	0,11
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	-0,02	0,00	0,00
1 A 2 e	NOX	0,9	0,3	10,0	40,0	41,23	0,32	0,00	0,01	-0,12	0,11	0,03
1 A 2 g 7	NOX	3,7	0,8	10,0	40,0	41,23	1,93	-0,03	0,02	-1,12	0,26	1,33
1 A 2 g 8	NOX	1,1	1,8	10,0	40,0	41,23	8,70	0,03	0,04	1,05	0,56	1,43
1 A 3 a	NOX	0,3	0,4	10,0	40,0	41,23	0,54	0,01	0,01	0,24	0,14	0,08
1 A 3 b	NOX	8,9	6,9	10,0	40,0	41,23	133,42	0,04	0,16	1,75	2,20	7,88
1 A 3 c	NOX	0,4	0,1	10,0	40,0	41,23	0,01	0,00	0,00	-0,14	0,02	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	0,18	0,00	0,01	0,19	0,08	0,04
1 A 4 b	NOX	0,8	0,4	20,0	40,0	44,72	0,59	0,00	0,01	-0,04	0,27	0,07
1 A 4 c	NOX	0,5	0,3	10,0	40,0	41,23	0,23	0,00	0,01	0,01	0,09	0,01
1 B 2 a	NOX	0,3	-	10,0	40,0	41,23	0,00	0,00	0,00	-0,15	0,00	0,02
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	1,13	0,01	0,01	0,23	0,65	0,48
5 C	NOX	0,1	0,0	10,0	200,0	200,25	0,12	0,00	0,00	0,06	0,01	0,00
Total Uncertainties						Uncertainty in total inventory %:	15,72				Trend uncertainty %:	3,94

Table 37: Uncertainty estimation of NMVOC emissions 1990 and 2017

Member State:	MK											
Reporting year:	2019											
NRF sector	Pollutan	Base year emissio	Year t emissio	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertaint	Contribution to variance by category in year x	Type A sensitivi	Type B sensitivi	Uncertainty in trend in national emissions introduced by emission factor / estimation paramete	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissior
		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	0,19	0,00	0,00	0,03	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	0,3	10,0	200,0	200,25	3,64	0,00	0,01	0,63	0,08	0,41
1 A 2 b	NMVOC	0,2	0,0	10,0	200,0	200,25	0,00	0,00	0,00	-0,54	0,00	0,29
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	0,01
1 A 2 e	NMVOC	0,1	0,0	10,0	200,0	200,25	0,07	0,00	0,00	0,02	0,01	0,00
1 A 2 g 7	NMVOC	0,4	0,1	10,0	40,0	41,23	0,02	0,00	0,00	-0,12	0,03	0,02
1 A 2 g 8	NMVOC	0,1	0,3	10,0	40,0	41,23	0,25	0,01	0,01	0,24	0,10	0,07
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	2,6	10,0	40,0	41,23	13,64	-0,13	0,05	-5,21	0,76	27,75
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	0,02	0,00
1 A 4 b	NMVOC	10,5	5,2	20,0	40,0	44,72	66,68	-0,02	0,11	-0,87	3,08	10,25
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	1,0	10,0	20,0	22,36	0,63	0,00	0,02	0,09	0,30	0,10
1 B 2 a	NMVOC	1,4	1,7	10,0	20,0	22,36	1,80	0,02	0,04	0,36	0,51	0,39
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	0,0	2,0	125,0	125,02	0,00	0,00	0,00	-0,17	0,00	0,03
2 D	NMVOC	9,4	8,2	20,0	125,0	126,59	1.305,68	0,05	0,17	6,65	4,82	67,41
2 G	NMVOC	0,5	0,3	20,0	40,0	44,72	0,17	0,00	0,01	-0,04	0,15	0,03
2 H	NMVOC	1,2	0,6	20,0	40,0	44,72	1,01	0,00	0,01	-0,04	0,38	0,14
3 B 1	NMVOC	2,6	2,4	5,3	40,0	40,35	11,68	0,02	0,05	0,71	0,38	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	0,04	0,00	0,00	0,06	0,03	0,00
3 B 4	NMVOC	1,6	0,5	10,0	40,0	41,23	0,55	-0,01	0,01	-0,38	0,15	0,17
3 D a	NMVOC	1,1	1,1	50,0	40,0	64,03	5,95	0,01	0,02	0,34	1,61	2,70
5 A	NMVOC	1,5	3,8	50,0	125,0	134,63	316,38	0,06	0,08	7,53	5,58	87,78
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 %:	41,57				Trend uncertainty %:	14,08

Table 38 Uncertainty estimation of NH3 emissions 1990 and 2017

Member State:	MK											
Reporting year:	2019											
NRF sector	Pollutan	Base year emissio	Year t emissio	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertaint	Contribution to variance by category in year x	Type A sensitivi	Type B sensitivi	Uncertainty in trend in national emissions introduced by emission factor / estimation paramete	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissior
		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	1,28	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	1,5	20,0	125,0	126,59	307,66	0,05	0,10	5,98	2,74	43,30
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	1.073,21	0,05	0,18	5,73	1,37	34,76
3 B 2	NH3	0,9	0,3	10,2	125,0	125,42	10,82	-0,02	0,02	-2,79	0,26	7,84
3 B 3	NH3	0,8	0,9	6,1	125,0	125,15	113,76	0,02	0,06	2,83	0,51	8,27
3 B 4	NH3	2,4	0,8	10,0	125,0	125,40	74,51	-0,06	0,05	-7,23	0,68	52,74
3 D a	NH3	7,3	4,5	50,0	200,0	206,16	7.071,21	-0,04	0,29	-7,78	20,16	467,11
Total Uncertainties						Uncertainty in total inventory %:	93,02				Trend uncertainty %:	24,79

Table 39 Uncertainty estimation of PM2.5 emissions 1990 and 2017

Member State:	MK											
Reporting year:	2019											
NRF sector	Pollutan	Base year emissio	Year t emissio	Activity data uncertainty (1)	Emission factor uncertainty (1)	Combined uncertaint	Contribution to variance by category in year x	Type A sensitivi	Type B sensitivi	Uncertainty in trend in national emissions introduced by emission factor / estimation paramete	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emission
		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	1,7	5,0	125,0	125,10	521,95	0,02	0,05	2,65	0,37	7,16
1 A 1 b	PM2.5	0,0	NO	5,0	40,0	40,31						
1 A 2 a	PM2.5	0,2	0,3	10,0	40,0	41,23	1,75	0,01	0,01	0,29	0,13	0,10
1 A 2 b	PM2.5	0,3	0,0	10,0	40,0	41,23	0,00	0,00	0,00	-0,09	0,00	0,01
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	-0,01	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	0,01	0,01	0,00
1 A 2 g 7	PM2.5	0,2	0,1	10,0	125,0	125,40	0,51	0,00	0,00	-0,06	0,02	0,00
1 A 2 g 8	PM2.5	0,1	0,3	10,0	125,0	125,40	20,35	0,01	0,01	1,20	0,14	1,46
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	2,05	0,01	0,01	0,38	0,14	0,16
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	0,79	0,00	0,00	0,23	0,03	0,05
1 A 4 b	PM2.5	11,8	5,6	20,0	125,0	126,59	6.015,26	0,07	0,17	8,82	4,90	101,84
1 A 4 c	PM2.5	0,0	0,0	10,0	125,0	125,40	0,08	0,00	0,00	0,04	0,01	0,00
1 B 1 a	PM2.5	0,0	0,0	10,0	200,0	200,25	0,44	0,00	0,00	0,12	0,01	0,01
1 B 2 a	PM2.5	0,0	-	10,0	200,0	200,25	0,00	0,00	0,00	-0,01	0,00	0,00
2 A 1	PM2.5	0,1	0,0	2,0	200,0	200,01	0,45	0,00	0,00	0,08	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	-0,04	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	0,1	10,0	200,0	200,25	1,27	0,00	0,00	0,24	0,02	0,06
2 C 1	PM2.5	0,1	0,0	2,0	40,0	40,05	0,00	0,00	0,00	-0,04	0,00	0,00
2 C 2	PM2.5	14,7	0,0	5,0	40,0	40,31	0,01	-0,13	0,00	-5,08	0,00	25,78
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	0,0	5,0	40,0	40,31	0,00	0,00	0,00	0,00	0,00	0,00
2 C 6	PM2.5	0,0	NO	5,0	40,0	40,31						
2 D	PM2.5	0,0	0,2	20,0	40,0	44,72	0,82	0,01	0,01	0,22	0,16	0,07
2 G	PM2.5	0,7	0,2	20,0	40,0	44,72	0,63	0,00	0,01	-0,05	0,14	0,02
3 B 1	PM2.5	0,1	0,1	5,3	200,0	200,07	2,60	0,00	0,00	0,32	0,02	0,10
3 B 2	PM2.5	0,0	0,0	10,2	200,0	200,26	0,07	0,00	0,00	0,01	0,01	0,00
3 B 3	PM2.5	0,0	0,0	6,1	200,0	200,09	0,09	0,00	0,00	0,06	0,00	0,00
3 B 4	PM2.5	0,1	0,0	10,0	200,0	200,25	1,04	0,00	0,00	0,04	0,02	0,00
3 D a	PM2.5	0,1	0,1	50,0	200,0	206,16	2,90	0,00	0,00	0,33	0,17	0,14
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	1,39	0,00	0,00	0,21	0,02	0,05
Total Uncertainties						Uncertainty in total inventory %:	**81,08**				Trend uncertainty %:	**11,71**

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 2017

The data for the whole year 2017 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

North 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 North 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 2016 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 2016 was 5.3%. The following table shows the calculated relative errors of the main categories of livestock in the survey for 2016. For 2017 data are gathered from MAKSTAT database. There are no available data for 2017 survey

Table 40 Relative errors of livestock survey 2015

Relative errors	Cattle	Pigs	Sheep	Poultry	Goats
Republic of North 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 North 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 North 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 North Macedonia, where emissions have not been estimated or have been included elsewhere as suggested by GB 2009/2013/2016 .

Table 41 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 42 Number of "not estimated" (NE) per sector and pollutant in 2017

Gas	Energy	Fugitives	IPPU	Agriculture	Waste	Other
NOx (as NO_2)	5	1	7	4	1	1
NMVOC	5	1	5	3	2	1
Sox (as SO_2)	6	1	7	1	1	1
NH_3	6	0	13	1	5	1
PM2.5	6	1	5	1	1	1
PM10	6	1	5	1	1	1
TSP	5	1	5	1	1	1
CO	8	1	8	0	1	1
Pb	5	1	6	0	1	1
Cd	5	1	8	0	0	1
Hg	5	1	7	0	0	1
As	5	0	9	0	1	1
Cr	6	0	6	0	0	1
Cu	5	1	6	0	1	1
Ni	5	1	6	0	1	1
Se	5	1	7	0	1	1
Zn	5	1	8	0	2	1
PCDD/ PCDF	5	1	7	0	2	1
PAHs	5	2	8	0	0	1
HCB	6	1	5	0	2	1
PCBs	6	1	9	0	1	1
Reasons for NE	**lack of detail activity data or lack of default emission factors in the EMEP/EEA Guidebook**					
Plans how to report in future	Please refer to Table 217					

2.8.2. Sources included elsewhere (IE)

Table 43 Number of "included elsewhere" (IE) per sector and pollutant in 2017

Gas	Energy	Fugitives	IPPU	Agriculture	Waste	Other
NOx (as NO_2)	0	0	1	3	0	0
NMVOC	0	0	1	3	0	0
Sox (as SO_2)	0	0	1	1	0	0
NH_3	0	0	1	1	0	0
PM2.5	0	0	1	1	0	0
PM10	0	0	1	1	0	0
TSP	0	0	1	1	0	0
CO	0	0	1	0	0	0
Pb	0	0	1	0	0	0

Gas	Energy	Fugitives	IPPU	Agriculture	Waste	Other
Cd	0	0	1	0	0	0
Hg	0	0	1	0	0	0
As	0	0	1	0	0	0
Cr	0	0	1	0	0	0
Cu	0	0	1	0	0	0
Ni	0	0	1	0	0	0
Se	0	0	1	0	0	0
Zn	0	0	1	0	0	0
PCDD/ PCDF	0	0	1	0	0	0
PAHs	0	0	1	0	0	0
HCB	0	0	1	0	0	0
PCBs	0	0	1	0	0	0
Reasons for IE	**lack of detailed activity data**					
Plans how to report in future	Please refer to Table 217					

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.

EMISSION TRENDS

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 1990-2017 are presented in the following table.

Table 44 Emission trends 1990 – 2017 for the main air pollutants and CO

Year	Emission in kt				
	NO_x	NMVOC	SO_2	NH_3	CO
1990	44,14	47,88	109,97	15,80	132,39
1991	36,30	42,06	89,23	14,83	111,52
1992	38,03	44,22	86,34	14,94	123,43
1993	39,44	46,21	88,93	15,26	133,29
1994	35,37	41,23	88,99	15,20	120,85
1995	38,02	43,90	95,10	14,99	125,23
1996	35,98	43,60	89,05	13,95	123,08
1997	36,83	44,73	93,01	13,53	126,30
1998	41,35	44,49	107,84	13,23	129,33
1999	38,92	45,36	98,04	13,41	132,33
2000	42,53	47,53	106,45	13,49	144,97
2001	39,53	39,98	108,45	12,74	113,19
2002	37,82	38,97	96,86	12,12	114,59
2003	34,14	38,66	95,22	12,06	116,33
2004	36,03	39,06	96,40	12,16	121,44
2005	36,94	37,38	97,13	11,57	114,66
2006	36,79	38,98	94,47	11,92	117,53
2007	39,65	39,20	99,49	11,57	112,71
2008	38,74	42,91	101,28	11,74	125,03
2009	38,98	43,43	96,20	11,06	133,88
2010	38,25	36,22	91,13	11,30	114,53
2011	40,66	38,68	101,89	11,61	120,36
2012	39,79	34,22	96,39	10,31	89,32
2013	38,13	34,46	82,90	10,33	90,15
2014	28,96	28,42	83,40	10,28	62,21
2015	27,43	29,56	77,03	10,34	64,59
2016	26,62	29,60	64,75	10,36	65,43
2017	24,48	28,48	56,06	11,20	56,91
Trend 1990-2017	***-45%***	***-41%***	***-49%***	***-29%***	***-57%***

3.1.1. NOx emissions

Emission trend

In 1990 national total NOx emissions amounted to 44 kt. Since then, the emissions decreased by 45% and in 2017 emissions were on the level of about 24,48 kt. Reasons for the decrease are due to significantly declining emissions from Energy Industries (Public electricity and heat production) and Manufacturing Industries. 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 2012 and 2013 is due to the lower consumption of coal in the major power plant. In the period 2013–2017, the decrease of emissions is due to shorter operation of the second power plant and the decrease of coal consumption. 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.

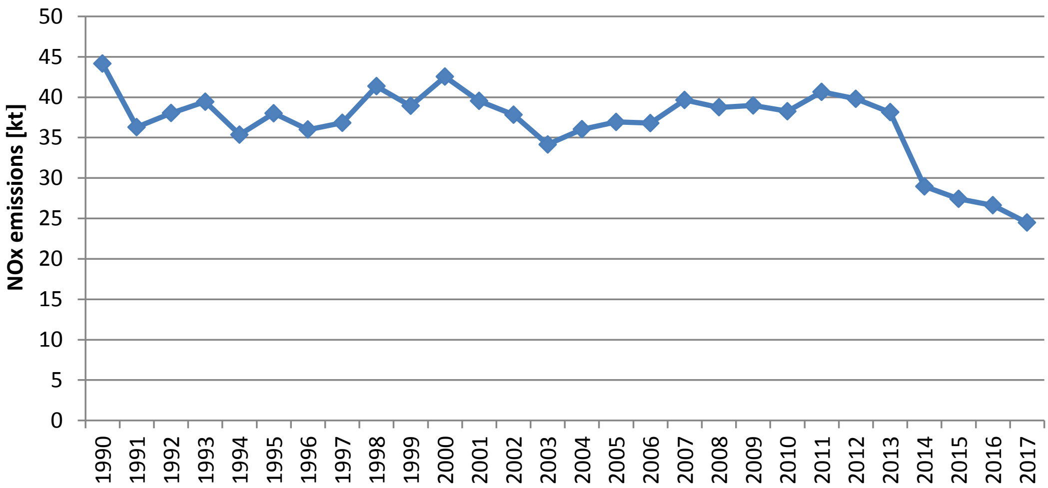

Figure 6 National total NOx emissions 1990-2017

The target value for NOx according to Gothenburg Protocol for the year 2010 is 39 kt. Republic of North 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 2017 are less than the NOx emissions reported for 1987.

Main emission sources in North 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 2017 are NFR source categories 1.A.3 Transport and 1.A.1 Energy Industries, which contributed with 30% (22% in 1990) and 48% (55% in 1990) respectively, of the national total NOx emissions. From NFR source category 1.A.2 Manufacturing Industries also 16% (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.

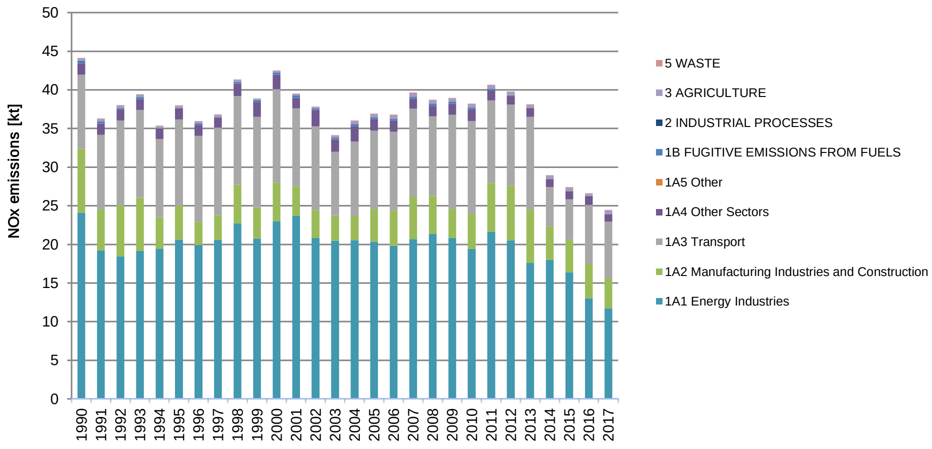

Figure 7 NOx emissions in North Macedonia 1990-2017 by sectors

3.1.2. NMVOC emissions

Emission trend

In 1990 national total NMVOC emissions amounted to about 48 kt. Emissions were down by 40% compared to 2017 and amounted to around 28,58 kt. Reasons for the decrease are mainly due to declining emissions from industrial procesis and. From 2016 to 2017 emissions decreased only by 3%, also due to 1.A.4 Other Sectors (mainly residential heating)

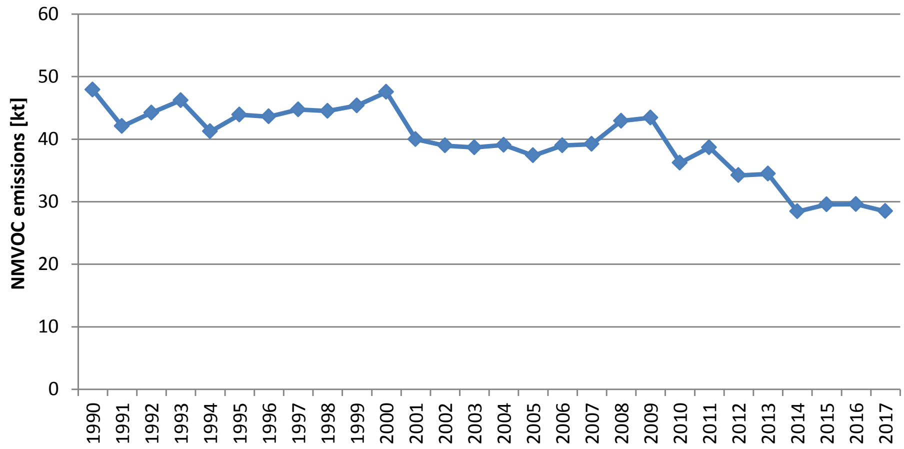

Figure 8 National total NMVOC emissions 1990-2017

Target value for NMVOC according to Gothenburg Protocol for year 2010 is 30 kt NMVOC. Emissions in 2017 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 40% in 2017.

Main emission sources in North Macedonia

NMVOC emissions are emitted from different source. The key category source in 2017 are NFR source categories is 2. Industial pollution 32% (23% in 1990) followed by 1.A.4 Other Sectors (mainly residential heating) which contributed with 19% (22% in 1990), to the national total NMVOC emissions. NFR source category 1.A.3 Transport is contributinf 9% in 2017 (31% in 1990) of total calculated national NMVOC emissions. Waste, Agriculture is contributing with around 15% while waste and fugitive emissions and with around 13 and 10% respectively .

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

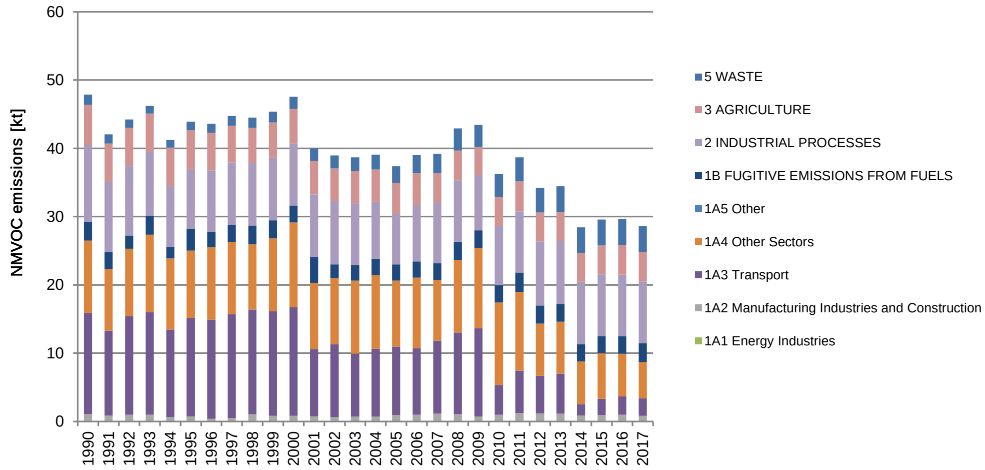

Figure 9 NMVOC emissions in North Macedonia 1990-2017 by sectors

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 2012 to 2017 the emissions trend is decrising while emission is 2017 are creduced reduced by compare to 2016 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. Additionally the power plant REK Olsomej has been in function only two mounths in this period and for calculations of 2017.

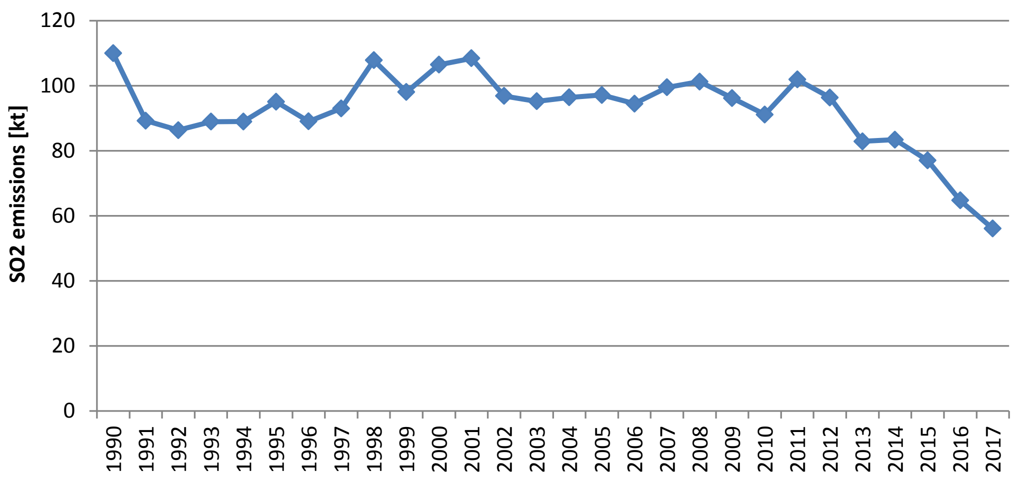

Figure 10 National total SO_2 emissions 1990-2017

North 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 2017 (56

Gg SOx) were around 49% below the national ceiling value (110 Gg SOx) in Republic of North 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, that should be implemented in accordance with the time dynamics sets in the revised National Plan for reduction of emissions from large combustion plants approved by the Government in December 2017.

Main emission sources in North Macedonia

Almost all SO_2 emissions are resulting from Energy sector. So, the main emission source in 2017 is NFR source category 1.A.1 Energy Industries (Public electricity and heat production), which contributed with 88% (94% in 1990) to the national total SO_2 emissions. About 10% (4% in 1990) of total emissions are stemming from NFR source category 1.A.2 Manufacturing Industries.

Other NFR sectors produce minor SO_2 emissions.

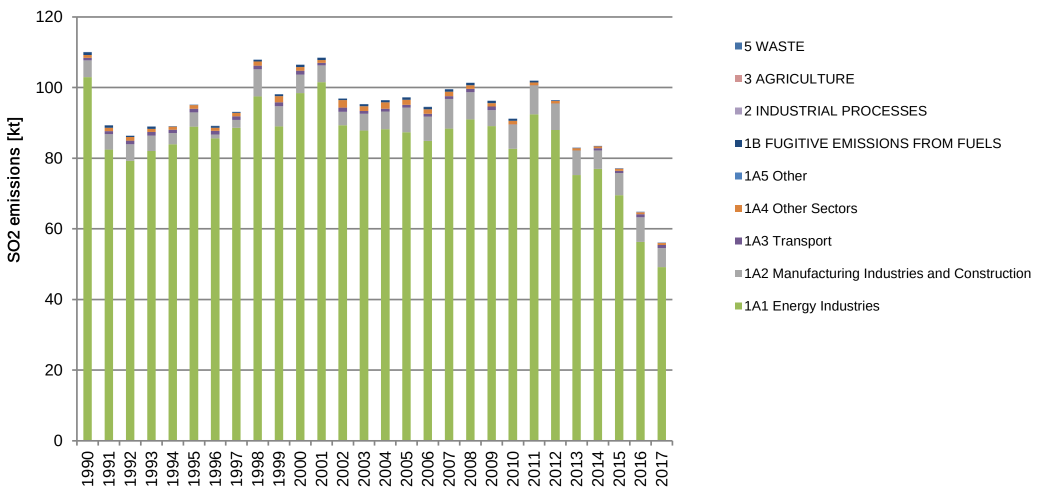

Figure 11 SO_2 emissions in North Macedonia 1990–2017 by sectors

3.1.4. NH_3 emissions

Emission trend

In 1990 national total NH_3 emissions, amounted to about 16 kt. Emissions were down by 29% compared to 2017 and amounted to 11,19 kt. Reasons for the decline are mainly decreasing emissions from Agriculture (Manure Management) related to decreasing livestock numbers. From 2016 to 2017 emissions increased by 8%.

