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ABBREVIATIONS

CAS	Chemical Abstracts Service, pollutants nomenclature
CEIP	Centre on Emission Inventories and Projections
CEPMEIP	Co-ordinated European Programme on Particulate Matter Emission Inventories, Projections and Guidance
CLRTAP	Convention on Long Range Transboundary Air Pollution
CN	Combined Nomenclature
CollectER	Point and area sources database
COPERT 5	Microsoft Windows software program which is developed as a European tool for the calculation of emissions from the road transport sector
CORINAIR	CORe INventory AIR emissions programme
GNFR	Gridding NFR (aggregated NFR categories)
EB	Energy Balance
EEA	European Environment Agency
EEB	Estonian Environmental Board
EERC	Estonian Environment Research Centre
EF	Emission factor
EMEP	Cooperative programme for the monitoring and evaluation of the long range transmission of air pollutants in Europe (European monitoring and evaluation programme)
EMTAK	Estonian Classification of Economic Activities
E-PRTR	European Pollutant Release and Transfer Register
ESTE A	Estonian Environment Agency
EU	European Union
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies model
GHG	Greenhouse gases
IIASA	International Institute for Applied Systems Analysis
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
LCP	Large combustion plant
LPS	Large point sources, equals to the definition of E-PRTR installations
NECD	Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC, OJ L 344, 17 December 2016
NFR	Nomenclature for Reporting

OSIS	Web-interfaced air emissions data system for point sources at the Estonian Environment Agency (ESTEIA)
PP	Power Plant
RAINS	Regional Air Pollution Information and Simulation model
QA/QC	Quality Assurance / Quality Control
SNAP	Selected Nomenclature for Air Pollution
TVP	True Vapour Pressure
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention for Climate Change

Pollutants

As	Arsenic
B(a)p	Benzo(a)pyrene
B(b)f	Benzo(b)fluoranthene
B(k)f	Benzo(k)fluoranthene
Cd	Cadmium
CFC	Chlorofluorocarbon
Cr	Chromium
Cu	Copper
CO	Carbon monoxide
HCB	Hexachlorobenzene
HCl	Hydrochloric acid
HFCs	Hydrofluorocarbons
Hg	Mercury
HMs	Heavy metals
I(1,2,3-cd)p	Indeno(1,2,3-cd)pyrene
NH ₃	Ammonia
Ni	Nickel
NMVOC	Non-methane volatile organic compounds, any organic compound, excluding methane, having a vapour pressure of 0.01 kPa or more at 293.15 K, or having a corresponding volatility under the particular conditions of use. For the purpose of the UNECE CLRTAP Reporting Guidelines, the fraction of creosote which exceeds this value of vapour pressure at 293.15 K is considered as a NMVOC.
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides, nitric oxide and nitrogen dioxide, expressed as nitrogen dioxide
PAH-4	Polyaromatic hydrocarbons expressed as the sum of benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene

Pb	Lead
PCDD/PCDF	Dioxins and furans: 1, 2,3,7,8-PeCDD; 2,3,4,7,8-PeCDF; 1,2,3,4,7,8-HxCDF; 1,2,3,6,7,8-HxCDF
PCB	Polychlorinated biphenyls
PCP	Pentachlorophenol
PFCs	Perfluorocarbons
PM _{2.5}	Particulate matter, the mass of particulate matter that is measured after passing through a size-selective inlet with a 50 per cent efficiency cut-off at 2.5 µm aerodynamic diameter
PM ₁₀	Particulate matter, the mass of particulate matter that is measured after passing through a size-selective inlet with a 50 per cent efficiency cut-off at 10 µm aerodynamic diameter
POPs	Persistent organic pollutants, (lindane, dichloro-diphenyl-trichloroethane (DDT), polychlorinated biphenyl (PCBs), pentabromodiphenyl ether (PeBDE), perfluorooctane sulfonate (PFOS), hexachlorobutadiene (HCBd), octabromodiphenyl ether (OctaBDE), polychlorinated naphthalenes (PCNs), pentachlorobenzene (PeCB) and short-chained chlorinated paraffins (SCCP)
Se	Selenium
SCCP	Short-chained chlorinated paraffins
SO ₂	Sulphur dioxide
SO _x	Sulphur oxides, all sulphur compounds expressed as sulphur dioxide
TSP	Total suspended particulates. The mass of particles, of any shape, structure or density, dispersed in the gas phase at the sampling point conditions which may be collected by filtration under specified conditions after representative sampling of the gas to be analysed, and which remain upstream of the filter and on the filter after drying under specified conditions
Zn	Zinc

Units

g	Gramme
g I-Teq	Gramme International Toxic Equivalent
Gg	Gigagramme, 10 ⁹ gramme
GJ	Gigajoule, 10 ⁹ joule
GWh	Gigawatt hour
kg	Kilogramme, 10 ³ gramme
kPa	Kilopascal, 10 ³ Pa
kt	Kilotonne, 10 ³ tonne
Mg	Megagramme, 10 ⁶ gramme
mg	Milligramme, 10 ⁻³ gramme
µg	Mikrogramme, 10 ⁻⁶ gramme

MJ	Megajoule, 10^6 joule
ng	Nanogramme, 10^{-9} gramme
t	Tonne
TJ	Terajoule, 10^{12} joule
PJ	Petajoule, 10^{15} joule

Notation keys

IE	Included elsewhere – Emissions for this source are estimated and included in the inventory but not presented separately for this source (the source where included is indicated).
NA	Not applicable – The source exists but relevant emissions are considered never to occur. Instead of NA, the actual emissions are presented for source categories where both the sources and their emissions are well-known due to availability of bottom-up data (i.e. mainly in the energy and industrial processes sectors).
NE	Not estimated – Emissions occur, but have not been estimated or reported.
NO	Not occurring – A source or process does not exist within the country.
C	Confidential information – Emissions are aggregated and included elsewhere in the inventory because reporting at a disaggregated level could lead to the disclosure of confidential information.
NR	Not relevant - According to paragraph 9 in the Emission Reporting Guidelines, emission inventory reporting should cover all years from 1980 onwards if data are available. However, NR (not relevant) is introduced to ease the reporting where emissions are not strictly required by the different protocols.



Like Snow (photo by Margus Muts)

EXECUTIVE SUMMARY

Estonia, as a party to the Convention on Long-range Transboundary Air Pollution (CLRTAP) is required to report annual emission data, projections of main pollutants, activity data and to provide an Informative Inventory Report. The emissions data of all pollutants for the period 1990-2016 was submitted on 15th February 2019. The first IIR was submitted in 2010.

The current report contains an explanation of pollutant trends and key categories, information about sectoral methodologies, recalculations and planned inventory improvements.

The latest recalculations in the emission inventory were made for the time period from 1990 to 2016. The reasons for the recalculations are specified in the [Table 0.1](#).

Table 0.1 The status of recalculations in the 2019 submission

NFR14 code	NFR name	Recalculation reasons	Pollutant	Recalculation period
1A1a	Public electricity and heat production	Correction of emissions data	NO _x , SO _x , TSP, PM _{2.5} , PM ₁₀ , BC	2012-2016
1A1c	Manufacture of solid fuels and other energy industries	Correction of emissions data	Cd, Hg, Cu, Zn	1990-1999
			Pb, As, Cr, Ni	1990-1992
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Correction of emissions data – emissions were reallocated from NFR 1A2b to NFR 2C7c	Cr, Ni, Zn	2010-2016
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Correction of emissions data	TSP, PM _{2.5} , PM ₁₀	2008-2009
1A2giii	Stationary combustion in manufacturing industries and construction: Other	Correction of emissions data	SO _x	2008-2009
1A3aii(i)	Domestic aviation LTO (civil)	Correction of emissions data	NO _x , NMVOC, SO _x , CO	2008
1A3ai	Road transport: Passenger cars	Correction of activity data and emission factors	NO _x , NMVOC, SO _x , NH ₃ , TSP, CO, HMs, PCDD/PF, PAHs, HCB, PCBs	1990-2016
			PM _{2.5} , PM ₁₀ , BC	2000-2016
1A3bii	Road transport: Light duty vehicles	Correction of activity data and emission factors	NO _x , NMVOC, SO _x , NH ₃ , TSP, CO, HMs, PCDD/PF, PAHs, HCB, PCBs	1990-2016
			PM _{2.5} , PM ₁₀ , BC	2000-2016
1A3biii	Road transport: Heavy duty vehicles and buses	Correction of activity data and emission factors	NO _x , NMVOC, SO _x , NH ₃ , TSP, CO, HMs, PCDD/F, PAHs, HCB, PCBs	1990-2016
			PM _{2.5} , PM ₁₀ , BC	2000-2016
1A3biv	Road transport: Heavy duty vehicles and buses	Correction of activity data and emission factors	NO _x , NMVOC, SO _x , NH ₃ , TSP, CO, HMs, PCDD/F, PAHs, HCB, PCBs	1990-2016
			PM _{2.5} , PM ₁₀ , BC	2000-2016
1A3bv	Road transport: Gasoline evaporation	Correction of activity data and emission factors	NMVOC	1990-2016
1A3bvi	Road transport: Automobile tyre and brake wear	Correction of activity data and emission factors	TSP, HMs	1990-2016
			PM _{2.5} , PM ₁₀ , BC	2000-2016
1A3bvii	Road transport: Automobile road abrasion	Correction of activity data and emission factors	TSP	1990-2016
			PM _{2.5} , PM ₁₀ , BC	2000-2016
1A3dii	National navigation (shipping)	Corrections of statistical data (fuel consumption) from Statistics Estonia	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, HMs, PCDD/F, PAHs, HCB, PCBs	2014-2016
1A4ai	Commercial/institutional: Stationary	Additionally calculated emissions	HCB	1990-2007
1A4bi	Residential: Stationary	Correction of emission factors and emission	NH ₃	1990-2016
1A4bii	Residential: Household and gardening (mobile)	Corrections of statistical data (fuel consumption) from Statistics Estonia	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, HMs, PCDD/F, PAHs	2016

NFR14 code	NFR name	Recalculation reasons	Pollutant	Recalculation period
1A4ciii	Agriculture/Forestry/Fishing: National fishing	Correction of emission factors	SO _x	2003-2016
1A3ai(ii)	International aviation cruise (civil)	Corrections of statistical data (fuel consumption) from Statistics Estonia	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, BC, CO	2001-2016
1A3aii(ii)	Domestic aviation cruise (civil)	Corrections of statistical data (fuel consumption) from Statistics Estonia	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, BC, CO	2001-2016
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	Notation key IE was replaced with the notation key NA	All substances	1990-2009
1B1c	Other fugitive emissions from solid fuels	Correction of emissions data	NH ₃	2000-2003
			NO _x	2004
		"0" value was replaced with a notation key NA	SO ₂	2000-2007
			NMVOC	2000-2007, 2012
2A1	Cement production	Correction of emissions data	PM _{2.5} , PM ₁₀ , TSP	2000-2003, 2006-2008
2A5a	Quarrying and mining of minerals other than coal	Notation key NA was replaced with the notation key IE	PM _{2.5} , PM ₁₀ , TSP	2000-2008
		Notation key NA was replaced with the notation key NE	TSP	1990-1999
2A5b	Construction and demolition	Correction of activity data and emissions data	PM _{2.5} , PM ₁₀ , TSP	2015-2016
2A6	Other mineral products	Correction of emissions data	PM _{2.5} , PM ₁₀ , TSP	2000-2003, 2006-2008
2B1	Ammonia production	Correction of emissions data	NH ₃	1990-1999
2B10a	Chemical industry: Other	Correction of emissions data	NH ₃	1990-1999
2D3d	Coating application	Corrections of statistical activity data from Statistics Estonia	NMVOC	2016
		Corrected emissions data form the OSIS point sources database	PM _{2.5} , PM ₁₀ , TSP	2016
2D3e	Degreasing	Correction of the emission calculation methodology	NMVOC	1990-2016
		"0" value was replaced with the notation key NA	Pb, Cu	2004
		Corrected emissions data form the OSIS point sources database. Emission was replaced with the notation key NE	PM _{2.5}	2007
		Corrected emissions data form the OSIS point sources database	NO _x	2008
		"0" value was replaced with the notation key NA	CO	2008
		"0" value was replaced with the notation key NA	Cr	2010, 2012
2D3f	Dry cleaning	Corrections of statistical activity data from Statistics Estonia	NMVOC	2004-2007, 2009-2016
2D3g	Chemical products	"0" value was replaced with the notation key NE	NO _x , SO _x	1990-2005
		"0" value was replaced with the notation key NE	NH ₃	1990-2004
		"0" value was replaced with the notation key NE	PM _{2.5} , PM ₁₀ , TSP	2004
		"0" value was replaced with the notation key NE	CO	1990-2000, 2003-2004
		"0" value was replaced with the notation key NE	Zn	2005
		"0" value was replaced with the notation key NE	Cr	2009
		Corrected emissions data form the OSIS point sources database	NMVOC	2015
		Corrected emissions data form the OSIS point sources database	TSP	2016
2D3h	Printing	Corrections of statistical activity data from Statistics Estonia	NMVOC	2004-2016

NFR14 code	NFR name	Recalculation reasons	Pollutant	Recalculation period
2D3i	Other solvent use	Corrections of statistical activity data (application of glues and adhesives) from Statistics Estonia	NMVOC	2004-2016
2G	Other product use	Slight corrections of emission	NO _x	1990, 1992, 1996, 1999
		Corrections of statistical activity data (use of tobacco) from Statistics Estonia	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Cd, Hg, As, Cu, PCDD/F, PAHs	2004-2016
3B1a	Manure management - Dairy cattle	More detailed calculation method with correction of emission factor and activity data	NO _x , NH ₃	1990-2016
3B1b	Manure management - Non-dairy cattle	Corrections of statistical activity data (use of tobacco) from Statistics Estonia	NO _x , NH ₃	1990-2016
3B3	Manure management - Swine	More detailed calculation method with correction of emission factor and activity data	NO _x , NH ₃	1990-2016
3B4gi	Manure management - Laying hens	More detailed calculation method	NO _x , NH ₃	1990-2016
		Corrections of statistical activity data	NMVOC, PM _{2.5} , PM ₁₀ , TSP	2016
3B4gii	Manure management - Laying hens	More detailed calculation method	NO _x , NH ₃	1990-2016
		Corrections of statistical activity data	NMVOC, PM _{2.5} , PM ₁₀ , TSP	2016
3B4giv	Manure management - Other poultry	More detailed calculation method	NO _x , NH ₃	1990-2016
3Da1	Inorganic N-fertilizers (includes also urea application)	Corrections of statistical activity data and inclusion of reduction measures	NO _x , NH ₃	2012-2016
3Da2a	Animal manure applied to soils	More detailed calculation method with correction of emission factor and activity data. Inclusion of reduction measures	NO _x , NH ₃	1990-2016
3Da3	Urine and dung deposited by grazing animals	More detailed calculation method with correction of emission factor and activity data	NO _x , NH ₃	1990-2016
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	Corrections of statistical activity data	PM _{2.5} , PM ₁₀ , TSP	2015-2016
3De	Cultivated crops	Corrections of statistical activity data	NMVOC	2016
5A	Solid waste disposal on land	Slight corrections of emissions	NMVOC, PM _{2.5} , PM ₁₀ , TSP	2012-2013, 2016
5C1bi	Industrial waste incineration	For years after 1996 corrected activity data is used. For years 1990-1995 emissions are calculated using the amount of population and IEF from the year 1996	PCDD/F	1990-2008, 2010-2011, 2013
		Slight corrections of emissions	PM _{2.5} , PM ₁₀ , TSP	2016
5C1biii	Clinical waste incineration	Emission was replaced with the notation key NE	PCBs	2002
5C1bv	Cremation	Corrections of activity data from crematoriums	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, CO, HMs, PCDD/F, PAHs, HCB, PCBs	1996-2016
5C2	Open burning of waste	Corrected mistake in emissions	NO _x , NMVOC, SO _x	2016
		Corrected mistake in emissions	PAHs Total	2011, 2013
5D1	Domestic wastewater handling	Emissions were moved from NFR 5D2	NMVOC	1994-2016
		New emissions for years 2008-2012. Slight correction of emissions for the year 2016	NO _x , SO _x	2008-2012, 2016
		New emissions	NH ₃	2009-2012
5D2	Industrial wastewater handling	Emissions for years 1994-2007 were moved under NFR 5D1. For years 2008-2016 facility reported emissions are taken from the OSIS database	NMVOC	1994-2016
5E	Other waste	Slight corrections of emissions	PM ₁₀ , PAHs	2012-2013

Detailed sector by sector explanations concerning the recalculations are presented in Chapter 8.

The differences in total emissions between the 2018 and 2019 submissions are presented in the [Table 0.2](#).

Table 0.2 Difference between the 2018 and 2019 submissions (%)

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb	Cd	Hg	As
1990	0.03	-1.54	0.00	-9.86	NR	NR	0.00	NR	0.00	0.01	0.02	0.10	0.05
1991	0.02	-1.59	0.00	-10.27	NR	NR	0.00	NR	0.00	0.01	0.02	0.12	0.06
1992	0.03	-2.45	0.00	-6.24	NR	NR	0.00	NR	0.00	0.02	0.03	0.13	0.07
1993	0.01	-3.06	0.00	-5.61	NR	NR	0.00	NR	0.00	0.00	0.04	0.17	0.00
1994	0.03	-2.87	0.00	-7.69	NR	NR	0.00	NR	0.00	0.00	0.03	0.16	0.00
1995	0.02	-2.62	0.00	-9.12	NR	NR	0.00	NR	0.00	0.00	0.05	0.17	0.00
1996	0.02	-2.66	0.00	-10.02	NR	NR	0.00	NR	0.00	0.00	0.15	0.35	0.00
1997	0.01	-2.52	0.00	-9.69	NR	NR	0.00	NR	0.00	0.00	0.15	0.34	0.00
1998	0.02	-2.67	0.00	-7.01	NR	NR	0.00	NR	0.00	0.00	0.16	0.38	0.00
1999	0.02	-2.87	0.00	-5.84	NR	NR	0.00	NR	0.00	0.00	0.17	0.39	0.00
2000	0.02	-2.90	0.00	-6.07	0.04	0.03	0.00	0.01	0.00	0.00	0.00	0.04	0.00
2001	0.14	-2.92	0.00	0.25	0.04	0.03	0.00	0.01	0.00	0.00	0.00	0.03	0.00
2002	0.01	-3.02	0.00	-6.13	0.03	0.03	0.00	0.00	0.00	0.01	-0.00	0.02	0.01
2003	-0.00	-3.12	0.03	-8.24	0.04	0.04	0.00	0.01	0.00	0.00	-0.00	0.04	0.00
2004	0.05	-3.11	0.02	-5.18	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
2005	-0.02	-3.32	0.02	-4.44	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.05	0.00
2006	0.05	-3.80	0.01	-4.71	0.03	0.03	-0.00	-0.00	0.01	0.00	0.00	0.09	0.01
2007	0.01	-3.93	0.01	-6.52	0.02	0.02	-0.00	0.00	0.00	0.00	0.00	0.07	0.01
2008	-0.06	-4.01	0.03	-8.31	0.01	0.01	-0.00	-0.00	0.01	0.01	0.00	0.10	0.01
2009	-0.07	-4.22	0.04	-10.38	-0.01	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.05	0.00
2010	-0.06	-4.32	0.01	-12.15	-0.00	-0.00	-0.00	-0.00	0.00	-0.83	0.00	0.04	0.00
2011	-0.08	-4.29	0.00	-12.64	-0.00	0.00	0.00	-0.00	0.03	-0.80	0.00	-0.02	0.00
2012	1.47	-4.50	5.76	-14.03	5.95	8.18	6.09	0.49	0.00	-0.87	0.00	-0.07	0.00
2013	5.75	-4.51	14.25	-13.72	12.22	16.55	13.86	1.14	0.00	-0.70	0.00	0.03	0.00
2014	5.44	-4.56	14.75	-14.23	12.45	16.37	12.33	0.75	-0.04	-0.00	0.04	0.08	0.00
2015	3.39	-4.73	13.52	-20.00	3.73	3.65	-6.40	-0.11	-0.09	-0.00	-0.01	0.05	0.00
2016	3.43	-4.21	17.11	-16.46	3.81	6.56	3.61	-0.69	0.14	0.01	-0.00	0.06	0.00

Table 0.2 continues

Year	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs Total	HCB	PCBs
1990	0.05	-0.03	0.16	3.12	0.03	0.67	0.00	-0.00	-0.00	-0.00	-0.00	1.58	0.00
1991	0.06	-0.04	0.17	3.16	0.03	0.68	0.00	-0.00	-0.00	0.00	0.00	1.63	0.00
1992	0.07	-0.03	0.24	4.33	0.04	0.99	0.00	0.00			0.00	1.82	0.00
1993	0.00	-0.03	0.03	4.68	0.05	1.19	0.00	0.00			0.00	0.35	0.00
1994	0.00	-0.02	0.03	3.26	0.05	1.20	0.00	0.00	0.00	0.00	0.00	0.57	0.00
1995	0.00	-0.02	0.04	2.48	0.05	0.88	0.00	0.00	0.00	0.00	0.00	0.30	0.00
1996	0.00	-0.05	0.06	3.69	0.07	0.79	0.00	0.00		0.00	0.00	0.27	0.01
1997	0.00	-0.03	0.06	3.03	0.07	0.42	0.00	0.00	-0.00	-0.00	0.00	0.26	0.01
1998	0.00	-0.04	0.06	3.55	0.08	0.79	0.00	-0.00	0.00	-0.00	-0.00	0.30	0.01
1999	0.00	-0.03	0.07	3.06	0.08	0.59	0.00	0.00	0.00	0.00	0.00	0.42	0.01
2000	0.00	-0.13	0.10	4.12	0.00	-0.05		-0.00	-0.00	0.00	0.00	0.64	0.01
2001	0.00	-0.12	0.10	3.94	0.00	-0.04	0.00	-0.00	0.00	-0.00	0.00	1.01	0.01
2002	0.00	-0.18	0.17	5.79	0.00	0.80	0.00	0.00	0.00	0.00	0.00	-1.77	0.01
2003	0.00	-0.14	0.12	4.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	-0.01

Year	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs Total	HCB	PCBs
2004	0.00	-0.12	0.11	4.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.93	0.01
2005	-0.00	-0.26	0.12	4.27	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	1.14	0.01
2006	-0.00	-0.29	0.18	5.84	0.00	0.09	0.00	0.00	0.00	0.00	0.00	1.59	0.02
2007	-0.00	-0.35	0.23	8.13	0.00	0.09	0.00	0.00	0.00	0.00	0.00	2.08	0.04
2008	-0.00	-0.41	0.31	9.10	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.48	0.03
2009	-0.00	-0.25	0.15	3.90	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.21	0.01
2010	-0.00	-0.22	0.11	3.68	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.18	0.01
2011	-0.00	-0.15	0.07	2.56	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.12	0.00
2012	-0.00	-0.17	0.07	2.09	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.09	0.00
2013	-0.00	-0.17	0.06	2.24	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.11	0.00
2014	-0.00	-0.28	0.09	2.95	-0.00	0.03	-0.00	-0.01	0.00	0.00	-0.00	0.19	0.01
2015	-0.01	-0.41	0.12	1.46	-0.01	0.03	-0.01	-0.01	0.00	0.00	-0.01	0.19	0.01
2016	0.00	0.06	0.09	1.38	0.01	0.06	-0.01	-0.02	0.00	0.00	-0.01	0.16	0.01

In comparison to last year's submission, recalculations were made for all pollutants (different pollutants for different sectors, see [Table 0.1](#) and [Table 0.2](#)). The detailed descriptions for recalculations are presented in the following chapters.

The main changes occurred in the emissions of NO_x, NMVOC, SO₂, NH₃, PMs and Se. The main reason for NO_x, SO₂ and PM emissions change is a recalculation of emissions for years 2012-2016 due to one LCP operator who was reporting annual emissions on the basis of stack measurements and subtracted the confidential interval for validated average values. The main reason for NMVOC emissions change is a recalculation of emissions for degreasing activity in solvent and other product use sector. The main reasons for the ammonia emissions change is an extensive ammonia emissions recalculation in the agriculture sector due to taking into account

technological changes in spreading of manures and updating the emission factor for ammonia emissions from biomass burning in boilers and households. The main reason for the selenium emissions change is mainly due to the correction of emission factor used for emission calculation from national shipping.

Priorities for future inventory improvement:

- Check the POPs emissions from energy sector and waste incineration;
- Check the activity data and emission factors in energy industries. The main problem appears to be a discrepancy in the data regarding fuel consumption between statistical energy balance and the reports of the facilities;
- Comprehensive check of activity data and emissions in waste sector.



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1. INTRODUCTION

1.1. National Inventory Background

Estonia ratified the Convention on Long-range Transboundary Air Pollution in 2000 and became a party to the Convention and the following protocols:

- The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent;
- The 1988 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes;
- The 1991 Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes;
- The 1984 Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP);
- The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs);
- The 1998 Aarhus Protocol on Heavy Metals.

According to the Guidelines for Estimating and Reporting Emission Data, each party must report the annual national emission data of pollutants in the NFR source category and shall submit an informative inventory report on the latest version of the templates to the Convention Secretariat.

Estonia's Informative Inventory Report is due by March 2019. The report contains information on Estonian emission inventory from 1990 to 2017. The inventory detail the anthropogenic emissions of the main pollutants (SO_x, NO_x, NMVOC, NH₃ and CO), particulate matter (TSP, PM₁₀, PM_{2.5}), heavy metals (Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn) and persistent organic pollutants (dioxins, HCB, PAHs, PCB). Projected emissions for sulphur dioxide, nitrogen oxides, ammonia, PM_{2.5} and NMVOCs are reported for the years 2020, 2025 and 2030.

Methods used to quantify emissions as well as data analysis and other additional information to understand the emission trends as required in the Guidelines are included in the national Informative Inventory Reports (IIR) submitted annually.

1.2. Institutional Arrangements for Inventory Preparation

The Atmospheric Air Protection Act regulates data collection and reporting. Methods for the calculation of emissions are laid down in several regulations of the Minister of the Environment. The Air Pollution Database consists of data on point sources (about 1,770 reports for the year 2017) and diffuse sources. Structure and emission calculations from small point sources and area sources are mainly based on the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016.

The Estonian Environment Agency (ESTE) is responsible for collecting, analysing, storing, reporting and publishing environment-related information and data. The ESTE was established on June 1st 2013 when two environmental organisations were joined together after reorganisation. The new agency will consolidate the former Estonian Environment Information Centre and the Estonian Meteorological and Hydrological Institute into a single organisation. The ESTE is a state authority administered by the Ministry of the Environment. The ESTE's field of activity is the fulfilment of the national environmental monitoring programme, the preparation of national and international reports in the field of environment, evaluating environmental status, ensuring vital services, including weather forecasts, and the maintenance and renewal of monitoring stations and equipment.

The Data Management Department of the ESTEA is responsible for the preparation of the air pollution inventory in Estonia.

The ESTEA performs the final data quality control and assurance procedure before its submission. In preparation for the inventory and in compiling basic data, ESTEA cooperates with the Ministry of the Environment, the Ministry of Economic Affairs and Communications, the Ministry of Rural Affairs, Statistics Estonia, Estonian Rescue Service, Estonian Defence Forces, Estonian Road Administration, Estonian Tax and Customs Board, EVR Cargo Ltd, Tallinn Airport Ltd and the Estonian Environmental Research Centre (EERC).

The important aim of the inventory is to test the effectiveness of governmental environmental policies and provide national and international bodies with official emission data within the

country. The emission data is updated every year and the results are reported annually.

1.3. The Process of Inventory Preparation

The processes of inventory preparation vary for different sources of pollution.

The Estonian national air pollution inventory preparation can be described as an annual cycle, primarily because there is an annual reporting obligation. In order to improve the quality of the inventory and the use of resources more efficiently, analysis of inventory preparation has to be a part of inventory preparation. The main activities of inventory preparation are given in [Figure 1.1](#). The inventory structure in question is presented in [Figure 1.3](#).

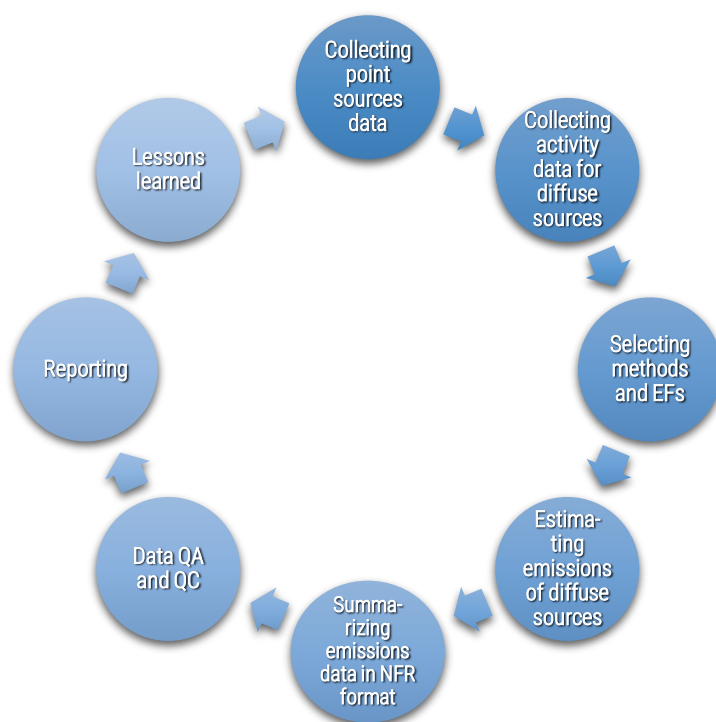


Figure 1.1 The main activities of inventory preparation

The national database contains data for both point and diffuse sources of emissions. The emission inventory for the period of 1990–1999 is based on data pertaining to the large point sources and diffuse sources. From 2000 to 2004, CollectER software was used to accumulate data (both point and diffuse sources). In order to accumulate data on point sources, the Estonian

Environment Information Centre created a web-interfaced air emissions data system for the point sources (OSIS) in 2004, where operators of point sources directly complete their annual air pollution reports. In 2000, the national database contained data from about 600 facilities; however, by 2017 the number had increased to 1,770.

The point sources information system contains data reported by the operators that have a pollution permit issued by the Estonian Environmental Board. Each facility submits data on the emissions of pollutants together with the data regarding burnt fuel, used solvents, amount of distributed liquid fuels, etc. Operators are obliged to specify any data related to accidental releases where such information is available (deliberate, accidental, routine and non-routine). Data is presented on each source of pollution and on the facility as a whole. Emission data is available in SNAP (Source Nomenclature for Air Pollutants) and E-PRTR codes. The operator of point sources can directly add their calculated or measured annual emissions into the OSIS information system by hand or use calculation modules, which use legally regulated national emissions estimation methodologies. The operator can also calculate emissions through

the use of other available methods, though this should be approved by the Environmental Board (regulated by the Atmospheric Air Protection Act). The operator shall indicate the method of emission calculation.

Emissions for some air pollutants (POPs, in some cases PM₁₀ and PM_{2.5}) not included in the reporting requirements under the environmental permits are additionally calculated by the Data Management Department and used in the preparation of the national inventory.

After entering the report into the OSIS information system, the local Environmental Board specialist confirms receipt of the report; at this point, the final verification at the ESTEA is carried out and the data is then ready for use in various reports (see [Figure 1.2](#)).

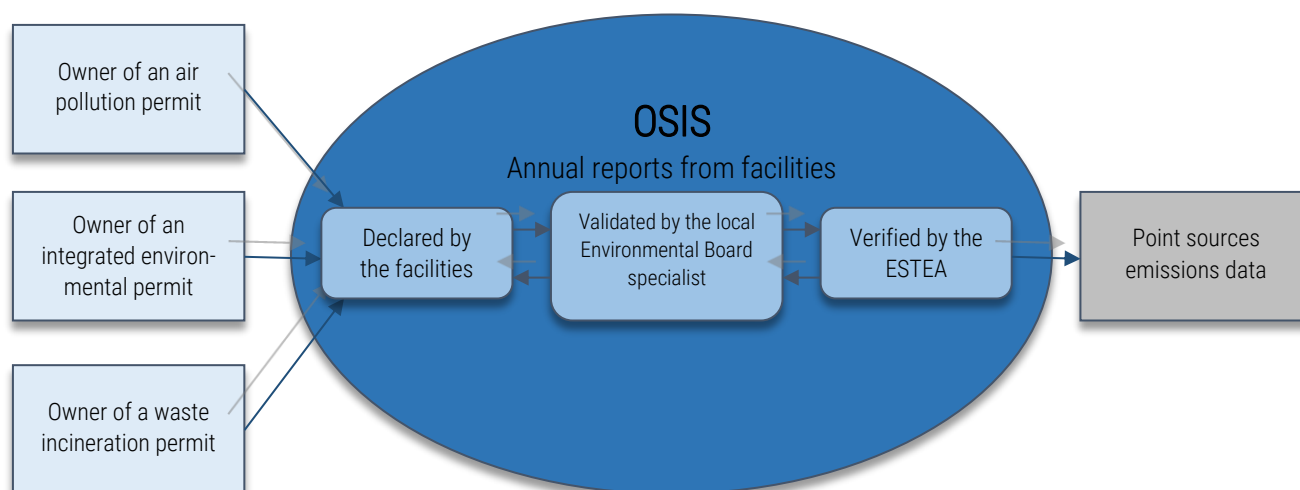


Figure 1.2 Validation of Estonian point sources data

The pollutant emissions from all diffuse sources have been calculated by the ESTEA. The main diffuse sources are combustion in the residential sector, mobile sources, agriculture, parts of solvent use and industrial activities and fugitive emissions from fuel consumption.

The non-direct GHG emissions (SO₂, NO_x, CO, NMVOC), also N₂O, CH₄ and road transport emissions and NMVOC emissions from the solvent use sector calculated by the ESTEA are used in reporting to the UNFCCC Secretariat and the EU CO₂ Monitoring Mechanism.

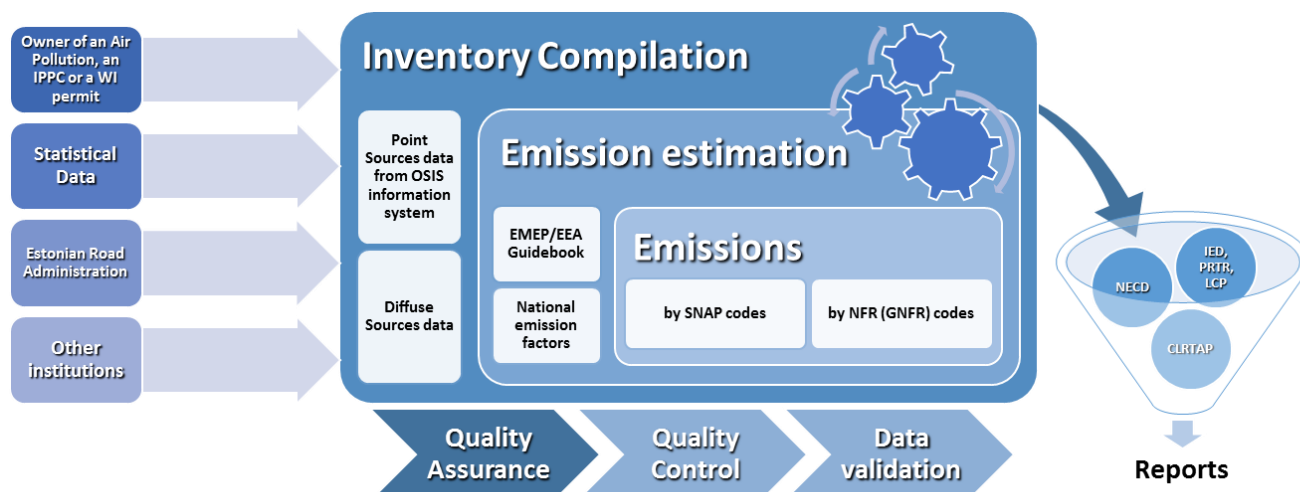


Figure 1.3 Air pollution inventory structure

1.4. Methods and Data Sources

The data reported by the operators and the national specific emission factors or EMEP/EEA Air Pollutant Emission Inventory Guidebook methodology for the emissions calculation from the diffuse sources are used in the preparation of emission inventories.

At present, the ESTEA uses the CollectER tool for the calculation of emissions of diffuse sources from energy sector. The Statistical Office energy balance (EB) and fuel consumption by point sources (PS) are used in this calculation.

$$\text{Diffuse sources Fuel} = \text{EB fuel} - \text{PS fuel}$$

With regard to the calculation of emissions from road transport, the COPERT 5 methodology and emission factors are used. Total emissions are calculated on the basis of the combination of firm technical data (e.g. emission factors) and activity data (e.g. number of vehicles, annual mileage per vehicle, average trip, speed, fuel consumption, monthly temperatures). ESTEA has obtained vehicle data (passenger cars, light and duty vehicles, buses, motorcycles) and annual mileage per vehicle from the Estonian Road Administration. Meteorological data are provided by the ESTEA's Meteorological Observation Department and data pertaining to fuel consumption by Statistics Estonia.

The detailed methods for emission calculations are described in each sector of the IIR.

1.5. Key Categories

This chapter presents the results of Estonian key sources analyses.

Key sources analysis is based on methods described in the EMEP/EEA Guidebook 2016.

Key categories are the categories of emissions that have a significant influence on the total inventory in terms of the absolute level of emissions (certain year). The key categories are those that together represent 80% of the inventory level or trend. According to the study, for certain emissions ("Key sources analysis and uncertainty assessment of sulphur dioxide, nitrogen oxides and ammonia emissions in Estonia" Elo Mandel, Tallinn 2009) in 2007 there were no significant differences between the results of the level and trend assessment of key sources analysis. So, for 2019, only the level assessment was chosen.

The results of all pollutants (including main pollutants), which are reported under CLRTAP, are presented in the [Table 1.1](#).

The energy (1A1a), stationary combustion (1A4bi) and road transport (1A3biii) sectors are the main

sources of NO_x. Energy sector emissions are mainly from oil-shale power plants. The energy and stationary combustion sector are also a key source for dioxins.

Decorative coating application (2D3d) is a main source of NMVOC (15.8%). Additionally, road transport (1A3bi) domestic solvent use (2D3a), combustion in residential plants (1A4bi), manure management (dairy cattle, non-dairy cattle and swine), distribution of oil products (1B2av) and road transport (1A3bi) constitute key sources.

According to level assessment SO₂ emissions for 2019 from the energy sector are responsible for 79.5% of SO₂ emissions in 2017. The majority of these emissions come from two oil shale power plants in east Estonia (Eesti and Balti power plants).

Agriculture is the key source for ammonia, especially livestock manure management (dairy

cattle, swine and non-dairy cattle), manure application to the soils (3Da2a) and the use of mineral fertilisers (3D1a), which are the main sources of pollution regarding ammonia. The influence of energy sector (1Aa) is also significant for ammonia.

The construction and demolition sector (2A5b) is a key source for particles. In addition, the public electricity and heat productions (1A1a) is a key source for TSP, PM₁₀, PM_{2.5}, BC and heavy metals. The influence of combustion in residential plants (1A4bi) is also significant for them.

According to level assessment, 49.7% of CO emissions come from residential combustion plants (1A4bi). In addition, road transport (1A3bi) and the oil-shale industry (1A1c) are the main polluters of CO. Combustion in the residential sector is also a key source for HCB and PAH also.

Table 1.1 Results of key sources analysis

Pollutant	Key categories (Sorted from high to low from left to right)													Total (%)
SO _x	1A1a	1A2gviii												92.9
	79.5%	13.4%												
NO _x	1A1a	1A4bi	1A3biii	1A3bi	1A4cii	3Da1	1A2gvii							80.1
	30.8%	14.9%	9.9%	9.6%	7.2%	4.5%	3.3%							
NH ₃	3Da2a	3B1a	3Da1	3B1b	3B3	3Da2c	1A1a							81.3
	24.3%	22.5%	14.3%	8.4%	6.4%	2.4%	2.4%							
NMVOC	2D3d	1A4bi	3B1a	2D3a	3B1b	1A3bi	1B2av	2D3i	1A2gviii	2H2	2D3h	1A1a	3De	80.9
	15.8%	15.1%	10.5%	7.1%	5.4%	4.4%	4.3%	3.6%	3.4%	3.1%	3.0%	2.9%	2.3%	
CO	1A4bi	1A1c	1A3bi	1A2gviii										85.3
	49.7%	22.6%	7.1%	6.0%										
TSP	1A1a	2A5b	1A2gviii	1A4bi	3Dc	1A1c	1A4ci							80.8
	23.2%	20.2%	16.0%	13.3%	4.6%	1.8%	1.8%							
PM ₁₀	1A1a	1A2gviii	1A4bi	2A5b	3Dc									82.2
	29.1%	20.6%	17.3%	8.6%	6.6%									
PM _{2.5}	1A2gviii	1A1a	1A4bi	1A4ai										81.7
	28.5%	25.2%	25.1%	2.9%										
Pb	1A1a													93.0
	93.0%													
Hg	1A1a													90.5
	90.5%													
Cd	1A1a	1A4bi												92.9
	66.5%	26.5%												
DIOX	1A1a	1A4bi	5C1bi	5E	1A2gviii									86.1
	22.8%	19.6%	18.6%	13.0%	12.0%									
PAH	1A1a	1A4bi	1A2gviii											95.6
	40.2%	37.3%	18.1%											
HCB	1A4bi	1A1a												81.5
	50.0%	28.5%												

1.6. QA/QC and Verification Methods

A quality management system has been developed to support the inventory of air pollutant emissions.

Quality Control (QC) is a system of routine technical activities used to measure and control the quality of the inventory as it is being developed.

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process.

Estonia's QA/QC plan consists of six parts:

- **Stakeholder engagement (stakeholders = e.g. suppliers of data, reviewers, recipients, other inventory compiling institutes):** The Estonian inventory was reviewed under the stage 3 review in 2016 summer by the EMEP emission centre CEIP acting as the review secretariat. The results are available at CEIP home page (<http://www.ceip.at/review-process/centralised-review-stage-3/>). In 2017 the Estonian inventory was a subject for the comprehensive technical review of national emission inventories pursuant to the Directive on the Reduction of National Emissions of Certain Atmospheric Pollutants (Directive (EU) 2016/2284). The recommendations from TERT and improvements made in the inventory are included in the Annex II of the IIR.
- **Data collection:** Data collection includes both point sources emissions and diffuse sources activity. Prior to using activity data, common statistical quality checking related to the assessment of trends is carried out. ESTEA uses only point sources data, which are checked and validated by local environmental departments.
- **Data manipulation:** Common statistical quality checking is carried out.

- **Inventory compilation:** Before submitting data to CEIP/EEA NFR, formats have to be checked with RepDab.
- **Reporting**
- **Archiving**

1.7. General Uncertainty Evaluation

Uncertainty analysis has been carried out for the 2019 submission under the terms and conditions of the LRTAP convention as part of the Estonian IIR 2019.

Any uncertainty was calculated regarding those pollutants and sectors that are reflected in the inventory of Estonian ambient air. These pollutants include sulphur dioxide (SO₂), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), ammonia (NH₃), particulate matter (PM_{2.5}, PM₁₀, TSP), carbon monoxide (CO), heavy metals (Pb, Cd, Hg), persistent organic pollutants (dioxins (PCDD/F), polycyclic aromatic hydrocarbons (PAHs), HCB, PCBs. Activities are defined according to NFR categories.

1.7.1. Overview of the Method

The process of evaluating the uncertainties was based on the Tier 1 methodology as described by the guidance document in the EMEP/EEA Guidebook 2016. Tier 1 methodology calculations are based on the emissions for the base year and what is known as the reference year, and on activity rate uncertainties and emissions factors for every NFR sector. Firstly, the uncertainty level was calculated on a pollutant-by-pollutant basis for every subcategory, and then the uncertainty levels for all subcategories were added together, thereby producing the overall uncertainty level for the inventory data. Uncertainty levels were also evaluated for aggregated sectors such as stationary combustion, aviation, road transport,

other forms of transportation, industrial processes, solvent use, and agriculture and waste management; the results are presented under each IIR chapter. The base year for all pollutants was 1990, except for the PM₁₀ and PM_{2.5} figures, in which case the appointed base year was 2000. The reference year is 2017.

The uncertainty values for emissions factors were for the most part based on the figures that are included in the EMEP/EEA guidance document. If

the default figures for uncertainty values of specific pollutant emissions were not set out in the guidance document, then expert evaluations were also used. The recommended range of error that is listed in the EMEP/EEA Guidebook 2016 for source data and emissions factors is given in [Table 1.3](#). The margins of error for source data and emissions factors in this document are shown respectively by sectors in [Table 1.2](#) and [Table 1.4](#).

Table 1.2 Activity data uncertainty and sources

NFR sector	Uncertainty, %	Data source
1A1	2	National energy statistics; operators data
1A2	2	National energy statistics; operators data
1A3	2	National energy statistics; operators data
1A4 (liquid fuels)	3	National energy statistics; operators data
1A4 (solid fuels)	2	National energy statistics; operators data
1A4 (natural gas)	2	National energy statistics; operators data
1A4 (biomass)	5	National energy statistics; operators data
1A4 (waste)	50	Expert judgement; waste management information system
1B1	2	National statistics; operators data
1B2	2	National statistics; operators data
2A1	2	National statistics; operators data
2A2	2	National statistics; operators data
2A5	2-5	National statistics; operators data
2B1	2	Operators data
2B10a	2	Operators data
2C1	2	Operators data
2C3	2	Operators data
2C5	2	Operators data
2C6	2	Operators data
2C7	2	Operators data
2D3	2-10	National statistics; operators data
2G	5	National statistics
2H1	2	National statistics; operators data
2H2	2	National statistics; operators data
2I	2	Operators data
2K	2	Operators data
2L	2	Operators data
3B1	2	National statistics
3B2	2	National statistics
3B3	2	National statistics
3B4	2	National statistics
3D	2	National statistics
5A	2	Operators data
5B1	2	Operators data
5B2	2	Operators data
5C1	2	Operators data
5C2	10	Expert judgement; waste management information system
5D1	2	National statistics; operators data
5D2	2	National statistics; operators data
5D3	2	National statistics; operators data
5E	2	National statistics; operators data

Table 1.3 The EMEP/EEA Guidebook emission factors uncertainty range

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 – 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 – 60 %
C	An estimate based on a large number of measurements made at a small number of representative facilities, or an engineering judgement based on a number of relevant facts	50 – 200 %
D	An estimate based on a single of measurements, or an engineering calculation derived from a number of relevant facts	100 – 300 %
E	An estimate based on an engineering calculation derived from assumption only	Order of magnitude

Table 1.4 NFR source categories with applicable quality data rating

NFR sector	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	CO	Heavy metals	Dioxins	PAHs	HCB	PCBs
1.A.1.a	B	C	A	C	B	B	B	B	D	D	D	D	D
1.A.1.c	B	C	A		B	B	B	B	D	D	D	D	D
1.A.2.a					B	B	B		D				
1.A.2.gvii	C	C	C	C	C	C	C	C	D		C		
1.A.2.gviii	B	C	A	C	B	B	B	B	D	D	C	C	C
1A3ai(i)	B	B	B		B	B	B	B					
1A3aii(i)	B	B	B		B	B	B	B					
1.A.3.bi	B	B	B	B	B	B	B	B	B	D	C	C	C
1.A.3.bii	B	B	B	B	B	B	B	B	B	D	C	C	C
1.A.3.biii	B	B	B	B	B	B	B	B	B	D	C	C	C
1.A.3.biv	B	B	B	B	B	B	B	B	B	D	C	C	C
1.A.3.bv		B											
1.A.3.bvi					B	B	B		B				
1.A.3.bvii					B	B	B						
1.A.3.c	D	D	C	C	B	B	B	D	B	D	D	D	D
1.A.4.ai	C	C	B		B	B	B	B	D	D	D	D	D
1.A.4.aii	C	C	B	C	C	C	C	C	D		D	D	D
1.A.4.bi (liquid fuels)	D	D	C	C	B	B	B	B	D	D	D	D	D
1.A.4.bi (solid fuels)	D	D	C	C	B	B	B	B	D	D	D	D	D
1.A.4.bi (gaseous fuels)	D	D	C	C	B	B	B	B	D	D	D	D	D
1.A.4.bi (biomass)	D	D	C	C	B	B	B	B	D	B	D	D	D
1.A.4.bii	C	C	B	C	C	C	C	C	C		D	D	D
1.A.4.ci	C	C	B	C	C	C	C	C	C	D	D	D	D
1.A.4.cii	C	C	B	C	C	C	C	C	C		D		D
1.B.1.a	C				D	D	D	D					
1.B.2.av		C											
1.B.2.b		C											
2A1					C	C	C						
2A2					C	C	C						
2A5a					C	C	C						
2.A.5.b					D	D	D						
2.A.6	B	B	B		D	D	D						
2.B.1	C												
2.B.10.a		C		B	B	B	B	C					
2C1		B			B	B	B						
2C3		B			B	B	B						
2C5					B	B	B						
2C6					B	B	B						
2C7a					B	B	B						
2.C.7.c	C			E	B	B	B						
2.D.3.a		B							B (Hg)				

NFR sector	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	CO	Heavy metals	Dioxins	PAHs	HCB	PCBs
2.D.3.b		D			D	D	D						
2.D.3.d		C											
2.D.3.e		B											
2.D.3.f		B											
2.D.3.g		B		D									
2.D.3.h		C											
2.D.3.i		C				B							
2.G	C	C	C	C	C	C	C	C	C	D	D		
2.H.1	C	C			D	D	D	C					
2.H.2		C			D	D	D						
2.L				E									
3.B.1.a	D	D		D	D	D	D						
3.B.1.b	D	D		D	D	D	D						
3.B.2	D	D		D	D	D	D						
3.B.3	D	D		D	D	D	D						
3.B.4.e	D	D		D	D	D	D						
3.B.4.gi	D	D		D	D	D	D						
3.B.4.gii	D	D		D	D	D	D						
3.B.4.giv	D	D		D	D	D	D						
3.B.4.h	D	D		D	D	D	D						
3.D.a.1	D	D		D	D	D	D						
5A		C		C	C	C	C						
5.B.1		C		C									
5.B.2	C	C	C	C			C	C					
5.C.1.bi	C	C		C	C	C	C	C		D			
5.C.1.biii										D			
5.C.1.bv	C	C	C	C	C	C	C	C	C	C	C	C	C
5.C.2	C	C	C		D	D	D	C	D	D	D	D	D
5.D.1		C											
5.D.2	C	C	C	C									
5.E		D			D	D	D		D				

1.7.2. Results of Uncertainty Evaluation

Table 1.5 shows the results of the uncertainty evaluation, which include the estimated emissions by pollutants for both 1990 and 2017, the uncertainties for trends in 1990-2017, and the full uncertainty figures for 2017's national emissions.

Table 1.5 Uncertainty evaluation

Pollutant	Total emission, 1990	Total emission, 2017	Unit	Trend in 1990-2017, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	79.039	33.200	kt	-57.99	12.39%	2.74%
NM VOC	64.860	22.245	kt	-65.70	17.66%	5.21%
SO _x	272.385	38.653	kt	-85.81	8.26%	0.34%
NH ₃	21.511	10.255	kt	-52.33	38.32%	10.07%
PM _{2.5} ¹	15.342	9.222	kt	-39.89	9.73%	4.62%
PM ₁₀	32.087	13.911	kt	-56.64	14.54%	5.45%
TSP	279.099	19.695	kt	-92.94	21.86%	1.48%
CO	236.466	138.286	kt	-41.52	11.33%	6.74%
Pb	205.472	34.078	t	-83.41	186.09%	21.15%

¹ For PM_{2.5} and PM₁₀ base year is 2000 and trend in 2000-2017.

Pollutant	Total emission, 1990	Total emission, 2017	Unit	Trend in 1990-2017, %	Uncertainty, %	Trend uncertainty 1990-2017, %
Cd	4.504	0.804	t	-82.16	135.55%	19.66%
Hg	1.162	0.587	t	-49.48	181.02%	4.73%
PCDD/F	8.121	4.316	g I-TEQ	-46.86	89.32%	49.71%
B(a)p	2.369	2.242	t	-5.34	97.49%	63.50%
B(b)f	2.750	2.618	t	-4.80	107.06%	79.04%
B(k)f	1.510	1.278	t	-15.36	91.21%	51.54%
I(1,2,3-cd)p	1.567	1.587	t	1.29	83.63%	52.32%
HCB	0.196	0.310	kg	58.30	93.04%	107.02%
PCBs	8.375	5.042	kg	-39.80	101.66%	7.09%

According to the results it can be concluded that most pollutant emissions originated mainly from electricity and heating production and the non-industrial combustion sector. Furthermore, a significant proportion originated from the road transport sector. The main source of ammonia emissions is the agricultural sector.

The uncertainty level was at its highest for the POPs and heavy metals. The main reason is a high emissions factors uncertainty level for energy-related activities. Ammonia also showed something of a higher uncertainty level than did

the others, with uncertainty levels at about 100%. Uncertainty levels regarding the pollutant trend were at their highest for HCB and PAHs.

1.8. General Assessment of Completeness

Next two tables present, which sources of pollution in emission inventory are not estimated (see [Table 1.6](#)) or are included elsewhere (see [Table 1.7](#)).

Table 1.6 Sources not estimated (NE)

NFR14 code	Substance(s)	Reason for not estimated
1A2gvii	NH ₃ , PCDD/F, B(k)f, I(1,2,3-cd)p	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A3ai(i)	NH ₃ , HMs, POPs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A3aii(i)	NH ₃ , HMs, POPs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A3ai(ii)	NH ₃ , HMs, POPs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A3aii(ii)	NH ₃ , HMs, POPs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A3bv	POPs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A3bvi	POPs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A3c	Pb, Hg, As, PCDD/F	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A3dii	B(k)f, I(1,2,3-cd)p	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A4aii	Hg, As, PCDD/F, B(k)f, I(1,2,3-cd)p	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A4bii	Hg, As, PCDD/F, B(k)f, I(1,2,3-cd)p	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A4cii	Hg, As, PCDD/F, B(k)f, I(1,2,3-cd)p	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1A4ciii	NH ₃ , PAHs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016

NFR14 code	Substance(s)	Reason for not estimated
1A3di(i)	NH ₃ , PAHs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1B1b	NH ₃	Will be calculated in the next year submission
1B1c	BC	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
1B2c	NH ₃ , Se	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2A1	NH ₃	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2A2	NH ₃	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2A3	NH ₃	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2A5a	BC	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2A6	BC	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2D3a	PM _{2.5}	Emission has not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2016
2D3e	PM _{2.5} , PM ₁₀	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2D3f	PM _{2.5}	Emission has not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2016
2D3g	NO _x , SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, HMs, PCDD/F, PAHs, HCB, PCBs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2D3h	PM _{2.5} , PM ₁₀ , BC	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2D3i	NO _x , SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, HMs, PCDD/F, PAHs, HCB, PCBs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2G	Se, HCB, PCBs	Emission have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
2L	BC	Emission have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
5A	NH ₃ , CO, Hg	For NH ₃ emission has not been estimated due to the lack of activity data. For CO and Hg emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
5B1	NO _x , NMVOC, SO ₂ , PM _{2.5} , PM ₁₀ , TSP, BC, CO	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
5B2	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO	Emissions have not been estimated due to lack of activity data
5C1bi	SO ₂ , NH ₃ , Cr, Cu, Se, Zn, PAHs	For SO ₂ emission has not been estimated due to lack of reported emission data from the facility. For other pollutants emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
5C1biii	NO _x , NMVOC, SO ₂ , NH ₃ , PMs, CO, HMs, PAHs, HCB, PCBs	As this is a minor source of pollution, emissions have not been estimated
5C1bv	BC	Emission has not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2016
5C2	NH ₃ , Se, I(1,2,3-cd)p	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
5D1	NO _x , NMVOC, SO ₂ , NH ₃ , PMs, HMs	For NO _x , NMVOC and SO ₂ emissions have not been estimated due to the lack of activity data. For other pollutants emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
5D2	NH ₃ , PMs, HMs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016
5E	NO _x , NMVOC, SO ₂ , NH ₃ , TSP, BC, CO, HMs, POPs	Emissions have not been estimated due to lack of emission factors in EMEP/EEA Guidebook 2016

Table 1.7 Sources included elsewhere (IE)

NFR14 code	Substance(s)	Included in NFR code
1A2a	NH ₃ , all POPs	1A2giii
1A2b	NH ₃ , all POPs	1A2giii
1A2c	NH ₃ , all POPs	1A2giii
1A2d	All POPs	1A2giii
1A2e	All POPs	1A2giii
1A2f	All POPs	1A2giii
1A4ciii	All (1990-2002)	1A4cii (1990-2002)
1A5b	All	1A4aii
2A1	All substances, excluding particulates	1A2f
2A2	All substances, excluding particulates	1A2f
2A3	All substances	1A2f
2A5a	PM ₁₀ , PM _{2.5} , TSP	2A6 (2000-2008)
3B4giii	NO _x , NH ₃ , NMVOC, PM ₁₀ , PM _{2.5} , TSP	3B4giv
5C1a	All (2013-2017)	1A1a
5D2	NMVOC (1994-2007)	5D1



Source: <http://coachespanel.com.au/>

2. POLLUTANT EMISSION TRENDS

Estonia has been reporting data regarding the total and sectoral national emissions under the LRTAP Convention since 2000.

Estimates are available as follows:

- NO_x, SO₂, NH₃, NMVOC, CO, TSP: 1990–2017;
- PM₁₀, PM_{2.5} and BC: 2000–2017;
- All Heavy Metals: 1990–2017;
- POPs: 1990–2017.

Table 2.1 Main pollutant emissions in the period of 1990–2017 (kt)

Year	NO _x	NMVOC	SO ₂	NH ₃	CO	PM _{2.5}	PM ₁₀	BC	TSP
1990	79.039	64.860	272.385	21.511	236.466	NR	NR	NR	279.099
1991	72.906	61.971	250.090	19.526	228.956	NR	NR	NR	277.781
1992	47.644	42.273	190.990	17.075	134.982	NR	NR	NR	249.331
1993	41.740	34.030	155.218	12.560	128.404	NR	NR	NR	195.388
1994	46.970	36.563	150.042	11.743	162.585	NR	NR	NR	169.968
1995	47.955	40.952	115.730	10.771	212.214	NR	NR	NR	127.411
1996	51.946	41.914	124.702	9.588	244.916	NR	NR	NR	115.318
1997	51.252	43.558	115.930	9.732	247.945	NR	NR	NR	92.260
1998	48.692	40.028	104.295	9.819	218.824	NR	NR	NR	84.187
1999	44.042	37.011	97.779	9.112	203.055	NR	NR	NR	82.536
2000	44.886	37.138	97.110	8.763	198.626	15.342	32.087	3.452	70.148
2001	46.894	36.107	90.712	9.722	200.472	16.263	31.996	3.743	68.349
2002	47.498	35.502	87.037	9.238	190.011	16.658	28.077	3.936	48.495
2003	48.413	34.138	100.331	9.874	182.820	14.309	24.355	3.701	44.485
2004	45.459	34.355	88.187	10.138	173.814	15.445	24.906	3.824	43.142
2005	41.862	32.313	76.257	10.256	155.447	14.224	22.497	3.495	35.740
2006	40.554	30.769	69.912	10.147	141.669	9.793	16.336	2.543	27.244
2007	44.875	28.241	88.050	10.317	157.593	12.714	22.808	3.046	32.868
2008	41.643	26.438	69.494	10.552	156.563	11.932	19.032	3.112	28.437
2009	36.509	23.816	54.895	9.877	155.924	9.641	15.516	2.590	22.625
2010	42.862	23.342	83.292	9.927	156.765	13.930	23.393	3.208	30.175
2011	41.377	23.152	72.719	9.980	131.862	18.227	34.442	3.544	42.713
2012	38.374	22.937	42.922	10.196	141.984	8.689	14.115	2.212	20.798
2013	37.226	22.372	41.695	10.257	134.329	12.128	20.415	2.583	26.677
2014	36.730	22.090	46.835	10.350	128.876	8.916	15.392	2.043	22.047
2015	32.636	21.707	36.082	10.083	128.915	9.634	14.539	2.548	19.731
2016	32.368	21.516	34.947	9.961	140.086	7.770	11.920	2.164	17.068
2017	33.200	22.245	38.653	10.255	138.286	9.222	13.911	2.490	19.708
trend 1990-2017, %	-58.0	-65.7	-85.8	-52.3	-41.5	-39.9	-56.6	-27.9	-92.9
trend 2005-2017, %	-20.7	-31.2	-49.3	0.00	-11.0	-35.2	-38.2	-28.8	-44.9

2.1. Sulphur Dioxide

During the period of 1990–2017, the emissions of sulphur dioxide had decreased by about 86%,

which was largely influenced by a decline in energy production (oil shale consumption as a main fuel in Estonia fell from 231 PJ in 1990 to 191.7 PJ in 2017) (see [Figure 2.1](#) and [Table 2.1](#)). The latter, in turn, was the result of a restructuring

of the economy. Likewise, the export possibilities regarding electricity have also decreased noticeably. The use of local fuels (including wood, oil shale oil) and natural gas has been constantly increasing since 1993, while the relevance of heavy fuel oil in the production of thermal energy

has reduced. The use of fuel with lower sulphur content was also the reason for a decrease in SO₂ emissions (with regard to fuel for road transport and heating). Other reasons for the decrease in emissions are given below.

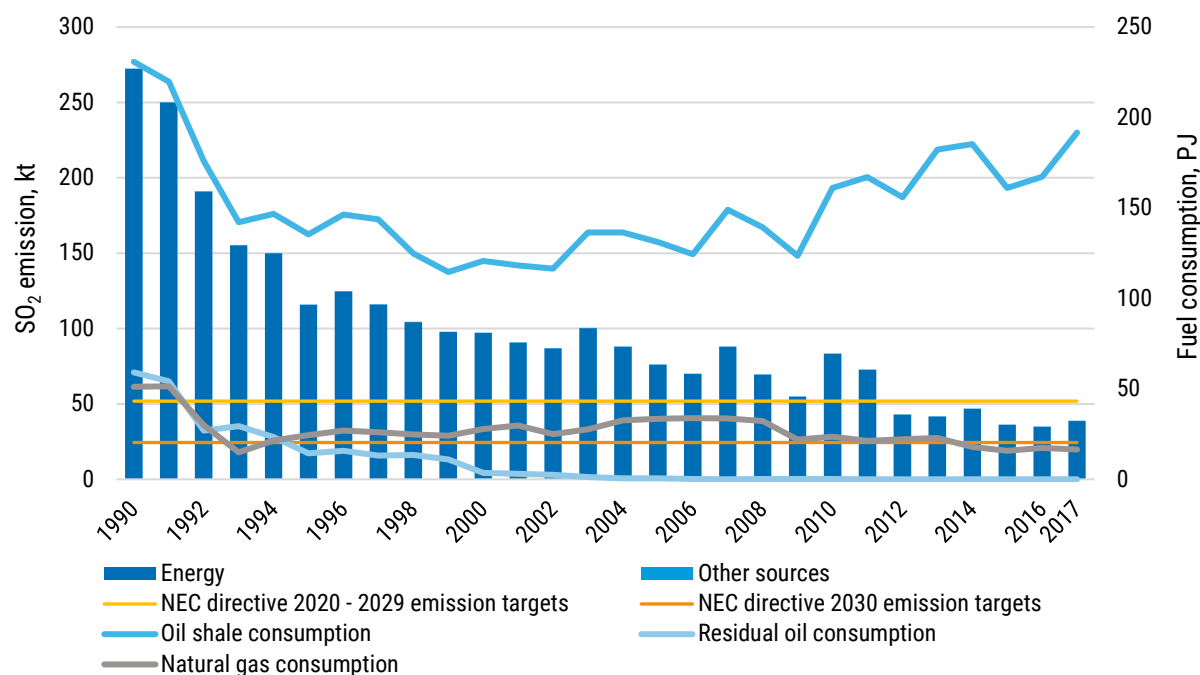


Figure 2.1 SO₂ emissions in the period of 1990–2017 and NEC directive 2016/2284 targets

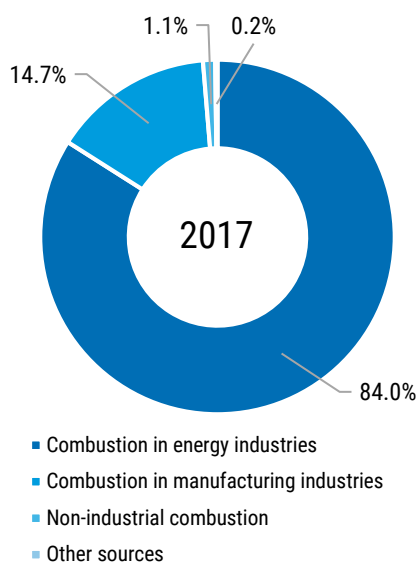


Figure 2.2 SO₂ emissions by sources of pollution in 2017

The main reason for the drop in emissions since 2004 is the launch of two new boilers at the Narva Power Plants (PP). The boilers, which are based on circulating fluidized bed (CFB) technology,

have reduced SO₂ emissions to virtually zero. Emissions have also been considerably reduced by shutting down the old blocks.

A number of additional measures to reduce SO₂ emissions have been implemented over the past decade.

Unique sulphur scrubbers designed in the course of five years of research and development were installed in the Narva PPs on four energy production units of the Eesti Power Plant (PP) in 2012. The semi-dry NID (Novel Integrated Desulphurisation) technology, which uses the fly ash in the gas itself, does not require any additional compounds to bind the SO₂. With regard to the energy units which have not been equipped with the clearing equipment, alternative methods are used for reducing SO₂ emissions, such as water injection to furnaces of PC (old pulverised combustion boilers). Water injection lowers the flame temperature and thus improves conditions for sulphur capture with limestone

included in oil shale. All these solutions mean that these filter equipped units will meet the tighter limits on sulphur emissions in flue gases that will come into effect from 2016. Measures are also being taken to reduce nitrogen emissions, which will enable units to work at full capacity after 2016, without limits. These scrubbers will also reduce the solid particle content of flue gases.

In 2014, SO₂ emissions had increased about 12% compared to 2013. Increase in emissions has occurred due to the fact that in 2014, pulverised limestone was not added to upper parts of furnaces of units 1, 2 and 7 of Eesti PP (adding limestone would reduce SO₂ emissions in PC boilers without NID systems).

In 2016, SO₂ emissions had decreased by about 3% when compared to 2015's figures. The main reason for the reduction of emissions is the conservation of one of the power plants in Ida-Virumaa, which used as its main source of fuel generator and coke oven gas (the facility worked for only half a month at a time and the reduction in emissions amounted to about four thousand tons).

In 2017, SO₂ emissions had increased by about 10.6% when compared to the figures for 2016. The increase in emissions has mainly been caused by the growth of electricity generation at the oil shale Power Plants (approximately 17%).

The share of energy sector, including mobile sources, in total SO₂ emission is 99.8%; the combustion in energy industry (NFRs 1A1a-c) is responsible for about 84% of total emissions in 2017 (see [Figure 2.2](#)). The share of SO₂ emissions from the two large oil shale plants – Narva PP (Eesti and Balti PPs) – accounts for approximately 72.1% of total SO₂ emissions.

According to the new NEC directive 2016/2284, the Member States should comply with the emission reduction commitments set out in this directive. Estonia fulfilled the requirements of the directive and the Gothenburg Protocol of LRTAP Convention, which provided for the reduction of sulphur dioxide emissions by 32% relative to 2005 baseline emissions by 2020, already in 2014. SO₂

emissions decreased by 49.3% in 2017 compared to 2005.

2.2. Nitrogen Oxides

Emissions of nitrogen oxides have decreased by 58% compared to 1990 (see [Figure 2.3](#) and [Table 2.1](#)). The reduction is mainly due to the decrease in energy production and the transport sector during the period of 1990–1993 (the consumption of petrol by road transport dropped 58% at this time and diesel by 45%). The increasing share of catalyst cars in more recent years was also a contributing factor to the reduction of NO_x emissions. The energy industry and road transport sector are the main sources of nitrogen oxide emissions – 31.8% and 22.6% respectively, the share of other mobile sources was 15.8% and non-industrial combustion – 16.1% in 2017 (see [Figure 2.4](#)).