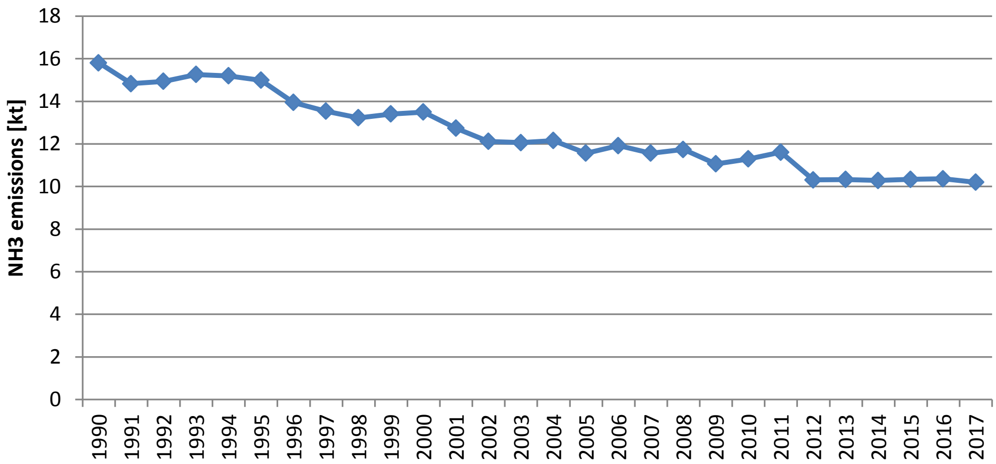

Figure 12 National total NH_3 emissions 1990-2017

Emissions of NH_3 are well below the respective ceiling. Emissions in 2017 were 7% below national ceiling value (12 Gg NH_3).

Main emission sources in North Macedonia

NH_3 emissions are mainly resulting from the Agriculture sector contributing with 84% (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 (52,01% in 2017) and emissions from cattle have the highest contribution (30,80%).

About 14% (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 1.A.3 Transport are minor sources of NH_3 emissions.

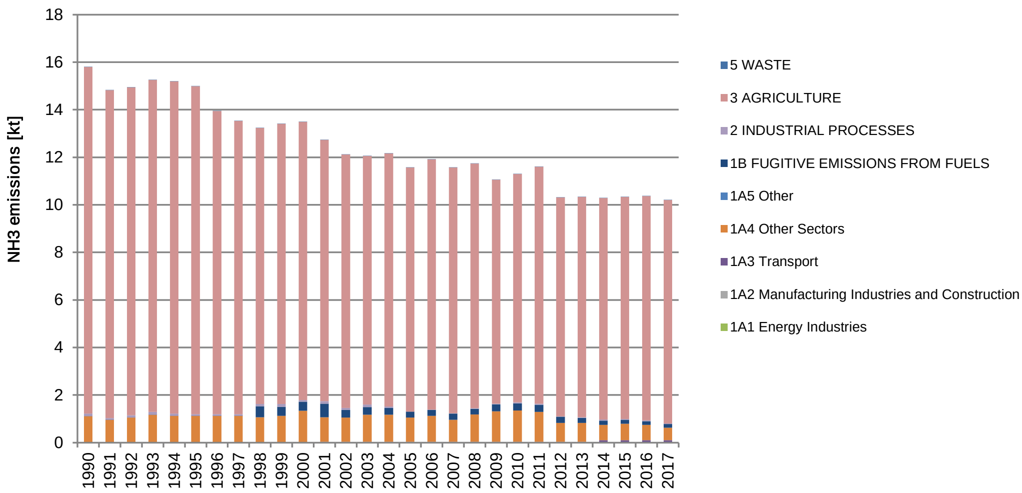

Figure 13 NH_3 emissions in North Macedonia 1990-2017 by sectors

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 57% compared to 2017 and amounted to 56,91 kt. The reason for the decrease is mainly due to declining emissions from the Transport sector (road transport). From 2016 to 2017 emissions decreased by 13% 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.

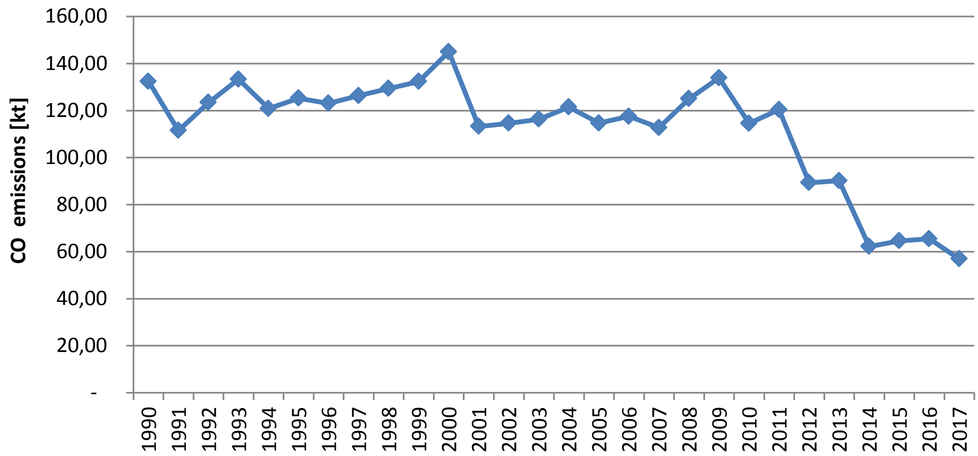

Figure 14 National total CO emissions 1990-2017

<u>**Main emission sources in North Macedonia**</u>

Almost all CO emissions are resulting from the Energy sector. So, the main emission sources in 2017 are NFR sectors 1.A.4 Other Sectors (residential heating) and 1.A.3 Transport, contributing with 57% (51% in 1990) and 22% (39% in 1990) to the national total CO emissions repectively. Further smaller emission sources in 2017 are 1.A.2 Manufacturing Industries, 5 Waste and 1.A1 Energy Industries with shares of 10%, 6% and 3%, respectively.

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

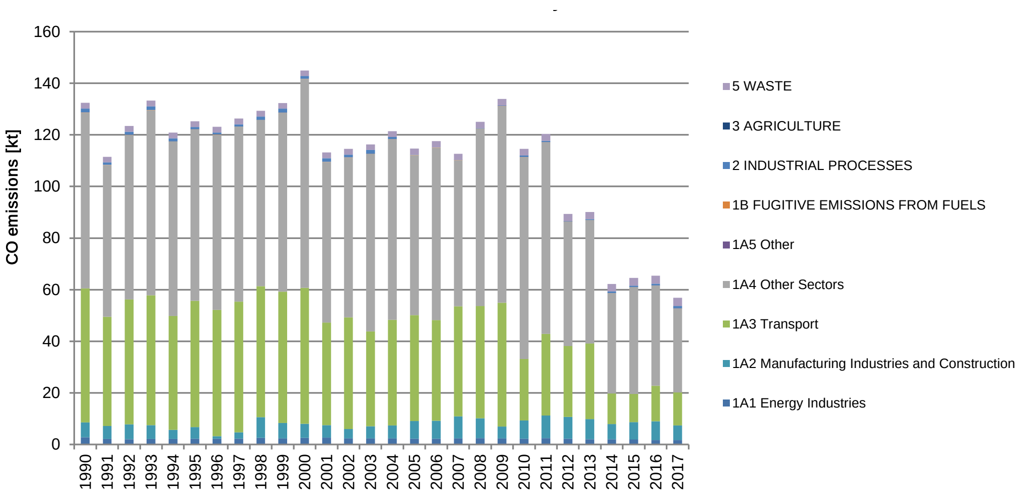

Figure 15 CO emissions in North Macedonia 1990-2017 by sectors

3.2. Emission Trends for Particulate Matter

Particulate Matter emissions in North 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 45 Emission trends for particulate matter 1990-2017

Year	Emissions			
	PM10 [kt]	PM2.5[kt]	TSP [kt]	BC [kt]
1990	32,49	48,02	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	46,93	55,55	2,97
1997	31,29	45,55	53,50	2,83
1998	35,66	52,02	61,72	3,25
1999	30,96	44,89	53,42	2,78
2000	29,88	43,41	53,77	2,68
2001	18,11	27,53	33,91	1,42
2002	18,59	27,88	33,78	1,58
2003	28,93	41,81	49,89	2,56
2004	31,48	45,55	54,65	2,82
2005	28,07	41,38	50,48	2,55
2006	26,67	38,98	47,11	2,40
2007	20,89	31,18	38,15	1,82
2008	24,64	35,86	44,16	2,16
2009	19,50	28,09	35,70	1,67
2010	24,06	34,36	42,91	2,14
2011	28,52	41,47	52,70	2,55
2012	22,40	34,67	44,75	1,99
2013	24,47	37,25	47,95	2,24
2014	17,44	27,90	36,05	1,47
2015	15,66	24,75	31,80	1,31
2016	13,47	21,97	31,28	1,13
2017	9,20	16,12	24,91	1,73
Trend 1990–2017	***-66%***	***-72%***	***-57%***	***-41%***

3.2.1. PM10 emissions

Emission trend

In 1990, national total PM10 emissions amounted to 48 kt. Emissions decreased by 66% compared to 2017, and were at the level of 16,12 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. Additionnay installation has been closed in November 2016 due to non-compilance with the activities for air quality protection set down in the IPPC permit, which effect with reduction of emissions from Industry compare with 2015 by 40%. In 2017 emissions were reduced by 27% mainly due to reduction of emissons coming from ferroalloys production. This explenations are also valid for reduction of PM2.5 and TSP emissions.

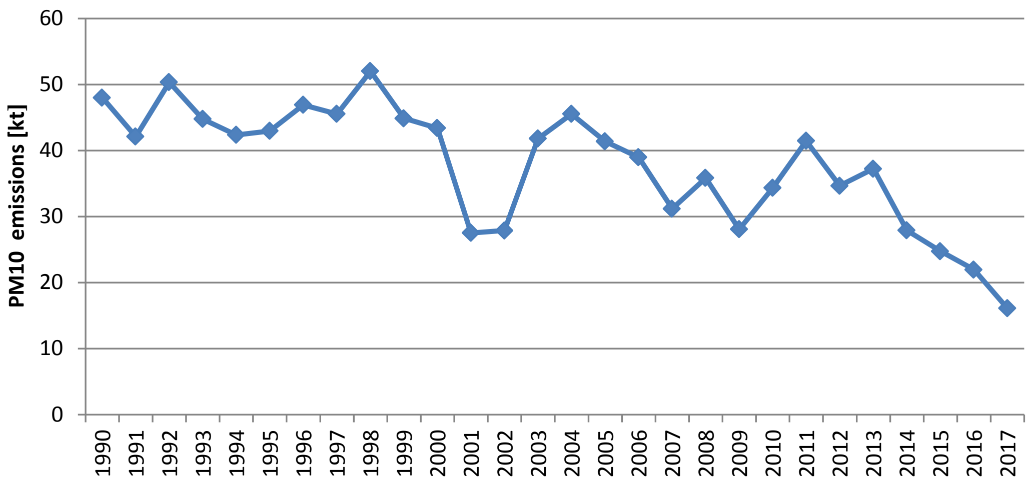

Figure 16 National total PM10 emissions 1990-2017

Main emission sources in North Macedonia

The main emission sources for PM10 in 2017 are NFR sectors 1.A.4 Other Sectors (residential heating), with a share of 37% (25% in 1990) in total PM10 emissions, 2 Industrial Processes and Product Use (mainly 2C2 Ferroalloys Production) with 13% (47% in 1990) and 1A1 Energy Industries with 26% (18% in 1990). With a share of 15% in 2017 (6% in 1990), the sector Agriculture is also contributing to the total PM10 emissions.

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

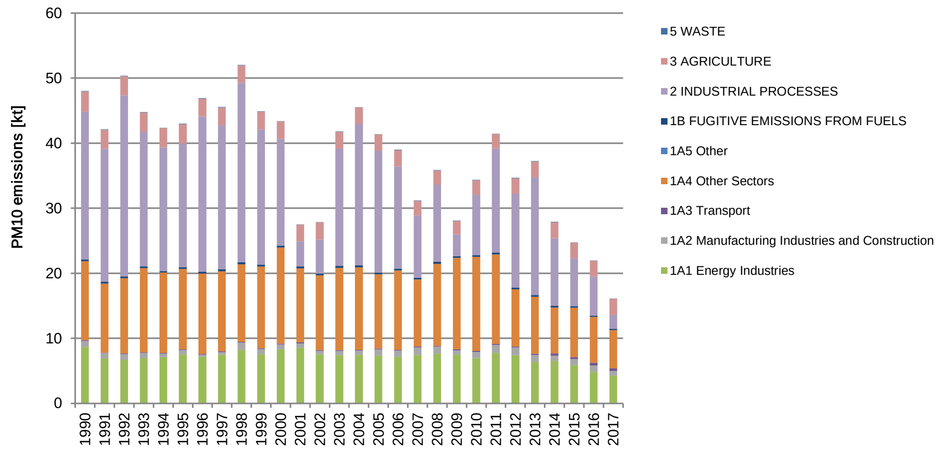

Figure 17 PM10 emissions in North Macedonia 1990-2017 by sectors

3.2.2. PM2.5 emissions

Emission trend

In 1990, national total PM2.5 emissions amounted to 32 kt. Emissions decreased by 72% compared to 2017 and amounted to 9,2 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. In 2017 emissions were reduced by 32% mainly due to reduction of emissons coming from ferroalloys production.

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

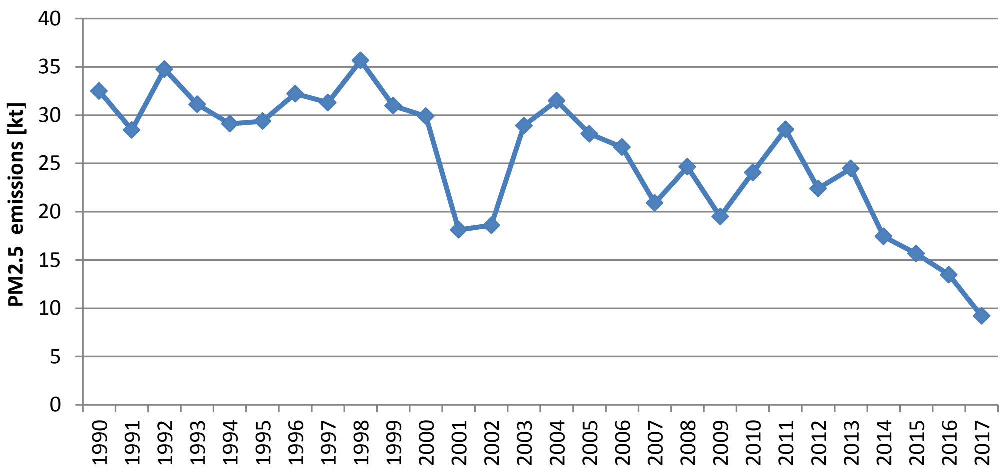

Figure 18 National total PM2.5 emissions 1990-2017

Main emission sources in North Macedonia

Same as for PM10, the main emission sources for PM2.5 in 2017 are NFR sectors 1.A.4 Other Sectors (residential heating) with a share of 62% (36% in 1990) in total PM10 emissions, 1.A.1 Energy

Industries with 18% (11% in 1990) and the contribution of the NFR sector - 2 Industrial Processes and Product Use (mainly 2.C.2 Ferroalloys Production) is very low, contributing only with 5% (48% in 1990) due to the fact the two major plants for production of ferroallows were out of operation, Transport is contributing with 4%.

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

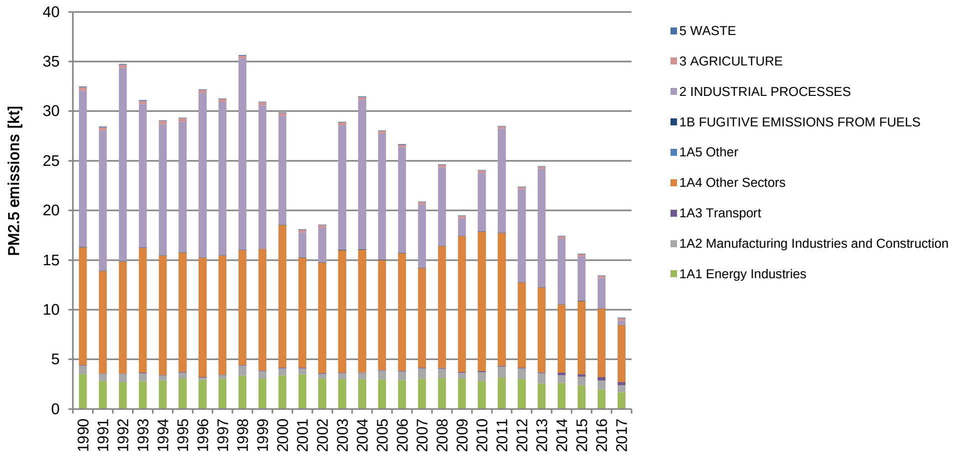

Figure 19 PM2.5 emissions in North Macedonia 1990-2017 by sectors

3.2.3. TSP emissions

Emission trend

In 1990, national total TSP emissions amounted to about 57 kt. Emissions decreased by 57% compared to 2017 and amounted to about 25 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.

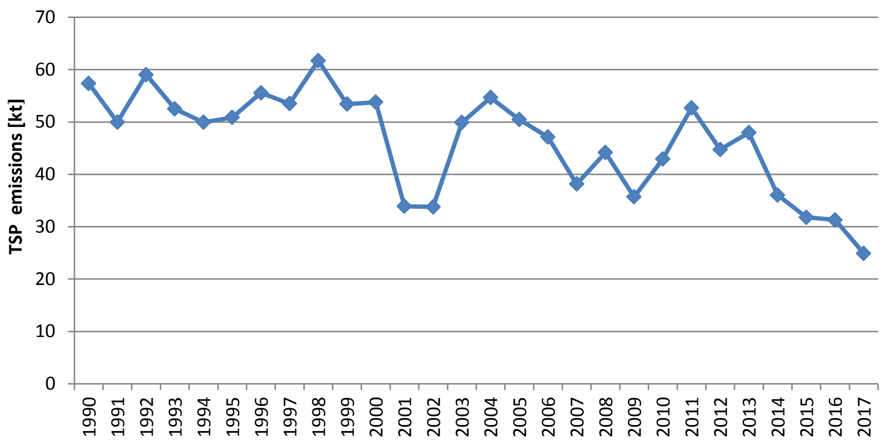

Figure 20 National total TSP emissions 1990-2017

Main emission sources in North Macedonia

The main emission sources for TSP in 2017 are 1.A.4 Other Sectors (residential heating) with 48% (22% in 1990) and 1.A.1 Energy Industries with 25% (22% in 1990). NFR sectors 2 Industrial Processes and Other Product Use (mainly NFR sector 2C2 Ferroalloys Production) with a share of 32% (50% in 1990) in total TSP emissions

NFR sectors 1.B Fugitive emissions, 3 Agriculture and 1.A.3 Transport and 1.A.2 Manufacturing Industries and Construction are minor sources of PM2.5 emissions.

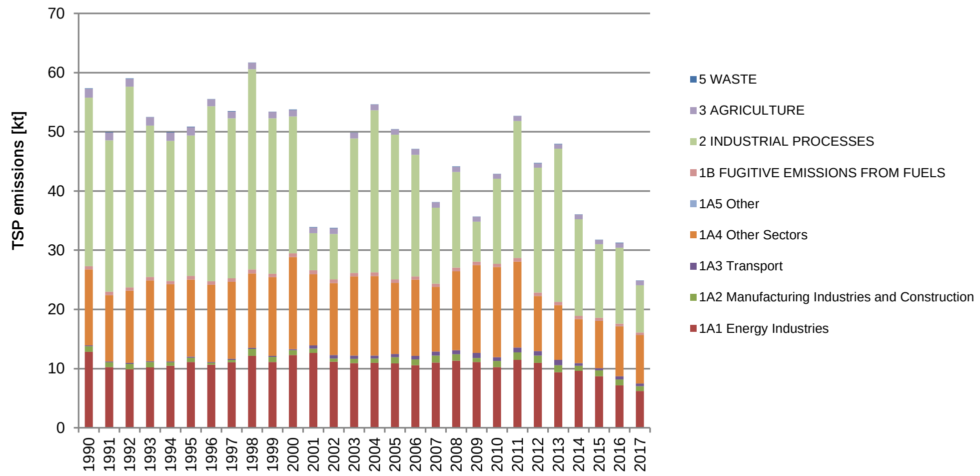

Figure 21 TSP emissions in North Macedonia 1990-2017 by sectors

3.2.4. BC emissions

Emission trend

In 1990, national total BC emissions amounted to about 3 kt. Emissions decreased by 41% compared to 2017 and amounted to about 1,731 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 %.

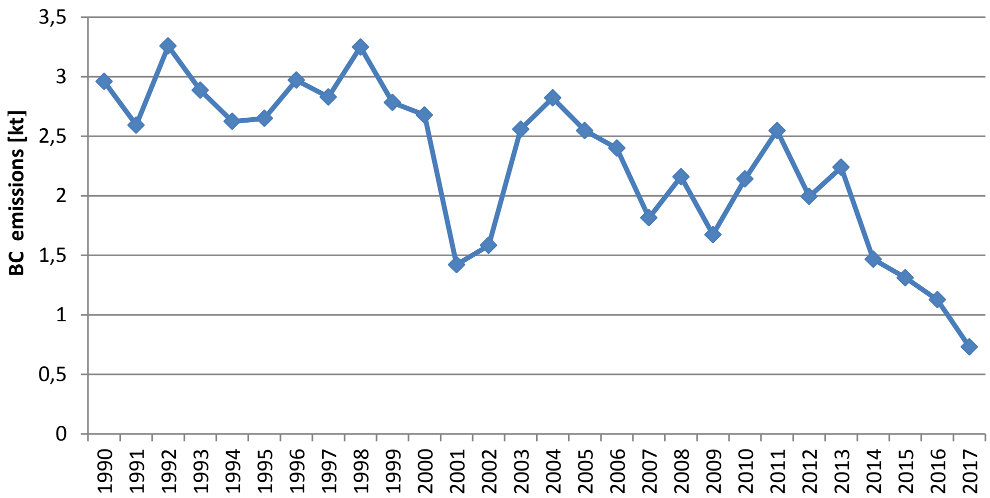

Figure 22 National total BC emissions 1990-2017

Main emission sources in North Macedonia

As expected, the main emission sources for BC are those for PM2.5. In 2017 the NFR sectors 1.A.4 Other Sectors (residential heating) contribute with a share of 34% (40% in 1990) in total PM10 emissions, 1.A.1.a Energy industries 34% (40% in 1990) in total BC emissions, 2 Industrial Processes and Product Use (mainly 2.C.2 Ferroalloys Production) with 20% (50% in 1990) and 1.A.2Energy Industries with 8 % both in 1990 and 2016.

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

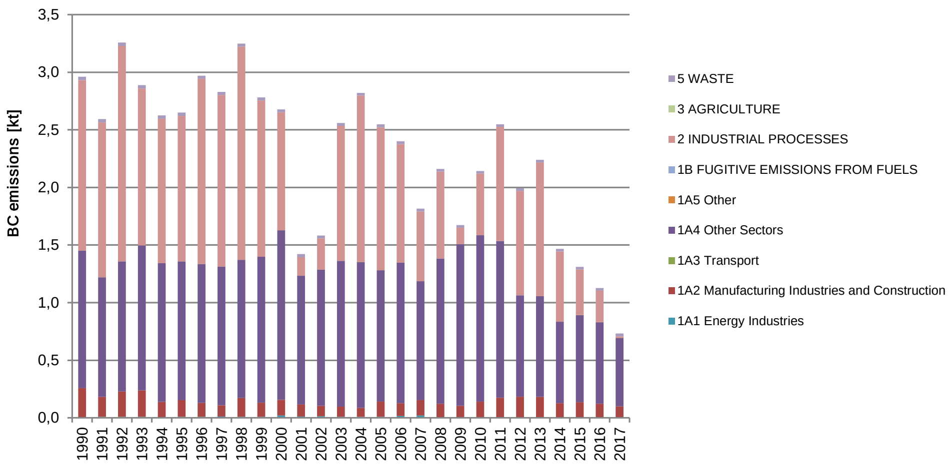

Figure 23 BC emissions in North Macedonia 1990-2017 by sectors

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 46 Emission trends for heavy metals 1990-2017

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	97,66	0,53
2000	0,31	100,19	0,54
2001	0,31	96,37	0,56

Year	Emissions		
	Cd [kt]	Pb [kt]	Hg [kt]
2002	0,31	103,44	0,59
2003	0,23	95,11	0,44
2004	0,23	25,95	0,43
2005	0,16	23,31	0,31
2006	0,16	8,18	0,31
2007	0,17	8,87	0,33
2008	0,17	6,22	0,32
2009	0,16	5,55	0,29
2010	0,16	6,18	0,30
2011	0,18	6,88	0,34
2012	0,16	5,16	0,30
2013	0,14	4,05	0,25
2014	0,13	4,38	0,25
2015	0,13	4,38	0,25
2016	0,13	2,43	0,21
2017	0,13	2,21	0,19
Trend 1990–2017	***-67%***	***-98%***	***-69%***

Republic of North Macedonia in 2017 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 109t in 1990; emissions have decreased steadily and in the year 2016 emissions were down by 98% to 2,21 t in the period 1990-2017. 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 North Macedonia, passenger cars can use only unleaded gasoline fuels which additionally reduced the Pb emissions.

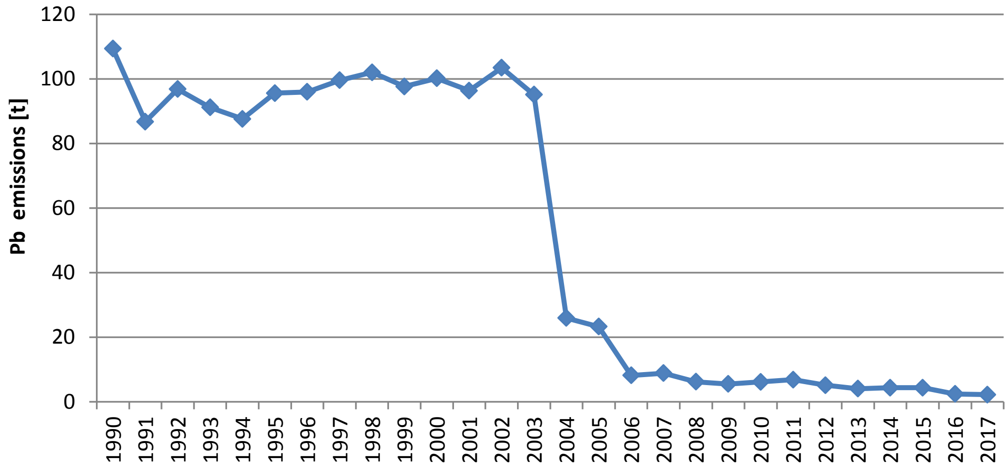

Figure 24 National total Pb emissions 1990-2017

Main emission sources in North Macedonia

The most important emission sources of Pb in 2017 are NFR sectors 1 Energy with shares in national total emissions of 34% from 1.A.2 and 21% in 1.A.4, 1A1a with share of 20% in Industrial Processes and Product Use with share of 21%. 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% and Industrial Processes and Product Use with share of 14%. 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 21% in 2017, due to the fact that leaded petrol was eliminated in 2004. The reduction of 98% 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.

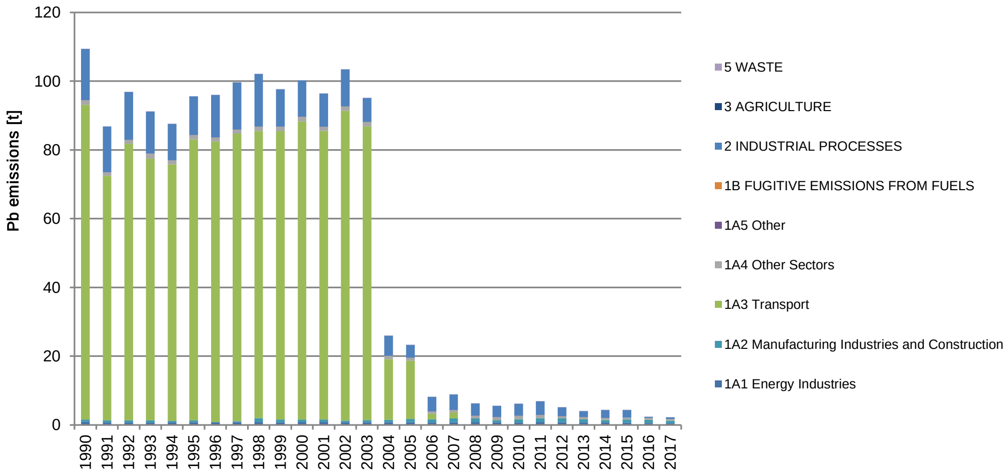

Figure 25 Pb emissions in North Macedonia 1990-2017 by sectors

3.3.2. Cadmium (Cd) emissions

Emission trend

National total Cd emissions amounted to 0,38 t in 1990; emissions have decreased steadily and in the year 2017 emissions were estimated to be 0,13 t, which means they were down by 67% 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 2016 and 2017, emissions slightly decreased by 4% mainly due to coming from residential heating, as well as emissions coming from industrial and electricity production.

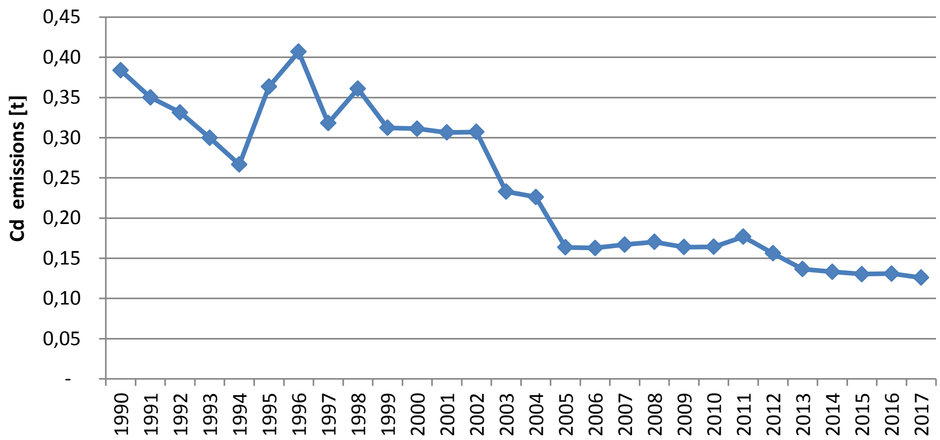

Figure 26 National total Cd emissions 1990-2017

Main emission sources in North Macedonia

The most important emission source in 2017 of Cd is NFR sector 1 Energy. Within the Energy sector the main contributors in 2017 are 1.A.1 Energy Industries, with a share of 42% (29% in 1990), 1.A.4 Other Sectors Energy with 10% (6% in 1990) 1.A.2 Manufacturing Industries with 9% (2%), in the national total emissions. NFR category 2 Industrial Processes and Product use, is also contributing with 28% (60%) and waste is contributing with 7% in 2017 to the national total cadmium emissions.

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

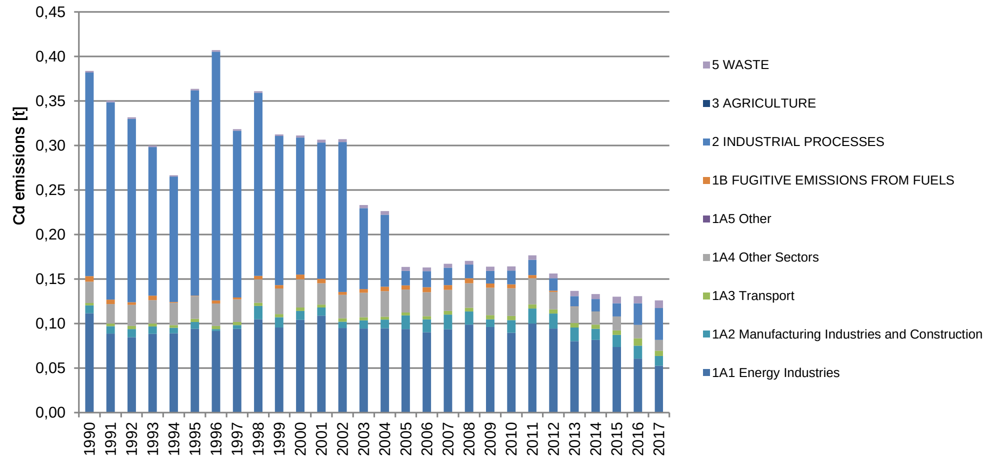

Figure 27 Cd emissions in North Macedonia 1990-2017 by sectors

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 2017 emissions (0,20t) were down by 69%, 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 2016 and 2017 total Hg emissions decreased by 9% due to a fall of emissions coming from residential heating, as well as emissions coming from industrial and electricity production.

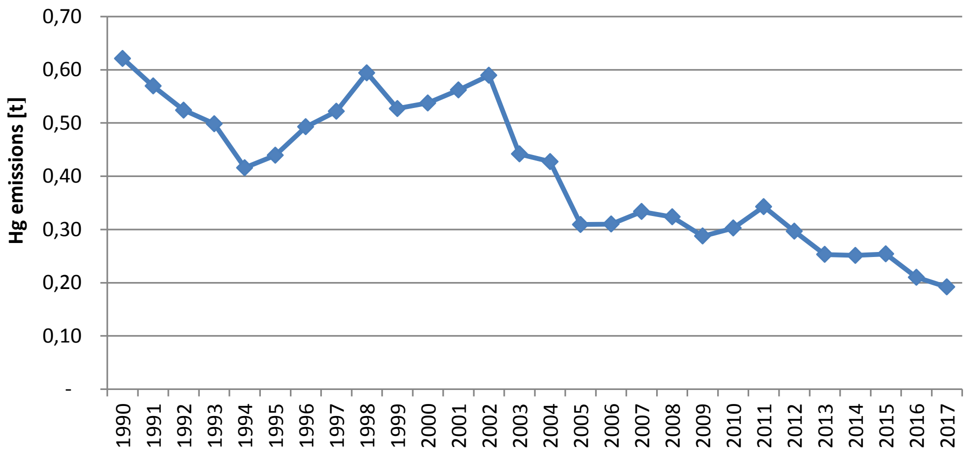

Figure 28 National total Hg emissions 1990-2017

Main emission sources in North Macedonia

The most important emission source in 2017 of Hg is NFR sector 1 - Energy. Within the Energy sector, the main contributors in 2017 are 1.A.1 Energy Industries with a share of 44% (28% in 1990) and 1.A.2, Manufacturing Industries and Construction with 23% (6% in 1990) in the national total emissions. NFR category 2 Industrial Processes and Product use is also one of the key sources with 11% (64% in 1990) to the national total mercury emissions. In 2017, also 20% 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.

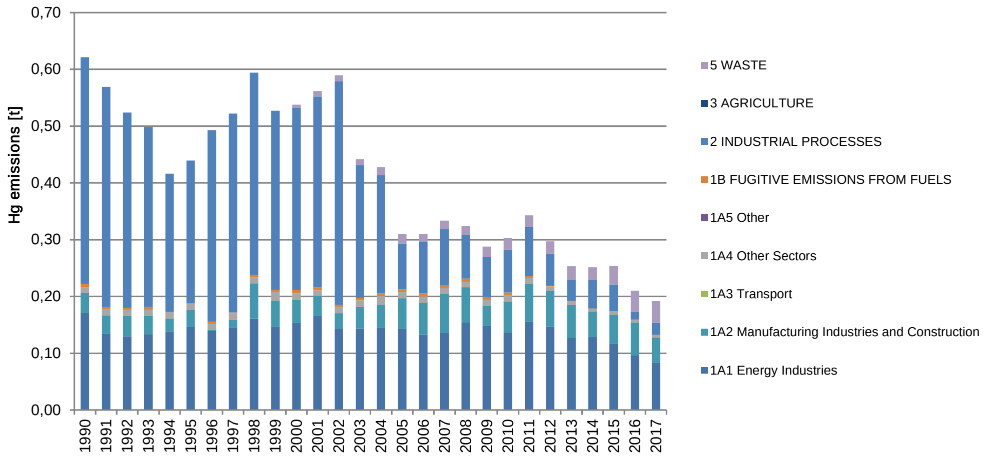

Figure 29 Hg emissions in North Macedonia 1990-2017 by sectors

3.4. Emission trends for POPs

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

Table 47 Emission trends for POPs 1990-2017

Year	Emissions			
	PCDD/F [g – I TEQ]	PAH [t]	HCB [kg]	PCB [kg]
1990	16,49	12,23	44,30	187,54
1991	14,51	10,80	39,23	177,69
1992	14,74	11,66	25,84	177,56
1993	15,23	12,77	24,20	131,33
1994	13,79	11,97	25,05	123,05
1995	13,96	12,09	18,64	237,82
1996	13,47	11,88	19,72	266,61
1997	14,00	11,92	27,90	150,21
1998	15,35	12,19	29,35	178,05
1999	15,29	12,39	53,99	128,32
2000	17,60	14,48	38,33	104,83
2001	14,61	11,43	34,16	93,29
2002	15,60	11,49	52,70	92,51
2003	16,22	12,82	42,99	49,31
2004	16,30	12,96	8,53	38,09
2005	15,17	12,18	7,58	4,23
2006	16,29	12,95	11,71	4,63

Year	Emissions			
	PCDD/F [g – I TEQ]	PAH [t]	HCB [kg]	PCB [kg]
2007	15,11	11,50	10,15	4,87
2008	16,43	13,31	10,40	4,36
2009	16,84	14,10	7,44	3,80
2010	17,85	14,88	9,56	4,26
2011	17,83	14,57	9,93	4,69
2012	12,33	9,72	7,24	7,85
2013	11,47	9,45	6,53	9,82
2014	9,92	7,62	4,87	9,21
2015	10,48	8,28	4,54	18,17
2016	9,17	7,72	5,52	19,04
2017	7,99	6,37	6,67	25,12
Trend 1990–2017	***-52%***	***-48%***	***-85%***	***-87%***

We can conclude from the figures presented in the previous table that Republic of North Macedonia in 2016 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 2017 emissions were nearly at 1990 levels to 12 t amounted to 6,4 t which reflect with only 48% reduction. The most important reductions could be observed in the sector for residential heating. Between 2016 and 2017, total PAH-4 emissions decreased by 18%, because of decreased emissions from residential heating, due to warmer weather which resulted with lower wood consumption as well as reduction of emissions coming from the 1.A.2 sector.

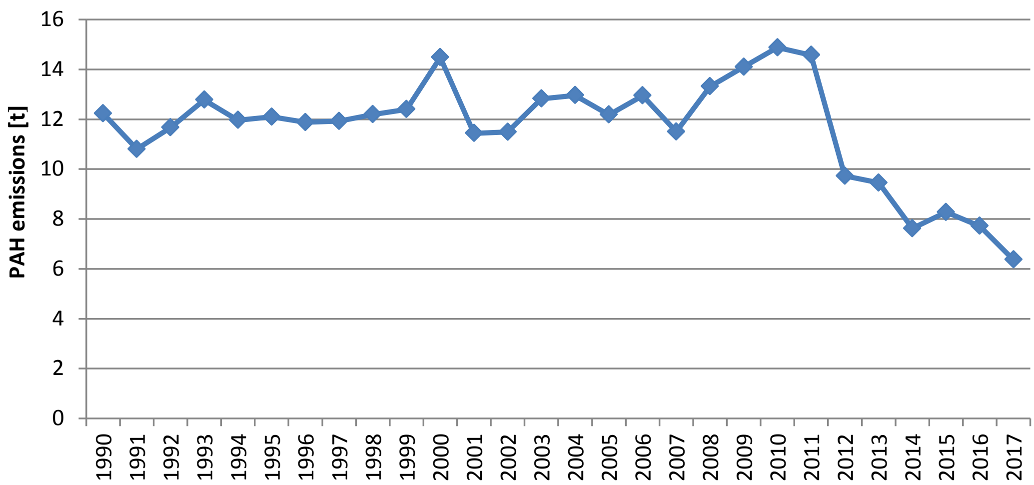

Figure 30 National total PAH emissions 1990-2017

Main emission sources in North Macedonia

The most important emission source in 2017 of PAH is NFR sector 1 - Energy. Within the Energy sector the main contributor in 2017 is 1.A.4 Other Sectors (residential heating), with a share of 84% (92% in 1990). Furthermore, 1.A.2 Manufacturing Industries is contributing with a share of 14% (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.

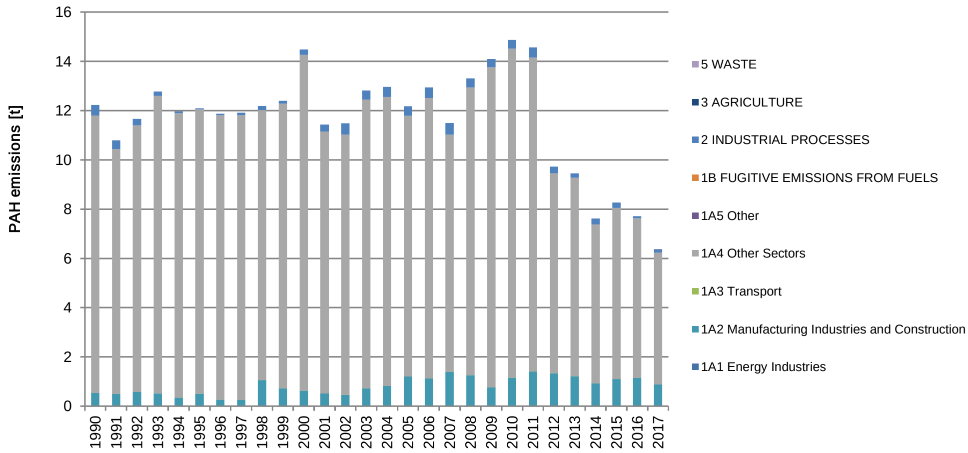

Figure 31 PAH-4 emissions in North Macedonia 1990-2017 by sectors

3.4.2. Dioxin and Furan emissions (PCDD/F)

Emission trend

National total dioxin/furan emissions amounted to 16,4g-I-TEQ in 1990; emissions have decreased since then, and in the year 2017 emissions were down to around 8 g-I-TEQ ans decreased by 13% in the period 1990-2017. 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 2015 and 2016, total dioxin/furan emissions decreased by 23%, due to a fall of emissions from residential heating, as well as emissions coming from industrial and electricity production.

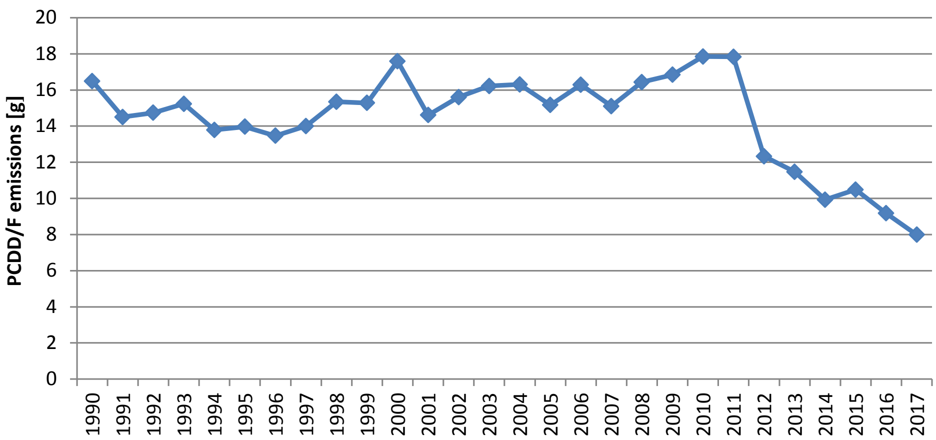

Figure 32 National total PCDD/F emissions 1990-2017

Main emission sources in North Macedonia

The most important emission source in 2017 of PCDD/F is NFR sector 1 - Energy. Within the Energy sector the main contributor in 2017 is 1.A.4 Other Sectors (mainly residential heating), with a share of 68% in 1990 and 2017. Furthermore, 1.A.2 Manufacturing Industries is contributing with a share of 14% (6% in 1990) in the national total emissions. NFR category 2 Industrial Processes and Product use (Metal Production) is also a main contributor with 12% (21%) to national total PCDD/F emissions.

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

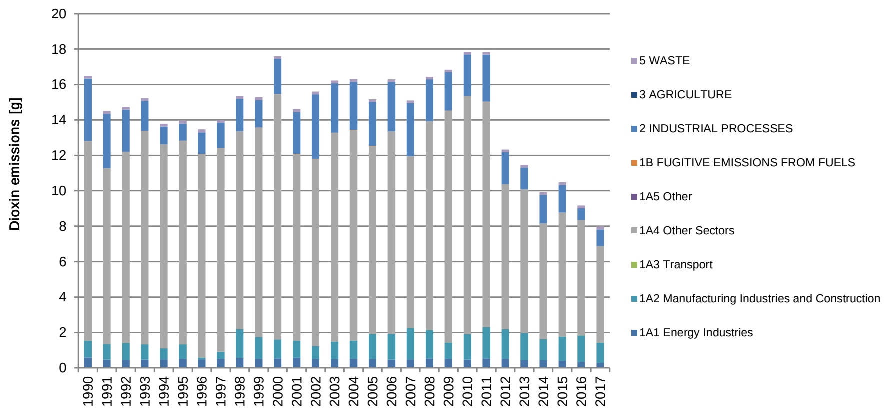

Figure 33 Dioxin/furan emissions in North Macedonia 1990-2016 by sectors

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 2017 emissions were down by 85% to 6,6 kg in the period 1990-2017. 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 2016 and 2017, total HCB emissions increased by 21% mainly due to increase of emissions in the Industry and waste sector.

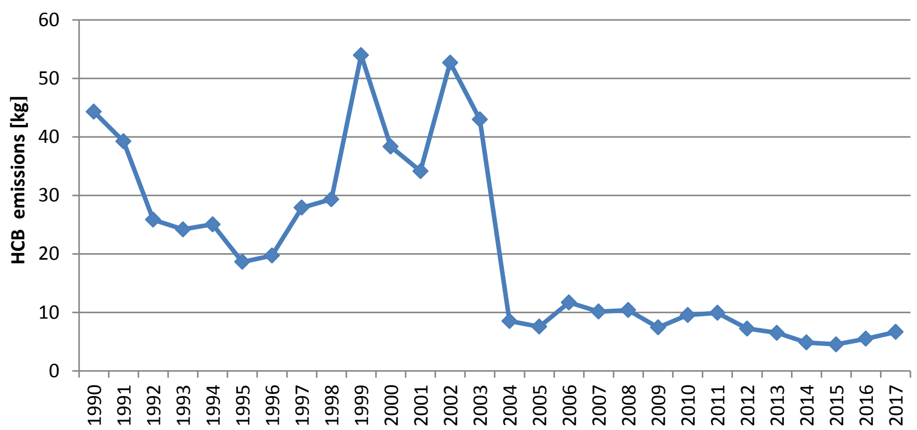

Figure 34 National total HCB emissions 1990-2017

Main emission sources in North Macedonia

The most important emission source in 2017 of HCB is NFR sector 2 Industrial Processes and Product Use. With a share of 98% (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.

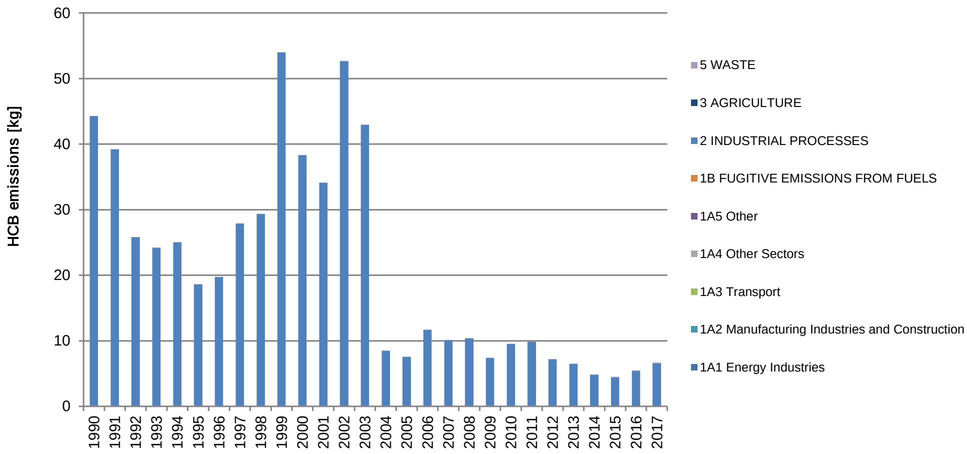

Figure 35 HCB emissions in North Macedonia 1990-2017 by sectors

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 2017 emissions were down by 94% to 25,12 kg in the period 1990-2017. 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 2016 and 2017, the total PCB emissions are increased by 32% due to increase of emissions coming from Industrial sector.

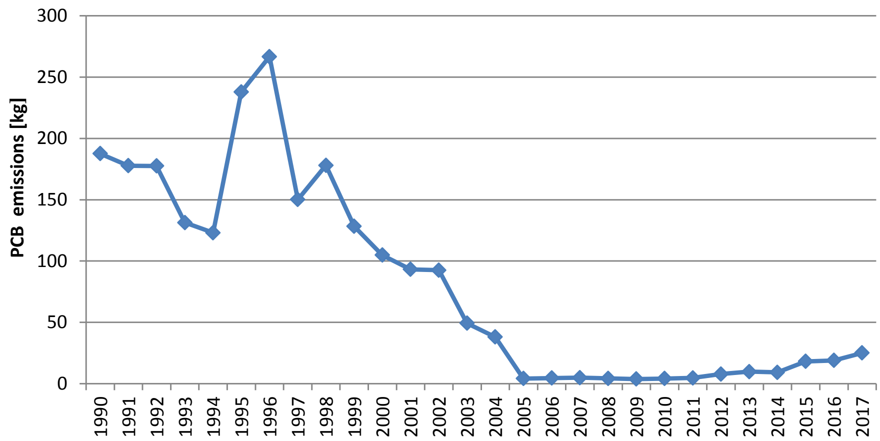

Figure 36 National total PCB emissions 1990-2017

Main emission sources in North Macedonia

The most important emission source in 2017 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 94% (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 2016 are NFR sectors 1.A.2 Manufacturing Industries (Iron and Steel Production) and 1.A.4 Other Sectors (mainly residential heating) with share of 4% and 2% respectively.

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

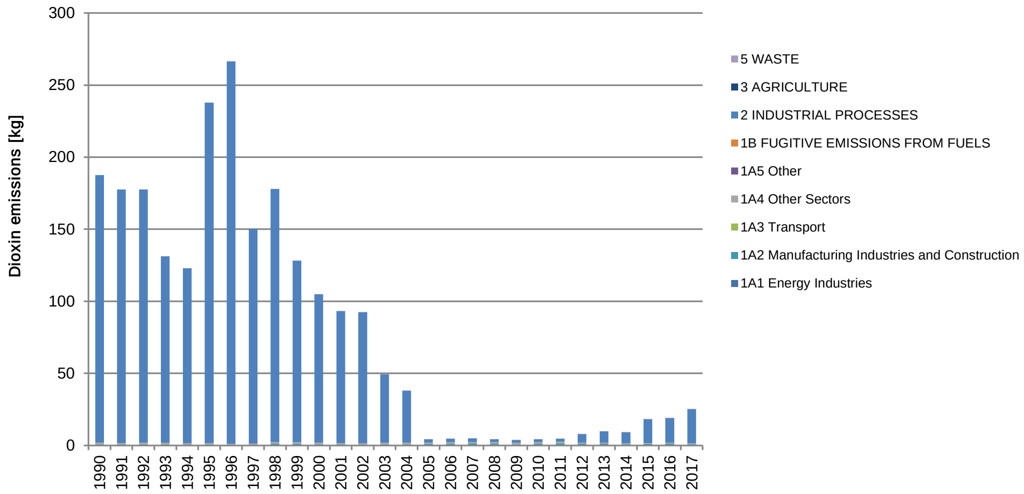

Figure 37 PCB emissions in North Macedonia 1990-2017 by sectors

ENERGY

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 North 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 48 NFR categories included in Energy sector for 2017

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	√
1A5b Other, 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	√

NFR category	Completeness
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	
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 49 NFR categories not included in Energy sector for 2017

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 6 power plants (two of them not in function)

1.A.1.b 1 refinery (Not in operation since 2014)

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[19]. Fuel consumption for 1.A.1.a has been provided by plant

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

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 were available. In the MAKSTATdatabase the separate data for road diesel and gasoil are available starting for 2015 and 2016 and also historical data dtarting from 2005. However only 2015-2017 emissions using separate road diesel and gasoil data were calculated, and the emissions for previous years (2005-2012) will be checked and recalculated in the future submissions.

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 derived form the emission measurements and national emission factors have been used for source category 1.A.1.a.