In 2017, NO_x emissions increased by 2.6% in comparison to 2016's figures. The primary reason for this change was the growth of electricity and cement production. However it should be noted that with the growth of electricity generation at the Narva Power Plants to a figure of 17%, the emission of nitrogen oxides increased to a significantly lower figure, because the introduction of clearing equipment at oil shale power plants played a role in keeping down that figure. One of Eesti Energia's major achievements over the past five years is the desulphurisation and denitrification systems that were added to the older energy production units of the Narva Power Plants that use pulverised combustion technology, owing to which the sulphur and nitrogen emissions have decreased by three and almost two times, respectively. (*Eesti Energia*)

At the same period the NO_x emission from road transport decreased by 4.4%, mainly by the stricter emission standards for new vehicles categories. This means that new technologies have been introduced gradually and the average age of vehicles has decreased over the years.

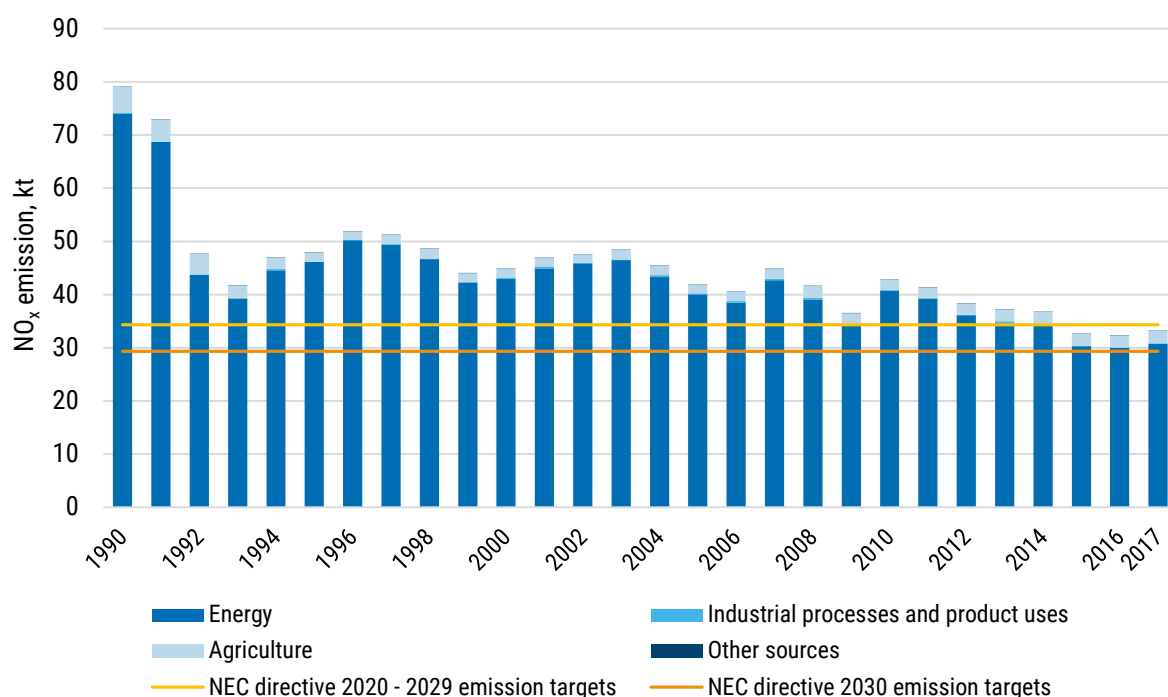


Figure 2.3 NO_x emissions in the period of 1990–2017 and NEC directive 2016/2284 targets

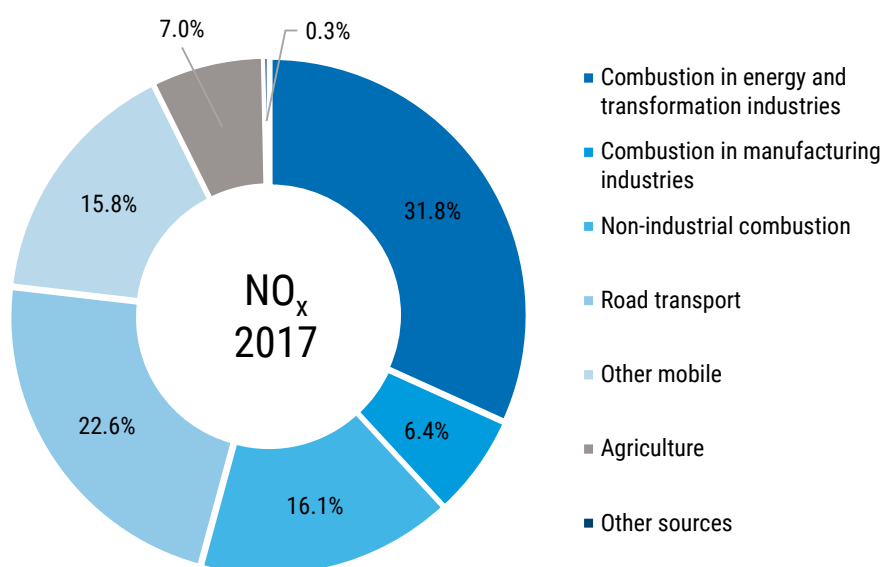


Figure 2.4 NO_x emissions by sources of pollution in 2017

Estonia fulfilled the requirements of the NEC directive 2016/2284 and the Gothenburg Protocol of LRTAP Convention, which provided for the reduction of nitrogen oxides emissions by 18% relative to 2005 baseline emissions by 2020, already in 2015. NO_x emissions decreased by 20.7% in 2017 compared to 2005.

2.3. Non-Methane Volatile Organic Compounds

Emissions of NMVOC in 2017 increased by 3.4% compared to 2016. During this period an insignificant increase or decrease in emissions in all sectors was observed (see Figure 2.6). The increase in the amount of wood being burned and

livestock changes resulted in an increase in emissions from the manufacturing industries (involving combustion processes) and also in the agricultural sector.

The year 2017 saw considerable reductions (5.9%) in NMVOC emissions in the transport sector when compared to the previous year, despite the general increase in transport activity

within this sector over the same period. This reduction has primarily been due to the introduction of progressively stricter Euro emission standards and the fact that older vehicles are being used far less than newer ones (meaning that older vehicles have a lower annual mileage).

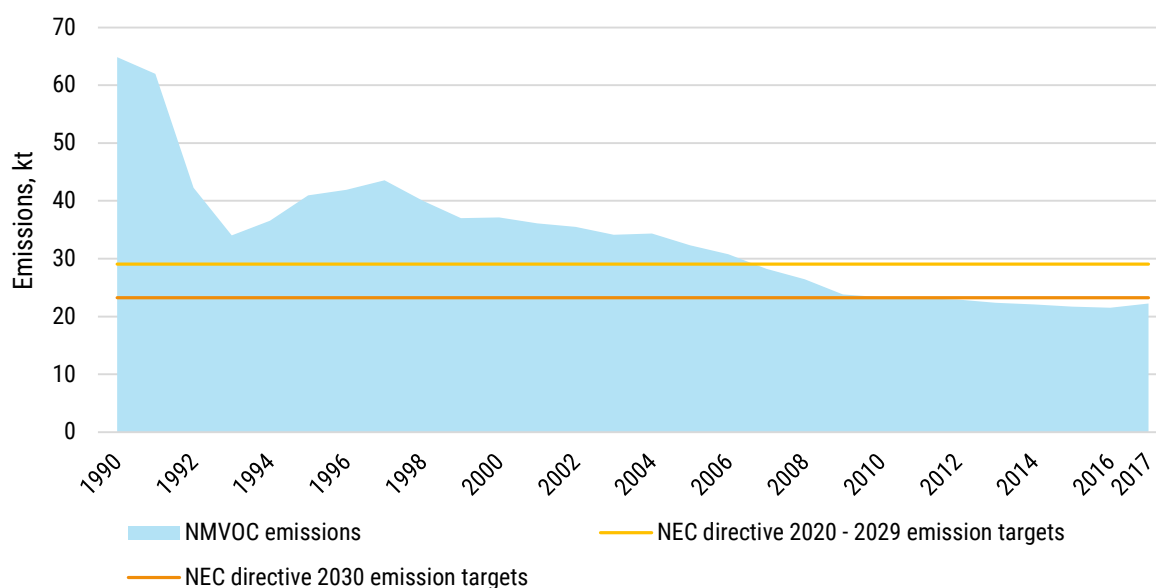


Figure 2.5 NMVOC emissions in the period of 1990–2017 and NEC directive 2016/2284 targets

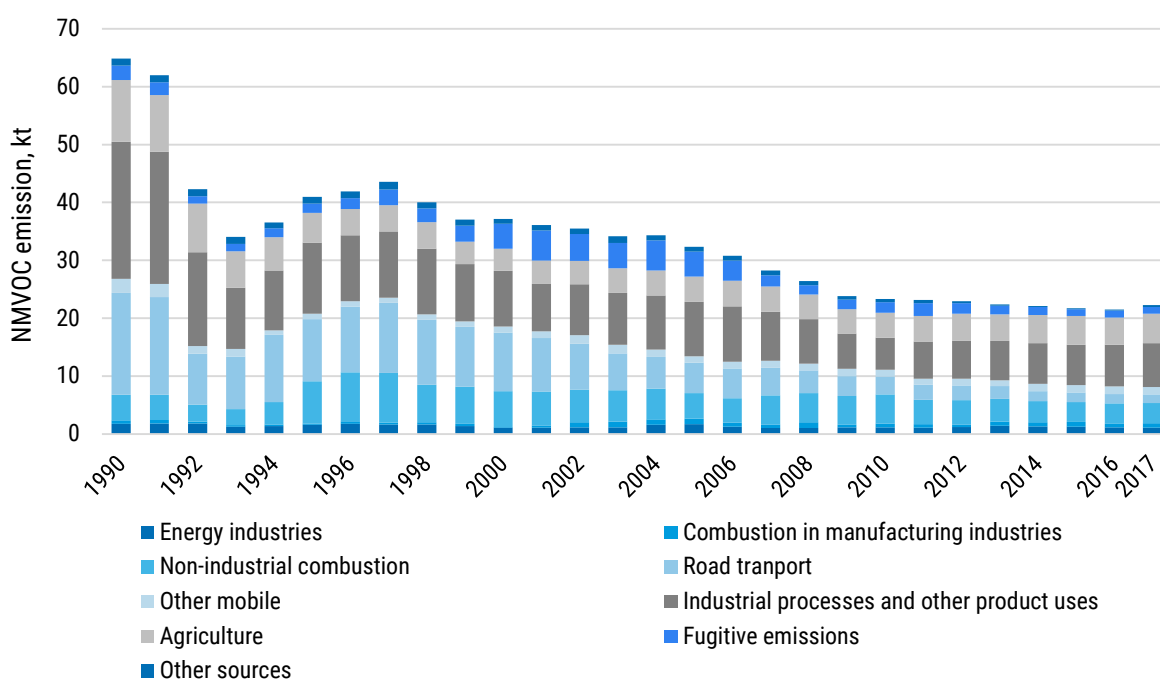


Figure 2.6 NMVOC emissions in the period of 1990–2017

The total emissions of non-methane volatile organic compounds decreased by 65.7% between 1990 and 2017 (see [Table 2.1](#), [Figure 2.5](#)). In 1990, the main polluters of NMVOC were industrial processes and product uses (36.5%) and road transport (27.1%). In 2017, the dominant source was the same – industrial processes and product uses sector (34.1%), but share of non-industrial combustion has increased from 6.8% to 15.6% and share of road transport has decreased from 27.1% to 6.6% (see [Figure 2.7](#)).

The decline in emissions since 1990 has primarily been due to reductions that have been achieved in the road transport sector due to the introduction of catalytic converters on vehicles to reduce exhaust emissions, and carbon canisters

on petrol-driven cars for evaporative emission control. These reductions have been driven by tighter vehicle emission standards, combined with limits on the maximum volatility of petrol. Also, reductions in NMVOC emissions have been enhanced by switching from petrol to diesel cars.

Secondly, during the period of 1990–2017, the production of chemical products fell. Emissions from non-industrial fuel combustion (mainly in households) have increased since 1995. These are the results of the increasing tendency towards wood and wood waste combustion (the NMVOC emission factor for these fuels is much higher for the domestic stoves and higher than for other fuels combustion).

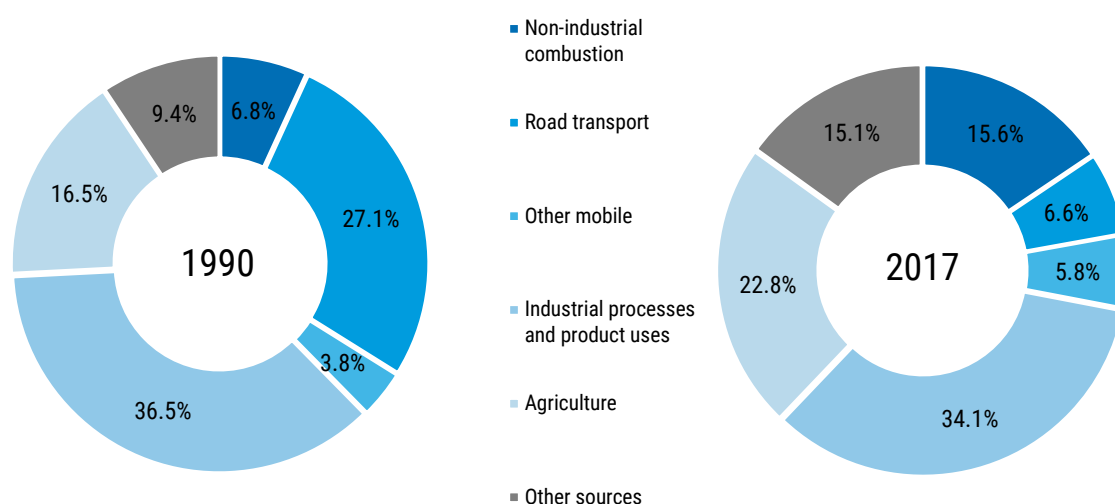


Figure 2.7 NMVOC emissions by sources of pollution in 1990 and 2017

2.4. Ammonia

Total NH_3 emissions decreased by 52.3% between the years 1990 to 2017 due to a reduction in the number of animals and the use of fertilisers (see [Figure 2.8](#)). Livestock manure management and use of mineral fertiliser are the main sources of pollution regarding ammonia (about 87.7% in 2017). The process of combustion in energy and transformation industries and combustion in manufacturing industries sectors is responsible for 4.3% and

2.5% of total emissions respectively. Fugitive emissions from solid fuels (oil shale open cast mining, mainly explosive works) account for approximately 1.6% of emissions, and road transport makes up 1.4%. All other sectors (non-industrial combustion, waste, and other mobiles) account for approximately 2.4% of total ammonia emissions (see [Figure 2.9](#)).

In 2017, NH_3 emissions increased by about 3% when compared to 2016's figures, due mainly to an increase in the livestock number and wood and wood waste combustion in manufacturing industries.

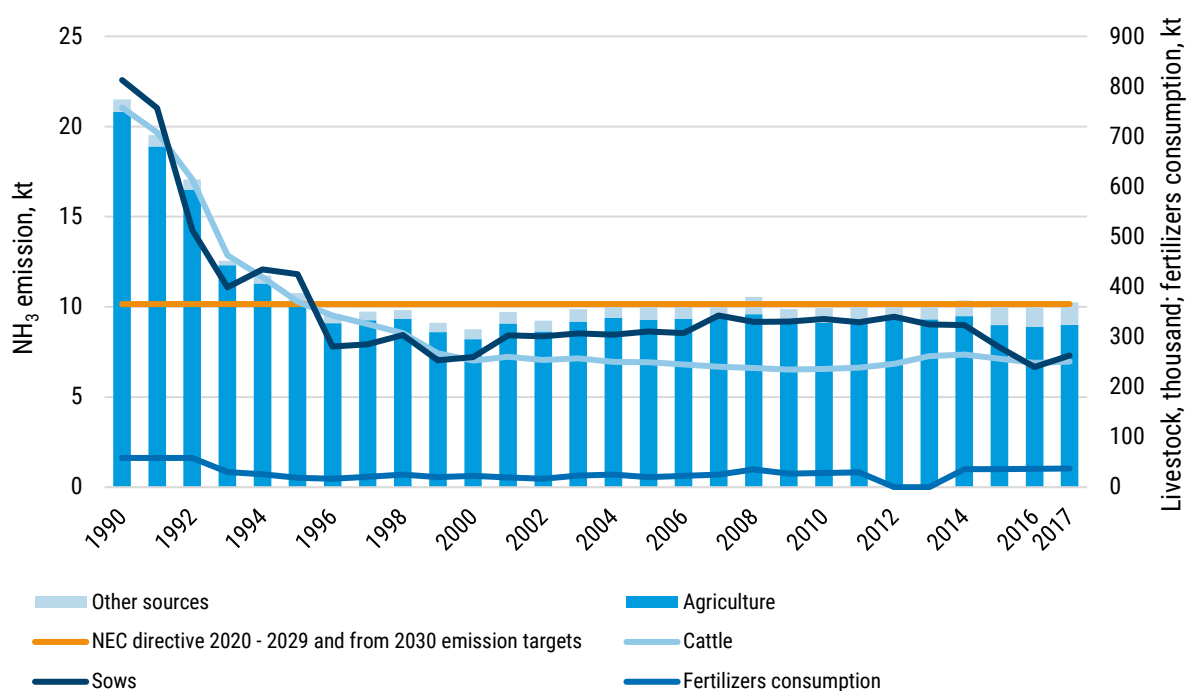


Figure 2.8 NH₃ emissions in the period of 1990–2017 and NEC directive 2016/2284 targets

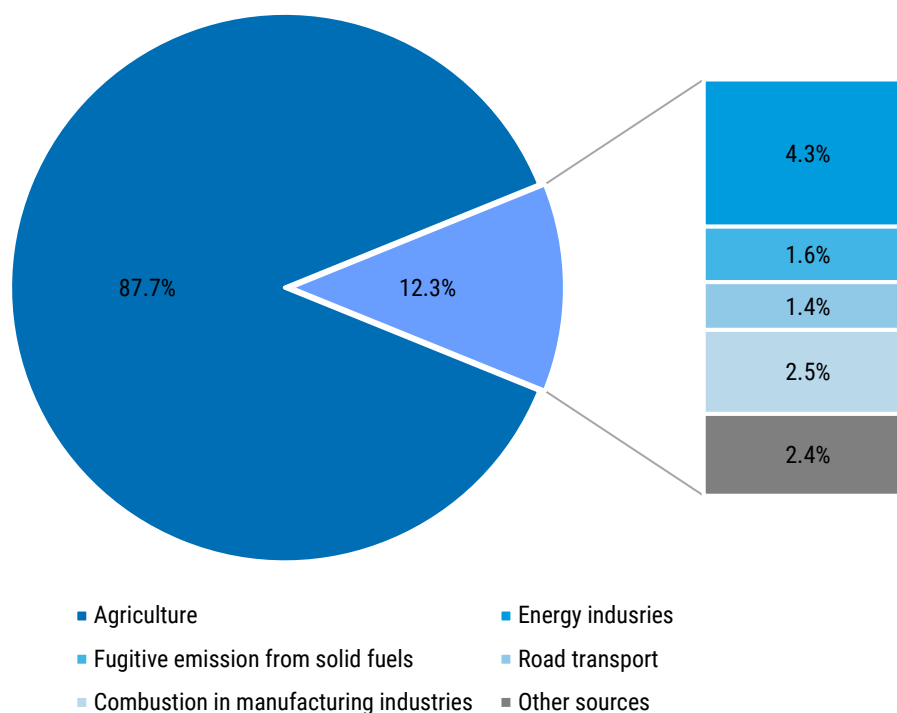


Figure 2.9 NH₃ emissions by sources of pollution in 2017

According to the new NEC directive 2016/2284 and the Gothenburg Protocol of LRTAP Convention, Estonia is obliged to reduce ammonia emissions by 2020 by 1% as compared with 2005.

In 2017, ammonia emissions remained at the 2005 level. Although in 2017, both the number of animals in total and their productivity was higher than in 2005, ammonia emissions have remained at the same level as in 2005 due to technological

innovations in the agricultural sector as well as in environmental protection measures (e.g. duration and time of manure spreading).

2.5. Carbon Monoxide

In the period of 1990–2017, the emissions of carbon monoxide decreased by 41.5%. That was, among other things, caused by the reduction in the use of vehicle fuels (especially from 1990 to 1992), and in recent years, by a decrease in the number of cars driving on petrol. The increase in emissions from 1994 to 1996 is caused by a growth in the burning of wood in the household sector (see [Figure 2.10](#)).

CO emissions from transport have declined over the past two decades. The introduction of catalytic converters and progressively stricter Euro emission standards are the main factors behind these reductions. However, the reductions have been accompanied by a shift from petrol to diesel-powered cars and the fact that older

vehicles are used less when compared to new vehicles (they have a lower annual mileage). These serve as additional reasons for CO emissions declining by 4.3% in the transport sector in 2017 when compared to the previous year.

In 1990, the main polluters of carbon monoxide were road transport (50.9%), while in 2017, the dominant source was non-industrial combustion (50.7%) (see [Figure 2.11](#)). Emissions from non-industrial fuel combustion (mainly in households) have increased since 1995. These are the results of the increasing tendency towards wood and wood waste combustion (the CO emission factor for these fuels is much higher for the domestic stoves and higher than for other fuels combustion). The share of the energy sector increased at the same period from 7.6% to 27%, mainly due to an increase in shale oil production in Eesti Energia Õlitööstus AS (Eesti Energia Oil Industry) plant.

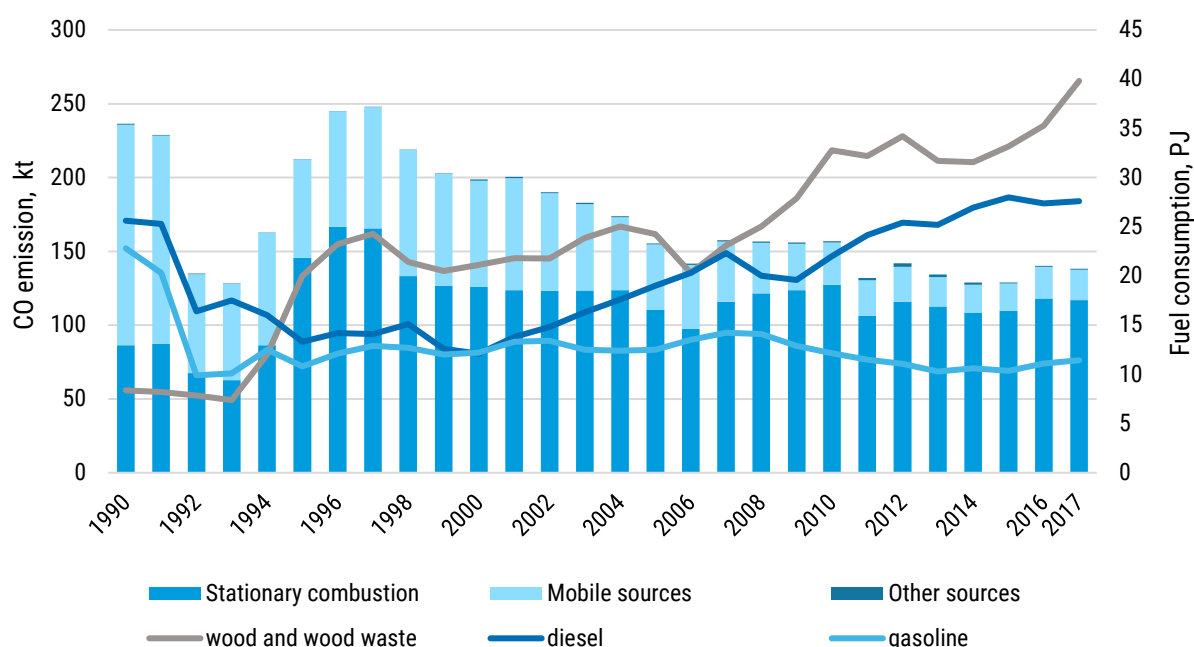


Figure 2.10 CO emissions in the period of 1990–2017

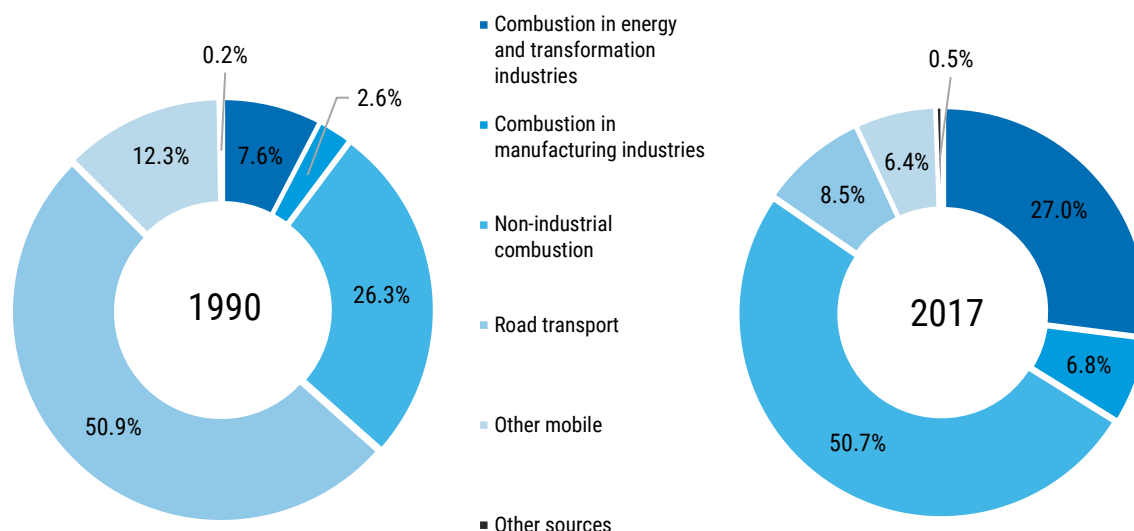


Figure 2.11 CO emissions by sources of pollution in 1990 and 2017

Emissions of CO in 2017 remained practically the same as the 2016 level. During this period an increase or decrease was observed in emissions in all combustion-related sectors. For example, carbon monoxide emissions have decreased in the manufacture of solid fuels and other energy industries, as well as in various sector industries and road transportation. At the same time, there has been a significant increase in emissions in the industrial sector as a result of an increase in wood combustion.

In 2017, the biggest polluters of CO were combustion in the non-industrial sector (about 50.7%, from which a large part is wood combustion in the domestic sector), combustion in the energy industry (27%, mainly from shale oil production industry) and road transport – 8.5% (see [Figure 2.11](#)).

2.6. Particulates

The main source of particulates is the energy sector (including mobile sources), which accounts for 65.1% of the total figure. The

emissions of TSP by sectors of pollution are shown in [Figure 2.13](#).

In 1990–2017, TSP emissions dropped significantly – by 92.9% (see [Figure 2.12](#) and [Table 2.1](#)). This is due to the increase in the efficiency of combustion devices and cleaning installations (especially in oil shale power plants and the cement factory – from 1990 to 1998) as well as the decrease in electricity production. The growth of TSP and fine particulates emission in 2010 resulted from the growth in electricity production at the same period. The significant growth of particulates emission in 2011 was due to the increase in electricity production by 34% in Balti PP (Eesti Energia Narva Elektriijaamad AS) and it is a result of bad operation of electric precipitators on two power units of this power plant.

In 2017, particulate emissions increased by 15.4% in comparison to 2016, due mainly to an increase in emissions from industrial combustion (mainly due to the growth of wood and wood waste combustion) and the construction/demolition sectors.

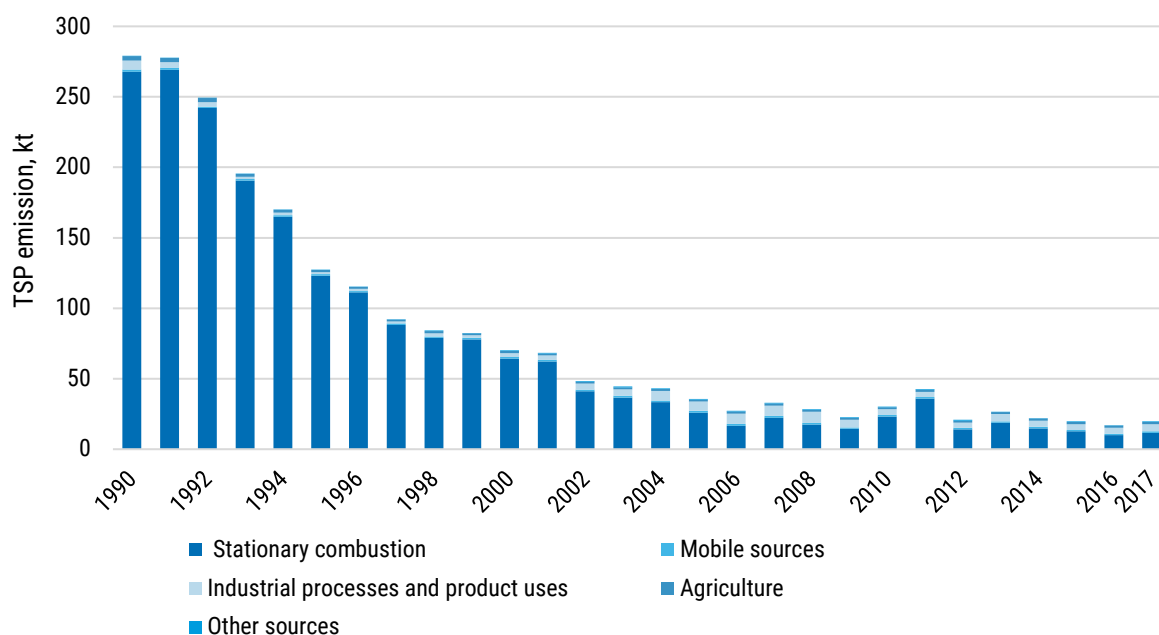


Figure 2.12 TSP emissions in the period of 1990–2017

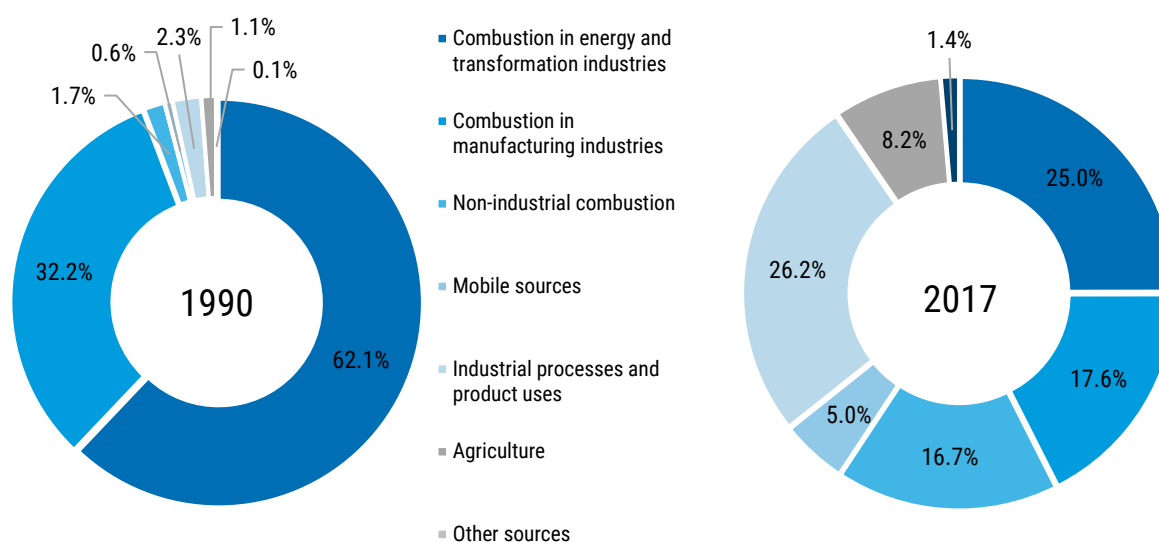


Figure 2.13 TSP emissions by sources of pollution in 1990 and 2017

In 1990, the main polluters of TSP were the energy industry (62.1%) and combustion in manufacturing industries (32.2%). In 2017, the share of combustion in energy industries dropped to 25% and dominant source was industrial processes and product uses (more precisely, construction and demolition) (26.2%). The share of energy and transformation sector has decreased by 37.1%, while the share of non-industrial combustion, agriculture, and mobile sources had increased by 15%, 7% and 4.4%

respectively compared to 1990 (see Figure 2.13). The main reasons for such changes are the following: an increase in the share of wood combustion in the domestic sector (high emission factor of particulates), modernisation of cleaning equipment at the cement plant, and a decrease in electricity production in the oil shale power plants. Other sources contribute to 1.4% of the total emissions.

The emissions of fine particulates PM₁₀, PM_{2.5} and BC are shown in Figure 2.14.

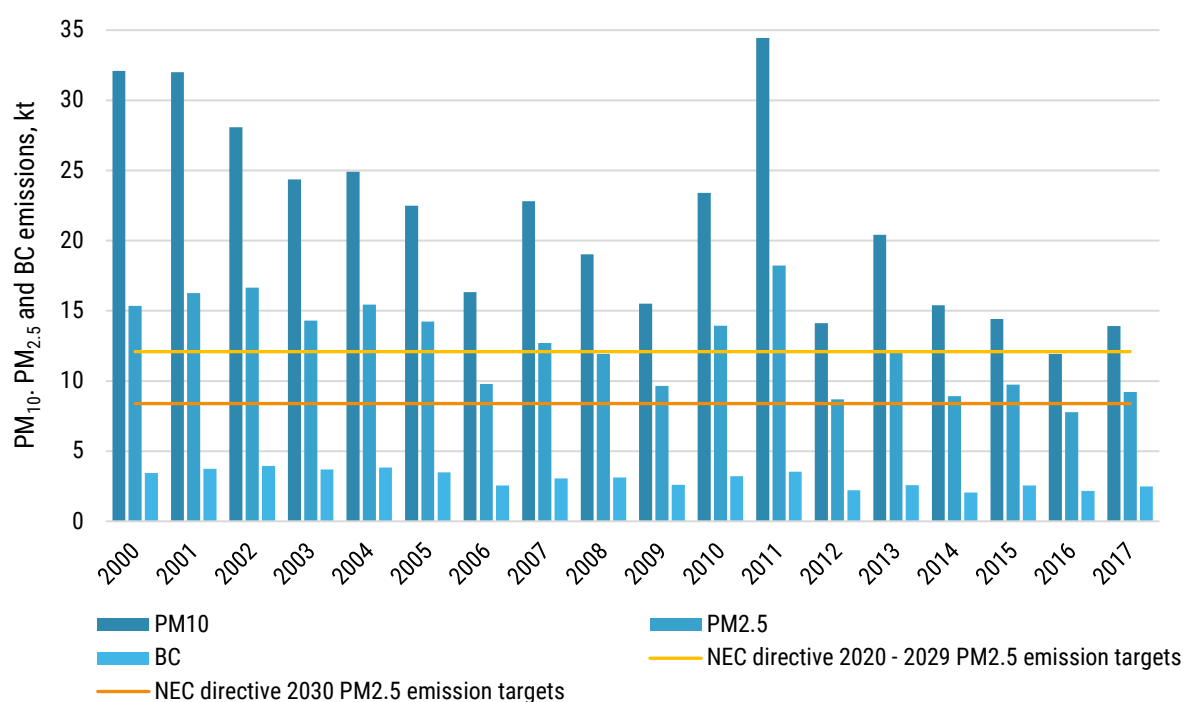


Figure 2.14 PM₁₀, PM_{2.5} and BC emissions in the period of 2000–2017 and NEC directive 2016/2284 PM_{2.5} targets

Emission of black carbon for all activities was calculated in this submission for 2000–2017. In the process of making the calculations in 2018 year submission, the new EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 methodology was applied.

In the period between 2000-2017, emissions of PM₁₀, PM_{2.5}, and BC increased by 56.6%, 39.9%, and 27.9% respectively, despite an increase in electricity production in the same period (by 51.6%). The main reason is an increase in the efficiency of combustion devices and cleaning installations in oil shale power plants.

The reasons of increase in emissions in 2017 in comparison with 2016 same as well as for TSP.

The primary sources of fine particulates (PM₁₀) emission in 2017 were combustion in energy and transformation industries (29%, mainly oil shale combustion), combustion in manufacturing industries (22%) and non-industrial combustion (21%, mainly wood combustion) (see [Figure 2.15](#)). The distribution of PM_{2.5} and BC emissions by sources of pollution is also visible in [Figure 2.15](#) and [Figure 2.16](#). It is interesting to note that if the share of non-industrial combustion (generally wood combustion in domestic sector) in TSP emissions makes up 16.7% of the total emissions, then share in emissions of BC is significantly higher and makes up 38.1%.

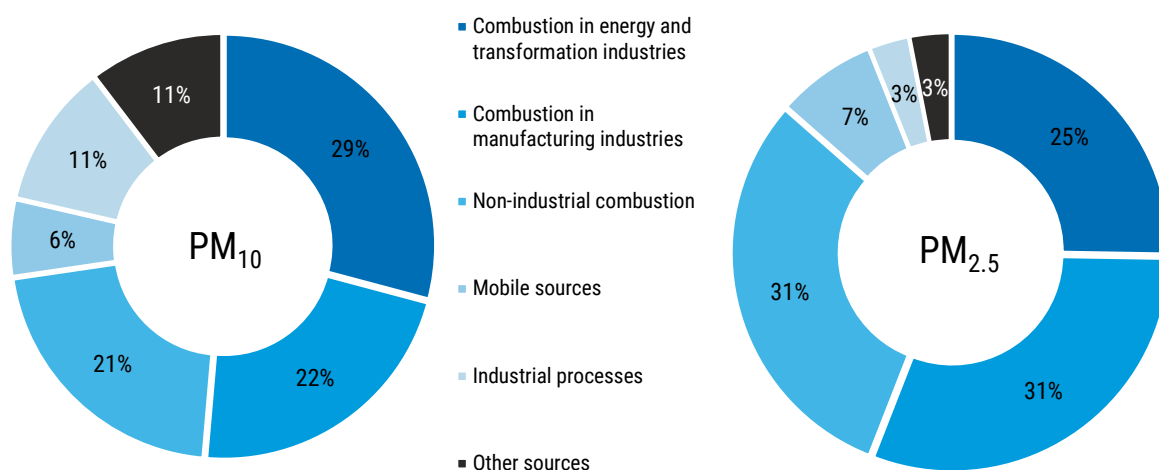


Figure 2.15 PM₁₀ and PM_{2.5} emissions by activities in 2017

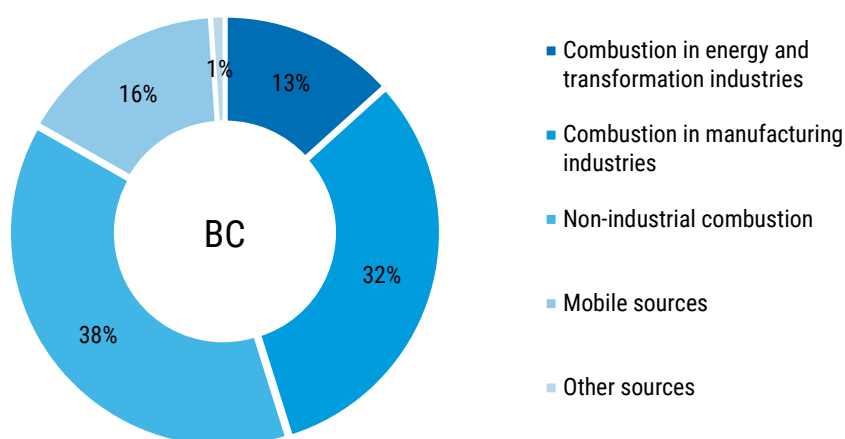


Figure 2.16 Black carbon emission by activities in 2017

The primary sources of black carbon emission in 2017 were non-industrial combustion (38%), combustion in manufacturing industry (32%), mobile sources (16%), combustion in energy and transformation industries (13%, mainly oil shale combustion) (see Figure 2.16). Other sources are mainly industrial processes.

Estonia fulfilled the requirements of the NEC directive 2016/2284 and the Gothenburg Protocol of LRTAP Convention, which provided for the reduction of fine particulate matter emissions by 15% relative to 2005 baseline emissions by 2020,

in 2015. PM_{2.5} emissions decreased by 35.2% in 2017 compared to 2005.

2.7. Heavy Metals

In 1990–2017, emissions of heavy metals dropped significantly, as can be seen in Table 2.2 and Figure 2.17.

Heavy metals are mainly released by combustion in energy and transformation industries and from mobile sources. The energy industry (mainly oil shale power plants) is a big heavy metals polluter

in Estonia. The emissions of lead decreased by 83.4% due to the modernisation of cleaning equipment at both the Narva PP and Kunda Nordic Cement and due to the decrease in energy

production. A further reason is the discontinued use of leaded petrol in Estonia since 2000. (see [Figure 2.19](#))

Table 2.2 Heavy metals emissions in the period of 1990–2017 (t)

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
1990	205.472	4.504	1.162	18.883	18.419	10.989	27.400	106.001
1991	188.142	4.296	1.051	16.482	16.049	10.202	25.616	97.122
1992	124.247	3.089	0.862	14.060	13.814	7.067	17.008	79.427
1993	102.677	2.311	0.678	10.868	10.505	5.819	14.331	61.963
1994	122.835	3.005	0.683	10.710	10.331	6.515	12.859	65.055
1995	85.895	2.180	0.642	10.105	9.963	5.606	10.484	63.477
1996	66.480	1.307	0.640	10.389	10.231	5.140	10.851	61.956
1997	47.333	1.345	0.646	10.233	9.976	5.218	9.746	61.924
1998	41.633	1.224	0.579	9.179	8.922	4.977	8.794	55.338
1999	40.065	1.159	0.558	8.751	8.510	4.648	7.507	53.005
2000	36.905	0.779	0.556	8.607	8.365	4.319	6.478	49.320
2001	36.994	0.755	0.543	8.408	8.239	4.757	6.432	49.044
2002	36.326	0.777	0.547	8.382	8.353	4.930	6.198	48.423
2003	38.439	0.847	0.638	10.007	9.824	5.259	6.799	56.868
2004	36.768	0.786	0.582	9.702	9.409	5.258	6.699	55.525
2005	35.620	0.760	0.562	9.240	9.095	5.419	6.454	52.780
2006	32.124	0.740	0.563	8.616	8.476	5.438	5.791	48.308
2007	40.480	0.909	0.692	11.088	10.810	6.198	6.780	61.370
2008	35.292	0.828	0.605	9.420	9.338	5.599	5.953	54.578
2009	28.441	0.709	0.474	7.613	7.554	4.899	4.868	45.836
2010	38.800	0.896	0.659	10.974	10.604	5.827	6.626	62.009
2011	38.292	0.859	0.663	10.892	10.431	5.845	6.453	60.036
2012	33.789	0.792	0.585	9.607	9.189	5.641	5.675	54.304
2013	39.292	0.965	0.695	11.247	10.593	5.932	6.533	61.836
2014	36.493	0.897	0.686	10.256	9.860	5.982	6.062	56.745
2015	28.398	0.747	0.548	7.754	7.611	5.439	4.690	46.193
2016	32.420	0.809	0.616	8.991	8.692	5.795	5.357	51.843
2017	34.078	0.804	0.587	9.500	9.169	5.949	5.712	55.111
trend 1990–2017, %	-83.4	-82.2	-49.5	-49.7	-50.2	-45.9	-79.2	-48.0

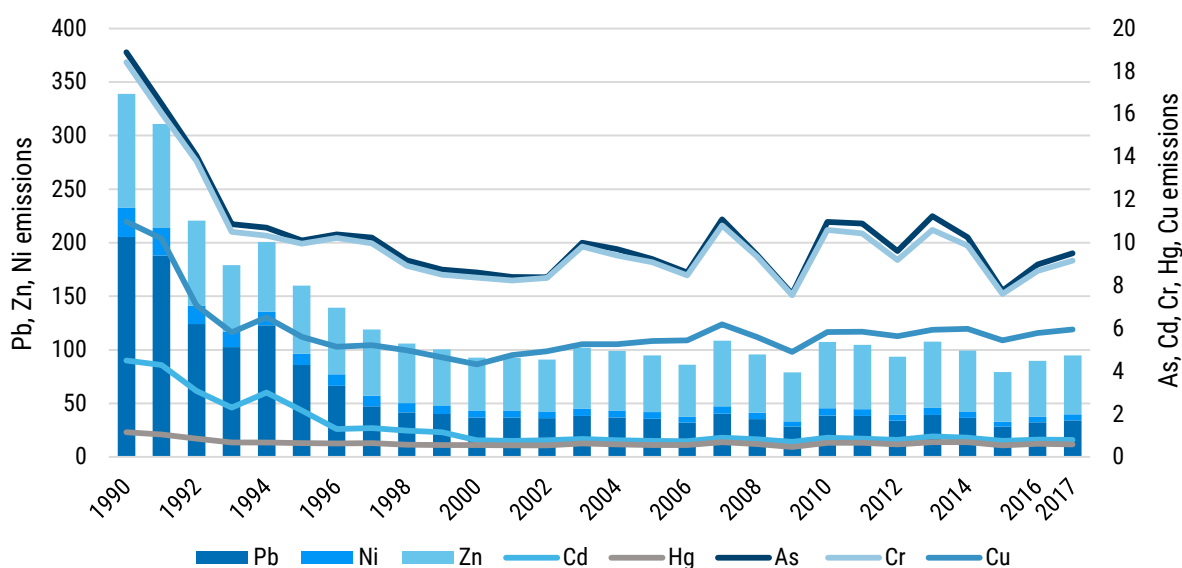


Figure 2.17 Heavy metals emissions in the period of 1990–2017(t)

The emissions of lead by sources of pollution in 1990 and 2017 are shown in Figure 2.18. The distribution of emissions by sector has considerably changed over the last 27 years. While in 1990 the main sources of lead pollution were almost equally road transport, energy

industries and industrial combustion (mainly cement manufacturing), in 2017 the main source of pollution by all heavy metals was the energy industry (mainly oil shale power plants).

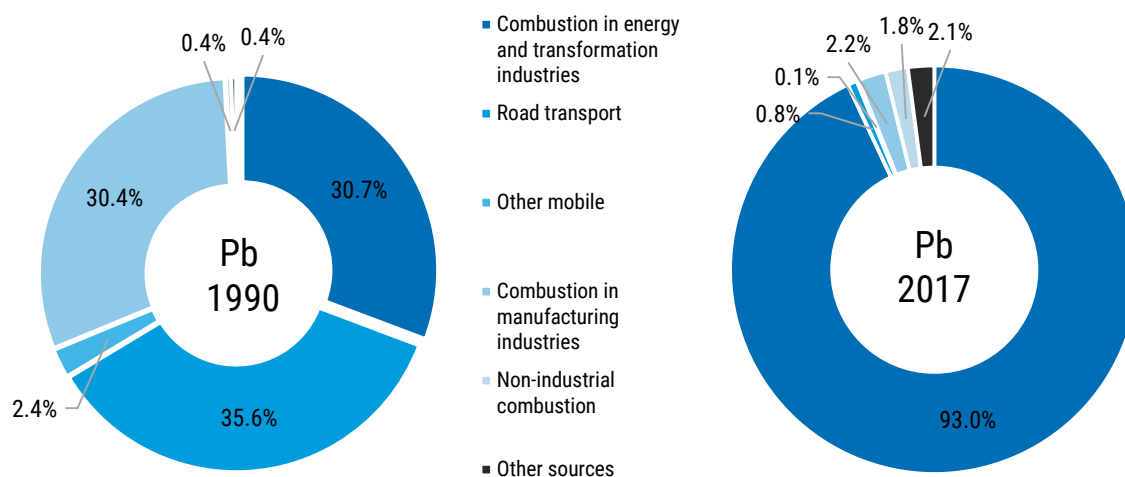


Figure 2.18 Pb emission by sources of pollution in the period of 1990 and 2017

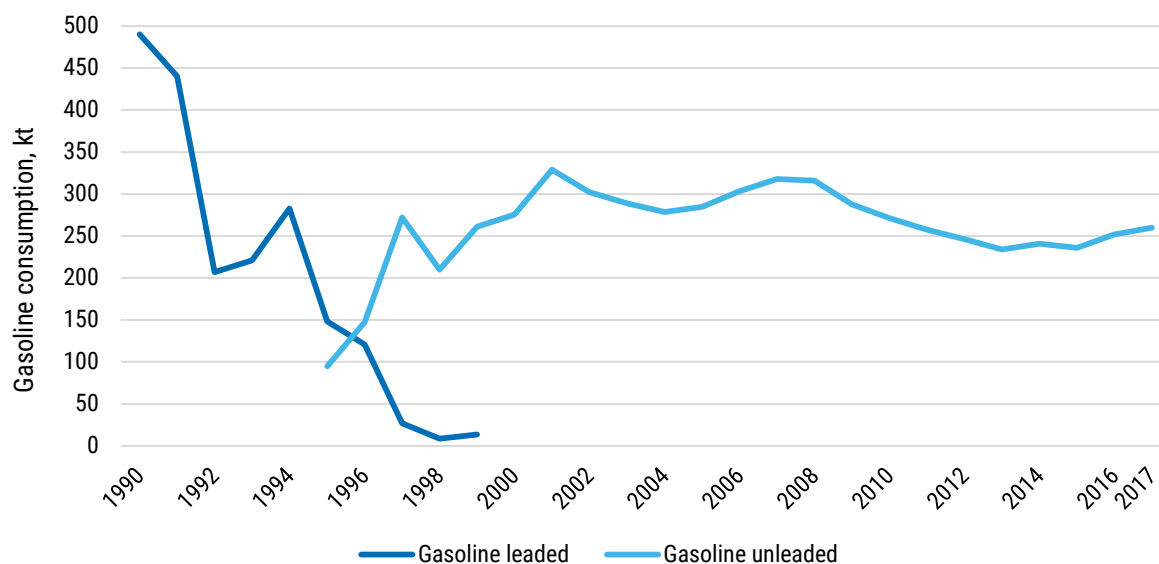


Figure 2.19 Petrol consumption in the period of 1990–2017

2.8. Persistent Organic Pollutants

In the period of 1990–2017, dioxin, PAHs total and PCB emissions decreased by approximately 46.9%, 5.7% and 39.8% respectively. Only HCB

emissions increased for the same period by 58.3% (the main reason is the increase in the share of wood burning), but decreased from 1995 to 2017 by 7.3%.

The emissions of POPs are shown in [Table 2.3](#) and [Figure 2.20](#).

Table 2.3 POPs emission in the period of 1990–2017

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs total	HCB	PCBs
	g I-TEQ	t				kg		
1990	8.121	2.369	2.750	1.510	1.567	8.196	0.196	8.375
1991	8.012	2.349	2.773	1.498	1.540	8.160	0.190	8.539
1992	5.385	1.629	1.797	1.020	1.160	5.606	0.166	5.609
1993	4.362	1.385	1.484	0.897	1.065	4.831	0.144	5.048
1994	4.244	1.744	1.776	1.124	1.501	6.145	0.216	5.149
1995	5.640	2.821	2.756	1.826	2.621	10.023	0.334	4.123
1996	6.344	3.226	3.200	2.106	3.006	11.537	0.371	4.725
1997	6.312	3.224	3.189	2.105	3.024	11.543	0.383	4.317
1998	7.167	2.620	2.650	1.689	2.375	9.333	0.331	4.350
1999	7.134	2.549	2.629	1.638	2.259	9.075	0.316	3.773
2000	6.731	2.398	2.455	1.527	2.153	8.532	0.319	2.621
2001	6.550	2.337	2.436	1.484	2.059	8.316	0.325	4.197
2002	6.936	2.301	2.409	1.456	2.004	8.171	0.300	4.003
2003	6.872	2.307	2.435	1.448	1.999	8.189	0.313	4.753
2004	6.175	2.416	2.595	1.486	1.994	8.491	0.344	3.710
2005	5.727	2.207	2.421	1.331	1.736	7.694	0.292	3.724
2006	5.044	1.895	2.049	1.165	1.428	6.537	0.262	3.045
2007	6.673	1.898	1.972	1.223	1.712	6.806	0.322	1.806
2008	6.689	2.014	2.099	1.254	1.752	7.120	0.335	2.802
2009	6.093	2.136	2.250	1.314	1.821	7.520	0.308	3.057
2010	6.406	2.386	2.600	1.431	1.928	8.346	0.348	4.175
2011	6.311	2.022	2.231	1.210	1.600	7.064	0.314	3.618
2012	4.729	2.039	2.247	1.229	1.620	7.135	0.329	3.480
2013	3.663	2.090	2.210	1.274	1.566	7.140	0.335	3.940
2014	4.039	2.049	2.326	1.198	1.530	7.103	0.280	4.222
2015	4.133	2.029	2.327	1.177	1.491	7.024	0.280	4.232
2016	4.019	2.008	2.295	1.166	1.486	6.955	0.284	4.194
2017	4.316	2.242	2.618	1.278	1.587	7.726	0.310	5.042
trend 1990-2017, %	-46.9	-5.3	-4.8	-15.4	1.3	-5.7	58.3	-39.8

The main sources of dioxin emission in 2017 are the waste sector (37.2%, mainly industrial and clinical waste incineration), combustion in energy industries (23.3%, includes also waste combustion as fuel), non-industrial combustion sector (21%), combustion in the manufacturing industry (12%, includes also waste combustion as fuel, mainly in the cement manufacturing industry) and road transport (6.5%) (see [Figure 2.22](#)).

The main source of PCBs emission is oil shale combustion, which directly depends on the amount of burned fuel.

The main contributor to the total PAHs and HCB emissions is the non-industrial combustion (40.8% and 54.9% respectively, mainly wood combustion in residential sector) (see [Figure 2.21](#), [Figure 2.23](#) and [Figure 2.24](#)), which is followed by the energy sector. Currently, national POPs emission factors are being developed for the energy sector.

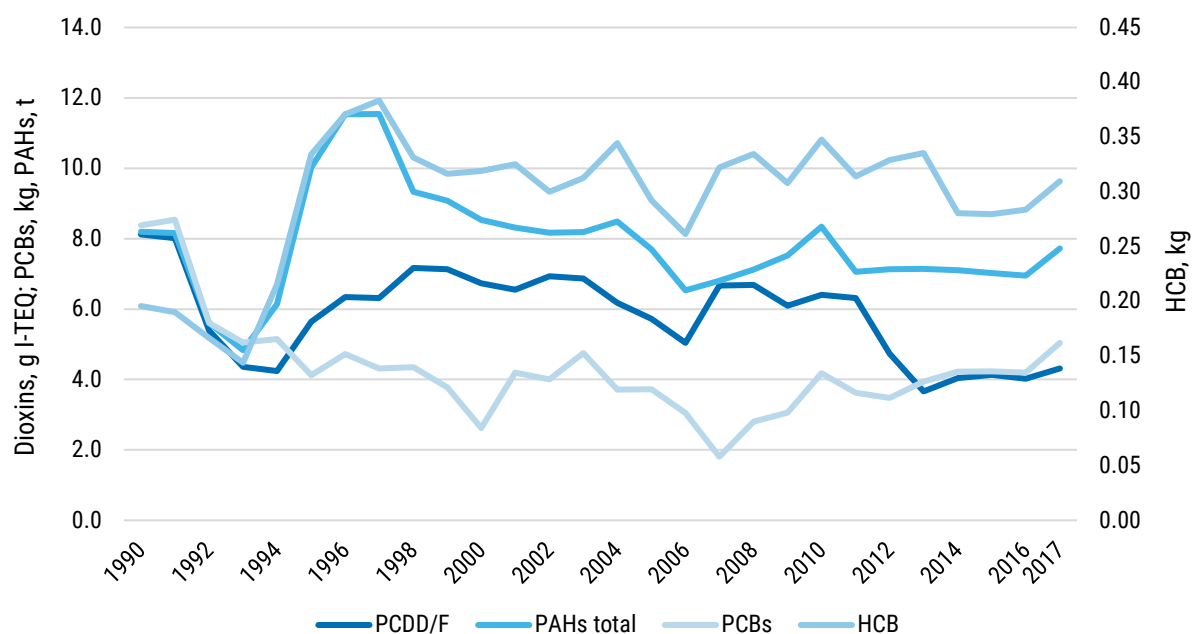


Figure 2.20 POPs emissions in the period of 1990–2017

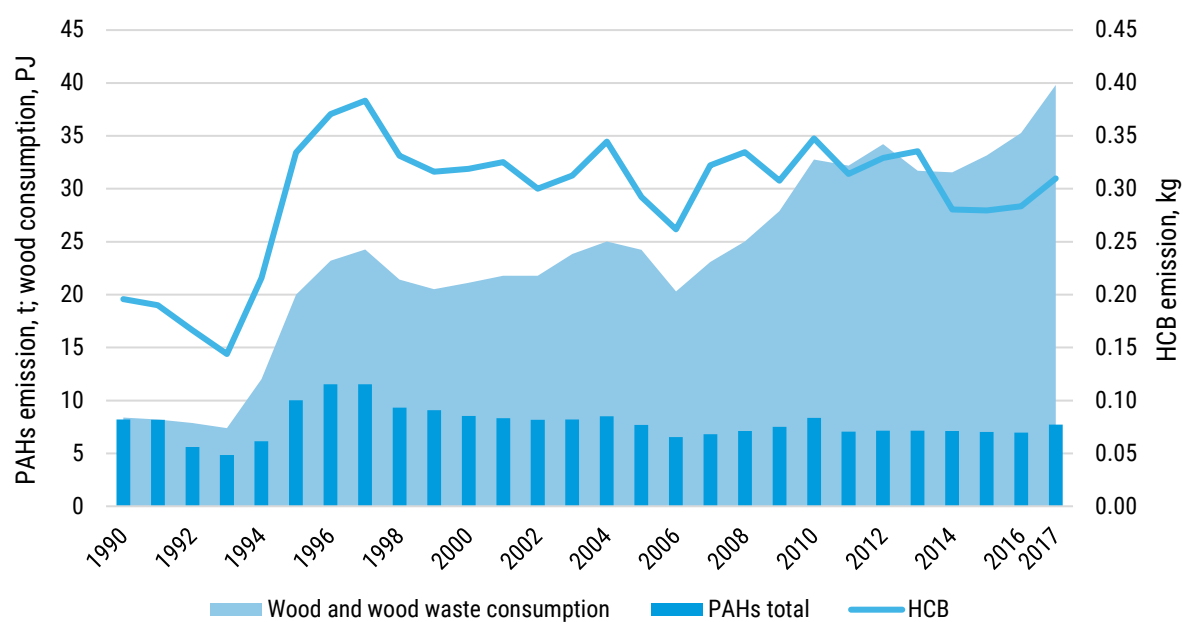


Figure 2.21 PAHs and HCB emissions and wood consumption in 1990–2017

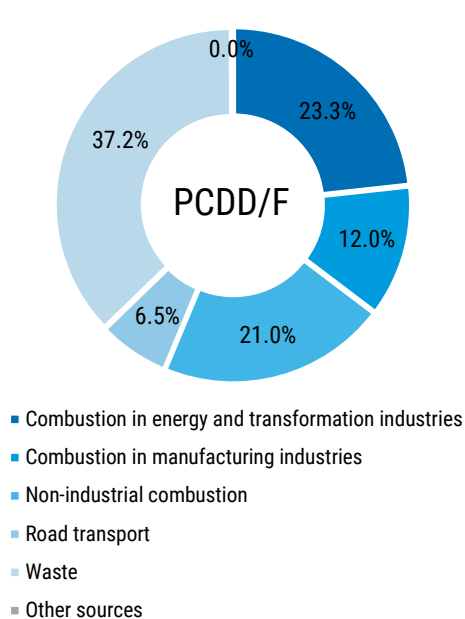


Figure 2.22 Dioxins/Furans (PCDD/F) emissions by activities in 2017

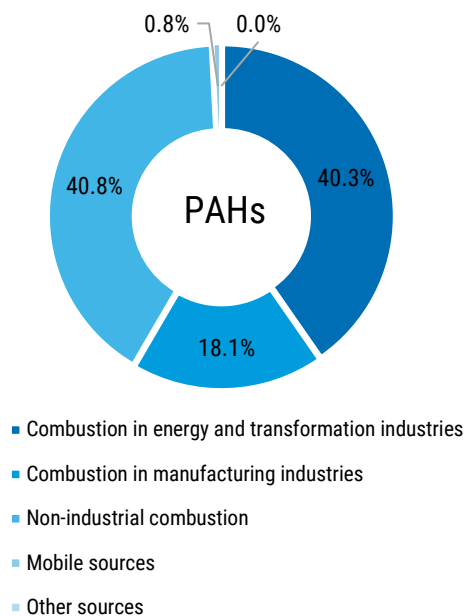


Figure 2.23 PAHs emissions by activities in 2017

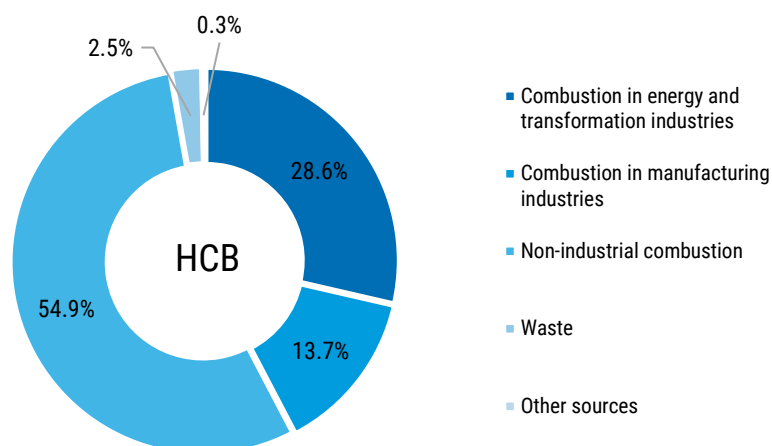
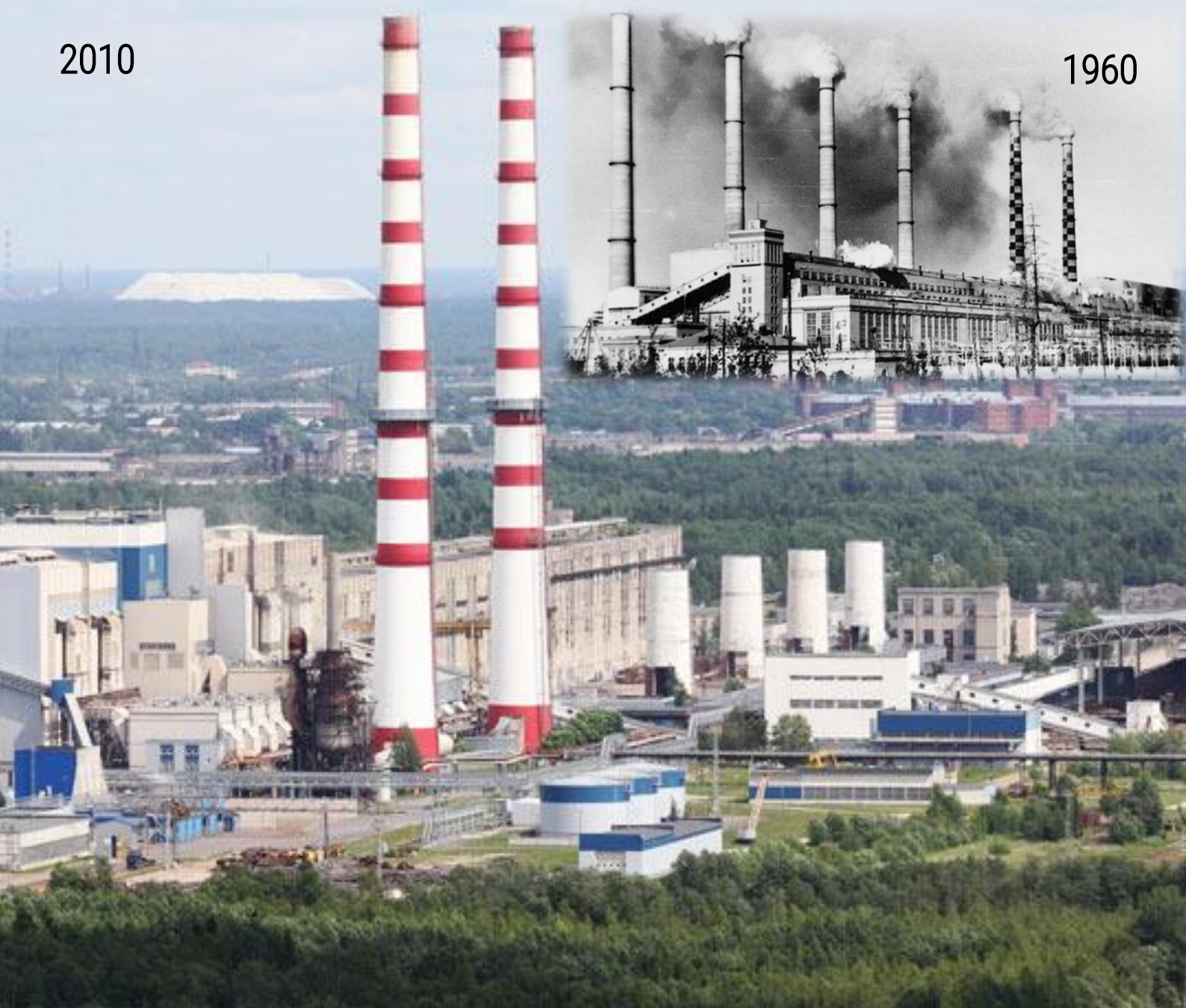


Figure 2.24 HCB emission by activities in 2017

2010

1960



Balti Power Plant in 1960 and in 2010 (Source: www.energia.ee)

3. ENERGY SECTOR (NFR 1)

3.1. Overview of the Sector

The energy sector includes stationary fuel combustion (NFR 1A1, NFR 1A2, NFR 1A4), mobile sources (NFR 1A3), and fugitive fuel emissions (NFR 1B).

The energy sector is a key source of all pollutants emissions.

Estonia is relatively rich in natural resources, both mineral and biological. It is a unique country whose energy production depends primarily on the use of oil shale. In 2017, the share of domestic fuels – oil shale, wood and peat – accounted for approximately 90.6% (from which oil shale is about 74%) of the primary energy supply. Coal, natural gas and liquid fuels were imported to Estonia in 2017. Imports of natural gas decreased by about 5% compared to 2016. The imports of motor gasoline and diesel decreased by about 6% and 3% respectively compared to the previous year. The imports of coal increased by about 96% compared to 2016. Imported fuels (natural gas, fuel oils, coal, and motor fuels) made up 8.2% (see [Figure 3.1](#)).

Due to energy security concerns, proportion of natural gas has remained small in Estonian energy mix. Recent developments in Estonian biogas sector have increased the share of locally sourced biogas used for electricity and heat production.

In Estonia, renewable energy is generated from hydro- and wind energy as well as from biomass. Since electricity generation has accelerated in hydroelectric power plants and wind parks, the proportion of renewable energy has increased. The generation of hydro energy has been stable over the past years (2017 saw a decrease from 35 GWh to 26 GWh). The share of wind energy in gross electricity production in 2017 is 5.6% and hydro energy only 0.2% (*Statistics Estonia*). In 2005, electricity generated from renewable energy sources was only 1.1%, but in 2016, it accounted for 12.2%. The growth was due to the enlargement of the existing wind parks and the commissioning of new combined heat and power plants working on wood fuel.