With regards to LHV, these values have been taken from energy balance[20], 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 this year separate LHV were used for fire wood – 6,7 $TJ/10^3$ m^3 10,66 $TJ/10^3$ m^3 for fruit wood , for wood wastes, wood briquettes and pellets – 17,00 $TJ/10^3$ t for heavy fuel – 40/40,19 $TJ/10^3t$, for heating oil and other gasoil – 42,5 $TJ/10^3t$, for diesel – 43/42,71 $TJ/10^3t$, , for coke – 26,795 $TJ/10^3t$, for other imported coal – 8,29 $TJ/10^3$, for natural gas –33,588/34,12 $TJ/10^6$ m^3n, LPG – 46/46,05 $TJ/10^3t$ 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 2017, only six 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.

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-

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

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.

Table 50 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	58.359	1.000	2.516
1991	45.655	NO	3.090
1992	44.356	NO	2.656
1993	45.442	NO	3.037
1994	47.507	NO	2.434
1995	49.958	NO	2.986
1996	47.675	NO	3.051
1997	49.362	NO	3.301
1998	55.194	NO	2.602
1999	50.091	NO	2.640
2000	51.991	715	6.345
2001	56.387	673	3.800
2002	48.716	641	4.286
2003	49.091	345	2.902
2004	49.291	69	2.936
2005	48.711	52	3.031
2006	45.153	197	5.152
2007	45.697	895	6.588
2008	52.597	1.627	1.270
2009	50.442	744	2.267
2010	46.386	1.475	2.330

Year	Lignite (TJ)	Natural gas (TJ)	Residual fuel oil (TJ)
2011	53.111	1.570	1.431
2012	50.549	974	1.594
2013	28.463	1.522	1.310
2014	44.158	1.633	1.671
2015	39.816	3.258	1.606
2016	32.903	5.653	1.138
2017	28.553	7.456	933

Data for the fuel consumption in the reporting period shows that solid and liquid fuels are reduced a and quantity of naturala gas is increasing. 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 yearly emissions are calculated on the basis of avalible measurements for several mounts), emissions for the basic pollutants are calculated when implied emission factors are multiplied with the quantity of fuel consumed reported by the installations.

<u>**Emission factors**</u>

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

Table 51 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	1.678	0,3	1.678
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

Pollutant	Unit	Lignite	Natural gas	Heavy fuel oil
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 2008-2017 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 2017, emission measurements for 6 out of 9 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 for 2017 were not taken into account. Instead, implied emission factors were used due to the fact that the installation did not made emission measurements in each mount in 2018 as the legislation is requiring.

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 52 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 2016 data reported by the plants in the inventory was done, and this is documented.

4.2.4. Source-specific recalculations

No source specific recalculations.

4.2.5. No recalculations were made in this sector.

No recalculations were done.

4.2.6. Source-specific planned improvements

Compilance with GHG emission inventory data in this sector and use of national emission factors instead of implied emission factors will be considered for future submissions.

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:

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

$E_{\text{pollutant}}$ annual emission of pollutant

$EF_{\text{pollutant}}$ emission factor of pollutant

$AR_{\text{fuel consumption}}$ 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 and 2016. 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 53 Activity data for source category 1.A.1.b- Petroleum refining by type of fuel

Year	Refinery gas (TJ)	Residual fuel oil (TJ)
1990	1.711	1.680
1991	1.356,2	1.331
1992	797,2	782
1993	1.432,4	1.406
1994	201,4	198
1995	168,0	165
1996	979,6	961
1997	534,2	524
1998	1.061,8	1.042
1999	1.076,8	1.057
2000	1.467,4	1.070,73
2001	1.424,9	1.108,95
2002	911,8	869,52
2003	1.102,6	1.140,30
2004	1.173,8	1.180,85
2005	1.373,3	1.035,27
2006	1.522,1	1.002,13
2007	1.550,6	1.228,2778
2008	1.483,0	1.304,25
2009	1.368,1	1.339,40
2010	1.293,8	1.920,79
2011	723	1.815,33
2012	235,68	990,27
2013	67,89	383,56
2014	NO	107,47
2015	NO	NO
2016	NO	NO
2017	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 54 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

Pollutant	Unit	Refinery gas	Heavy fuel oil
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	1.030
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

No specific QA/QC and data verification were done due to the fact that the the process is not occurring in the last few years.

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 the Tables 56-61:

- 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 55 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	1.395,926	3.104,251
1991	NO	NO	2.133,226	1.184,316
1992	NO	NO	2.451,098	1.610,82
1993	NO	NO	1.963,745	1.290,54
1994	NO	NO	960,3717	631,14
1995	NO	NO	2.100,154	655,996
1996	NO	NO	NO	33,744
1997	NO	NO	272,3442	178,98
1998	0,294	NO	5.165,955	1.793,497
1999	0,526	NO	3.443,079	1.414,101
2000	NO	26,93758	2.285,072	1.698,71
2001	0,083736	815,651	1.912,153	780,1264
2002	NO	959,6427	1.378,295	1.076,008
2003	2,595816	1.119,32	2.882,068	1.195,541
2004	2,219004	1.225,525	3.299,994	1.040,671
2005	130,4188	1.272,347	4.851,748	1.963,107

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
2006	111,2014	1.310,301	5.060,46	2.739,465
2007	50,74402	1.321,856	6.819,795	3.588,004
2008	14,57006	1.201,376	5.930,518	2.968,651
2009	1,549116	1.094,23	2.636,009	2.530,209
2010	83,736	1.079,216	4.446,214	2.977,233
2011	47,29337	1.598,382	6.163,09	4.014,444
2012	110,699	437,1438	5.846,866	3.543,205
2013	6,48954	609,8074	5.220,06	3.366,229
2014	5,527314	754,3067	5.410,196	1.981,182
2015	4,0100	657,63	5.516,38	1.398,53
2016	2,4094	878,06	4.521,10	1.141,65
2017	1,3883	1.044,20	2.588,43	717,91

Table 56 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	1.826,964	277,653
1992	NO	NO	1.830,27	591,1085
1993	NO	NO	1.833,576	904,564
1994	NO	NO	1.685,519	861,8515
1995	NO	NO	1.537,461	819,139
1996	NO	NO	NO	26,015
1997	NO	NO	919,528	82,2985
1998	NO	NO	1.839,056	138,582
1999	NO	NO	1.754,216	699,846
2000	NO	NO	2.045,964	770,8317
2001	NO	NO	1.918,81	374,0068
2002	NO	NO	1.246,117	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

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
2013	6,00	NO	NO	43,29151
2014	4,00	37,950	NO	2,846268
2015	NO	NO	NO	41,2632
2016	NO	NO	NO	51,8352
2017	NO	NO	NO	54,5612

Table 57 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	1.059,869
1994	NO	NO	0,746996	1.136,4
1995	NO	NO	0,643452	1.212,93
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	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	35,9029	NO	65,2251
2015	NO	36,4389	NO	86,217
2016	NO	39,4274	NO	74,07233
2017	NO	42,0359	NO	79,1639

Table 58 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
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	0,1465	8,917884
2012	0,586152	23,99036	0,2938	17,58456
2013	0,460548	15,15622	0,2093	16,37039
2014	0,1954	15,04326	0,9045	17, 74865
2015	0,1752	15,23901	0,2238	26,3925
2016	0,2713	14,2451	0,2073	18,6370
2017	0,1906	16,1893	0,2487	22,5738

Table 59 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	1.610,597
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

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]
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	1.614,472
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	127,3495	200,9358	3,92653	655,6439
2015	81,5628	211,4667	NO	700,649
2016	75,5322	233,4048	NO	688,6886
2017	59,7863	240,5310	NO	612,1577

Table 60 Activity data for category source category 1.A.2.gviii - 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	2.666,445	491.902
1991	66,61725	NO	111,1813	2.727,26	465.375
1992	66,5935	NO	110,5954	2.605,63	396.496
1993	66,641	NO	110,0094	2484	413.444
1994	66,546	NO	122,5078	2116,5	375.914
1995	66,736	NO	135,0063	1749	365.121
1996	66,356	NO	32,1626	6.040,328	396.015
1997	67,116	NO	592,8778	2.495,243	475.252
1998	65,596	NO	668,367	2.990,737	346.867
1999	68,636	152,862	517,3887	1.999,75	427.080
2000	66,609	262,511	634,3643	2.540,039	614.162
2001	34,81	204,082	649,0153	2.743,566	716.963
2002	29,986	266,2	686,5682	2.922,048	739.492

Year	Biomass [TJ]	Natural gas [TJ]	Lignite [TJ]	Heavy Fuels [TJ]	Clinker [tonnes]
2003	38,4199	29,32	1.084,274	2.731,35	602.569
2004	29,32638	NO	1.705,716	1.349,179	643.258
2005	29,4332	NO	1.781,248	4.627,66	694.922
2006	4,898556	NO	1.885,137	1.349,179	801.302
2007	29,32638	NO	1.750,728	1.451,279	882.834
2008	23,48795	NO	1.822,425	1.349	843.765
2009	16,70533	10,0442	1.752,379	1.488,677	478.404
2010	22,19004	126,8029	2.386,236	1.925,877	588.978
2011	110,9388	242,1364	2.130,342	1.828,516	687.986
2012	136,0982	133,3791	1.929,546	1.645,066	645.482
2013	97,6007	127,0221	2.009,455	1.061,103	577.845
2014	112,1663	136,6032	73,49527	1.015,77	518.198
2015	54,6151	142,639	927,8762	2.467,986	553.232
2016	59,1141	169,4593	2.658,3135	1.022,9190	739.807
2017	74,0667	213,4557	2.808,8044	989,1536	736.625

Activity data – mobile combustion

Activity data for category 1.A.2.gvii for diesel fuel is presented in Table 62. 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 2015-2017, data from the category diesel and other gasoil has been used.

Table 61 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	4.879	2004	507
1991	3.520	2005	429
1992	4.707	2006	459
1993	4.925	2007	528
1994	2.074	2008	558
1995	2.408	2009	789
1996	2.074	2010	1.020
1997	1.796	2011	1.378
1998	1.624	2012	1.737
1999	1.316	2013	2.300
2000	1.050	2014	1.254
2001	1.156	2015	1.182
2002	680	2016	1.165
2003	549	2017	1.073

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 63-66.

Table 62 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 63 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

Pollutant	Value	Unit	References
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
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 64 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

Pollutant	Value	Unit	References
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 65 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
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 67.

Table 66 Emission factors for category 1.A.2 - Stationary combustion in manufacturing industries and construction: Other for clinker

Pollutant	Value	Unit	References
NOx	1.241	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	1.455	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 68.

Table 67 Emission factors for source category 1.A.2.gvii - Mobile Combustion in manufacturing industries and construction: for diesel fuel

Pollutant	Value	Unit	References
NOx	32.792	g/tonne	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
NMVOC	3.385	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	2.086	g/tone	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
PM10	2.086	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

Pollutant	Value	Unit	References
TSP	2.086	g/tonne	GB 2013 Table 3-1 Tier 1 emission factors for off-road machinery
CO	10.722	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 2016 were performed, due to the use of final data (from the energy balance) for fuel consumption and in some NFRs recalucations for the period 2013-2016, were used for emissions coming from biomass combustion due to available LHV for different types of biomass.

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:

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

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, 2015,2016 and 2017. 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 North 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 1990-2016[21]. Data on number of vehicles were taken from Statistical yearbook for the period 1990-2002 and publication Transport and other communication for the period 2003-2015[22]. The data on mileage was received from the Faculty for Mechanical Engineering in Skopje.

Table 68 Activity data for source category 1.A.3.b - Road transport for period 1990-2017

NFR	1A3bi	1A3bi	1A3bii	1A3biii	1A3biv
Year	Liquied fuels	Gas fuel	Liquied fuels	Liquied fuels	Liquied fuels
1990	7.647	2.064	1.553	3.054	101

[21] State Statistical Office of the Republic of Macedonia, Statistical Yearbook of the Republic of Macedonia, 1990-2016;

[22] State Statistical Office of the Republic of Macedonia,Transport and other communications, 2007-2015 Makstat database for 2016 data - http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef

NFR	1A3bi	1A3bi	1A3bii	1A3biii	1A3biv
Year	Liquied fuels	Gas fuel	Liquied fuels	Liquied fuels	Liquied fuels
1991	6.331	1.396,6	2.148,1	4.293,3	121
1992	7.097	1.565,6	2.544,1	5.084,8	181,8
1993	7.353,6	1.622,2	2.652,8	5.302,1	198,9
1994	6.674	1.472,3	2.300,1	4.597,1	96,1
1995	7.250,3	1.599,4	2.579,2	5.154,9	152,6
1996	7.202,5	1.588,8	2.556,6	5.109,8	179
1997	7.333,9	1.617,8	2.614,7	5.225,9	227,7
1998	7.320,6	1.614,9	2.649	5.294,4	236,2
1999	7.350,6	1.621,5	2.640,6	5.277,5	232,2
2000	7.597,3	1.675,9	2.739,8	5.475,9	246,9
2001	6.115,9	1.395,2	2.198,5	4.466,2	50,5
2002	6.599	1.395,2	2.410,2	4.819	76,6
2003	6.188	1.395,2	2.260,1	4.518,8	71,8
2004	6.324,3	1.395,2	2.005,2	3.991,3	91,5
2005	6.034,5	1.249,3	2.229,9	4.460	100,6
2006	5.685,8	1.489,4	1.868,6	4.982,6	135,1
2007	6.150,6	1.987,7	2.156,3	5.763,2	152,8
2008	5.943	1.953	1.656,9	4.390,4	339,3
2009	6.477,3	1.987,7	2.971,0	5.972,4	342,1
2010	7.456,4	2.634	3.980	8.045	92,5
2011	7.272,1	1.599,6	3.464,3	6.986,6	93,7
2012	6.300,4	1.543,1	3.553,6	7.178,4	83,3
2013	6.847,1	1.693	4.168,3	8.433,1	87,4
2014	10.298	726,0	2.122,0	6990,0	51,6
2015	10.873	717,0	2.826,0	7.877,0	60,4
2016	11.446	734,0	2.288,0	11.568	70,0
2017	11.902	737,0	1.995,7	11.723,0	84,0

Table 69 Activity data for source category 1.A.3.b Road transport for 2017

NFR code	Fuel	Fuel consumption [TJ]
1A3bi	Gasoline	4.102,8
	Diesel	7.799,6
	LPG	737,0
1A3bii	Gasoline	623,1
	Diesel	1.955,7
1A3biii	Gasoline	/
	Diesel	11.723,0
1A3biv	Gasoline	84.0

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 Tables 71-76, 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 70 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 71 Emission factor for source category 1.A.3.bi Road Transport: Passenger cars used for calculation of emissions in the period 2014-2016 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

Fuel type	g/km	CO	NH_3	NMVOC	NO_x	Pb	PM2.5	B(a)P
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
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 72 Emission factor for source category 1.A.3.bii - Road Transport: Light duty vehicles, used for calculation of emissions in the period 2014-2016 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 73 Emission factor for source category 1.A.3.biii - Road Transport: Heavy duty vehicles used for calculation of emissions in the period 2014-2016 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

Type	Technology	CO	NH3	NMVOC	NOx	Pb	PM2.5	B(a)P
		g/km	g/km	g/km	g/km	g/km	g/km	g/km
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
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 74 Emission factor for source category 1.A.3.biii - Buses used for calculation of emissions in the period 2014-2016 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
+ 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 75 Emission factor for source category 1A3biv - Road Transport: Mopeds & motorcycles used for calculation of emissions in the period 2014-2016 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, 2015 and 2016, 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 North Macedonia is available only for the years 2014, 2015 and 2016. The data was not quality checked and controlled and it needed further analysis and calculations. The National Car Registry of North 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, 2015 and 2016, 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 North 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 North 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 North 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 period 2014 - 2016. 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

No specific uncertainty calculations are performed in this category.

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 on historical years (2006-2013) that has been recently 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.b.v) 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:

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

Where:

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

N_j =the number of vehicles in category j.

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

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

Activity Data

The number of vehicles in category PCs and TWs are taken directly from the statistical yearbooks for the period 1990-2004 and Publication transport and communication for the period 2005-2013, and MOI database for 2014 - 2016. The LDVs were calculated gathering subcategories (fright cars. special vehicles).

Table 76 Activity data for source category 1.A.3.v - Gasoline evaporation

Year	Passenger cars (PCs)	Light-duty vehicles (LDVs)	Two-wheel vehicles (TWVs)
1990	196.282	4.500	1.523
1991	212.340	4.729	1.489
1992	238.032	5.601	2.238
1993	246.638	5.841	2.448
1994	223.845	5.065	1.183
1995	243.175	5.678	1.879

Year	Passenger cars (PCs)	Light-duty vehicles (LDVs)	Two-wheel vehicles (TWVs)
1996	241.572	5.629	2.203
1997	245.979	5.757	2.803
1998	245.532	5.832	2.907
1999	246.537	5.814	2.858
2000	254.811	6.032	3.040
2001	263.294	6.312	3.654
2002	261.609	5.872	2.379
2003	254.999	5.532	1.746
2004	195.915	4.340	1.203
2005	198.088	4.139	1.484
2006	186.812	3.804	3.132
2007	207.218	3.962	4.396
2008	203.234	4.212	8.319
2009	216.380	4.674	8.684
2010	227.184	4663	7.457
2011	217.016	4363	7.510
2012	199.329	4096	7.965
2013	213.808	4311	7.681
2014	215.175	4128	8.180
2015	209.231	7069	10.077
2016	202.608	5859	11.810
2017	197.787	5751	14.193

Emission factors

For the calculation of emissions for emission parameters from 1990-2016, 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^{o}C, according to the automatic meteorological station under responsibility of HMA – Hydro Meteorological Administration.

These emission factors are presented in Table 78 below.

Table 77 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.

Pollutant	Vehicle type	Value	Unit	References
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.

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.

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

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 2003-2013, and from the chapter Transport from the Statistical yearbook for the period 1990-2002, and from MOI database for 2014 - 2016. 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 78 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	5.596.151	1.623.758.097	364.624.335	357.046.031
1991	5.473.324	1.756.600.415	383.221.612	379.976.496
1992	8.223.466	1.969.141.086	453.867.724	434.940.721
1993	8.996.382	2.040.332.747	473.265.390	466.679.239
1994	4.346.903	1.851.778.276	410.458.384	416.094.438
1995	6.905.315	2.011.681.586	460.129.592	474.896.809
1996	8.097.643	1.998.418.463	456.104.105	474.355.532
1997	10.302.550	2.034.879.739	466.462.083	479.719.096
1998	10.683.017	2.031.178.729	472.582.705	485.673.143
1999	10.503.269	2.039.495.446	471.076.090	496.449.478
2000	11.171.332	2.107.943.013	488.778.815	543.737.410
2001	13.430.164	2.178.121.470	511.472.201	599.046.084
2002	8.741.739	2.164.182.878	475.831.344	629.308.392
2003	6.417.000	2.109.498.000	448.265.000	654.650.000
2004	4.140.000	1.774.428.000	358.100.000	615.340.000
2005	5.169.000	1.800.211.000	346.780.000	675.610.000
2006	10.323.000	1.724.960.000	319.505.000	706.385.000
2007	14.118.000	1.915.348.000	327.040.000	821.205.000

Year	2W x Mileage [km]	PCs x Mileage [km]	LDTs x Mileage [km]	HDVs x Mileage [km]
2008	25.875.000	1.874.564.000	329.716.982	813.077.500
2009	27.282.000	2.009.790.000	367.222.156	896.444.016
2010	23.277.000	2.205.249.000	381.681.101	946.292.282
2011	25.119.000	2.223.648.000	370.832.622	936.272.203
2012	25.416.000	2.141.113.000	352.826.216	892.923.288
2013	24.270.000	2.458.887.000	402.735.024	1.028.991.603
2014	25.887.000	2.633.300.000	431.162.836	1.107.184.651
2015	30.231.000	2.727.403.000	795.305.000	567.040.000
2016	35.430.000	2.806.809.000	643.330.000	873.605.000
2017	42.579.000	2.870.567.000	677.195.000	719.510.000

Emission factors

Tables 80 and 81 summarizes the emission factors used for the calculation of particulate emissions in the complete reporting period.

Table 79 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 80 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
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.

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 2016 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 2005-2016. For the previous year, the surrogate method has been used. The estimates of the activity data were related to the passenger numbers. MEPP has send official request to the TAV aeroport in Skopj and Civil aviation agency (CAA) of Repubic of North Macedonia regarding jumps in 1999 and 2000 on LTO, but did not recive answer.

Table 81 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	11.986	2000	23.168	2010	12.721
1991	11.297	2001	11.664	2011	11.873
1992	10.539	2002	12.767	2012	11.284
1993	14.581	2003	12.170	2013	12.380
1994	14.351	2004	11.986	2014	13.968
1995	14.305	2005	13.204	2015	15.585
1996	12.307	2006	13.509	2016	15.719
1997	11.067	2007	14.174	2017	16.796
1998	13.249	2008	14.323		
1999	24.156	2009	12.800		

Emission factors

The calculation of emissions for emission parameters from 1990-2016 were used emission factors taken from GB 2013. The used emission factors are presented in Table 83.

Table 82 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[23] for the period 2005-2010, and from the Statistical yearbooks chapter energy balance for period 2011-2016. 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 2005-2016, the data is taken from the special publication Transport and other services.

Table 83 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	28.265	2010	6.867
1991	19.461	2001	25.104	2011	3.652
1992	18.156	2002	46.843	2012	8.488
1993	25.117	2003	15.973	2013	10.108
1994	24.722	2004	8.882	2014	11.946
1995	24.642	2005	6.433	2015	13.419
1996	21.201	2006	4.670	2016	15.269
1997	19.065	2007	6.861	2017	20.133
1998	22.823	2008	6.121		
1999	41.611	2009	2.772		

Emission factors

Emission factors taken from GB 2013 (Cruise (kg/t) — average fleet (B767)). These emission factors are given in Table 85 below.

Table 84 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))

[23] 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, Makstat database 2005-2016 - http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef;

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 86 provides the Tier 1 calculated activity data.
Domestic Cruise is not occurring (NO) in North Macedonia as there are no flight movements with kerosene within the country. All flight movements with kerosene are international.

Table 85 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	2016	NO
1997	NO	2007	NO	2017	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 87 below.

Table 86 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	1.200	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

No recalculations were done

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

Correction of data that contains jumps and deeps is planned to be implemented in future reporting rounds

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, 1999-2016 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 87 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	7.300	2000	4.212	2010	3.580
1991	5.932	2001	3.373	2011	3.734
1992	3.233	2002	2.328	2012	3.169
1993	1.958	2003	2.000	2013	2.616
1994	1.987	2004	2.138	2014	2.616
1995	1.928	2005	2.607	2015	1.877
1996	3.559	2006	3.597	2016	2.008
1997	4.182	2007	3.736	2017	1.202
1998	4.449	2008	3.701		
1999	3.957	2009	3.634		

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 89 below.

Table 88 Emission factors for source category 1.A.3 - Railways

Pollutant	Value	Unit	References
NOx	52,4	kg/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
CO	10,7	kg/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
NMVOC	4,65	kg/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
NH_3	0,007	kg/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
TSP	1,52	kg/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
PM10	1,44	kg/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
PM2.5	1,37	kg/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
Cd	0,01	g/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
Cr	0,05	g/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
Cu	1,7	g/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
Ni	0,07	g/t fuel	GB 2016. 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 2016. 1.A.3.c Railways, Table 3-1. pg. 8
Benzo(a)pyrene	0,03	g/t fuel	GB 2016. 1.A.3.c Railways, Table 3-1. pg. 8
Benzo(b)fluoranthene	0,05	g/t fuel	GB 2016 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

No recalculations were carried out for the other pollutants, only 2015 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 second time reported in this submission. For the previous years (years before 2015) 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 2016, are presented in the following table.

Table 89 Activity data for diesel fuel oil consumption for source category 1.A.5.b - Other, Mobile for 2017

Type of fuel	Diesel fuel oil consumption [L] for 2015	Diesel fuel oil consumption [t] for 2015	Diesel fuel oil consumption [L] for 2016	Diesel fuel oil consumption [t] for 2016
ED	708.450	592,97	898.497	752.0420
MB-95	94.500	79,10	144.732	121.141
Total	802.950	672,07	1.043.229	873.182

Diesel fuel consumption has been reported in L and converted in tons by use of diesel density of 0,837kg/m^3. MEPP has used 2016 data since 2017 data were not recived before the submission deadline.

Emission factors

See table 66.

4.5.4.2. Source-specific uncertainties and time-series consistency

No specific uncertainty analysis is done for this category.

4.5.4.3. 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.

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

Emissions for 2015 were recalculated but the racalculations are minor and due to typing mistakes.

4.5.4.5. 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

Recalculations of the emissions were carried out only due to the use of final energy consumption data for 2015.

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 1990-2016. For the period 1990-1998, activity data were taken from the GHGs inventory.

Table 90 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	2.640
1999	712	607	NO	5.649
2000	848	58	NO	1.702
2001	NO	33	NO	1.202
2002	NO	196	NO	15.928
2003	311	246	NO	5.812
2004	325	656	NO	4.180
2005	209	203	22	5.141
2006	436	63	26	3.016
2007	334	223	30	3.811
2008	562	53	29	3.338
2009	592	53	33	3.650
2010	562	53	79	3.189
2011	253	47	83	2.144
2012	448	88	91	2.501
2013	196	62	109	2.476
2014	279	12	198	2.275
2015	269	24	222	1.896
2016	273	34	235	2.022

Year	Biomass [TJ]	Coal [TJ]	Gaseous Fuels [TJ]	Liquid Fuels [TJ]
2017	190	42	265	1.953

Emission factors

Emission factors are taken from GB 2013. Emission factors for different type of fuels are presented in tables 94-97.

Table 91 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	1.600	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 92 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

Pollutant	Value	Unit	References
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
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 93 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

Pollutant	Value	Unit	References
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 94 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

4.6.6.2. 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 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).

4.6.6.3. 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.

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

Recalculations were done for 2015 emissions within the category 1.A.4.ai due to use of final consumption data for this year.

4.6.6.5. 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[24]. 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 95 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)	3.633
Derived heat	317.082 (MWh)	46.590
Wood mass consumed for other purposes (for food in winter. producing brandy. etc.)	149.366	N/A

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

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 96 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	1.038
1995	16.024	294	NO	1.097
1996	16,024	284	NO	1.156
1997	16,024	275	NO	1.214
1998	15,273	213	NO	1.225
1999	16,028	276	NO	1.316
2000	19,040	235	NO	1.394
2001	14,811	177	NO	1.435
2002	14,654	227	NO	1.513
2003	16,315	228	NO	1.577
2004	16,271	248	NO	1.657
2005	14,629	249	NO	1.700
2006	15,688	305	NO	1.775
2007	13.280	228	NO	1.907
2008	16.335	128	NO	1.828
2009	18.250	85	NO	1.912
2010	18.759	95	NO	1.872
2011	17.953	44	NO	1.828
2012	11.380	47	NO	1.445
2013	9.115	55	0,390	535
2014	9.835	37	1,661	431
2015	9.168	33	2,557	449
2016	7.584	34	3,826	476
2017	8.861	51	6,267	497

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 97 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	5.300	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
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 98 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	4.600	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 99 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

Pollutant	Value	Unit	References
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 100 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

4.6.7.2. 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 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).

4.6.7.3. 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.

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

Recalculations were done for 2015 emissions due to use of final consumption data for this year.

4.6.7.5. 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, CO_2 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 101 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	2016	34
1997	38,0	2007	34	2017	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 105.

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

Pollutant	Value	Unit	References
NOx	4.941	g/tonne fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
NMVOC	129.899,5	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
NH3	3,5	g/tonne fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
TSP	1.959,5	g/tonne fuel	GB 2009 1A4bii Table 3-1 Tier 1 emission factors for off-road machinery, pg.19
CO	695.580,5	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

4.6.8.2. Source-specific uncertainties and time-series consistency

See chapter 3.6.7.1.

4.6.8.3. Source-specific QA/QC and verification

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

4.6.8.4. 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 2001-2016.

4.6.8.5. 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 for the next reporting period.

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 103 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	1.302
1991	NO	33,41493	NO	1.545,235
1992	NO	33,08283	NO	1.321,978
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	1.124,645
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	1.260,63
2001	NO	0,37485	NO	998,088
2002	NO	0,00765	NO	570,7749
2003	14,07214	1,3617	NO	456,596

Year	Biomass [TJ]	Coal [TJ]	Gaseous Fuels [TJ]	Liquid Fuels [TJ]
2004	18,07457	1,84365	NO	1.507,755
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	251,2026
2016	81,472	32,55483	NO	247,903
2017	55,943	34,05532	NO	282,538

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 104 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	9.558	NO	2.441
1991	12.917	NO	1.326
1992	11.276	NO	909
1993	7.651	NO	1.046
1994	7.364	NO	842
1995	8.305	NO	772
1996	9.482	NO	884
1997	6.932	NO	1.130
1998	7.346	NO	294
1999	8.149	NO	692

Year	Diesel [TJ]	LPG [TJ]	Gasoline[TJ]
2000	11.598	NO	985
2001	9.574	NO	813
2002	5.325	NO	452
2003	4.260	NO	362
2004	14.066	NO	1.195
2005	1.865	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	3.762	NO	379
2013	5.710	NO	368
2014	6.007	NO	390
2015	6.477	NO	372
2016	6.535	NO	397
2017	6.866	NO	395

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

Pollutant	Value	Unit	References
NOx	35.043	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
NMVOC	3.366	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
PM2.5	1.738	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
PM10	1.738	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
TSP	1.738	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 19
CO	10.939	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 106 Emission factors for LPG source category 1.A.4.cii - Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

Pollutant	Value	Unit	References
NOx	61.093	g/t	GB 2016 Table 3-1 emission factor for source category 1.A.4.c.ii, page 24-25
NMVOC	6.720	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	4.823	g/t	GB 2016 Table 3-1 emission factor for source category 1.A.4.c.ii, page 24-25

Table 107 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	7.117	g/t	GB 2013 Table 3-1 emission factor for source category 1.A.4.c.ii-Agriculture, page 20
NMVOC	17.602	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	770.368	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

4.6.10.2. 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 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).

4.6.10.3. 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.

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

No recalculations were done in this sector.

4.6.10.5. 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 North 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:

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

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

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

Activity data

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

Table 108 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	6.643.409	2000	7.513.998	2010	6.583.074
1991	6.978.171	2001	8.142.082	2011	7.902.084
1992	6.472.920	2002	7.571.202	2012	7.309.546
1993	6.917.774	2003	7.271.202	2013	6.633.560
1994	6.859.762	2004	7.296.136	2014	6.681.752
1995	7.249.237	2005	6.882.862	2015	5.927.749
1996	7.145.667	2006	6.653.474	2016	5.101.758
1997	7.442.876	2007	6.569.220	2017	5.056.918
1998	8.144.653	2008	7.669.103		
1999	7.277.623	2009	7.395.915		

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 109 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

4.7.1.2. 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).

4.7.1.3. 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.

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

No recalculations were performed in this category.

4.7.1.5. 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 North Macedonia for the whole reporting period and are presented in the following table. For 2015 and 2016 no crude oil input was reported. Therefore emissions in this category did not occur.

Table 110 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	1.216.491	2000	1.043.104	2010	853.000
1991	964.033	2001	1.012.872	2011	705.144
1992	566.701	2002	648.137	2012	259.606
1993	1.018.201	2003	78.749	2013	59.676
1994	143.148	2004	975.262	2014	7.274
1995	119.437	2005	946.747	2015	NO
1996	696.341	2006	1.067.096	2016	NO
1997	379.759	2007	1.050.007	2017	NO
1998	754.775	2008	1.061.736		
1999	765.412	2009	972.532		

Emission factors

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

Table 111 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 North Macedonia for the period 2005-2016[25], and the Industry chapter within the Statistical yearbooks of the Republic of North 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 North Macedonia, for the whole reporting period. The quantity of distributed oil is presented in the following table.

Table 112 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	592.133	2000	394.487	2010	516.450
1991	457.295	2001	959.035	2011	566.686

[25] 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, Makstat database for 2016 data http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef

Year	Distributed oil (Mg)	Year	Distributed oil (Mg)	Year	Distributed oil (Mg)
1992	278.185	2002	178.107	2012	572.365
1993	597.143	2003	338.459	2013	626.447
1994	117.255	2004	383.553	2014	598.267
1995	828.450	2005	402.385	2015	675.630
1996	334.711	2006	409.568	2016	745.722
1997	459.252	2007	454.633	2017	858.093
1998	484.508	2008	456.165		
1999	514.251	2009	447.263		

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

Table 113 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

4.7.3.2. Source-specific uncertainties and time-series consistency

See chapter 3.7.2.1.

4.7.3.3. Source-specific QA/QC and verification

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

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

No recalculations were performed in this category.

4.7.3.5. 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 and 2016 so the emissions in this category are not occurring.

Table 114 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	2016	NO
1997	73	2007	209	2017	NO
1998	146	2008	211		
1999	148	2009	193		

Emission factors

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

Table 115 Emission factors for source category 1B2c Venting and flaring

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

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

Emissions for NH_3, Hg and As were calculated for the period 2005-2017, 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 1998-2016 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 North Macedonia, where it is stated that 1 Gcal = 1,16 $*10^{-3}$ GWh.

Table 116 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	181.751	2010	141.326
1991	NE	2001	269.512	2011	142.551
1992	NE	2002	151.114	2012	122.982
1993	NE	2003	153.373	2013	98.741
1994	NE	2004	136.983	2014	84.884
1995	NE	2005	115.561	2015	78.217
1996	NE	2006	116.846	2016	75.999
1997	NE	2007	124.244	2017	71.177
1998	217.375	2008	115.379		
1999	178.608	2009	141.326		

Emission factors

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

Table 117 Emission factors for source category 1.B.2.d -Other fugitive emissions from energy

Pollutant	Value	Unit	References
NH_3	2.100	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

Emissions in the category 1.B.2.d for the period 2011-2014 were recalucated due to available fiinal energy consumption data in the MAKSTAT database.

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

No planned improvements in this category.

INDUSTRY

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 pollutants (POPs) 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 1990-2017.

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 North 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 118 NFR categories covered in Industrial processes sector for 2017

NFR sector	Completeness
2.A.1 Cement production	√
2.A.2 Lime production	√
2.A.3 Glass production	√
2.A.5.a Quarrying and mining of minerals other than coal	√
2.A.5.b Construction and demolition	√
2.A.5.c Storage. handling and transport of mineral products	√
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	NO
2. B.5.b Storage. handling and transport of chemical products	NO
2.B.7 Soda ash production and use	NE
2.C.1 Iron and steel production	√
2.C.2 Ferroalloys production	√
2.C.3 Aluminum production	√
2.C.4 Magnesium production	NO
2.C.5 Lead production	√
2.C.6 Zinc production	NO

NFR sector	Completeness
2.C.7.a Copper production	√
2.C.7.b Nickel production	NO
2.C.7.c Other metal production	√
2.C.5.d Storage. handling and transport of metal products	NE
2.D.3.a Domestic solvent use including fungicides	√
2.D.3.b Road paving with asphalt	√
2.D.3.c Asphalt roofing	√
2.D.3.d Coating applications	√
2.D.3.e Degrsing	√
2.D.3.f Dry cleaning	√
2.D.3.g Chemical products	√
2.D.3.h Printing	√
2.G Other product use and 2.D.3.i Other solvent use	√
2.H.1 Pulp and paper industry	NO
2.H.2 Food and beverage production industry	√
2.H.2 Other industrial processes	NE
2.I Wood processing	√
2.J Production of POPs	NO
2.K Consuption of POPs and HM	NE
2.L 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 North Macedonia there is only one installation (factory) for cement production "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 119 Activity data for source category 2.A.1 - Cement production

Year	Clinker produced (t)	Year	Clinker produced (t)	Year	Clinker produced (t)
1990	491.900	2000	614.160	2010	588.980
1991	465.380	2001	716.960	2011	687.990
1992	396.500	2002	739.490	2012	645.480
1993	413.440	2003	602.570	2013	577.850
1994	375.910	2004	643.260	2014	518.200
1995	365.120	2005	694.920	2015	553.232
1996	396.020	2006	801.300	2016	739.810
1997	475.250	2007	882.830	2017	735.625
1998	346.870	2008	843.770		
1999	427.080	2009	478.400		

Emission factors

For 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 the table below:

Table 120 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

For calculation (estimation) of emissions for PM2.5, PM10 and TSP for 2016 and 2017 emission factors were taken from GB 2016 (Table 121) with combination of Tier 2, Table 122 were is taken in account the abatement efficiencies

For this calculation was used the following equation:

$EF_{tehnology/abated} = (1 - \eta_{abatement}) \times EF_{tehnology/unabated}$

Table 121 Abatement efficiencies ($\eta_{abatement}$) for source category 2.A.1 Cement production

Abatement technology	Pollutant	Value	References
Additional fabric filters on the oven stack; effective control of fugitive sources	particle > 10 µm	98%	GB 2016 2.A.1 Cement production. Table 3-2. pg. 12
	10 µm > particle > 2.5 µm	80%	GB 2016 2.A.1 Cement production. Table 3-2. pg. 12
	2.5 µm > particle	73%	GB 2016 2.A.1 Cement production. Table 3-2. pg. 12

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 2.7), 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 make recalculation, applying the Tier 2 method, for the previous years, taking into account the abatement technology installed at the cement plant where there is available activity data and established abatement technology.

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, originates from the Statistical Yearbook - Chapter industry, while activity data for the period 2000-2013, was taken from the International Mineral yearbook[26]. No data was 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, 2015, 2016 and 2017 from the Statistical publication Industry in the Republic of North 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	37.452	2000	1.000	2010	2.700
1991	29.194	2001	500	2011	2.700

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

Year	Lime produced (t)	Year	Lime produced (t)	Year	Lime produced (t)
1992	33.872	2002	500	2012	2.700
1993	24.904	2003	500	2013	2.700
1994	14.097	2004	500	2014	10.836
1995	12.538	2005	15.009	2015	8.003
1996	9.707	2006	12.704	2016	8.684
1997	4.344	2007	7.517	2017	1399
1998	964	2008	NE		
1999	4.264	2009	2.713		

Emission factors

For the calculation (estimation) of emissions for PM2.5, PM10 and TSP for the period 1990-2017 emission factors were taken from GB 2016.

These emission factors are given in Table 124 below.

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

Pollutant	Value	Unit	References
PM10	3.500	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	9.000	g/Mg lime	GB 20162.A.2 Lime production, Table 3-1, pg. 8

5.3.2.2. 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.

5.3.2.3. 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.

5.3.2.4. 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, 2015, 2016 and 2017 was used as activity data due to the recommendation given by the MS solvent and industry expert.

5.3.2.5. 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 North 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	2016	NO
1997	NO	2007	NO	2017	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 126 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 2016 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Cd	0.068	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
Hg	0.003	g/Mg glass	GB 2016 2.A.3 Glass production. Table 3-2. Flat glass production pg. 16
As	0.08	g/Mg glass	GB 2016 2 A.3 Glass production. Table 3-2. Flat glass production pg. 16

Pollutant	Value	Unit	References
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	2.739	2000	NO	2010	NO
1991	1.176	2001	NO	2011	NO
1992	1.828	2002	NO	2012	NO
1993	444	2003	NO	2013	NO
1994	1.332	2004	NO	2014	NO
1995	3.043	2005	NO	2015	NO
1996	1.454	2006	NO	2016	NO
1997	961	2007	NO	2017	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 128 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
NH3	1.400	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

5.3.3.2. Source-specific uncertainties and time-series consistency

The activity data uncertainty was estimated to be 10%; the emission factor uncertainty was estimated to be 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.

5.3.3.3. 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.

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

No recalculations were carried out in this category.

5.3.3.5. 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 in 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 2005-2017 are taken from the statistical publication for industry.

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

Year	Mineral produced [t]	Year	Mineral produced [t)]	Year	Mineral produced [t)]
1990	6.117.811	2000	4.917.560	2010	6.845.344
1991	5.730.999	2001	3.488.792	2011	7.105.665
1992	5.299.552	2002	2.855.005	2012	7.039649
1993	5.246.466	2003	739.786	2013	7.779.306
1994	4.817.372	2004	347.795	2014	7.217.928
1995	5.215.134	2005	2.827.908	2015	7.577.091
1996	5.233.110	2006	4.605.478	2016	8.310.640
1997	5.528.418	2007	4.473.612	2017	7.837.715
1998	5.158.798	2008	4.598.850		
1999	4.658.946	2009	3.766.500		

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 130 below.

Table 129 Emission factors for minerals produced for 2.A.5.a 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

5.3.4.2. 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.

5.3.4.3. 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 was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

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

Recalculations were done in this category due to available activity data.

5.3.4.5. 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	1.810.252	2000	897.868	2010	920.066
1991	1.532.878	2001	957.742	2011	958.890
1992	1.375.918	2002	871.894	2012	967.773

Year	m²/year	Year	m²/year	Year	m²/year
1993	1.203.495	2003	952.813	2013	924.887
1994	1.017.799	2004	1.021.573	2014	803.889
1995	949.006	2005	961.766	2015	752.207
1996	927.963	2006	1.016.189	2016	943.400
1997	843.602	2007	892.385	2017	1.130.829
1998	793.938	2008	817.091		
1999	940.300	2009	858.076		
2000	897.868	2010	920.066		

Emission factors

Emission factors for the particulates PM2.5, PM10 and TSP are taken from GB 2016. These emission factors are given in Table 132 below.

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

Pollutant	Value	Unit	References
TSP	0,29	kg/m²/year	GB 2016 2.A.5.b Construction and demolition. Table 3-1. pg. 6
PM10	0,086	kg/m²/year	GB 2016 2.A.5.b Construction and demolition. Table 3-1. pg. 6
PM2.5	0,0086	kg/m²/year	GB 2016 2.A.5.b Construction and demolition. Table 3-1. pg. 6

5.3.5.2. 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.

5.3.5.3. 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 was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

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

No recalculations were carried out in this category.

5.3.5.5. 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 underestimated. 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 2009-2017. 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	246.717	2000	48.708	2010	2.820.746
1991	143.309	2001	575.864	2011	3.330.100
1992	96.043	2002	685.869	2012	3.499.387
1993	152.750	2003	8.006.331	2013	3.407.267
1994	49.973	2004	10.497.726	2014	5.564.332
1995	57.838	2005	8.475.328	2015	4.142.405
1996	34.404	2006	16.441.405	2016	5.034.346
1997	106.462	2007	4.813.390	2017	4.717.295
1998	189.443	2008	1.965.897		
1999	152.301	2009	7.058.289		

Emission factors

For estimation of emissions for particulates, PM2.5, PM10 and TSP, the emission factors were taken from GB 2016. 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	12	g/Mg product	GB 2016 2.A.5.c Storage handling and transport of mineral products. Table 3-4. pg. 7
PM10	6	g/Mg product	GB 2016 2.A.5.c Storage handling and transport of mineral products. Table 3-4. pg. 7
PM2.5	0.6	g/Mg product	GB 2016 2.A.5.c Storage handling and transport of mineral products. Table 3-4. pg. 7

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

Recalculations were carried out in this category using new emission factors from Guidebook 2016 given in Table 134.

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.
- 2.B.7 – Soda ash production

In the inventory, these are reported as NO due to the fact that in North Macedonia this kind of production does not exist. Regarding Soda ash production this category is defined as NE since the process should be checked

The NFR categories: 2.B.5.a - Other chemical industry and 2.B.5.b - 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 North 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 North 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 North 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 North Macedonia 2002-2015. Activity data for 2016 and 2017 are taken directly from the two installations mentioned above.

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

Year	Products [t]	Year	Products [t]	Year	Products [t]
1990	885.015	2000	437.934	2010	759.924
1991	755.634	2001	583.379	2011	862.827
1992	548.462	2002	960.178	2012	564.054
1993	353.822	2003	760.538	2013	363.887
1994	140.045	2004	833.328	2014	498.459
1995	83.407	2005	807.782	2015	466.847
1996	128.117	2006	905.272	2016	613.479
1997	230.274	2007	982.650	2017	742.976
1998	347.846	2008	766.310		
1999	237.409	2009	705.567		

Table 135 Activity data for steel and hot and cold ingots production in 2016 and 2017

Year	Name of Products	[t]
2016	Liquid steel	173.113
	Hot rolled sheet	274.721
	Cold rolled sheet	165.645
2017	Liquid steel	277.599
	Hot rolled sheet	310.840
	Cold rolled sheet	154.537

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

Pollutant	Value	Unit	References
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
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

5.5.1.2. 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.

5.5.1.3. 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.

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

No recalculations were carried out in this category.

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

Use of tier 2 for historical year will be taken into account in the next reporting round.

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: ferrosilicon, ferronickel and ferrosilicon manganese. The installation “Skopski Leguri” produces ferrosilicon manganese, and was operational in the period 2007 – 2012. “Jugohrom ALZAR DOOEL” produces ferrosilicon and EURONIKEL (FENI) INDUSTRY produces ferronickel.

“Jugohrom ALZAR DOOEL” is one of the biggest industrial polluters in Republic of North Macedonia. Jugohrom installed a filter facility for gas uptake 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 North 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, in November 2016, with an approval of the Ministry of environment and physical planning. The installation remains closed until the requirement for installation of filter facility is not fulfilled. In 2017 there is no ferroalloys production from this installation.

FENI Industry is one of the biggest installation in the sector Ferroalloys Production (ferronickel 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 installation worked with reduced capacity of around 40% compared to 2015. This installation is under bankruptcy proceedings from 2017.

This sector significantly contributes to the national total amount of emission of particulates untill 2016.

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 2005–2016, while data for ferronickel for the period 2005-2017 was reported by the operator. Activity data for 2017 for ferroalloys production are taken directly from the installation FENI Industry. Other installation Jugohrom ALZAR DOOEL (ferrosilicon production) didn’t work in 2017, so the total activity data from ferroalloays production are coming only from FENI Industry (ferronickel production).

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	85.148	2000	58.520	2010	133.347
1991	77.442	2001	8.779	2011	184.310
1992	107.866	2002	15.085	2012	146.970
1993	78.357	2003	67.283	2013	165.803
1994	72.134	2004	83.160	2014	163.489
1995	72.735	2005	106.590	2015	130.970
1996	92.638	2006	108.920	2016	69.455
1997	85.908	2007	175.719	2017	34.558
1998	106.661	2008	170.252		
1999	78.009	2009	60.458		

Emission factors

For calculation of PM2.5, PM10 and TSP from 1990 to 2011 as well as 2015 coming from ferronickel and ferrosilicon manganese production, GB 2016 emission factors have been used.

Table 140 Emission factors for source category 2.C.2 - Ferroalloys production – production of ferronickel for historical data

Pollutant	Value	Unit	References
PM10	850	g/Mg alloy produced	GB 2016 Table 3.1 Tier 1 emission factors for source category 2.C.2 Ferroalloys production
PM2.5	600	g/Mg alloy produced	GB 2016 Table 3.1 Tier 1 emission factors for source category 2.C.2 Ferroalloys production
TSP	1000	g/Mg alloy produced	GB 2016 Table 3.1 Tier 1 emission factors for source category 2.C.2 Ferroalloys production
BC	10	% PM2.5	GB 2016 Table 3.1 Tier 1 emission factors for source category 2.C.2 Ferroalloys production

For the estimation of emissions coming from the ferrosilicon production, due to the huge difference of the calculated emissions with the use of EF and emission measurements data, as well as no implementation of BAT in this installation, implied EF for TSP has been used, while EF for PM10 and PM2.5 have been calculated as 0,85% and 0,60% of TSP Emission factor value. These emission factors are presented in the following table.

Table 141 Implied emission factors for 2.C.2 Ferroalloys production – production of ferrosilicon for historical data

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

Emission measurements

For the period 2012-2014, 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 142 above. For 2015, since no measurements were delivered by the company, TSP, PM10 and PM2,5 emissions coming from ferrosilicon production were calculated using the emission factors presented in Table 142. For 2016, there were available measurement data for TSP by the operator, as well as, activity data for ferrosilicon produced. The emissions of PM10 and PM2.5 were calculated using the values using proportions (0,85% and 0,60% of TSP emissions factor value).

5.5.2.2. 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.

5.5.2.3. 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. 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.

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

No recalculations were carried out in this category.

5.5.2.5. 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 North Macedonia, there is no primary aluminum production.

5.5.3.1. Methodological Issues

Activity Data

The activity data were taken from the Statistical Yearbooks 1990-2016. 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 – 2017	Sum of unwrought aluminum, alloyed in ingot
	Aluminum alloyed bars, rods, profiles
	Aluminum tubes and pipes, non-alloyed

Table 142 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	8.841	2000	7.641	2010	1.880
1991	7.829	2001	6.809	2011	1.953
1992	5.150	2002	10.516	2012	1.424
1993	4.819	2003	8.573	2013	1.280
1994	4.991	2004	1.679	2014	952
1995	3.709	2005	1.489	2015	879
1996	3.924	2006	2.316	2016	1.075

Year	Aluminum and aluminum products [t]	Year	Aluminum and aluminum products [t]	Year	Aluminum and aluminum products [t]
1997	5.561	2007	2.005	2017	1306
1998	5.850	2008	2.053		
1999	10.777	2009	1.457		

Emission factors

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

Table 143 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
BC	2,3	% of PM2.5	GB 2016 2.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

5.5.3.2. 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.

5.5.3.3. 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.

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

No recalculations were carried out in this category.

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

It is planned MEPP to discuss with The State Statistical Office the possibility for this institution to start collecting data on the quantity of secondary aluminium produced.

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 144 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	28.585*	21.858*	2004	NO	3.591****
1991	33.938*	19.265*	2005	NO	34*****
1992	27.860*	23.341*	2006	NO	46*****
1993	23.575*	21.881*	2007	NO	18*****
1994	20.569*	20.965*	2008	NO	21*****
1995	24.007*	22.490*	2009	NO	39*****
1996	29.259*	23.584*	2010	NO	NE
1997	30.508*	26.046*	2011	NO	NE
1998	29.242*	28.415*	2012	NO	NE
1999	27.086*	19.738*	2013	NO	NE
2000	19.000**	17.137***	2014	NO	NE
2001	19.000**	13.543***	2015	NO	2648
2002	19.000**	11.934****	2016	NO	4472
2003	19.000**	6.357****	2017	NO	7486

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
****Statistical 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 145 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

Pollutant	Value	Unit	References
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 146 Emission factors for source category 2.C.5 - Secondary Lead production

Pollutant	Value	Unit	References
TSP	20	g/Mg lead	GB 2016 2.C.5.b Lead production. Table 3-5. pg. 17
PM10	16	g/Mg lead	GB 2016 2.C.5.b Lead production. Table 3-5. pg. 17
PM2.5	8	g/Mg lead	GB 2016 2.C.5.b Lead production. Table 3-5. pg. 17
Pb	2,6	g/Mg lead	GB 2016 2.C.5.b Lead production. Table 3-5. pg. 17
Cd	0,02	g/Mg lead	GB 2016 2.C.5.b Lead production. Table 3-5. pg. 17
As	0,3	g/Mg lead	GB 2016 2.C.5.b Lead production. Table 3-5. pg. 17
Zn	0,05	g/Mg lead	GB 2016 2.C.5.b Lead production. Table 3-5. pg. 17
PCBs	2,6	g/Mg lead	GB 2016 2.C.5.b Lead production. Table 3-5. pg. 17
PCDD/F	3,2	µg I-TEQ/Mg lead	GB 2016 2.C.5.b Lead production. Table 3-5. pg. 17

5.5.4.2. 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.

5.5.4.3. 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.

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

Recalculations were carried out in this category due to using emission factors from Guidebook 2016 for Lead production – secondary lead production for the period 2015 - 2017.

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

MEPP will further discuss 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 1990-2017*, 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 147 Activity data for source category 2.C.6 - Zinc production

Year	Primary Zinc (t)	Secondary zinc (t)	Year	Primary Zinc (t)
1990	56.734*	17.383*	2004	25.000**
1991	56.081*	17.244*	2005	NO
1992	52.728*	14.526*	2006	NO
1993	51.931*	3.315*	2007	NO
1994	41.984*	4.532*	2008	NO
1995	44.081*	34.526*	2009	NO
1996	59.416*	37.853*	2010	NO
1997	59.693*	3.116*	2011	NO
1998	58.865*	8.594*	2012	NO
1999	53.304*	4.017*	2013	NO
2000	52.000**	NO	2014	NO
2001	52.000**	NO	2015	NO
2002	56.000**	NO	2016	NO
2003	28.000**		2017	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 148 Emission factors for source category 2.C.6 - Primary Zinc production

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

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

Pollutant	Value	Unit	References
TSP	80	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
PM10	65	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12
PM2.5	50	g/Mg zinc	GB 2013 2.C.6 Zinc production. Table 3.2. pg. 12

Pollutant	Value	Unit	References
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

5.5.5.2. 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.

5.5.5.3. 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.

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

No recalculations were carried out in this category.

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

No improvements are planned in this category.

5.5.6. Copper production –NFR 2.C.7 a

Copper is produced from primary and secondary raw materials.

Primary cooper is produced from concentrates produced from copper ores. The pyrometallurgical copper production route entails a number of steps, depending on the concentrate used. The majority of concentrates are sulphidic and the stages involved are roasting, smelting, converting, refining and electro-refining. Concentrates usually contain 20–30% Cu. In roasting, charge material of copper mixed with a siliceous flux is heated in air to about 650 °C, eliminating 20–50% of sulphur and portions of volatile trace elements. The roasted product, calcine, serves as a dried and heated charge for the smelting furnace.

In Republic of North Macedonia there is a primary production of copper with pampering of copper ores for obtaining cathode copper.