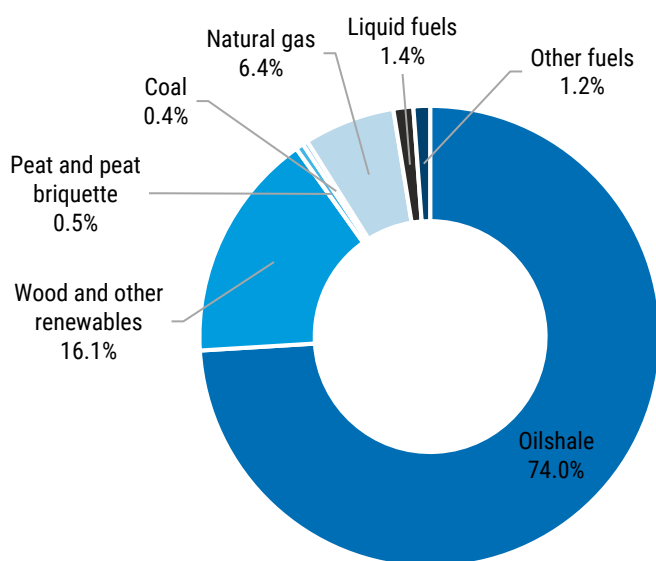


Figure 3.1 Structure of primary energy supply in Estonia in 2017

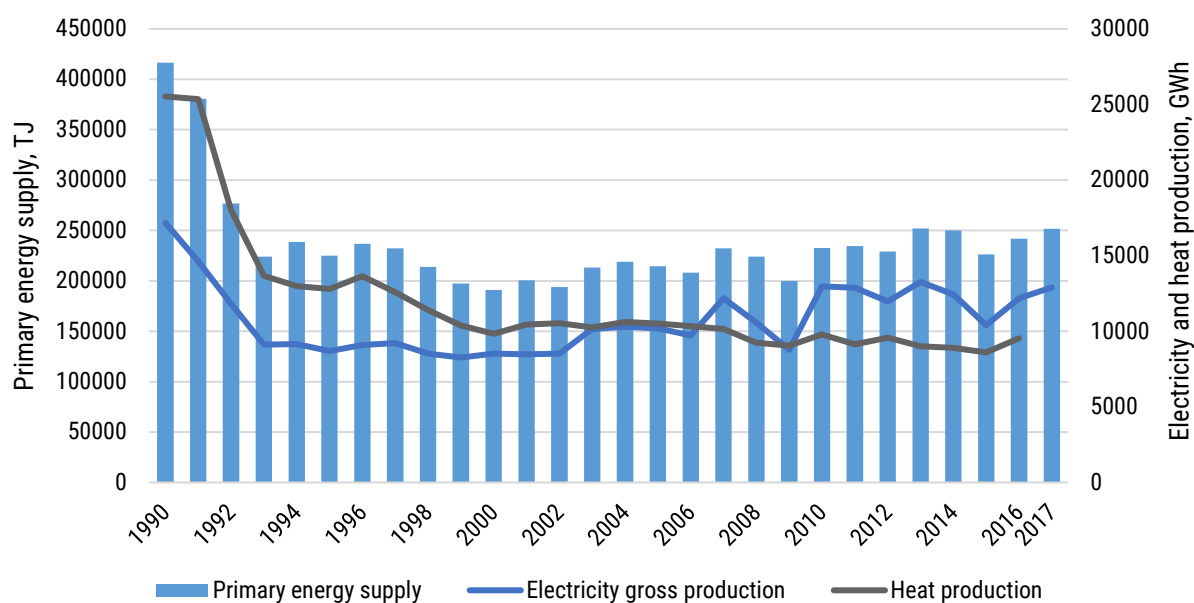


Figure 3.2 Total energy supply, electricity and heat production in the period of 1990–2017

(Source: Statistics Estonia)

The energy sector is the main source of SO₂, NO_x, CO, particulates, HMs and POPs in Estonia. In 2017, the energy sector contributed 99.9% of total SO₂ emissions, 92.5% of total NO_x emissions,

80.5% of PM₁₀ emissions, 41.7% of total NMVOC emissions, 99.6% of total CO emissions, and 97.9% of Pb emissions (see [Figure 3.4](#), [Figure 3.5](#), [Figure 3.6](#) and [Table 3.1](#)).

Table 3.1 Pollutant emissions from the energy sector in the period of 1990–2017

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	BC	TSP	CO	Pb
	kt									t
1990	74.054	29.268	272.372	0.155	NR	NR	NR	269.465	235.891	204.675
1995	46.094	22.424	115.712	0.275	NR	NR	NR	124.147	212.084	84.792
2000	43.004	22.907	97.050	0.410	14.553	29.701	3.419	65.521	197.980	35.654
2005	40.031	17.697	76.098	0.720	13.217	18.814	3.453	27.351	154.946	34.605
2006	38.499	15.982	69.781	0.625	8.754	12.393	2.503	18.094	141.166	31.118
2007	42.690	14.571	88.010	0.655	11.742	18.922	2.995	23.765	156.932	39.681
2008	39.053	13.747	69.460	0.719	10.895	14.996	3.080	18.880	155.988	34.663
2009	34.467	12.927	54.845	0.616	8.945	12.558	2.555	15.772	155.350	28.011
2010	40.788	12.910	83.245	0.678	13.314	20.869	3.187	24.581	156.213	38.267
2011	39.274	11.757	72.680	0.691	17.700	32.019	3.517	37.386	131.313	37.746
2012	36.102	11.378	42.864	0.709	8.196	11.720	2.187	15.516	141.531	33.180
2013	34.755	10.733	41.647	0.735	11.483	17.504	2.554	20.019	133.829	38.628
2014	34.373	10.010	46.819	0.771	8.377	12.757	2.018	16.059	128.339	35.753
2015	30.278	9.629	36.049	0.981	9.119	11.922	2.522	13.853	128.389	27.770
2016	29.984	9.440	34.895	0.931	7.263	9.187	2.138	11.027	139.585	31.737
2017	30.794	9.264	38.644	1.105	8.677	11.011	2.465	12.827	137.717	33.369
trend 1990–2017, %	-58.4	-68.4	-85.8	612.9	-40.4	-62.9	-27.9	-95.24	-41.6	-83.7

Table 3.1 continues

Year	Cd	Hg	As	Cr	Cu	Ni	Zn	PAHs total	PCDD/F	HCB	PCBs
	t								kg		
1990	4.456	1.121	18.855	18.418	10.965	27.399	105.993	8.195	7.292	0.180	8.335
1995	2.132	0.598	10.077	9.961	5.583	10.482	63.462	10.022	4.743	0.313	4.067
2000	0.728	0.505	8.575	8.350	4.263	6.474	49.271	8.532	3.866	0.296	2.559
2005	0.728	0.526	9.221	9.018	5.234	6.413	52.668	7.694	3.192	0.282	3.697
2006	0.709	0.527	8.598	8.407	5.228	5.759	48.192	6.536	3.063	0.251	3.018
2007	0.874	0.655	11.068	10.735	5.944	6.748	61.227	6.805	4.666	0.314	1.783
2008	0.806	0.574	9.406	9.255	5.443	5.904	54.491	7.119	4.695	0.326	2.780
2009	0.684	0.442	7.599	7.508	4.800	4.856	45.798	7.520	4.085	0.301	3.038
2010	0.878	0.631	10.963	10.469	5.676	6.604	61.910	8.346	4.970	0.341	4.157
2011	0.838	0.631	10.879	10.280	5.682	6.425	59.930	7.063	4.911	0.307	3.600
2012	0.772	0.554	9.595	9.110	5.437	5.646	54.174	7.135	3.490	0.322	3.462
2013	0.944	0.663	11.234	10.515	5.712	6.504	61.695	7.139	2.550	0.328	3.921
2014	0.875	0.653	10.243	9.777	5.729	6.033	56.563	7.103	2.751	0.273	4.203
2015	0.725	0.515	7.741	7.536	5.260	4.657	46.050	7.024	2.620	0.272	4.212
2016	0.787	0.582	8.977	8.635	5.592	5.332	51.683	6.954	2.479	0.276	4.173
2017	0.782	0.553	9.437	9.123	5.724	5.674	54.945	7.725	2.710	0.302	5.022
trend 1990-2017, %	-82.5	-50.6	-50	-50.5	-47.8	-79.3	-48.2	-5.7	-62.8	67.4	-39.8

During the period of 1990–2017, the emissions of sulphur dioxide from the energy sector decreased by 85.6% and the emissions of nitrogen oxides by about 58.4% resulting from a decline in energy production (oil shale consumption as a main fuel in Estonia fell from 231 PJ in 1990 to 191.7 PJ in 2017) (see [Figure 3.4](#) and [Table 3.1](#)). The other reason for the drop in emissions in last years was installation of the semi-dry NID (Novel Integrated Desulphurisation) technology in the Eesti Energia Narva Elektriijaamad AS (Eesti PP), which uses the fly ash in the gas itself and does not require any additional compounds to bind the SO₂. With regard to the energy units, which are not equipped with the clearing equipment, alternative methods of reduction of SO₂ emissions are used, such as water injection to furnaces of PC (old pulverised combustion boilers). Water injection lowers the flame temperature and therefore improves conditions for sulphur captured with limestone included in oil shale.

In 2014, SO₂ emissions from energy sector had increased by about 12.4% compared to 2013. Increase in emissions has occurred due to the fact that in 2014, pulverised limestone was not added to upper parts of furnaces of Units 1, 2 and

7 of Eesti PP (adding limestone would reduce SO₂ emissions in PC boilers without NID systems).

In 2015, SO₂ emissions from energy sector had decreased by about 23% compared to 2014, mainly resulting from a decline in energy production. The electricity gross production in 2015 was reduced by 16.3% in comparison with 2014, but import of electricity (mainly from Finland) has increased by 56% for the same period. Export has slightly decreased, only by 1.7% (see [Figure 3.1](#) and [Figure 3.2](#)).

In 2016, SO₂ emissions had decreased by about 3% when compared to 2015's figures. The main reason for the reduction of emissions is the conservation of one of the power plants in Ida-Virumaa, which used as its main source of fuel generator and coke oven gas (the facility worked for only half a month at a time and the reduction in emissions amounted to about four thousand tons).

Electricity production volume increased in 2016 by about 18% compared to 2015. A significant

factor that supported production growth was a decrease in production costs.²²

In 2017, SO₂ emissions from energy sector had increased by about 10.7% compared to 2016. The increase in emissions has mainly been caused by the growth of electricity production on the oil shale Power Plants (about 17%).

In 2015, NO_x emissions decreased by 12% compared to 2014, mainly due to the reduction in energy production for the same period. In addition, the introduction of clearing devices at oil shale power plants played a role. By the end of 2014, the pilot project on reduction of nitrogen emissions, first in the history of oil shale industry, had run little over 12 months. In 2013, one boiler of the Eesti PP was supplied with NO_x capture system, which has allowed reducing its NO_x emissions approximately two times. Last year, the pilot project was followed by a three-year project to equip another seven boilers with similar emission capture systems. (Eesti Energia "Environmental Report 2014").

In 2016, NO_x emissions from energy sector decreased by 1% in comparison to 2015's figures, despite an increase in electricity production.

In 2017, NO_x emissions increased by 2.7% in comparison to 2016's figures. The primary reason for this change was growth of electricity and cement production. However it should be noted that with the growth of the generated electricity at the Narva Power Plants by 17%, the emission of nitrogen oxides increased significantly less, because the introduction of clearing devices at oil shale power plants played a role.

The TSP emissions decreased in 2016 by 20.4% compared to 2015. The PM₁₀ and PM_{2.5} emissions decreased in the same period by 22.2% and 21.3% respectively, which was mainly the result of decreasing the amount of wood and solid fuels burned in industrial boiler. At the same time, emissions of particulates from NFR 1A1 were reduced as a result of modernisation of electric precipitators at oil shale power plants.

In 2017, particulate emissions increased by 16.2% in comparison to 2016, due mainly to an increase in emissions from industrial combustion (mainly due to the growth of wood and wood waste combustion) and the construction/demolition sectors. The increase in wood consumption has also caused an increase in ammonia emissions in the energy sector.

Increase in electricity production also was the cause of increase in emissions of heavy metals and POPs (see [Figure 3.3](#) and [Table 3.1](#)). During the same period, insignificant decrease in emissions in residential sector took place.

Only ammonia and HCB emissions have increased in comparison with the figures from the 1990s due to the growth of wood and wood waste consumption.

In terms of the efficiency of electricity generation, the renovation of two units in the Narva PP of Eesti Energia AS was essential. These resulted in introducing a new technology – the combustion of oil shale in a low-temperature circulating fluidised bed (CFB). Renovation of the 8th unit in the Eesti PP was completed in November 2003. Since the beginning of 2004, the new and more efficient unit has been in constant commercial use. In 2005, the specific fuel consumption for electricity generation in Narva Elektriijaamad AS decreased as a result of shutting down the older boilers: in May 2005, Narva Elektriijaamad AS terminated the use of the old low-efficiency and high-polluting equipment of the first three stages in the Balti PP. On 1 June 2005, the renovated unit N° 11 in the Balti PP was launched. The two boilers of the new unit fire oil shale in a circulating fluidised bed. The new units save more than 20% in fuel. The pollution level is several times lower than that stipulated in EU environmental regulations.

In order to meet the targets of different EU legislations, a five-year research and testing project was completed in the beginning of 2012

²² Eesti energia „Annual Report 2016“ https://www.energia.ee/-/doc/8457332/ettevotttest/investorile/pdf/annual_report_2016_eng.pdf

by installing unique desulphurisation systems on four generating units of the Eesti PP.

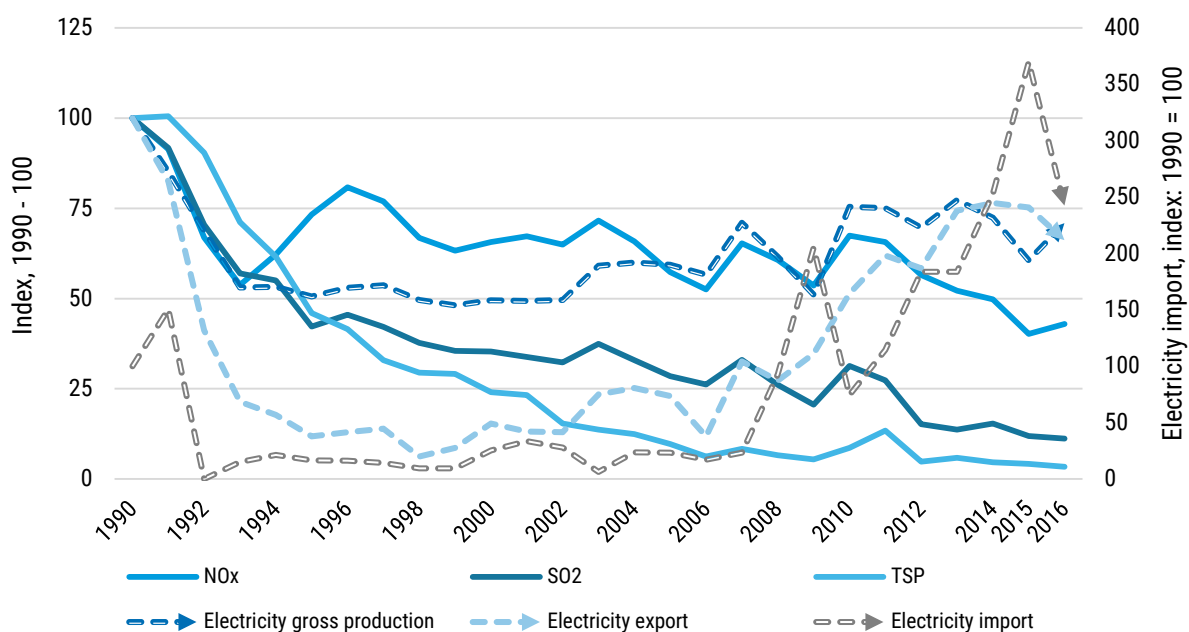


Figure 3.3 Pollutant emissions from stationary combustion, electricity production, and export in the period of 1990–2016

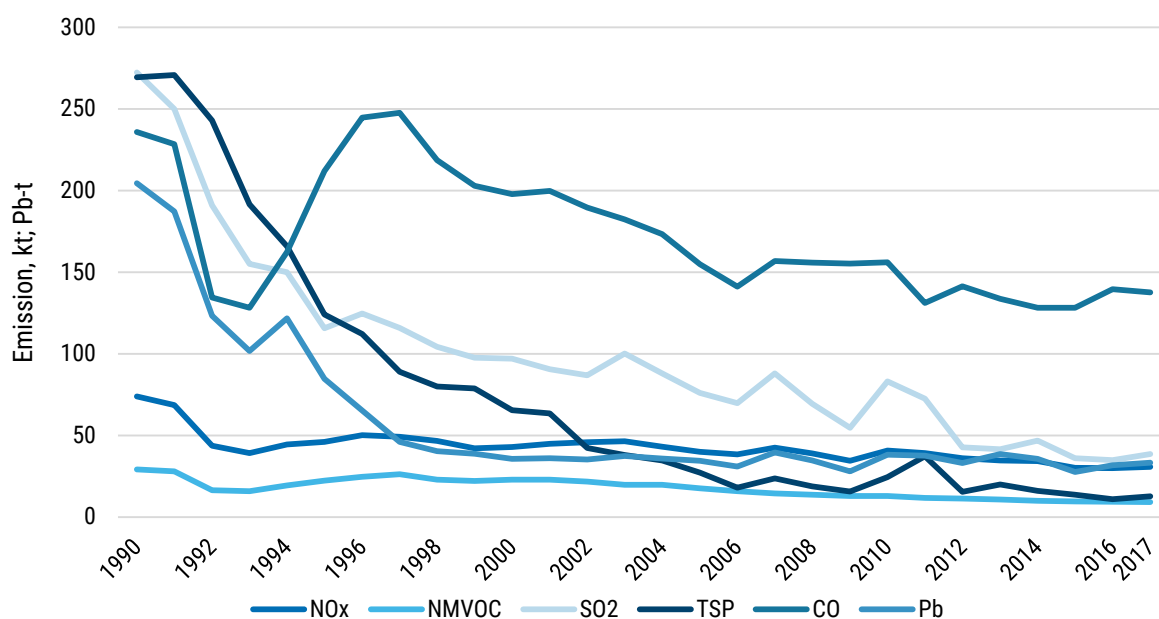


Figure 3.4 Pollutant emissions from the energy industry in the period of 1990–2017

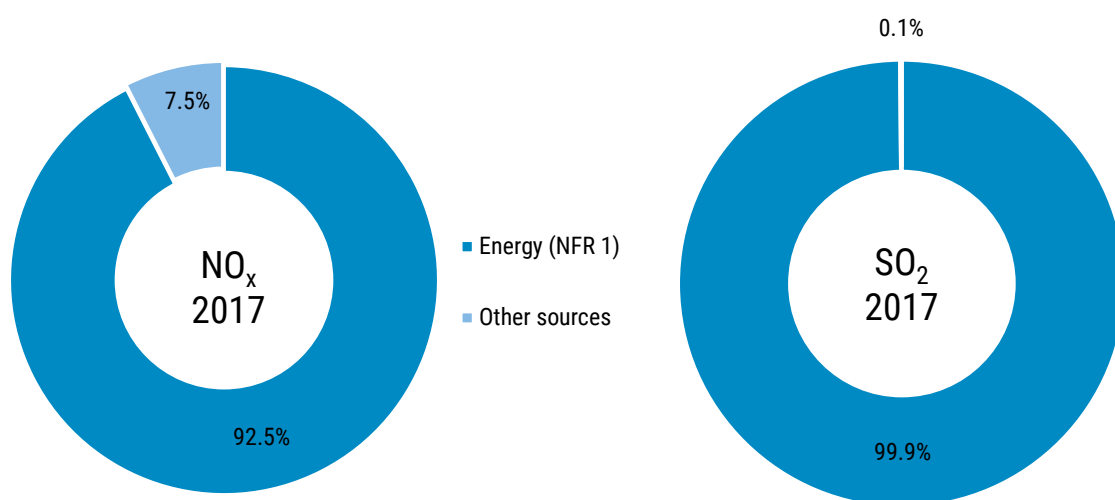


Figure 3.5 Share of SO_2 and NO_x emissions from the energy sector in total emissions in 2017

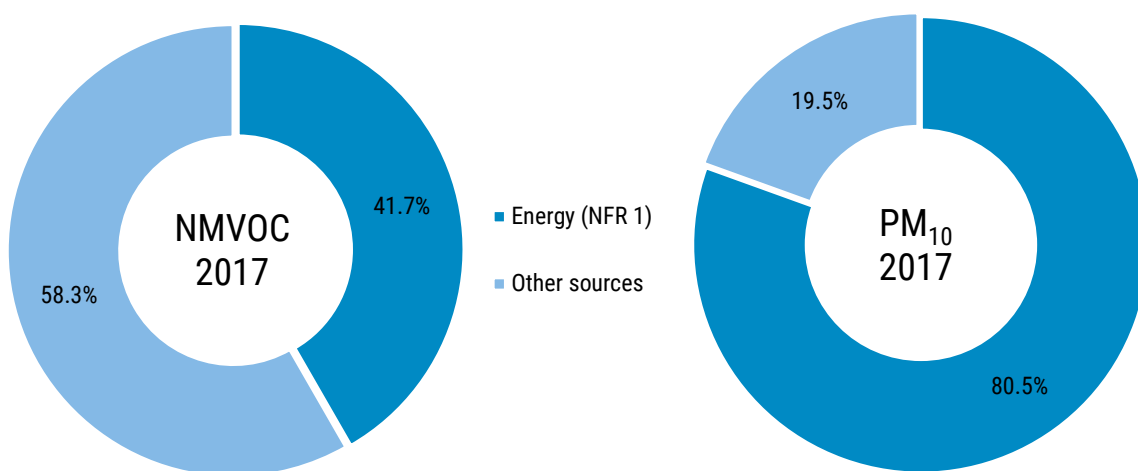


Figure 3.6 Share of NMVOC and PM_{10} emissions from the energy sector in total emissions in 2017

3.2. Stationary Fuel Combustion

3.2.1. Sector Overview

This chapter gives an overview of stationary fuel combustion, which includes energy industries (NFR 1A1), stationary combustion in manufacturing industries (NFR 1A2) and non-industrial combustion plants (NFR 1A4). Energy related activities (excluding transport) are the most significant contributors to SO₂ emissions – 99.8% in 2017. The share of mobile sources of the

total emissions is very small – 0.2% (see [Figure 3.8](#) and [Figure 3.9](#), includes in other sources).

The stationary fuel combustion sector is a key source for all pollutants except ammonia. Pollutant emissions in the 1990-2017 period and the distribution of emissions between stationary combustion and other sectors are presented in the [Table 3.3](#), [Figure 3.7](#), [Figure 3.8](#) and [Figure 3.9](#).

3.2.1.1. Source Category Description

Sources category description are presented in the [Table 3.2](#).

Table 3.2 Stationary fuel combustion activities

NFR	Source	Description	Emissions reported
1A1	Energy Industries		
	a. Public electricity and heat production	Includes emissions from public power and district heating plants on the basis of point and diffuse sources.	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO, HMs, PCDD/F, PAHs, HCB, PCBs
	c. Manufacture of solid fuels and other energy industries	Includes emissions from solid fuel transformation plants. Only point sources data.	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO, HMs, PCDD/F, PAHs, HCB, PCBs
1A2	Stationary combustion in manufacturing industries and construction		
	a. Iron and steel	Includes emissions from processes with contact (SNAP 030303). Only point sources data.	NO _x , SO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , BC, CO, Pb, As, Cr, Cu, Ni, Zn
	b. Non-ferrous metals	Includes emissions from processes with contact (SNAP 030307 - secondary lead production, 030308 - secondary zinc production, 030310 - secondary aluminium production). Only point sources data.	NO _x , SO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , BC, CO, Pb, As, Cr, Cu, Ni, Zn
	c. Chemicals	Includes emissions from combustion plants of this activity reported by 7 operators.	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO, Pb, As, Cr, Cu, Zn
	d. Pulp, Paper and Print	Includes emissions from combustion plants of this activity reported by 13 operators.	NO _x , SO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , BC, CO, Pb, As, Cr, Cu, Ni, Zn
	e. Food processing, beverages and tobacco	Includes emissions from combustion plants and other stationary equipment of this activity reported by 52 operators.	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO, HMs
	f. Non-metallic minerals	Includes emissions from all boilers in the manufacturing industry, other processes with contact: cement, lime, glass, bricks and other productions. (SNAP 0301, 030311-030320). Data reported from 34 operators.	NO _x , SO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , BC, CO, HMs

NFR	Source	Description	Emissions reported
gviii.	Other	Includes emissions from all boilers in the manufacturing industry, other processes with contact: (SNAP 030204-030205; 030326). Data of point and diffuse sources.	NO _x , SO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , BC, CO, HMs, PCDD/F, PAHs, HCB, PCBs
1A4	Non-industrial combustion plants		
ai	Commercial / institutional: Stationary	Includes emissions from boilers or other equipment in the commercial sector. Data of point and diffuse sources.	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO, HMs, PCDD/F, PAHs, HCB, PCBs
bi	Residential: Stationary plants	Includes emissions from boilers and other equipment in the residential sector. Only diffuse sources data.	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO, HMs, PCDD/F, PAHs, HCB, PCBs
ci	Agriculture/Forestry/Fishing: Stationary	Includes emissions from boilers and other equipment in the agriculture and forestry sectors. Data of point and diffuse sources.	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO, HMs, PCDD/F, PAHs, HCB, PCBs
1A5a	Other stationary (including military)		IE, reported under 1A4ai

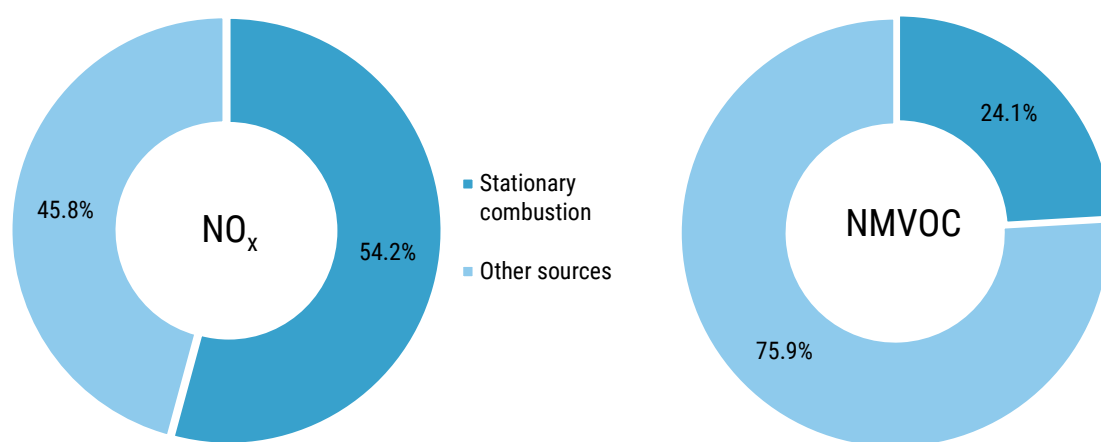


Figure 3.7 NO_x and NMVOC emissions from stationary fuel combustion and other sources in 2017

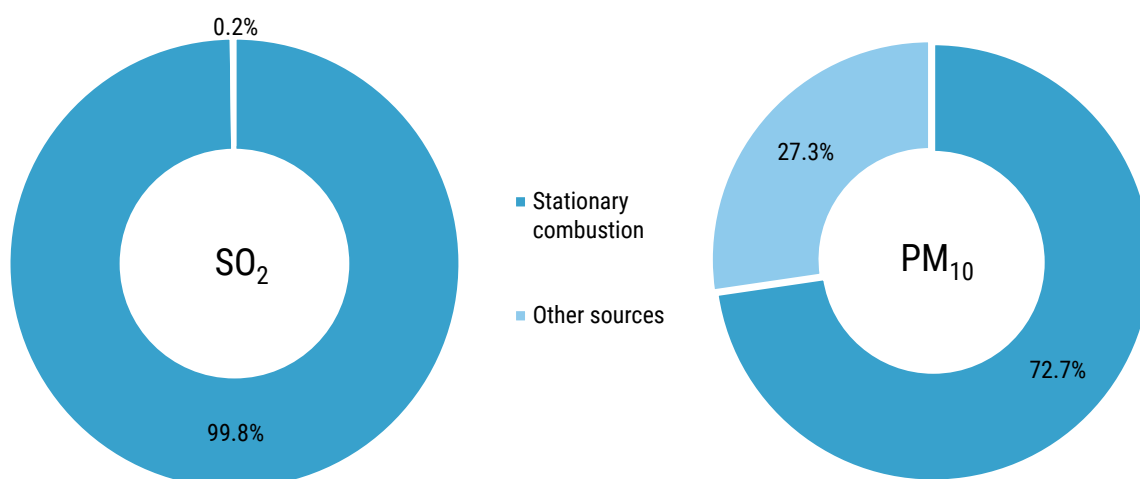


Figure 3.8 SO₂ and PM₁₀ emissions from stationary fuel combustion and other sources in 2017

Table 3.3 Pollutant emissions from stationary fuel combustion in the period of 1990–2017

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	BC	TSP	CO	Pb
	kt									t
1990	36.062	6.811	265.480	0.137	NR	NR	NR	267.731	86.444	126.501
1995	26.435	9.087	112.073	0.249	NR	NR	NR	123.138	145.675	60.376
2000	23.680	7.372	93.898	0.305	13.637	28.657	2.944	64.309	125.786	30.670
2005	20.682	7.061	75.716	0.470	12.254	17.656	2.921	25.966	110.369	32.476
2006	18.942	6.181	69.445	0.335	7.789	11.204	1.963	16.646	97.363	29.651
2007	23.539	6.681	87.691	0.319	10.764	17.734	2.444	22.330	115.783	38.140
2008	21.904	7.072	69.185	0.374	10.008	13.897	2.588	17.531	121.604	33.142
2009	19.324	6.555	54.679	0.307	8.169	11.557	2.128	14.507	123.709	26.616
2010	24.323	6.839	83.100	0.359	12.482	19.780	2.720	23.207	127.343	37.981
2011	23.691	5.888	72.538	0.321	16.899	30.949	3.075	36.002	106.270	37.456
2012	20.951	5.834	42.773	0.314	7.387	10.654	1.742	14.151	115.794	32.884
2013	20.895	6.081	41.567	0.385	10.766	16.583	2.143	18.862	112.701	38.344
2014	19.992	5.679	46.745	0.430	7.611	11.790	1.583	14.851	108.585	35.490
2015	15.912	5.539	35.972	0.635	8.348	10.950	2.084	12.637	109.845	27.502
2016	17.003	5.292	34.829	0.642	6.559	8.296	1.743	9.916	117.959	31.442
2017	17.999	5.355	38.574	0.792	7.975	10.111	2.072	11.690	116.950	33.062
trend 1990-2017. %	-50.1	-21.4	-85.5	479.7	-41.5	-64.7	-29.6	-95.6	35.3	-73.9

Table 3.3 continues

Year	Cd	Hg	As	Cr	Cu	Ni	Zn	PAHs total	PCCD/F	HCB	PCBs
	t								g I-TEQ		kg
1990	4.445	1.114	18.854	18.273	7.283	27.310	104.276	8.102	6.938	0.180	8.314
1995	2.127	0.594	10.076	9.881	3.588	10.437	62.537	9.980	4.522	0.313	4.060
2000	0.723	0.502	8.575	8.266	2.146	6.425	48.300	8.495	3.643	0.295	2.558
2005	0.721	0.521	9.220	8.906	2.406	6.342	51.332	7.643	2.879	0.281	3.697
2006	0.700	0.522	8.597	8.286	2.163	5.683	46.740	6.481	2.718	0.250	3.018
2007	0.866	0.649	11.067	10.607	2.713	6.662	59.694	6.747	4.299	0.312	1.782
2008	0.797	0.569	9.405	9.132	2.339	5.816	53.027	7.066	4.359	0.324	2.779
2009	0.676	0.437	7.598	7.394	1.923	4.783	44.440	7.470	3.768	0.299	3.037

Year	Cd	Hg	As	Cr	Cu	Ni	Zn	PAHs total	PCCD/F	HCB	PCBs
	t								g I-TEQ	kg	
2010	0.870	0.626	10.962	10.351	2.672	6.530	60.500	8.290	4.647	0.340	4.157
2011	0.829	0.627	10.879	10.158	2.606	6.355	58.497	7.006	4.580	0.306	3.600
2012	0.764	0.549	9.595	8.986	2.306	5.575	52.714	7.076	3.162	0.322	3.462
2013	0.936	0.658	11.234	10.394	2.653	6.436	60.267	7.082	2.238	0.328	3.921
2014	0.867	0.649	10.242	9.647	2.553	5.959	55.069	7.042	2.452	0.272	4.202
2015	0.716	0.510	7.741	7.404	1.981	4.581	44.504	6.960	2.310	0.271	4.212
2016	0.778	0.577	8.977	8.502	2.255	5.255	50.109	6.892	2.185	0.275	4.168
2017	0.772	0.548	9.487	8.987	2.259	5.595	53.307	7.661	2.429	0.301	5.021
trend 1990-2017, %	-82.6	-50.8	-49.7	-50.8	-69.0	-79.5	-48.9	-5.4	-65.0	67.7	-39.6

The energy industry sector is responsible for the about 84% of Estonian total SO₂ emissions, 32% of NO_x, 29% of PM₁₀, and 93% of Pb. The main contributors are oil shale power plants.

Estonian oil shale is high-ash shale (up to 46%) with low net caloric value (8.4–9.0 MJ/kg) and sulphur content of 1.4% to 1.8%. Two different combustion technologies – the old pulverised combustion of oil shale and the new circulated fluidised bed combustion technology – are currently used in the Estonian power plants. In the combined heat and power block of the Balti PP, around 7.2% of the fuel used in 2017 is biomass, which is burned together with oil shale. This has significantly increased the proportion of renewable energy both in the Eesti Energia AS portfolio and in overall electricity production in Estonia. Each year, the new power block produces 130–140 GWh of renewable energy, enough to cover 2% of annual electricity consumption in Estonia. Renewable energy from biofuel produced in the Narva PP provides enough electricity to cover the annual consumption of 50,000 Estonian families.

The oil shale power plants contribute about 72% to the total SO₂ emissions. The Narva PP is investing in scrubbers to reduce sulphurous and nitrous wastes from flue gas in order to make energy production from oil shale cleaner and to ensure that the current production capacity can be maintained after the environmental requirements become stricter in 2012 and 2016.



(Photo by Lembit Michelson: Eesti Power Plant)

In 2012, the desulphurisation equipment was finally installed in four blocks of Eesti PP. Eesti Energia AS also completed the building of an additional lime dosing system.

Studies and tests conducted in 2009 and 2010 showed that the nitrogen oxides emissions can also be cut below the limits permitted in the stricter environmental requirements that will enter into force in 2016, and in 2012, the instalment of the equipment (nitrogen oxides scrubbers) to reduce NO_x emissions of the Eesti PP was commenced.

The most efficient and newest power plant at Eesti Energia is the Auvere power plant that was launched in 2015. It uses oil shale as its main fuel, and up to 50% of it can be replaced with biomass.

2017 was the fifth year when we used waste as fuel for heat and power cogeneration. We can save approximately 70 million m³ of natural gas by producing energy from waste. After sorting household waste, another 300,000 tonnes of mixed municipal waste remains in Estonia, which is now used for producing heat and power in Iru.

In 2017, 235.7 tonnes of mixed municipal waste was used to produce heat and electricity. The mixed municipal waste used in Iru plant is mostly local, but the power plant is also providing environment friendly waste management services to Irish and Finnish cooperation partners. Heat generated by Iru power plant is provided to the inhabitants of Maardu and Tallinn at prices that are up to 25% lower than before. Iru waste-to-energy unit impacts every single inhabitant in Estonia since the waste management in Iru is approximately twice cheaper than landfilling. The launching of waste-to-energy unit can be seen as a nation-wide environmental project: the Estonian waste management became environmentally friendlier

and the large-scale landfilling in the country has ended.³



(Iru Power Plant, the green building is waste-to-energy unit; Source: www.etsnord.ee)

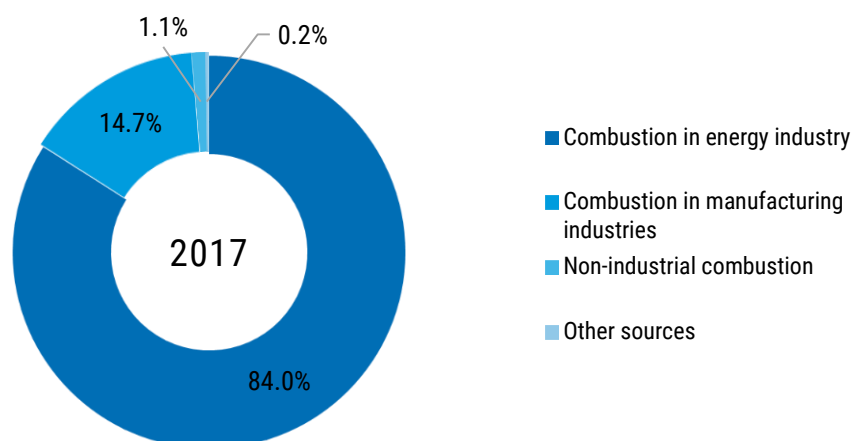


Figure 3.9 SO₂ emissions by sources of pollution in 2017

Non-industrial combustion is responsible for about 64.7% of the total NMVOC and 60% of CO emissions in stationary combustion, for approximately 1.1% of SO₂ and 28.2% of TSP emissions. Combustion in energy and transformation industries accounts for 84.2% of

SO₂, for 42.1% of TSP and for the 32% of CO emissions in stationary combustion (the main part of carbon monoxide is emitted from shale oil production plant) (see [Figure 3.10](#), [Figure 3.11](#), [Figure 3.12](#), [Figure 3.13](#), [Figure 3.14](#)).

³³ Eesti Energia Keskkonnaaruanne_2014_eng. https://www.energia.ee/-/doc/8457332/keskkond/pdf/keskkonnaaruanne_2014_eng.pdf

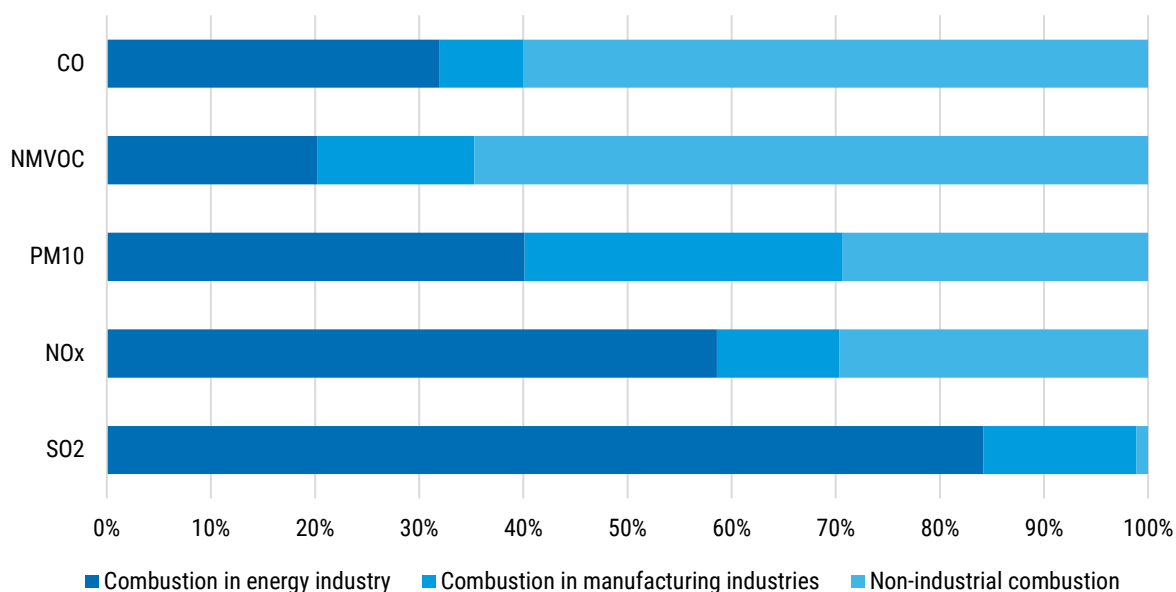


Figure 3.10 Distribution of pollutant emissions by sector in stationary combustion in 2017

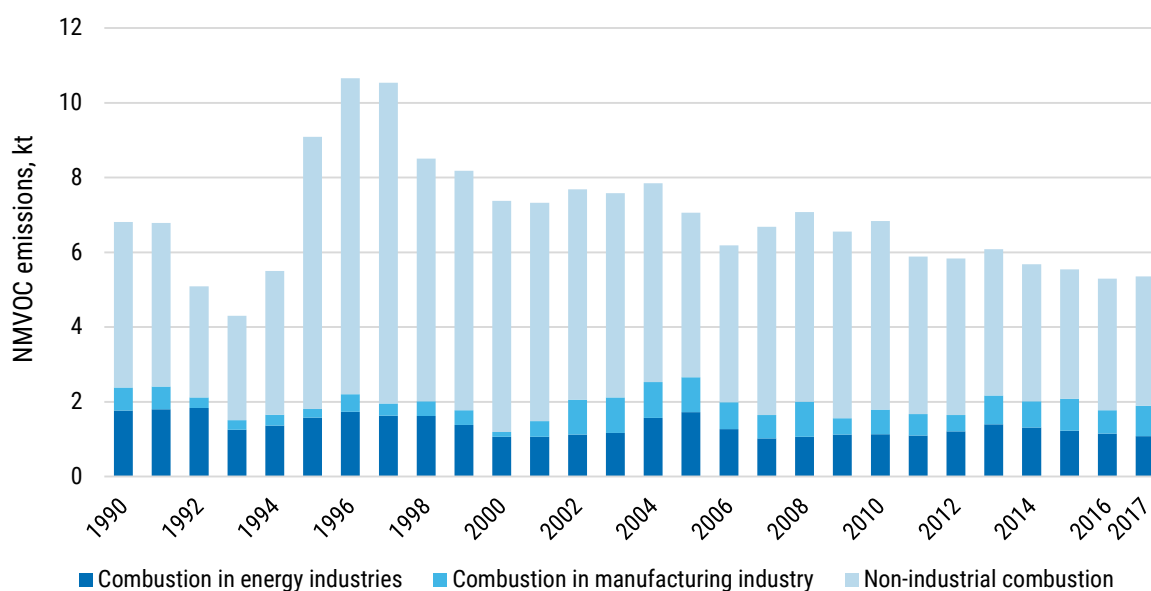


Figure 3.11 Distribution of NMVOC emissions by sector in stationary combustion in the period of 1990–2017

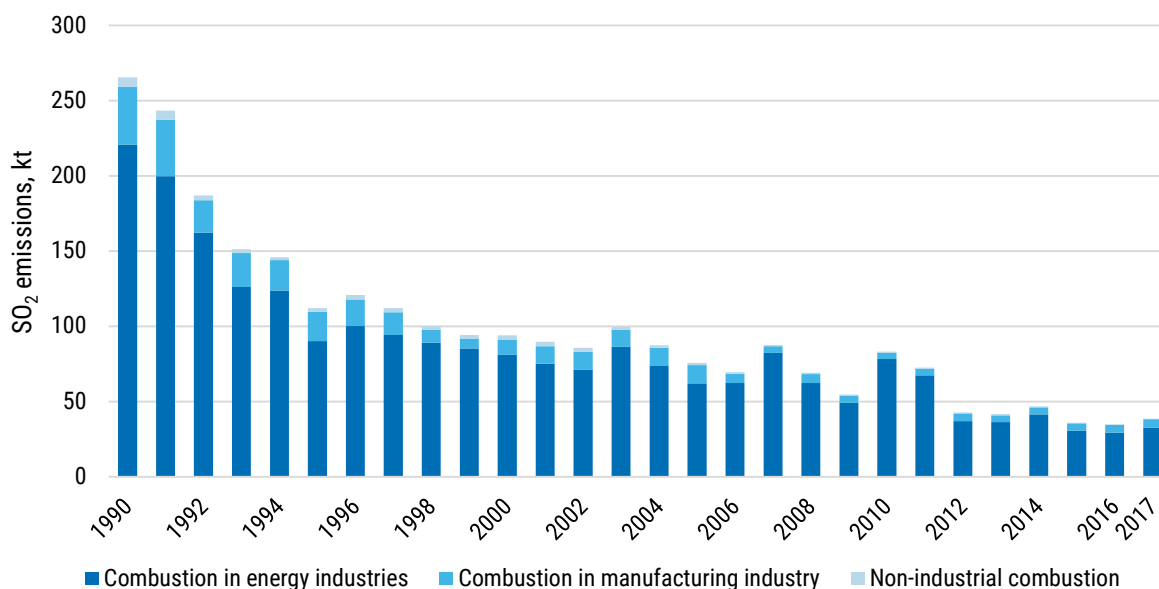


Figure 3.12 Distribution of SO₂ emissions by sector in stationary combustion in the period of 1990–2017

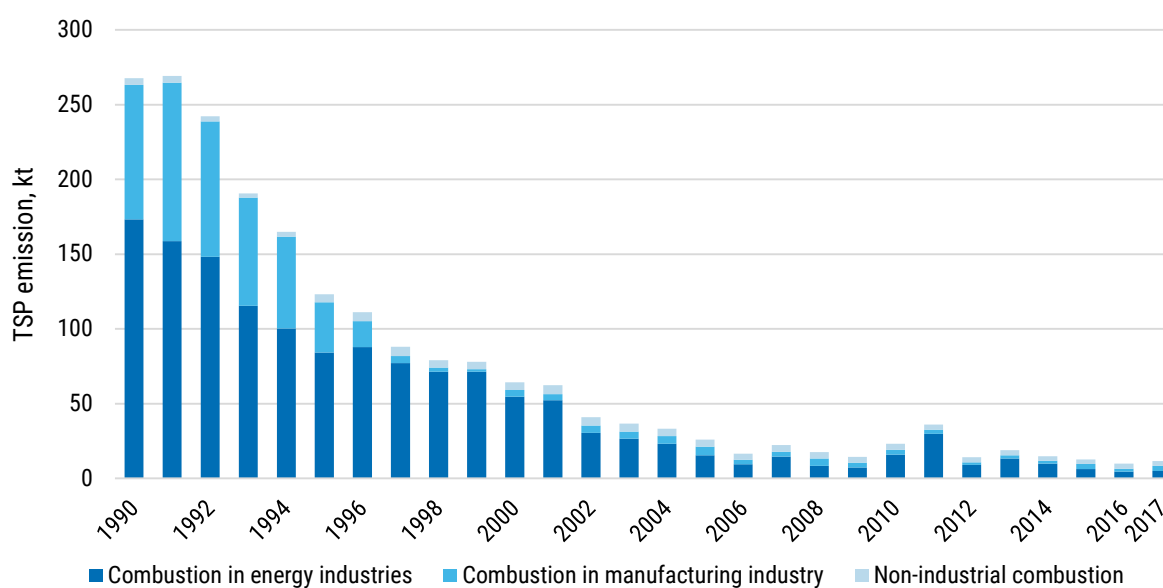


Figure 3.13 Distribution of TSP emissions by sector in stationary combustion in the period of 1990–2017

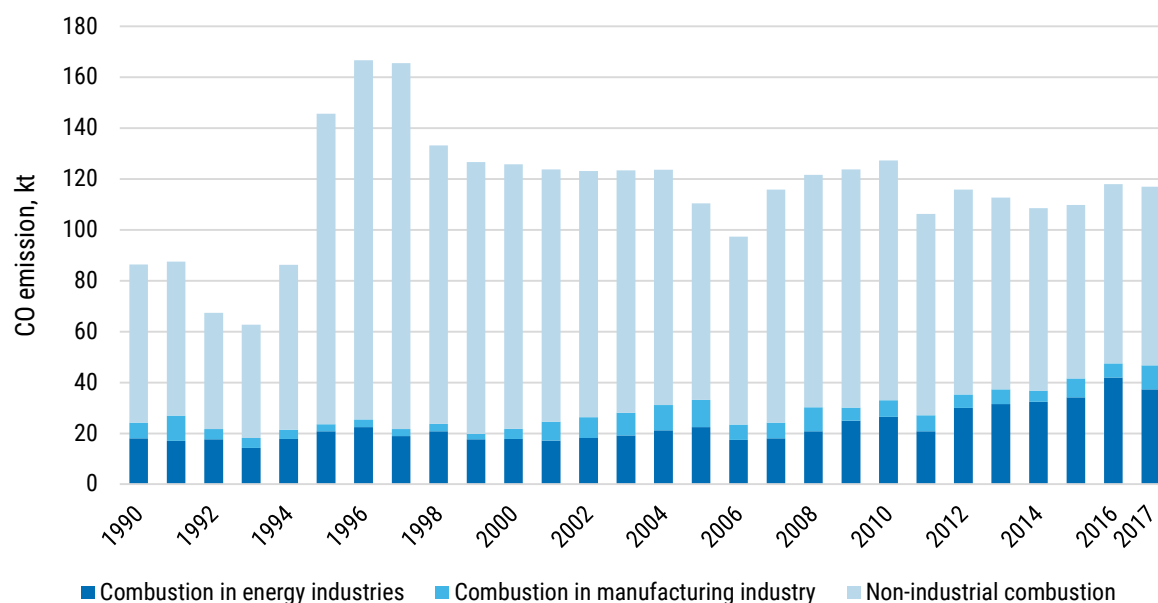


Figure 3.14 Distribution of CO emissions by sector in stationary combustion in the period of 1990–2017

3.2.1.2. Uncertainty

An uncertainty analysis was carried out to the year 2017 inventory. The uncertainty in the emission factors for main pollutants from stationary combustion sector is estimated in the range from 20% to 50%, for heavy metals and

PAHs 100–200%, for dioxin 100–250%; in the activity data, in the range from 2% to 5% (for the waste combustion in domestic sector – 50%). Uncertainty estimates for stationary combustion are given in [Table 3.4](#).

Table 3.4 Uncertainties in stationary combustion sector

Pollutant	Emission, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	17.999	kt	54.21	9.53%	2.14%
NM VOC	5.355	kt	24.07	7.75%	2.00%
SO _x	38.574	kt	99.80	8.26%	0.33%
NH ₃	0.792	kt	7.72	2.04%	0.90%
PM _{2.5}	7.975	kt	86.48	9.54%	4.52%
PM ₁₀	10.111	kt	72.68	9.56%	4.04%
TSP	11.690	kt	59.35	6.50%	0.62%
CO	116.950	kt	84.57	11.11%	4.82%
Pb	33.062	t	97.02	186.09%	21.13%
Cd	0.772	t	96.09	135.55%	19.66%
Hg	0.548	t	93.39	181.01%	4.70%
PCDD/F	2.429	g I-TEQ	56.29	66.93%	39.64%
B(a)p	2.227	t	99.31	97.49%	63.50%
B(b)f	2.595	t	99.11	107.06%	79.04%
B(k)f	1.263	t	98.87	91.20%	51.53%
I(1,2,3-cd)p	1.576	t	99.30	83.62%	52.32%
HCB	0.301	kg	97.20	92.89%	104.62%
PCBs	5.021	kg	99.58	101.66%	7.09%

3.2.2. Energy Industries (NFR 1A1)

Energy industries sources category description are presented in the [Table 3.5](#).

3.2.2.1. Source Category Description

The energy industries are a key source of SO₂, NO_x, NMVOC, TSP, PM₁₀, PM_{2.5}, CO, all heavy metals, and POPs emissions.

Table 3.5 Energy industries reporting activities

NFR	Description	Method	Activity data	Emissions factor
1A1a	Public electricity and heat production	Tier 1/Tier 3	Fuel consumption reported by operators; Energy balance from the Statistics Estonia	National EF; Measurements; Default EMEP/EEA Guidebook
1A1c	Manufacture of solid fuels and other energy industries	Tier 3	Reported by operators	National methodologies; National EF; Measurements; Default EMEP/EEA Guidebook

The energy and transformation industries sector is responsible for about 84% of total SO₂ emissions, 32% of NO_x, 29% of PM₁₀, 27% of CO, and 98% of Pb. The main contributors of all pollutants are oil shale power plants, while for CO emissions the main source is shale oil production facilities.

Pollutant emissions from this sector and the trend in emissions are presented in the

Table 3.6.

During the 1990-2017 period, emissions of SO₂ decreased by 85% and NO_x emissions by 59%, resulting in a decline in energy production and also in the installation of desulphurisation technology by Eesti Narva Elektriijaamad AS (see Chapters 3.1 and 3.2.1.1).

Particulate emissions also dropped significantly during the same period – by about 97%. A decrease in electricity production and the introduction of more effective clearing installations at oil shale power plants was the cause. The significant growth of particulates in 2011 was due to an increase in electricity production, and is a result of the poor operation of electric precipitators on two power units in the oil shale Balti Power Plant.

The growth of wood consumption was the reason for an increase in emissions of ammonia.

The increase of carbon monoxide emissions was in the result of increasing shale oil production level.

In 2016, SO₂ emissions had decreased by about 8.2% compared to 2015's figures. The main reason for the reduction of emissions is the conservation of one of the power plants in Ida-Virumaa, which used as its main source of fuel generator and coke oven gas (the facility worked for only half a month at a time and the reduction in emissions amounted to about four thousand tons).

In 2017, SO₂, NO_x and PM₁₀ emissions increased by about 11%, 4.2% and 11% respectively compared to 2016's figures. The increase in emissions of these and other substances resulted from the growth of electricity production on the oil shale Power Plants (about 17%).

Table 3.6 Pollutant emissions from energy in the period of 1990-2017

Year	NO _x kt	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	BC	TSP	CO	Pb t
1990	25.690	1.763	220.880	0.081	NR	NR	NR	173.286	18.020	63.142
1995	14.080	1.574	90.270	0.171	NR	NR	NR	84.206	20.870	34.474
2000	12.780	1.065	81.110	0.177	7.667	21.397	0.895	54.697	17.790	29.190
2005	12.400	1.726	62.090	0.180	4.486	8.956	0.515	15.516	22.460	30.740
2006	10.890	1.271	62.340	0.128	2.767	5.427	0.312	9.407	17.450	28.400
2007	14.100	1.022	82.360	0.130	5.707	11.947	0.663	14.687	18.000	36.700
2008	12.298	1.061	62.286	0.124	3.398	6.515	0.392	8.478	20.818	31.015
2009	10.637	1.125	49.138	0.133	3.201	5.808	0.357	7.394	24.955	25.115
2010	15.283	1.132	78.214	0.143	6.851	13.598	0.777	15.909	26.475	36.416
2011	15.111	1.096	67.393	0.115	11.940	25.532	1.431	29.830	20.772	36.144
2012	12.780	1.208	36.997	0.119	3.348	6.377	0.336	9.059	30.005	31.826
2013	12.724	1.398	36.328	0.156	6.109	11.595	0.605	13.254	31.490	37.211
2014	12.486	1.314	41.516	0.213	3.892	7.792	0.349	9.909	32.402	34.333
2015	9.234	1.229	30.577	0.348	3.033	5.322	0.394	6.202	34.127	26.141
2016	10.118	1.150	29.233	0.398	2.312	3.652	0.392	4.572	41.976	30.274
2017	10.546	1.081	32.466	0.444	2.330	4.055	0.331	4.920	37.371	31.706
trend 1990-2017, %	-58.9	-38.7	-85.3	451.2	-69.6	-81.0	-63.0	-97.2	107.4	-49.8

Table 3.6 continues

Year	Cd	Hg	As	Cr	Cu	Ni	Zn	PAHs total	PCCD/F g I-TEQ	HCB kg	PCBs
1990	1.131	1.015	18.314	17.460	4.652	20.336	84.921	2.000	2.330	0.020	5.244
1995	0.621	0.552	9.972	9.460	2.502	7.550	48.031	1.870	1.300	0.030	2.724
2000	0.505	0.476	8.532	7.810	1.970	5.640	40.090	1.370	0.810	0.030	1.699
2005	0.530	0.506	9.152	8.180	2.225	5.630	42.340	1.630	0.560	0.030	1.811
2006	0.520	0.506	8.532	7.610	1.964	5.310	38.760	1.280	0.450	0.020	1.547
2007	0.620	0.615	10.972	9.780	2.454	6.250	50.330	1.020	1.870	0.020	1.096
2008	0.523	0.521	9.275	8.255	2.082	5.299	42.577	1.066	2.264	0.021	1.414
2009	0.426	0.418	7.490	6.679	1.694	4.376	34.470	1.921	2.184	0.047	2.100
2010	0.613	0.608	10.864	9.680	2.445	6.180	49.922	2.635	2.978	0.068	2.868
2011	0.611	0.611	10.804	9.646	2.428	6.102	49.433	2.184	3.120	0.056	2.472
2012	0.533	0.533	9.510	8.474	2.131	5.363	43.610	2.302	1.707	0.060	2.501
2013	0.709	0.643	11.165	9.888	2.492	6.257	51.020	2.500	0.810	0.077	2.695
2014	0.632	0.630	10.143	9.053	2.382	5.722	46.336	2.757	1.127	0.079	3.125
2015	0.492	0.494	7.668	6.854	1.839	4.358	35.126	2.584	1.023	0.073	2.817
2016	0.549	0.562	8.900	7.963	2.107	5.043	40.706	2.777	1.031	0.078	2.965
2017	0.534	0.531	9.437	8.430	2.113	5.368	43.069	3.116	1.004	0.089	3.295
trend 1990-2017, %	-52.8	-47.6	-48.5	-51.7	-54.6	-73.6	-49.3	55.8	-56.9	342.9	-37.2

NFR 1A1a Public electricity and heat production include pollutants emission data from point sources (PS) reported by operators and from diffuse sources. Emissions from the point sources are calculated on the basis of measurements, or the combined method (measurements plus calculations), or on the basis of national emission factors.

In 2016 an in-depth review of the Estonian inventory was performed by the CLRTAP emission inventory review team (ERT), in which the ERT encourages Estonia to create some quality checks for the measurement data. The data which the ERT received on request from the Party were found to be plausible and consistent. Only the SO₂ EFs in fluidized combustion systems

seem to be low compared to plants from other countries using similar technology. In such a case, there should be an explanation.

The Estonian inventory team sent questions for an additional explanation to the operator and Tallinn University of Technology. Below is given the explanation of the University, according to which Estonian Oil Shale (EOS) is a solid fossil fuel that has low heating value and high ash content. Oil shale burned in power plants has the following proximate characteristics: $W_i^f = 9\text{--}13\%$, $A^f = 45\text{--}57\%$, $CO_2 = 16\text{--}19\%$, and $Q_i^f = 7\text{--}11\text{ MJ/kg}$. The molar ratio of Ca/S of 8–10 in oil shale exceeds by over 2–3 times the ratio of Ca/S sufficient to capture SO_2 completely. Oil shale contains a lot of carbonate minerals. Due to decomposition of the carbonate minerals, the CO_2

footprint is bigger than in typical coal firing power plant, but during the calcite decomposition, free lime is formed that binds the Sulphur during combustion process. In 2004, a novel Circulating Fluidized Bed Combustion (CFBC) was introduced for EOS. For EOS CFBC, no sand is needed for bed material since ash is the material that is forming the bed. The circulating ash contains free lime that is one of the key parameters for almost 100% sulphur binding and the second key parameter is low combustion temperature – around 800 °C. Low combustion temperature and low fuel nitrogen content (below 0.1%) mean that NO_x emissions are also below the limit values (below 200 mg/Nm³) (see

Table 3.7).

Table 3.7 Block No 8 of the Eesti PP and old PF Blocks. CFBC unit parameters (Hotta *et al*)

Indices	CFB block	PF block (TP – 101)
Operational capacity, MW _{el}	215/187	180
Self-consumption, %	- /9.13	8.93
Net efficiency factor, %	34 – 36/35	30
Heat rate, kJ/kWh	9230/10256	11,737
CO ₂ emission, kg/kWh	0.9744	1.2985
SO ₂ emission, mg/Nm ³	43,952	ca 2000
NO _x emission, mg/Nm ³	90 – 120/140 – 160	ca 300
Fly ash emission, mg/Nm ³	25 – 30/20	ca 100
Boiler gross efficiency factor, %	93.3 – 94.9	82.28
Fuel consumption as coal equivalent, g/kWh	350	401

Therefore, no deSO_x and deNO_x facilities are needed for EOS CFBC combustion (as can be seen on Figure 3.15). For people dealing with coal firing units, it is difficult to understand, but bear in mind that for coal it is a matter of economics. No power company is willing to put additional/excess lime into the CFBC for Sulphur binding. They insert only the amount of free CaO that is needed

to achieve the 200 or 400 mg/Nm³ for SO₂ emissions. For EOS, the free CaO is already present in the fuel. Initially, of course, in the form of limestone, but during combustion process, it decomposes to CO₂ and CaO. So, this is the key element for officials to understand. We have more than enough CaO for efficient Sulphur binding.

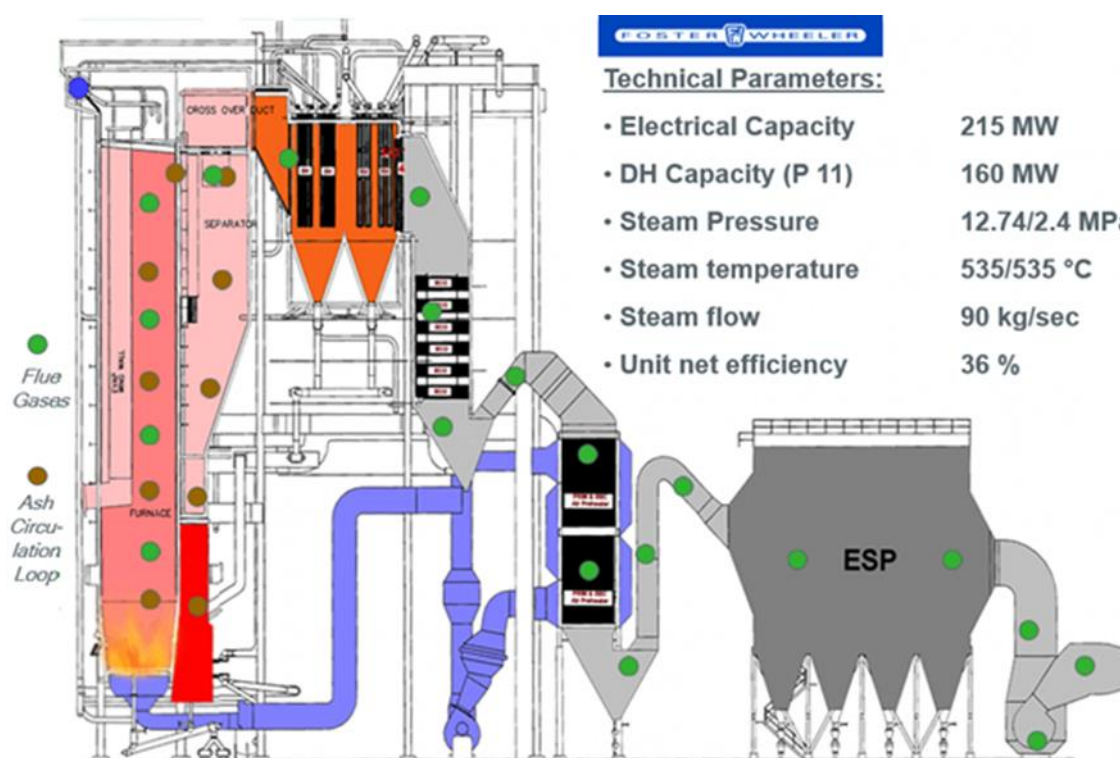


Figure 3.15 Existing EOS CFBC boiler drawing

For CFBC units, CEMS monitoring has been applied. The monitoring values are checked periodically by accredited authorities and the sulphur increase in the ash has also been checked. Therefore, low SO₂ emissions are nothing abnormal. It is normal for EOS CFBC units.

Tallinn University of Technology has conducted a lot of laboratory and in situ experiments in the Oil

Shale Firing Power Plants. We have an accredited Laboratory that has competence according to CEN/TS 15675:2007 and our flue gas measurements have validated the results given by CEMS monitoring. Also, we have published a lot of research papers regarding EOS firing and emission and ash formation. Some of the results can be seen in [Table 3.8](#) (Konist et. al, Plamus et. al) that validate the SO₂ numbers given so far.

Table 3.8 Concentration of main pollutants in flue gas before ESP (6% O₂) (Konist et. al)

Fuel used	CO ₂ , %	CO, mg/Nm ³	NO _x , mg/Nm ³	SO ₂ , mg/Nm ³
OS + BIO	13.8	20 – 30	140 – 200	0
OS 8.5	14.4	20 – 45	200	15.0
OS 11.1	11.2	20 – 45	200	15.0

NFR 1A1c The manufacture of solid fuels includes pollutant emission data reported by shale oil production facilities (oil shale transformation processes). Emissions are calculated by operators on the basis of measurements, or the combined method (measurements plus calculations) is used.

Under this code, data are also given on boilers in oil shale mining and other fuel transformation

industries. Operators used measurement results, national EF or the combined method for emission estimations.

The production of shale oil in Estonia is carried out at three factories: Enefit Õlitööstus (Narva Oil Plant under Eesti Energia AS), KKT Oil OÜ (Kiviõli Chemicals Plant under Alexela Group), and VKG Oil AS (under Viru Chemistry Group Ltd).

Two different technologies are applied in the production of shale oil: the old one – the technology of processing large-particle oil shale in vertical retorts with a gaseous heat carrier. The process itself takes place in a vertical retort with a cross-sectional heat carrier (Kiviter type retort). Oil shale, from which a small-sized fraction has been selected, is fed to the retort from above. Oil shale from the loading box enters a distillation chamber and moves downwards, and hot flows of fuel gases pass through this chamber towards the oil shale movement. Oil and water vapours and gas of low heating value that originate from distillation are emitted from the retort top and are fed to the condensation unit where oil and water condense. Raw oil is refined in oil extraction and distillation units. Phenol water reaches the phenol recovery unit. Retort gas is partly fed back into the process and is burnt to create the heat carrier required, while the remaining gas is sent to the power plant for heat and power production. Semi-coke from oil shale processing is discharged from the retort base and is stored in a semi-coke storage area.



(Photo by Matti Kämärä: Petroter technology in VKG Oil plant)

The second technology of processing is fine-grained oil shale with solid heat carrier (SHC). The Solid Heat Carrier Plant (SHCP) is designed for the thermal decomposition (pyrolysis) of fine-grained technological oil shale, with the objective of producing shale oils, gas with high calorific value, and high-pressure steam. The oil shale pyrolysis process is effected in a drum rotating reactor in the absence of air, at a temperature of 450–500 °C, due to the mixture of oil shale with hot ash (as a solid heat carrier). The vapour-gas mixture that appears in the reactor during the pyrolysis process is fed through several process

vessels to be refined from ash and mechanical impurities, and then it is subject to a distillation process to produce liquid products and gas with high calorific value. Liquid products are fed to other units for loading as final products, or for further processing. Gas is fed to the heat power plant for heat and power production. Steam is fed to the heat power plant for power production. The by-products of this process include phenol water, flue gases, and ash from thermal processing.

In the Kiviõli Oil Shale Processing (KKT Oil OÜ) and VKG Oil plants, both these technologies are used.

Eesti Energia AS Enefit Õlitööstus operates an industrial plant producing liquid fuels from oil shale. This plant, the only one of its kind in the world, uses the efficient Enefit-140 (in the left on the photo) solid heat carrier system, which was developed and patented by Eesti Energia engineers. Eesti Energia Õlitööstus produces liquid fuels and retort gas, which is used in electricity production in the Narva Power Plants.



(Photo: Enefit technology. Source: www.enefit.com)

The oil Industry produces about one million barrels of liquid fuels per year. Currently, about one fifth of the oil shale mined in Estonia is used in the production of fuel oil and chemicals. In 2009, Eesti Energia started building a new oil plant with Enefit-280 technology, which is cleaner, more reliable, and more efficient. This new generation of technology has been developed jointly by Eesti Energia and the international engineering company Outotec. Having produced its first oil in December 2012, the new Enefit-280 plant will gradually increase its operations to reach the designed parameters. Eesti Energia is

planning to expand its oil business and build a hydrogen processing complex by 2016, creating a business capable of producing liquid fuels of higher quality than the current shale oil that will meet all the legal requirements for use as motor fuel.

The production of shale oil has increased in comparison with 1990 by about a factor of four. In 2017 production figures have increased by 24%

compared to 2016 (see [Figure 3.16](#) and [Table 3.19](#)). In recent years the production of shale oil in solid heat carrier installations has increased, leading to a significant growth in emissions of carbon monoxide (by 50% in 2017 in comparison with 2010). In 2017, a total of 60% of shale oil was produced with the use of new SHC technologies.

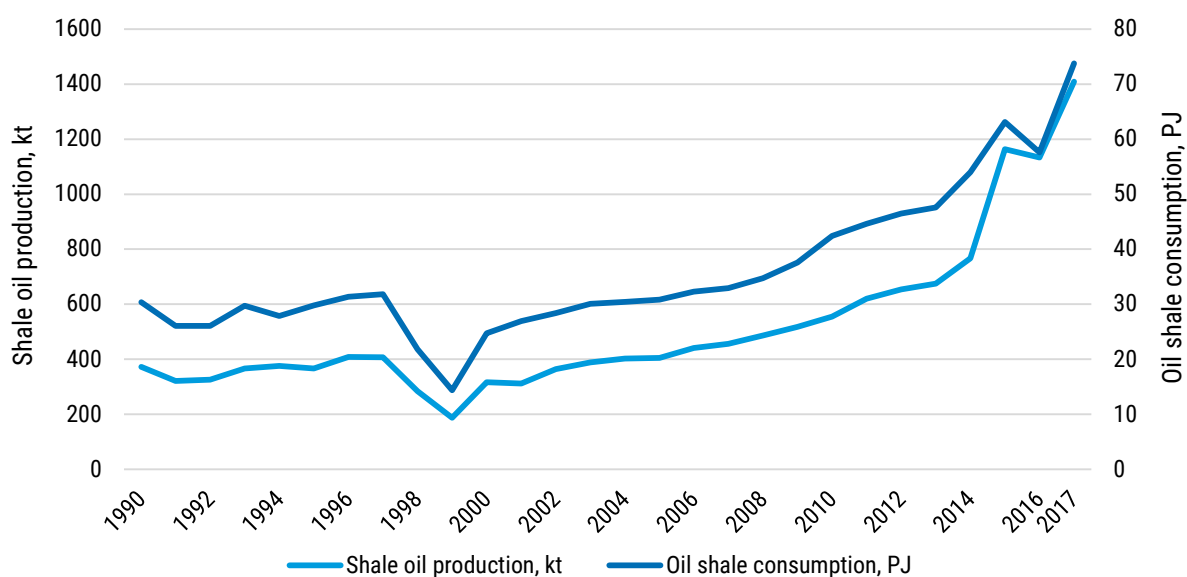


Figure 3.16 Shale oil production and oil shale consumption in the period 1990-2017

3.2.2.2. Methodological Issues

According to national legislation, all operators with boiler capacity from 0.3 MW_{th} must prepare an annual report. The report for the energy-related activities contains data about the type and capacity of boilers, fuel characteristics and consumption, pollutant emissions and so on.

Fuel consumption data from point sources have been summarised by SNAP codes. Emissions from the diffuse sources were calculated by using data on fuel consumption from Energy Balance (EB), prepared by Estonian Statistics:

$$\text{Diffuse sources Fuel} = \text{EB fuel} - \text{PS fuel}$$

The main tables of the Energy Balance contain summary data for the district heating and industrial boilers (SNAP 01 and SNAP 03). Fuel consumption by the manufacturing industry is only shown under final consumption (SNAP 0303). In this case, it is difficult to compare fuel

data from the national database (by SNAP) and the Estonian Energy Balance. In order to determine fuel consumption by diffuse sources, combined data from two tables were used: "Energy balance sheet" and "Consumption of fuel by branches of the economy".

Emissions from PS have been calculated according to national emission factors and fuel consumption or on the basis of measurements. According to national legislation, all large combustion plants >100 MW_{th} are obliged to carry out continuous monitoring.

Within the framework of the 2017 Comprehensive Technical Review of National Emission Inventories under the NEC Directive, the TERT noted that in case when continuously measurements are used to estimate annual emissions, there is a risk that operators have misinterpreted the IED and have used validated average values (after having subtracted the value

of the confidence interval) although this subtraction must not be applied in the context of reporting annual emissions. The TERT notes that this issue relates to an underestimate, which could correspond to 20% of SO₂, 20% of NO_x, 30% of dust of the sector (depending on the fraction of the operators subtracting confidence interval). The TERT recommended that Estonia organise a survey among operators to identify whether any are reporting emissions on the basis of the validated average values and try to derive a methodology to adjust the national emissions over the time series in order to compensate for any under reporting.

Estonia has organised a survey amongst its operators in order to be able to understand whether any operator is reporting emissions on the basis of the validated average values. The investigation showed that in Estonia there is one operator (covering three facilities) who is using validated average values for reporting emissions.

Within the framework of the 2018 Comprehensive Technical Review of National Emission Inventories under the NEC Directive, the TERT noted that for category 1A1 there was a potential under-estimate due to the use of annual emissions reported by operators on the basis of stack measurements, which may subtract the confidential interval for validated average values. In response to a question raised during the review, Estonia explained that one operator was using

validated average values since the 4th quarter of 2012. Estonia provided the emissions from these stack measurements and provided revised estimates for years 2012-2016 and stated that it will be further revised if the operator provides more accurate uncertainty data. The TERT agreed with the revised estimate provided by Estonia. The TERT recommends that Estonia includes the revised estimate in its next submission and continues to work with the operator to obtain more accurate data. It will be note that 2019 submission includes recalculated, correct emission data. Explanations and recalculations are presented in Chapter 8.

For other sources, the frequency of measurements is regulated by emission permits. National emission factors for the calculation of emissions from boilers were adopted by a Regulation of the Minister of the Environment in 2016 (see

[Table 3.9](#), [Table 3.10](#), [Table 3.11](#), [Table 3.12](#) and [Table 3.13](#)).

The SO₂ emissions are calculated by the formula:

$$Emissions = 0.02 \times B \times S^r \times (1-\eta)$$

where

B – fuel consumption;
S^r – sulphur content in fuel;
η – retention of sulphur in ash.

Table 3.9 TSP emission factors for boilers (g/GJ)

Fuel /purification equipment	P < 10 MW _{th}				50 MW _{th} > P > 10 MW _{th}		
	burner	extended furnace	grate-fired furnace	fluidized	burner	extended furnace	fluidized
Coal			3,000				
Oil shale			12,000				
- cyclone					3000		
- electrostatic precipitator					1000		
Peat							
- no control		1,000	2,000				
- cyclone		220	230	700			700
- cyclone + multicyclone				80			
- electrostatic precipitator							80
Wood							
- no control			1,000	1,000	1000		1,000
- cyclone		240	240	500		70	

Fuel /purification equipment	P < 10 MW _{th}				50 MW _{th} > P > 10 MW _{th}		
	burner	extended furnace	grate-fired furnace	fluidized	burner	extended furnace	fluidized
- electrostatic precipitator						70	80
Heavy fuel oil	100				100		
Oil shale oil	100				100		
Light fuel oil	100				100		

Information on which sectors include the condensable component of PM₁₀ and PM_{2.5} can

be found in Appendix 1 'Summary Information on Condensable in PM'.

Table 3.10 NO_x emission factors for boilers (g/GJ)

Fuel	P < 10 MW _{th}				50 MW _{th} > P > 10 MW _{th}	
	burner	extended furnace	grate-fired furnace	fluidized	burner	fluidized
Coal		200	200			
Oil shale					150	
Peat		300	300	300		300
Wood		100	100	100	100	100
Heavy fuel oil	200				250	
Oil shale oil	150				200	
Light fuel oil	100					
Gas	60				100	

Table 3.11 NMVOC emission factors for boilers (g/GJ)

Fuel	P < 10 MW _{th}	50 MW _{th} > P > 10 MW _{th}
Coal	15	1.5
Peat	100	
Wood	48	
Heavy fuel oil	3	3
Oil shale oil	1.1	
Light fuel oil	1.5	
Gas	4	2.5

Table 3.12 Carbon monoxide emission factors for boilers (g/GJ)

Fuel	P < 10 MW _{th}				50 MW _{th} > P > 10 MW _{th}	
	burner	extended furnace	grate-fired furnace	fluidized	burner	fluidized
Coal		100	100			
Oil shale					100	
Peat		1,200	500	100		200
Wood		1,200	1,000	400		200
Heavy fuel oil	100				100	
Oil shale oil	100				100	
Light fuel oil	100				100	
Gas	60				40	

Table 3.13 Heavy metals emission factors for boilers (mg/GJ)

Fuel /purification equipment	Heavy metals EF							
	Hg	Cd	Pb	Cu	Zn	As	Cr	Ni
Coal								
- no control	5	30	700	100	230	90	400	400
- cyclone	5	10	200			20	80	80
- electrostatic precipitator	5	5	40			5	10	10
Oil shale								
- electrostatic precipitator	5	5	300	20	410	90	80	50
Peat								
- no control	5	10	200	50	150	100	80	350
- cyclone	5	4	50			30	20	80
- electrostatic precipitator	5	0.7	15			7	6	25
Wood								
- no control	0.5	5	200	5	500	1	35	30
- cyclone	0.5	2	60			0.3	10	10
- electrostatic precipitator	0.5	0.5	15			0.1	2	2
Heavy fuel oil								
- no control	0.03	0.3	20	10	40	2	1	300
- cyclone	0.03	0.2	10			1	0.5	150
Oil shale oil	0.04	0.11	50	16.0	290	24	3.5	8
Light fuel oil	0.03	0.04	10	11	6	6	2	4

At present, Estonia has no national emission factors for PM₁₀ and PM_{2.5}. For emission calculations from point sources, CEPMEIP project emission factors were used (not directly, but shared from TSP, because some national EFs differ from CEPMEIP emission factors). For example, with regard to an oil shale power plant, TSP emission factors were first estimated on the basis of emissions (operator data on the base of measurements) and fuel usage data for various boilers, followed by emissions of fine particles, depending on the technology (high, medium or low). The calculated fine particulates and BC emission factors are presented in Table 3.14.

Table 3.14 PM₁₀, PM_{2.5} and BC emission factor for point sources

Fuel	PM ₁₀	PM _{2.5}	BC
	g/GJ		% PM _{2.5}
Coal	972	486	6.4
Peat and peat briquette	510	255	6.4
Wood and wood waste	950	900	28
Residual oil	83	67	56
Diesel oil	100	100	56
Gas oil	100	100	56
Shale-oil	100	100	56

Table 3.15 POPs emission factors

Fuel	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PCBs	HCB
	ng/GJ	mg/GJ				μg/GJ	
Coal	10	63	70	32	25	0.13	0.6
Peat	50	60	80	30	30	NE	NE
Wood	50	60	80	30	30	0.19	6.34
Residual oil	2.5	5	6	4	2	0.09	NE
Shale-oil	2.5	5	6	4	2	NE	NE
Distillate oil	0.5	5	6	4	2	NE	NE
Natural gas	0.5	0.00056	0.00084	0.00084	0.00084	NE	NE

Table 3.16 PM and HMs emission factors from natural gas combustion

Pollutant	Unit	EF
PM _{2.5}	g/GJ	0.45 (0.89 for capacity >50MW)
PM ₁₀	g/GJ	0.45 (0.89 for capacity >50MW)
TSP	g/GJ	0.45 (0.89 for capacity >50MW)
BC	g/GJ (5.4% PM _{2.5})	0.02
Pb	mg/GJ	0.0015
Cd	mg/GJ	0.00025
Hg	mg/GJ	0.10
As	mg/GJ	0.12
Cr	mg/GJ	0.00076
Cu	mg/GJ	0.00008
Ni	mg/GJ	0.00051
Se	mg/GJ	0.011
Zn	mg/GJ	0.0015

The national methodology is co-ordinated by the Ministry of the Environment, and the national methodology for boilers is being updated at present. Therefore, it was decided not to use the new EMEP/EEA Guidebook 2016 for NFR 1A1, 1A2, 1A4ai and 1A4ci sectors this year. Most probably, the national methodology will be used next year.

Table 3.17 NFR 1A1a pollutants IEF, g/total fuels GJ

Year	SO ₂	NO _x	TSP	PM _{2.5}	Pb
1990	753.5	87.8	590.8		215.8
1995	640.9	99.9	595.4		246.2
2000	666.8	104.4	445.2	61.6	244.9
2005	474.7	94.6	113.4	32.8	240.3
2006	503.8	87.0	70.3	20.9	233.5
2007	551.4	92.6	92.2	36.5	247.6
2008	477.9	92.5	61.5	24.8	240.2
2009	432.9	92.0	58.4	25.8	223.9
2010	486.9	92.8	92.4	39.8	229.2
2011	430.4	95.8	190.1	76.2	234.8
2012	253.4	88.6	59.7	22.1	225.0
2013	226.7	80.0	82.5	38.3	238.9
2014	277.4	83.9	64.4	25.5	236.0
2015	246.6	75.9	49.5	25.6	221.0
2016	206.4	72.8	30.6	17.1	223.7
2017	214.5	71.5	31.8	16.2	221.2

The main impact when it comes to changes in the IEF in this sector is shown in the change of the situation regarding oil shale power plants as they are a key source of emissions. At the beginning of the nineties a change in energy supply involving a decrease in the consumption of residual fuel oil and natural gas also played a role. After 2004 the

Pollutant emissions from shale oil production are calculated by operators on the basis of national methodologies, measurements, or the combined method (measurements plus calculations) is used.

The ammonia emissions from biomass combustion and emissions of particulates, heavy metals, PAHs from natural gas are calculated based on the default EMEP/EEA Guidebook 2016 emission factors for boilers with the capacity less than 50MW_{th} (see [Table 3.16](#)). The particulates emissions for power plants with capacity >50 MW_{th} were calculated on the base of the EMEP/EEA Guidebook 2016 EFs only for the 2017. Particulate emissions from natural gas combustion for previous years are calculated, using emission factors for small boiler houses.

The calculated implied emission factors (IEF) for some pollutant for NFR 1A1a are given in the [Table 3.17](#).

introduction of new technologies in the oil shale Narva Power Plants began, and a change in the IEF was influenced by the distribution of oil shale burned in new and old boilers as, in the case of electricity production growth, the share of work for old boilers increased. A sharp jump in the TSP and PM_{2.5} IEF in 2011 resulted from poorly-

operated clearing equipment in the oil shale Baltic Power Plant (see [Figure 3.17](#)).

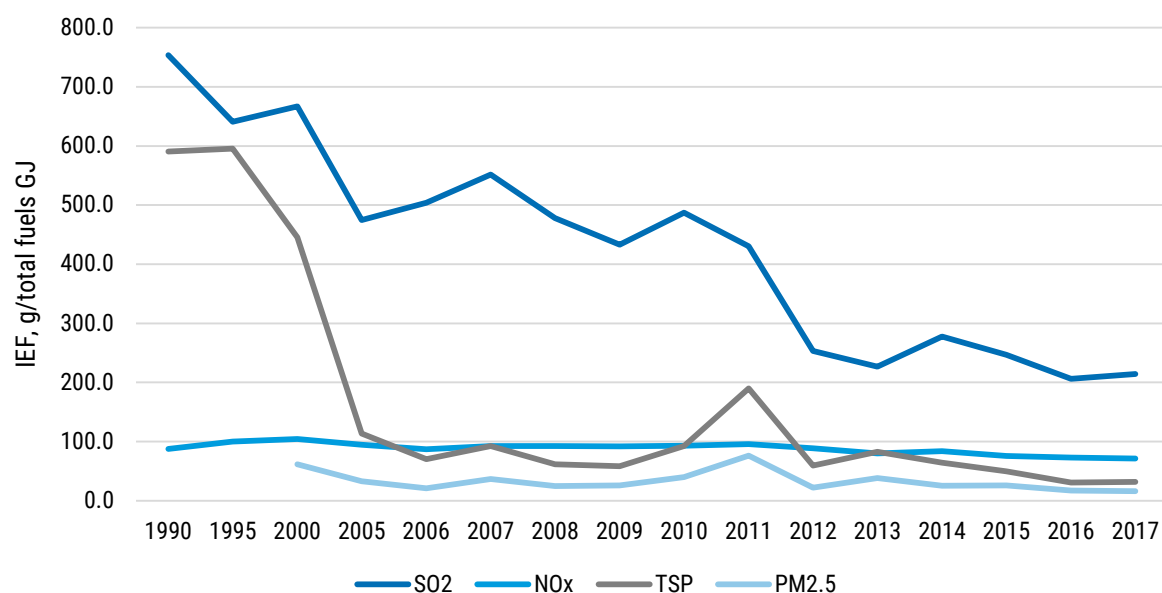


Figure 3.17 Implied emission factors for NFR 1A1a

Activity Data

Fuel consumption data from point sources have been summarised by SNAP codes. Emissions from the diffuse sources were calculated by using data on fuel consumption from Energy Balance (EB), prepared by Statistics Estonia:

$$\text{Diffuse sources Fuel} = \text{EB fuel} - \text{PS fuel}$$

The main tables of the Energy Balance contain summary data for the district heating and industrial boilers (SNAP 01 and SNAP 03). Fuel consumption by the manufacturing industry is only shown under final consumption (SNAP 0303). In this case, it is difficult to compare fuel data from the national database (by SNAP) and the Estonian Energy Balance. In order to determine fuel consumption by diffuse sources, combined data from two tables were used: "Energy balance sheet" and "Consumption of fuel by branches of the economy".

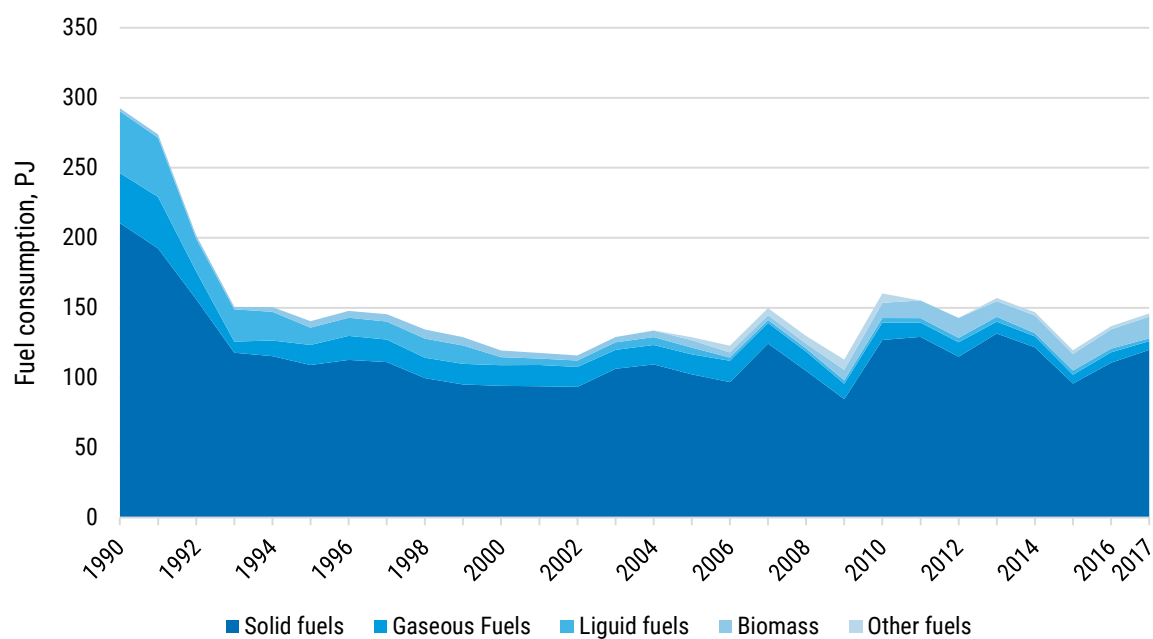
Discrepancies may occur between energy balance and the point sources database in the

data concerning fuels. These are the reasons for the distinction in the data regarding the consumed oil shale, the operators of which are represented in the Statistical Office and entered to the Point Sources Information System (OSIS) (the data in tonnes are identical, but not in TJ).

The fuel consumption data in energy and transformation industries are presented in the [Table 3.18](#) and [Figure 3.18](#). The consumption of all fuels by this sector with the exception of biomass (mainly wood and wood waste) has decreased across 1990-2017. The biggest decrease has been in terms of liquid fuel, by 94%. The consumption of solid fuels decreased by about 52%, mainly due to a decrease in electricity production, but it still remains the main fuel in this sector (involving mainly oil shale) (see [Figure 3.19](#)). During this period, the consumption of coal decreased significantly, from 3.8 PJ to 0.03 PJ. The consumption of peat increased slightly – from the 0.5 PJ to 1.3 PJ. The combustion of biomass has grown approximately by six times.

Table 3.18 Fuel consumption in energy industries in the period of 1990–2017 (PJ)

Year	Liquid fuels	Solid fuels	Biomass	Gaseous fuels	Other fuels
1990	44.09	210.42	2.18	35.81	0.00
1995	12.37	109.09	4.63	14.30	0.00
2000	5.74	94.21	4.77	14.73	0.00
2005	4.86	102.42	5.30	14.25	2.09
2006	2.31	96.89	3.64	15.25	4.80
2007	2.12	124.41	3.53	14.74	4.94
2008	2.29	104.91	3.49	13.69	5.45
2009	2.41	84.74	7.51	10.96	7.35
2010	3.25	126.99	10.88	12.41	6.65
2011	3.15	129.17	12.59	10.25	0.00
2012	3.17	115.04	14.21	10.28	0.00
2013	3.43	131.57	11.21	8.49	2.24
2014	2.31	121.71	12.57	7.84	2.39
2015	3.01	95.84	11.84	6.29	2.61
2016	2.63	110.72	13.74	7.43	2.32
2017	2.02	119.91	15.57	6.20	2.22
trend 1990-2017, %	-95.4	-43.0	614.7	-82.7	

**Figure 3.18** Fuel consumption by energy industries sector in the period 1990-2017

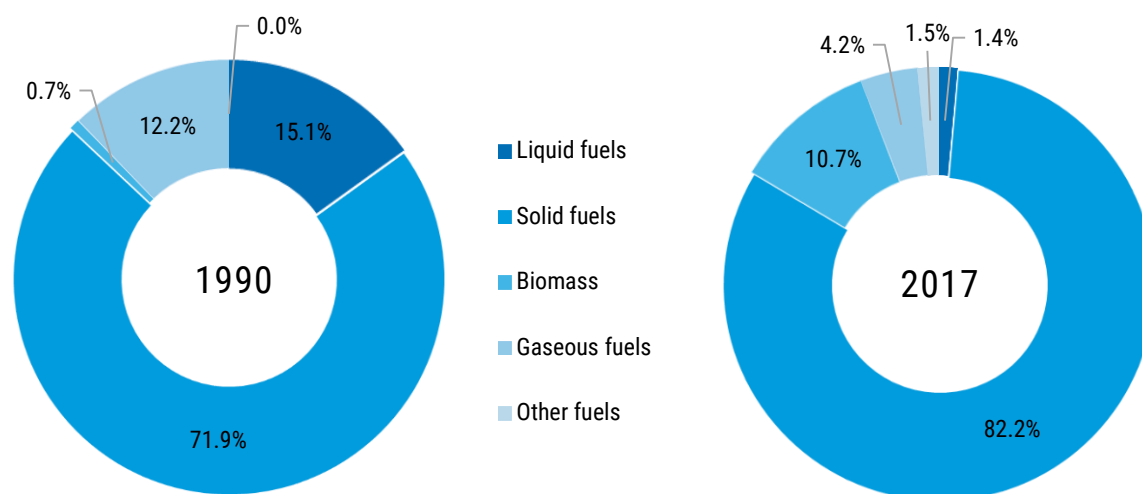


Figure 3.19 Distribution of fuel consumption in energy industries in 1990 and 2017

Table 3.19 Shale-oil production in the period of 1990-2017 (kt)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
372.98	321.62	325.96	367.14	375.42	366.39	408.87	407.04	283.61	187.02	317.02	311.59	363.82	389.04
2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
402.23	405.27	440.96	456.54	486.49	518.27	555.45	619.79	653.45	675.13	766.86	1163.71	1133.12	1408.47

Table 3.20 Oil-shale consumption for oil-shale production by different technologies, PJ⁴

Year	Solid Heat Carrier (SHC)			Total		Gas generators (GGS)		Total	Total
	Narva	VKG Oil	Kiviõli	SHC		VKG	Kiviõli	GGS	oil-shale
1990	3.24	NO	NO	3.24		21.56	5.55	27.11	30.35
1995	4.31	NO	NO	4.31		20.14	5.35	25.49	29.80
2000	5.86	NO	NO	5.86		13.57	5.30	18.87	24.73
2005	8.87	NO	NO	8.87		17.78	4.21	21.99	30.86
2006	8.40	NO	NO	8.40		19.73	4.17	23.90	32.30
2007	7.96	NO	NO	7.96		20.72	4.26	24.98	32.94
2008	10.85	NO	NO	10.85		19.99	3.87	23.86	34.71
2009	13.07	NO	NO	13.07		20.45	4.04	24.49	37.56
2010	14.74	2.22	0.2	17.16		21.15	4.10	25.25	42.41
2011	13.39	5.48	0.54	19.41		21.28	3.93	25.21	44.62
2012	15.13	6.00	0.31	21.44		21.18	3.86	25.04	46.48
2013	15.59	6.43	0.18	22.20		21.45	3.96	25.41	47.61
2014	18.76	9.37	0.35	28.48		21.35	4.18	25.53	54.01
2015	23.86	18.61	0.4	42.87		15.36	4.91	20.27	63.14
2016	21.66	23.88	1.5	47.04		5.71	4.85	10.56	57.60
2017	26.74	24.45	1.65	52.84		15.54	5.39	20.93	73.77

3.2.2.3. Uncertainty

An uncertainty analysis for the stationary combustion sector alone (NFRs 1A1, 1A2, and

1A4) was carried out upon the 2017 inventory (Chapter 3.2.1.2).

⁴ Greenhouse Gas Emissions in Estonia 1990-2017, National Inventory Report, Submission to the European Commission, Tallinn 2019

3.2.2.4. Source-Specific QA/QC and Verification

Several QC procedures are used in the framework of inventory preparation.

Before usage, data are presented by operators, and the data in reports (emissions, fuel used and methods of calculations) are verified. The Point Sources information system consists of calculation modules on the basis of national emission factors, and if the operator uses the calculation module, one can be relatively certain that the received results are correct.

The data on fuel consumption are then summarised by SNAP codes and compared to the statistical energy balance data. There are difficulties in comparing the consumption of fuel in activities. The principle of a database is that, for example, the industrial boiler is designated SNAP 03, irrespective of whether the heat is sold or is used for its own needs.

3.2.2.5. Recalculations

In the 2019 submission the following recalculations were carried out:

- Recalculated emissions of SO₂, NO_x, TSP, PM₁₀, PM_{2.5}, BC from oil-shale Power Plants (NFR 1A1a);
- Calculated emissions of heavy metals from NFR 1A1c for 1990-1998.

3.2.2.6. Source-Specific Planned Improvements

- Correction of activity data for the period 1990-2009 (fuel groups);
- Recalculation of POPs emissions.

3.2.3. Manufacturing Industries and Construction (NFR 1A2)

This sector is a key source of PM_{2.5} (28.5%), PM₁₀ (20.6%), TSP (16%), PAHs (18.1%), SO₂ (13.4%), dioxins (12%), NMVOC (3.4%), and CO (6.0%).

Emissions of all pollutants from the NFR 1A2 sector have decreased across 1990-2017, with the exception of NMVOC, ammonia, PAHs and particulates (2000-2017) which can mainly be explained by the increase in biomass combustion (see [Table 3.22](#)). The main reason for the decrease in the main pollutants and HM emissions is the corresponding decrease in the production of cement and also in an increase in the efficiency of combustion and cleaning equipment in the cement production plant. The other reasons are described below.

The increase in emissions for all pollutants as produced by industrial combustion in 2017 when compared to 2016 is explained by an increase in wood burning by a total of 90% and an increase in clinker production by about 63%.

The main sources of SO₂ emissions from NFR 1A2gvi before 2005 was VKG Energia OÜ, Lõuna soojuselektrijaam (the main fuel is generator gas from shale oil production). Before 2000 the power plant was a part of the shale oil production enterprise Kiviter RAS (in the future Viru Keemia Grupp AS and VKG Oil AS) and units were classified as being combustion-related in manufacturing industries (SNAP 03). Since 2001 the power plant has begun independent activities as part of the Viru Keemia Grupp AS but, nevertheless, the main part of energy use was for technology needs. Since 2006 the power plant had begun to be used more as a thermal power plant for heating residential areas and has been classified as SNAP 0101, with emissions from this enterprise being reported under an NFR 1A1a.

Therefore, a different SNAP code was the cause of changes in emissions. A reallocation of emissions from NFR 1A2giii to NFR 1A1a has not influenced emissions in 2006 as, during this period, there was a decrease in emissions at the Baltic power plant. The other important SO₂

pollution source in this sector is industrial boilers at the Kiviõli oil shale production plant, which uses as its fuel oil shale and generator gas.

3.2.3.1. Source Category Description

Manufacturing industries sources category description are presented in the [Table 3.21](#).

Table 3.21 Manufacturing industries reporting activities

NFR	Description	Method	Activity data	Emissions factor
1A2a	Iron and steel	Tier 3	Fuel consumption reported by operators, includes in NFR 1A2giii	National EF; Measurements
1A2b	Non-ferrous metals	Tier 3	Reported by operators	National EF; Measurements
1A2c	Chemicals	Tier 3	Reported by operators	National methodologies; National EF; Measurements
1A2d	Pulp, Paper and Print	Tier 3	Reported by operators	National methodologies; National EF; Measurements
1A2e	Food processing, beverages and tobacco	Tier 3	Reported by operators	National EF; Measurements; EMEP/EEA Guidebook
1A2f	Non-metallic minerals	Tier 3	Reported by operators	National methodologies; National EF; Measurements
1A2gviii	Other	Tier1/Tier 3	Fuel consumption reported by operators; Statistical Energy Balance	National EF; Measurements; Default EMEP/EEA Guidebook

NFR 1A2a: Iron and steel include emissions from processes with contact and combustion plants of this activity reported by 5 operators. Emissions are calculated on the basis of measurements, or the combined method (measurements plus calculations) is used.

NFR 1A2b: Non-ferrous metals include emissions from processes with contact (secondary lead, zinc and aluminium production) and combustion plants of this activity reported by 5 operators. Emissions are calculated on the basis of measurements, or the combined method (measurements plus calculations) is used.

NFR 1A2c: Chemicals include emissions from combustion plants of this activity reported by 6 operators. Emissions are calculated on the basis of measurements, or the combined method (measurements plus calculations) is used.

NFR 1A2d: Pulp, paper and print include emissions from combustion plants of this activity reported by 13 operators. Emissions are calculated on the basis of measurements, or the combined method (measurements plus calculations) is used.

NFR 1A2e: Food processing, beverages, and tobacco include emissions from combustion

plants and other stationary equipment of this activity reported by 52 operators. Emissions are calculated on the basis of measurements, or the combined method (measurements plus calculations) is used.

NFR 1A2f: Non-metallic minerals include emissions from all boilers and other processes with contact in the non-metallic minerals industry: cement, lime, glass, bricks, and other productions (SNAP 0301, 030311-030326). Data are only from point sources (33 operators). Emissions from the point sources are calculated on the basis of measurements, national emission factors, or the combined method (measurements plus calculations) is used. Emissions of the main pollutants and heavy metals are calculated on the basis of national emission factors and POPs on the basis of the EMEP/EEA Guidebook. For cement production, the HCB and PAHs emissions are calculated on the basis of measurements.

NFR 1A2gviii: Others include emissions from all boilers in the other manufacturing industry (excluding NFRs 1A2a-e, 1A2f), other processes with contact: other productions (SNAP 0301, 030326). Data are from point and diffuse sources. Emissions from the point sources are calculated on the basis of measurements, national emission

factors, or the combined method (measurements plus calculations) is used. Emissions of the main pollutants and heavy metals from diffuse sources

are calculated on the basis of national emission factors and POPs on the basis of the EMEP/EEA Guidebook.

Table 3.22 Pollutants emissions from combustion in manufacturing industries in the period of 1990-2017

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	BC	TSP	CO	Pb
	kt									t
1990	5.600	0.620	38.510	0.010	NR	NR	NR	89.791	6.180	62.460
1995	2.340	0.230	19.510	0.006	NR	NR	NR	33.610	2.720	25.340
2000	2.470	0.130	10.100	0.055	1.662	2.679	0.426	4.506	4.050	0.780
2005	2.140	0.930	12.170	0.226	4.312	4.892	1.167	5.842	10.720	0.950
2006	2.130	0.720	6.020	0.133	1.590	2.088	0.427	2.993	6.070	0.570
2007	2.060	0.620	4.390	0.102	1.431	1.899	0.385	3.124	6.220	0.690
2008	2.330	0.943	6.030	0.174	3.212	3.776	0.872	4.942	9.419	1.454
2009	1.337	0.435	4.840	0.096	1.587	2.176	0.432	3.077	5.241	0.849
2010	1.621	0.659	4.136	0.133	2.140	2.506	0.584	3.157	6.573	0.852
2011	2.397	0.576	4.445	0.138	1.995	2.290	0.531	2.686	6.293	0.699
2012	1.871	0.437	5.097	0.129	1.226	1.327	0.323	1.767	5.334	0.467
2013	2.357	0.769	4.569	0.154	1.787	1.978	0.473	2.279	5.776	0.525
2014	1.973	0.700	4.608	0.132	1.134	1.282	0.303	1.900	4.427	0.603
2015	1.405	0.856	4.915	0.209	2.723	2.906	0.773	3.401	7.417	0.809
2016	1.481	0.623	5.088	0.160	1.461	1.670	0.393	1.898	5.507	0.515
2017	2.114	0.809	5.678	0.254	2.828	3.091	0.793	3.471	9.436	0.752
trend 1990-2017, %	-62.2	30.4	-85.3	2 568.8	70.2	15.4	86.2	-96.1	52.7	-98.8

Table 3.22 continues

Year	Cd	Hg	As	Cr	Cu	Ni	Zn	PAHs total	PCCD/F	HCB	PCBs
	t								g I-TEQ	kg	
1990	3.230	0.080	0.500	0.530	2.470	6.070	15.390	0.741	1.440	0.064	2.000
1995	1.310	0.030	0.080	0.049	0.962	2.429	6.514	0.213	0.920	0.046	1.030
2000	0.030	0.010	0.021	0.069	0.040	0.289	0.578	0.386	0.530	0.060	0.380
2005	0.020	0.002	0.031	0.289	0.062	0.379	2.080	1.356	0.670	0.091	1.460
2006	0.010	0.004	0.030	0.309	0.070	0.219	1.170	0.867	0.790	0.074	0.990
2007	0.030	0.021	0.061	0.360	0.120	0.239	0.788	0.683	0.930	0.094	0.440
2008	0.057	0.034	0.104	0.442	0.127	0.389	1.734	1.051	0.600	0.107	1.040
2009	0.021	0.006	0.085	0.271	0.100	0.285	0.847	0.658	0.171	0.049	0.670
2010	0.020	0.005	0.072	0.202	0.090	0.219	1.102	0.822	0.246	0.068	0.940
2011	0.014	0.004	0.054	0.113	0.062	0.163	0.844	0.847	0.222	0.077	0.835
2012	0.015	0.004	0.063	0.102	0.053	0.130	0.489	0.793	0.216	0.080	0.753
2013	0.018	0.003	0.055	0.109	0.048	0.109	0.791	0.904	0.259	0.078	0.886
2014	0.018	0.004	0.080	0.206	0.061	0.172	0.577	0.780	0.222	0.023	0.779
2015	0.022	0.004	0.059	0.169	0.037	0.153	1.388	1.168	0.314	0.035	1.145
2016	0.013	0.004	0.054	0.092	0.028	0.094	0.893	0.928	0.250	0.028	0.949
2017	0.021	0.006	0.036	0.139	0.034	0.140	1.570	1.397	0.520	0.043	1.369
trend 1990-2017, %	-99.3	-92.5	-92.9	-73.7	-98.6	-97.7	-89.8	88.4	-63.9	-33.2	-31.6

3.2.3.2. Methodological Issues

Fuel consumption data from point sources have been summarised by SNAP codes. Emissions from the diffuse sources were calculated by using data on fuel consumption from Energy Balance (EB), prepared by Estonian Statistics:

$$\text{Diffuse sources Fuel} = \text{EB fuel} - \text{PS fuel}$$

The main tables of the Energy Balance contain summary data for the district heating and industrial boilers (SNAP 01 and SNAP 03). Fuel consumption by the manufacturing industry is only shown under final consumption

(SNAP 0303). In this case, it is difficult to compare fuel data from the national database (by SNAP) and the Estonian Energy Balance. In order to determine fuel consumption by diffuse sources, combined data from two tables were used: "Energy balance sheet" and "Consumption of fuel by branches of the economy".

Emissions from PS and diffuse sources have been calculated according to national emission factors and fuel consumption, or on the basis of measurements. Emission factors are presented in Chapter 3.2.2.2.

Implied emission factors (IEF) for some pollutants for sector 1A2 are presented in the [Table 3.23](#).

The main impact on the IEF decrease in the period of 1990-2000 was exerted by changes on the enterprise for cement production - primarily the introduction of effective clearing equipment and new technologies. In addition, a change of structure in the fuel consumed in this sector in

general was also to blame, with a growth in the consumption of natural gas and biomass exerting an impact (see [Figure 3.20](#) and [Table 3.24](#)).

Table 3.23 NFR 1A2 pollutants IEF, g/total fuels GJ

Year	SO ₂	NO _x	TSP	PM _{2.5}
1990	1,359.6	197.7	3,170.1	
1995	1,463.3	175.5	2,520.8	
2000	841.8	205.9	375.6	138.5
2005	632.9	111.3	303.8	224.3
2006	428.0	151.4	212.8	113.0
2007	246.1	115.5	175.1	80.2
2008	287.2	111.0	235.3	153.0
2009	305.9	84.5	194.4	100.3
2010	267.8	104.9	204.4	138.6
2011	290.0	156.4	175.2	130.1
2012	330.7	121.4	114.6	79.5
2013	315.4	162.7	157.3	123.4
2014	316.2	135.4	130.4	77.8
2015	330.4	94.4	228.7	183.0
2016	379.6	110.5	141.6	109.0
2017	315.9	117.6	193.1	157.3

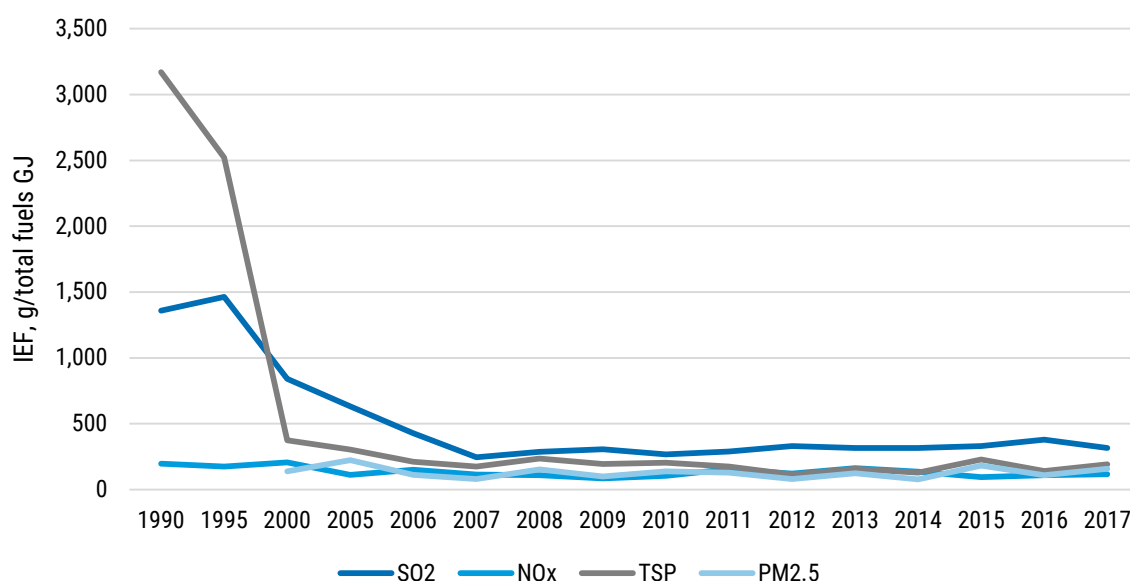
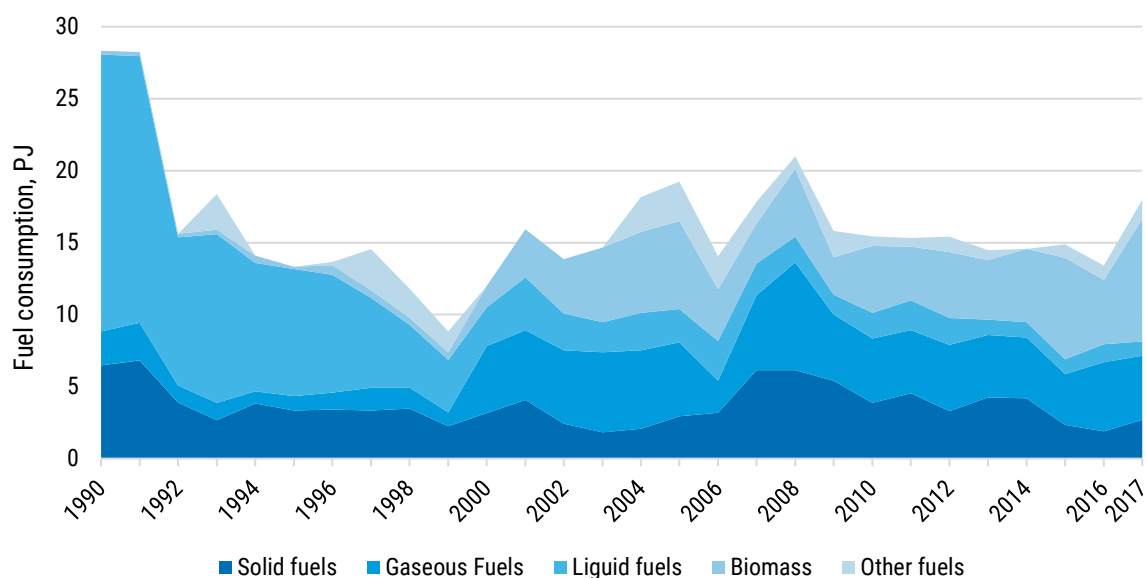
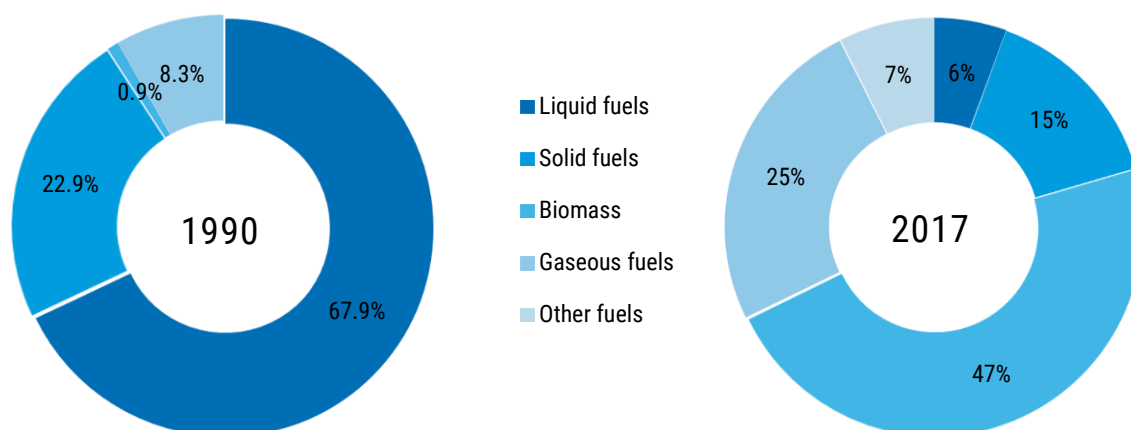


Figure 3.20 Implied emission factors for NFR 1A2

Details on fuel consumption by manufacturing industries are presented in the [Table 3.24](#), [Figure 3.21](#) and [Figure 3.22](#).

Table 3.24 Fuel consumption by manufacturing industries in the period of 1990-2017

Year	Liquid fuels	Solid fuels	Biomass	Gaseous fuels	Other fuels
1990	19.24	6.47	0.26	2.35	NA
1995	8.81	3.34	0.17	1.01	NA
2005	2.32	2.93	6.10	5.14	2.73
2006	2.75	3.19	3.61	2.22	2.29
2007	2.21	6.15	2.77	5.19	1.52
2008	1.77	6.15	4.71	7.48	0.88
2009	1.39	5.40	2.61	4.60	1.82
2010	1.76	3.88	4.66	4.47	0.67
2011	2.06	4.53	3.74	4.39	0.60
2012	1.86	3.29	4.58	4.60	1.07
2013	1.06	4.26	4.15	4.33	0.69
2014	1.07	4.18	5.10	4.23	0.00
2015	1.03	2.33	7.05	3.54	0.92
2016	1.25	1.90	4.47	4.80	0.99
2017	0.99	2.69	8.51	4.46	1.33
trend 1990-2017, %	-93.5	-70.6	1 637.8	104.0	

**Figure 3.21** Fuel consumption by manufacturing industries in the period of 1990-2017**Figure 3.22** Distribution of fuel consumption in manufacturing industries in 1990 and 2017

3.2.3.3. Source-Specific QA/QC and Verification

Several QC procedures are used in the framework of inventory preparation.

Before usage, data are presented by operators, and the data in reports (emissions, fuel used and methods of calculations) are verified. The Point Sources information system consists of calculation modules on the basis of national emission factors, and if the operator uses the calculation module, one can be relatively certain that the received results are correct.

The data on fuel consumption are then summarised by SNAP codes and compared to the statistical energy balance data. There are difficulties in comparing the consumption of fuel in activities. The principle of a database is that, for example, the industrial boiler is designated SNAP 03, irrespective of whether the heat is sold or is used for its own needs.

3.2.3.4. Recalculations

In the 2019 submission the following recalculations were carried out:

- Correction of Cr, Ni, Zn emissions data for 2010-2016 – emissions were reallocated from NFR 1A2b to NFR 2C7c;
- Correction of emissions TSP, PM₁₀, PM_{2.5} data for NFR 1A2f for 2008-2009;
- Correction of SO_x emissions data for NFR 1A2giii for 2008-2009.

3.2.3.5. Source-Specific Planned Improvements

- Recalculation of POPs emissions.

3.2.4. Non-Industrial Combustion (NFR 1A4)

3.2.4.1. Source Category Description

NFR 1A4 sectors include emissions from the small combustion plants used in the Commercial/Institutional, Residential sectors and Agriculture/Forestry/Fisheries.

The non-industrial combustion sector is a key source of NO_x (14.9%), NMVOC (15.1%), CO (49.7%), PM_{2.5} (25.1%), PM₁₀ (17.3%), TSP (13.3%), some heavy metals and POPs emissions. The main source of pollution inside this sector is residential stationary, which contributes to over 40% of final energy consumption in Estonia, with the largest share being consumed by building. The volume of biomass consumption in this sector increased by about three times in comparison with the 1990-s.

During the 1990-2017 period, the emission of some pollutants from this sector have decreased, and some pollutants such as NO_x, CO, NH₃, Cd, Cr, Zn, and HCB, have increased due to an increase in wood combustion and higher wood emissions factors for these substance (see

[Table 3.26](#)).

Table 3.25 Non-industrial combustion activities

NFR	Description	Method	Activity data	Emissions factor
1A4ai	Commercial / institutional: Stationary	Tier 1/Tier 3	Fuel consumption reported by operators; Energy balance of Statistics Estonia	National EF; Measurements; Default EMEP/EEA Guidebook
1A4bi	Residential: Stationary plants	Tier 2	Energy balance of Statistics Estonia	National EF; Default EMEP/EEA Guidebook
1A4ci	Agriculture/Forestry/Fishing: Stationary	Tier 1/Tier 3	Fuel consumption reported by operators; Energy balance of Statistics Estonia	National EF; Measurements; Default EMEP/EEA Guidebook

NFR 1A4ai-ci: Commercial / institutional: Stationary and Agriculture/Forestry/Fishing: Stationary includes pollutant emissions from combustion processes in this sector. Data are from point and diffuse sources. Emissions from the point sources are calculated on the basis of measurements, national emission factors, or the combined method (measurements plus

calculations) is used. Emissions of the main pollutants and heavy metals from diffuse sources are calculated based on national emission factors and POPs on the basis of the EMEP/EEA Guidebook.

NFR 1A4bi: Residential: Stationary plants include pollutant emissions data from diffuse sources.

Table 3.26 Pollutant emissions from combustion in non-industrial sector in the period of 1990-2017

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	BC	TSP	CO	Pb
	kt									t
1990	4.772	4.428	6.090	0.046	NR	NR	NR	4.654	62.244	0.899
1995	10.015	7.282	2.293	0.072	NR	NR	NR	5.321	122.085	0.562
2000	8.430	6.178	2.688	0.073	4.309	4.581	1.623	5.106	103.946	0.700
2005	6.142	4.405	1.456	0.064	3.455	3.808	1.239	4.608	77.189	0.786
2006	5.922	4.190	1.085	0.074	3.432	3.690	1.224	4.247	73.843	0.681
2007	7.379	5.040	0.941	0.087	3.626	3.888	1.396	4.520	91.563	0.750
2008	7.276	5.068	0.869	0.075	3.398	3.606	1.324	4.111	91.368	0.673
2009	7.351	4.995	0.702	0.078	3.380	3.573	1.338	4.036	93.513	0.652
2010	7.420	5.048	0.750	0.084	3.491	3.676	1.359	4.141	94.296	0.713
2011	6.183	4.215	0.700	0.067	2.964	3.127	1.113	3.486	79.205	0.613
2012	6.301	4.189	0.679	0.065	2.812	2.951	1.083	3.326	80.455	0.590
2013	5.814	3.913	0.670	0.075	2.870	3.009	1.066	3.328	75.434	0.608
2014	5.532	3.666	0.622	0.084	2.585	2.716	0.932	3.042	71.756	0.554
2015	5.273	3.454	0.481	0.078	2.592	2.722	0.916	3.034	68.300	0.553
2016	5.404	3.519	0.507	0.084	2.785	2.974	0.957	3.446	70.476	0.652
2017	5.339	3.465	0.430	0.093	2.817	2.965	0.948	3.299	70.142	0.604
trend 1990-2017, %	11.9	-21.8	-92.9	101.2	-34.6	-35.3	-41.6	-29.1	12.7	-32.8

Table 3.26 continues

Year	Cd	Hg	As	Cr	Cu	Ni	Zn	PAHs total	PCCD/F	HCB	PCBs
	t								g I-TEQ	kg	
1990	0.084	0.019	0.039	0.283	0.161	0.904	3.964	5.361	3.168	0.093	1.071
1995	0.196	0.011	0.025	0.372	0.124	0.458	7.992	7.897	2.302	0.236	0.306
2000	0.188	0.015	0.023	0.387	0.136	0.496	7.632	6.739	2.303	0.204	0.479
2005	0.171	0.013	0.038	0.437	0.119	0.333	6.912	4.657	1.649	0.157	0.426
2006	0.170	0.012	0.035	0.367	0.129	0.154	6.810	4.334	1.478	0.152	0.481
2007	0.216	0.013	0.035	0.467	0.139	0.173	8.576	5.044	1.499	0.193	0.246
2008	0.217	0.014	0.027	0.435	0.130	0.128	8.717	4.949	1.495	0.196	0.325
2009	0.229	0.013	0.023	0.444	0.129	0.121	9.123	4.891	1.413	0.203	0.267
2010	0.236	0.013	0.026	0.469	0.137	0.131	9.476	4.833	1.424	0.204	0.349
2011	0.204	0.012	0.020	0.399	0.116	0.090	8.220	3.975	1.238	0.173	0.293
2012	0.215	0.012	0.021	0.410	0.122	0.082	8.614	3.980	1.239	0.182	0.208
2013	0.209	0.012	0.014	0.397	0.113	0.070	8.456	3.678	1.168	0.173	0.340
2014	0.217	0.015	0.019	0.389	0.110	0.066	8.157	3.505	1.103	0.171	0.299
2015	0.201	0.011	0.014	0.382	0.105	0.070	7.991	3.209	0.973	0.163	0.251
2016	0.216	0.011	0.023	0.447	0.119	0.118	8.510	3.187	0.905	0.169	0.254
2017	0.217	0.011	0.014	0.417	0.112	0.086	8.667	3.149	0.905	0.170	0.358
trend 1990-2017, %	158.4	-43.6	-63.3	47.5	-30.4	-90.5	118.6	-41.3	-71.4	81.9	-66.6

3.2.4.2. Methodological Issues

Fuel consumption details from point sources (NFR 1A4ai and 1A4ci) have been summarised by SNAP codes. Emissions from the diffuse sources were calculated by using data on fuel consumption from the Energy Balance (EB), which was prepared by Statistics Estonia:

$$\text{Diffuse sources: Fuel} = \text{EB fuel} - \text{PS fuel}.$$

Emissions from PS and diffuse sources have been calculated according to national emissions factors and fuel consumption, or on the basis of measurements. Emissions factors are presented in Chapter 3.2.2.2.

The calculation of main pollutants and POPs emissions for the residential stationary combustion sector was achieved by the use of national factors for wood burning defined within the project "The Geneva Convention on Long Range Transboundary Air Pollution on Persistent Organic Pollutants Protocol compliance". Within the project, measurements for various types of burning installations (stoves, single household boilers, open fireplaces) were carried out and average values were defined. Measurements were also made for conventional and advanced stoves and boilers. Emission factors are shown in [Table 3.29](#). For the calculation of heavy metals emissions from wood combustion and POPs and HMs from other fuels were used as emission factors for the new EMEP/EEA Guidebook 2016

and these are presented in the [Table 3.27](#) and [Table 3.28](#).

Calculations of emissions of POPs from the burning of waste in stoves were made in addition. Emission factors were also defined within the project "Tööstuslikest allikatest ja koduahjustest eralduvate välisõhu saasteainete heitkoguste inventuuri metoodikate täiendamine" (see [Table 3.30](#)). Data on the amount of the burned waste were obtained on the basis of the Statistics Estonia questionnaire (see [Table 3.34](#)). Emissions are included in sector 1A4bi.

The NGO Estonian Chimney Court, believes that in addition to paper and paperboard packaging, diapers, sanitary napkins, various plastic packaging, shoes, clothes, and other residues are burned in domestic stoves. Thanks to growing awareness and new technology, waste burning in households shows a downward trend. People should be motivated not to burn waste as heaters used in such a way will wear faster and maintenance and repair are expensive.

It is estimated that approximately 45% of private households may burn waste (see [Table 3.33](#)). It might be considered that growing awareness and continuous notification concerning the quantities of waste incinerated will assist in its downward trend.

Table 3.27 Main pollutant emission factors for NFR 1A4bi (Tier 2 EMEP/EEA Guidebook 2016)

Pollutant	Unit	Solid fuels (not biomass)			Liquid fuels		Natural gas	
		Conventional stoves, fireplaces, saunas, outdoor heaters (average)	Advanced stoves	Small boilers (<=50 kW _{th})	Stoves	Small boilers (<=50 kW _{th})	Fireplaces, saunas, outdoor heaters	Small boilers (<=50 kW _{th})
NO _x	g/GJ	80	150	158	34	69	60	42
SO ₂	g/GJ	700	450	900	138	79	0.3	0.3
NH ₃	g/GJ	0.3	NA	NA	NA	NA	NA	NA
NM VOC	g/GJ	600	300	174	1.2	0.17	2	1.8
CO	g/GJ	5,000	2,000	4,787	111	3.7	30	22
TSP	g/GJ	425	250	261	2.2	1.5	2.2	0.2
PM ₁₀	g/GJ	390	240	225	2.2	1.5	2.2	0.2
PM _{2.5}	g/GJ	390	220	201	2.2	1.5	2.2	0.2
BC	g/GJ	30.634	14.08	12.864	0.286	0.059	0.119	0.011

Pollutant	Unit	Solid fuels (not biomass)			Liquid fuels		Natural gas	
		Conventional stoves, fireplaces, saunas, outdoor heaters (average)	Advanced stoves	Small boilers (<=50 kW _{th})	Stoves	Small boilers (<=50 kW _{th})	Fireplaces, saunas, outdoor heaters	Small boilers (<=50 kW _{th})
Pb	mg/GJ	100	100	200	0.012	0.012	0.0015	0.0015
Cd	mg/GJ	1	1	3	0.001	0.001	0.00025	0.00025
Hg	mg/GJ	5	5	6	0.12	0.12	0.1	0.1
As	mg/GJ	1.5	1.5	5	0.002	0.002	0.12	0.12
Cr	mg/GJ	10	10	15	0.2	0.2	0.00076	0.00076
Cu	mg/GJ	20	15	30	0.13	0.13	0.000076	0.000076
Ni	mg/GJ	10	10	20	0.005	0.005	0.00051	0.00051
Se	mg/GJ	2	2	2	0.002	0.002	0.011	0.011
Zn	mg/GJ	200	200	300	0.42	0.42	0.0015	0.0015
PCBs	µg/GJ	170	170	170				
PCDD/F	ng/GJ	1,000	500	500	10	1.8	1.5	1.5
B(a)p	mg/GJ	250	150	270	0.08	0.08	0.00056	0.00056
B(b)f	mg/GJ	400	180	250	0.04	0.04	0.00084	0.00084
B(k)f	mg/GJ	150	100	100	0.07	0.07	0.00084	0.00084
I(1,2,3-cd)p	mg/GJ	120	80	90	0.16	0.16	0.00084	0.00084
HCB	µg/GJ	0.62	0.62	0.62				

Table 3.28 HMs and PCBs emission factors for wood combustion for NFR 1A4bi (EMEP/EEA Guidebook 2016)

Pollutant	Unit	Biomass			
		Conventional stoves, fireplaces, saunas, outdoor heaters (average)	Small boilers (<=50 kW _{th})	Advanced stoves and boilers	Pellet stoves and boilers
Pb	mg/GJ	27	27	27	27
Cd	mg/GJ	13	13	13	13
Hg	mg/GJ	0.56	0.56	0.56	0.56
As	mg/GJ	0.19	0.19	0.19	0.19
Cr	mg/GJ	23	23	23	23
Cu	mg/GJ	6	6	6	6
Ni	mg/GJ	2	2	2	2
Se	mg/GJ	0.5	0.5	0.5	0.5
Zn	mg/GJ	512	512	512	512
PCBs	µg/GJ	0.06	0.06	0.007	0.01

Table 3.29 Main pollutants and POPs national emission factors for NFR 1A4bi (wood combustion)

Pollutant	Unit	Biomass					
		Conventional stoves, fireplaces	Advanced stoves	Conventional small boilers (<=35 kW _{th})	Advanced small boilers (<=35 kW _{th})	Wood briquette stoves and boilers	Wood pellet stoves and boilers
NO _x	g/GJ	140.41	117.582	2,382.816	74.512	176.21	45.875
SO ₂	g/GJ	11	10.91	26.647	11	10.89	12.34
NH ₃	g/GJ	2.629	2.629	9.869	0.308	2.497	0.933
NM VOC	g/GJ	66.763	60.625	1,851.82	57.883	204.556	2.28
CO	g/GJ	3,295.845	2,574.958	24,264.87	758.454	4032.213	269.283
TSP	g/GJ	275.217	26.81	341.703	10.681	792.251	26.651
PM ₁₀	g/GJ	257.627	24.153	310.639	9.71	720.228	23.986
PM _{2.5}	g/GJ	249.935	23.996	295.107	9.224	684.217	22.786

Pollutant	Unit	Biomass					
		Conventional stoves, fireplaces	Advanced stoves	Conventional small boilers (<=35 kW _{th})	Advanced small boilers (<=35 kW _{th})	Wood briquette stoves and boilers	Wood pellet stoves and boilers
BC	g/GJ	120.702	11.436	140.638	4.396	326.075	10.859
PCDD/F	ng/GJ	161.9	8.8	15.025	0.4696	6.5	1.9
B(a)p	mg/GJ	37.9	1.185	489.008	0.037	2.942	3.381
B(b)f	mg/GJ	28.5	0.891	433.051	0.028	2.212	1.994
B(k)f	mg/GJ	18.2	0.569	358.864	0.018	1.413	1.098
I(1,2,3-cd)p	mg/GJ	28.1	0.878	591.64	0.027	2.181	2.137
HCB	µg/GJ	17.104	8.341	8.333	0.261	5.217	1.288

Table 3.30 National pollutants emission factors for the waste combustion in stoves

Pollutant	Unit	Emission factor
NO _x	g/GJ	224.593
SO ₂	g/GJ	19.749
NH ₃	g/GJ	3.067
NM VOC	g/GJ	190.561
CO	g/GJ	2,795.054
TSP	g/GJ	1,167.613
PM ₁₀	g/GJ	1,061.466
PM _{2.5}	g/GJ	1,008.393
BC	g/GJ	77.349
PCDD/PCDF	µg/GJ	0.055
B(a)p	µg/GJ	10,428.571
B(b)f	µg/GJ	10,557.619
B(k)f	µg/GJ	4,566.167
I(1,2,3-cd)p	µg/GJ	5,637.013
HCB	µg/GJ	35.943

Implied emission factors (IEF) for some pollutants for sector 1A4 are presented in the [Table 3.31](#).

The main impact on the change of IEF in this sector is the exerted change of the situation regarding residual stationary as it is a main source of pollution inside the non-industrial sector. At the beginning of the 1990s this involved a change in energy supply, involving a decrease in the consumption of solid fuel, mainly coal and

peat, and the significant growth of wood consumption after 1995 (see [Table 3.32](#), [Figure 3.24](#) and [Figure 3.25](#)). A sharp increase in the IEF of NO_x and a decrease in SO₂ is explained by it. A further decrease of NO_x IEF is explained by a change in the share of conventional and advanced technologies for wood burning in residential sector (the share of new equipment grows every year) (see [Figure 3.23](#)).

Table 3.31 NFR 1A4 pollutants IEF, g/total fuels GJ

Year	SO ₂	NO _x	TSP	PM _{2.5}
1990	297.9	233.4	227.7	
1995	108.3	472.9	251.2	
2000	131.7	413.1	250.3	211.2
2005	74.6	314.7	236.1	177.1
2006	51.8	282.6	202.7	163.8
2007	38.1	299.0	183.1	146.9
2008	34.2	286.3	161.8	133.7
2009	29.4	307.8	169.0	141.6
2010	27.9	275.9	154.0	129.8
2011	30.3	267.5	150.8	128.2
2012	27.5	255.1	134.6	113.9
2013	28.6	248.5	142.2	122.7
2014	26.6	236.3	129.9	110.4
2015	21.5	236.4	136.0	116.2
2016	22.1	235.3	150.0	121.3
2017	18.1	225.2	139.1	118.8

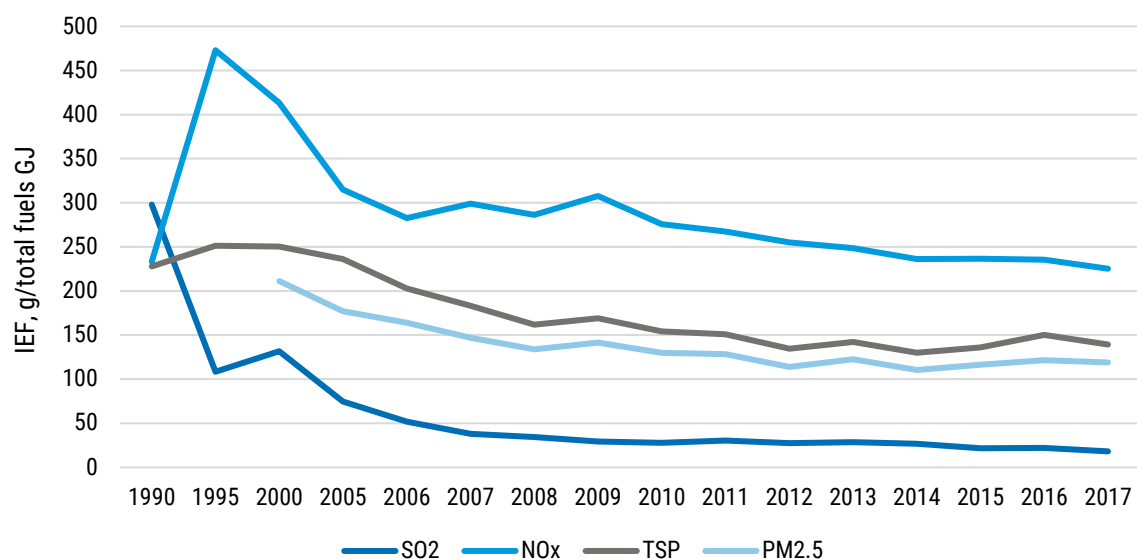


Figure 3.23 Implied emission factors for NFR 1A4

Activity Data

The fuel consumption figures for the non-industrial stationary combustion sector are presented in [Table 3.32](#) and [Figure 3.24](#). The consumption of liquid and solid fuels (mainly coal and peat) has decreased across 1990-2017, by

about 89% and 98% respectively. At the same time, wood burning and natural gas consumption increased by about 199% and 116%. The distribution of fuel consumption rates in 1990 and 2017 are shown in [Figure 3.25](#).

Table 3.32 Fuel consumption in non-industrial combustion plants in the period of 1990–2017 (PJ)

Year	Liquid fuels	Solid fuels	Biomass	Gaseous fuels	Other fuels
1990	4.80	7.26	5.93	2.45	NA
1995	1.44	2.53	15.20	2.01	NA
2000	2.25	1.38	14.36	2.41	NA
2005	1.08	1.40	12.81	4.16	0.07
2006	1.25	1.03	12.80	5.87	0.02
2007	1.13	0.72	16.55	6.20	0.08
2008	1.15	0.62	16.82	6.24	0.57
2009	0.95	0.44	17.31	5.11	0.07
2010	1.12	0.47	18.55	6.59	0.17
2011	0.83	0.55	15.21	6.52	NA
2012	0.93	0.49	16.78	6.49	NA
2013	0.58	0.50	16.56	5.76	NA
2014	0.56	0.45	16.68	5.73	NA
2015	0.55	0.30	16.11	5.31	0.03
2016	0.51	0.26	17.02	5.17	0.00
2017	0.53	0.18	17.71	5.29	NA
trend 1990-2017, %	-89.0	-97.5	198.6	116.0	

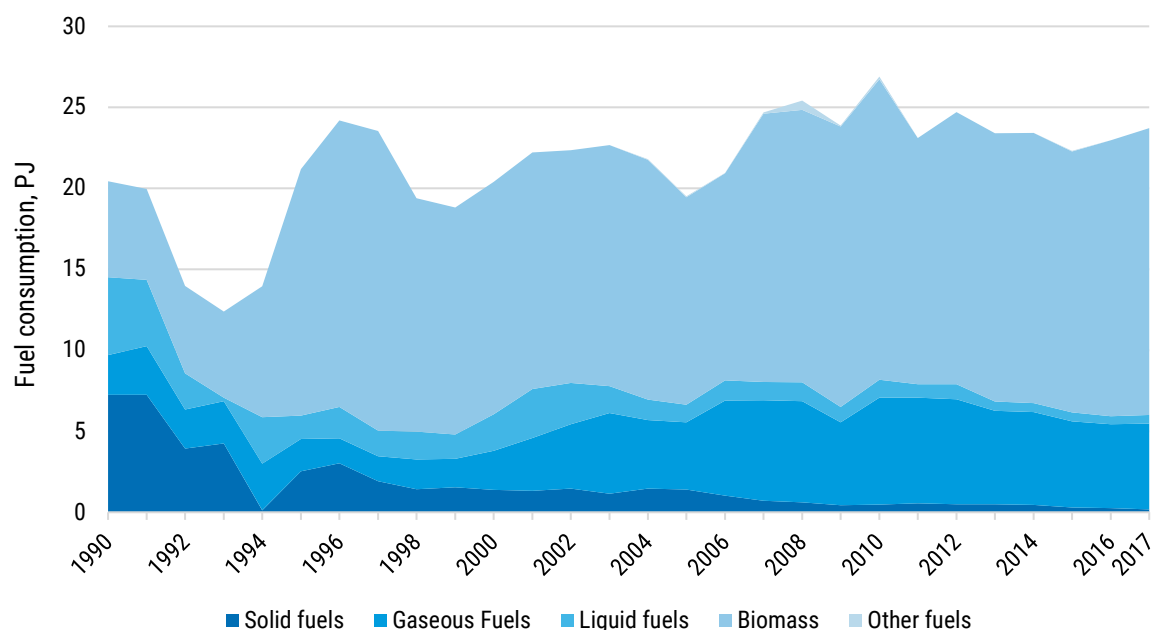


Figure 3.24 Fuel consumption by non-industrial combustion plants in the period of 1990–2017

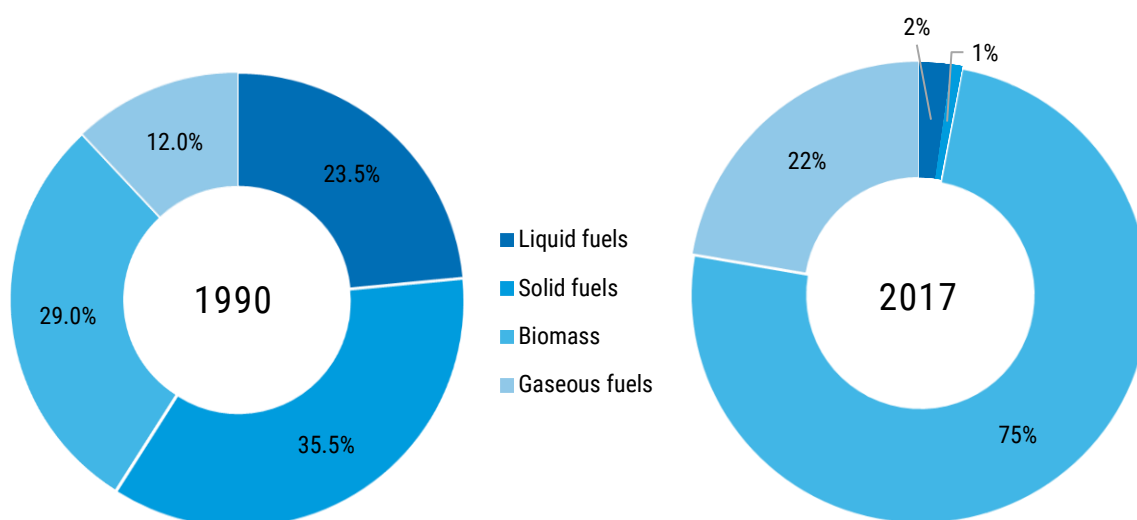


Figure 3.25 Distribution of fuel consumption in non-industrial combustion sector in 1990 and 2017

Fuel consumption figures by residential stationary sector are presented in [Table 3.33](#). [Figure 3.26](#) shows fuel consumption levels for

each non-industrial sector in 2017. It should be noted that the domestic sector is the main source of wood burning.