A secondary copper smelter is defined as any plant or factory in which copper-bearing scrap or copper-bearing materials, other than copper-bearing concentrates (ores) derived from a mining operation, is processed by metallurgical or chemical process into refined copper and copper powder (a premium product).

5.5.6.1. Methodological Issues

Activity Data

There are activity data for primary copper production (from in the Statistical yearbook – chapter Industry), for the period 2012-2017.

Table 150 Activity data for source category 2.C.7 a - Copper production

Year	Primary copper (t)	Secondary copper (t)	Year	Primary copper (t)
1990	NO	NO	2004	NO
1991	NO	NO	2005	NO
1992	NO	NO	2006	NO
1993	NO	NO	2007	NO
1994	NO	NO	2008	NO
1995	NO	NO	2009	NO
1996	NO	NO	2010	NO
1997	NO	NO	2011	NO
1998	NO	NO	2012	1180
1999	NO	NO	2013	1878
2000	NO	NO	2014	1741
2001	NO	NO	2015	2268
2002	NO	NO	2016	1397
2003	NO	NO	2017	958

Emission factors

Emission factors for senondary copper production are taken from GB 2016. These emission factors are presented in the following table.

Table 151 Emission factors for source category 2.C.6 - Secondary Copper production

Pollutant	Value	Unit	References
TSP	320	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
PM10	250	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
PM2.5	190	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
BC	0,1	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
SOx	1320	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
Pb	24	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
Cd	2,3	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
As	2	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
Cu	28	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
Ni	0,13	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
PCBs	3,7	g/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13
PCDD/F	50	µg I-TEQ/Mg copper	GB 2016 2.C.7.a Copper production. Tier 2. Table 3.3. pg. 13

5.5.6.2. 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.

5.5.6.3. 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.

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

Recalculation were carried out in this category due to new activity data for copper production in the period od 2012-2017.

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

It is planned in this category to make control are the activity data from copper production in Republic of North Macedonia is covered with primary or secondary copper production given in EMEP/EEA air pollutant emission inventory guidebook 2016, 2.C.7.a Copper production.

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

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

5.5.7.1. 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 152 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 153 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

5.5.7.2. Source-specific uncertainties and time-series consistency

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

5.5.7.3. 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 North Macedonia.

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

No recalculations were carried out in this category.

5.5.7.5. 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 2017 was 7,5%.

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)[27]. It should be emphasized that the last census in the country was carried out in 2002, and therefore the data for the period 2003-2017 are estimated population numbers.

Table 154 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	2.028.000	2000	2.026.350	2010	2.055.044
1991	2.033.964	2001	2.034.882	2011	2.058.539
1992	2.056.000	2002	2.020.547	2012	2.061.044
1993	2.066.000	2003	2.026.773	2013	2.064.032
1994	1.945.932	2004	2.032.544	2014	2.069.172
1995	1.966.000	2005	2.036.855	2015	2.071.278
1996	1.983.000	2006	2.040.228	2016	2.073.702
1997	1.996.869	2007	2.043.559	2017	2.075.301
1998	2.007.523	2008	2.046.898		
1999	2.017.142	2009	2.050.671		

Emission factors

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

Table 155 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

[27] 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

5.6.1.2. 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.

5.6.1.3. 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.

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

No recalculations were carried out in this category.

5.6.1.5. 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 2017 is 0,03% and in TSP is 24%. 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 several asphalt production companies in 2016 delivered data on produced asphalt. For 2017 Activity data are taken from Statistical yearbook – Chapter Construction. 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 156 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	86.320	2000	327.937	2010	274.654
1991	74.296	2001	137.305	2011	356.596
1992	44.067	2002	119.651	2012	336.725
1993	65.194	2003	124.492	2013	389.163
1994	84.729	2004	149.323	2014	336.545
1995	87.814	2005	180.559	2015	305.856
1996	98.545	2006	130.847	2016	366.536
1997	53.600	2007	101.508	2017	461.664
1998	101.563	2008	170.049		
1999	136.540	2009	232.001		

Emission factors

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

Table 157 Emission factors for source category 2.D.3.b - Road paving with asphalt

Pollutant	Value	Unit	References
NMVOC	16	g/Mg asphalt	GB 2016 2.D.3.b Road paving with asphalt. Table 3.1. pg. 8
TSP	14.000	g/Mg asphalt	GB 2016 2.D.3.b Road paving with asphalt. Table 3.1. pg. 8
PM10	3.000	g/Mg asphalt	GB 2016 2.D.3.b Road paving with asphalt. Table 3.1. pg. 8
PM2.5	400	g/Mg asphalt	GB 2016 2.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

Untill now 2016 the activity data for asphalt produced are collected directly from the asphalt production installations. For 2017 Activity data are taken from Statistical yearbook – Chapter Construction.

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 2017.

5.6.3.1. Methodological issues

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

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

where:

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

$AR_{prodution}$ = the activity rate (data) for the 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 2005-20162017, activity data have been taken from Statistical Yearbooks – Chapter Industrythe 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 158 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	12.572	2000*	13.075	2010	14.908
1991	12.593	2001*	12.525	2011	25.145
1992	5.325	2002*	12.104	2012	17.727
1993	4.067	2003*	11.668	2013	13.676
1994	5.901	2004*	12.458	2014	6.922
1995	8.873	2005	11.305	2015	10.146
1996	5.992	2006	9.773	2016	14.402
1997	6.442	2007	9.998	2017	15.183

Year	Asphalt roofing products (t)	Year	Asphalt roofing products (t)	Year	Asphalt roofing products (t)
1998	5.489	2008	9.489		
1999	13.429	2009	16.407		

*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 2005-2017 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 2005-2017

1990 – 1999 Roof patch, Bitumen paper and jute;

Bituminous products for building;

2005 – 2016 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;

Tar or other bituminous materials;

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 159 Emission factors for source category 2.D.3.c - Road paving with asphalt

Pollutant	Value	Unit	References
CO	9,5	g/Mg shingle	GB 2016 2.D.3.c Asphalt roofing. Table 3.1. pg. 7
NMVOC	130	g/Mg shingle	GB 2016 2.D.3.c Asphalt roofing. Table 3.1. pg. 7
TSP	1.600	g/Mg shingle	GB 2016 2.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

5.6.3.2. Source-specific uncertainties and time-series consistency

No specific 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.

5.6.3.3. 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.

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

Recalculations were done in this sector for the period 2010-2016 due to adding of new activity data (tar or other bituminous materials).

5.6.3.5. 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 North 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 0,125% in 2017 where the imported paints is taken into account.

5.6.4.1. Methodological Issues

The methodology of the estimation of emisions in this sector was done by use of Croatian methodology[28]. Namely according to this methodology sectors Industrial application and Decorative application contribute in paints consumption with equal weighting as sector Other industrial application. When took into account all previously mentioned, the application of paint in the industry present about 33% of the paint produced in North Macedonia, and the same proportion was allocated the two other sectors. As a result, each sub-sector contributes with 33.3% to the total application of paint. At the end, the total amount of the paint produced in North Macedonia was distributed by the present methodology and resulting amounts of paint in each sub-sector were multiplied by the recommended FE (NMVOC) from the EMEP / EEA Guidebook – 2016.

Activity data

The quantity of paint produced in the period 2005-2015 is taken from the publications Industry in the Republic of North Macedonia, for 2016 and 2017 production data were taken form the MAKSTAT database, and the data for the imported-exported paints are taken from the publication External trade in the Republic of North Macedonia for the period 2006-2015[29]. For the year 2016 and 2017, only data on produced paint were available for use.

Table 160 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	5.039.128	5.039.128	5.039.128
1991	4.595.330	4.595.330	4.595.330

[28] The Republic of Croatia Informative Inventory Report for 2010, Zagreb, March 2012

[29] 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;

Year	Industrial application	Decorative application	Other industrial application
	Paint [kg]	Paint [kg]	Paint [kg]
1992	4.309.611	4.309.611	4.309.611
1993	4.044.373	4.044.373	4.044.373
1994	3.671.095	3.671.095	3.671.095
1995	3.416.632	3.416.632	3.416.632
1996	3.608.965	3.608.965	3.608.965
1997	3.687.358	3.687.358	3.687.358
1998	3.771.334	3.771.334	3.771.334
1999	3.651.404	3.651.404	3.651.404
2000	3.739.061	3.739.061	3.739.061
2001	3.745.437	3.745.437	3.745.437
2002	3.728.881	3.728.881	3.728.881
2003	3.800.742	3.800.742	3.800.742
2004	3.683.217	3.683.217	3.683.217
2005	2.022.667	2.022.667	2.022.667
2006	3.388.000	3.388.000	3.388.000
2007	3.828.333	3.828.333	3.828.333
2008	3.926.667	3.926.667	3.926.667
2009	2.998.667	2.998.667	2.998.667
2010	3.287.000	3.287.000	3.287.000
2011	3.750.580	3.750.580	3.750.580
2012	4.516.084	4.516.084	4.516.084
2013	4.365.688	4.365.688	4.365.688
2014	4.273.947	4.273.947	4.273.947
2015	4.372.150	4.372.150	4.372.150
2016	4.077.318	4.077.318	4.077.318
2017	3.571.937	3.571.937	3.571.937

Emission factors

Emission factors for Tier 1 method from GB 2016 are presented in the following table:

Table 161 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 2016 Table 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 2016 Table 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 2016 Table 3-3 Tier 1 emission factors for source category 2.D.3.d Other coating application

5.6.4.2. Source-specific uncertainties and time-series consistency

No specific uncertainty analysis was done for this category.

5.6.4.3. 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 was checked for completeness and for consistency between the calculation files, NFR tables and the IIR.

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

Recalculations were done due to available activity data.

Recalculations in this category were done for all reporting period, due to the change of methodology

5.6.4.5. 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.

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 2007-2017.

Emission factors

Emission factor for the calculation of NMVOC emissions is presented below.

Table 162 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[30] which refers to GB 2006

[30] The Republic of Serbia Informative Inventory Report to LRTAP Convention, Belgrade, 2012

5.6.5.2. 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.

5.6.5.3. 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.

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

No recalculations were made in this category.

5.6.5.5. 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_North_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.

Table 163 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

5.6.6.2. 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.

5.6.6.3. 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.

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

No recalculations were done in this reporting round.

5.6.6.5. 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[31], 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. Additionally, MEPP will try to gather data on amount of treated textile in dry cleaning shops due to high uncertainty of current calculation of emissions by use of population number.

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:

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

$EF_{tehnology,pollutants}$ = the emission factor for this technology and this pollutants.

[31] https://en.wikipedia.org/wiki/Demographics_of_the_Republic_of_Macedonia

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 North Macedonia for the period 2005-2016. The activity data are presented in the following table.

Table 164 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	16.450.000	NO	NO	6.638.000	NO	NO	NO
1991	12.440.000	NO	NO	4.049.000	NO	NO	NO
1992	11.150.000	NO	364.000	3.667.000	10.797.000	NO	1.355.000
1993	4.466.000	NO	382.000	2.308.000	10.197.000	NO	1.145.000
1994	8.628.000	NO	455.000	1.529.000	9.177.000	NO	978.000
1995	9.904.000	NO	378.500*	1.122.000	10.119.500*	NO	680.500*
1996	3.212.000	NO	302.000	1.231.000	11.062.000	NO	383.000
1997	3.820.000	NO	363.000	1.509.000	7.491.000	NO	371.000
1998	2.642.000	NO	547.000	1.790.000	4.908.000	NO	417.000
1999	NO	NO	NO	2.488.000	NE	NO	NO
2000	NO	NO	NO	2.129.000	NE	NO	NO
2001	NO	NO	NO	1.073.000	NE	NO	NO
2002	NO	NO	NO	1.521.000	NE	NO	NO
2003	NO	NO	NO	1.799.000	NE	NO	NO
2004	NO	NO	NO	1.785.000	NE	NO	NO
2005	NO	1.095.000	NO	1.540.000	NE	6.068.000	NO
2006	NO	1.405.000	NO	1.739.000	NE	5.252.000	NO
2007	NO	1.129.000	NO	1.949.000	NE	4.982.000	NO
2008	NO	1.239.000	NO	2.196.000	NE	4.604.000	NO
2009	NO	1.133.000	NO	3.074.000	NE	3.972.000	NO
2010	NO	1.033.000	NO	3.090.000	3.000	5.407.000	NO
2011	NO	1.059.000	NO	3.104.000	9.000	2.834.000	NO
2012	NO	1.221.000	NO	3.047.000	9.000	1.914.000	NO
2013	NO	1.166.000	NO	4.631.000	11.000	1.306.000	NO
2014	NO	697.000	NO	5.096.000	14.000	817.000	NO
2015	NO	NO	NO	3.968.000	24.000	991.000	NO
2016	NO	896.000	NO	4.253.000	10.000	891.000	NO
2017	NO	1.633.000	NO	3.815.000	11.000	768.000	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 2016 for different types of activities. The emission factors are presented in the following table.

Table 165 Emission factors for source category 2.D.3.g - Chemical Products

Pollutant	Value	Unit	References
NMVOC	50	g/kg polyester monomer used	GB 2016 2.D.3.g Chemical products. Table 3-2. pg. 17
NMVOC	120	g/kg polyurethane foam processed	GB 2016 2.D.3.g Chemical products. Table 3-3. pg. 17
NMVOC	60	g/kg polystyrene	GB 2016 2.D.3.g Chemical products. Table 3-4. pg. 18
NMVOC	8	g/kg rubber produced	GB 2016 2.D.3.g Chemical products. Table 3-5. pg. 18
NMVOC	11	g/kg products (paints. inks. glues)	GB 2016 2.D.3.g Chemical products. Table 3-11. pg. 21
NMVOC	0,045	kg/pairs of shoes	GB 2016 2.D.3.g Chemical products. Table 3-13. pg. 22
NH3	0,68	g/kg raw hid (leather tanning)	GB 2016 2.D.3.g Chemical products. Table 3-14. pg. 23

5.6.7.2. 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.

5.6.7.3. 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.

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

Recalculations were done in this sector for the period 2010-2017 due to changing of activity data (polyurethane foam processing, shoes manufacturing, paint, ink and glues production and leather tanning).

5.6.7.5. 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 and Pharmaceutical products manufacturing) and report emissions in the following submissions.

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 1990-2017, 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 166 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

5.6.8.2. Source-specific uncertainties and time-series consistency

No source specific uncertainty was done for this sector.

5.6.8.3. 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.

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

No recalculations were done in the sector.

5.6.8.5. 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 North Macedonia”, for the period 2005-2016. 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 167 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 North Macedonia (2005-2017)

Year	Tobacco	Creosote	Fat, edible and non-edible oil extraction-seed	Pairs of shoes
1990	26.481	261.440	38.303	6.638.000
1991	16.576	209.583	39.190	4.049.000
1992	22.297	241.980	32.975	3.667.000
1993	25.964	197.934	30.218	2.308.000
1994	21.143	163.377	47.598	1.529.000
1995	16.152	123.016	30.990	1.122.000
1996	13.980	82.013	54.763	1.231.000
1997	14.904	55.388	52.515	1.509.000
1998	23.297	47.551	47.063	1.790.000
1999	29.005	43.522	28.165	2.488.000
2000	18.991	38.073	39.048	2.129.000
2001	26.110	127.308	38.388	1.073.000
2002	20.547	100.054	71.910	1.521.000
2003	25.689	111.090	64.698	1.799.000
2004	15.317	158.732	61.148	1.590.000
2005	2.721	86.241	59.138	1.892.504
2006	1.881	78.125	63.578	2.121.404
2007	1.040	68.738	61.973	2.320.371
2008	4.366	53.457	76.303	3.142.440
2009	4.893	11.184	75.020	2.957.658
2010	10413	58.775	78.368	3.408.829
2011	10.138	54.654	82.848	3.388.013
2012	3.151	144.749	80.805	1.599.026
2013	6.365	113.177	77.008	3.876.229
2014	11.133	82.300	83.258	4.381.143
2015	9.904	106.723	102.678	4.355.002
2016	6.425	83.275	101.118	3.876.436
2017	6.054	78.150	65.370	1.599.026

Emission factors

The Emission factors have been taken from GB 2016 and are presented in the following table.

Table 168 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
NH3	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
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

Pollutant	Activity	Value	Unit	References
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
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

5.6.9.2. 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.

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

Based on the recommendation given by the MS solvent ekspert stipulated in the Twining mission report 24/2016, expert activity data on use of shoes and use of tobacco has been recalculated for the period 2004-2015, bearing in mind that the import and export data should be taken into account. Additionally emissions from creosote were recalculated due to the recommendtaions given in the same report.

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

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.

<u>Activity Data</u>

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 North Macedonia for the period 2005-2017. 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. Also for 2016 and 2017 are taken into account activity data for roasted coffee. The activity data is presented in the following table.

Table 169 Activity data for source category 2.H.2 - Food and beverage industry (Source Statistical yearbook (year) (1990-2004) and Industry in the Republic of North Macedonia (2005-2017)

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	Coffee /t
1990	13.100	958.224	1.296.900	180.625	1.972	13.904	11.855	13.063	102.392	NE
1991	16.165	928.043	1.572.000	167.137	1.972	8.624	10.921	13.328	86.892	NE
1992	21.708	860.843	2.111.000	140.320	1.972	8.140	8.121	15.112	99.149	NE
1993	21.708	951.854	2.274.000	143.034	1.972	6.677	7.128	12.602	85.379	NE
1994	23.710	724.974	2.347.290	126.146	1.972	6.351	33.787	12.583	85.014	NE
1995	26.920	620.201	2.665.080	126.583	1.972	7.205	29.375	12.308	84.901	NE
1996	40.040	622.223	3.963.960	130.248	1.972	17.993	29.368	11.824	84.382	NE
1997	31.800	600.092	3.148.200	105.754	1.972	35.183	27.800	11.426	83.817	NE
1998	24.790	578.212	2.454.210	97.947	1.972	40.354	25.971	11.657	82.740	NE
1999	30.070	652.165	2.976.930	97.946	1.972	43.039	26.512	12.296	81.184	NE
2000	27.820	659.829	2.754.180	97.995	1.972	31.923	27.470	11.408	78.632	NE
2001	43.900	622.181	4.346.100	75.003	1.972	18.004	26.041	10.995	74.689	NE
2002	37.960	637.894	3.758.040	68.382	1.972	36.614	27.471	10.828	68.425	NE
2003	28.350	680.217	2.806.650	61.474	1.972	33.334	29.835	10.454	58.606	NE
2004	12.424	717.496	516.000	55.235	1.972	27.810	29.839	10.113	43.115	NE
2005	10.548	675.325	948.489	77.025	1.734	36.815	28.264	8.051	45.654	NE
2006	11.831	669.648	703.005	73.497	1.903	19.325	28.041	8.030	44.774	NE
2007	11.237	695.140	613.188	80.137	1.916	35.927	27.228	10.998	54.757	NE
2008	7.929	702.382	984.684	54.873	1.877	43.731	25.065	14.048	50.408	NE
2009	6.652	635.926	1.133.998	46.104	1.877	23.472	25.362	14.678	47.272	NE
2010	11.284	631.371	1.060.716	72.434	2.387	37.998	28.644	25.419	62.492	4.338
2011	7.442	611.836	1.216.737	77.183	2.340	30.423	30.722	25.548	67.518	4.185
2012	10.341	633.621	1.047.797	62.695	2.228	21.414	35.473	30.144	68.723	4.214
2013	11.548	617.124	1.274.972	46.983	2.433	22.916	35.686	31.181	60.127	4.405
2014	9.847	640.948	789.816	47.553	2.339	12.085	32.155	31.150	62.919	3.894
2015	10.848	656.672	1.095.692	45.542	2.328	NO	31.278	39.532	63.808	4.160
2016	12.481	672.487	1.053.303	40.563	2.118	NO	32.125	36.303	64.751	4.609
2017	11.582	705.497	657.227	48.348	2.374	NO	30.706	36.374	59.968	4.239

Emission factors

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

Table 170 Emission factors for source category 2.H.2 - Food and beverages industry

Pollutant	Value	Unit	References
NMVOC	15	kg/hL alcohol(spirits)	GB 2016 2.H.2 Food and beverages industry. Table 3-27. pg. 22
NMVOC	35	g/hL beer	GB 2016 2.H.2 Food and beverages industry. Table 3-26. pg. 22

Pollutant	Value	Unit	References
NMVOC	80	g/hL wine	GB 2016 2.H.2 Food and beverages industry. Table 3-23. pg. 20
NMVOC	1	kg/Mg animal feed	GB 2016 2.H.2 Food and beverages industry. Table 3-21. pg. 19
NMVOC	10	kg/Mg product (Margarine and solid cooking fats)	GB 2016 2.H.2 Food and beverages industry. Table 3-20. pg. 19
NMVOC	10	kg/Mg sugar	GB 2016 2.H.2 Food and beverages industry. Table 3-19. pg. 18
NMVOC	0.3	kg/Mg product (meat, fish and poultry)	GB 2016 2.H.2 Food and beverages industry. Table 3-18. pg. 18
NMVOC	1	kg/Mg product (cakes, biscuits and breakfast cereals)	GB 2016 2.H.2 Food and beverages industry. Table 3-17. pg. 17
NMVOC	4.5	kg/Mg bread	GB 2016 2.H.2 Food and beverages industry. Table 3-10. pg. 14
NMVOC	0.55	kg/Mg beans (roasted coffee)	GB 2016 2.H.2 Food and beverages industry. Table 3-22. pg. 20

5.6.10.2. 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.

5.6.10.3. 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.

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

Recalculations were done in this sector for the period 2010-2017 due to changing of activity data taken from Statistical yearbooks – Sector Industry 2010-2017.

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

It is planned to make recalculation for historical data using the available activity data on coffee roasting and on wine production if data on wine production are recived by the wine production assosiations.

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.

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 North Macedonia for the period 1990-2017 and the publication Industry in the Republic of North Macedonia for the period 2005-2017.

Table 171 Activity data for source category 2.I - Wood processing

Year	Wood processed [Mg]	Year	Wood processed [Mg]	Year	Wood processed [Mg]
1990	66.889	2000	18.173	2010	14.225
1991	52.422	2001	16.882	2011	11.986
1992	46.790	2002	10.015	2012	19.251
1993	44.454	2003	19.913	2013	14.211
1994	40.402	2004	24.263	2014	14.414
1995	29.144	2005	15.509	2015	11.496
1996	27.210	2006	21.866	2016	10.098
1997	23.188	2007	15.173	2017	10.660
1998	17.048	2008	12.863		
1999	22.568	2009	4.429		

Emission factors

Emission factor for estimation of TSP have been taken from GB 2016 and they are presented in the table below.

Table 172 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

5.6.11.2. Source-specific uncertainties and time-series consistency

No source specific uncertainty was done for this sector.

5.6.11.3. 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.

5.6.11.4. 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 2007-2015, 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.

5.6.11.5. 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 for period 1990-2006 will be carried out because currently the emissions in this sector are overestimated.

AGRICULTURE

6. AGRICULTURE (NFR 3)

6.1. Sector overview

The Agriculture sector is a major source category for ammonia emissions. 89% 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 2017 are presented, which are not included in this sector and for which appropriate notation keys are used.

Table 173 NFR categories covered in Agriculture sector for 1990-2017

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

NFR category	Completeness
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
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 North Macedonia. No additional animal categories are relevant for North 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, North 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 and MAKSTAT database for activity data for 2016[32]. The numbers per livestock category are presented in Table 176. Number of different categories of poultry are presented in Table 172.

Table 174 Domestic livestock population and its trend 1990–2017

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

[32] State Statistical Office of the Republic of Macedonia, Livestock, 2007-2015, http://www.stat.gov.mk/PrikaziPoslednaPublikacija.aspx?id=6, http://makstat.stat.gov.mk/PXWeb/pxweb/en/MakStat/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef;

Year	Dairy	Non-diary	Total Swine	Fattening pigs	Sows	Sheep	Goats	Horses
1992	121.097	165.001	173.006	147.479	25.527	2.351.408	238.027	64.576
1993	121.614	159.835	184.920	151.605	33.315	2.458.648	230.589	61.748
1994	122.006	160.351	171.571	138.809	32.762	2.466.099	223.151	61.797
1995	122.419	161.835	175.063	143.672	31.391	2.319.905	215.712	61.733
1996	129.223	166.403	192.396	161.365	31.031	1.813.895	208.274	66.479
1997	130.519	159.817	184.293	148.802	35.491	1.631.034	200.836	65.869
1998	122.551	145.807	196.838	164.150	32.688	1.315.176	193.397	59.847
1999	126.536	144.336	226.047	190.933	35.114	1.288.733	185.959	57.152
2000	126.371	139.229	204.135	173.006	31.129	1.250.686	178.520	56.486
2001	128.218	137.653	189.293	160.794	28.499	1.285.099	171.082	45.638
2002	127.135	132.437	196.223	164.056	32.167	1.233.830	163.644	41.775
2003	118.325	142.217	179.050	143.557	35.493	1.239.330	156.205	42.883
2004	118.872	136.496	158.231	131.992	26.239	1.432.369	148.767	40.391
2005	115.485	133.174	155.753	128.940	26.813	1.244.000	141.329	39.651
2006	120.682	135.157	167.116	137.102	30.014	1.248.801	133.890	40.553
2007	121.005	132.761	255.146	209.641	45.505	817.536	126.452	31.065
2008	125.004	128.469	246.874	210.106	36.768	816.604	133.017	30.936
2009	109.858	142.662	193.840	164.796	29.044	755.356	94.017	29.418
2010	119.060	140.827	190.552	161.346	29.206	778.404	75.708	26.658
2011	136.926	128.373	196.570	171.412	25.158	766.631	72.777	25.415
2012	123.392	127.848	176.920	152.256	24.664	732.338	63.585	21.676
2013	128.677	109.656	167.492	140.768	26.724	731.828	75.028	20.682
2014	126.762	114.845	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
2016	125.243	129.525	202.758	174.087	28.671	723.295	101.669	19.263
2017	122.604	132.432	202.197	175.623	26.574	724.555	107.466	17.951
Trend 1990-2017	***0%***	***-20%***	***13%***	***14%***	***10%***	***-68%***	***-58%***	***-73%***

Table 175 Domestic polutry and its trend 1990–2017

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

Year	Laying hens	Broilers	Livestock category – Population size [heads] *				
			Ducks	Geese	Turkeys	Total Poultry
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
2016	1.705.948	97.322	25.416	10.829	26.254	1.865.769
2017	1.770.504	20.456	27.257	8.782	13.174	1.840.173
Trend 1990–2017	***-68%***	***-80%***	***-54%***	***-42%***	***-65%***	***-68%***

Official data sets of the period 1990–2006 and from 2007 onwards are not fully consistent. In 2007, a new census was introduced[33], 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 annual animal accountings in the years between are based on samples of about 5.000 farms. The total farm number of North Macedonia is about 90.000. 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.