Table 3.33 Fuel consumption in residential combustion plants (NFR 1A4bi) in the period of 1990–2017, PJ

Year	Liquid fuels	Solid fuels	Biomass	Gaseous fuels
1990	2.211	7.03	5.344	2.115
1995	0.051	2.483	15.007	1.998
2000	0.656	1.222	13.888	1.757
2005	0.258	0.969	12.254	1.871
2006	0.278	0.7725	11.945	1.907
2007	0.232	0.444	15.668	2.034
2008	0.303	0.479	16.26	2.062

Year	Liquid fuels	Solid fuels	Biomass	Gaseous fuels
2009	0.216	0.31	16.751	2.102
2010	0.169	0.36	17.701	2.299
2011	0.224	0.462	14.541	2.135
2012	0.195	0.406	16.297	2.294
2013	0.173	0.406	15.75	2.135
2014	0.169	0.365	15.552	2.135
2015	0.19	0.229	15.133	2.079
2016	0.113	0.087	16.068	2.367
2017	0.085	0.109	16.346	2.251
trend 1990-2017, %	-96.2	-98.4	205.9	6.4

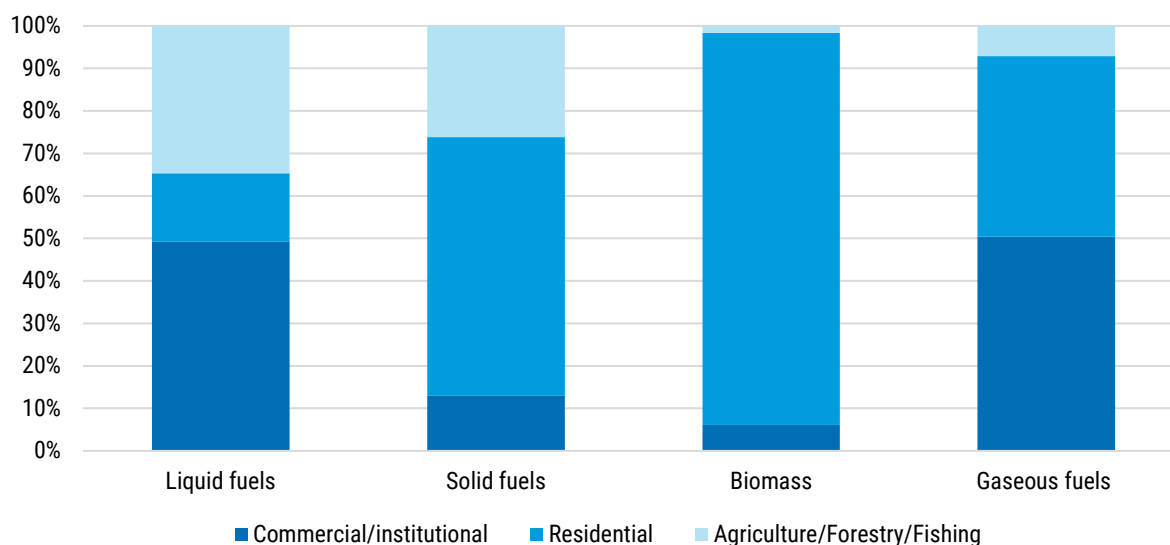


Figure 3.26 Fuel consumption by non-industrial sectors in 2017

Table 3.34 Amount of waste incinerated in domestic stoves (tonnes)

Year	Amount of waste
1990	16,757.789
1995	22,886.049
2000	24,996.018
2005	19,764.689
2006	20,547.828
2007	21,005.810
2008	21,200.339
2009	21,104.040
2010	20,701.470
2011	20,980.553
2012	21,270.634
2013	21,501.930
2014	21,431.000
2015	21,389.500
2016	21,430.500
2017	21,456.489

3.2.4.3. Uncertainty

An uncertainty analysis for the stationary combustion sector alone (NFR 1A1, 1A2, and 1A4) was carried out for the 2015 inventory (see Chapter 3.2.1.2).

3.2.4.4. Source-Specific QA/QC and Verification

Several QC procedures are used in the framework of inventory preparation.

Before usage, data are presented by operators, and the data in reports (emissions, fuel used and methods of calculations) are verified. The Point Sources information system consists of calculation modules on the basis of national emission factors, and if the operator uses the calculation module, one can be relatively certain that the received results are correct.

The data on fuel consumption are then summarised by SNAP codes and compared to the statistical energy balance data. There are difficulties in comparing the consumption of fuel in activities. The principle of a database is that, for example, the industrial boiler is designated SNAP 03, irrespective of whether the heat is sold or is used for its own needs.

3.2.4.5. Recalculations

The recalculation for NFR 1A4bi was carried out in this reporting year.

- NH₃ emission for the period 1990-2016 from residual combustion (wood EF correction for conventional stoves).

3.2.4.6. Source-Specific Planned Improvements

- Recalculation of POPs emissions for NFRs 1A4ai and 1A4ci.

- Recalculation of all pollutants emission from the waste incineration in domestic sector.

3.3. Transport

3.3.1. Overview of the Sector

In this chapter the trends and shares in emissions of the different source categories within the transport sector are described. A detailed description of methodology, activity data, emission factors and emissions is given in each subsector. [Table 3.35](#) gives an overview of all the transport sectors and the methodologies used for calculating emissions from the transport sector.

Table 3.35 Transport sector reporting activities

NFR	Source	Description	Method	Emissions
1A2gvii	Mobile combustion in manufacturing industries and construction	Mobile combustion in manufacturing industries and construction land based mobile machinery (e.g. rollers, asphalt pavers, excavators, cranes, tractors, other industrial machinery)	Tier 1	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, PAHs total
1A3ai-ii(i)	International and Civil aviation (LTO)	Activities include all use of aircraft (jets, turboprop powered and piston engine aircraft, helicopters) consisting passengers and freight transport	Tier 2	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, BC, CO
1A3ai-ii(ii)	International and Civil aviation (Cruise)	Activities include all use of aircraft consisting passengers and freight transport	Tier 1	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, BC, CO
1A3bi-iv	Road transport	Road transport includes use of vehicles with combustion engines: passenger cars, light duty vehicles, heavy duty trucks, buses and motorcycles	Tier 3	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs total, HCB, PCBs
1A3bv	Road transport: Gasoline evaporation	Fuel evaporation from automobiles	Tier 3	NMVOC
1A3bvi	Automobile tyre and brake wear	PM and heavy metal emissions from automobile tyre and brake wear	Tier 3	PM _{2.5} , PM ₁₀ , TSP, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn
1A3bvii	Road transport: Automobile road abrasion	PM emissions from road abrasion	Tier 1	PM _{2.5} , PM ₁₀ , TSP, BC
1A3c	Railways	Railway transport operated by steam and diesel locomotives	Tier 1	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Cd, Cr, Cu, Ni,

NFR	Source	Description	Method	Emissions
				Se, Zn, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs total
1A3dii	National navigation (Shipping)	Merchant ships, passenger ships, technical ships, pleasure and tour ships and other inland vessels	Tier 1	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, B(a)p, B(b)f, PAHs total, HCB, PCBs
1A4aii	Commercial/Institutional: Mobile	Commercial and institutional land based mobile machinery. This source category includes 1A5b Other, Mobile - Military sector	Tier 1	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, PAHs total
1A4bii	Residential: Household and gardening (mobile)	Household and gardening sector includes various machinery: lawn mowers, wood splitters, lawn and garden tractors etc.	Tier 1	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, PAHs total
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Land based mobile off-road vehicles and other machinery used in agriculture/forestry sector (agricultural tractors, harvesters, combines etc.)	Tier 1	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, PAHs total
1A4ciii	Agriculture/Forestry/Fishing: National fishing	National fishing sector covers emissions from fuels combusted for inland, coastal and deep-sea fishing	Tier 1	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, HCB, PCBs
1A3di(i)	International maritime navigation	Vessels of all flags that are engaged in international water-borne navigation	Tier 1 (cruise); Tier 3 (hotelling, maneuvering)	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, HCB, PCBs

The transport sector is a major contributor to national emissions. The transport sector includes road transport which is the largest and most important emission source (Figure 3.27). The share of mobile sources in total national emissions in 2017 was the following: NO_x – 38.5%, BC – 15.8%, CO – 14.9% and NMVOC – 12.4%. The share of other pollutants is not so significant. Emissions of most compounds have decreased throughout the time series, mainly due to the stricter emission standards for road vehicles. The emissions of nitrogen oxides have decreased compared to 1990 by 66.4%. The emissions of NMVOC and CO from the transport sector have decreased by 86.2% since 1990. The trend of the emissions of these categories is given in Figure 3.28 and Table 3.36.

Recalculations have been made for the following sectors: aviation (1A3ai-ii(ii)), road transport (1A3bi-vii), national navigation (1A3dii), household and gardening machinery (NFR 1A4bii) and national fishing (NFR 1A4ciii) sector. Recalculations entail using the new COPERT 5 program to calculate emissions from road transport, updated activity data and emission factors, which all led to a change in total emissions. A detailed overview is given in each transport subsector and in Chapter 8.

In addition, information on which transport sectors include the condensable component of PM₁₀ and PM_{2.5} can be found in Appendix 1 'Summary Information on Condensable in PM'.

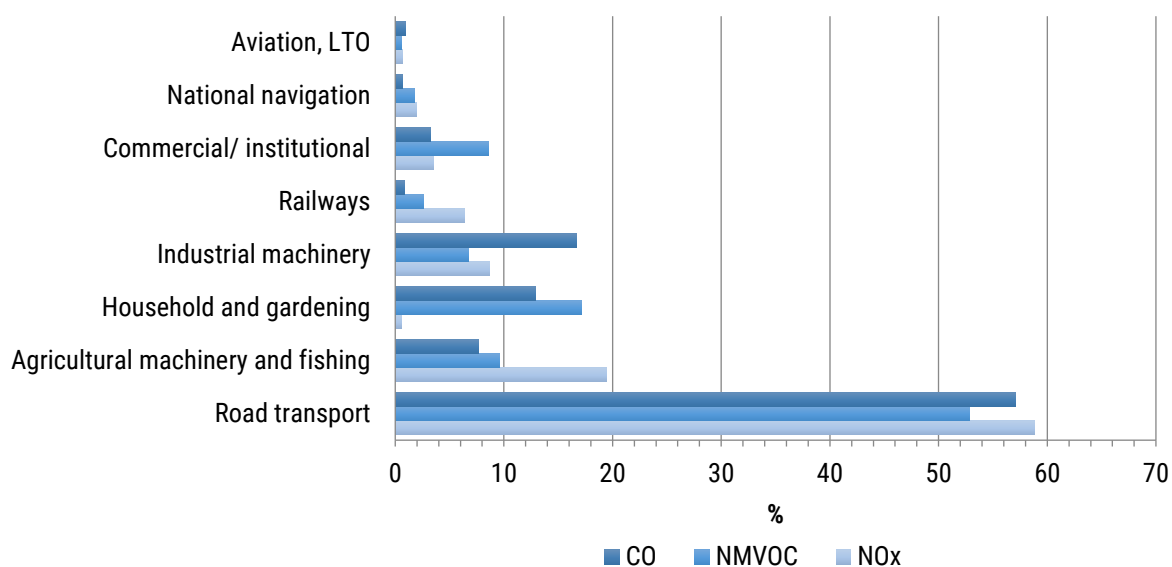


Figure 3.27 NO_x, NMVOC and CO emission shares in the transport sectors in 2017

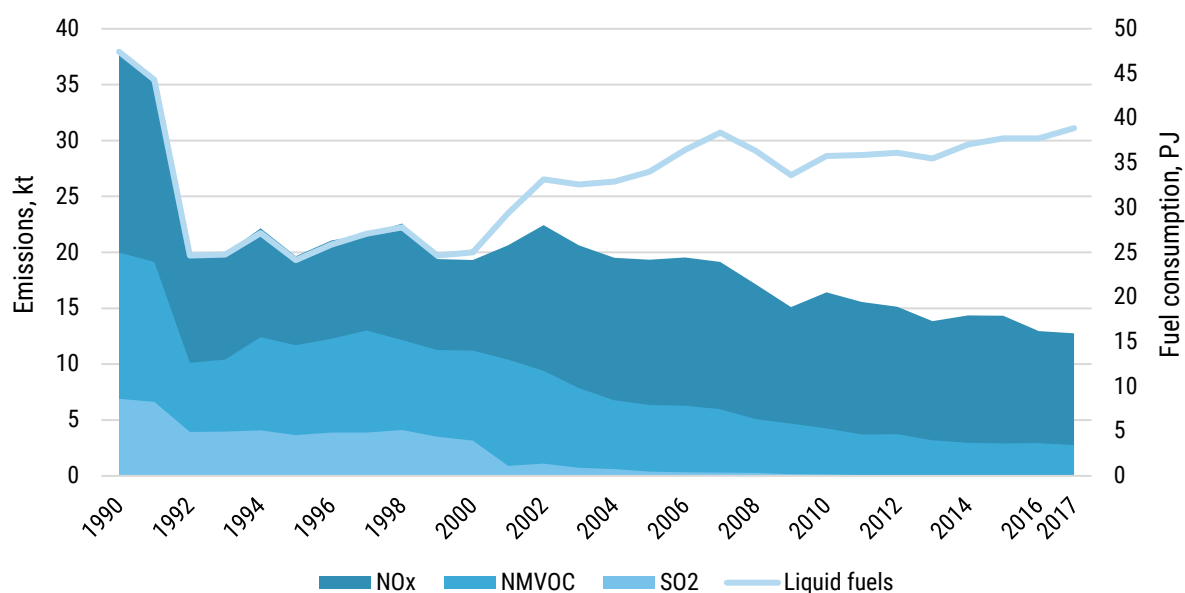


Figure 3.28 NO_x, NMVOC and CO emissions from the transport sector in the period of 1990-2017

Table 3.36 Total emissions from the transport sector in the period of 1990-2017

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
kt									
1990	37.993	19.983	6.891	0.018	NR	NR	1.733	NR	149.447
1995	19.659	11.705	3.639	0.026	NR	NR	1.010	NR	66.409
2000	19.314	11.209	3.152	0.096	0.905	0.994	1.102	0.475	71.994
2005	19.339	6.352	0.381	0.199	0.953	1.067	1.205	0.532	44.407
2006	19.547	6.285	0.335	0.231	0.955	1.079	1.228	0.539	43.554
2007	19.141	5.968	0.309	0.246	0.968	1.098	1.255	0.551	40.929
2008	17.132	5.082	0.262	0.244	0.873	0.998	1.147	0.493	34.107
2009	15.107	4.688	0.139	0.220	0.745	0.860	0.998	0.427	31.473
2010	16.429	4.254	0.128	0.203	0.798	0.919	1.065	0.467	28.682
2011	15.551	3.690	0.066	0.195	0.759	0.883	1.033	0.442	24.231
2012	15.132	3.719	0.054	0.183	0.758	0.884	1.036	0.445	23.727
2013	13.836	3.181	0.030	0.158	0.696	0.819	0.967	0.410	19.775

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
kt									
2014	14.356	2.965	0.036	0.150	0.746	0.871	1.021	0.435	18.726
2015	14.342	2.905	0.045	0.150	0.754	0.881	1.035	0.437	18.362
2016	12.961	2.933	0.042	0.147	0.691	0.822	0.979	0.395	21.484
2017	12.766	2.760	0.040	0.145	0.688	0.823	0.986	0.392	20.569
trend 1990-2017, %	-66.4	-86.2	-99.4	688.9	-24.1	-17.3	-43.1	-17.4	-86.2

Table 3.36 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
t									
1990	78.174	0.011	0.007	0.924	0.145	3.682	0.089	0.012	1.718
1995	24.416	0.005	0.004	0.409	0.080	1.996	0.045	0.006	0.925
2000	4.983	0.005	0.004	0.406	0.084	2.117	0.049	0.007	0.971
2005	2.129	0.008	0.005	0.608	0.112	2.827	0.070	0.009	1.336
2006	1.467	0.008	0.005	0.654	0.121	3.066	0.077	0.010	1.452
2007	1.541	0.009	0.005	0.900	0.128	3.231	0.086	0.011	1.534
2008	1.520	0.008	0.006	1.108	0.123	3.104	0.088	0.011	1.463
2009	1.395	0.008	0.005	0.668	0.114	2.877	0.073	0.010	1.358
2010	0.286	0.008	0.005	0.577	0.119	3.004	0.074	0.010	1.410
2011	0.289	0.008	0.005	0.389	0.122	3.077	0.070	0.010	1.433
2012	0.297	0.008	0.005	0.371	0.124	3.131	0.071	0.010	1.461
2013	0.284	0.008	0.005	0.335	0.121	3.059	0.068	0.009	1.428
2014	0.263	0.009	0.005	0.393	0.125	3.177	0.073	0.010	1.494
2015	0.267	0.009	0.005	0.400	0.129	3.279	0.076	0.010	1.546
2016	0.296	0.009	0.005	0.396	0.131	3.337	0.076	0.010	1.574
2017	0.307	0.009	0.005	0.437	0.136	3.464	0.080	0.011	1.637
Trend 1990-2017, %	-99.6	-12.1	-23.7	-52.7	-6.0	-5.9	-9.9	-9.0	-4.7

Table 3.36 continues

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs total	HCB	PCBs
g I-TEQ								
1990	0.354	0.023	0.041	0.017	0.012	0.093	0.835	20.571
1995	0.221	0.009	0.017	0.009	0.007	0.042	0.467	6.820
2000	0.223	0.007	0.014	0.009	0.006	0.037	0.724	1.328
2005	0.312	0.011	0.019	0.012	0.008	0.050	1.227	0.521
2006	0.345	0.012	0.021	0.013	0.009	0.055	1.345	0.562
2007	0.367	0.013	0.022	0.013	0.009	0.057	1.851	0.793
2008	0.335	0.012	0.020	0.012	0.009	0.053	2.251	0.991
2009	0.317	0.011	0.019	0.012	0.008	0.050	1.388	0.579
2010	0.323	0.013	0.021	0.013	0.009	0.056	1.218	0.495
2011	0.332	0.013	0.021	0.014	0.009	0.056	0.857	0.320
2012	0.328	0.013	0.022	0.014	0.009	0.058	0.816	0.301
2013	0.312	0.013	0.021	0.014	0.010	0.057	0.739	0.269
2014	0.298	0.014	0.023	0.014	0.010	0.061	0.840	0.323
2015	0.310	0.015	0.024	0.014	0.010	0.063	0.865	0.331
2016	0.294	0.015	0.023	0.014	0.011	0.063	0.831	0.323
2017	0.280	0.015	0.023	0.014	0.011	0.064	0.895	0.361
Trend 1990-2017, %	-20.7	-32.9	-43.5	-15.5	-7.9	-31.2	7.3	-98.2

3.3.2. Aviation (1.A.3.a.i-ii (i-ii))

3.3.2.1. Source Category Description

Estonia's inventory contains estimates for both domestic and international aviation. Emission estimates from the aviation sector include all aircraft types: helicopters, jets, turboprop powered and piston engine aircrafts.

Emissions from the aviation sector are split into different aircraft activities, and allocations are made according to the requirements for reporting:

- 1.A.3.a.i (i) International aviation LTO (civil);
- 1.A.3.a.ii (i) Domestic aviation LTO (civil);
- 1.A.3.a.i (ii) International aviation cruise (civil);
- 1.A.3.a.ii (ii) Domestic aviation cruise (civil).

In addition, emissions from the cruise phase are reported as a memo item and are not included in national totals.



(Photo by Nordica: Nordica's Bombardier CRJ-900-NG)

The aviation sector has quite a minor share in total emissions. The total contribution of aircraft LTO emissions to the emissions of nitrogen oxides, non-methane volatile compounds, and carbon monoxide in the transport sector in 2017

was 0.7%, 0.6%, and 1.0% respectively. Other pollutants have an even smaller share.

Aviation emissions reflect the level of overall aviation activity. The growth of air travel for the past decades has been noticeable. During the period of 1990–2017, the emission of NO_x, NMVOC, and CO from the LTO phase increased by 70.2%, 36.3%, and 62.8% respectively (see [Figure 3.29](#) and [Table 3.37](#)), mainly due to changes in fuel consumption, which increased by 61.5% (see [Table 3.41](#)) and the number of landing and take-off operations (see [Figure 3.31](#)). This is roughly in line with the trends in the number of air passengers and passenger traffic volume over the same period. [Figure 3.30](#) illustrate the importance of the international aviation sector, which contributes the majority of the emissions from the aviation sector.

In 2017, the emissions of NO_x, NMVOC and CO increased by 8.8%, 11.7% and 9.5% respectively compared to 2016. An increase in emissions took place within the context of the amount of fuel consumed, passenger traffic volumes, the number of passengers and landing and take-off operations increasing by 12.9%, 37.6%, 66.2%, and 10.3% respectively.

Recalculations

All emissions have been recalculated for the 1A3ai(ii) and 1A3aii(ii) sector for the period between 2001-2016 due to a correction in statistical fuel consumption data which was provided by airports and Statistics Estonia (see [Table 8.10](#)). In addition, BC emission factors were adjusted using corrected values for 2016. An overview of the updated data is given in [Chapter 8](#).

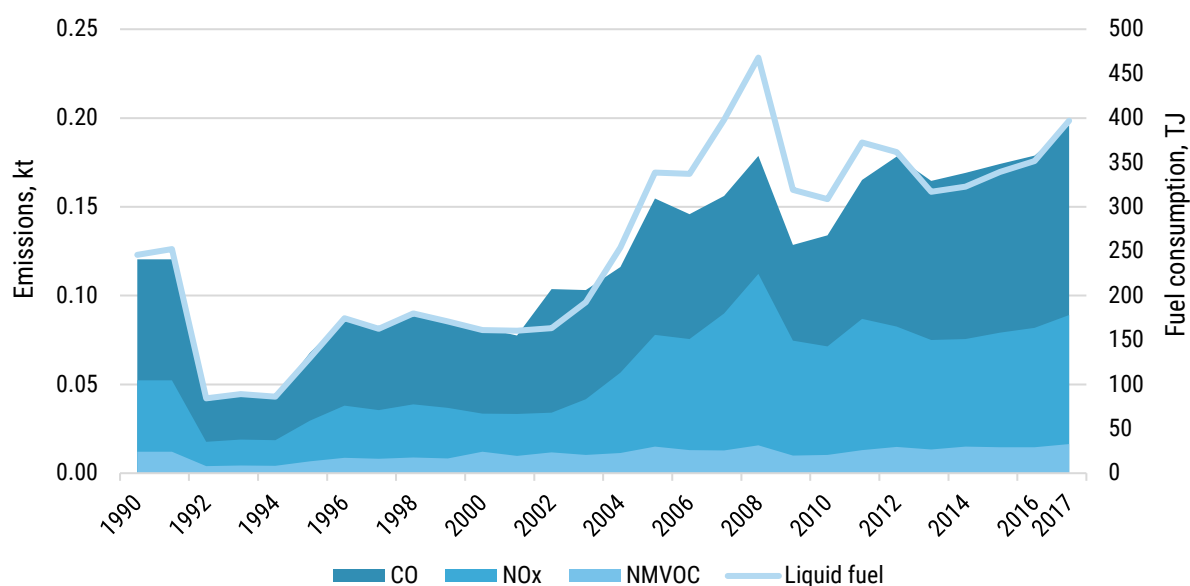


Figure 3.29 NO_x, NMVOC and CO emissions from the LTO cycle in aviation sector in the period of 1990-2017

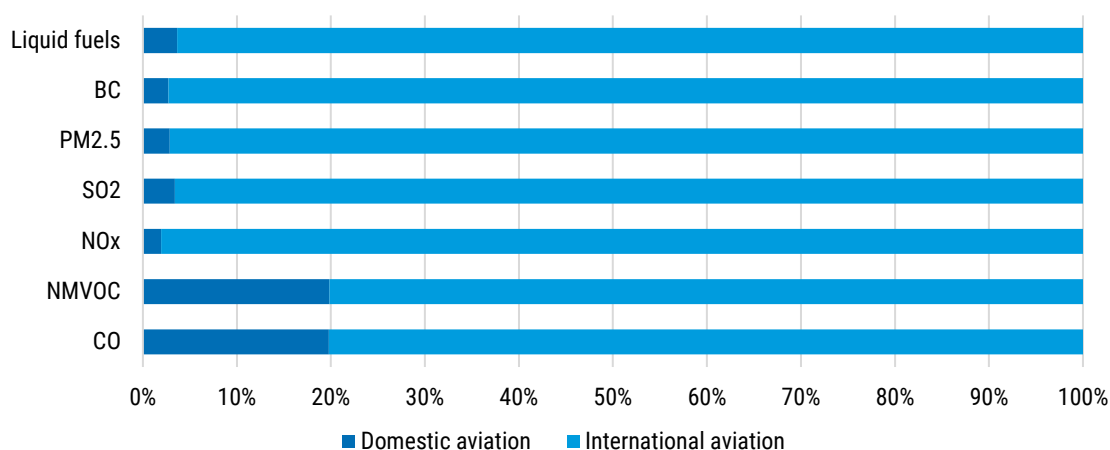


Figure 3.30 The share of pollutant emissions from the LTO cycle in aviation sector in 2017

Table 3.37 Emissions from the LTO cycle in the aviation sector in the period of 1990–2017

Year	NO _x	NMVOC	SO ₂	PM _{2.5}	PM ₁₀	TSP	BC	CO
	kt			t				kt
1990	0.052	0.012	0.006	NR	NR	0.392	NR	0.120
1995	0.030	0.007	0.003	NR	NR	0.221	NR	0.068
2000	0.033	0.012	0.004	0.314	0.314	0.314	0.151	0.082
2005	0.078	0.015	0.008	0.652	0.652	0.652	0.312	0.155
2006	0.076	0.013	0.008	0.643	0.643	0.643	0.308	0.146
2007	0.090	0.013	0.009	0.780	0.780	0.780	0.373	0.156
2008	0.112	0.016	0.010	0.941	0.941	0.941	0.452	0.175
2009	0.075	0.010	0.007	0.603	0.603	0.603	0.289	0.129
2010	0.071	0.010	0.007	0.558	0.558	0.558	0.267	0.134
2011	0.087	0.013	0.008	0.638	0.638	0.638	0.306	0.165
2012	0.083	0.015	0.008	0.466	0.466	0.466	0.222	0.178
2013	0.075	0.013	0.007	0.463	0.463	0.463	0.222	0.165
2014	0.076	0.015	0.007	0.483	0.483	0.483	0.231	0.169
2015	0.079	0.015	0.007	0.501	0.501	0.501	0.240	0.174
2016	0.082	0.015	0.008	0.517	0.517	0.517	0.248	0.179
2017	0.089	0.016	0.009	0.560	0.560	0.560	0.268	0.196
Trend 1990-2017, %	70.2	36.3	61.2	78.4	78.4	42.8	78.6	62.8

Table 3.38 Emissions from the cruise phase in the aviation sector in the period of 1990–2017 (kt)

Year	NO _x	NM VOC	SO ₂	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	0.385	0.015	0.030	NR	NR	0.006	NR	0.035
1995	0.190	0.007	0.015	NR	NR	0.003	NR	0.017
2000	0.224	0.009	0.018	0.004	0.004	0.004	0.002	0.020
2005	0.482	0.018	0.038	0.008	0.008	0.008	0.004	0.043
2006	0.523	0.020	0.041	0.008	0.008	0.008	0.004	0.046
2007	0.636	0.024	0.050	0.010	0.010	0.010	0.005	0.056
2008	0.722	0.028	0.057	0.011	0.011	0.011	0.005	0.064
2009	0.373	0.014	0.029	0.006	0.006	0.006	0.003	0.033
2010	0.337	0.013	0.026	0.005	0.005	0.005	0.003	0.030
2011	0.472	0.018	0.037	0.007	0.007	0.007	0.004	0.042
2012	0.651	0.025	0.051	0.010	0.010	0.010	0.005	0.057
2013	0.513	0.020	0.040	0.008	0.008	0.008	0.004	0.045
2014	0.512	0.020	0.040	0.008	0.008	0.008	0.004	0.045
2015	0.537	0.021	0.042	0.008	0.008	0.008	0.004	0.047
2016	0.479	0.018	0.038	0.008	0.008	0.008	0.004	0.042
2017	0.638	0.025	0.050	0.010	0.010	0.010	0.005	0.056
Trend 1990-2017, %	65.9	69.3	64.8	183.9	183.9	64.8	183.9	60.5

3.3.2.2. Methodological Issues

All flights to and from Estonian airports are divided into domestic and international flights. Detailed aircraft type data is supplied by 7 Estonian airports. Separate emission estimates are made for domestic and international civil aircrafts, which are divided into emissions from the landing and take-off (LTO) phase and the cruise phase. Emission calculations from the LTO cycle are based on the Tier 2 method and cruise emission calculations on Tier 1.

For the LTO phase, fuel consumed and the emissions of pollutants per LTO cycle are based on representative aircraft type group data. The energy use by aircrafts is calculated for both domestic and international LTOs by multiplying the LTO fuel consumption factor for each representative aircraft type (see [Table 3.39](#)) by the corresponding number of LTOs. In order to calculate domestic and international LTO emissions, the number of LTOs for each aircraft type is multiplied by the respective emission factor per LTO.

Cruise energy usage is estimated as the difference between the total fuel use from aviation fuel sale statistics and the total calculated LTO fuel use (see [Table 3.41](#)). Fuel-based cruise emission factors are taken from the

EMEP/EEA Guidebook 2013 as a single set for an average aircraft (see [Table 3.40](#)). Finally, when given the fuel-related cruise emission factors, total domestic and international energy use and emissions can be calculated. All the calculations are made by using the following equations:

$$LTO \text{ emissions} = \text{number of LTOs} \times \text{emission factor LTO}$$

$$LTO \text{ fuel consumption} = \text{number of LTOs} \times \text{fuel consumption per LTO}$$

$$\text{Cruise emissions} = (\text{total fuel consumption} - LTO \text{ fuel consumption}) \times \text{emission factor cruise}$$

Tier 2 methodology requires information on the number of LTOs grouped by representative aircraft types (see [Table 3.39](#)). This kind of detailed knowledge is hard to obtain (individual aircraft with their specific engines) and therefore data is aggregated for practical reasons. Assumptions are made if missing data exist in some situations. In spite of the different levels of aviation statistics, it is possible to divide air traffic activity into the number of LTOs per aircraft type by using different statistical sources. Estonian emission calculations are based on the EMEP/EEA methodology and other referred sources in the EMEP/EEA Guidebook (IPCC, FOCA, ICAO engine database etc.).

A complete emission calculation (LTO and cruise emissions for domestic and international flights) was carried out by ESTEA between 1992 and

2017. Extrapolation has been done for 1990 and 1991.

Table 3.39 Emission factors for the LTO cycle (kg/LTO)

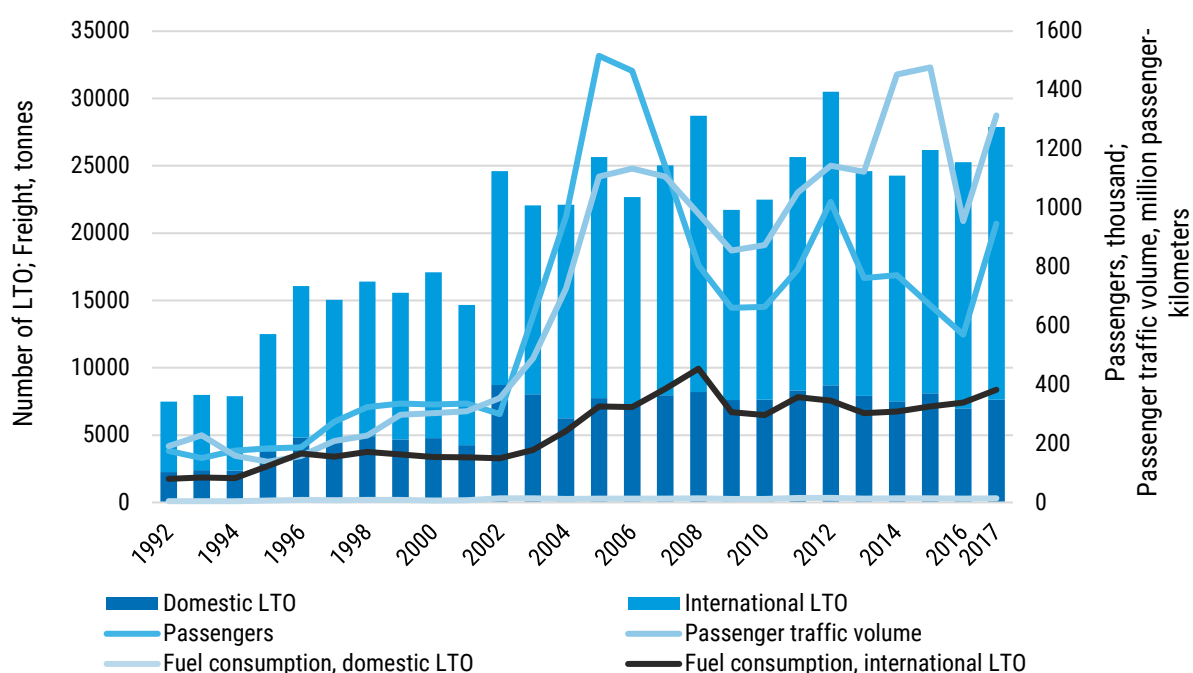
	NO _x	NM VOC	SO ₂	PM _{2.5}	CO	Fuel consumption
Turbofans (Jets)						
Airbus A310	23.20	5.00	1.50	0.14	25.80	1,540.5
Airbus A320	10.80	1.70	0.80	0.09	17.60	802.3
Bae 111	4.90	19.30	0.70	0.17	37.70	681.6
Bae 146	4.20	0.90	0.60	0.08	9.70	569.5
B727	12.60	6.50	1.40	0.22	26.40	1,412.8
B737-100	8.00	0.50	0.90	0.10	4.80	919.7
B737-400	8.30	0.60	0.80	0.07	11.80	825.4
B747-100-300	55.90	33.60	3.40	0.47	78.20	3,413.9
B747-400	56.60	1.60	3.40	0.32	19.50	3,402.2
B757	19.70	1.10	1.30	0.13	12.50	1,253.0
B767-300	26.00	0.80	1.60	0.15	6.10	1,617.1
B777	53.60	20.50	2.60	0.20	61.40	2,562.8
Fokker 100	5.80	1.30	0.70	0.14	13.70	744.4
Fokker 28	5.20	29.60	0.70	0.15	32.70	666.1
2XB737-100	16.00	1.00	1.80	0.20	9.60	1,839.4
McDonnell Douglas DC-9	7.30	0.70	0.90	0.16	5.40	876.1
McDonnell Douglas DC-10	41.70	20.50	2.40	0.32	61.60	2,381.2
McDonnell Douglas	12.30	1.40	1.00	0.12	6.50	1,003.1
C525	0.74	3.01	0.34	0	34.07	340.0
EC RJ_100ER	2.27	0.56	0.33	0	6.70	330.0
ERJ-145	2.69	0.50	0.31	0	6.18	310.0
GLF4	5.63	1.23	0.68	0	8.88	680.0
GLF5	5.58	0.28	0.60	0	8.42	600.0
RJ85	4.34	1.21	0.60	0	11.21	600.0
Turboprop						
turboprop, <1000sph/engine	0.30	0.58	0.07	0	2.97	70.0
turboprop, 1000-2000sph/engine	1.51	0	0.20	0	2.24	200.0
turboprop, >2000sph/engine	1.82	0.26	0.20	0	2.33	200.0
Piston engine						
microlight aircraft	0.03	0.04	0.00	0	0.94	1.4
4 seat single engine (<180hp)	0.01	0.06	0.00	0	3.93	3.9
single engine high performance (180-360hp)	0.02	0.16	0.00	0	7.33	7.5
twin engine high performance (2x235hp)	0.05	0.22	0.01	0	19.33	21.6
Helicopters						
A109	0.13	0.89	0.02	0.01	1.31	32.8
A139	0.38	0.68	0.03	0.01	0.97	60.3
AL03	0.11	0.28	0.01	0.00	0.40	21.4
AS32	0.65	0.49	0.04	0.02	0.68	77.4
AS35	0.18	0.22	0.01	0.01	0.32	27.5
AS55	0.15	0.82	0.02	0.01	1.20	34.8
H269	0.01	0.09	0.00	0.00	6.59	6.6
B412	0.64	0.49	0.04	0.02	0.69	77.0
B06	0.08	0.35	0.01	0.00	0.50	18.2
EC35	0.21	0.71	0.02	0.01	1.03	41.1
EN48	0.08	0.34	0.01	0.00	0.48	18.6
MI8	0.53	0.55	0.04	0.02	0.78	70.0
R22	0.01	0.09	0.00	0.00	6.21	6.2
R44	0.02	0.11	0.00	0.00	8.79	8.8
S76	0.29	0.59	0.02	0.01	0.85	48.2

Table 3.40 Emission factors for the cruise phase (kg/t)

	NO _x	NM VOC	SO ₂	PM _{2.5}	f-BC	CO
Domestic aviation	10.3	0.1	1.0	0.2	0.15	2.0
International aviation	12.8	0.5	1.0	0.2	0.15	1.1

Table 3.41 Fuel consumption in the aviation sector (TJ)

Year	Domestic LTO	Domestic cruise	International LTO	International cruise	Total
1990	12.413	65.987	233.371	1,256.229	1,568.0
1995	6.102	39.498	123.667	571.733	741.0
2000	6.576	27.424	154.654	730.346	919.0
2005	13.244	52.847	325.441	1,576.563	1,968.1
2006	13.500	51.983	323.501	1,716.742	2,105.7
2007	12.510	60.352	385.527	2,089.154	2,547.5
2008	13.953	65.502	454.071	2,374.085	2,907.6
2009	12.214	32.197	306.777	1,228.779	1,580.0
2010	12.339	26.768	296.382	1,112.111	1,447.6
2011	14.596	51.848	357.731	1,542.408	1,966.6
2012	15.497	39.689	345.973	2,154.439	2,555.6
2013	13.473	41.053	303.570	1,691.283	2,049.4
2014	13.763	41.291	308.784	1,687.080	2,050.9
2015	13.836	44.305	325.494	1,767.179	2,150.8
2016	12.803	34.544	338.793	1,580.193	1,966.3
2017	14.395	35.598	382.477	2,115.109	2,547.6

**Figure 3.31** The number of LTO cycles, passengers carried and freight transported

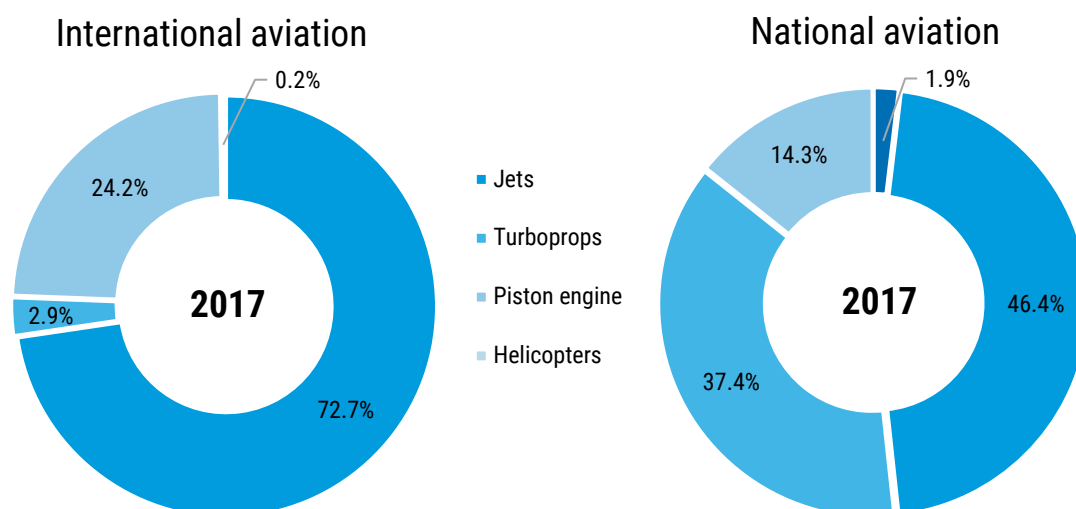


Figure 3.32 The share of different aircraft types in domestic and international civil aviation

3.3.2.3. Uncertainty

An uncertainty analysis was carried out for the 2017 inventory. The uncertainty in the emission factors for all pollutants from the aviation (LTO)

sector is estimated to be 30% and in the activity data 2%. All uncertainty estimates for this source are given in [Table 3.42](#). No uncertainty estimation for cruise phase has been carried out.

Table 3.42 Uncertainties in the aviation (LTO) sector

Pollutant	Emission, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	0.089041	kt	0.268	0.079	0.025
NM VOC	0.016403	kt	0.074	0.018	0.005
SO _x	0.008895	kt	0.023	0.007	0.001
PM _{2.5}	0.000560	kt	0.006	0.002	0.001
PM ₁₀	0.000560	kt	0.004	0.001	0.0004
TSP	0.000560	kt	0.003	0.001	0.0001
CO	0.195948	kt	0.142	0.035	0.014

3.3.2.4. Source-Specific QA/QC and Verification

Common statistical quality control related to the assessment of trends was carried out.

3.3.2.5. Source-Specific Planned Improvements

The aviation sector is no key category and contributes to only a marginal share of total emissions. Therefore, there are currently no improvements planned for this sector.

3.3.3. Road Transport (1A3bi-vii)

3.3.3.1. Source Category Description

Road transport is the largest and most important emission source in the transport sector. This sector includes all types of vehicles on the roads (passenger cars, light duty vehicles, heavy duty trucks, buses, motorcycles). The source category does not cover farm and forest tractors that occasionally drive on roads because they are included in other sectors, such as off-roads (agricultural and industrial machinery, etc.).

The road transport sector includes emissions from fuel combustion, lubricant oil, road abrasion,

tyre and brake wear, and NMVOC emissions from fuel evaporation.



(Photo from www.tallinn.ee: Ülemiste intersection – one of the busiest ones in Tallinn)

In 2017, road transport contributed to the total national emissions of nitrogen oxides, non-methane volatile compounds, and carbon monoxide by 22.6%, 6.6%, and 8.5% respectively, and in the transport sector, 58.8%, 52.9%, and 57.1% respectively (see [Figure 3.27](#)). Emissions from the main pollutants and particulate matter have decreased significantly throughout the time series with the exception of NH_3 . The decrease in emissions (see [Figure 3.33](#)) has mainly been

caused by the stricter emission standards for road vehicles. In addition, [Figure 3.34](#) illustrates the importance of different vehicle types in pollutant emissions in the road transport sector.

The lead emissions from road transport have decreased by about 99.6% since 1990 (see [Figure 3.33](#)). The reduction of emissions is related to the prohibition on leaded petrol in 2000. The share of road transport in the total Pb emissions was 0.8% in 2017.

The reduction of sulphur content in fuels has led to a substantial decrease in SO_2 emissions in the road transport sector (see [Figure 3.33](#)). In 2001, the sulphur content was reduced from 5,000 ppm (diesel) and 1,000 ppm (petrol) to 500 ppm and since then, sulphur content in fuel has been gradually reduced even more (see [Table 3.44](#)). Currently, all road transport fuels are sulphur free (sulphur content less than 10 ppm). Therefore, SO_2 emissions have decreased by 99.4% between 1990 and 2017.

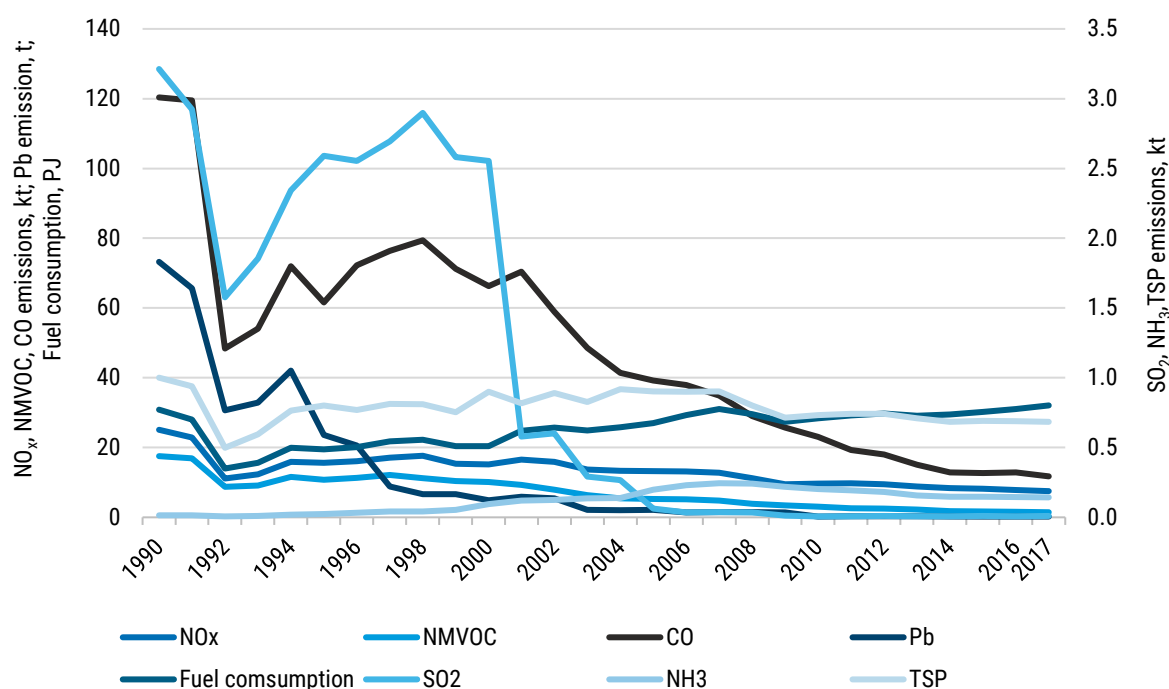


Figure 3.33 Fuel consumption and pollutant emissions from road transport in the period 1990-2017

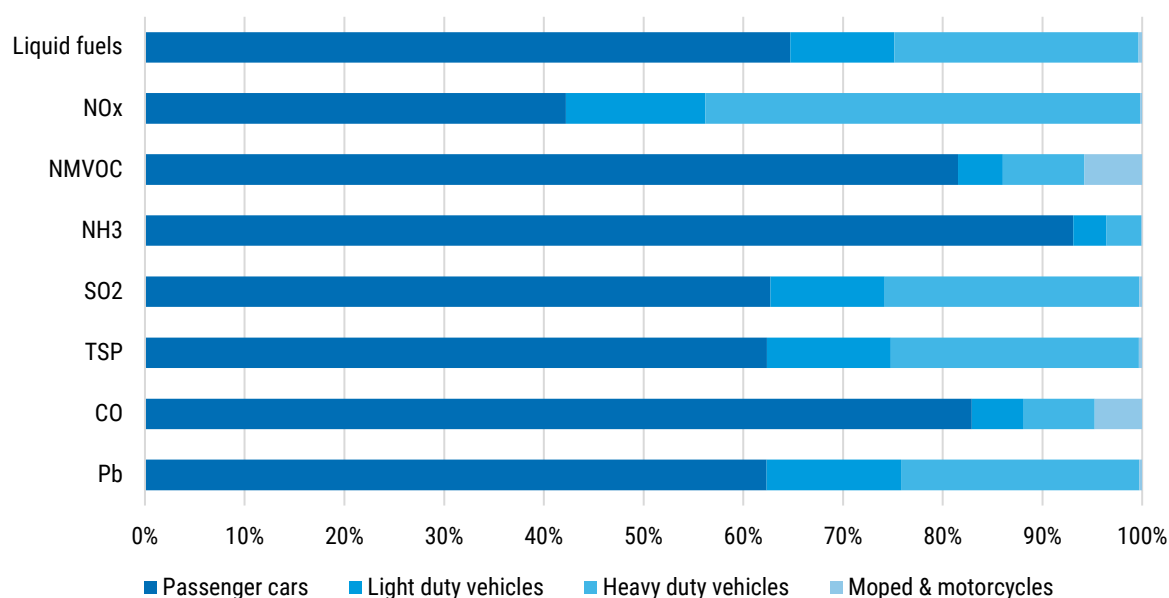


Figure 3.34 The share of pollutant emissions in the road transport sector in 2017

Fuel consumption has changed over the decades in the road transport sector. In the 1990s, petrol consumption dominated but from 2003, we can see the continuous growth in diesel consumption in road transport (see [Figure 3.35](#) and [Table 3.49](#)). This trend can be explained by the fact that the popularity of vehicles with petrol engines has declined in recent years, and diesel engines dominate due to their greater fuel efficiency and torque compared to petrol engines.

Emissions from petrol vehicles have been dramatically reduced by the introduction of catalytic converters which have much lower CO, NMVOC, and NO_x emissions in comparison to petrol cars without catalysts. Since 1990, the number of petrol-driven passenger cars and light duty vehicles which are equipped with catalytic converters has increased, resulting in relatively decreasing emissions in such areas as NO_x and NMVOC, by 95% and 92% respectively between 1990 and 2017. Whilst significantly reducing emissions of carbon monoxide, nitrogen oxides, and non-methane volatile organic compounds, some catalytic converters may also produce other nitrogen-containing pollutants such as ammonia.

Road transport emissions of NH₃ have increased by sixteen times during the period between 1990-2007 as a result of the increased use of three-way catalytic converters for petrol vehicles which

produce NH₃ as a by-product. However, NH₃ emissions have fallen since 2008 as the second generation of catalytic converters – which emit lower levels of NH₃ than the first generation of catalytic converters – become more widely used in the vehicle fleet. NH₃ emissions have decreased by 41.3% in 2017 in comparison to 2007's figures. The second reason for the decline in NH₃ emissions in recent years is the fact that the share of diesel vehicles has grown rapidly, which has had only a minor impact upon total road transport NH₃ emissions. Nevertheless, NH₃ emissions emitted by road transport amounted to only 1.4% of the national total NH₃ emissions in 2017.

However, despite these improvements, petrol vehicles which are fitted with catalytic converters still produce more CO and NMVOC than diesel vehicles, although exhaust emissions containing NO_x and particulates are much lower than with diesel vehicles. Diesel engines are the main power source in heavy-duty trucks and buses, and their share is rapidly growing in passenger cars as well. Therefore, the reasons for emission reductions include a 48.7% decrease in petrol consumption during the period of 1990–2017 and an increasing amount of new cars that are designed to reduce both energy consumption and pollutant emissions, as a result of new technologies.

In addition, Estonia has taken the obligation to reach a level of 10% in the use of renewable sources of energy in transport sector by 2020. Over the last few years, steps have been taken to

use biofuels in road transport. The share of biofuels used for road transport accounted for 0.02% in 2005 and increased to 0.1% in 2017 (see [Table 3.49](#)).

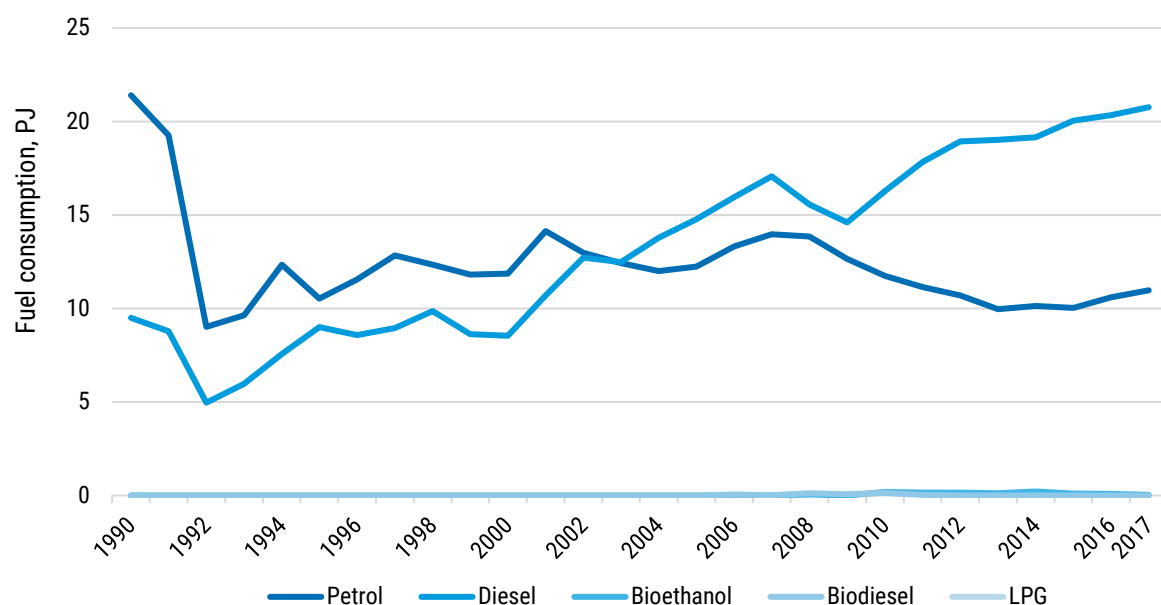


Figure 3.35 Fuel consumption in the road transport sector

TSP exhaust emissions from road transport vehicles have decreased by 57.8% during the 1990-2017 period. In 2017, petrol and diesel vehicles contributed 2.8% and 97.1% respectively of the total TSP exhaust emissions in the road transport sector. PM exhaust emissions are declining in new model vehicles due to tightening regulations, and new engine and after-treatment technologies. However, a significant part of the total PM emissions also originate from non-exhaust sources (road abrasion, and tyre and brake wear). [Figure 3.36](#) illustrates the importance of different sources in pollutant emissions in the road transport sector.

As shown in [Figure 3.36](#), only a small volume of heavy metal emissions originate from vehicle exhausts. Instead, a substantial share of heavy metals originate from lubricant combustion, since

vehicle engines consume a small amount of lubricant oil while they operate. A significant increase in lubricant oil consumption is apparent: the total lubricant oil consumption in this sector increased by 23.5% between 1990 and 2017 (1.2 thousand tonnes to 1.4 thousand tonnes) which is directly linked with the change in annual mileage driven by the vehicles (an increase of 22.4%) over the same period of time. As shown in [Figure 3.36](#), the share of lubricant combustion in heavy metals emissions are relatively high, except for Pb. The combustion of lubricants contributed around 83.9% of Cd, 21.7% of Cr, 35.2% of Cu, 74.6% of Ni, 75.4% of Se, 44.0% of Zn, and only 0.02% of Pb across the entire total road transport sector in 2017.

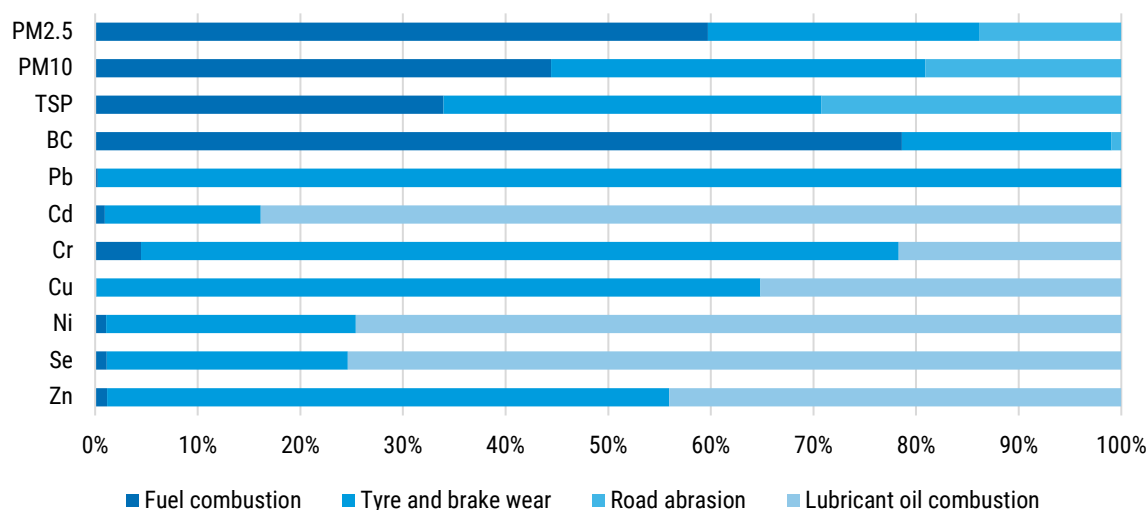


Figure 3.36 The share of different sources in pollutant emissions in 2017

The emission trend in recent years has been impacted by the improved fuel efficiency and minimised emissions of new vehicles. In 2017, statistics showed that the number of vehicles continued to increase (3.8%) compared to 2016. Therefore, the total mileage driven by vehicles and the amount of fuel consumed also increased by 4.5% and 2.7% respectively. Although there has been an increase in activity data, the main pollutant emissions from road transport decreased compared to 2016: nitrogen oxides emissions by 4.4%, non-methane volatile organic compounds by 10.2%, and carbon monoxide by 8.5%.

In the [Figure 3.33](#) and [Figure 3.34](#), a detailed overview of NO_x, NMVOC, NH₃, SO₂, TSP, CO and Pb emission sources in the road transport sector is provided. All the emission trends are presented in [Table 3.43](#).

Passenger cars (1A3bi)

Passenger cars contributed the majority of emissions within the road transport sector: 42.2% of NO_x, 81.5% of NMVOC, 62.7% of SO₂, 93.1% of NH₃, 62.3% of PM_{2.5}, 62.3% of PM₁₀, 62.4% of TSP, 63.6% of BC, 82.9% of CO in 2017.

The passenger car fleet has grown over the last decades from 241 thousand vehicles to 584 thousand between 1990 and 2017. Cars with petrol engines make up a majority of registered passenger cars – 88% in 1990 and 56% in 2017

(see [Figure 3.37](#)). This trend reflects that the number of diesel cars has grown fast during the same period (see [Figure 3.38](#)). Significant changes have also taken place in annual mileage – annual mileage driven by diesel cars increased nine times (442 to 4,072 million km) and annual mileage per petrol cars decreased by 29% (5,122 to 3,653 million km). Overall fuel consumption in this subsector increased by 32% between 1990 and 2017. In detail, fuel consumed by diesel cars increased approximately ten times and petrol fuel amount decreased by 29% during the same period.

During the period of 1990–2017, the pollutant emissions decreased significantly: 75.6% of NO_x, 90.9% of NMVOC, 99.4% of SO₂ and 90.4% of CO, although all the activity data increased in the same time. Therefore, the main pollutant emissions from passenger cars have been reduced by improving the quality of fuels and by setting increasingly stringent emission limits for new vehicles categories. This means that new technologies have been introduced gradually (Euro 1-6) and the fact that older vehicles are used less compared to new ones (i.e. they have a lower annual mileage). However, medium-sized engines still dominate in diesel and petrol-powered cars, and cars which are powered by alternative fuels, including hybrid cars, make up only a minor share of the car fleet in 2017.

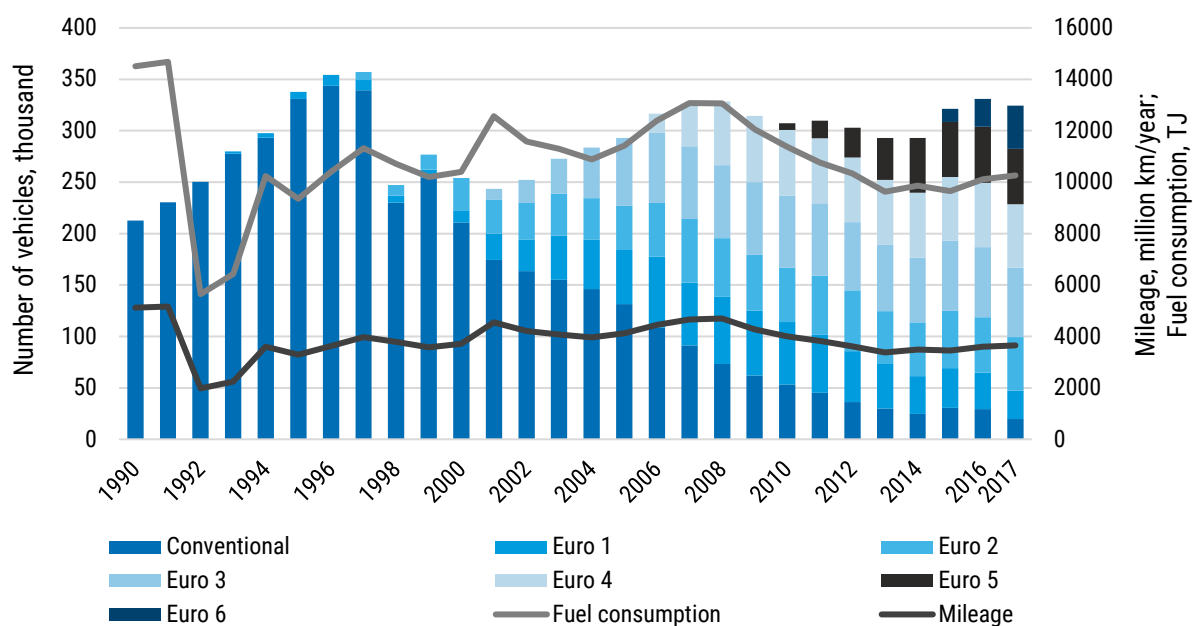


Figure 3.37 Petrol passenger cars: number of vehicles, annual mileage, and fuel consumption in the period of 1990–2017

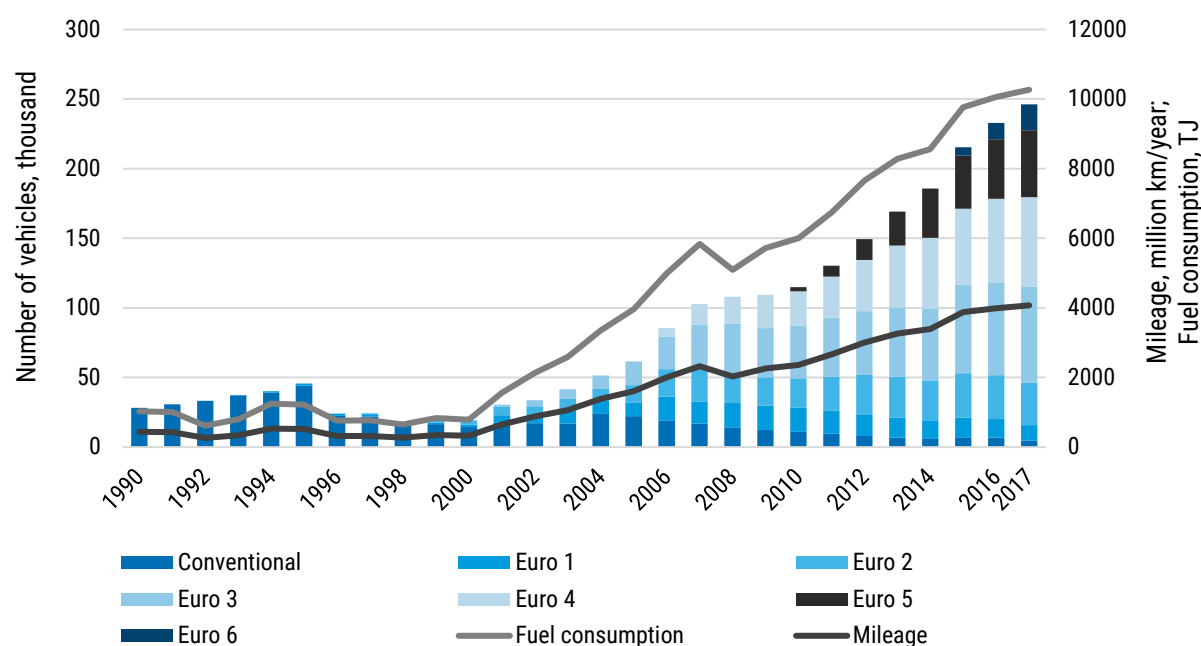


Figure 3.38 Diesel passenger cars: number of vehicles, annual mileage, and fuel consumption in the period of 1990–2017

Light duty vehicles (1A3bii)

Light commercial vehicles contributed about 14.0% of NO_x, 4.5% of NMVOC, 11.5% of SO₂, 3.3% of NH₃, 13.3% of PM_{2.5}, 13.0% of PM₁₀, 12.4% of TSP, 14.7% of BC and 5.1% of CO in the total road transport sector in 2017.

The light commercial vehicle fleet has grown over the last decades from 31 thousand vehicles to

63 thousand between 1990 and 2017. Vehicles with diesel engines dominated during the entire period. The number of diesel light duty vehicles was 18 thousand in 1990 and increased approximately three times to 55 thousand vehicles in 2017 (see Figure 3.40). The petrol light duty vehicle fleet decreased by 35% over the same period from 13 thousand to 8 thousand vehicles (see Figure 3.39). A similar trend can be seen in the annual mileage and fuel consumption

– mileage and fuel consumption increased by 60% and 44% respectively in this subsector. As expected, annual mileage driven by petrol vehicles declined by 68% and the total annual kilometres driven by diesel vehicles increased almost three times. In addition, petrol fuel consumption decreased by 69% and diesel fuel consumption increased more than twice in this subsector during the same period.

The pollutant emissions decreased significantly: 33.2% of NO_x, 93.3% of NMVOC, 99.7% of SO₂, 51.1% of TSP and 93.2% of CO, although all the activity data increased in the period of 1990–2017. Therefore, main pollutant emissions from light duty vehicles have been reduced by improving the quality of fuels and by setting increasingly stringent emission limits for new vehicle categories.

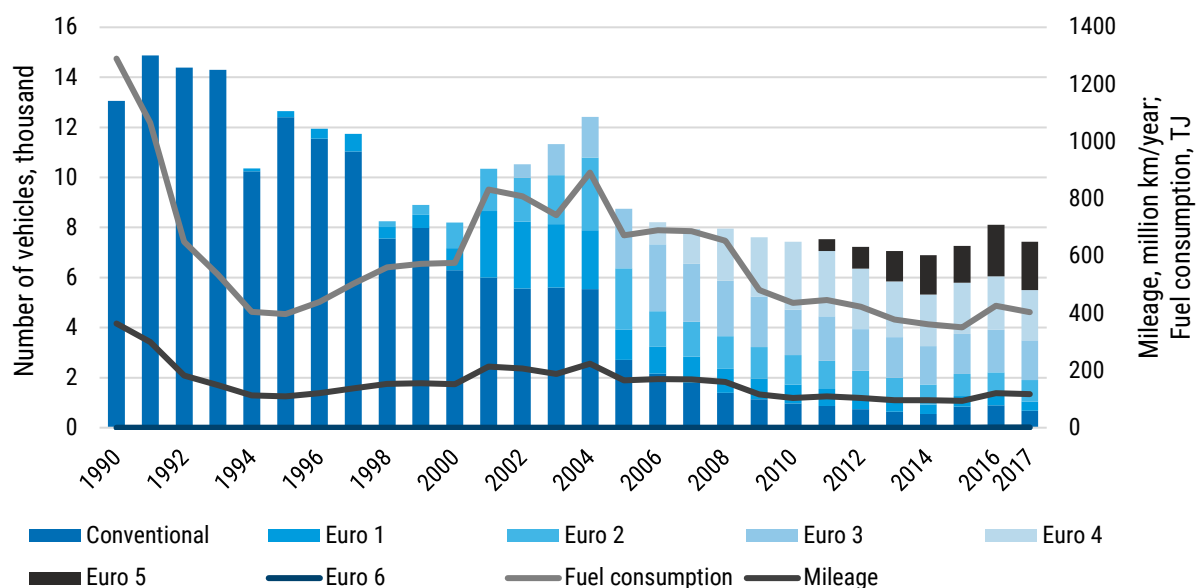


Figure 3.39 Petrol light duty vehicles: number of vehicles, annual mileage, and fuel consumption in the period of 1990–2017

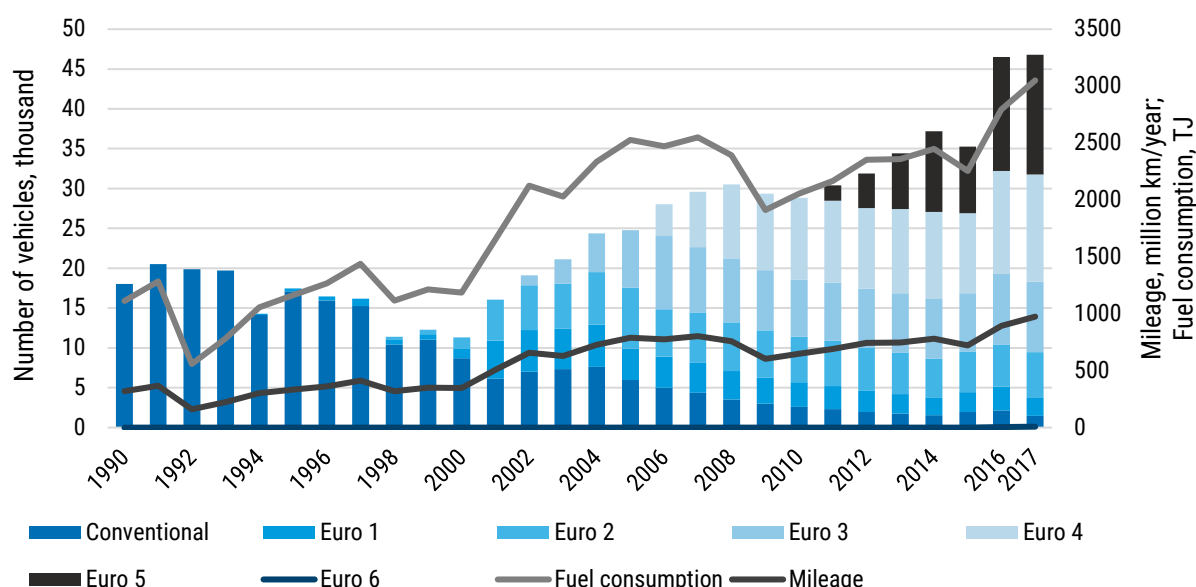


Figure 3.40 Diesel light duty vehicles: number of vehicles, annual mileage, and fuel consumption in the period of 1990–2017

Heavy duty vehicles and buses (1A3biii)

Heavy duty vehicles contributed about 43.6% of NO_x, 8.2% of NMVOC, 25.5% of SO₂, 3.5% of NH₃, 24.0% PM_{2.5}, 24.4% of PM₁₀, 24.9% of TSP, 21.5% of BC and 7.2% of CO in the total road transport sector in 2017.

The heavy duty vehicle fleet has declined over the last decades from 45 thousand vehicles to 31 thousand between 1990 and 2017. Heavy duty vehicles with diesel engines make up the majority of registered vehicles – 60% in 1990 and 94% in 2017. The number of petrol vehicles has declined by 90% and the number of diesel vehicles increased by 8%. Total annual mileage and fuel consumption decreased by 47% and 40% respectively during this period. In detail, mileage

driven and fuel consumed by petrol vehicles decreased by 99% (see [Figure 3.41](#)). However, the same indicators for diesel powered heavy duty vehicles increased by 4% and 1% (see [Figure 3.42](#)).

During the period of 1990–2017, the pollutant emissions decreased significantly: 68.6% of NO_x, 95.8% of NMVOC, 99.9% of SO₂, 65.1% of TSP and 79.5% of CO, although all the activity data increased in the same time. Therefore, the main pollutant emissions from heavy duty vehicles have been reduced by improving the quality of fuels and by setting increasingly stringent emission limits for new vehicle categories.

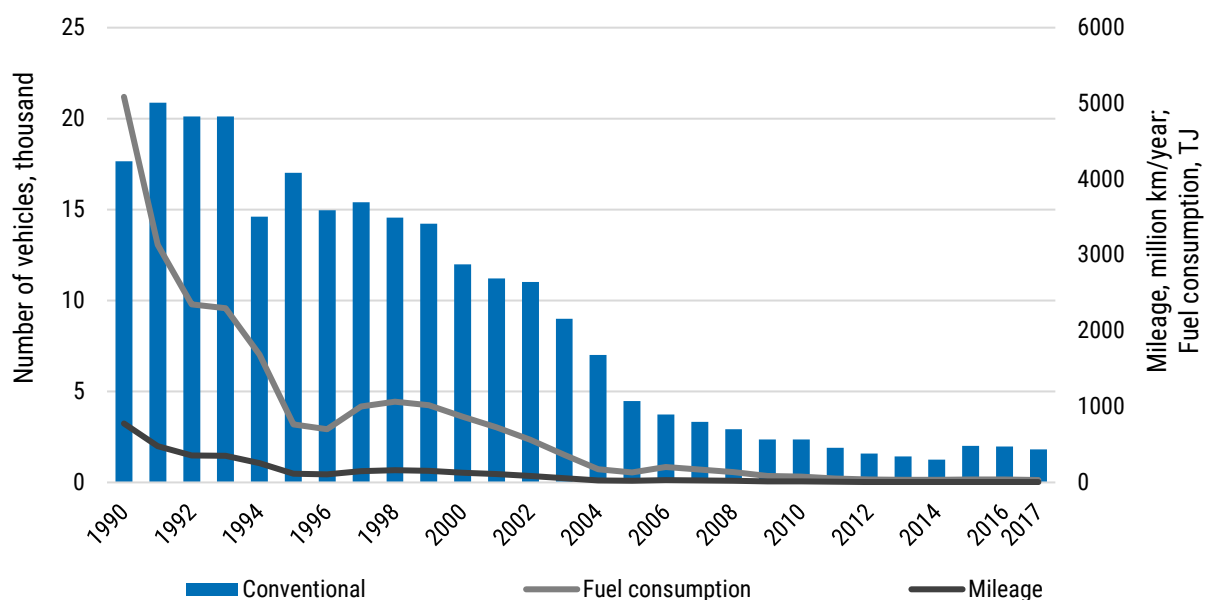


Figure 3.41 Petrol heavy duty vehicles: number of vehicles, annual mileage, and fuel consumption in the period of 1990–2017

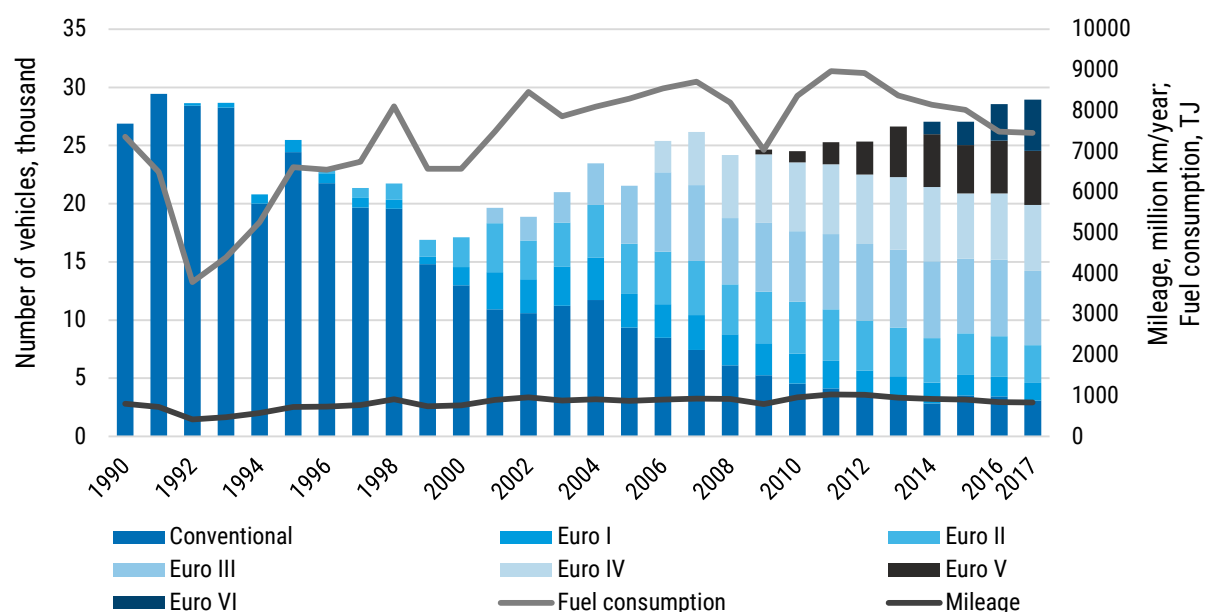


Figure 3.42 Diesel heavy duty vehicles: number of vehicles, annual mileage, and fuel consumption in the period of 1990–2017

Motorcycles and mopeds (1A3biv)

This subsector contributes only a marginal share of the total road transport sector emissions: 0.2% of NO_x, 5.8% of NMVOC, 0.3% of SO₂, 0.1% of NH₃, 0.4% PM_{2.5}, 0.3% of PM₁₀, 0.3% of TSP, 0.1% of BC and 4.8% of CO in 2017.

The number of motorcycles, annual mileage, and fuel consumption decreased by 63.3%, 75.8%, and

78.3% respectively between 1990 and 2017 (see [Figure 3.43](#)). During this period, NO_x emissions decreased by 87.9%, NMVOC emissions by 86.6%, SO₂ emissions by 99.9%, and CO emissions by 91.2%. In addition, there was a very high statistical number of motorcycles in use during the period between 1990–1994. After 1994, the statistical data no longer reflects vehicles which have not been technically inspected for years.

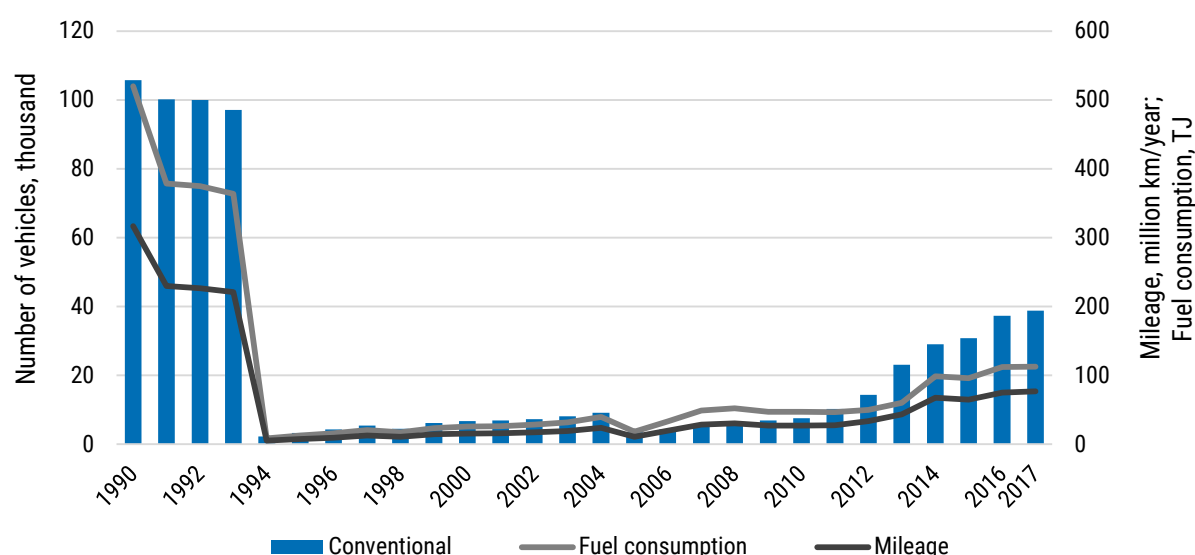


Figure 3.43 Motorcycles and mopeds: number of vehicles, annual mileage, and fuel consumption in the period of 1990–2017

Recalculations

All the emissions from road transport have been recalculated for the period 1990-2016. Recalculations entail using corrected activity

data, updated emission factors, and the taking into use of an improved new edition of the COPERT 5 program (version 5.2.0) for emission calculations. An overview of the updated data is given in Chapter 8.

Table 3.43 Emissions from road transport in the period of 1990-2017

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
kt									
1990	25.100	17.546	3.212	0.015	NR	NR	1.001	NR	120.362
1995	15.594	10.777	2.591	0.025	NR	NR	0.802	NR	61.589
2000	15.132	10.155	2.553	0.095	0.709	0.795	0.899	0.362	66.293
2005	13.200	5.258	0.063	0.198	0.656	0.767	0.901	0.359	39.219
2006	13.186	5.128	0.036	0.230	0.634	0.754	0.899	0.352	37.931
2007	12.798	4.768	0.037	0.245	0.623	0.749	0.903	0.350	34.898
2008	11.182	3.928	0.036	0.243	0.533	0.655	0.802	0.298	28.982
2009	9.465	3.442	0.012	0.219	0.466	0.578	0.714	0.268	25.681
2010	9.654	3.086	0.006	0.202	0.473	0.590	0.732	0.276	23.063
2011	9.772	2.603	0.008	0.194	0.472	0.594	0.742	0.276	19.281
2012	9.447	2.530	0.009	0.182	0.469	0.593	0.743	0.278	18.049
2013	8.880	2.201	0.008	0.157	0.442	0.563	0.709	0.263	15.103
2014	8.360	1.730	0.008	0.148	0.414	0.537	0.685	0.243	12.908
2015	8.243	1.650	0.009	0.149	0.412	0.538	0.690	0.241	12.733
2016	7.851	1.625	0.008	0.146	0.403	0.533	0.688	0.233	12.834
2017	7.507	1.459	0.009	0.144	0.389	0.523	0.685	0.221	11.743
Trend 1990-2017, %	-70.1	-91.7	-99.7	828.1	-100.0	-100.0	-31.6	-100.0	-90.2

Table 3.43 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
t									
kg									
1990	73.231	0.007	0.005	0.168	0.124	3.035	0.054	0.007	1.310
1995	23.654	0.004	0.003	0.093	0.074	1.820	0.034	0.005	0.811
2000	4.900	0.004	0.003	0.102	0.079	1.946	0.036	0.005	0.864
2005	2.104	0.006	0.004	0.120	0.104	2.576	0.048	0.007	1.180
2006	1.439	0.007	0.005	0.129	0.113	2.801	0.053	0.007	1.287
2007	1.511	0.007	0.005	0.136	0.120	2.967	0.056	0.008	1.365
2008	1.495	0.007	0.005	0.134	0.116	2.862	0.054	0.008	1.304
2009	1.363	0.006	0.004	0.121	0.106	2.647	0.051	0.007	1.213
2010	0.259	0.006	0.004	0.120	0.110	2.725	0.051	0.007	1.238
2011	0.266	0.007	0.004	0.117	0.114	2.827	0.053	0.007	1.282
2012	0.268	0.007	0.005	0.118	0.116	2.881	0.054	0.008	1.309
2013	0.261	0.007	0.004	0.114	0.115	2.840	0.054	0.008	1.295
2014	0.235	0.007	0.004	0.116	0.117	2.899	0.055	0.008	1.326
2015	0.241	0.007	0.005	0.116	0.120	2.997	0.057	0.008	1.375
2016	0.248	0.008	0.005	0.121	0.124	3.096	0.060	0.008	1.428
2017	0.258	0.008	0.005	0.124	0.129	3.215	0.062	0.009	1.486
Trend 1990-2017, %	-99.6	18.8	-11.8	-26.3	3.7	5.9	15.5	18.8	13.4

Table 3.43 continues

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs total	HCB	PCBs
	g I-TEQ	t				g		
1990	0.329	0.006	0.015	0.013	0.009	0.043	0.201	0.075
1995	0.212	0.004	0.009	0.007	0.006	0.026	0.123	0.038
2000	0.221	0.004	0.009	0.008	0.006	0.026	0.160	0.042
2005	0.311	0.007	0.012	0.010	0.008	0.037	0.252	0.057

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs total	HCB	PCBs
	g I-TEQ	t				g		
2006	0.343	0.007	0.013	0.011	0.009	0.040	0.295	0.063
2007	0.364	0.008	0.014	0.012	0.009	0.043	0.323	0.067
2008	0.332	0.007	0.013	0.011	0.008	0.040	0.303	0.065
2009	0.315	0.007	0.012	0.010	0.008	0.038	0.295	0.060
2010	0.321	0.008	0.013	0.012	0.008	0.040	0.304	0.061
2011	0.331	0.008	0.014	0.012	0.009	0.043	0.314	0.062
2012	0.327	0.009	0.014	0.013	0.009	0.045	0.312	0.062
2013	0.312	0.009	0.014	0.013	0.009	0.046	0.297	0.059
2014	0.298	0.009	0.015	0.013	0.010	0.046	0.285	0.060
2015	0.309	0.010	0.015	0.014	0.010	0.049	0.298	0.062
2016	0.293	0.011	0.016	0.014	0.011	0.050	0.281	0.062
2017	0.279	0.011	0.016	0.014	0.011	0.051	0.270	0.064
Trend 1990-2017, %	-15.0	93.7	4.1	10.0	15.9	20.0	34.1	-14.8

3.3.3.2. Methodological Issues

1) Fuel combustion

Emission calculations from road transport are based on the Tier 3 method, whereby exhaust emissions are calculated by using a combination of reliable technical and detailed activity data. Tier 3 is implemented in the COPERT 5 program (Computer Program to calculate Emissions from Road Transport, COPERT 5 version 5.2.0), which is used for the calculations and distributed by the EEA. Total emissions are calculated through a combination of default COPERT emission factors and activity data (e.g. number of vehicles, annual mileage per vehicle, average trip, speed, fuel consumption, monthly temperatures, driving and evaporation share). The vehicle classes are defined by the vehicle category, fuel type, weight class, environmental class and, in some instances, the engine type and/or the emission reduction technology. Therefore, the calculation of emissions from road vehicles is a very complicated and demanding procedure that requires good quality activity data and detailed emission factors.

Meteorological data is obtained from the Estonian Weather Service and fuel consumption data from Statistics Estonia. Calculations also require annual mileage per vehicle category (see [Table 3.47](#)) and the number of vehicles (see [Table 3.48](#)), which is supplied by the Estonian Road Administration. Annual mileage per vehicle category is based on odometer readings taken

during the annual technical inspection. The number of vehicles is not taken directly from statistics; this is a combination of Estonian vehicle register and technical inspection data. This approach was proposed and formulated by the scientists of the Tallinn University of Technology during the project "Calculation and analysis of the pollution of mobile sources". This suggested approach presumes that the older vehicles in the Estonian vehicle register are not actually taking part of every-day traffic; therefore, periodic technical inspections data is used. On the other hand, new vehicles do not have to be examined by technical inspection every year; therefore, the Estonian vehicle register data is used. These improved statistics are available from 2001 and data for the years 1990–2000 is extrapolated. However, changes have been implemented in Estonian vehicle register procedures since 2015, where vehicles that had not had a technical inspection for two years or more were marked as "stopped" and removed during the data export from the register. From now on, there is no need to combine different datasets. This change in data helped improve the quality of activity data and prevent mistakes in data management.

Emissions from different type of vehicles are heavily dependent on the engine operation conditions. Driving situations impose different engine operating conditions and therefore a distinct emission performance. Different activity data and emission factors are attributed to each

driving situation. Total emissions are calculated by combining activity data for each vehicle category with appropriate emission factors. The emission factors vary according to the input data (driving situations, climatic conditions etc.). In this calculation method, total exhaust emissions from road transport are calculated as the sum of hot and cold emissions:

$$E_{TOTAL} = E_{HOT} + E_{COLD}$$

where

E_{TOTAL} – total emissions of any pollutant for the spatial and temporal resolution of the application;
 E_{HOT} – emissions during stabilised (hot) engine operation when the engine is at its normal operating temperature;

E_{COLD} – emissions during transient engine operation (cold start).

Exhaust emissions of CO, NMVOC, NO_x, NH₃ and PM in these source categories depend on fuel type, emission reduction technology, vehicle type and vehicle use. These emissions are calculated on the basis of vehicle kilometres and specific emission factors for a variation of different vehicle classes and for three different road types (urban, rural, highway).

Emissions of SO₂ and heavy metals are dependent on fuel consumption and fuel type. SO₂ and heavy metals emissions are calculated by multiplying statistical fuel use (see [Table 3.49](#)) by emission factors (see [Table 3.44](#), [Table 3.45](#) and [Table 3.46](#)). The emission factors are based on the sulphur and heavy metal content of the fuels.

SO₂ emissions are estimated on the assumption that all sulphur in the fuel is completely transformed into SO₂. Since the beginning of 2010, the country-specific average sulphur content is used for SO₂ emission calculations. Average sulphur content in fuel (see [Table 3.44](#)) is derived from fuel quality monitoring reports, which are submitted to the European Commission every year as established by the Fuel Quality Directive (2009/30/EC). Equation:

$$E_{SO_2} = 2 \times k \times FC$$

where

E_{SO_2} – SO₂ emissions;

k – weight-related sulphur content in fuel (kg/kg fuel);

FC – fuel consumption.

Table 3.44 Sulphur content in fuel (mg/kg)

Year	Petrol	Diesel
1990	1000	5000
2001	500	500
2003	150	350
2004	130	300
2005	50	50
2006	10	40
2007	8	40
2009	8	10
2010	5	4.8
2011	5.5	6.2
2012	6.3	7.1
2013	5.9	6.1
2014	5.9	5.4
2015	5.9	6.6
2016	5.3	5.2
2017	5.4	6.6

Pb emissions from leaded fuel are estimated according to the calculation that 75% of lead contained in petrol is emitted into the atmosphere (three quarters of the total). In unleaded petrol the full total quantity of lead is presumed to be emitted into the atmosphere. Equation:

$$E_{Pb} = 0.75 \times k \times FC$$

where

E_{Pb} – Pb emissions;

k – weight-related lead content of petrol (kg/kg);

FC – fuel consumption.

Table 3.45 Lead content in fuel (mg/kg)

Fuel	Leaded petrol	Unleaded petrol	Diesel
1990	200	17.3	0.0005
2003	-	6.7	0.0005
2006	-	4	0.0005
2010	-	0.027	0.0005
2014	0.0016	0.0016	0.0005

Emissions of other heavy metals are estimated on the assumption that the total quantity is emitted into the atmosphere. Equation:

$$E_{\text{Heavy metal}} = k \times FC$$

where

k – weight-related content of heavy metal in fuel (kg/kg);

FC – fuel consumption.

Table 3.46 Heavy metals content in fuel and lubricant oil (mg/kg)

Fuel	Cd	Cu	Cr	Ni	Se	Zn	Hg	As	Pb
Petrol	0.00020	0.0045	0.0063	0.0023	0.0002	0.0330	0.0057	0.0003	equation
Diesel	0.00005	0.0057	0.0085	0.0002	0.0001	0.0180	0.0053	0.0001	equation
Lubricant oil	4.56	778	19.2	31.89	4.54	450.2	0	0	0.0322

Table 3.47 Annual mileage driven in the road transport sector (million km per year)

Year	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1990	5,564.0	684.5	1,577.9	316.6	8,143.0
1995	3,811.4	443.9	838.8	7.6	5,101.7
2000	4,044.5	501.1	894.7	15.6	5,455.9
2005	5,726.3	954.0	895.8	10.6	7,586.6
2006	6,453.4	946.0	933.9	19.3	8,352.6
2007	6,984.7	971.4	952.2	28.2	8,936.5
2008	6,723.3	918.6	938.1	30.1	8,610.0
2009	6,537.5	720.6	809.0	26.9	8,093.9
2010	6,360.5	752.5	967.3	26.8	8,107.0
2011	6,487.5	800.2	1,034.5	27.5	8,349.6
2012	6,623.3	847.4	1,027.2	33.4	8,531.4
2013	6,633.2	843.6	953.7	43.1	8,473.5
2014	6,877.8	877.3	924.9	67.3	8,747.3
2015	7,328.9	817.0	909.5	64.8	9,120.3
2016	7,596.8	1,012.9	845.9	75.0	9,530.6
2017	7,954.9	1,092.0	839.9	76.5	9,963.4

Table 3.48 Number of vehicles in the road transport sector (thousand)

Year	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1990	240.9	31.1	44.5	105.7	422.2
1995	383.4	30.1	42.5	3.3	459.3
2000	273.1	19.5	29.1	6.7	328.5
2005	354.7	33.5	26.0	3.5	417.7
2006	402.1	36.3	29.1	4.2	471.7
2007	429.2	37.5	29.5	5.8	502.0
2008	436.3	38.5	27.1	6.1	507.9
2009	424.0	36.9	27.0	6.9	494.8
2010	422.1	36.3	26.9	7.5	492.8
2011	440.2	37.9	27.2	10.2	515.5
2012	452.2	39.1	26.9	14.3	532.6
2013	462.2	41.5	28.1	23.1	554.9
2014	478.6	44.1	28.3	29.1	580.0
2015	536.5	42.5	29.0	30.8	639.0
2016	563.8	58.9	30.5	37.3	690.5
2017	584.0	63.2	30.8	38.8	716.8

Table 3.49 Fuel consumption in the road transport sector (TJ)

Year	Petrol	Diesel	Bioethanol	Biodiesel	LPG	Total
1990	21,406.3	9,499.9	-	-	-	30,906.2
1995	10,527.3	8,999.8	-	-	-	19,527.1
2000	11,872.0	8,539.9	-	-	-	20,411.9
2005	12,248.7	14,780.8	0.0	6.5	-	27,036.0
2006	13,322.7	15,959.2	0.0	46.9	-	29,328.8
2007	13,977.2	17,073.1	0.5	21.6	-	31,072.5
2008	13,845.1	15,560.6	58.1	120.4	-	29,584.2
2009	12,661.0	14,598.0	4.0	69.7	-	27,332.7
2010	11,744.8	16,283.5	185.2	136.4	-	28,349.8
2011	11,143.6	17,849.3	160.0	27.5	-	29,180.4
2012	10,695.0	18,934.9	151.9	0.0	-	29,781.8
2013	9,967.3	19,017.0	128.9	0.0	-	29,113.2
2014	10,144.9	19,157.1	215.4	0.0	-	29,517.5
2015	10,033.0	20,042.6	107.8	0.0	-	30,183.4
2016	10,604.8	20,337.4	84.7	0.0	-	31,026.9
2017	10,971.6	20,767.6	39.7	6.5	319.0	32,104.3

2) Automobile tyre wear, brake wear and road abrasion

Tyre wear, brake wear, and road surface wear are abrasion processes. Emission calculations cover those particles emitted as a direct result of the wear of tyres, brakes, or surfaces.

Airborne particles are produced as a result of the interaction between a vehicle's tyres and the road surface, as well as when the brakes are applied to decelerate the vehicle. A secondary mechanism involves the evaporation of material from surfaces at the high temperatures developed during contact. Emissions from these sectors are considered in relation to the general vehicle classes (1A3bi-iv) and depend on annual mileage.

PM_{2.5}, PM₁₀ and TSP emissions from automobile tyre and brake wear calculations are based on the Tier 2 method and use the COPERT 5 model (EMEP/EEA Guidebook 2016). Nevertheless, BC emissions from the road abrasion, tyre and brake wear sector is not included in the COPERT model and therefore these emissions are calculated separately by using appropriate default emission factors from the EMEP/EEA Guidebook 2016 (see [Table 3.50](#)).

Table 3.50 BC fractions of TSP for road abrasion, tyre and brake wear

Transport Category	f-BC		
	Road abrasion	Road tyre wear	Road brake wear
Passenger cars	0.0106	0.153	0.0261
Light duty vehicles	0.0106	0.153	0.0261
Heavy duty vehicles	0.0106	0.153	0.0261
Motorcycles	0.0106	0.153	0.0261

3) Fuel evaporation

This sector includes NMVOC evaporative fuel-related emissions from petrol vehicles, which are not derived from fuel combustion. Most evaporative emissions of NMVOCs emanate from the fuel systems (tanks, injection systems, and fuel lines) of petrol vehicles. Evaporative emissions from diesel vehicles are considered negligible.

Fuel evaporation calculations are based on the Tier 3 method and use the COPERT 5 model (EMEP/EEA Guidebook 2016).

4) Lubricant consumption

The emissions estimation also covers heavy metals (lead, arsenic, cadmium, copper, chromium, mercury, nickel, selenium, and zinc) which is contained in lubricant oils. At first, lubricant oil consumption needs to be calculated by taking into account oil consumption factors for

different vehicle types, fuel used, the engine category, and the vehicle age (see [Table 3.51](#)). Necessary lubricant metal content factors for heavy metal emissions calculations are provided in [Table 3.46](#). The full total of heavy metals in fuel is presumed to be emitted into the atmosphere.

Table 3.51 Lubricant oil consumption rate for different vehicle types, fuel and age (kg/10 000km)

Category	Fuel/engine category	Age	Lubricant oil consumption
Passenger cars	Petrol	Old	1.45
	Petrol	New	1.28
	Diesel	Old	1.49
	Diesel	New	1.28
Light duty vehicles	Petrol	Old	1.45
	Petrol	New	1.28
	Diesel	Old	1.49
	Diesel	New	1.28
Heavy duty vehicles	Diesel	All	1.56

Category	Fuel/engine category	Age	Lubricant oil consumption
Buses, coaches	Diesel	Old	1.91
	Diesel	New	1.70
Mopeds	Petrol	Old	10.20
	Petrol	New	6.80
Motorcycles	Petrol	All	0.43

3.3.3.3. Uncertainty

An uncertainty analysis was carried out for the 2017 inventory. The uncertainty in the emission factors for main pollutants, particulate matter, and heavy metals from the road transport sector is estimated to be 20%, for POPs 100–250%, and in the activity data 2%. All uncertainty estimates for this source are given in [Table 3.52](#).

Table 3.52 Uncertainties in the road transport sector

Pollutant	Emissions, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	7.509	kt	26.62	2.83	0.67
NM VOC	1.465	kt	6.59	0.93	0.87
SO _x	0.009	kt	0.02	0.003	0.02
NH ₃	0.144	kt	1.40	0.26	0.12
PM _{2.5}	0.389	kt	4.22	0.43	0.24
PM ₁₀	0.523	kt	3.76	0.39	0.13
TSP	0.685	kt	3.47	0.37	0.02
CO	11.770	kt	8.51	1.43	4.18
Pb	0.258	t	0.76	0.23	0.85
Cd	0.008	t	0.98	0.14	0.02
Hg	0.005	t	0.81	0.12	0.03
PCDD/F	0.279	g I-TEQ	6.47	12.59	3.52
B(a)p	0.011	t	0.48	0.75	0.45
B(b)f	0.016	t	0.60	0.80	0.41
B(k)f	0.014	t	1.08	1.39	0.81
I(1,2,3-cd)p	0.011	t	0.69	1.05	0.31
HCB	0.0003	kg	0.09	0.17	0.06
PCBs	0.0001	kg	0.001	0.001	0.0004

3.3.3.4. Source-Specific QA/QC and Verification

Common statistical quality control related to the assessment of trends was carried out.

3.3.3.5. Source-Specific Planned Improvements

Include more detailed vehicle subsectors in emission calculations: light duty vehicles, heavy duty vehicles, mopeds, hybrid and LPG/CNG vehicles. Specify activity data and recalculate, if necessary.

A more detailed emissions estimation is required for the 1A3bvii sector so that the use of studded tyres can be included in the calculations, since the use of studded tyres in winter has been widespread in Estonia.

It is also necessary to estimate the share of two-stroke and four-stroke engines out of the total number of mopeds and motorcycles on the road. Currently, an assumption has been made in terms of emissions calculations that all mopeds and motorcycles operate with a four-stroke engine. However, this has minor importance for the overall road transport emissions figures.

3.3.4. Railways (NFR 1A3c)

3.3.4.1. Source Category Description

Railway transport in Estonia is a small emission source in transport sector. This sector concerns the movement of goods or people that is mostly performed by diesel locomotives.

There are more than 2,000 km of railways in Estonia, most of which are owned by state-controlled businesses. The railways in Estonia today are mainly used for freight transport, but a good deal of passenger traffic is also handled.



(Photo: Estonian Railways' GE C36-7 diesel-electric locomotive #1504; source: www.bahnbilder.de)

Nowadays, emissions from rail use originate primarily from the combustion by locomotives of diesel and light fuel oil. Coal-powered railway locomotives were only used in the period between

1990-2002. Since emissions from the railway sector are calculated by using the Tier 1 method which takes into account the amount of fuel consumed and default emission factors, deviations in the time series can be explained by statistical fuel consumption deviations in the railway sector.

The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 6.4%, 2.6% and 0.8% respectively, in the transport sector in 2017. The emissions of NO_x, NMVOC and CO have decreased compared to 1990 by 66.4%, 67.7 and 72.3% respectively. The trend of all the emissions is given in [Table 3.53](#). During the same period, fuel consumption decreased 67.3%.

The number of passengers carried by rail decreased by approximately 81.8% during the period between 1990-2013 (23.1 million passengers down to 4.2 million passengers). After 2014, when the train fleet for passenger transport had been fully replaced by new and refurbished units, the number of passenger carried by rail has increased. In 2014, passenger numbers increased from 4.2 million passengers to 5.9 million passengers (40.9%), and the growth in the number of passengers continued across the next few years. This increase is roughly in line with the trends in passenger traffic volumes in the same period.

In 2017, although the volume of goods carried by rail grew (7.5%), the freight turnover decreased by 0.6% compared to 2016. Despite the decreasing trend in freight turnover figures, the emissions increase in the railway sector was in line with the carriage of goods performance which influenced the overall railway sector significantly. Therefore, fuel consumption increased by 5.0% in 2017 when compared to 2016, and a similar increase in emissions for this period can be observed. Emissions of nitrogen oxides, non-methane volatile compounds, and carbon monoxide have increased by 4.0% during that period (see [Figure 3.44](#)).

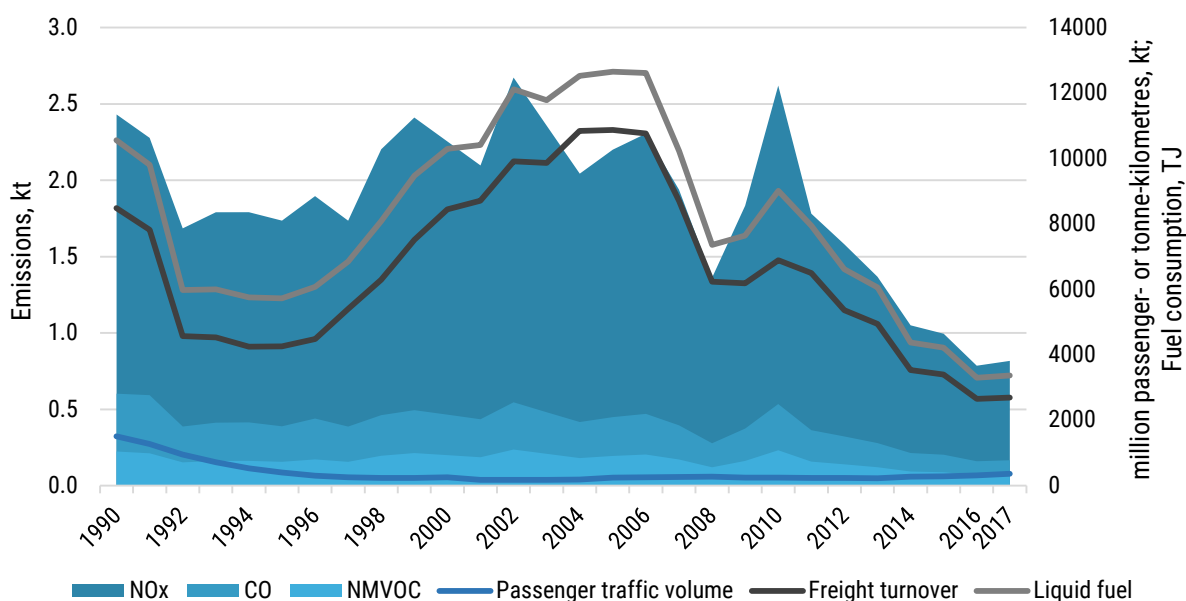


Figure 3.44 NO_x, NMVOC and CO emissions from the railway sector

Table 3.53 Emissions from railway transport in the period of 1990-2017

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
	kt			t			kt		
1990	2.431	0.224	0.567	0.322	NR	NR	0.085	NR	0.603
1995	1.736	0.157	0.365	0.231	NR	NR	0.055	NR	0.389
2000	2.254	0.200	0.177	0.301	0.060	0.063	0.066	0.038	0.466
2005	2.201	0.195	0.168	0.294	0.058	0.060	0.064	0.037	0.449
2006	2.306	0.205	0.168	0.308	0.060	0.063	0.067	0.039	0.471
2007	1.939	0.172	0.121	0.259	0.051	0.053	0.056	0.033	0.396
2008	1.362	0.121	0.050	0.182	0.036	0.037	0.040	0.023	0.278
2009	1.834	0.163	0.050	0.245	0.048	0.050	0.053	0.031	0.375
2010	2.620	0.233	0.070	0.350	0.069	0.072	0.076	0.045	0.535
2011	1.782	0.158	0.001	0.238	0.047	0.049	0.052	0.030	0.364
2012	1.581	0.140	0.001	0.211	0.041	0.043	0.046	0.027	0.323
2013	1.368	0.121	0.001	0.183	0.036	0.038	0.040	0.023	0.279
2014	1.050	0.093	0.000	0.140	0.027	0.029	0.030	0.018	0.215
2015	0.996	0.088	0.000	0.133	0.026	0.027	0.029	0.017	0.203
2016	0.786	0.070	0.000	0.105	0.021	0.022	0.023	0.013	0.161
2017	0.818	0.073	0.000	0.109	0.021	0.022	0.024	0.014	0.167
trend 1990-2017, %	-66.4	-67.7	-99.9	-66.1	-64.1	-64.1	-72.0	-63.8	-72.3

Table 3.53 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t		kg			t		kg	t
1990	0.016	0.674	0.940	0.476	0.004	0.080	0.005	0.674	0.070
1995	0.005	0.400	0.308	0.156	0.002	0.057	0.003	0.400	0.041
2000	0.001	0.441	0.047	0.024	0.002	0.073	0.003	0.441	0.044
2005	NE	0.420	NE	NE	0.002	0.071	0.003	0.420	0.042
2006	NE	0.440	NE	NE	0.002	0.075	0.003	0.440	0.044
2007	NE	0.370	NE	NE	0.002	0.063	0.003	0.370	0.037
2008	NE	0.260	NE	NE	0.001	0.044	0.002	0.260	0.026
2009	NE	0.350	NE	NE	0.002	0.060	0.002	0.350	0.035
2010	NE	0.500	NE	NE	0.003	0.085	0.004	0.500	0.050
2011	NE	0.340	NE	NE	0.002	0.058	0.002	0.340	0.034
2012	NE	0.302	NE	NE	0.002	0.051	0.002	0.302	0.030

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t	kg			t			kg	t
2013	NE	0.261	NE	NE	0.001	0.044	0.002	0.261	0.026
2014	NE	0.200	NE	NE	0.001	0.034	0.001	0.200	0.020
2015	NE	0.190	NE	NE	0.001	0.032	0.001	0.190	0.019
2016	NE	0.150	NE	NE	0.001	0.026	0.001	0.150	0.015
2017	NE	0.156	NE	NE	0.001	0.027	0.001	0.156	0.016
trend 1990-2017, %	-100.0	-76.9	-100.0	-100.0	-80.0	-67.0	-77.1	-76.9	-77.6

Table 3.53 continues

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs total	HCB	PCBs
	g I-TEQ	t					g	kg
1990	0.024	0.007	0.009	0.004	0.003	0.023	0.074	0.020
1995	0.008	0.003	0.004	0.002	0.001	0.010	0.024	0.007
2000	0.001	0.002	0.003	0.002	0.000	0.006	0.004	0.001
2005	NE	0.001	0.002	0.001	0.000	0.005	NA	NA
2006	NE	0.001	0.002	0.002	0.000	0.005	NA	NA
2007	NE	0.001	0.002	0.001	0.000	0.005	NA	NA
2008	NE	0.001	0.001	0.001	0.000	0.003	NA	NA
2009	NE	0.001	0.002	0.001	0.000	0.004	NA	NA
2010	NE	0.002	0.003	0.002	0.000	0.006	NA	NA
2011	NE	0.001	0.002	0.001	0.000	0.004	NA	NA
2012	NE	0.001	0.002	0.001	0.000	0.004	NA	NA
2013	NE	0.001	0.001	0.001	0.000	0.003	NA	NA
2014	NE	0.001	0.001	0.001	0.000	0.002	NA	NA
2015	NE	0.001	0.001	0.001	0.000	0.002	NA	NA
2016	NE	0.000	0.001	0.001	0.000	0.002	NA	NA
2017	NE	0.000	0.001	0.001	0.000	0.002	NA	NA
trend 1990-2017, %	-100.0	-93.1	-91.6	-87.8	-95.2	-91.7	-100.0	-100.0

3.3.4.2. Methodological Issues

All the emission calculations are based on the Tier 1 method. Emissions from the railway transport sector are calculated by multiplying the statistical fuel consumption (see Table 3.56) by respective emission factors. Default emission factors for the main pollutants and heavy metals are taken from EMEP/EEA Guidebook 2016 and are presented in Table 3.54.

Emissions of SO₂ are dependent on fuel consumption and fuel type. SO₂ emissions are calculated by multiplying statistical fuel use (see

Table 3.56) by emission factors (see Table 3.55). SO₂ emissions are estimated according to the assumption that all sulphur in the fuel is completely transformed into SO₂. Equation:

$$E_{SO_2} = 2 \times k \times FC$$

where

E_{SO₂} – emissions of SO₂;

k – weight related sulphur content in fuel (kg/kg fuel);

FC – fuel consumption.

Table 3.54 Emission factors for railway transport

Pollutant	Diesel / light fuel oil		Coal	
	Unit	Value	Unit	Value
NO _x	kg/t	52.4	g/GJ	173
NM VOC	kg/t	4.65	g/GJ	88.8
SO ₂	kg/t	equation	g/GJ	900
NH ₃	kg/t	0.007	g/GJ	NE
PM _{2.5}	kg/t	1.37	g/GJ	108
PM ₁₀	kg/t	1.44	g/GJ	117
TSP	kg/t	1.52	g/GJ	124
BC	kg/t	0.891	g/GJ	6.912
CO	kg/t	10.7	g/GJ	931
Pb	g/t	NE	mg/GJ	134
Cd	g/t	0.01	mg/GJ	1,8
Hg	g/t	NE	mg/GJ	7,9
As	g/t	NE	mg/GJ	4
Cr	g/t	0.05	mg/GJ	13.5
Cu	g/t	1.70	mg/GJ	17.5
Ni	g/t	0.07	mg/GJ	13
Se	g/t	0.01	mg/GJ	1.8
Zn	g/t	1.00	mg/GJ	200
PCDD/F	TEQµg /t	NE	ng I-TEQ/GJ	203
B(a)p	g/t	0.03	mg/GJ	45.5
B(b)f	g/t	0.05	mg/GJ	58.9
B(k)f	g/t	0.034	mg/GJ	23.7
I(1,2,3-cd)p	g/t	0.008	mg/GJ	18.5
HCB	mg/t	NA	µg/GJ	0.62
PCBs	mg/t	NA	µg/GJ	170

Table 3.55 Sulphur content of fuel (by weight)

Fuel	1990	2000	2001	2003	2004	2005	2006	2008	2009
Light fuel oil	0.5%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%
Diesel	0.5%	0.5%	0.05%	0.035%	0.030%	0.005%	0.004%	0.004%	0.001%

Table 3.56 Fuel consumption, passenger traffic volume and freight turnover in the railway sector

Year	Fuel consumption			Passenger traffic volume million passenger-km	Freight turnover million tonne-km
	Coal	Diesel	Light fuel oil		
	TJ				
1990	119	0	1,951	1,510.0	6,977
1995	39	0	1,425	408.2	3,851
2000	6	0	1,842	260.5	8,186
2005	0	243	1,531	247.0	10,629
2006	0	95	1,757	255.9	10,504
2007	0	279	1,249	271.7	8,425
2008	0	45	1,076	274.4	5,961
2009	0	415	1,048	249.4	5,934
2010	0	634	1,491	247.9	6,642
2011	0	1,442	0	241.3	6,261
2012	0	1,248	7	235.8	5,126
2013	0	1,105	5	224.9	4,722
2014	0	835	2	281.9	3,256
2015	0	814	0	288.7	3,114
2016	0	645	0	315.7	2,339
2017	0	677	0	366.0	2,325

3.3.4.3. Uncertainty

An uncertainty analysis was carried out for the 2017 inventory. The uncertainty in the emission factors for NO_x, NMVOC, NH₃ and CO from railways is estimated to be 100%, for SO_x, NH₃ and heavy metals 50%, for particulate matter 20%, for POPs 100-250% and in the activity data 2%. Uncertainty estimates for railway sector are described together with non-road mobile machinery sector in [Table 3.66](#).

3.3.4.4. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends has been carried out.

3.3.4.5. Source-Specific Planned Improvements

There are currently no improvements planned for this sector.

3.3.5. National Navigation (NFR 1A3dii)

3.3.5.1. Source Category Description

Domestic navigation includes the most important domestic water transport in Estonia: merchant ships, passenger and technical ships, pleasure and tour ships and other inland vessels.



(Photo by Madis Press: Riverboat Pegasus on the river Emajõgi)

National navigation in Estonia is also a small emission source in the transport sector. The share of navigation transport in total transport emissions in 2017 was: NO_x – 2.0%, NMVOC – 1.8%, CO – 0.6%. Detailed emission data are provided in [Table 3.57](#).

Deviations of time series can be explained by changing statistical fuel consumption in the national navigation sector (see [Figure 3.45](#)). Fuel consumption increased 23.3% in 2017 compared to 2016, therefore all the emissions increased also.

Recalculations

In the national navigation sector, all emissions have been recalculated for the period 2014-2016. Heavy metals and persistent organic pollutants emissions have been recalculated for the period between 1990-2016. The reason for the recalculation was correction of emission factors and statistical fuel consumption used for emission calculations. An overview of the updated data is given in Chapter 8.

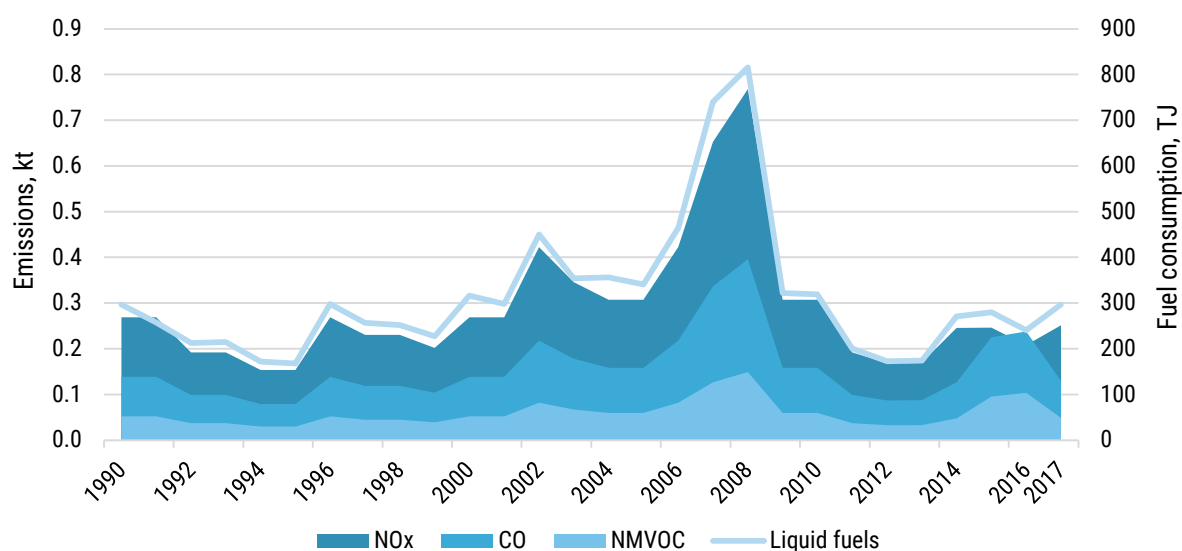


Figure 3.45 NO_x, NMVOC and CO emissions from the national navigation sector

Table 3.57 Emissions from national navigation in the period of 1990-2017

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
	kt			t	kt				
1990	0.269	0.052	0.070	0.049	NR	NR	0.032	NR	0.139
1995	0.154	0.030	0.040	0.028	NR	NR	0.018	NR	0.079
2000	0.269	0.052	0.028	0.049	0.032	0.032	0.032	0.018	0.139
2005	0.307	0.060	0.032	0.056	0.037	0.037	0.037	0.020	0.158
2006	0.422	0.082	0.044	0.077	0.051	0.051	0.051	0.028	0.218
2007	0.653	0.127	0.068	0.119	0.078	0.078	0.078	0.043	0.337
2008	0.768	0.149	0.080	0.140	0.092	0.092	0.092	0.051	0.396
2009	0.307	0.060	0.032	0.056	0.037	0.037	0.037	0.020	0.158
2010	0.307	0.060	0.016	0.056	0.037	0.037	0.037	0.020	0.158
2011	0.192	0.037	0.010	0.035	0.023	0.023	0.023	0.013	0.099
2012	0.169	0.033	0.009	0.031	0.020	0.020	0.020	0.011	0.087
2013	0.170	0.033	0.009	0.031	0.020	0.020	0.020	0.011	0.087
2014	0.246	0.048	0.013	0.045	0.029	0.029	0.029	0.016	0.127
2015	0.246	0.095	0.013	0.045	0.032	0.032	0.032	0.016	0.225
2016	0.208	0.104	0.011	0.039	0.028	0.028	0.028	0.014	0.238
2017	0.251	0.049	0.013	0.046	0.030	0.030	0.030	0.017	0.130
trend 1990-2017, %	-6.5	-6.5	-81.3	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5

Table 3.57 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t	kg				t			
1990	0.001	0.070	0.210	0.280	0.350	0.006	0.007	0.001	0.008
1995	0.001	0.040	0.120	0.160	0.200	0.004	0.004	0.000	0.005
2000	0.001	0.070	0.210	0.280	0.350	0.006	0.007	0.001	0.008
2005	0.001	0.080	0.240	0.320	0.400	0.007	0.008	0.001	0.010
2006	0.001	0.110	0.330	0.440	0.550	0.010	0.011	0.001	0.013
2007	0.002	0.170	0.510	0.680	0.850	0.015	0.017	0.002	0.020
2008	0.003	0.200	0.600	0.800	1.000	0.018	0.020	0.002	0.024
2009	0.001	0.080	0.240	0.320	0.400	0.007	0.008	0.001	0.010
2010	0.001	0.080	0.240	0.320	0.400	0.007	0.008	0.001	0.010
2011	0.001	0.050	0.150	0.200	0.250	0.004	0.005	0.001	0.006
2012	0.001	0.044	0.132	0.176	0.220	0.004	0.004	0.000	0.005
2013	0.001	0.044	0.133	0.177	0.221	0.004	0.004	0.000	0.005
2014	0.001	0.064	0.192	0.256	0.320	0.006	0.006	0.001	0.008

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t	kg				t			
2015	0.001	0.064	0.192	0.256	0.320	0.006	0.006	0.001	0.008
2016	0.001	0.054	0.162	0.216	0.270	0.005	0.005	0.001	0.006
2017	0.001	0.065	0.196	0.262	0.327	0.006	0.007	0.001	0.008
trend 1990-2017, %	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5

Table 3.57 continues

Year	PCDD/F	B(a)p	B(b)f	PAHs total	HCB	PCBs
	g I-TEQ	kg			g	
1990	0.001	0.210	0.350	0.560	0.001	0.266
1995	0.001	0.120	0.200	0.320	0.000	0.152
2000	0.001	0.210	0.350	0.560	0.001	0.266
2005	0.001	0.240	0.400	0.640	0.001	0.304
2006	0.001	0.330	0.550	0.880	0.001	0.418
2007	0.002	0.510	0.850	1.360	0.001	0.646
2008	0.003	0.600	1.000	1.600	0.002	0.760
2009	0.001	0.240	0.400	0.640	0.001	0.304
2010	0.001	0.240	0.400	0.640	0.001	0.304
2011	0.001	0.150	0.250	0.400	0.000	0.190
2012	0.001	0.132	0.220	0.352	0.000	0.167
2013	0.001	0.133	0.221	0.354	0.000	0.168
2014	0.001	0.192	0.320	0.512	0.001	0.243
2015	0.001	0.192	0.320	0.512	0.001	0.243
2016	0.001	0.162	0.270	0.432	0.000	0.205
2017	0.001	0.196	0.327	0.524	0.001	0.249
trend 1990-2017, %	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5

3.3.5.2. Methodological Issues

All the emission calculations are based on the Tier 1 method. Emissions in the national navigation sector are calculated by multiplying the statistical fuel consumption (see Table 3.60) by respective emission factors. Default emission factors for the main pollutants are taken from EMEP/EEA Guidebook 2016 and are presented in Table 3.58.

Emissions of SO₂ are dependent on fuel consumption and fuel type. SO₂ emissions are calculated by multiplying statistical fuel use (see Table 3.60) by emission factors (see Table 3.59). SO₂ emissions are estimated according to the assumption that all sulphur in the fuel is completely transformed into SO₂. Equation:

$$E_{SO_2} = 20 \times k \times FC$$

where

E_{SO_2} – emissions of SO₂;

k – sulphur content in fuel (% by mass);

FC – fuel consumption.

Table 3.58 Emission factors for national navigation transport

Pollutant	Unit	Diesel / light fuel oil	Petrol
NO _x	kg/t	38.4	3.27
NM VOC	kg/t	7.45	233
NH ₃	kg/t	0.007	0.003
PM _{2.5}	kg/t	4.6	12.6
PM ₁₀	kg/t	4.6	12.6
TSP	kg/t	4.6	12.6
BC	kg/t	2.53	0.63
CO	kg/t	19.8	481
Pb	g/t	0.13	NE
Cd	g/t	0.01	NE
Hg	g/t	0.03	NE
As	g/t	0.04	NE
Cr	g/t	0.05	NE
Cu	g/t	0.88	NE
Ni	g/t	1.00	NE
Se	g/t	0.10	NE
Zn	g/t	1.20	NE
PCDD/F	TEQ _{μg} /tonne	0.13	NE
B(a)p	g/t	0.03	NE
B(b)f	g/t	0.05	NE
HCB	mg/t	0.08	NE
PCBs	mg/t	0.038	NE

Table 3.59 Sulphur content of fuel (by weight)

	1990	2000	2006	2010
Marine diesel oil/ marine gas oil	0.5%	0.2%		0.1%
Bunker Fuel Oil	2.7%		1.5%	

Table 3.60 Fuel consumption in the navigation sector in the period of 1990-2017 (TJ)

Year	Marine gas oil	Marine diesel oil	Petrol	Total
1990	0	297	0	297
1995	0	168	0	168
2000	91	225	0	316
2005	106	235	0	341
2006	193	272	0	465
2007	523	217	0	740
2008	537	279	0	816
2009	64	258	0	322
2010	70	249	0	319
2011	0	201	0	201
2012	17	156	0	173
2013	18	156	0	174
2014	17	254	0	271
2015	17	254	9	280
2016	17	211	12	240
2017	0	297	0	297

3.3.5.3. Uncertainty

An uncertainty analysis was carried out for the 2017 inventory. The uncertainty in the emission factors for NO_x, NMVOC, NH₃ and CO from national navigation is estimated to be 100%, for SO_x, NH₃ and heavy metals 50%, for particulate matter 20%, for POPs 100-250% and in the activity data 2%. Uncertainty estimates for national sector are described together with non-road mobile machinery sector in [Table 3.66](#).

3.3.5.4. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends has been carried out.

3.3.5.5. Source-Specific Planned Improvements

There are currently no improvements planned for this sector.

3.3.6. Other Non-Road Mobile Machinery

This chapter covers several mobile sources: industrial machinery (NFR 1A2gvii), commercial machinery (NFR 1A4aii), household and gardening machinery (NFR 1A4bii), agricultural machinery (NFR 1A4cii) and national fishing (NFR 1A4ciii) sector.



(Photo: Tractor on the field; Source: Shutterstock)

All these mobile sources are aggregated in one chapter because each of these sectors have minor importance into total transport emissions and all the emission calculations are made by using Tier 1 methodology.

3.3.6.1. Source Category Description

Other non-road machinery includes following sectors and activities:

- The industrial machinery sector (NFR 1A2gvii) includes mobile combustion in manufacturing industries and construction land-based mobile machinery: tractors, cranes and any other mobile machine that run on petroleum fuels.
- Commercial sector (NFR 1A4aii) includes different small petrol and diesel working machinery in the residential sector.
- The household and gardening sector (NFR 1A4bii) include various machinery: trimmers, lawn mowers, chain saws snow mobiles, other vehicles and equipment.
- The agricultural sector (NFR 1A4cii) includes off-road vehicles and other machinery used in agriculture/forestry (agricultural tractors, harvesters, combines, etc.).

- National fishing sector (NFR 1A4ciii) covers activities from inland, coastal and deep-sea fishing.

The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 32.1%, 42.1% and 40.5% respectively, in the transport sector in 2017.

As the emissions depend on the amount of fuel used, emissions from the other non-road mobile machinery sector show trends similar to fuel consumption. All the emissions have decreased in the period 1990 to 2017, where the emissions of nitrogen oxides, non-methane volatile compounds, sulphur oxide and carbon monoxide have decreased by approximately 59.4%, 45.9%, 99.7% and 70.5% compared to 1990. Also, the amount of fuel consumed decreased by 61.3% during that period. Therefore, deviations of time series can be explained by changing statistical fuel consumption in non-road machinery sector (see [Figure 3.46](#), [Figure 3.47](#) and [Figure 3.48](#)) and the share of some specific sector in total non-road machinery emissions. Detailed emission data are provided in [Table 3.61](#).

In 2017, fuel consumption decreased by approximately 1.2% when compared to 2016's figures. As a result of this, sulphur dioxide

emissions decreased by 43.2%. In opposition to this, NO_x, NMVOC and CO emissions increased by 1.6%, 3.8 and 3.2% respectively. The significant decline in SO₂ emissions was due to the decrease in light fuel oil consumption in the agricultural sector, which was approximately three times lower and has relatively high impact on emissions compared to other fuels (e.g. diesel and petrol).

In general, the most important deployment of other off-road mobile machinery is its use in the agricultural and industrial sectors, which are responsible for about 83.3% of total energy use in these sectors, with diesel being the dominant fuel type, accounting for 93.3% of the total energy use in 2017.

Recalculations

Recalculations have been carried out for the household and gardening sector for 2016 and for the national fishing sector for the period 2003-2016. The reason for the recalculations was updated statistical fuel consumption data for the household and gardening sector and corrections in SO₂ emissions calculations for the national fishing sector. A detailed overview is given in Chapter 8.

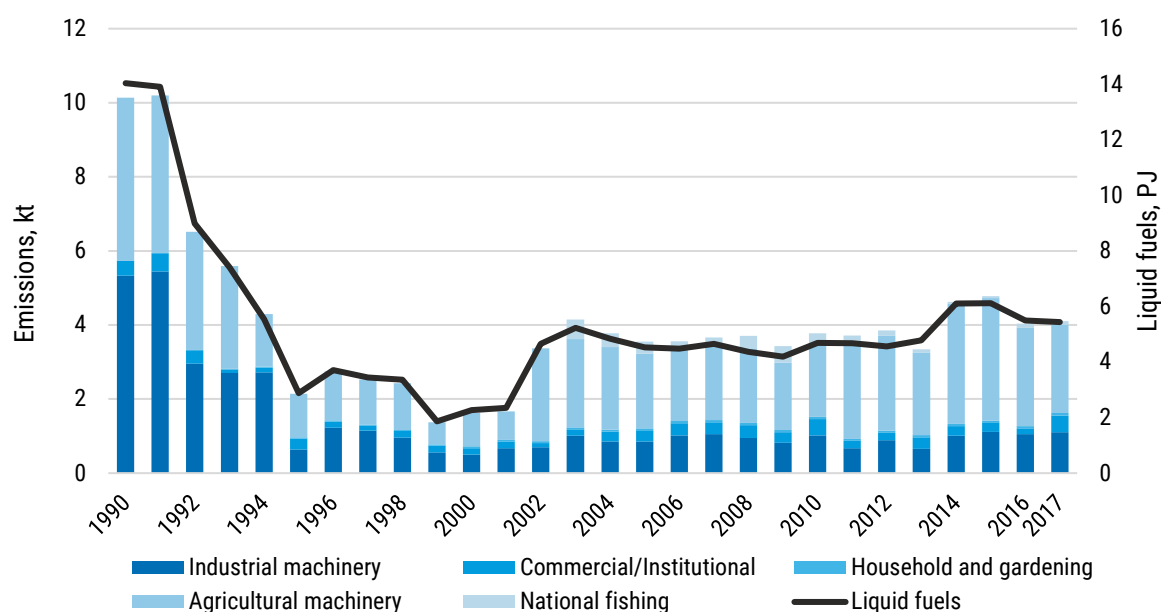


Figure 3.46 NO_x emissions from other non-road machinery

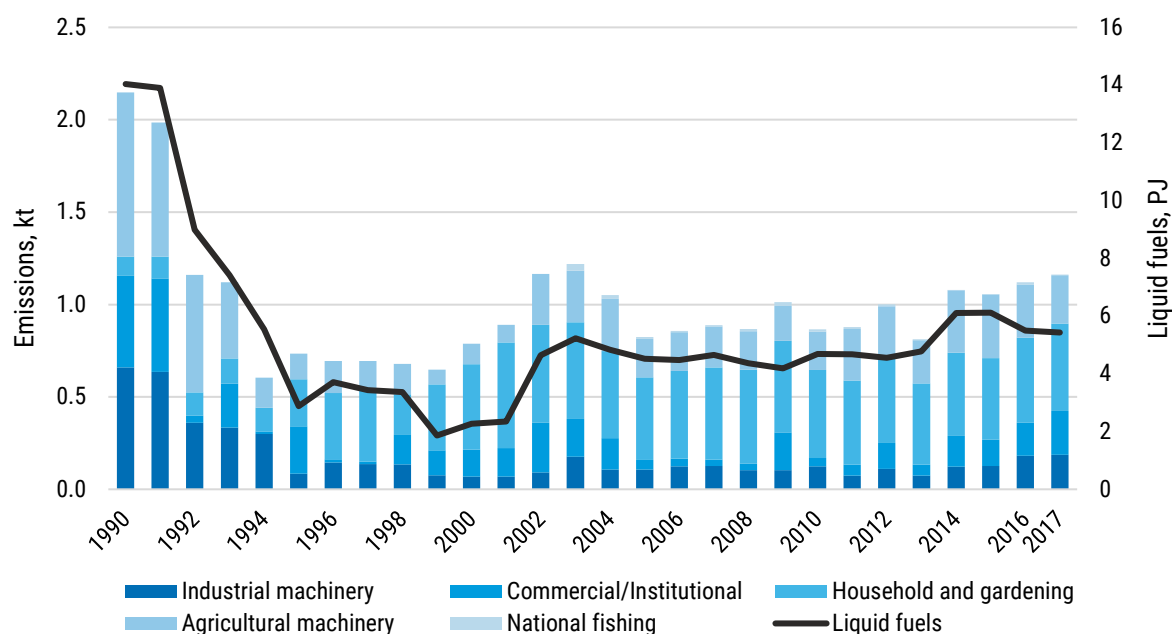


Figure 3.47 NMVOC emissions from other non-road machinery

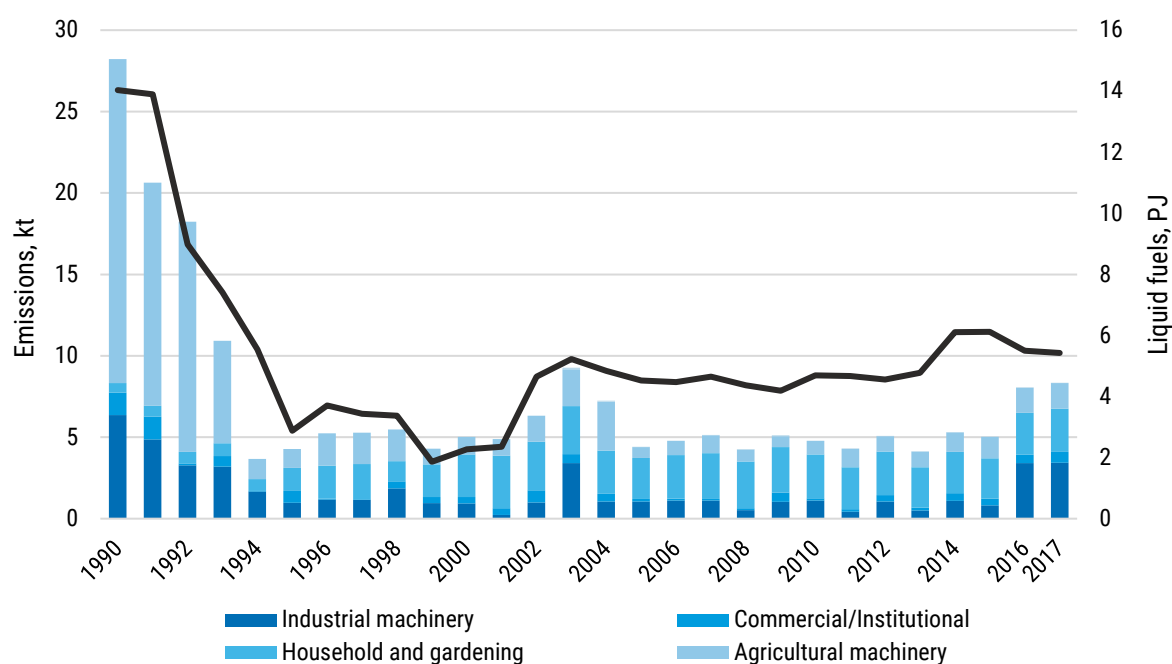


Figure 3.48 CO emissions from other non-road machinery

Table 3.61 Emissions from other non-road machinery in the period of 1990-2017

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
kt									
1990	10.140	2.148	3.036	0.003	NR	NR	0.615	NR	28.223
1995	2.145	0.735	0.640	0.001	NR	NR	0.134	NR	4.283
2000	1.626	0.789	0.390	0.000	0.104	0.104	0.104	0.057	5.015
2005	3.553	0.825	0.111	0.001	0.202	0.202	0.202	0.115	4.426
2006	3.557	0.857	0.079	0.001	0.210	0.210	0.210	0.120	4.789
2007	3.661	0.888	0.074	0.001	0.216	0.216	0.216	0.124	5.143
2008	3.707	0.868	0.086	0.001	0.212	0.212	0.212	0.120	4.272
2009	3.426	1.014	0.038	0.001	0.193	0.194	0.194	0.107	5.130
2010	3.777	0.865	0.028	0.001	0.219	0.220	0.220	0.126	4.792

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
kt									
2011	3.719	0.879	0.040	0.001	0.216	0.216	0.216	0.123	4.321
2012	3.853	1.001	0.027	0.001	0.227	0.227	0.227	0.129	5.090
2013	3.343	0.813	0.005	0.001	0.198	0.198	0.198	0.113	4.140
2014	4.625	1.078	0.008	0.001	0.275	0.275	0.275	0.158	5.308
2015	4.778	1.057	0.015	0.001	0.283	0.283	0.283	0.163	5.026
2016	4.034	1.120	0.016	0.001	0.239	0.239	0.239	0.135	8.073
2017	4.101	1.163	0.009	0.001	0.246	0.246	0.246	0.141	8.333
trend 1990-2017, %	-59.6	-45.9	-99.7	-61.2	136.0	136.2	-60.0	145.6	-70.5

Table 3.61 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
t		kg		t					
1990	4.926	0.003	NE	NE	0.016	0.561	0.023	0.003	0.330
1995	0.756	0.001	NE	NE	0.003	0.116	0.005	0.001	0.068
2000	0.082	0.001	NE	NE	0.003	0.091	0.004	0.001	0.054
2005	0.024	0.001	0.126	0.168	0.005	0.173	0.011	0.001	0.104
2006	0.026	0.001	0.064	0.085	0.005	0.180	0.009	0.001	0.107
2007	0.028	0.001	0.063	0.084	0.006	0.186	0.010	0.001	0.111
2008	0.023	0.001	0.131	0.174	0.005	0.180	0.012	0.001	0.109
2009	0.030	0.001	0.170	0.227	0.005	0.164	0.012	0.001	0.100
2010	0.026	0.001	0.103	0.137	0.006	0.187	0.011	0.001	0.113
2011	0.022	0.001	0.054	0.071	0.006	0.187	0.009	0.001	0.111
2012	0.028	0.001	0.057	0.076	0.006	0.195	0.010	0.001	0.116
2013	0.022	0.001	0.033	0.044	0.005	0.171	0.008	0.001	0.101
2014	0.027	0.001	0.016	0.022	0.007	0.238	0.010	0.001	0.140
2015	0.025	0.001	0.021	0.028	0.007	0.245	0.011	0.002	0.144
2016	0.047	0.001	0.044	0.059	0.006	0.211	0.010	0.001	0.125
2017	0.049	0.001	0.038	0.051	0.006	0.216	0.010	0.001	0.128
trend 1990-2017, %	-99.0	-61.2	-80.9	-80.9	-61.2	-61.4	-56.1	-57.7	-61.1

Table 3.61 continues

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs total	HCB	PCBs
mg I-TEQ		t				g		
1990	NE	0.010	0.016	NE	NE	0.026	NA	NA
1995	NE	0.002	0.003	NE	NE	0.005	NA	NA
2000	NE	0.002	0.003	NE	NE	0.004	NA	NA
2005	0.546	0.003	0.005	NE	NE	0.008	0.336	0.159
2006	0.277	0.003	0.005	NE	NE	0.008	0.170	0.081
2007	0.273	0.003	0.005	NE	NE	0.009	0.168	0.080
2008	0.566	0.003	0.005	NE	NE	0.008	0.348	0.166
2009	0.736	0.003	0.005	NE	NE	0.007	0.453	0.215
2010	0.445	0.003	0.005	NE	NE	0.009	0.274	0.130
2011	0.232	0.003	0.005	NE	NE	0.009	0.143	0.068
2012	0.248	0.003	0.006	NE	NE	0.009	0.153	0.073
2013	0.144	0.003	0.005	NE	NE	0.008	0.088	0.042
2014	0.071	0.004	0.007	NE	NE	0.011	0.044	0.021
2015	0.090	0.004	0.007	NE	NE	0.011	0.055	0.026
2016	0.192	0.004	0.006	NE	NE	0.010	0.118	0.056
2017	0.166	0.004	0.006	NE	NE	0.010	0.102	0.048
trend 1990-2017, %	-80.9	-61.9	-61.4	NE	NE	-61.6	-80.9	-80.9

3.3.6.2. Methodological Issues

All the emission calculations are based on the Tier 1 method. Emissions from these transport sectors are calculated by multiplying the statistical fuel consumption (see [Table 3.65](#)) by respective emission factors. Default emission factors for the main pollutants and heavy metals are taken from EMEP/EEA Guidebook 2013 and are presented in [Table 3.62](#).