[33] Census of agriculture, 2007, Individual agricultural holdings grouped by total available land, by regions, 2008, Skopje;

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 North 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 (+3.5% from 1990 to 2017).

Non-dairy cattle

Reduced rentability of beef production is responsible for the decrease of Non-dairy cattle numbers by 22% between 1990 and 2017 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.

In North Macedonia total swine production increased by 13% between 1990 and 2017, 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 2007-2017 have been used. Goat numbers decreased by -68% between 1990 and 2017, 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 (-73%). 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 68% from 1990 to 2017

mainly due to declining numbers of laying hens as a result of a reduced egg production in North 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.For 2016 the same distinction between systems has been used.

The following expert judgment (REF) has been provided:

Cattle husbandry

The cattle husbandry is mostly in traditional holdings – 97% of all farms in North 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 North 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 North 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 2017 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 North 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 North 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

Tables 174 and 175 provide emission factors taken from the EMEP EEA GB 2013 (updated July 2015 version) and for NH_3 from EMEP EEA GB 2016, for each livestock category. 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 176 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 (EFNH3) for calculation of NH3 emissions from manure management		

*reported under source category 3.D.a.2

** reported under source category 3.D.a.3

Table 177 NOx and NMVOC emission factors for source category 3B - Manure management

NFR code	Pollutants	
	NOx	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

NFR code	Pollutants	
	NOx	NMVOC
	kg AAP-1 a-1	kg AAP-1 a-1
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 178 TSP, PM10 and PM2.5 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 North 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 179 Uncertainties of activity data, emission factors and emissions for NFR 3.B

Categories		NH3 Emissions	NOx Emissions	NMVOC Emissions	PM2.5 Emissions	EF NH3	EF NOx	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 2017. 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

No recalculations have been carried out in this sector.

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 North 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 North Macedonia for is 11,5 degrees.

In the following table the quantities of applied N fertilizers is shown.

Table 180 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	10.540
1991	412	3.696	1.007	5,000	0	20	304	0	0	10.440
1992	412	3.696	1.007	4,600	0	20	304	0	0	10.040
1993	412	3.696	1.007	4,117	0	20	304	0	0	9.557
1994	412	3.696	1.007	3,804	0	20	304	0	0	9.244
1995	429	3.654	708	3,168	0	20	304	0	0	8.283
1996	431	4.009	462	3,025	0	20	304	0	0	8.252
1997	434	4.069	144	2,657	0	20	304	0	0	7.629
1998	420	3.910	126	3,097	0	20	304	0	0	7.878
1999	420	3.139	54	3,266	0	20	304	0	0	7.204
2000	420	2.618	54	3,220	0	20	304	0	0	6.636
2001	420	1.825	54	3,005	0	20	304	0	0	5.628
2002	607	3.168	45	2,260	0	20	304	0	0	6.405
2003	751	4.689	617	2,410	0	19	555	0	0	9.042
2004	630	6.530	1.657	2,348	0	22	1,540	0	0	12.727
2005	317	6.476	3.205	2,610	1	24	3,023	2	0	15.658
2006	46	6.916	3.515	2,520	61	27	3,775	3	0	16.863
2007	42	7.173	4.190	2,373	77	23	4,159	3	0	18.041
2008	42	7.248	3.438	2,628	77	18	3,765	3	0	17.217
2009	30	4.516	4.277	3,291	35	18	3,814	3	53	16.036
2010	27	4.873	4.811	3,618	19	17	3,586	4	82	17.037
2011	13	2.693	6.068	3,708	18	14	4,009	3	100	16.627
2012	13	2.693	6.296	3,314	0	5	4,742	1	92	17.157
2013	0	0	5.731	3,634	0	0	5,673	0	63	15.102
2014	0	823	5.641	3,986	0	0	6,119	0	116	16.685
2015	0	3.090	4.340	3,858	0	0	4,996	0	147	16.431
2016	0	3.124	3.381	3.187	0	0	3.531	0	150	13.373
2017	0	4.561	2.729	2.694	54	0	5.351	0	213	15.603

*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 181 NH_3 Emissions factors for source category NFR 3.D.a.1 - Inorganic fertilizers

Fertilizer type	Value	Unit	References
AS	0,09	kg NH3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
AN	0,015	kg NH3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
CAN	0,008	kg NH3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
U	0,155	kg NH3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
MAP	0,05	kg NH3kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
DAP	0,05	kg NH3 kg-1 fertilizer-N applied	GB 2016 Table 3-2 emission factor for source category 3.D.a.1
NPK	0,05	kg NH3kg-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 182 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 2007-2017. The numbers per livestock category are presented in Table 176. Numbers of different categories of poultry were presented in Table 177. For further information, please refer to chapter 3.B Manure Management.

Emission factors

In Table 178 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 2007-2017. The numbers per livestock category are presented in Table 176. Number of different categories of poultry are presented in Table 177. For further information, please refer to chapter 3.B Manure Management.

Emission factors

In Table 178 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 North 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 183 Uncertainties of emissions, emission factors and activity data

Categories		NH3 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 2009-2017, 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

No recalculations were done in this sector.

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

No planned improvments in this sector.

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.

WASTE

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, about 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 eight Waste Water treatment plants (WWTP) operating in North Macedonia. For the plant in Ohrid and Dojran, activity data are available for the whole time series. Emissions have been estimated based on these activity data and the data from the another three waste water treatment plants However, as data for the other three 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 184 NFR categories not included in Waste sector for 2016

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
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.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_3 were 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 second 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 2017 (source: Eurostat statistics and EEA report34). The hereby available information provided data on waste generation from 2003 to 2017. For the data from 1990-2003 the average annual change between 2003 and 2017 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 about 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

[34] EEA, Municipal Waste Management in FYROM (2013), page 7-8

series (1950 to 2017) due to a lack of better data, although, it can be assumed that in 1950 the waste composition was different.

Table 185 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

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 2017. Before 1994, GDP for former Yugoslavia were found and used. Industrial waste * by category, tons.

Table 186 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 187 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
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
2016	797	1634	2.430.236	105.691.090
2017	787	1634	2.420.537	113.123.375

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 1887 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 CH4	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 1898 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	0,96 7	-
Absolute density [kg/Nm3] bei 30°C	0,650	0,72	1,13	-
Concentration in landfill gas [%] (Cd, Hg, Pb, NMVOC, NH3 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 190 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

Uncertainties of activity data and emission factors have been estimated by using Tier 1 methodology of the EMEP/EEA GB 2013.

Table 1910 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

No recalculation has been done in this sector.

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

No plans improvement for the next reporting.

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 - http://drisla.mk/page_detail.asp?lID=3&ID=25.

Table 1921 Quantity of clinical waste incinerated in the period 2000–2016

Year	Clinical waste[Mg]	Year	Clinical waste [Mg]
2000	0,1149	2009	0,4163
2001	0,2319	2010	0,4584
2002	0,2486	2011	0,4700
2003	0,2551	2012	0,5016
2004	0,3227	2013	0,5666

Year	Clinical waste[Mg]	Year	Clinical waste [Mg]
2005	0,3756	2014	0,5729
2006	0,3270	2015	0,7749
2007	0,3550	2016	0,8694
2008	0,3589	2017	0,8910

7.3.1.2. Emission Factors

The emission factors used are as outlined in the GB 2016 and presented in the following table.

Table 1932 Emission factors for source category 5.c.1.dii - Clinical waste incineration

Pollutant	Value	Unit	References
NOx	2,3	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
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 2016 Table 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 2016 Table 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 2016 Table 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 2016 Table 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 2016 Table 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 2016 Table 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 2016 Table 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

Recaluclations were done only for 2016 due to the use of final data.

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

Officially published activity data on amount of clinical waste from the Drisla webside will taken into account instad of the preliminary amount 1,0231 Mg of medical incenerated waste for 2016.

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 North Macedonia, Field crops, orchards and vineyards, 2007-2015[35].

Table 1943 Activity data for source category 5.C.2 - Open burning of waste

Year	Arable farmland [hectare]	Waste [kg]	Year	Arable farmland [hectare]	Waste [kg]
1990	667.000	16.675	2004	560.000	14.000
1991	664.000	16.600	2005	546.000	13.650
1992	662.000	16.550	2006	537.000	13.425
1993	663.000	16.575	2007	529.000	13.225
1994	661.000	16.525	2008	521.000	13.025
1995	656.000	16.400	2009	513.000	12.825
1996	658.000	16.450	2010	504.000	12.600
1997	647.000	16.175	2011	511.000	12.775

[35] State Statistical Office of the Republic of Macedonia, Field crops, orchards and vineyards, 2007-2016, http://www,stat,gov,mk/PrikaziPoslednaPublikacija,aspx?id=5

Year	Arable farmland [hectare]	Waste [kg]	Year	Arable farmland [hectare]	Waste [kg]
1998	635.000	15.875	2012	510.000	12.750
1999	633.000	15.825	2013	509.000	12.725
2000	598.000	14.950	2014	511.579	12.789
2001	612.000	15.300	2015	513.564	12.839
2002	577.000	14.425	2016	516.644	12.916
2003	569.000	14.225	2017	516870	12.922

7.4.1.2. Emission Factors

The emission factors used are as outlined in the GB 2016 for source category 5.C.2.

Table 1954 Emission factors for source category 5.C.2 - Open burning of waste

Pollutant	Value	Unit	References
NOx	3,18	kg/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
NMVOC	1,23	kg/Mg	GB 2016 Table 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 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
TSP	4,64	kg/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
BC	42	% of PM2.5	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
CO	55,83	kg/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Pb	0,49	g/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Cd	0,1	g/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Cr	0,01	g/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Cu	0,2	g/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
Se	0,07	g/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
"PCDD/PCDF (dioxins/furans)"	10	mg I-Teq/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
benzo(a) pyren	2,33	g/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
benzo(b) fluoranthen	4,63	g/Mg	GB 2016 Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning
benzo(k) fluoranthen	5,68	g/Mg	GB 2016 Table 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 eight 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 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 NH3 emissions. For this reason, NH3 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 plants are presented in the following table:

Table 1965 Activity data for source category 5.D.1 - Wastewater treatment

Year	Water treated [m3]	Year	Water treated [m3]
1990	14.690.160	2004	15.462.500
1991	15.320.880	2005	16.408.580
1992	14.374.800	2006	16.250.900
1993	15.636.240	2007	15.304.820
1994	15.320.880	2008	16.093.220
1995	14.374.800	2009	21.187.840
1996	14.847.840	2010	21.698.560
1997	15.163.200	2011	21.113.200
1998	15.793.920	2012	22.836.899
1999	15.951.600	2013	21.079.644

Year	Water treated [m3]	Year	Water treated [m3]
2000	14.532.480	2014	24.709.351
2001	15.478.560	2015	25.322.341
2002	14.374.800	2016	12.675.451
2003	15.163.200	2017	9.639.664

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 m^3 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 recalculated for the whole period due to extendet data availability.

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

Activity data were received only from five out of eight 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.

NATURAL SOURCES

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 1990-2017.

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 table.

Table 1976 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 North Macedonia, Forestry, 2000 –2017[36], as well on data recived on the requirement sent to the Public enterprise Macedonian forests by MEPP.

Table 1987 Activity data for source category 11.B Forest fires

Year	Area burned [ha]	Wood burned [m^3]	Wood burned [kg]
1990	NE	1.131	870.870
1991	NE	3.729	2.871.330
1992	NE	2	1.540
1993	NE	4.213	3.244.010
1994	NE	96.612	74.391.240
1995	NE	54.228	41.755.560
1996	NE	636	489.720
1997	NE	4.084	3.144.680
1998	NE	4.214	3.244.780
1999	NE	3.856	2.969.120
2000	4807	711.782	548.072.140
2001	5255	88.260	67.960.200
2002	5482	24.661	18.989.186
2003	1922	10.987	8.459.990
2004	1798	4.322	3.328.171
2005	3093	1.063	8.185.510
2006	3594	12.978	9.993.060
2007	34443	617.678	475.612.060
2008	15046	35.652	27.452.425
2009	1030	1.551	1.194.270
2010	4725	2.033	1.565.410
2011	8702	55.743	42.922.341
2012	19312	102.160	78.663.200
2013	2844	15.268	11.756.090
2014	1150	19.152	14.747.040
2015	3165	32.494	25.020.380
2016	2166	17.573	13.531.749
2017	13.405	82.981,11	63.895.454,7

[36] State Statistical Office of the Republic of Macedonia, Forestry, 2000 – 2014; http://www.stat.gov.mk/PrikaziPoslednaPublikacija.aspx?id=7; MAKSTAT Database, http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef; Data recived by the Public enterprice "Macedonian forests".

8.3.1.2. Emission factors

Calculation of emission parameters was used and emission factors were taken from the GB 2016.

Table 1998 Emission factors for source category 11.B Forest fires

Pollutant	Value	Unit	References
NOx	100	kg/ha area burned	GB 2016 11B Forest fires. Table 3-1. pg. 9
CO	3.000	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 2000-2016 [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 the previous 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 recalculations were done in this sector.

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

No planned improvements.

RECALCULATIONS

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

In this reporting round improvements of the emission inventory made were made due to the recommendations given in the Twinning project (finalized in end of January 2017), that have not been implemented in the previous reporting round. The recalculation was based on the availability and correction of activity data and use of updated emission factors from the GB 2016. Explanations for recalculation per sector are given in the respective chapters. The tables indicating recalculations per pollutant can be found in tables 200-214.

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 2015 used for the last year reporting round, final fuel consumption data has been used.

Transport (NFR 1.A.3)

Due to availability of detailed car fleet data for 2014 and 2016 from MOI, Tier 2 method has been introduced in the previous IIR. 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.

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.

Agriculture (NFR 3)

No recalculations were performed in thi sector

Waste (NFR 5)

Major recalculation occurred for the sector 5 NFR sector 5.D - Wastewater handling due to availability of activity data from 5 waste water treatment plants compare to previous submission.

9.1.2. Recalculations per pollutant

The following tables present the changes of emissions for all air pollutants (reported mandatory by North Macedonia), compared to the previous submission. Detailed explanations on the reasons for recalculations are provided in the sector chapters.

Table 199 Recalculation difference of NOx emissions [kt] compared to submission 2017

NOx emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
1A1	Energy Industries	0,00	0%	-4,17	-32%
1A2	Manufacturing Industries & Construction	0,00	0%	-0,10	-2%
1A3	Transport	0,00	0%	0,00	0%
1A4	Other Sectors	0,00	0%	0,12	12%
1B	Fugitive Emissions	0,00	0%	0,00	-
2	Industrial Processes and Product Use	0,00	0%	0,00	-10%
3	Agriculture	0,00	0%	0,00	0%
5	Waste	0,00	0%	0,00	1%
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**-4,16**	**-16%**

Table 2000 Recalculation difference of NMVOC emissions [kt] compared to submission 2017

NMVOC emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
1A1	Energy Industries	0,00	0%	0,00	0%
1A2	Manufacturing Industries & Construction	0,00	0%	-0,02	-2%
1A3	Transport	0,00	0%	0,00	0%
1A4	Other Sectors	0,00	0%	1,62	26%
1B	Fugitive Emissions	0,00	0%	0,00	0%
2	Industrial Processes and Product Use	0,00	0%	-3,60	-40%
3	Agriculture	0,00	0%	0,00	0%
5	Waste	0,00	0%	0,00	0%
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**-2,00**	**-7%**

Table 201 Recalculation difference of SO_2 emissions [kt] compared to submission 2017

SO2 emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	0%	-5,65	-10%
1.A.2	Manufacturing Industries & Construction	0,00	0%	-0,35	-5%
1.A.3*	Transport	0,00	0%	0,00	0%
1.A.4	Other Sectors	0,00	0%	0,04	7%
1.A.5	Other	0,00	0%	0,00	-
1.B	Fugitive Emissions	0,00	-	-0,02	-65%
2	Industrial Processes and Product Use	0,00	-	0,00	-
3	Agriculture	0,00	0%	0,00	4%
5	Waste	0,00	-	0,00	-
6	Other	0,00	0%	-5,98	-9%
	Total emissions	**0,00**	**0%**	**-5,65**	**-10%**

Table 2012 Recalculation difference of NH_3 emissions [kt] compared to submission 2017

NH_3 emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-	0,00	-
1.A.2*	Manufacturing Industries & Construction	0,00	-	0,00	-
1.A.3	Transport	0,00	0%	0,00	0%
1.A.4	Other Sectors	0,00	0%	0,19	29%
1.B	Fugitive Emissions	0,00	-	0,00	0%
2	Industrial Processes and Product Use	0,00	0%	-0,01	-
3	Agriculture	0,00	0%	0,00	0%
5	Waste	0,00	-	0,00	-
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**0,18**	**2%**

Table 2023 Recalculation difference of PM2.5 emissions [kt] compared to submission 2017

PM2.5 emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-	-1,10	-56%
1.A.2	Manufacturing Industries & Construction	0,00	-	-0,04	-4%
1.A.3	Transport	0,00	-	0,00	0%
1.A.4	Other Sectors	0,00	-	1,99	29%
1.B	Fugitive Emissions	0,00	-	0,00	0%
2	Industrial Processes and Product Use	0,00	-	-0,07	-2%
3	Agriculture	0,00	-	0,00	0%
5	Waste	0,00	-	0,00	0%
6	Other	0,00	-	0,00	-

PM2.5 emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
	Total emissions	**0,00**	**0%**	**0,79**	**6%**

Table 2034 Recalculation difference of PM10 emissions [kt] compared to submission 2017

PM10 emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-	-2,71	-56%
1.A.2	Manufacturing Industries & Construction	0,00	-	-0,04	-4%
1.A.3	Transport	0,00	-	0,00	0%
1.A.4	Other Sectors	0,00	-	2,05	25%
1.B	Fugitive Emissions	0,00	-	0,00	0%
2	Industrial Processes and Product Use	0,00	-	-0,10	-1%
3	Agriculture	0,00	-	0,00	0%
5	Waste	0,00	-	0,00	3%
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**-0,80**	**-6%**

Table 2045 Recalculation difference of TSP emissions [kt] compared to submission 2017

TSP emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-	-4,00	-56%
1.A.2	Manufacturing Industries & Construction	0,00	-	-0,04	-4%
1.A.3	Transport	0,00	-	0,00	0%
1.A.4	Other Sectors	0,00	-	2,16	25%
1.B	Fugitive Emissions	0,00	-	0,00	0%
2	Industrial Processes and Product Use	0,00	-	-0,14	-1%
3	Agriculture	0,00	-	0,00	0%
5	Waste	0,00	-	0,00	3%
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**-2,03**	**-6%**

Table 2056 Recalculation difference of CO emissions [kt] compared to submission 2017

CO emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,00	-0,31	0%	-18%
1.A.2	Manufacturing Industries & Construction	0,00	-0,34	0%	-5%
1.A.3	Transport	0,00	0,00	0%	0%
1.A.4	Other	0,00	10,84	0%	28%
1.B	Fugitive Emissions	0,00	0,00	0%	#DIV/0!
2	Industrial Processes and Product Use	0,00	-0,10	0%	-16%
3	Agriculture	0,00	0,00	-	-

CO emissions [kt]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
5*	Waste	0,00	0,00	0%	0%
6	Other	0,00	0,00	-	-
	Total emissions	**0,00**	**10,10**	**0%**	**15%**

*Note: High increase is due to the fact that avalible data from 5 instead of 1 waste water treatment plant were used.

Table 2067 Recalculation difference of Pb emissions [t] compared to submission 2017

Pb emissions [t]		1990		2017	
		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%	-0,05	-5%
1.A.3	Transport*	0,00	0%	0,00	0%
2	Industrial Processes and Product Use	0,00	0%	-0,01	-4%
3	Agriculture	0,00	-	0,00	-
5	Waste	0,00	0%	0,01	16%
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**0,05**	**2%**

*Note: High increase is due to the fact that emissions wrong unit conversion in previous reporting round.

Table 2078 Recalculation difference of Cd emissions [t] compared to submission 2017

Cd emissions [t]		1990		2017	
		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	-1%
1.A.3	Transport	0,00	0%	0,00	-49%
1.A.4	Other Sectors	0,00	0%	0,00	21%
1.B	Fugitive Emissions	0,00	-	0,00	-
2	Industrial Processes and Product Use	0,00	0%	0,00	-1%
3	Agriculture	0,00	-	0,00	-
5	Waste	0,00	0%	0,00	15%
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**0,00**	**0%**

Table 20809 Recalculation difference of Hg emissions [t] compared to submission 2017

Hg emissions [t]		1990		2017	
		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	-5%
1.A.3	Transport	0,00	0%	0,00	0%
1.A.4	Other Sectors	0,00	0%	0,00	27%
1.B	Fugitive Emissions	0,00	0%	0,00	0%
2	Industrial Processes and Product Use	0,00	0%	0,00	0%

Hg emissions [t]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
3	Agriculture	0,00	0%	0,00	-
5	Waste	0,00	0%	0,01	18%
6	Other	0,00	0%	0,00	-
	Total emissions	**0,00**	**0%**	**0,01**	**2%**

Table 2090 Recalculation difference of PCDD/ PCDF emissions [t] compared to submission 2017

PCDD/ PCDF emissions [t]		1990		2017	
		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%	-0,07	-5%
1.A.3	Transport	0,00	-	0,00	-
1.A.4	Other Sectors	0,00	0%	1,90	29%
1.B	Fugitive Emissions	0,00	-	0,00	-
2	Industrial Processes and Product Use	0,00	0%	-0,01	-2%
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%**	**1,82**	**20%**

Table 2101 Recalculation difference of PAHs emissions [t] compared to submission 2017

PAH emissions [t]		1990		2017	
		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	-4%
1.A.3	Transport	0,00	-	0,00	-
1.A.4	Other Sectors	0,00	0%	1,84	28%
1.B	Fugitive Emissions	0,00	-	0,00	-
2	Industrial Processes and Product Use	0,00	0%	0,00	-25%
3	Agriculture	0,00	-	0,00	-
5	Waste	0,00	0%	0,00	-
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**1,78**	**25%**

Table 2112 Recalculation difference of HCB emissions [kg] compared to submission 2017

HCB emissions [kg]		1990		2017	
		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	0%
1.A.3	Transport	0,00	-	0,00	-
1.A.4	Other Sectors	0,00	0%	0,02	29%
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	-	0,02	18%
6	Other	0,00	-	0,00	-
	Total emissions	**0,00**	**0%**	**0,03**	**1%**

Table 2123 Recalculation difference of PCB emissions [kg] compared to submission 2017

PCB emissions [kg]		1990		2017	
		Δ kt	Δ %	Δ kt	Δ %
1.A.1	Energy Industries	0,01	-	0,00	-
1.A.2	Manufacturing Industries & Construction	0,00	0%	-0,07	-5%
1.A.3	Transport	0,00	-	0,00	-
1.A.4	Other Sectors	0,00	0%	0,17	30%
1.B	Fugitive Emissions	0,00	-	0,00	-
2*	Industrial Processes and Product Use	0,00	0%	-11,63	-67%
3	Agriculture	0,00	-	0,00	-
5	Waste	0,00	-	0,00	18%
6	Other	0,00	-	0,00	-
	Total emissions	0,01	0%	-11,52	-60%

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 Twining project (which has not been already implemented in the previous submissions), as well as findings by the sectorial experts. Planned improvements at sector level are described in the respective sector chapters.

Table 2134 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/2 016/ North Macedonia § 16	High	Currently Tier 2 methodologies are implemented only on limited NFR sectors but few more sectors in this submission. However for most of the sectors, T1 calculations are possible due to data constraints, but further methodological improvements will be investigated. Tier 3

Subject	Source	rating	Improvement made
			COPERT methodology for 2014-2016 has been implemented but data were not submitted in the reporting round. The submission for the period 2005-2018 will be done in the next submission.
QA/QC procedures improved	Peer-Review 2016	High	QA/QC procedures were improved due to the fact that all experts followed the QA/QC procedures and the QA/QC Plan has been partially implemented,

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 215) and sector improvements (Table 216). 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 2145 Planned improvements (general issues)

Subject	Source	Rating	Improvement planned	Timeline
The ERT notes that the country 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/ North 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, 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/ North 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 2017) only for 1990 and 2016	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
Preparation of projections	Peer-Review 2016	High	It is planned to be carried out in IPA 2 project that it is planned to start at the end of 2019	Planned to be implemented in the following submissions

Table 2156 Sectoral improvements planned

NFR Category	Subject	Source	rating	Timeline
1.A.2.a				
1.A.3.b	For 2014, 2015 and 2016 data, Tier 2 methodology was applied. MEPP is planning to start with the use COPERT V model for calculating transport emissions in future. We have alrady planned to carried out these activities through a	CEIP/S3.RR/2016/North Macedonia § 16	High	2019-2020

NFR Category	Subject	Source	rating	Timeline
	TAEIX expert mission and UNDP project on GHG inventory.			
1.A.4.bii	Due to not available activity data for Residential: Household and gardening (mobile) same activity data are used for the last year. Acording to the last stage 3 review report number of households maybe used ad surrogate data.	CEIP/S3.RR/2016/North Macedonia § 16	Low	2019-2020
1.A.5	2017 activity data received after the deadline for reporting will be repleased with 2016 data	National emission inventory team	Medium	2019
2.A.1	For 2016 and 2017 Tier 2 method has been applied. It is planned to use higher 2 methodology also for the prevous years (2015 and before)	National emission inventory team	Medium	2019-2020
2.C.3	There is a lack of avalible data on secondary aluminium production. MEPP will try to collect these data for future submissions.	National emission inventory team	Medium	2020-2021
2.C.5	There is a lack of avalible data on secondary lead production. MEPP will try to collect these data for future submissions.	National emission inventory team	Medium	2020-2021
2.C.7.a	There is some uncertainty of activity data for copper produation, so there is a need of deeper analysis of the tehnological process for production of secondary copper.	National emission inventory team	Medium	2019
2.D.3.b	Data on quantity of asphalt produced are not completed. MEPP will discuss with the State Statistical Office the possibility for this institution to start collecting these data. Currently they are gatherd from the companies.	National emission inventory team	High	2018
2H	Historical data for wine production (No data are available within MAFWS, MEPP will try to find data from the wine production cooperations)	Twinning mission report No. 24/2016	Low	2019-2020
2.H.2	Activity data for total weight of beans roasted to produce coffee, were used for the first time for 2016-2017 emissions calculation. It is planned to calculate emissions for prevous years if activity data are available.	National emission inventory team	Low	2019 - 2020
2G	Production instead of used products was taken as activity data. Recalculations were done only for several years, recalculations omly until 2013, other historical data will be carried out for the all reporting period will be carried out for the next reporting round.	Twinning mission report No. 24/2016	High	2019
2I	All wooden products were taken into account. Therefore, an overestimation was carried out. Recalculations were done only until 2007 , but recalculations for the all reporting period will be done for the next reporting round	Twinning mission report No. 24/2016	High	2019
5.D.2	Emissions from this NFR sector are underestimated. MEPP will try to calculate emissions for the next reporting	National emission inventory team	Medium	2019

NFR Category	Subject	Source	rating	Timeline
	round since we expect to complete activity data.			