Emissions of SO₂ are dependent on fuel consumption and fuel type. SO₂ emissions are calculated by multiplying statistical fuel use (see [Table 3.65](#)) by emission factors (see [Table 3.63](#)). SO₂ emissions are estimated according to the assumption that all sulphur in the fuel is completely transformed into SO₂. Equation (1) can be applied to industrial, commercial,

household/ gardening and agricultural sectors, equation (2) only for national fishing sector:

$$E_{SO_2} = 2 \times k \times FC \quad (1)$$

$$E_{SO_2} = 20 \times S \times FC \quad (2)$$

where

E_{SO_2} – emissions of SO₂;

k – weight related sulphur content in fuel (kg/kg fuel);

S – sulphur content in fuel (% by mass);

FC – fuel consumption.

Pb emissions are estimated by assuming that 75% of the lead contained in petrol is emitted into the air (see [Table 3.64](#)). Equation:

$$E_{Pb} = 0.75 \times k \times FC$$

Table 3.62 Emission factors for other mobile sources

Pollutant	Unit	1A2gii, 1A4aii, 1A4bii			1A4cii		1A4ciii	
		Diesel/ light fuel oil	Petrol 2-stroke	Petrol 4-stroke	Diesel /light fuel oil	Petrol	Diesel/ light fuel oil	Petrol
NO _x	kg/t	32.629	2.765	7.117	34.457	7.117	78.5	9.4
NM VOC	kg/t	3.377	227.289	18.893	3.542	18.893	2.8	181.5
NH ₃	kg/t	0.008	0.003	0.004	0.008	0.004	NE	NE
PM _{2.5}	kg/t	2.104	3.762	0.157	1.913	0.157	1.4	9.5
PM ₁₀	kg/t	2.104	3.762	0.157	1.913	0.157	1.5	9.5
TSP	kg/t	2.104	3.762	0.157	1.913	0.157	1.5	9.5
BC	kg/t	1.306	0.188	0.008	1.111	0.008	0.434	0.475
CO	kg/t	10.774	620.793	770.368	11.469	770.368	7.4	573.9
Cd	g/t	0.01	0.01	0.01	0.01	0.01	0.01	NE
Hg	g/t	NE	NE	NE	NE	NE	0.03	NE
As	g/t	NE	NE	NE	NE	NE	0.04	NE
Cr	g/t	0.05	0.05	0.05	0.05	0.05	0.05	NE
Cu	g/t	1.7	1.7	1.7	1.7	1.7	0.88	NE
Ni	g/t	0.07	0.07	0.07	0.07	0.07	1.0	NE
Se	g/t	0.01	0.01	0.01	0.01	0.01	0.1	NE
Zn	g/t	1.0	1.0	1.0	1.0	1.0	1.2	NE
PCDD/F	TEQµg /t	NE	NE	NE	NE	NE	0.13	NE
B(a)p	g/t	0.03	0.04	0.04	0.03	0.04	NE	NE
B(b)f	g/t	0.05	0.04	0.04	0.05	0.04	NE	NE
HCB	mg/t	NA	NA	NA	NA	NA	0.08	NA
PCBs	mg/t	NA	NA	NA	NA	NA	0.038	NA

Table 3.63 Sulphur content of fuel (by weight)

NFR	Fuel	1990	2000	2001	2003	2004	2005	2006	2009	2010
1A2gvii										
1A4aii	Petrol	0.1%	0.1%	0.05%	0.015%	0.013%	0.005%	0.002%	0.002%	0.002%
1A4bii										
1A4cii	Diesel	0.5%	0.5%	0.05%	0.035%	0.030%	0.005%	0.004%	0.002%	0.002%
1A4ciii	Light fuel oil	0.5%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%

Table 3.64 Lead content in fuel

NFR	Fuel	Unit	1990	2000	2004
1A2gvii	Petrol	g/l	0.15	0.013	0.005
1A4aai					
1A4bii					
1A4cii					
1A4ciii	Diesel/ Light fuel oil	g/t	0.13	0.13	0.13
1A4ciii					

Table 3.65 Total fuel consumption in other mobile sectors for the period of 1990-2017 (TJ)

Year	Diesel	Light fuel oil	Petrol	Total
1990	12,219	383	1,435	14,037
1995	2,526	152	205	2,883
2000	1,321	679	267	2,267
2005	3,401	926	199	4,526
2006	3,572	703	202	4,477
2007	3,767	661	223	4,651
2008	3,464	705	196	4,365
2009	3,725	217	245	4,187
2010	4,034	446	209	4,688
2011	3,807	671	196	4,674
2012	4,325	10	224	4,559
2013	4,085	501	190	4,776
2014	5,746	109	251	6,105
2015	5,665	233	219	6,117
2016	4,875	220	402	5,497
2017	4,918	85	429	5,432

3.3.6.3. Uncertainty

An uncertainty analysis was carried out for the 2017 inventory. The uncertainty in the emission factors for main pollutants, particulate matter and heavy metals from non-road mobile machinery sector is estimated to be 50%, for SO_x 20%, for POPs 100-250% and in the activity data 2%. All uncertainty estimates for this source are given in [Table 3.66](#).

Table 3.66 Uncertainties in non-road mobile machinery sector

Pollutant	Emission, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	5.170	kt	15.57	8.34	1.63
NM VOC	1.284	kt	5.77	2.34	0.68
SO _x	0.022	kt	0.06	0.02	0.05
NH ₃	0.001	kt	0.01	0.003	0.001
PM _{2.5}	0.298	kt	3.23	0.83	0.38
PM ₁₀	0.299	kt	2.15	0.55	0.20
TSP	0.300	kt	1.52	0.39	0.02
CO	8.630	kt	6.24	1.70	2.19
Pb	0.049	t	0.15	0.04	0.15
Cd	0.002	t	0.19	0.05	0.01
Hg	0.0002	t	0.04	0.02	0.02
PCDD/F	0.001	g I-TEQ	0.02	0.05	0.40
B(a)p	0.005	t	0.20	0.22	0.62
B(b)f	0.007	t	0.28	0.31	0.78
B(k)f	0.001	t	0.04	0.08	0.42
I(1,2,3-cd)p	0.0001	t	0.01	0.02	0.32
HCB	0.001	kg	0.20	0.17	0.20
PCBs	0.0003	kg	0.01	0.01	0.15

3.3.6.4. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends has been carried out.

3.3.6.5. Source-Specific Planned Improvements

Separate emission calculations for 1A4ciii sector for the period 1990-2002. These emissions are included under 1A4cii sector in this submission.

More detailed emission calculations for other non-road machinery sectors which are based on Tier 2 method. The improvements to be carried out in the inventory methodology will depend on how possible it is to attain detailed information from Statistics Estonia and other authorities.

3.3.7. International Maritime Navigation (NFR 1A3di(i))

3.3.7.1. Source Category Description

International maritime navigation comprise the carriage of goods and passengers in sea-going vessels and cover vessels of all flags engaged in international water-borne navigation. Emissions from international navigation are reported as a memo item and are not included in the national totals.



(Photo on the left: Tallinn Passenger Terminal)

In general, the total energy use in the international maritime navigation sector has fluctuated

throughout the time series. The total fuel consumption in this sector increased by 78.3% between 1990 and 2017. As of 2012, a significant increase in fuel consumption is apparent: fuel consumption is more than twice higher (7 838 to 16 665 TJ) compared to 2011. This can be explained by the structural changes in the statistical information collection by Statistics Estonia – since 2012, data for imports and exports also include re-exports data.

As emission levels depend upon the amount of fuel being used, emissions from the international maritime navigation sector show trends similar to those for fuel consumption. Emissions of nitrogen oxides, non-methane volatile compounds, and carbon monoxide have increased by approximately 69.5%, 82.7%, and 79.2% in comparison to 1990's figures. Therefore, emissions from maritime transport are an increasing concern. However, sulphur oxide emissions have decreased by 23.6% during the same period due to stringent measures having been adopted by the IMO in relation to sulphur content in marine fuels. The dominant fuel in this sector is bunker fuel oil. But recent years have shown a rise in marine diesel and gas oil consumption at the expense of bunker fuel oil. Therefore a decrease in SO₂ emissions has occurred, since marine diesel and gas oil has a lower sulphur content in fuel. Detailed emissions data are provided in [Table 3.67](#).

According to Statistics Estonia, in 2017, compared to 2016, the number of passengers served by Estonian ports increased by 3% and the freight volume of ports in tonnes increased by 3%. Therefore, a similar trend can be seen in emissions. In 2017, emissions from the international maritime navigation sector have increased compared to 2016. This decrease in emissions occurred due to higher fuel consumption in 2017 (14.5%). The emissions of NO_x, NMVOC, SO_x and CO increased by 15.8%, 14.4%, 23.0% and 14.7% respectively during the same period.

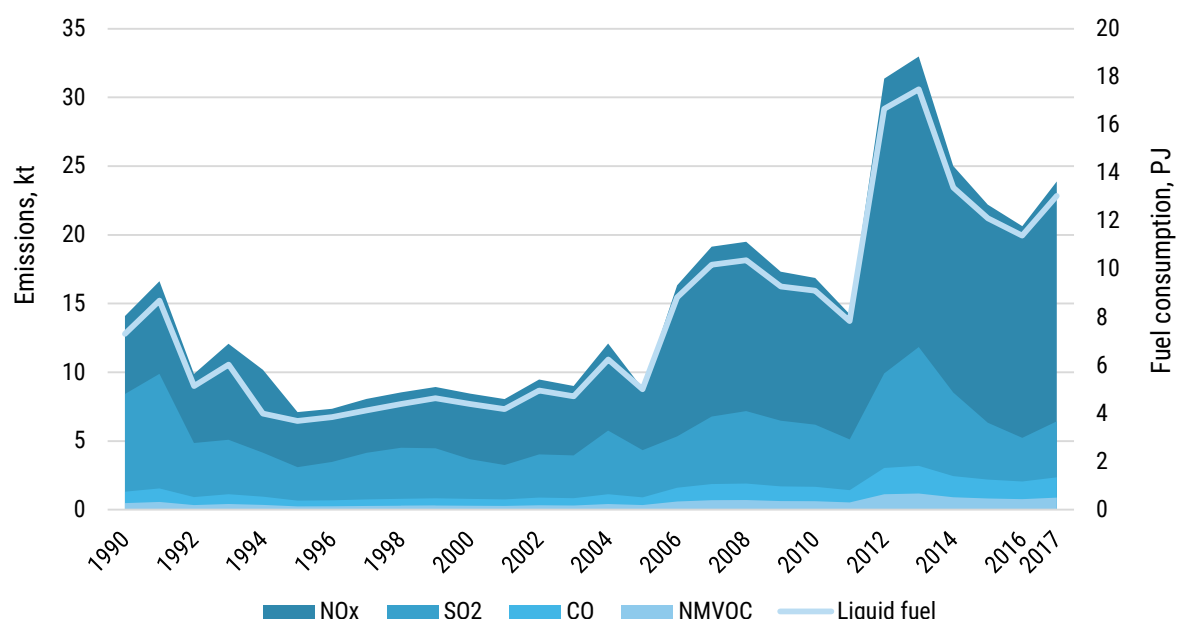


Figure 3.49 NO_x, NMVOC, SO_x and CO emissions from the international navigation sector

Table 3.67 Emissions from the international maritime navigation sector in the period of 1990-2017

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb	Cd
	kt									t	
1990	14.094	0.483	8.424	NE	NR	NR	0.977	NR	1.317	0.031	0.003
1995	7.105	0.247	3.100	NE	NR	NR	0.370	NR	0.666	0.014	0.001
2000	8.452	0.293	3.678	NE	0.423	0.466	0.466	0.062	0.792	0.017	0.002
2005	8.810	0.345	4.338	NE	0.491	0.522	0.522	0.071	0.903	0.020	0.002
2006	16.330	0.602	5.340	NE	1.023	1.110	1.110	0.135	1.606	0.037	0.004
2007	19.140	0.697	6.784	NE	1.283	1.397	1.397	0.163	1.872	0.044	0.005
2008	19.496	0.708	7.180	NE	1.355	1.477	1.477	0.168	1.909	0.045	0.005
2009	17.319	0.633	6.480	NE	1.220	1.329	1.329	0.151	1.702	0.041	0.004
2010	16.864	0.623	6.192	NE	1.173	1.274	1.274	0.147	1.672	0.040	0.004
2011	14.218	0.535	5.118	NE	0.975	1.055	1.055	0.124	1.428	0.034	0.004
2012	31.365	1.130	9.922	NE	1.934	2.112	2.112	0.256	3.041	0.070	0.007
2013	32.975	1.182	11.840	NE	2.244	2.455	2.455	0.281	3.197	0.076	0.008
2014	25.009	0.910	8.530	NE	1.637	1.783	1.783	0.210	2.449	0.057	0.006
2015	22.197	0.822	6.334	NE	1.268	1.371	1.371	0.177	2.198	0.049	0.005
2016	20.631	0.772	5.232	NE	1.081	1.163	1.163	0.160	2.057	0.044	0.004
2017	23.884	0.883	6.434	NE	1.307	1.413	1.413	0.187	2.361	0.052	0.005
trend 1990-2017, %	69.5	82.7	-23.6	NE	209.1	203.1	44.6	202.6	79.2	68.8	59.9

Table 3.67 continues

Year	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/F	HCB	PCBs
	t							g I-TEQ	kg	
1990	0.004	0.104	0.110	0.213	4.859	0.034	0.214	0.074	0.023	0.087
1995	0.002	0.036	0.038	0.098	1.640	0.015	0.108	0.029	0.010	0.030
2000	0.003	0.046	0.049	0.118	2.122	0.018	0.128	0.036	0.012	0.039
2005	0.003	0.054	0.058	0.136	2.509	0.021	0.146	0.042	0.014	0.046
2006	0.005	0.119	0.126	0.255	5.549	0.041	0.260	0.087	0.028	0.100
2007	0.005	0.152	0.161	0.305	7.135	0.050	0.304	0.108	0.034	0.128
2008	0.005	0.163	0.172	0.315	7.636	0.052	0.310	0.114	0.035	0.136
2009	0.005	0.147	0.156	0.282	6.895	0.047	0.276	0.103	0.031	0.123
2010	0.005	0.140	0.149	0.275	6.581	0.045	0.271	0.099	0.030	0.118
2011	0.004	0.116	0.123	0.232	5.432	0.038	0.232	0.083	0.026	0.097

Year	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/F	HCB	PCBs
	t							g I-TEQ	kg	
2012	0.009	0.224	0.238	0.482	10.486	0.077	0.493	0.164	0.052	0.189
2013	0.009	0.268	0.284	0.525	12.584	0.086	0.518	0.189	0.058	0.225
2014	0.007	0.193	0.205	0.395	9.042	0.064	0.397	0.139	0.043	0.162
2015	0.007	0.143	0.152	0.337	6.652	0.052	0.356	0.108	0.036	0.120
2016	0.007	0.118	0.126	0.306	5.455	0.046	0.334	0.093	0.032	0.099
2017	0.008	0.145	0.155	0.357	6.736	0.055	0.383	0.112	0.038	0.122
trend 1990-2017, %	95.8	40.0	40.5	68.1	38.6	58.9	79.2	50.2	62.8	40.4

3.3.7.2. Methodological Issues

All the emission calculations are based on the Tier 1 method for the period of 1990–2004. Detailed activity data (annual number of vessels per vessel category) is available from 2005. Therefore, detailed emission calculations for NO_x, NMVOC and PM from hotelling and manoeuvring of the ships are included in the submission from 2005.

Emission calculations from hotelling and manoeuvring activities are calculated by using statistical data, such as the number of vessels and vessel size per category (see [Table 3.70](#) and [Table 3.71](#)). Although there are no activity data available at the level required by the Tier 3 methodology, adjustments, suggested by the EMEP/EEA Guidebook 2016 (e.g. engine size and technology, power installed or fuel use, hours in different activities), have been made.

Cruise emissions are calculated by the Tier 1 method, where the statistical fuel consumption (see [Table 3.72](#)) is multiplied by respective emission factors (see [Table 3.68](#)). Default emission factors for the main pollutants and heavy metals are taken from the EMEP/EEA Guidebook 2016.

SO₂ emissions are dependent on fuel consumption and fuel type. SO₂ emissions are calculated by multiplying statistical fuel use (see

[Table 3.72](#)) by emission factors (see [Table 3.69](#)). SO₂ emissions are estimated based on the assumption that all sulphur in the fuel is completely converted into SO₂. Equation:

$$E_{SO_2} = 20 \times k \times FC$$

Table 3.68 Emission factors for the international maritime navigation sector, (kg/t)

Pollutant	Unit	Bunker fuel oil	Marine diesel oil
		Value	Value
NO _x	kg/t	79.3	78.5
NMVOC	kg/t	2.7	2.8
PM _{2.5}	kg/t	5.6	1.4
PM ₁₀	kg/t	6.2	1.5
TSP	kg/t	6.2	1.5
BC	kg/t	0.672	0.434
CO	kg/t	7.4	7.4
Pb	g/t	0.18	0.13
Cd	g/t	0.02	0.01
Hg	g/t	0.02	0.03
As	g/t	0.68	0.04
Cr	g/t	0.72	0.05
Cu	g/t	1.25	0.88
Ni	g/t	32	1
Se	g/t	0.21	0.1
Zn	g/t	1.2	1.2
PCDD/F	TEQµg /tonne	0.47	0.13
HCB	mg/t	0.14	0.08
PCBs	mg/t	0.57	0.038

Table 3.69 Sulphur content of fuel (by weight)

	1990	2000	2006	2008
Marine diesel oil	0.5%	0.2%		0.1%
Bunker fuel oil	2.7%		1.5%	

Table 3.70 Number of vessels visiting Estonian ports by type of vessel in the period of 2005–2017

Year	Liquid bulk ships	Dry bulk carriers	Container	General cargo	Passenger	Fishing	Other	Total
2005	961	2,026	495	1,466	10,581	2	9	15,540
2006	1,121	2,017	444	1,724	9,931	0	3	15,240
2007	1,004	2,061	435	1,825	9,088	0	30	14,443
2008	753	1,910	428	1,787	7,323	27	9	12,237
2009	886	1,384	399	1,702	5,831	54	15	10,271
2010	970	1,688	338	1,654	6,201	0	32	10,883
2011	1,092	1,789	318	1,870	6,251	2	18	11,340
2012	1,044	1,612	435	1,884	6,469	1	27	11,472
2013	1,051	1,455	382	2,384	5,878	1	34	11,185
2014	1,173	1,319	362	2,347	5,809	0	11	11,021
2015	819	1,007	359	2,653	6,303	0	4	11,145
2016	900	876	374	2,721	6,533	0	6	11,410
2017	904	1000	350	2731	6,495	0	32	11,512

Table 3.71 Gross tonnage of vessels visiting Estonian ports by type of vessel in the period of 2005–2017 (thousand)

Year	Liquid bulk ships	Dry bulk carriers	Container	General cargo	Passenger	Fishing	Other	Total
2005	21,677	8,704	3,131	9,880	114,704	24	11	158,132
2006	20,751	10,382	2,698	12,623	115,955	0	2	162,410
2007	18,911	8,352	3,073	13,948	131,809	0	26	176,119
2008	16,699	5,543	3,158	13,489	158,100	3	9	197,001
2009	18,881	7,426	4,262	13,673	157,074	9	25	201,350
2010	21,316	7,237	4,045	14,505	164,731	0	61	211,895
2011	23,658	7,203	3,223	27,962	168,999	0	19	231,063
2012	21,046	6,633	4,976	24,424	179,017	0	37	236,133
2013	21,102	5,875	4,896	35,152	191,938	0	1,019	259,982
2014	21,767	5,479	5,512	27,750	189,853	0	13	250,374
2015	15,058	4,715	4,989	29,621	195,666	0	7	250,056
2016	13,617	4,711	5,664	30,047	205,522	0	10	259,571
2017	13,768	5,421	5,126	31,618	223,137	0	98	279,168

Table 3.72 Fuel consumption in the international maritime navigation sector in the period of 1990-2017 (TJ)

Year	Bunker fuel oil	Marine diesel oil/ Marine gas oil	Total
1990	6,172	1,145	7,317
1995	2,008	1,690	3,698
2000	2,605	1,788	4,393
2005	3,087	1,917	5,004
2006	6,904	1,921	8,825
2007	8,904	1,289	10,193
2008	9,563	813	10,376
2009	8,644	639	9,283
2010	8,216	898	9,114
2011	6,809	1,029	7,838
2012	13,042	3,623	16,665
2013	15,744	1,738	17,482
2014	11,279	2,116	13,395
2015	8,230	3,892	12,122
2016	6,705	4,695	11,400
2017	8,311	4,738	13,049

3.3.7.3. Uncertainty

No uncertainty estimation for international maritime navigation has been carried out.

3.3.7.4. Source-Specific QA/QC and Verification

Common statistical quality control related to the assessment of trends has been carried out.

3.3.7.5. Source-Specific Planned Improvements

There are currently no improvements planned for this sector.

3.4. Fugitive Emissions (NFR 1B)

3.4.1. Overview of the Sector

Under fugitive emissions from fuels, Estonia reports on NMVOC, TSP, PM₁₀, PM_{2.5}, BC, CO, NH₃, NO_x, SO₂ and HMs emissions from the following activities:



(Photo on the left: Muuga Terminal; source: www.portoftallinn.com)

Table 3.73 Fugitive emissions activities

NFR	Source	Description	Emissions reported
1B	Fugitive emissions from fuel		
1c	Other fugitive emissions from solid fuels	Includes emissions from open oil shale mining activity, mainly explosive works. Only point sources data.	SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , CO
1b	Fugitive emission from solid fuels: Solid fuel transformation	Includes emissions from coke oven. Only point sources data.	TSP, PM ₁₀ , PM _{2.5} , BC, CO, Cr
2aiv	Refining / storage	Includes emissions from product process and storage and handling in oil shale oil industry. Only point sources data.	NO _x , SO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , CO
2av	Distribution of oil products	Includes emissions from liquid fuel distribution. Data of point and diffuse sources.	NMVOC
2b	Natural gas	Includes emissions from gas distribution networks. Only diffuse sources data.	NMVOC
2c	Venting and flaring	Waste gas incineration. Only two point sources data.	NO _x , SO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , BC, CO, Pb, Cu, Cr, Ni, Zn, PCDD/F, PAHs

NMVOC emissions from this sector contribute about 5% to total national emissions and have decreased by about 54% up to 2017 compared to 1990 due to decreasing emissions from terminals and also has slightly decreased (by 6%) in comparison with 2016 due to the same reason (see [Figure 3.50](#), [Figure 3.52](#) and [Table 3.75](#)). Emissions of other pollutants are very small compared to the emissions from the other sectors (see [Table 3.74](#)).

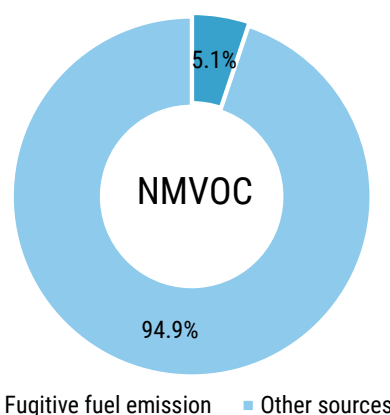


Figure 3.50 NMVOC emission distribution in 2017

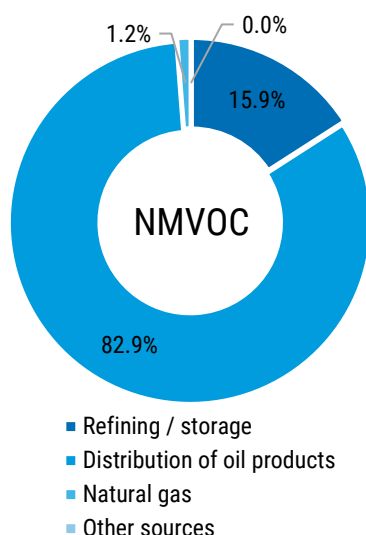


Figure 3.51 NMVOC emission distribution within the fuel fugitive emission sector in 2017

Figure 3.51 shows that the distribution of oil products is a main source of NMVOC emissions in the fuel fugitive emissions sector (86%).

Table 3.74 Fugitive emission in the period of 1990-2017(kt)

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	NA	2.474	NA	NA	NR	NR	NR	NR	NA
1995	NA	1.632	NA	NA	NR	NR	NR	NR	NA
2000	0.010	4.326	NA	0.010	0.010	0.050	0.110	NA	0.200
2005	0.010	4.284	NA	0.050	0.010	0.090	0.180	NA	0.170
2006	0.010	3.516	NA	0.060	0.010	0.110	0.220	NA	0.250
2007	0.010	1.922	0.010	0.090	0.010	0.090	0.180	NA	0.220
2008	0.017	1.593	0.013	0.102	0.014	0.102	0.202	NA	0.276
2009	0.036	1.684	0.026	0.089	0.031	0.142	0.267	0.0001	0.168
2010	0.035	1.818	0.018	0.115	0.034	0.170	0.309	0.0002	0.188
2011	0.032	2.179	0.076	0.175	0.042	0.187	0.351	0.0002	0.813
2012	0.019	1.824	0.038	0.212	0.051	0.182	0.329	0.0001	2.011
2013	0.024	1.471	0.051	0.192	0.021	0.103	0.190	0.0003	1.353
2014	0.025	1.366	0.038	0.191	0.020	0.096	0.187	0.0002	1.028
2015	0.024	1.186	0.032	0.196	0.018	0.090	0.181	0.0001	0.183
2016	0.020	1.215	0.024	0.142	0.014	0.069	0.132	0.0001	0.142
2017	0.026	1.144	0.029	0.168	0.014	0.077	0.151	0.0003	0.171
trend 1990-2017, %		-53.8		1 577.0	40.0	54.8	37.5		-14.5

The emission data for 1B1c Other fugitive emissions from solid fuels (mainly explosive works in the open oil shale mining industry), 1B2aiv Refining/storage and 1B2c Venting and flaring are obtained from the point sources database. Emissions are calculated on the basis of measurements, or the combined method (measurements plus calculations) is used.

3.4.2. Distribution of Oil Products (NFR 1B2av)

3.4.2.1. Source Category Description

In the past, emissions from this source category have contributed significantly to total anthropogenic NMVOC emissions. However, European Directive 94/63/EC (EU, 1994) has mandated vapour collection and recovery during the loading of gasoline transport equipment (i.e. tank trucks, rail tank cars and barges) and during the discharge of tank trucks into storage at service stations. It has also imposed emission controls on all gasoline storage tanks at

terminals, dispatch stations and depots. The result of these controls has been a very significant reduction in NMVOC emissions from this sector in the EU.



(Photo by Ilmar Saabas)

Emissions of NMVOCs into the atmosphere occur in nearly every element of the oil product

distribution chain. The vast majority of emissions occur during the storage and handling of gasoline due to its much higher volatility compared to other fuels such as gasoil, kerosene, etc.

In Estonia, oil terminals and service stations must have permits when the total loading turnover exceeds 10 000 m³ per year⁵ (before 2017 was 2000 m³ per year). That means the smallest service stations are regarded as diffuse sources. Emissions from oil terminals are based only on the facilities data. 23 terminals presented reports on emissions in 2017. In the table below NMVOC emissions from gasoline distribution and terminals are presented.

Table 3.75 NMVOC emissions from liquid fuel distribution in the period of 1990-2017 (kt)

	1990	1995	2000	2005	2006	2007	2008	2009
Gasoline distribution	2.055	0.971	1.108	0.467	0.482	0.514	0.508	0.467
Terminals	0.323	0.625	3.157	3.199	2.626	1.2	0.629	0.799
	2010	2011	2012	2013	2014	2015	2016	2017
Gasoline distribution	0.447	0.478	0.511	0.46	0.427	0.397	0.404	0.426
Terminals	0.644	1.265	0.854	0.74	0.737	0.594	0.642	0.521

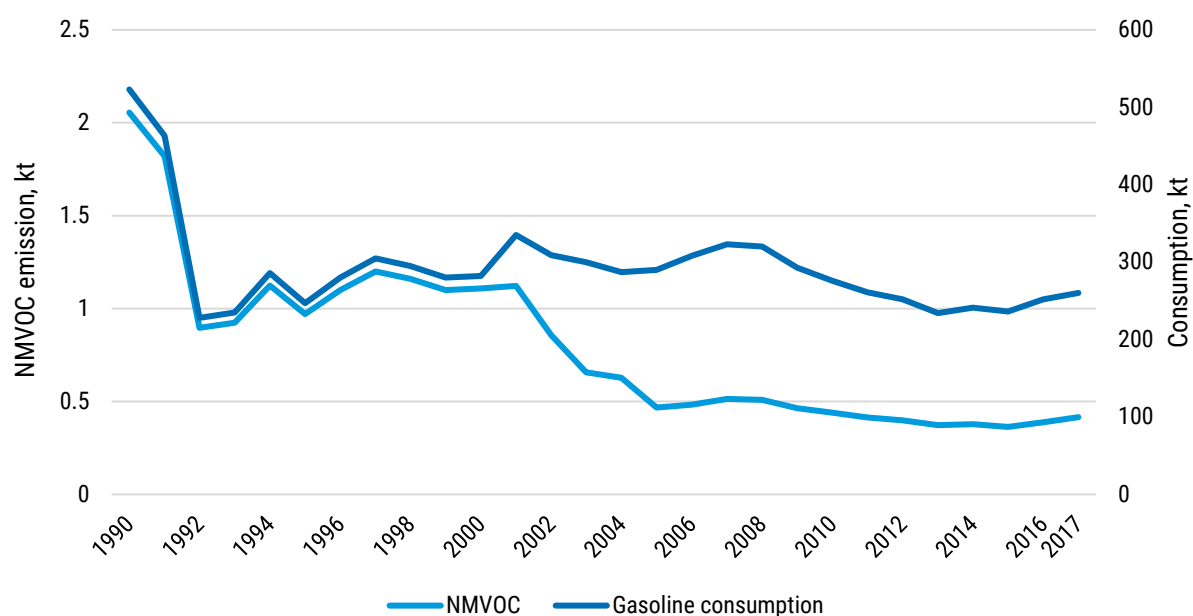


Figure 3.52 NMVOC emission and gasoline distribution in the period of 1990-2017

⁵ Emission levels of pollutants and capacities of plants used, beyond which an ambient air pollution and special pollution permit are required. Regulation No. 67 of the Minister of Environment of 14 December 2016. <https://www.riigiteataja.ee/akt/122122016005>

European Directive 94/63/EC has mandated vapour collection and recovery for the discharge of tank trucks into storage at service stations (Stage 1.B). In Estonia, the regulation on implementation of the requirements of the EU Directive 94/63/EC came into force in 1998.

The timetable for the implementation of Stage 1.B vapour collection and recovery equipment according the requirements is the following:

- from 1 January 2001 for existing service stations with a turnover over 1000 m³ and all others situated in densely populated or industrial areas;
- from January 2004 for service stations with a turnover over 500 m³;
- from January 2005 for service stations with a turnover over 100 m³.

3.4.2.2. Methodological Issues

EMEP/CORINAIR methodology is used to estimate fugitive NMVOC emissions from operations with gasoline in the period 1990-2004.

From 2005, facilities data are used in emission estimates (about 80% from total gasoline distribution in 2016 and only 23% 2017 after changes were made in the legislation concerning the total loading turnover, Chapter 3.4.2.1). Facilities are obligate to use the national method for NMVOC emission calculation [Naftasaaduste laadimisel välisõhku väljutatavate lenduvate orgaaniliste ühendite heidete arvutusliku määramise meetodid - Elektroonline Riigi Teataja](#)

In the period 2005-2017, activity data relating to point sources is available and activity data for emission calculations from diffuse sources is calculated using the following method:

$$\text{Gasoline distribution in diffuse sources} = \text{total gasoline consumption} - \text{gasoline distribution in point sources}$$

Emission factors for diffuse sources

As the situation regarding the requirements of vapour recovery equipment has changed over the

years, different emission factors are used for different periods.

1) For the period 1990-2000. the emission factor from Corinair 2007 is applied (3930 g NMVOC/Mg of total gasoline handled);

- For 2001 – 3350 g/Mg;
- For 2002 – 2770 g/Mg;
- For 2003–2004 – 2190 g/Mg.

2) For the period 2005-2017, the Tier 2 technology specific emission factors for Service Stations from the EMEP/EEA Guidebook 2016 is applied. As the majority of the emissions at service stations are from gasoline storage and refuelling (compared to emissions from gasoil), emission factors are only provided for gasoline.

Abatement

In the previous chapter, the Stage 1.B abatement technology requirement is described. The resulting emission can be calculated by replacing the technology specific emission factor with an abated emission factor as given in the formula:

$$EF_{\text{technology.abated}} = (1 - \eta_{\text{abatement}}) \times EF_{\text{technology.unabated}}$$

The Abatement efficiencies ($\eta_{\text{abatement}}$) for source category 1B2av Distribution of oil products. Service stations. Storage tank filling from the EMEP/EEA Guidebook 2016 is applied (default value is 95%).

The emission factors depend on the True Vapour Pressure (TVP). This pressure is the vapour pressure at loading, and it depends on the loading temperature. The definition of the TVP is as follows:

$$TVP = RVP \cdot 10^{AT+B}$$

where

A = 0.000007047 RVP + 0.0132 and B = 0.0002311 RVP - 0.5236. T is the temperature (in °C) and RVP is the Reid Vapour Pressure (in kPa).

The annual average loading temperature at terminals can be assumed to equal the average annual ambient temperature.

The annual average temperature in Estonia is equal to 5 °C⁶.

The RVP for gasoline (gasoline 95) in Estonia according to the Register of Fuel Monitoring in the period 2005-2015 is presented in the following [Table 3.76](#).

Table 3.76 Annual average RVP of gasoline 95 in Estonia in the period 2005-2015

Year	Annual average RVP, kPa
2005	72.3
2006	75.8
2007	74.8
2008	75.3
2009	74.5
2010	75.3
2011	76.9
2012	75.5
2013	73.8
2014	73.0
2015	72.8
Average	74.6

RVP for gasoline is up to 74.6 kPa.

$$TVP = 74.6 \times 10^{(0.000007047 \times 74.6 + 0.0132) \times 5 + (0.0002311 \times 74.6 - 0.5236)} = 27.2 \text{ kPa}$$

Consequently, an average true vapour pressure for gasoline is 27.2 kPa (5 °C).

One integrated emission factor representing all activities in the small service station is calculated for emission calculations.

Table 3.77 Total Tier 2 emission factor for emissions from gasoline handling in service stations

Category	Emission source	NMVOC emission factor, g/m ³ throughput/kPa TVP	Abatement efficiency (η _{abatement}), %	True Vapour Pressure (TVP), kPa	NMVOC emission factor for gasoline, g/m ³ throughput
Gasoline in service stations	Storage tank Filling with no Stage 1.B	24	95%	27.2	33
	Storage tank Breathing	3	-	27.2	82
	Automobile refuelling with no emission controls in operation	37	-	27.2	1006
	Automobile refuelling Drips and minor spillage	2	-	27.2	54
	Emission factor for all the activities total	66	-	-	1175

⁶ Estonian Weather Service (<http://www.ilmateenistus.ee/?lang=en>)

Activity data

Activity data on the subject of gasoline consumption is available from Statistics Estonia (see [Table 3.78](#)).

Table 3.78 Consumption of motor gasoline in the period of 1990-2017 (kt)

Year	Gasoline consumption
1990	523
1995	247
2000	282
2005	290
2006	308
2007	323
2008	320
2009	293
2010	276
2011	261
2012	252
2013	234
2014	241
2015	236
2016	252
2017	260

3.4.2.3. Source-Specific QA/QC and Verification

Statistical quality checking related to the assessment of emission, activity data and trends has been carried out.

3.4.2.4. Source-Specific Planned Improvements

There are currently no improvements planned for this sector.

3.4.3. Natural Gas (NFR 1B2b)

3.4.3.1. Source Category Description

The term “fugitive emissions” is broadly applied here to mean all greenhouse gas emissions from gas systems, except contributions from fuel combustion. Natural gas systems comprise all

infrastructure required to produce, collect, process or refine and deliver natural gas and petroleum products to the market. The system begins at the wellhead, or oil and gas source, and ends at the final sales point to the consumer.



(Photo: Natural gas distribution; source: www.delfi.ee)

The sources of fugitive emissions on gas systems include, but are not limited to, equipment leaks, evaporation and flashing losses, venting, flaring, incineration and accidental releases (e.g. pipeline dig-ins, well blow-outs and spills). While some of these emission sources are engineered or intentional (e.g. tank, seal and process vents, and flare systems), and therefore relatively well characterized, the quantity and composition of the emissions is generally subject to significant uncertainty.

Natural gas is imported into Estonia from Russia and from the Inčukalns underground gas storage in Latvia (see [Figure 3.53](#)).

The Estonian gas transmission network was built between 1951 and 2006, and is part of the former Soviet Union’s transmission network. The construction of the natural gas pipeline to the towns of Pärnu and Sindi was completed in 2006. The natural gas pipelines also reached customers in the county town of Rapla and the town of Püssi.⁷

Estonia has operational interconnections with the Russian natural gas network in Värskä, and with Latvia in Karksi, with a maximum capacity of 11 mcm/d.

The gas network in Estonia is 2.314 km long, of which 878 km are for transmission and 1.436 km

⁷ Eesti Gaas. Annual Report 2006

for distribution. There are three GMSs in Värskas, Karksi and Misso and 36 gas distribution stations. The system is owned by Eesti Gaas AS, and operated by EG Võrguteenus, which provides transmission and distribution services, and operates the gas metering systems on the Estonian border. Eesti Gaas AS owns the entire gas transmission and distribution system and

supplies gas to all the wholesale markets and the majority of the retail markets. The only exception is the large chemical industry Nitrofert, a Kohtla-Järve company producing mineral fertilisers, which imports gas for its own use⁸. Nitrofert halted operations since 2014.



Figure 3.53 Map of high-pressure gas distribution pipelines in Estonia

The gas pipeline passes through ten counties: Ida-Viru, Lääne-Viru, Harju, Rapla, Jõgeva, Tartu, Põlva, Võru, Viljandi and Pärnu. There are gas consumers in every county.

The main reason for the reduction of NMVOC emissions in 2017 compared to 1990 is a decrease in gas consumption over the same period (see [Table 3.79](#), [Table 3.82](#) and [Figure 3.54](#)).

Table 3.79 NMVOC emissions from gas distribution in the period of 1990-2017 (kt)

	1990	1995	2000	2005	2006	2007	2008	2009	
NMVOC	0.096	0.036	0.031	0.028	0.028	0.028	0.027	0.018	
	2010	2011	2012	2013	2014	2015	2016	2017	1990-2017, %
NMVOC	0.019	0.018	0.019	0.019	0.015	0.013	0.014	0.0138	-85.6

⁸ Estonia 2013. Energy Policies Beyond IEA Countries. OECD/IEA 2013

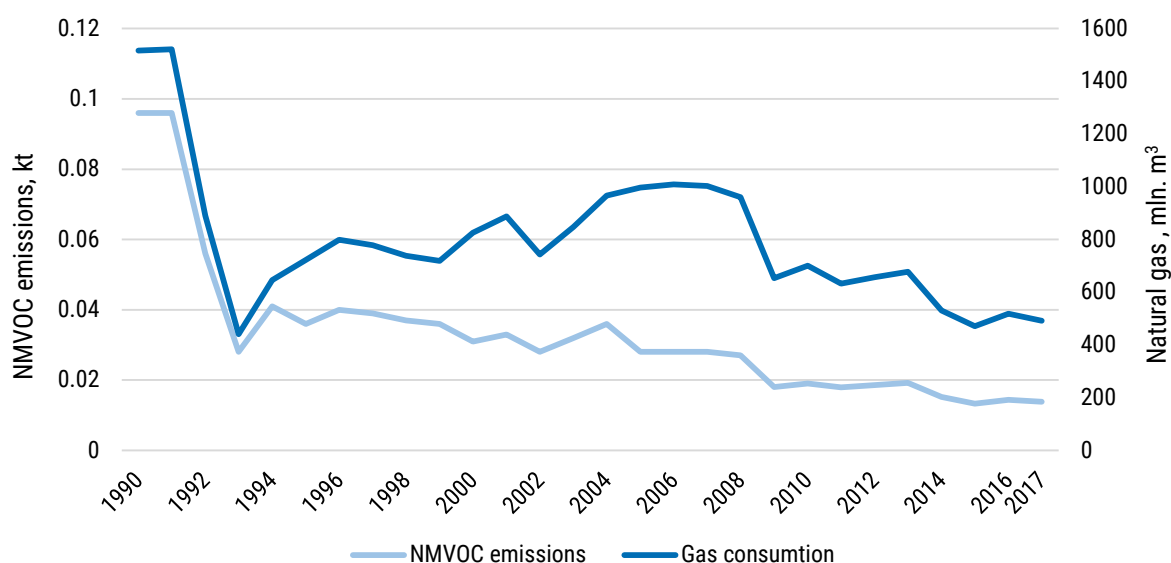


Figure 3.54 NMVOC emission from natural gas distribution in the period of 1990-2017

3.4.3.2. Methodological Issues

Emission factors

For NMVOC calculations from gas distribution the IPCC Guidelines for National Greenhouse Gas Inventories (2006) are used.

Tier 1 emission factors are used (Equation 1).

The activity rate for this sector is natural gas consumption. Unit: million m³.

Emission factor unit: Gg per 10⁶ of marketable gas/Utility sales.

The available default emission factors are presented below in [Table 3.80](#) and [Table 3.81](#). While some types of fugitive emissions correlate poorly with, or are unrelated to, throughput on an individual source basis (e.g. fugitive equipment leaks), the correlations with throughput become more reasonable when large populations of sources are considered. Furthermore, throughput statistics are the most consistently available activity data for use in Tier 1 calculations.

Table 3.80 Tier 1NMVOC emission factors for fugitive emissions (including venting and flaring) from gas operations

Category	Sub-category	Emission source	IPCC Code	Developed countries		Developing countries and countries with economies in transition		Units of measure
				Value	Uncertainty value (% of value)	Value	Uncertainty value (% of value)	
Gas transmission & Storage	Transmission	Fugitives	1.B.2.b	7.0E-06	+100%	7.0E-06 to 1.6E-05	-40 to +250%	Gg per 10 ⁶ m ³ of marketable gas
		Venting	1.B.2.b	4.6E-06	+75%	4.6E-06 to 1.1E-05	-40 to +250%	Gg per 10 ⁶ m ³ of marketable gas
Gas Distribution	All	All	1.B.2.b	1.6E-05	-20 to +500%	1.6E-05 to 3.6E-5	-20 to +500%	Gg per 10 ⁶ m ³ of utility sales

Table 3.81 Tier 1 emission factors for fugitive emissions (including venting and flaring) from gas operations for different years

Category	Sub-category	Emission source	IPCC Code	1990	1995	2000	2005-2016	Units of measure
Gas transmission & Storage	Trans-mission	Fugitives	1.B.2.b	1.6E-05	1.3E-05	9.6E-06	7.0E-06	Gg per 10 ⁶ m ³ of marketable gas
		Venting	1.B.2.b	1.1E-05	8.7E-06	6.4E-06	4.6E-06	Gg per 10 ⁶ m ³ of marketable gas
Gas Distribution	All	All	1.B.2.b	3.6E-05	2.9E-05	2.2E-05	1.6E-05	Gg per 10 ⁶ m ³ of utility sales
Total	-	-	-	6.3E-05	5.0E-05	3.8E-05	2.8E-05	Gg per 10 ⁶ m ³ of utility sales

The Estonian economy up to 2004 can be classified as an economy in transition. The emission factors are chosen accordingly. For the transition period from 1990 to 2004, the emission factor for countries with economies in transition is used. It is expected that the emissions have decreased equally within this period.

Activity data

Activity data on the subject of annual natural gas consumption are available from Statistics Estonia (see [Table 3.82](#)).

Table 3.82 Gas consumption in the period 1990-2017 (mln m³)

	1990	1995	2000	2005	2006	2007	2008	2009	
Gas consumption	1,516	723	826	997	1,009	1,003	961	653	
	2010	2011	2012	2013	2014	2015	2016	2017	1990-2017, %
Gas consumption	701	632	657	678	530	471	518	492	-67.5

3.4.3.3. Uncertainty

An uncertainty analysis was carried out to the year 2017 inventory. The uncertainty in the emission factors for main pollutants from fugitive

emission sector is estimated in the range from 20% to 100%; in the activity data in the range from 2% to 50%. Uncertainty estimates for fugitive emission sector are given in [Table 3.83](#).

Table 3.83 Uncertainties in fugitive emission sector

Pollutant	Emission, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	0.026	kt	0.08	0.04%	0.02%
NM VOC	1.144	kt	5.14	2.13%	0.11%
SO _x	0.029	kt	0.08	0.01%	0.00%
NH ₃	0.168	kt	1.64	0.82%	0.39%
PM _{2.5}	0.014	kt	0.15	0.10%	0.05%
PM ₁₀	0.077	kt	0.56	0.44%	0.13%
TSP	0.151	kt	0.77	0.63%	0.04%
CO	0.171	kt	0.12	0.12%	0.07%

3.4.3.4. Source-specific QA/QC and Verification

Statistical quality checking related to the assessment of emission, activity data and trends has been carried out.

3.4.3.5. Source-specific Planned Improvements

- To check of point sources data for NFRs 1B1b,c and 1B2aiv regarding correctness of SNAP codes.
- To check the emission factors for NFR 1B2b.



Kunda Nordic Tsement (Source: www.knc.ee)

4. INDUSTRIAL PROCESSES AND PRODUCT USE (NFR 2)

4.1. Industrial Processes

4.1.1. Source Category Description

In Estonia, the share of the industrial sector in the economy is nearly as big as the EU average based on value added (approx. 15%). The situation of the manufacturing industry improved in 2017 together with the general increase of economic activity. Production volume grew at the fastest pace of recent years, manufacture increased in nearly all fields, the economic indicators of the sector improved. Enterprises expect the growth to continue in 2018. According to preliminary data, the production volume of the manufacturing industry grew by 3.5% in 2017. Preliminary data show that in 2017, Estonian manufacturing companies produced 6.5% more output than the year before. Biggest contribution to the growth

came from the wood and metal industries, whereas a bigger drop in output could be seen in the electronics industry.⁹

The main activities in the industrial processes sector in Estonia are the paper, wood and chemical industries as well as the production of mineral products and food. The industry has undergone major changes since 1990. The industrial sector's share of total emissions is no longer as significant as it used to be. This is mainly due to a decrease in production volume; also, some enterprises have ceased operating (phosphor fertilizers, benzene and toluene).

The Estonian inventory of air pollutants from industrial processes presently includes emissions from the chemical, pulp, paper, metal, metal and mineral products industries, as listed in [Table 4.1](#).

Table 4.1 Industrial processes reporting activities

NFR	Source	Description	Emissions reported
2A	Mineral Products		
2A1	Cement production	Includes emissions from cement production. Data reported by one operator. 5 operators of concrete production	TSP, PM ₁₀ , PM _{2.5} , BC
2A2	Lime production	Includes emissions from lime production. Data reported by one operator.	TSP, PM ₁₀ , PM _{2.5} , BC
2A3	Glass production	Particles emissions from this sector are allocated to 1A2f.	IE
2A5a	Quarrying and mining of minerals other than coal	Includes emissions from quarrying and mining of limestone and dolomite. Data reported by operators.	NO _x , SO _x , TSP, PM ₁₀ , PM _{2.5} , CO
2A5b	Construction and demolition	Includes emissions from construction and demolition.	TSP, PM ₁₀ , PM _{2.5}
2A6	Other Mineral products	Includes emissions mainly from crushed stone production. Data reported by operators.	NO _x , NMVOC, SO _x , TSP, PM ₁₀ , PM _{2.5} , CO
2B	Chemical industry		
2B10a	Other chemical industry	Includes emission from urea and formaldehyde production. Data reported by two operators.	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , CO, BC

⁹ Overview of economy 2017. The Ministry of Economic Affairs and Communications, the Ministry of Finance. Tallinn 2018

NFR	Source	Description	Emissions reported
2B10b	Storage, handling and transport of chemical products	Includes emission from storage, handling and transport of chemical products. Data reported by operators.	NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC
2C	Metal Production		
2C1	Iron and steel production	Includes emission from Iron and steel production. Data reported by operators.	NO _x , TSP, PM ₁₀ , PM _{2.5} , BC, CO, Cr, Cu, Ni, Zn
2C3	Aluminium production	Includes emission from secondary aluminium production. Data reported by operators.	NMVOC, TSP, PM ₁₀ , PM _{2.5} , BC
2C7a	Copper production	Includes emission from secondary copper production. Data reported by operators.	TSP, PM ₁₀ , PM _{2.5} , BC
2C5	Lead production	Includes emission from lead battery and accumulators recycling plant. Data reported by operators.	SO _x , TSP, PM ₁₀ , PM _{2.5} , Pb
2C6	Zinc production	Includes emission from zinc plating. Data reported by operators.	TSP, PM ₁₀ , PM _{2.5} , Zn
2C7c	Other metal production	Includes emission from galvanizing and electroplating. Data reported by operators.	NO _x , NMVOC, SO _x , NH ₃ , TSP, PM ₁₀ , PM _{2.5} , CO, BC, Pb, Cr, Ni, Zn
2D	Product use		
2D3b	Road paving with asphalt	Includes emissions from road paving with asphalt.	NMVOC, TSP, PM ₁₀ , PM _{2.5} , BC
2H	Pulp, paper and food industries		
2H1	Pulp and paper	Includes emission from pulp, paper and chipboard production. Data reported by operators.	NO _x , NMVOC, SO _x , TSP, PM ₁₀ , PM _{2.5} , BC, CO
2H2	Food and drink	Includes emission from the food and drink industry. Data reported by 15 operators, includes statistical data also.	NO _x , NMVOC, SO _x , TSP, PM ₁₀ , PM _{2.5} , CO
2I	2I	Wood processing	
		Includes emission from wood processing. Data reported by 95 operators.	NO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , CO
2L	2L	Other production, consumption, storage, transportation or handling of bulk products	
		Includes emission from storage and handling of peat, bulk, etc. Data reported by operators.	NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , CO

The Industrial processes sector includes emissions from SNAP 04 activities. Emissions from combustion processes in manufacturing industry are included under NFR 1A2, which are the main sources of emissions from industrial sector.

Emissions data from the manufacturing industry are based on the facilities data (Tier 3 method) and only NMVOC emissions from the food industry and NMVOC, particulates from road paving with asphalt are calculated as diffuse sources on the basis of statistical data and the

EMEP/EEA Guidebook 2016 emission factors (Tier 2 and Tier 1 method).

TSP, PM₁₀ and PM_{2.5} emissions from constructions and demolition are also calculated as diffuse sources (EMEP/EEA Guidebook 2016 Tier 1 method).

BC emissions from industry are calculated for the period 2000–2017.

The share of industry sources in total emissions in 2017 was: NMVOC – 3.6%, PM_{2.5} – 3%, PM₁₀ – 11% and TSP about 25.6%. The shares of other pollutants were not so significant. The emissions

of NMVOC, NH₃ and NO_x have decreased in comparison with 1990 by 94.8%, 84.6% and 70.9%, respectively. The main reason is that during the period of 1990–2017, the production of chemical products fell.

The emissions of PM_{2.5}, PM₁₀ and TSP increased in 2017 compared to 2016 by 29.4%, 18.2% and 21.5%. The growth in construction sector (both, residential and non-residential building) was the cause of increase in emissions of particulates. Emissions of other substances remained approximately at the level of 2016.

The trend of NMVOC and PM emissions in these categories are given in [Figure 4.1](#) and [Figure 4.4](#).

The distribution of NMVOC and PM₁₀ emissions by sources of pollution inside of manufacturing industry sector in 2017 are shown in [Figure 4.2](#) and [Figure 4.3](#). The biggest polluter of NMVOC emissions were Pulp, paper and food industries – 90% (mainly food production), the chemistry industry is responsible for the 5% of emission and share of other activities are not significant. The main polluter of particulates emission is mineral industry (81%, mainly construction and demolition sector).

The pollutants emissions from the industrial sector are presented in [Table 4.2](#).

Table 4.2 Pollutant emissions from the industrial sector in the period of 1990-2017

Year	NO _x	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb
	kt									t
1990	0.190	15.341	NA	0.530	NR	NR	6.172	NR	0.340	NA
1995	0.070	4.379	NA	0.240	NR	NR	1.390	NR	0.000	NA
2000	0.199	2.085	0.040	0.124	0.317	1.031	2.766	0.005	0.530	0.010
2005	0.176	1.569	0.130	0.201	0.582	2.269	6.472	0.009	0.340	NA
2006	0.268	1.299	0.120	0.159	0.624	2.494	7.221	0.009	0.350	0.001
2007	0.250	1.068	0.020	0.135	0.550	2.357	7.071	0.007	0.440	0.001
2008	0.295	0.959	0.020	0.181	0.701	2.788	7.830	0.012	0.477	0.001
2009	0.058	0.881	0.025	0.083	0.367	1.804	5.207	0.005	0.424	0.006
2010	0.037	0.861	0.030	0.070	0.339	1.399	3.981	0.005	0.461	0.014
2011	0.062	0.919	0.022	0.093	0.234	1.208	3.605	0.003	0.420	0.011
2012	0.047	0.909	0.001	0.103	0.197	1.141	3.509	0.002	0.336	0.010
2013	0.200	0.892	0.000	0.162	0.365	1.736	4.988	0.006	0.381	0.011
2014	0.032	0.860	0.001	0.052	0.235	1.336	4.149	0.002	0.413	0.017
2015	0.045	0.809	0.002	0.065	0.231	1.298	4.044	0.002	0.405	0.010
2016	0.045	0.768	0.001	0.071	0.214	1.300	4.147	0.002	0.378	0.011
2017	0.055	0.790	0.000	0.082	0.277	1.537	5.039	0.002	0.451	0.000
trend										
1990-2017, %	-70.9	-94.8	-99.6	-84.6	-12.6	49.0	-18.3	-64.2	32.6	-96.0

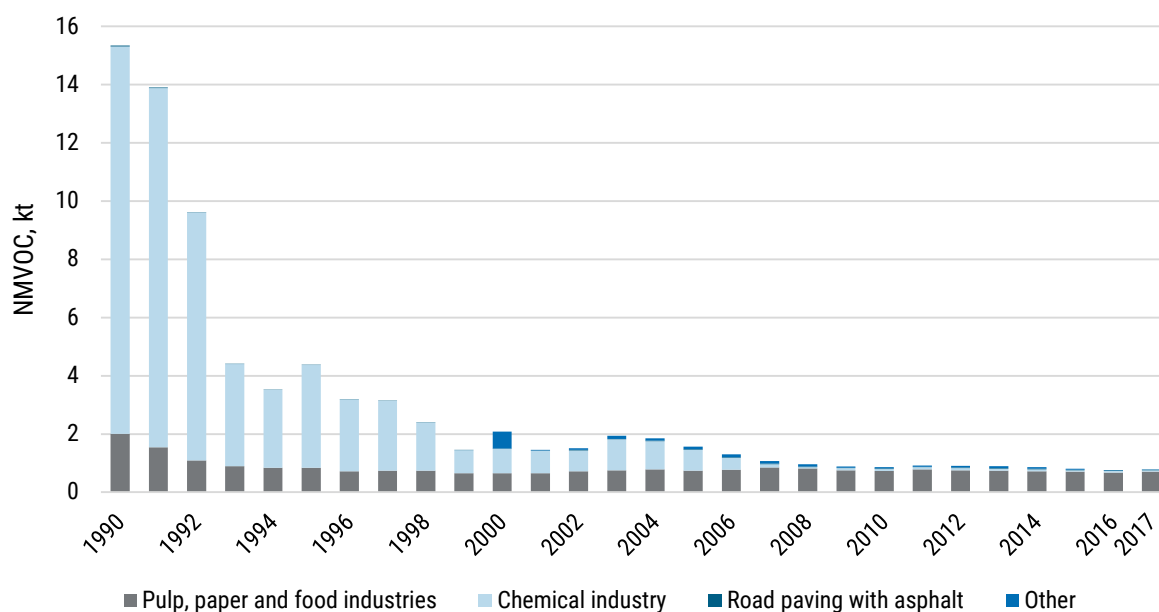


Figure 4.1 NMVOC emissions from the industrial sector in the period of 1990-2017

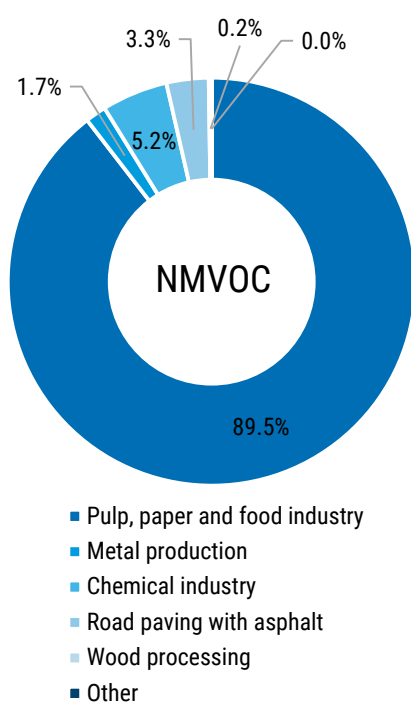


Figure 4.2 Distribution of NMVOC emissions by activities in industry in 2017

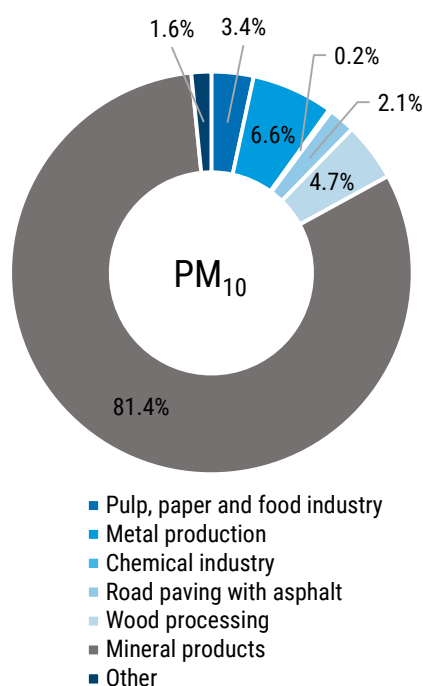


Figure 4.3 Distribution of PM₁₀ emissions by activities in industry in 2017

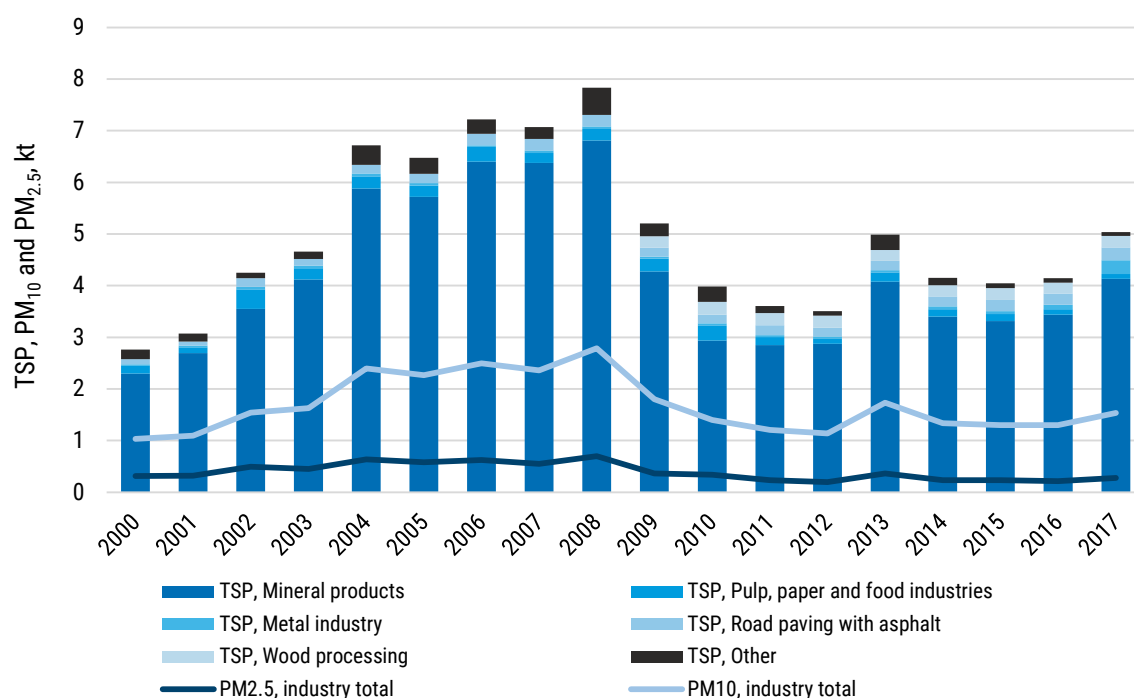


Figure 4.4 Particulates emissions from the industrial sector in the period of 2000-2017

4.1.2. Mineral Products (NFR 2A)

4.1.2.1. Source Category Description

This chapter includes activities data and emissions from the following processes:

- Cement production;
- Lime production;
- Limestone and dolomite use;
- Quarrying and mining of minerals other than coal;
- Construction and demolition;
- Storage, handling and transport of mineral products;
- Other mineral products.

In Estonia, the only enterprise that produces cement is Kunda Nordic Tsement AS. Cement is produced by the standard wet process. The clinker burning process takes place in three rotary kilns. Crushed limestone is blended with prepared clay (raw material contains calcium, aluminium, iron and silica oxides) and heated to about 1450 °C in a kiln. The ingredients react and turn into an intermediate product called clinker, which is then further mixed with gypsum and, in some

cases, limestone, blast furnace slag or fly ash. This mixture is then ground into a fine powder, known as cement, the binding agent of concrete. The production process is energy-intensive, resulting in the emission of CO₂, SO_x, NO_x and dust. During the period 1993-2000, cement manufacturing in Kunda was thoroughly modernised. The main goal was to eliminate dust pollution from clinker kilns and cement mills, which were provided with filters required for exhaust cleaning. In 1999, the company closed the local electricity and heat production plant, which had operated on natural gas. (Sustainability report 2007. Kunda Nordic Tsement AS, 2007).

There are two facilities for lime production, one of which presents an annual report on emissions (Nordkalk AS). The other company's production volumes are very small. In Estonia, Nordkalk excavates Silurian dolomite from the Kurevere quarry. The chemical composition of this 400-million-year old dolomite makes it suitable for fertiliser and other industrial applications as well as for soil improvement.



(Photo by Ilmar Saabas: Limestone excavation in Vão quarry)

The quarrying and mining of minerals in Estonia include limestone and dolomite extraction as well as crushed stone production (Paekivitoodete Tehase OÜ, Saare Dolomiit-Väokivi OÜ etc).

Currently in Estonia, only one container glass manufacturing facility and all pollutants emissions are reported Under NFR 1A2f.

The Estonian construction sector has remained largely oriented on the domestic market and therefore developments in the construction market are closely related to general economic development. If the situation in the economy as a whole is good, the volumes and prices of construction grow quickly. Thus the economic situation in the country has a direct impact on economic results of the construction industry and the areas dependent thereon, such as construction consulting services, real estate services, construction materials industry, etc. There are approximately 10,000 construction

companies operating in Estonia, 91% of whom are micro-enterprises with fewer than ten employees. The large share of micro-enterprises is characteristic to the construction sector in all of Europe, whereas the EU average rate is nearly 94%. Larger Estonian construction companies are AS Merko Ehitus, Nordecon AS, AS TREV-2 Grupp, Lemminkäinen Eesti AS, OÜ Astlanda Ehitus, OÜ Mapri Ehitus, AS Ehitusfirma Rand ja Tuulberg, AS TREF, Kodumaja AS, OÜ Fund Ehitus¹⁰.

In 2017, indicators of the construction sector were characterized by partial recovery from the fall, also contributing to growth of economy as a whole. Construction volumes, value added, employment and to a degree, construction prices increased. Productivity and investments remained on a stable level¹⁰.

In 2017, the construction sector remained in the position of the third largest economic sector by number of employed people, only remaining below the processing industry and the wholesale and retail trade¹⁰.

The completed residential dwelling has increased by about 16% in 2017 comparing to 2016, non-residential has increased in the same period by 21.5%. It is a primary reason of the increasing of particulates emissions from the mineral industry. The TSP, PM₁₀ and PM_{2.5} emissions increased in 2017 compared to 2016 by the same period by 20.3%, 16.7% and 18.7% respectively.

Table 4.3 Pollutant emissions from mineral products in the period of 1990-2017 (kt)

Year	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	NA	NA	NA	NA	NR	NR	4.975	NR	NA
1995	NA	NA	NA	NA	NR	NR	0.829	NR	NA
2000	NA	0.570	NA	0.010	0.128	0.722	2.296	0.0002	0.040
2005	0.010	0.080	NA	NA	0.285	1.778	5.718	0.0003	0.020
2006	0.010	0.080	NA	NA	0.313	1.987	6.399	0.0003	NA
2007	0.010	NA	NA	NA	0.312	1.962	6.378	0.0003	NA
2008	0.000	NA	0.0022	NA	0.300	2.106	6.813	0.0001	NA
2009	0.007	NA	0.0005	NA	0.144	1.393	4.278	0.0001	0.006
2010	0.006	NA	0.0004	NA	0.099	0.953	2.934	0.0001	0.005
2011	0.010	NA	0.0009	NA	0.098	0.928	2.848	0.0001	0.008
2012	0.008	NA	0.0009	NA	0.100	0.922	2.872	0.0002	0.007
2013	0.008	NA	0.0000	NA	0.135	1.294	4.078	0.0002	0.007

¹⁰ Overview of Economy 2017. The Ministry of Economic Affairs and Communications, the Ministry of Finance. Tallinn 2018

Year	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
2014	0.006	NA	0.0000	NA	0.112	1.067	3.404	0.0001	0.006
2015	0.006	NA	0.0001	NA	0.109	1.044	3.314	0.0001	0.006
2016	0.006	NA	0.0000	NA	0.113	1.071	3.437	0.0001	0.006
2017	0.0066	NA	0.0001	NA	0.134	1.250	4.135	0.0001	0.008
trend 1990-2017, %							-16.9		
trend 2000-2017, %					4.6	73.2	-41.8	-79.0	

4.1.2.2. Methodological Issues

As was mentioned above (overview of the industrial sector), emissions data are based on data from facilities (Tier 3 method). The operator submits data concerning the facility as a whole, as well as separately on sources of emissions by SNAP codes. Basically, all emissions from the mineral industry are included in the combustion activity – NFR 1A2f, excluding fugitive emissions from construction and excavations and storage and handling activities. In recent years, the cement industry have not been the key source of pollution because very large efforts were made for the reduction of pollutant emissions. The emission of dust from Kunda Nordic Tsement during the period 1990-2009 was reduced by 99.7%.