PROJECTIONS

10. PROJECTIONS

The need for preparation of national emission projections comes from the:

- Obligation under the Gothenburg protocol (Republic of North Macedonia 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; Emission projections need to be sent by 15 March 2017 and every two years thereafter
- Need to prepare National air pollution control programme under NEC directive 2016/2284/EU
- 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[37] 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 North Macedonia by 2030, the Energy Balance of the Republic of North Macedonia for the period 2012 to 2016, the Environmental Assessment of Strategy, the Strategy for Energy Efficiency Promotion in the Republic of North Macedonia by 2020, the Baseline Study on Renewable Energy Sources in the Republic of North 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 North 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

[37] 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)

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. The revised plan has been approved by the government in April 2017.

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.

Regarding the inventory the current inventory has been completed with whole time series for all pollutants for the period 1990-2017 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. This document has been taken into account within current preparation of a TOR for a Technical project under IPA 2 program (OIS has already been accepted). One of the planned activity in the project is preparation of National emission projections under NEC directive 2016/2248/EC. The project is envisaged to start in 2019, which means that we will be able to report projections in 2020 at earliest stage,

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ANNEX 1 Nomenclature for reporting format (NFR)- Format for reporting under the UNECE/LRTAP convention for 2017

MK: 15.02.2018: 2016	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	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxins/ furans)	PAHs: benzo(a) pyrene	PAHs: benzo(b) fluoranthene	PAHs: benzo(k) fluoranthene	PAHs: Indeno (1,2,3-cd) pyrene	PAHs: 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	Notes	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		11,728 78471	0,0615 05957	49,187 5617	NA	1,6795 07325	4,2298 70301	6,2203 97501	0,003	1,76 276 315 5	0,4325 65518	0,0526 10603	0,0838 68501	0,4129 20665	0,2622 20102	0,0335 07165	0,5148 3795	1,2869 07265	0,3331 8159	0,2882 38642	4,2201 9E-05	0,0010 66936	0,0008 38509	7,2680 2E-05	0,002 02032 7	NE	9,422 62E-05	932,80 92	28553 ,3816	7456,062 17	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		0,8934 81149	0,2722 33278	2,3640 42176	NE	0,2949 17245	0,3182 17267	0,3363 45985	0,026	2,48 828 203	0,3469 55833	0,0046 82467	0,0210 99382	0,0104 79936	0,0351 32873	0,0454 66484	0,0336 71666	0,0047 99399	0,5399 78072	0,5271 37888	0,1191 52156	0,1632 5227	0,0625 74287	0,0489 69468	0,393 94818 2	0,001 6117 67	0,440 0329 42	717,90 567	2588, 42858	1044,203 5	1,3883 2693	NO	NA	*TJ NCV*
B_Industry	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals		0,0279 8987	0,0013 64029	0,0025 64374	NA	0,0010 91223	0,0010 91223	0,0010 91223	6E-04	0,00 360 103 6	4,3648 9E-06	3,2736 7E-07	6,5473 4E-06	1,6368 3E-06	1,0912 2E-05	1,2003 5E-05	4,3648 9E-07	6,0017 3E-06	0,0015 82273	7,6385 6E-05	0,0001 03666	0,0008 18417	9,2754 E-05	8,1841 7E-05	0,001 09667 9	NO	NO	54,561 15	NO	NO	NO	NO	NA	*TJ NCV*
B_Industry	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals		0,0110 27049	0,0017 58465	0,0111 11116	NE	0,0013 38993	0,0017 34813	0,0022 09796	7E-04	0,00 438 559 8	0,0012 67085	2,3787 E-05	3,0615 8E-05	8,3367 5E-05	0,0010 13845	0,0005 7009	0,0205 83171	NO	0,0006 63998	0,0008 13498	0,0004 11683	0,0004 90938	0,0003 16702	0,0017 41652	0,002 96097 5	NE	NO	79,163 94	NO	42,03587 96	NO	NO	NA	*TJ NCV*
B_Industry	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print		0,0127 95674	0,0009 93864	0,0010 73908	NE	0,0004 9078	0,0004 91352	0,0004 92686	3E-04	0,00 206 797 3	7,1289 8E-06	2,6272 4E-06	1,1557 8E-05	2,3323 5E-06	9,1079 9E-06	6,1516 5E-06	7,7216 2E-07	3,5173 7E-06	0,0007 64021	5,9077 2E-05	4,4807 3E-05	0,0003 41702	3,9345 9E-05	3,4640 3E-05	0,000 46049 5	9,527 78E-07	1,143 33E-08	22,573 73	0,248 7	16,18932 58	0,1905 5568	NO	NA	*TJ NCV*
B_Industry	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco		0,3372 76726	0,0387 72036	0,0295 90215	NA	0,0208 00845	0,0209 80204	0,0213 98708	0,009	0,08 145 597 9	0,0016 65848	0,0007 81111	0,0002 36826	5,3777 2E-05	0,0015 00643	0,0004 94018	0,0001 27597	0,0001 11181	0,0485 3873	0,0069 60724	0,0017 61135	0,0101 39643	0,0013 39864	0,0011 57641	0,014 39828 4	0,000 2989 31	3,587 18E-06	612,15 766	NO	240,5310 23	59,786 2702	NO	NA	*TJ NCV*
B_Industry	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	2A1	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)		0,8240 35322	0,0850 62197	NE	0,0002 01033	0,0524 19422	0,0524 19422	0,0524 19422	0,029	0,26 943 482 3	NO	2,5129 2E-07	NA	NE	4,1201 8E-08	0,0427 19567	0,0017 59041	0,0002 51292	0,0251 29157	NO	0,0007 53875	0,0012 56458	NE	NE	0,002 01033 3	NO	NA	1073,0 1501	NO	NO	NO	NO	NA	*TJ NCV*
B_Industry	1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)		1,7511 09187	0,3442 2325	2,9444 50489	NE	0,3308 21988	0,3611 0625	0,3871 84236	0,032	2,77 810 994 5	0,3940 85795	0,0055 92642	0,0223 83008	0,0123 47276	0,0512 10879	0,0567 02072	0,2940 55988	0,0050 95016	0,5810 76472	0,6046 51497	0,1362 47704	0,1763 78434	0,0722 58611	0,0753 7612	0,460 26086 9	0,002 1858 59	0,477 5011 94	989,15 362	2808, 80441	213,4557 44	74,066 7301	NO	0,735 625	*TJ NCV*
H_Aviation	1A3ai(i)	International aviation LTO (civil)		0,4366 96	0,0033 592	0,0268 736	NA	0,0025 194	NA	NA	NA	0,10 245 56	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NA	NE	NA	NA	*TJ NCV*
H_Aviation	1A3aii(i)	Domestic aviation LTO (civil)		0,0009 76533	3,8145 8E-05	7,6291 6E-05	NA	1,5258 3E-05	NA	NA	NA	8,39 208 E- 05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NA	NE	NA	3,280 53912	*TJ NCV*
F_RoadTransport	1A3bi	Road transport: Passenger cars		1,6525 40489	0,6814 72594	0,4611 4496	0,0903 23049	0,0694 28123	0,0694 28123	0,0694 28123	NA	6,74 392 041 1	0,0522 51053	0,0029 19519	NA	NA	0,4691 10063	0,0137 97355	0,0193 16297	0,0027 59471	0,2759 47096	NA	0,0028 44868	NA	NA	NA	NA	NA	NA	11902	NA	737	NO	NA	NA	*TJ NCV*
F_RoadTransport	1A3bii	Road transport: Light duty vehicles		0,6441 4002	0,1065 0332	0,0804 80354	0,0054 34429	0,0453 65997	0,0453 65997	0,0453 65997	NE	0,96 278 992 5	2,7339 6E-06	0,0004 66502	NA	NA	0,0793 0529	0,0023 32509	0,0032 65512	0,0004 66502	0,0466 5017	NA	0,0005 05221	NA	NA	NA	NA	NA	NA	1994	NA	NE	NA	NA	NA	*TJ NCV*
F_RoadTransport	1A3biii	Road transport: Heavy duty vehicles and buses		4,5513 94435	0,5855 9432	0,2991 17129	0,0036 7952	0,1226 1772	0,1226 1772	0,1226 1772	NA	4,74 291 71	8,5730 2E-06	0,0025 90599	NA	NA	0,4404 01762	0,0129 52993	0,0181 3419	0,0025 90599	0,2590 5986	NA	0,0008 18867	NA	NA	NA	NA	NA	NA	11723	NA	NE	NA	NA	NA	*TJ NCV*
F_RoadTransport	1A3biv	Road transport: Mopeds & motorcycles		0,0085 77225	0,0547 17519	0,0083 05831	6,6171 6E-05	0,0006 81214	0,0006 81214	0,0006 81214	NA	0,20 317 836	2,083E -07	1,9695 E-05	NA	NA	0,0033 48155	9,8475 1E-05	0,0001 37865	1,9695 E-05	0,0019 69503	NA	9,4771 2E-06	NA	NA	NA	NA	NA	NA	84	NA	NE	NA	NA	NA	*TJ NCV*
F_RoadTransport	1A3bv	Road transport: Gasoline evaporation		NA	1,1314 26708	NA	NA	NA	NA	NA	NA	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	0,0520 46662	0,0969 64832	0,1278 71429	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4309, 851	*10^6 km*
F_RoadTransport	1A3bvii	Road transport: Automobile road abrasion		NA	NA	NA	NA	0,0293 63906	0,0540 77332	0,1081 54664	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4309, 851	*10^6 km*

MK: 15.02.2018: 2016	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	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxins/ furans)	PAHs: benzo(a) pyrene	PAHs: benzo(b) fluoranthene	PAHs: benzo(k) fluoranthene	PAHs: Indeno (1,2,3-cd) pyrene	PAHs: 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	Notes	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	1A3c	Railways		0,0629848	0,0055893	0,00004808	0,000008414	0,00164674	0,00173088	0,00182704	NA	0,0128614	NA	0,00001202	NA	NA	0,0000601	0,0020434	0,00008414	0,00001202	0,001202	NA	0,00003606	0,0000601	NA	NA	0,00009616	NA	NA	51,686	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	NA	NO	NA	NA	TJ NCV
G_Shipping	1A3dii	National navigation (shipping)		0,005379616	0,000191884	1,22225E-05	NA	9,59422E-05	9,59422E-05	0,000102795	NA	0,000507123	8,90892E-06	6,85301E-07	2,0559E-06	2,74121E-06	3,42651E-06	6,03065E-05	6,85301E-05	6,85301E-06	3,42651E-05	8,90892E-06	NA	NA	NA	NA	NA	5,48241E-06	0,000076646	2,94679628	NO	NA	NO	NA	NA	TJ NCV
I_Offroad	1A3ei	Pipeline transport		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NO	NA	NA	NA	NA	NA	TJ NCV
I_Offroad	1A3eii	Other (please specify in the IIR)		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NO	NO	NO	NO	NO	NA	TJ NCV
C_OtherStationaryComb	1A4ai	Commercial/institutional: Stationary		0,249526617	0,051594235	0,318403369	NA	0,065130063	0,075460959	0,088610066	0,026	0,427105239	0,041805676	0,001138895	0,000719649	0,002410414	0,02697027	0,015770751	0,509000797	0,000172908	0,049196432	0,090371832	0,020515256	0,02687839	0,013240485	0,009299218	NE	2,58649E-05	0,018473941	1953,1479	41,717535	264,85418	189,69934	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		0,418945426	4,582946241	0,198774817	0,530912681	5,634440249	5,786430578	6,092975729	0,563	30,57129402	0,30999212	0,010697515	0,004053142	0,007712067	0,022568428	0,066361933	0,034023196	0,003843087	0,997233911	5,349691115	1,604400994	1,685334475	0,992573624	1,067398266	5,349707359	0,045537046	0,463706618	496,72762	50,89231	6,26939302	8861,47074	NA	NA	TJ NCV
I_Offroad	1A4bii	Residential: Household and gardening (mobile)		0,001383185	0,635748963	0,000626218	3,44076E-06	NE	NE	2,003664408	NE	1,229279819	0,10668	0,000008589	NA	NA	0,000042945	0,00146013	0,000060123	0,000008589	0,0008589	NA	NE	NE	NE	NA	NA	NA	NA	IE	NA	NA	IE	NA	NA	TJ NCV
C_OtherStationaryComb	1A4ci	Agriculture/Forestry/Fishing: Stationary		0,042536756	0,015571088	0,072353273	NE	0,009173394	0,010898175	0,012865354	0,003	0,051957852	0,004663905	9,48923E-05	3,24388E-05	0,000290506	0,003653306	0,002060601	0,073471444	2,85844E-06	0,00290486	0,004656024	0,00172025	0,002116808	0,001261864	0,000746965	0,005845888	NO	0,003362354	282,537742	34,05532	NO	55,9427433	NE	NA	TJ NCV
I_Offroad	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery		0,243417669	0,030063863	NA	5,65083E-05	0,011995183	0,011995183	0,011995183	NE	0,375654059	NA	7,26103E-05	NA	NA	0,000363052	0,012343759	0,000508272	NA	0,007261035	NA	0,000221781	0,000359102	NA	NA	NA	NA	NA	7261,03471	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	1A5a	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	1A5b	Other, Mobile (including military, land based and recreational boats)		0,03075998	0,003038793	0,000166173	NA	0,001854687	0,001821459	0,001821459	0,001	0,009545017	NA	8,73183E-09	NA	NA	1,43167E-09	0,001484411	6,11228E-05	8,73183E-06	0,000873183	NO	8,59002E-10	NA	NA	NA	8,59002E-10	NO	NO	36,0075245	NA	NO	NO	NA	NA	TJ NCV
D_Fugitive	1B1a	Fugitive emission from solid fuels: Coal mining and handling		NA	1,011382589	NA	NA	0,030341508	0,197219802	0,414667276	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,056918	Coal produced [Mt]
D_Fugitive	1B1b	Fugitive emission from solid fuels: Solid fuel transformation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA	NA	NO	Coal used for transformation [Mt]
D_Fugitive	1B1c	Other fugitive emissions from solid fuels		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NO	Please specify
D_Fugitive	1B2ai	Fugitive emissions oil: Exploration, production, transport		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NO	Crude oil produced [Mt]
D_Fugitive	1B2aiv	Fugitive emissions oil: Refining / storage		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	NA	NA	NA	NA	NA	NO	Crude oil refined [Mt]
D_Fugitive	1B2av	Distribution of oil products		NA	1,716186702	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,85809335	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	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	NO	Gas vented flared [TJ]
D_Fugitive	1B2d	Other fugitive emissions from energy production	(a)	NE	NE	NE	0,149472721	NE	NE	NE	NE	NE	NE	NE	3,13181E-05	1,77944E-06	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NA	NA	NA	NA	71177,4864	
B_Industry	2A1	Cement production		NA	NA	NA	NA	0,031	0,0438	0,0166	9E-04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NA	NA	NA	NA	735,63	Clinker produced [kt]
B_Industry	2A2	Lime production		NA	NA	NA	NA	0,0009793	0,0048965	0,012591	5E-06	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1399	Lime produced [kt]

MK: 15.02.2018: 2016	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	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxins/ furans)	PAHs: benzo(a) pyrene	PAHs: benzo(b) fluoranthene	PAHs: benzo(k) fluoranthene	PAHs: Indeno (1,2,3-cd) pyrene	PAHs: 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	Notes	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	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	0,039188575	0,39188575	0,79944693	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7,837715	*Material quarried [Mt]*
B_Industry	2A5b	Construction and demolition		NA	NA	NA	NA	0,009725129	0,097251294	0,32794041	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1130829	*floor space constructed/demolished [M3]*
B_Industry	2A5c	Storage, handling and transport of mineral products		NA	NA	NA	NA	0,002830377	0,02830377	0,05660754	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4,717295	*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]*
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		0,03608787	0,014945434	0,0165594	NE	0,005829579	0,006662376	0,025961082	2E-05	0,4719183	0,4163985	0,03331188	0,021097524	0,002248552	0,029147895	0,00555198	0,11381559	NE	0,6384777	0,832797	NE	NE	NE	NE	0,13324752	NE	0,6939975	NA	NA	NA	NA	NA	742,976	*Steel produced [kt]*
B_Industry	2C2	Ferroalloys production		NA	NA	NA	NA	0,0207348	0,0293743	0,034558	0,002	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	34,558	*Ferroalloys produced [kt]*
B_Industry	2C3	Aluminium production		NA	NA	NA	NA	0,0007183	0,0018284	0,002612	2E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,04571	NA	NA	NA	NA	NA	6,53	NA	NA	NA	NA	NA	NA	1,306	*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	0,03743	NA	0,000059888	0,000119776	0,00014972	NA	NA	0,0194636	0,0003743	NE	0,0022458	NA	NA	NA	NA	0,0003743	0,0239552	NA	NA	NA	NA	NA	NA	19,4636	NA	NA	NA	NA	NA	7486	*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	0,00126456	NA	0,00018202	0,0002395	0,00030656	2E-07	NA	0,022992	0,0022034	NA	0,001916	NA	0,026824	0,00012454	NA	NA	0,0479	NA	NA	NA	NA	NA	NA	3,5446	NA	NA	NA	NA	NA	0,958	*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	2,075301	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2075,301	
E_Solvents	2D3b	Road paving with asphalt		NA	0,007386624	NA	NA	0,1846656	1,384992	6,463296	0,011	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	461,664	
B_Industry	2D3c	Asphalt roofing		NE	0,00197379	NA	NA	0,00121464	0,0060732	0,0242928	2E-07	0,000144239	NE	NE	NE	NA	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	15,183	

MK: 15.02.2018: 2016	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	$PM_{2.5}$	PM_{10}	TSP	BC	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	Notes	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	2D3d	Coating applications		NA	3,27911225	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,715812	Paint applied [kt]
E_Solvents	2D3e	Degreasing		NA	1,76400585	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2075,301	Solvents used [kt]
E_Solvents	2D3f	Dry cleaning		NA	0,6225903	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2075,301	Solvents used [kt]
E_Solvents	2D3g	Chemical products		NA	0,376083	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
E_Solvents	2D3h	Printing		NA	0,0232165	NA	NA	NA	NA	NA	NA	NA	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	0,008308381	NE	NE	0,000039222	0,000058833	0,000071907	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	8,20575E-05	4,14195E-05	4,14195E-05	4,14195E-05	0,000206316	NE	NE	NA	NA	NA	NA	NA	NA	
E_Solvents	2G	Other product use (please specify in the IIR)		0,010896835	0,261886536	NE	0,025123258	0,163452519	0,163452519	0,163452519	7E-04	0,333564215	NE	3,26905E-05	6,0538E-07	9,68608E-07	2,11883E-06	0,032690504	NE	NE	NE	6,0538E-07	6,0538E-07	6,0538E-07	6,0538E-07	0,000272421	0,000274237	NE	NE	NA	NA	NA	NA	NA	NA	Please specify
B_Industry	2H1	Pulp and paper industry		NO	NO	NO	NA	NO	NO	NO	NA	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NO	Pulp production [kt]
B_Industry	2H2	Food and beverages industry		NA	0,640861805	NA	NA	NA	NA	NA	NA	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	
B_Industry	2I	Wood processing		NA	NA	NA	NA	NA	NA	0,010659918	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,6599182	Please specify
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		0,018881016	1,592871168	NA	2,0720076	0,05026764	0,07724052	0,16919352	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	122,604	Population size (1000 head)
K_AgriLivestock	3B1b	Manure management - Non-dairy cattle		0,012448608	0,827964864	NA	0,8210784	0,02383776	0,03575664	0,07813488	NA	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	132,432	Population size (1000 head)
K_AgriLivestock	3B2	Manure management - Sheep		0,003622775	0,122449795	NA	0,289822	0,012100069	0,040285258	0,100713145	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	724,555	Population size (1000 head)
K_AgriLivestock	3B3	Manure management - Swine		0,000281919	0,142050369	NA	0,941658	0,01372626	0,07804788	0,17237547	NE	NA	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	202,197	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		0,00053733	0,058246572	NA	0,0429864	0,001794682	0,00597511	0,014937774	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	107,466	Population size (1000 head)
K_AgriLivestock	3B4e	Manure management - Horses		0,002351581	0,139676731	NA	0,125657	0,00251314	0,00394922	0,00861648	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	17,951	Population size (1000 head)
K_AgriLivestock	3B4f	Manure management - Mules and asses		NE	NE	NA	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	Population size (1000 head)
K_AgriLivestock	3B4gi	Manure mangement - Laying hens		0,005311512	0,29213316	NA	0,56656128	0,040721592	0,210689976	0,210689976	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1770,504	Population size (1000 head)
K_AgriLivestock	3B4gii	Manure mangement - Broilers		0,000020456	0,002209248	NA	0,0030684	0,000184104	0,001411464	0,001411464	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20,456	Population size (1000 head)
K_AgriLivestock	3B4giii	Manure mangement - Turkeys		0,00006587	0,006442086	NA	0,00737744	0,00092218	0,00685048	0,00685048	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13,174	Population size (1000 head)
K_AgriLivestock	3B4giv	Manure management - Other poultry		0,00011781	0,017623071	NA	0,01490025	0,0008086	0,00592366	0,00592366	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	36,039	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)

NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	Notes	Main Pollutants (from 1990): NOx (as NO_2)	Main Pollutants: NMVOC	Main Pollutants: SOx (as SO_2)	Main Pollutants: NH_3	Particulate Matter (from 2000): $PM_{2.5}$	Particulate Matter: PM_{10}	Particulate Matter: TSP	Particulate Matter: BC	Other (from 1990): CO	Priority Heavy Metals (from 1990): Pb	Priority Heavy Metals: Cd	Priority Heavy Metals: Hg	Additional Heavy Metals (from 1990, voluntary reporting): As	Additional Heavy Metals: Cr	Additional Heavy Metals: Cu	Additional Heavy Metals: Ni	Additional Heavy Metals: Se	Additional Heavy Metals: Zn	POPs (1) (from 1990): PCDD/ PCDF (dioxins/ furans)	POPs: PAHs: benzo(a) pyrene	POPs: PAHs: benzo(b) fluoranthene	POPs: PAHs: benzo(k) fluoranthene	POPs: PAHs: Indeno (1,2,3-cd) pyrene	POPs: PAHs: Total 1-4	POPs: HCB	POPs: PCBs	Activity Data (from 1990): Liquid Fuels	Activity Data: Solid Fuels	Activity Data: Gaseous Fuels	Activity Data: Biomass	Activity Data: Other Fuels	Activity Data: Other activity (specified)	Other Activity Units
MK: 15.02.2018: 2016	*NFR sectors to be reported*			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		
L_AgriOther	3Da1	Inorganic N-fertilizers (includes also urea application)		0,405669804	1,08876688	NA	0,79054457	0,07596048	1,97497248	NA	NA	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	2,47966619	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	
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	
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	
L_AgriOther	3Da3	Urine and dung deposited by grazing animals		IE	IE	NA	1,2366151	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	
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	
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	
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	
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	
L_AgriOther	3De	Cultivated crops	(b)	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	
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	
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 [k ha/yr]*
L_AgriOther	3I	Agriculture other (please specify in the IIR)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NO	*NA*
J_Waste	5A	Biological treatment of waste - Solid waste disposal on land		NA	3,776	NA	0,001131	0,00079878	0,00053	0,00112071	NA	2,5623	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,420537	*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	
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	
J_Waste	5C1a	Municipal waste incineration	(c)	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	NA	*MSW incinerated [kt]*
J_Waste	5C1bi	Industrial waste incineration	(c)	NO	NO	NO	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NE	NO	NE	NE	NO	NE	NE	NE	NE	NE	NO	NE	NA	NA	NA	NA	NA	NA	*Waste incinerated [kt]*
J_Waste	5C1bii	Hazardous waste incineration	(c)	NO	NO	NO	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NE	NO	NE	NE	NE	NE	NE	NO	NO	NA	NA	NA	NA	NA	NA	*Waste incinerated [kt]*
J_Waste	5C1biii	Clinical waste incineration	(c)	0,002049272	0,000623692	0,000481134	NA	NA	NA	0,015146796	3E-04	0,000169288	0,055241256	0,007127904	0,038312484	0,000178198	0,001781976	0,087316824	0,001781976	NA	NA	0,03563952	NA	NA	NA	NA	3,56395E-08	0,0890988	0,0178197 6	NA	NA	NA	NA	NA	0,890988	*Waste incinerated [kt]*
J_Waste	5C1biv	Sewage sludge incineration	(c)	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	
J_Waste	5C1bv	Cremation	(c)	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]*
J_Waste	5C1bvi	Other waste incineration (please specify in the IIR)	(c)	NA	NA	NA	NA	NA	NA	NA	NA	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		0,041091165	0,015893753	0,001421393	NE	0,054142133	0,058277093	0,05995692	0,023	0,721421303	0,006331658	0,001292175	NE	0,005297918	0,000129218	0,00258435	NE	NA	5,1687	0,1292175	9,57424E-08	7,35881E-08	8,07351E-09	NE	1,77404E-07	NE	NA	NA	NA	NA	NA	NA	NA	
J_Waste	5D1	Domestic wastewater handling		NA	0,000144595	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	9639664	*Total organic product [Gg DC/yr]*

MK: 15.02.2018: 2016	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	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxins/ furans)	PAHs: benzo(a) pyrene	PAHs: benzo(b) fluoranthene	PAHs: benzo(k) fluoranthene	PAHs: Indeno (1,2,3-cd) pyrene	PAHs: 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	Notes	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	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)	(d)	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	NA	NA	NA	NA	NA	NE	*NA*
	NATIONAL TOTAL	National total for the entire territory (based on fuel sold)		24,47519226	28,58010599	56,06402933	10,19835486	9,196501235	16,11954702	24,90780567	0,732	56,91316773	2,212391765	0,126057695	0,191885655	0,458193933	1,427986408	0,465211832	1,638890216	1,307064985	8,981657527	7,987885416	1,889672763	2,068535771	1,144578079	1,205192334	6,366533837	6,668764704	25,12326878	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)	(e)	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(ii)	International aviation cruise (civil)																																		
O_AviCruise	1A3aii(ii)	Domestic aviation cruise (civil)																																		
P_IntShipping	1A3di(i)	International maritime navigation		0,080531603	0,382525116	0,020132901	NA	NA	NA	NA	NA	24,15948104	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NA	NE	NA	868,130685	*TJ NCV*
z_Memo	1A5c	Multilateral operations		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*
z_Memo	1A3	Transport (fuel used)		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	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	NO	NO	NO	NO	NO	NA	
N_Natural	11A	Volcanoes		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	
N_Natural	11B	Forest fires		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	11C	Other natural emissions (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	NA	NA	NA	NA	NA	NA	NA	NA	NO	*Please specify*

Republic of North Macedonia
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Macedonian Environmental Information Center
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