The enterprise has been presenting data regarding heavy metal emissions since 2004 on the basis of measurements; therefore, emissions for the period 1990-2003 have been calculated on the basis of national emissions factors and clinker production data. [Tselluloosi ja tsemendi](#)

[tootmisel välisõhku eralduvate saasteainete heitkoguste määramismeetodid – Elektrooniline Riigi Teataja.](#)

The dioxin emissions from the mineral industry (cement, lime and brick) have been calculated on the basis of productions and the UNEP "Standardized Toolkit for Identification of Dioxin and Furan Releases" emissions factors. For cement production, Toolkit EF was used from 1990 to 1996, and from 1997 to 2010 calculations were carried out on the basis of results from the "Dioxin in Candidate Countries" project, in which frameworks for the measurements of dioxins from technological equipment have been implemented (see [Table 4.5](#)). Now, Kunda Nordic is obliged to carry out measurements twice a year and report on dioxin emissions. It must be noted that the measured dioxin emissions are much less than the emissions calculated on the basis of the emissions factor. Dioxin emissions are also reported under NFR 1A2giii.

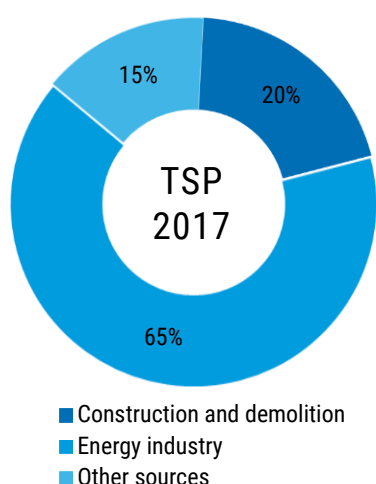
Table 4.4 Clinker production and heavy metal emission factors

Year	Clinker, thousand tonnes	Heavy metals EF, g/t of clinker					
		Pb	Cd	Hg	Cu	Ni	Zn
1990	790.0	78.125	4.060	0.088	2.687	0.313	18.000
1991	773.0	78.125	4.060	0.088	2.687	0.313	18.000
1992	517.0	78.125	4.060	0.088	2.687	0.313	18.000
1993	378.0	78.125	4.060	0.088	2.687	0.313	18.000
1994	540.0	78.125	4.060	0.088	2.687	0.313	18.000
1995	571.0	43.750	2.275	0.049	1.505	0.175	10.080
1996	590.0	12.500	0.650	0.014	0.430	0.050	2.880
1997	651.0	0.780	0.040	0.004	0.030	0.003	0.180
1998	659.0	0.780	0.040	0.004	0.030	0.003	0.180
1999	590.0	0.780	0.040	0.004	0.030	0.003	0.180
2000	620.0	0.780	0.040	0.004	0.030	0.003	0.180
2001	629.0	0.780	0.040	0.004	0.030	0.003	0.180
2002	590.0	0.780	0.040	0.004	0.030	0.003	0.180
2003	560.0	0.780	0.040	0.004	0.030	0.003	0.180

Table 4.5 Dioxins emission factors for the mineral industry

Year	Cement			Lime			Bricks and tiles		
	Production, tonnes	EF, µg I-TEQ/t	Emission, g	Production, tonnes	EF, µg I-TEQ/t	Emission, g	Production, tonnes	EF, µg I-TEQ/t	Emission, g
1990	938.000	0.6000	0.5630	185.000	0.07	0.0130	541.401	0.2	0.108
1995	417.600	0.6000	0.2510	16.800	0.07	0.0010	81.343	0.2	0.016
2000	329.100	0.0700	0.0230	21.200	0.07	0.0010	45.072	0.2	0.009
2005	726.000	0.0700	0.0510	37.200	0.07	0.0020	69.342	0.2	0.014
2006	848.900	0.0700	0.0590	39.700	0.07	0.0027	82.667	0.2	0.016
2007	936.200	0.0700	0.0650	43.500	0.07	0.0030	143.485	0.2	0.029
2008	806.100	0.0700	0.0560	59.400	0.07	0.0041	113.081	0.2	0.023
2009	326.000	0.0700	0.0230	30.200	0.07	0.0021	38.938	0.2	0.007
2010	536.700	0.0700	0.0370	27.200	0.07	0.0019	56.500	0.2	0.011
2011	719.002	0.0040	0.0030	36.100	0.07	0.0025	84.544	0.2	0.017
2012	714.600	0.0060	0.0040	72.000	0.07	0.0050	107.213	0.2	0.021
2013	691.400	0.0110	0.0070	69.600	0.07	0.0049	118.148	0.2	0.024
2014	720.480	0.0070	0.0050	69.600	0.07	0.0049	118.148	0.2	0.024
2015	356.287	0.0360	0.0130	43.018	0.07	0.0030	61.341	0.2	0.012
2016	422.800	0.0175	0.0074	42.084	0.07	0.0029	54.407	0.2	0.011
2017	502.920	0.3230	0.1625	69.324	0.07	0.0049	54.940	0.2	0.011

Construction and demolition sector is a key source of emissions of TSP (20% of total emission, [Figure 4.5](#)) and PM₁₀ (8.6% of total emission).

**Figure 4.5** The share of construction and demolition sector in total TSP emissions

Emission calculations from construction and demolition (2A5b) sectors are based on the Tier 1 method from the renewed EMEP/EEA Guidebook 2016.

The Tier 1 method uses readily available statistical data and default emission factors (see [Table 4.6](#)).

Table 4.6 PM emission factors for construction and demolition, NFR 2A5b

NFR	Unit	PM _{2.5}	PM ₁₀	TSP
Construction and demolition of houses	kg/m ² /year	0.0086	0.086	0.29
Construction and demolition of apartment buildings	kg/m ² /year	0.03	0.3	1
Non-residential construction and demolition	kg/m ² /year	0.1	1	3.3

4.1.2.3. Activity Data

Information regarding completed dwelling (houses and apartments) and non-residential buildings, new construction and demolition for the years 2000-2017 is available from Statistics Estonia (www.stat.ee). Data on the years 1994-2000 were obtained from the Statistical Yearbooks 1994-2000. Data on permits for the period from 1990 to 1993 for dwelling

construction are an expert judgement and have been calculated by using of surrogate data. The same way were used to get data for non-residential construction permits for 1990-1995. Data regarding demolition permits are available in the statistical database only since 2003. The data for the period 1990-2002 have been calculated also by using of surrogate data (see [Table 4.7](#)).

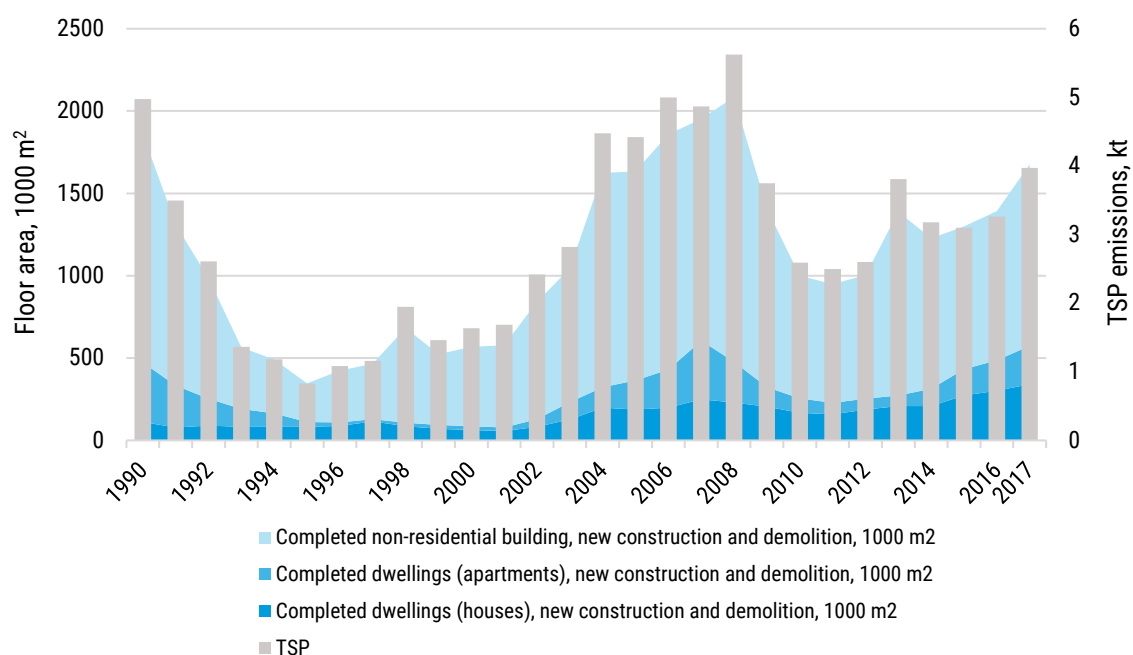


Figure 4.6 The completed dwelling and non-residential building, new construction and demolition and TSP emission in the period of 1990-2017

Table 4.7 Activity data for PM emission calculations from the construction sector in the period of 1990-2017(1000 m² floor area)

Year	Completed dwellings (houses), new construction and demolition, 1000 m ²	Completed dwellings (apartments), new construction and demolition, 1000 m ²	Completed non-residential building, new construction and demolition, 1000 m ²
1990	111.8	361.4	1,388.3
1995	81.6	29.2	235.2
2000	62.4	23.2	483.2
2005	187.5	176.4	1,268.8
2006	198.3	232.5	1,427.4
2007	249.5	356.4	1,345.7
2008	229.5	247.8	1,608.1
2009	205.3	117.6	1,082.5
2010	168.0	87.0	744.5
2011	157.7	69.9	721.3
2012	186.5	66.9	750.8
2013	208.7	63.6	1,116.1
2014	208.4	105.4	912.6
2015	273.1	158.6	867.0
2016	301.5	185.3	905.7
2017	341.2	233.4	1,102.2

4.1.3. Chemical Industry (NFR 2B)

4.1.3.1. Source Category Description

A unique part of the Estonian chemical industry is the industry based on oil-shale. However, the majority of the sector is made up of other sub-sectors such as building chemicals or household chemicals. The smallest sub-sector (a few hundred employees) is the pharmaceuticals industry. In Estonia, one hundred companies operate in the chemical industry. More than half of the chemical industry is located in Ida-Viru County, nearly one-third of the workforce is in Tallinn and Harju County. The largest companies of the chemical industry are VKG Oil AS, Kiviõli Keemiatööstuse OÜ and Enefit Energiatootmine AS (production of shale oil), Akzo Nobel Baltics AS, AS Tikkurila and AS Eskaro (paints and varnishes), NPM Silmet AS (rare metals), AS Novotrade Invest (recycling of petroleum products), OÜ Krimelte and Henkel Balti Operations OÜ (installation foam), Eastman Specialties AS (benzoic acid, sodium benzoate, plasticisers), Orica Eesti OÜ (explosives), AS Takeda Pharma (pharmaceuticals) and Interchemie Werken De Adelaar Eesti AS (veterinary medicines and supplies). (*Overview of Economy 2016. The Ministry of Economic Affairs and Communications, the Ministry of Finance. Tallinn 2017*)

In 2017, the three-year decline period of the chemical industry was defeated⁴, manufacture decreased only in the smallest sub-sector. The sustained price of crude oil should support the oil industry in 2018. However, assessments of manufacturers of chemical products were more pessimistic at the start of the year, even though that was not reflected in production volumes.

The output of the chemical industry grew by more than a tenth in 2017. The sector was most impacted by the oil industry, where a quarter more output was produced than the year before thanks to the higher price of crude oil. Output in manufacture of chemical products increased by nearly 7%. (*Overview of Economy 2017. The Ministry of Economic Affairs and Communications, the Ministry of Finance. Tallinn 2018*)

Estonia's only producer of fertiliser, Nitrofert AS, halted operations since 2014.



(Photo by Rauno Volmar: Nitrofert production facility)

The share of NMVOC emissions from the chemical industry in the total country emissions amounted to approximately 20% in 1990, and only 0.2% in 2017 (see [Figure 4.7](#)). The main reason for this is the decrease in the manufacturing of chemical production at shale oil enterprises.

Emissions from the chemical industry sector are presented in [Table 4.8](#).

During 1990-2017 emissions of all substances were reduced considerably, except carbon monoxide emission. The main source of CO emissions is facility for benzoic acid, sodium benzoate and plasticizers production.

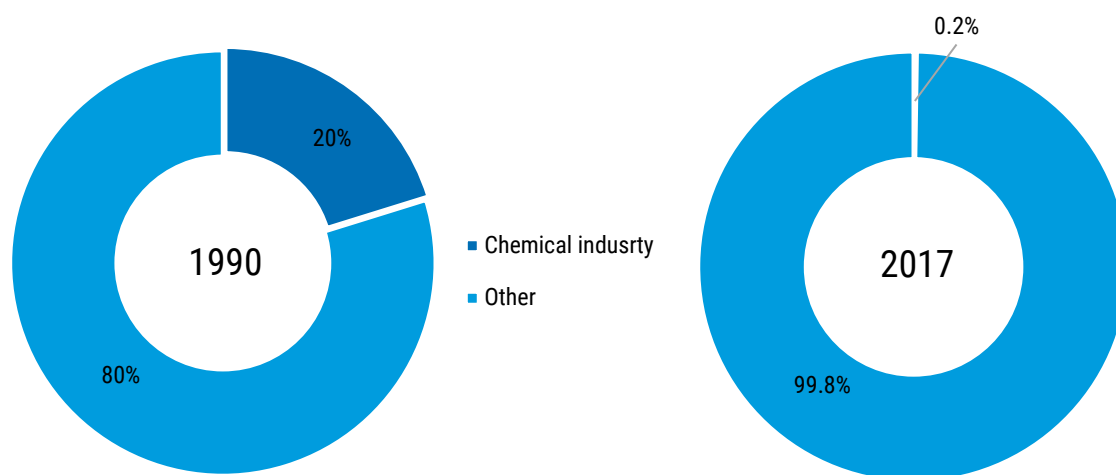


Figure 4.7 Distribution of NMVOC emissions by activities in 1990 and 2017

Table 4.8 Emissions from the chemical industry in the period of 1990-2017 (kt)

Year	NO _x	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	0.190	13.300	NA	0.370	NR	NR	0.940	NR	0.340
1995	0.070	3.530	NA	0.140	NR	NR	0.490	NR	NA
2000	0.190	0.840	NA	0.040	0.09	0.163	0.190	0.00270	0.340
2005	0.160	0.720	0	0.080	0.146	0.266	0.310	0.00440	0.290
2006	0.230	0.410	NA	0.060	0.126	0.232	0.280	0.00370	0.330
2007	0.200	0.120	0	0.070	0.099	0.184	0.230	0.00290	0.360
2008	0.255	0.041	0.002000	0.116	0.246	0.447	0.522	0.00730	0.398
2009	0.025	0.068	0.000300	0.009	0.026	0.052	0.082	0.00070	0.364
2010	NO	0.071	0.000005	0.010	0.005	0.014	0.042	0.00010	0.405
2011	NO	0.073	0.000006	0.017	0.004	0.013	0.038	0.00010	0.374
2012	0.024	0.073	0.000006	0.021	0.004	0.012	0.036	0.00010	0.305
2013	0.134	0.074	0.000005	0.066	0.092	0.171	0.213	0.00270	0.327
2014	0	0.073	0.000005	0.008	0.004	0.012	0.037	0.00010	0.367
2015	0.0002	0.046	0.000005	0.007	0.001	0.002	0.007	0.00001	0.353
2016	0	0.054	0.000005	0.007	0.001	0.003	0.009	0.00001	0.353
2017	0.00001	0.041	0	0.007	0.001	0.003	0.008	0.00001	0.420
Trend 1990-2017, %	-100	-99.7		-98	-99	-98	-99.1	-99.6	23.6

4.1.3.2. Methodological Issues

All the largest facilities as well as the facilities in which emissions exceed thresholds established by the decision of the Minister of the Environment are obliged to deliver annual reports on emissions. Therefore, all the data pertaining to emissions presented to this section are based on the data of the enterprises (Tier 3 method). Emissions data are based on measurements or calculation methods. For some enterprises, such as oil shale chemistry, part of the emissions is included in the energy sector (SNAP 010406 and

010407 – coke furnaces and coal gasification or liquefaction). BC emission have been calculated on the base EMEP/EEA Guidebook 2016 emission factors.

According to a recommendation which was made by the expert team following the 2018 review ('A comprehensive technical review of national emissions inventories'), the ammonia emissions for the year 1990-1999 were split between NFRs 2B1 and 2B10a. A more detailed description is presented in Chapter 8.

4.1.4. Metal Production (NFR 2C)

4.1.4.1. Source Category Description

Metals industry is related to several fields, such as manufacturing and construction of machinery and equipment. Companies of metals industry employ about 12,000 people in Estonia which makes it one of the largest industries after food industry and the timber industry. More than one thousand companies operate in this sector. Metals industry is concentrated in Tallinn and its vicinity (60% of employees) and Ida-Viru County and Tartu County (tenth of the staff).

The long-term expectation in the metal industry is the continued growth in production volumes, with exports as the main driver.

The year 2017 was the best in recent years for the metal industry. Output increased, the number of employed persons grew and financial results

improved. (*Overview of Economy 2017. The Ministry of Economic Affairs and Communications, the Ministry of Finance. Tallinn 2018*)



(Machine-building plant of BLRT Masinaehitus OÜ; source: www.masinaehitus.ee)

Emissions from the metal industry are presented in [Table 4.9](#).

Table 4.9 Emissions from the metal production sector in the period of 1990-2017 (kt)

Year	NO _x	SO _x	NMVOC	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb, t
1990	NA	NA	NA	0.160	NR	NR	NA	NR	NA	NA
1995	NA	NA	NA	0.100	NR	NR	NA	NR	NA	NA
2000	NA	NA	0.010	0.040	0.014	0.018	0.030	0.00005	0.010	0.0100
2005	0.010	NA	0.010	0.060	0.023	0.030	0.050	0.000084	0.010	NA
2006	0.030	NA	0.010	0.080	0.014	0.018	0.030	0.00005	0.020	0.0010
2007	0.020	NA	0.010	0.060	0.023	0.030	0.050	0.000017	0.020	0.0010
2008	0.015	0.0002	0.008	0.034	0.022	0.029	0.048	0.000081	0.023	0.0005
2009	0.008	0.0000	0.004	0.066	0.016	0.021	0.035	0.000066	0.012	0.0058
2010	0.013	0.0000	0.006	0.052	0.020	0.027	0.044	0.000095	0.009	0.0142
2011	0.014	0.0001	0.008	0.070	0.015	0.020	0.033	0.000081	0.009	0.0112
2012	0.014	0.0001	0.007	0.072	0.015	0.020	0.034	0.000081	0.009	0.0095
2013	0.015	0.0001	0.008	0.074	0.021	0.028	0.045	0.000095	0.012	0.0109
2014	0.020	0.0001	0.007	0.043	0.023	0.033	0.056	0.000106	0.021	0.0170
2015	0.022	0.0001	0.008	0.058	0.029	0.035	0.061	0.000148	0.027	0.0099
2016	0.025	0.0001	0.010	0.051	0.030	0.039	0.087	0.000159	0.026	0.0109
2017	0.031	0.000	0.013	0.066	0.077	0.101	0.265	0.000	0.011	0.0004

4.1.4.2. Methodological Issues

All the largest facilities as well as the facilities in which emissions exceed thresholds established by the decision of the Minister of the Environment are obliged to deliver annual reports on emissions. Therefore, all the data pertaining to emissions presented to this section are based on the data of the enterprises (Tier 3 method).

Emissions data are based on measurements or calculation methods.

BC emission have been calculated on the base EMEP/EEA Guidebook 2016 emission factors.

4.1.5. Road Paving with Asphalt (NFR 2D3b)

4.1.5.1. Source Category Description

Emission calculations from road paving with asphalt (NFR 2D3b) sectors are based on the Tier 1 method from the EMEP/EEA Guidebook 2016. Emissions from the road paving with asphalt are presented in [Table 4.10](#) and [Figure 4.8](#).



(Photo: Road paving with asphalt; source: Scanpix)

Table 4.10 Emissions from the road paving with asphalt in the period of 1990-2017 (kt)

Year	NM VOC	PM _{2.5}	PM ₁₀	TSP	BC
1990	0.0274	NR	NR	0.2567	NR
1995	0.0076	NR	NR	0.0713	NR
2000	0.0107	0.0007	0.0133	0.1001	0.0003
2005	0.0186	0.0012	0.0233	0.1746	0.0006
2006	0.0237	0.0015	0.0296	0.2223	0.0008
2007	0.0238	0.0015	0.0297	0.2230	0.0008
2008	0.0241	0.0015	0.0301	0.2260	0.0008
2009	0.0188	0.0012	0.0235	0.1762	0.0006
2010	0.0179	0.0011	0.0224	0.1677	0.0006
2011	0.0204	0.0013	0.0256	0.1917	0.0006
2012	0.0181	0.0011	0.0226	0.1693	0.0006
2013	0.0189	0.0012	0.0237	0.1775	0.0006
2014	0.0206	0.0013	0.0258	0.1934	0.0007
2015	0.0232	0.0015	0.0291	0.2180	0.0007
2016	0.0232	0.0015	0.0291	0.2179	0.0007
2017	0.0264	0.0017	0.0330	0.2477	0.0008
trend 1990-2017, %	-3.5	147.5	147.6	-3.5	179.0

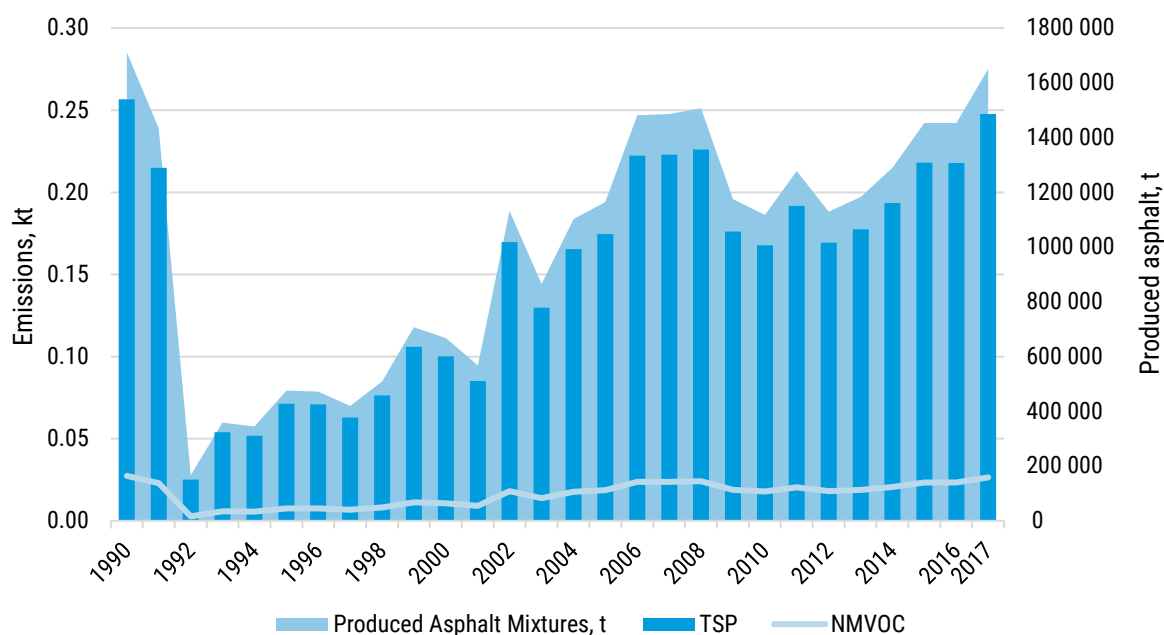


Figure 4.8 Emissions of NMVOC and TSP from road paving with asphalt and asphalt production in the period of 1990-2017

4.1.5.2. Methodological Issues

The default emission factors for road paving with asphalt are constructed based on an assessment of the available emission factors from a detailed review of the hot mix industry (US EPA, 2004). The

emission factor represents an average between the batch mix and the drum mix hot mix asphalt plants. The Tier 1 method uses readily available statistical data and default emission factors (see [Table 4.11](#)). For particles 99% abatement efficiencies are used.

Table 4.11 NMVOC emission factors for road paving with asphalt and PM emission factors for construction and demolition

NFR	Unit	NMVOC	PM ₁₀	PM _{2.5}	BC	TSP
2D3b Road paving with asphalt	g/Mg asphalt	16	2 000	100	5.7 % of PM _{2.5}	15000

4.1.5.3. Activity Data

Information regarding asphalt production and laying is available from the Estonian Asphalt Pavement Association (www.asfaldiliit.ee) for the years 1990-2017 (see [Table 4.12](#)). According to the Asphalt Pavement Association, all production companies but not all asphalt laying companies are members of the association. The value of the asphalt produced is higher than the quantity of laid asphalt. For that reason, asphalt production values are used for emission calculations from road paving with asphalt.

Table 4.12 Activity data for NMVOC emission calculations from asphalt production in the period of 1990-2017 (tonnes)

Year	Produced Asphalt Mixtures
1990	1,711.000
1995	475.000
2000	667.000
2005	1,164.000
2006	1,481.908
2007	1,486.572
2008	1,506.846
2009	1,174.624
2010	1,118.187
2011	1,277.793
2012	1,128.815
2013	1,183.263
2014	1,289.663
2015	1,453.025
2016	1,452.025
2017	1,651.228

4.1.6. Pulp, Paper and Food Industry (NFR 2H)

4.1.6.1. Source Category Description

This chapter includes the pollutant emissions from pulp and paper, food and drink, wood and furniture industries.

The pulp and paper industry in Estonia has a long tradition, having been established as far back as the 17th century. The high level of automation and modern technology has made the production of pulp one of the highest productivity sectors in Estonia. There are about 60 companies in Estonia that manufacture paper, pulp or paper products. Over 81% of the sector's production is exported which is why, as users of local raw materials, they are important in improving foreign trade balance. The sector's main players in Estonia are two companies: pulp producer AS Estonian Cell and the paper and cardboard producer Horizon Tselluloosi ja Paberi AS with a slightly smaller turnover. Together they provide more than two-thirds of the sector's sales revenue. (*Overview of Economy 2016. The Ministry of Economic Affairs and Communications, the Ministry of Finance. Tallinn 2017*)

In 2017, sales volumes of the paper industry increased by a tenth thanks to strong export.

The paper industry is a heavily concentrated industry in Estonia. Horizon Tselluloosi ja Paberi AS is the largest paper and cardboard producer. Horizon produces a wide range of high-quality paper products for the packaging industry. The

product range is completely based on 100% virgin long fibre softwood pulp – the raw material that has brought Nordic sack craft qualities to the fore globally.



(Photo by Rauno Volmar: Horizon Tselluloosi ja Paberi AS)

Horizon only manufactures unbleached varieties. Estonian Cell AS, an aspen pulp factory in Kunda (established in 2006), is the largest pulp producer.

The wood industry is one of largest industries. Wood is one of the most important natural resources in Estonia besides oil shale and makes a significant contribution to the balancing of foreign trade. Timber industry is one of the largest industries in Estonia.

More than one thousand companies are operating in wood processing and manufacture of wood products. The larger companies in the sector have modern technology and are highly competitive in domestic and foreign markets. Timber industry has a wide range of products, from the

manufacture and processing of lumber to the manufacture of wooden houses, windows and doors. Furniture industry has also long traditions in Estonia. The larger companies of furniture industry in terms of the number of employees are located mainly in North and South Estonia. (Overview of Economy 2016. The Ministry of Economic Affairs and Communications, the Ministry of Finance. Tallinn 2017)

The food industry is also one of the largest industries in Estonia in terms of production volume. It is the primary economic activity of nearly 500 companies. Along with the increase in the competitiveness, the share of exports in the sector has reached more than one-third of the turnover. In food production, 36.6% of the production was exported and this percentage has grown year by year. The food industry consists of two major sectors: food production and beverage production. The year 2016 was somewhat more successful for beverage producers as they were successful in foreign markets and managed to increase exports by more than a fifth. (Overview of Economy 2016. The Ministry of Economic Affairs and Communications, the Ministry of Finance. Tallinn 2017)

The emissions from sector NFR 2H are presented in [Table 4.13](#). Emissions of all pollutants has increased in 2017 compared to 2016 due to increase of emissions in food and pulp industry.

Table 4.13 Pollutant emissions from the pulp, paper and food industries in the period of 1990-2017 (kt)

Year	NO _x	NM VOC	SO _x	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	NA	2.008	NA	NR	NR	NA	NR	NA
1995	NA	0.839	NA	NR	NR	NA	NR	NA
2000	0.010	0.649	0.040	0.085	0.115	0.150	0.002	0.140
2006	0,0	0.779	0.120	0.169	0.227	0.290	0.004	0.000
2007	0.010	0.848	0.020	0.114	0.152	0.190	0.003	0.020
2008	0.018	0.823	0.018	0.132	0.176	0.221	0.003	0.028
2009	0.017	0.758	0.024	0.160	0.186	0.247	0.003	0.027
2010	0.018	0.729	0.028	0.158	0.217	0.290	0.004	0.028
2011	0.038	0.785	0.020	0.079	0.111	0.158	0.002	0.015
2012	0.000	0.757	0.000	0.046	0.069	0.110	0.001	0.000
2013	0.043	0.739	0.000	0.083	0.120	0.180	0.002	0.019
2014	0.003	0.761	0.0004	0.060	0.089	0.141	0.001	0.003
2015	0.015	0.706	0.002	0.057	0.085	0.134	0.001	0.005
2016	0.013	0.673	0.0009	0.037	0.059	0.104	0.0008	0.002
2017	0.015	0.708	0.0000	0.032	0.052	0.094	0.0007	0.011

The emissions of NMVOC and particulates from the wood processing are presented in [Table 4.14](#); emissions of other substances from this sector are insignificant and aren't given in the table. Emissions from 2000 for 2008 are given under NFR sectors 2A6 and 2L.

Table 4.14 NMVOC and PM emission from the wood processing (kt)

Year	NMVOC	PM _{2.5}	PM ₁₀	TSP
2009	0.009	0.024	0.072	0.219
2010	0.014	0.027	0.082	0.248
2011	0.013	0.026	0.079	0.240
2012	0.010	0.026	0.077	0.233
2013	0.009	0.023	0.073	0.210
2014	0.001	0.023	0.076	0.212
2015	0.002	0.025	0.074	0.226
2016	0.001	0.023	0.069	0.210
2017	0.002	0.024	0.072	0.221

4.1.6.2. Methodological Issues

Emissions data from these branches of industry are based on facilities data (Tier 3 method) and only NMVOC emissions from the food industry are calculated as diffuse sources on the basis of statistical data and renewed EMEP/EEA Guidebook 2016 default emission factors (Tier 2 method).

Emissions from food manufacturing include all processes in the food production chain, which occur after the slaughtering of animals and the harvesting of crops. Emissions from drinks manufacturing include the production of alcoholic beverages, especially wine, beer and spirits. Emissions from the production of other alcoholic drinks are not covered.

It is recommended to use the product-based default emission factors (not background emission factors), since relevant activity statistics for these factors are more likely to be available.

Emission factors presented in this section are based on the following assumptions:

- 0.15 tonne of grain is required to produce 1 tonne of beer (Passant, 1993).
- Malt whiskies typically need ten years to mature. Grain whiskies typically require six years to mature. It is assumed that brandy matures in three years and that other spirits do not mature.
- Beer is considered to be typically 4% alcohol by volume and to weigh 1 tonne per m³.
- If no better data are available, spirits are assumed to be 40% alcohol by volume.
- Alcohol (ethanol) has a density of 789 kg/m³.

Tier 2 emission factors are used for emission calculations. The relevant emission factors are given in the tables below (see [Table 4.15](#)). The emission factor for rye bread and white bread production is the same (EF 5 kg/Mg NMVOC bread). Statistical data for white bread production (shortened process, emission factor 2 kg/Mg NMVOC bread), wholemeal bread production (EF 3 kg/Mg NMVOC bread) and light rye bread production (EF 3 kg/Mg NMVOC bread) are not available.

For spirits, the emission factor 0.4 kg/hl alcohol is chosen, since Estonia mainly produces vodka, the production of which does not involve maturation processes.

There are also some permitted fish processing companies (mainly smoking) that report NMVOC emissions. Some permit applications were studied (Maseko and Spratfil in Harju and Ida-Viru County) and it was found that NMVOC emission originates from smoke generators as a result of incomplete combustion and not from the fish processing itself. Therefore, these emissions are different from the calculated NMVOC emission, which primarily occur from the cooking of meat, fish and poultry, releasing mainly fats and oils and their degradation products.

Table 4.15 NMVOC emission factors for the food and drink industries

Product group (food and drink)	Emission factor	Unit
Bread	4.5	kg/Mg bread
Cakes, biscuits and breakfast cereals	1	kg/Mg product
Meat, fish and poultry etc. frying/curing	0.3	kg/Mg product
Meat processed	0.3	kg/Mg product
Fish processed	0.3	kg/Mg product
Margarine and solid cooking fats	10	kg/Mg product
Solid cooking fats	10	kg/Mg product
Margarine	10	kg/Mg feed
Animal feed	1	kg/Mg product
Wine	0.08	kg/hl wine
Beer	0.035	kg/hl beer
Other sprits	0.4	kg/hl alcohol
Crude spirits	0.4	kg/hl alcohol
Distilled spirits	0.4	kg/hl alcohol

4.1.6.3. Activity Data

for the years 1990-2017 ([Table 4.16](#) and [Table 4.17](#)).

Information regarding food and drink production is available from Statistics Estonia (www.stat.ee)

Table 4.16 Activity data for the food industries in the period of 1990-2017 (thousand tonnes)

Year	Bread and pastry	Flour confectionery	Meat total (slaughter weight)	Fish total	Solid cooking fats	Margarine	Concentrated feeding stuffs
1990	151.0	14.9	182.5			6.6	851.8
1995	99.7	5.0	67.7	132.0	3.6	0.1	162.8
2000	76.5	4.4	53.3	113.4	0.8		133.3
2005	72.4	..	67.1	99.3	1.2		177.0
2006	74.4	9.4	69.4	90.6	..	..	208.9
2007	78.8	9.7	70.5	98.5	..	..	214.2
2008	77.6	8.9	74.6	101.7	..	..	229.5
2009	74.1	7.1	76	98.2	..	..	203.1
2010	73.7	8.4	75.4	96.0	..	..	203.0
2011	77.0	9.5	80.6	81.3	..	..	216.2
2012	76.7	8.1	78.4	67.8	..	..	198.8
2013	79.2	8.6	79.8	70.1	..	..	161.9
2014	80.0	9.9	80.7	69.2	..	..	117.5
2015	78.9	11.2	85.6	73.7	..	..	127.4
2016	76.98	10.69	77.9	76.4	..	..	109.9
2017	79.93	13.3	71.5	83.4	..	..	160.9

Table 4.17 Activity data for the drinks industries in the period of 1990-2017 (thousand hl)

Year	Wine of fruits and berries	Beer	Crude spirits	Distilled spirits
1990	37.0	769.0	82	147.0
1995	14.0	499.6	91	176.0
2000	32.6	950.1	20.4	86.4
2005	88.8	1,342.5	37.1	167.9
2006	77.5	1,431.1	61.6	183.1
2007	53.5	1,411.6	39.3	216.0
2008	38.8	1,281.8	15.5	202.8

Year	Wine of fruits and berries	Beer	Crude spirits	Distilled spirits
2009	40.4	1,223.0	1.3	186.6
2010	64.7	1,291.7	0.1	150.7
2011	73.3	1,358.8	13.3	169.2
2012	96.3	1,460.0	4.5	182.0
2013	106.6	1,472.7	1.8	157.7
2014	107.3	1,636.7	11.6	136.0
2015	107.7	1,446.9	18.1	157.3
2016	117.45	1,419.1	20.2	150.9
2017	97.77	1,389.9	23.7	119.3

4.1.7. Uncertainty

An uncertainty analysis was carried out to the year 2017 inventory. The uncertainty in the emission factors for NO_x, NMVOC and SO_x from industrial processes is estimated in the range

from 20% to 50%, for ammonia 20-200%, for particulates 20-100%; in the activity data in the range from 2% to 5%. Uncertainty estimates for stationary combustion are given in [Table 4.18](#).

Table 4.18 Uncertainties in industrial processes sector

Pollutant	Emission, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	0.055	kt	0.17	0.05%	0.05%
NMVOC	0.790	kt	3.55	1.57%	3.49%
SO _x	0.000	kt	0.00	0.00%	0.00%
NH ₃	0.082	kt	0.79	1.30%	0.20%
PM _{2.5}	0.277	kt	3.01	1.60%	0.85%
PM ₁₀	1.537	kt	11.04	8.68%	3.11%
TSP	5.039	kt	25.59	20.27%	1.31%
CO	0.451	kt	0.33	0.15%	0.05%
Pb	0.0004	t	0.00	0.00%	0.00%

4.1.8. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends was carried out.

Data from operators was checked by the EEB and also by the ESTEA.

4.1.9. Source-Specific Planned Improvements

- Allocate the historical emission from wood and furniture industries from NFR 2A6 and NFR 2L and to include in NFR 2I Wood processing. This process demands certain efforts as corrections are necessary for

carrying this out in a national point sources database.

- Correction in allocation emission in metal industries (NFR 2C).

4.2. Solvent and Other Product Use

4.2.1. Source Category Description

This chapter describes emissions from solvents and other product use. The use of solvents and products containing solvents results in emissions of non-methane volatile organic compounds (NMVOC) when emitted into the atmosphere. In

addition to solvents, this sector also includes the emissions of particulate matter from painting, tobacco smoking and the use of fireworks under NFR 2G. Also, the heavy metals, CO, SO_x, NH₃, NO_x and POPs emissions are calculated from tobacco smoking.

In 2009-2010, the Estonian Environment Information Centre (nowadays ESTEA) outsourced an expert opinion of the estimation of NMVOC emissions from diffuse sources, including NMVOC emissions from the use of solvents and other products use. The most common method of estimating NMVOC emissions is the use of emission factors. The emissions are estimated based on the production or activity level of the source from which an emission level is calculated using existing emission factors. The main database of emission factors is the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016.

This sector covers emissions from the use of solvents and other products for the following NFR14 categories: domestic solvent use including fungicides (NFR 2D3a), coating application (NFR 2D3d), degreasing (NFR 2D3e), dry-cleaning (NFR 2D3f), chemical products (NFR 2D3g), printing (NFR 2D3h), other solvent use (NFR 2D3i) and other product use (NFR 2G).



Source: www.hdwallpapersos.com

Air pollutants under solvent and other product use sector in the Estonian inventory are presented in **Table 4.19**.

Table 4.19 Activities and emissions reported from the solvent and other product use sector

NFR	Source	Description	Method	Emissions reported
2D3a	Domestic solvent use including fungicides	Includes emissions from domestic solvent use	Tier 1 / Tier 2	NMVOC, Hg
2D3d	Coating application	Includes emissions from domestic and industrial paint application	Tier 2 / Tier 3	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, CO, Pb, Cu, Zn
2D3e	Degreasing	Includes emissions from degreasing (vapour and cold cleaning), electronic components manufacturing and other industrial cleaning	Tier 2 / Tier 3	NO _x , NMVOC, NH ₃ , PM ₁₀ , TSP, Pb, Cr, Cu
2D3f	Dry cleaning	Includes emissions from dry cleaning	Tier 1 / Tier 3	NMVOC
2D3g	Chemical products	Includes emissions from polyurethane, polystyrene foam and rubber processing, paints, inks and glues manufacturing, textile finishing, leather tanning and other use of solvents	Tier 3	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, Pb, Cr, Zn
2D3h	Printing	Includes emissions from solvents in printing houses	Tier 1 / Tier 3	NO _x , NMVOC, NH ₃ , TSP, CO
2D3i	Other solvent use	Includes emissions from edible and non-edible oil extraction, application of glues and adhesives, preservation of wood and underseal treatment and conservation of vehicles	Tier 2 / Tier 3	NO _x , NMVOC, SO _x , NH ₃ , PM ₁₀ , TSP, Pb, Cr, Cu
2G	Other product use	Emissions from the use of tobacco and the use of fireworks	Tier 2	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs Total, HCB, PCBs

4.2.2. Quantitative Overview of NMVOCs

In 2017, the solvent and other product use sector, which was the largest pollution source of NMVOC emissions in Estonia, accounted for 30.6% of total

NMVOC emissions. The largest share within the solvent and other product sector was for coating application at 51.60%, with the others being domestic solvent use at 23.22%, other solvent use 11.92%, printing 9.75%, chemical products 1.90%, degreasing 1.37%, other product use 0.13% and dry cleaning 0.11% (see [Figure 4.9](#)).

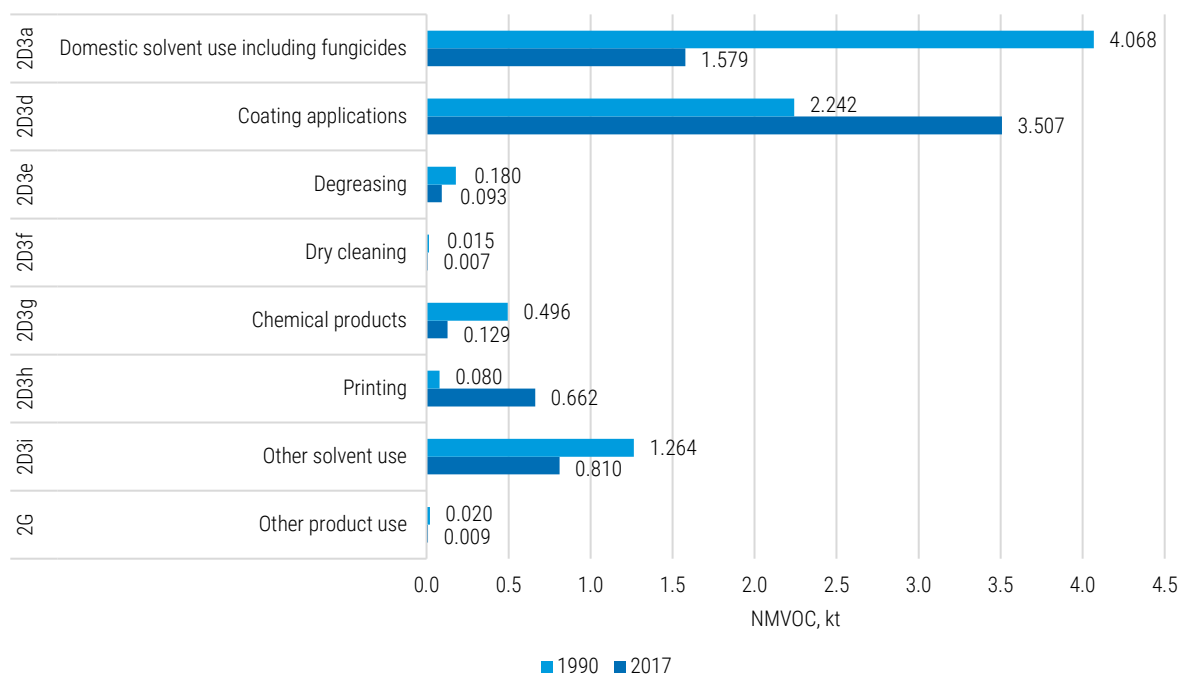


Figure 4.9 NMVOC emissions by sectors in 1990 and 2017

There has been a slight increase in trends of NMVOC emissions from solvent and other product use in recent years. Since 1990, NMVOC emissions have decreased in the solvent sector by 18.7% (see [Figure 4.10](#)). The trend in emissions is determined, in order of importance, by NFR categories 2D3d (Coating application) and 2D3a (Domestic solvent use). The major category where an increase in NMVOC emissions has occurred in recent years is the coating application (NFR 2D3d). The fluctuation of NMVOC emissions in the period of 1990-2017 has mostly occurred due to the welfare of the economic state of the country. The decrease in emissions between 1991 and 1993 was due to the renewed independence of the Republic of Estonia and the cessation of large-scale production that was distinctive of the Soviet Union. Between 1993 and

1998, the economic growth induced the growing usage of NMVOC containing paints in decorative and industrial coating applications. At the end of 1998, the world was struck by an economic crisis that affected the construction sector, resulting in a knock-on effect on the usage of decorative coatings. From 2001, the economy began to grow again until 2008, when the world suffered its worst ever economic depression, which also greatly affected the Estonian economy. As a result, by the year 2010, NMVOC emissions fell 43.2% in comparison with 2006 (see [Figure 4.11](#)). In 2011, there was a slight increase in NMVOC emissions by 8.9% compared to 2010, which meant that the bottom of the emissions was reached, and henceforward, the emissions have been started to rise again.

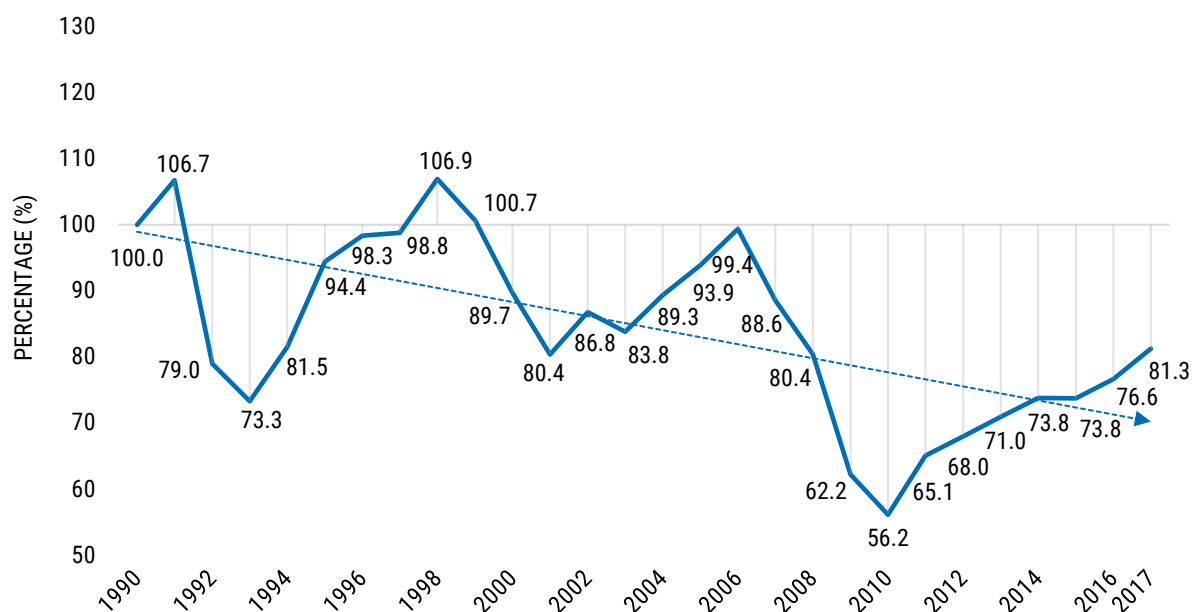


Figure 4.10 The dynamics of NMVOC emissions from the solvent and other product use sector in the period of 1990-2017 (1990 = 100%)

In 2004 and 2005, Estonia adopted directives 1999/13/EC and 2004/42/EC into its legislation, but it seems that the economic growth at the time did not have a significant effect on the decrease in NMVOC emissions, which grew steadily until the economic depression. One reason why the

possible positive effect of the legislation did not manifest on the graph is because the emissions from the point sources, which are calculated more precisely by the facilities than the emissions from the diffuse sources, represent only about 20% of total solvent sectors NMVOC emissions.

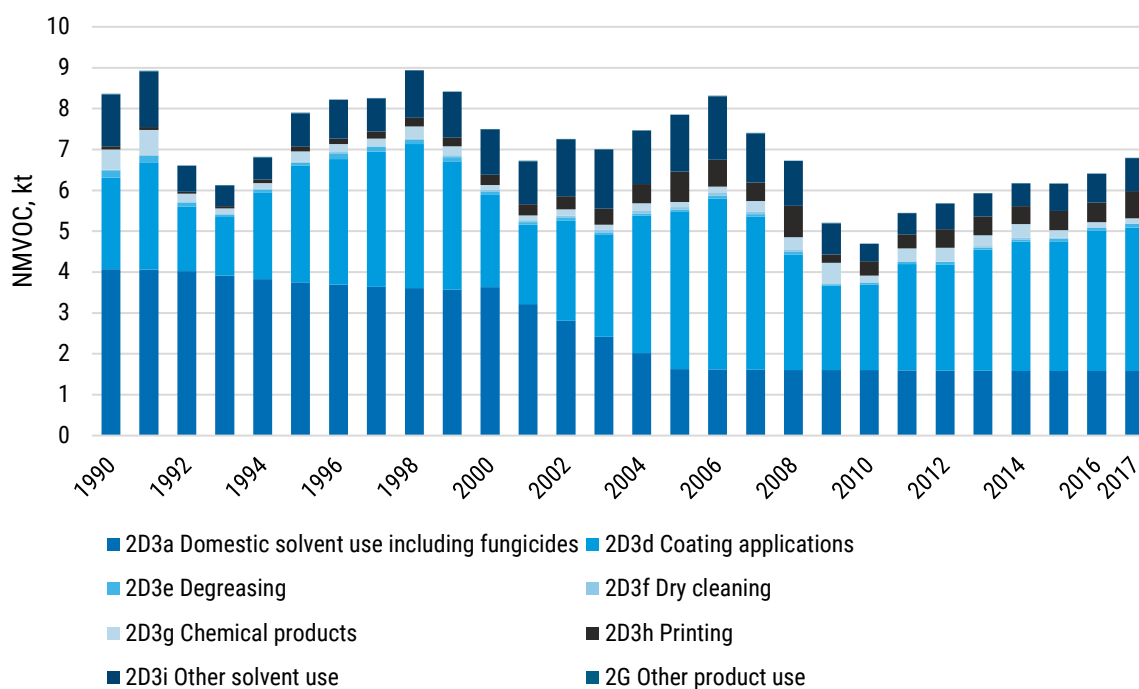
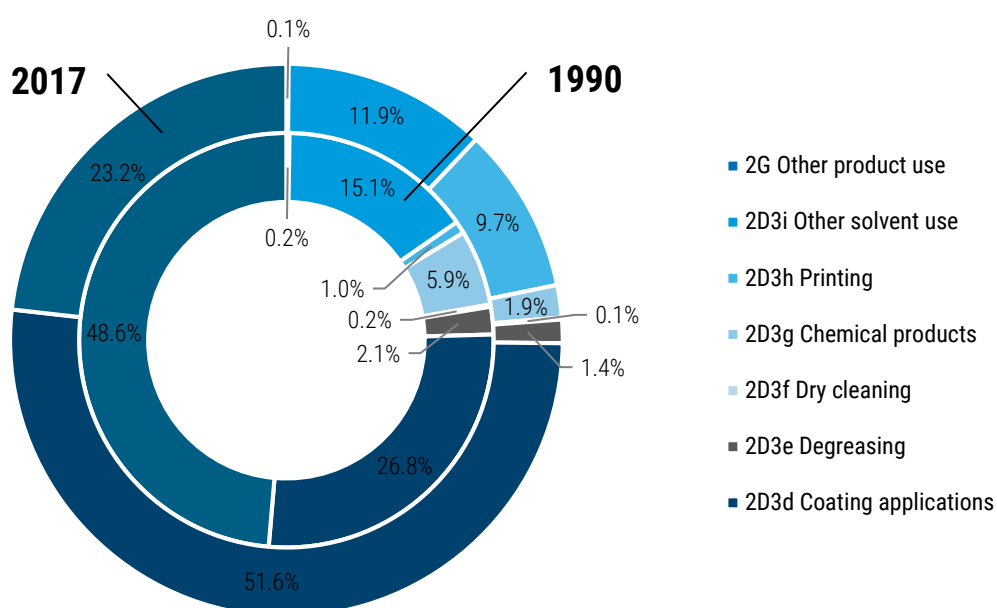


Figure 4.11 NMVOC emissions from the solvent and other product use sector in the period of 1990-2017

Table 4.20 NMVOC emissions from the solvent and other product use sector in the period of 1990-2017 (kt)

Year\NFR	2D3a	2D3d	2D3e	2D3f	2D3g	2D3h	2D3i	2G
1990	4.068	2.242	0.180	0.015	0.496	0.080	1.264	0.020
1995	3.751	2.848	0.077	0.025	0.250	0.126	0.810	0.011
2000	3.629	2.258	0.084	0.050	0.107	0.248	1.115	0.009
2005	1.631	3.842	0.053	0.062	0.125	0.745	1.384	0.013
2006	1.621	4.177	0.073	0.063	0.158	0.658	1.550	0.012
2007	1.612	3.742	0.065	0.054	0.265	0.454	1.199	0.017
2008	1.606	2.815	0.068	0.051	0.314	0.766	1.098	0.007
2009	1.603	2.066	0.036	0.022	0.497	0.206	0.763	0.012
2010	1.600	2.092	0.047	0.012	0.164	0.354	0.423	0.006
2011	1.596	2.600	0.054	0.019	0.313	0.344	0.512	0.009
2012	1.590	2.599	0.058	0.008	0.337	0.456	0.630	0.009
2013	1.584	2.961	0.051	0.039	0.268	0.461	0.563	0.009
2014	1.579	3.167	0.051	0.041	0.338	0.439	0.551	0.009
2015	1.576	3.179	0.058	0.030	0.179	0.473	0.665	0.009
2016	1.579	3.432	0.075	0.007	0.125	0.479	0.705	0.009
2017	1.579	3.507	0.093	0.007	0.129	0.662	0.810	0.009
Trend 1990-2017, %	-61.2	56.4	-48.3	-53.3	-74.0	727.5	-35.9	-55.0

**Figure 4.12** The share of NMVOC emissions in 1990 and 2017 by NFR solvent subcategory codes

4.2.3. Methods

NMVOC emission estimations from solvent and other product use are based on several data sources and methods. Emissions from point sources are gathered from the web-based air emissions data system for point sources (OSIS)

and the emissions for diffuse sources are calculated from the data received and gathered mainly from Statistics Estonia using international emission factors and expert opinions. Information sources for the NMVOC inventory by different subcategories are presented in the [Table 4.21](#) together with emission sources not included in the inventory.

Table 4.21 Information sources for the NMVOC inventory in solvents sector

*PS – point sources

*DS – diffuse sources

*GB – Guidebook

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC emission factors*
2D3a	Personal care, household cleaning agents, car care products, cosmetics and toiletries, adhesives and sealants, pharmaceutical products	060408	Domestic solvent use (other than paint application)	Statistics Estonia	DS: 2,59 kg/person/year (1990-2000, GB2007); 1,2 kg/person/year (since 2005, GB2016); EFs for the years 2001-2004 are interpolated
		060411	Domestic use of pharmaceutical products	Included under SNAP 060408	DS: 1.9% share of the previous emission factors
2D3d	Coating application: Solvents in paints	060101	Manufacture of automobiles	Reported by operators (for the years 2005-2007)	PS: facility specific
		060102	Car repairing	Expert estimate for the whole time series (DS); reported by operators (PS, since 2006)	DS: 720 g/kg paint applied (1990-2006, GB2016, solvent based), 2007-2017 IEF from the PS; 216 g/kg paint applied (1990-2007, GB2016, water based), 2008-2017 IEF from the PS; PS: facility specific
		060103	Construction and buildings	Statistics Estonia and expert estimate	DS: 230 g/kg of paint (1990-2017, GB2016, solvent based); 69 g/kg of paint applied (1990-2017, GB2016, water based); 149.5 g/kg of paint applied (1990-2017, calculated as an average of SB and WB emission factors)
		060104	Domestic use	Statistics Estonia and expert estimate	PS: facility specific
		060105	Coil coating	Reported by operators (since 2012)	PS: facility specific
		060106	Boat building	Reported by operators (since 2000)	PS: facility specific
		060107	Wood coating	Reported by operators (since 1993)	PS: facility specific
		060108	Other industrial paint application	Reported by operators (since 1990)	PS: facility specific
		060109	Other non-industrial paint application	Included in 060103 and 060104	NA
		060200	Degreasing (vapour and cold cleaning)	Statistics Estonia	DS: 710 g/kg cleaning products in combination with the abatement efficiencies (GB2016)
2D3e	Degreasing: Solvents in products	060201	Metal degreasing (regarded as vapour cleaning)	Reported by operators (since 2001)	PS: facility specific
		060203	Electronic components manufacturing	Reported by operators (since 2000)	PS: facility specific
		060204	Other industrial cleaning	Reported by operators (since 2001)	PS: facility specific

NFR	Product group	SNAP	Activity where used	Activity data	NM VOC emission factors*
2D3f	Dry cleaning: Chlorinated solvents in products	060202	Dry cleaning	Statistics Estonia; reported by operators (since 2002)	DS: 400 g/kg solvent use (GB2016) PS: facility specific
2D3g	Solvents in chemical products manufacture and processing	060300	Chemical products manufacturing or processing	Aggregated emissions for the whole SNAP 0603**, reported by operators (1990-2005)	PS: facility specific
		060301	Polyester processing	Not relevant	NA
		060302	Polyvinylchloride processing	Not relevant	NA
		060303	Polyurethane processing	Reported by operators (since 2006)	PS: facility specific
		060304	Polystyrene foam processing	Reported by operators (since 2006)	PS: facility specific
		060305	Rubber processing	Reported by operators (since 2006)	PS: facility specific
		060306	Pharmaceutical products manufacturing	Not included	NA
		060307	Paints manufacturing	Reported by operators (since 2006)	PS: facility specific
		060308	Inks manufacturing	Reported by operators (2007-2010)	PS: facility specific
		060309	Glues manufacturing	Reported by operators (2006-2014)	PS: facility specific
		060310	Asphalt blowing	Not occurring	NO
		060311	Adhesive, magnetic tapes, films and photographs manufacturing	Not included	NA
		060312	Textile finishing	Reported by operators (since 2006)	PS: facility specific
		060313	Leather tanning	Reported by operators (since 2006)	PS: facility specific
		060314	Other	Reported by operators (since 2006)	PS: facility specific
2D3h	Printing ink and solvents in printing houses	060403	Printing industry	Statistics Estonia; reported by operators (since 2001)	DS: 500 g/kg ink (GB2016); PS: facility specific
2D3i	Other solvent use	060400	Other use of solvents and related activities	Aggregated emissions for the whole SNAP 0604**, except 060405; reported by operators (1990-1999)	PS: facility specific
		060401	Glass wool enduction	Not included	NA
		060402	Mineral wool enduction	Not included	NA
		060404	Fat, edible and non-edible oil extraction	Emissions reported by operators (since 2002), activity data is not available	PS: facility specific
		060405	Application of glues and adhesives	Statistics Estonia; reported by operators (since 1990)	DS: 780 g/kg adhesives (1990-2000, GB2009); 522 g/kg adhesive (since 2005, GB2016); EFs for the years 2001-2004 are interpolated; PS: facility specific

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC emission factors*
2G		060406	Preservation of wood	Reported by operators (since 2000)	PS: facility specific
		060407	Underseal treatment and conservation of vehicles	Eurostat (1990-2004; since 2005 any occurring emissions are considered negligible)	DS: see Chapter 4.2.11.2 subparagraph 5
		060409	Vehicles dewaxing	Not included (emissions are negligible)	NA
		060412	Other (preservation of seeds,...)	Reported by operators (since 2000)	PS: facility specific
	Other product use	060601	Use of fireworks	Statistics Estonia	NA
		060602	Use of tobacco	Statistics Estonia	DS: 4.84 kg/Mg tobacco (GB2016)
		060603	Use of shoes	Not included	NA
		060604	Other	Not included	NA

Emissions, other than NMVOC, are taken from the OSIS database (reported by operators and are facility specific), except emissions from fluorescent tubes, fireworks and tobacco use, where Tier 2 emission factors are taken from the EMEP/EEA Guidebook 2016.

The facilities that are obliged to have an ambient air pollution permit or IPPC permit, submit their annual air emissions and activity data into OSIS database by point sources. The ambient air pollution permit is required for facilities where total NMVOC emissions are more than 0.5 tonnes per year.

The data collected in the annual air emissions report for the solvent use are:

- Class – solvent, varnish, adhesive, paint or other chemicals that do not fall into any other previously named categories, such as hardeners, stains, resins, etc.;
- Type – water based (WB) or solvent based (SB);
- Total NMVOC content of the used chemical in mass%;

- Activity or technological process by the SNAP activity codes where the reported chemical has been used;
- The annual consumption of solvent or solvent containing mixture (i.e. paint, varnish, adhesive or other chemical) in tonnes per year;
- Emissions of pollutants by the used solvent or solvent containing mixture – CAS number, name of the substance, NMVOC emission in tonnes per year;
- The number of a source of pollution on a plan or map of the facility.

4.2.4. Uncertainty

An uncertainty analysis was carried out to the year 2015 inventory. The uncertainty in the emission factors for NMVOC from solvent and other product use is estimated in the range from 20% to 100%, for NO_x and SO_x 50%, for ammonia and particulates 50-100%; in the activity data in the range from 2% to 5%. Uncertainty estimates for solvent and other product use are given in [Table 4.22](#).

Table 4.22 Uncertainties in solvent and other product use sector

Pollutant	Emission, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	0.003414	kt	0.010	0.01%	0.0003%
NMVOC	5.218813	kt	23.460	9.33%	2.36%
SO _x	0.001424	kt	0.004	0.002%	0.0003%
NH ₃	0.010505	kt	0.102	0.05%	0.01%
PM _{2.5}	0.073476	kt	0.797	0.40%	0.13%

Pollutant	Emission, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
PM ₁₀	0.096088	kt	0.691	0.35%	0.11%
TSP	0.115668	kt	0.587	0.26%	0.02%
CO	0.106558	kt	0.077	0.04%	0.01%
Pb	0.367648	t	1.079	0.54%	0.09%
Cd	0.010519	t	1.309	0.66%	0.07%
Hg	0.004939	t	0.841	0.49%	0.07%
PCDD/F	0.000182	g I-TEQ	0.004	0.01%	0.001%
B(a)p	0.000202	t	0.009	0.02%	0.02%
B(b)f	0.000082	t	0.003	0.01%	0.01%
B(k)f	0.000082	t	0.006	0.01%	0.01%
I(1,2,3-cd)p	0.000082	t	0.005	0.01%	0.01%
HCB	NA	kg	NA	NA	NA
PCB	NA	kg	NA	NA	NA

4.2.5. Domestic Solvent Use Including Fungicides (NFR 2D3a)

4.2.5.1. Source Category Description

Emissions occur due to the evaporation of NMVOCs contained in the products during their

domestic use. This category does not include the use of decorative paints, which is covered under NFR 2D3d coating applications.

The products sold for public use can be divided into a number of categories presented in the [Table 4.23](#).

Table 4.23 Description of the product categories used in the NFR category 2D3a

Category	Description
Cosmetics and toiletries	Products for the maintenance or improvement of personal appearance, health or hygiene.
Household (cleaning) products	Products used to maintain or improve the appearance of household durables.
Construction/DIY	Products used to improve the appearance or the structure of buildings such as adhesives and paint remover. This sector would also normally include coatings; however these fall outside the scope of this chapter and are therefore omitted.
Car care products	Products used for improving the appearance of vehicles to maintain vehicles, or winter products such as antifreeze.
Pesticides	Pesticides, such as garden fungicides, herbicides and insecticides, and household insecticide sprays may be considered as consumer products. Most agrochemicals, however, are produced for agricultural use and fall outside the scope of this chapter.

Pesticides such as garden herbicides and insecticides and household insecticide sprays may be considered as consumer products. Most agrochemicals, however, are produced for agricultural use and fall outside the scope of this sector. Domestic use of pharmaceutical products and emissions of other pollutants, such as mercury (Hg), are also included in this category.

For most products, all of the NMVOC will be emitted into the atmosphere. However, in some

products the NMVOC will be lost mainly in wastewater.

In 2017, NMVOC emissions from the NFR 2D3a sector decreased by 61.2% compared to the year 1990.

4.2.5.2. Methodological Issues

The Tier 1 default method uses a single emission factor expressed on a per-person basis to derive an emission estimate for the activity by

multiplying the emission factor with the population of the country.

Tier 1 emission factor is used for calculations. The following equation is applied:

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

where

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

$AR_{\text{production}}$ = the activity rate for the population;

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

At the moment there is no detailed information about the use of domestic solvent products in Estonia, thus the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 (Chapter 2.D.3.a Domestic solvent use including fungicides, Table 3.1 on Page 8) Tier 1 NMVOC emission factor 1.2 kg/capita is used to calculate NMVOC emissions from the NFR sector 2D3a for the years 2005 and onward.

Although the EMEP/EEA Guidebook 2016 provides so-called Tier 2b emission factors for NMVOC emission calculations using population as activity data, it is recommended that those emission factors are to be used only then, when the product statistics for the use of Tier 2a approach is not complete in terms of the product types covered by domestic solvent use.

Table 4.24 presents the EMEP/EEA Guidebook 2016 default Tier 2b emission factors for NFR source category 2D3a for NMVOC by the four main subcategories: household products, car care products, cosmetics and toiletries, DIY/buildings in addition to pharmaceutical products and other various products and a Tier 2 emission factor for calculating Hg emissions from the use of fluorescent tubes. For those Tier 2b emission factors the share for different product categories has been calculated and those shares are being used to divide NMVOC emission, using Tier 1 emission factor, between different product types covered in the Guidebook 2016.

Table 4.24 Tier 2 emission factors for NFR source category 2D3a domestic solvent use including fungicides

Source category	Pollutant	Tier 2 EFs	Unit	Share, %	EFs to Tier 1	Unit
Domestic solvent use including fungicides, total	Σ NMVOC	2,462	g/person	100.0	1,200	g/person
Household products (aerosol)	NMVOC	200	g/person	8.1	97	g/person
Household (cleaning) products – aerosols	NMVOC	201	g/person	8.2	98	g/person
Household (cleaning) products – non-aerosols	NMVOC	252	g/person	10.2	123	g/person
Car care product – aerosol	NMVOC	161	g/person	6.5	78	g/person
Car care product – non-aerosol	NMVOC	303	g/person	12.3	148	g/person
Cosmetics and toiletries – aerosol	NMVOC	355	g/person	14.4	173	g/person
Cosmetics and toiletries – non-aerosol	NMVOC	494	g/person	20.1	241	g/person
DIY/buildings – adhesives	NMVOC	76	g/person	3.1	37	g/person
DIY/buildings – paint thinner	NMVOC	205	g/person	8.3	100	g/person
DIY/buildings – paint and varnish removers, solvents	NMVOC	68	g/person	2.8	33	g/person
DIY/buildings – sealants, filling agents	NMVOC	23	g/person	0.9	11	g/person
Pharmaceutical products (SNAP 060411)	NMVOC	48	g/person	1.9	23	g/person
Pesticides	NMVOC	76	g/person	3.1	37	g/person
Domestic solvent use including fungicides (fluorescent tubes)	Hg	5.6	mg/person	–		

NMVOC emissions for years 1990-2000 are calculated using EMEP/Corinair Emission Inventory Guidebook 2007 Tier 1 default emission factor for domestic solvent use 2.59 kg/capita, because it describes probably better the situation

in 1990s when high NMVOC containing products were produced and used. The emission factors for years 2001-2004 are interpolated gradually:

- 2001 – 2.312 kg/capita;
- 2002 – 2.034 kg/capita;

- 2003 – 1.756 kg/capita;
- 2004 – 1.478 kg/capita.

4.2.5.3. Activity Data and Results

The basic activity statistics for using the Tier 1 emission factor are national population figures obtained from the Statistics Estonia (see [Table 4.25](#)).

Table 4.25 NMVOC and Hg emissions from domestic solvent use (other than paint application) and the population of Estonia in the period of 1990-2017

Year	Population, mln. inhab.	NMVOC emissions by domestic solvent use categories, kt						
		Household products (aerosol)	Household (cleaning) products: aerosols	Household (cleaning) products: non-aerosols	Car care product: aerosol	Car care product: non-aerosol	Cosmetics and toiletries: aerosol	Cosmetics and toiletries: non-aerosol
1990	1.571	0.330	0.332	0.416	0.266	0.501	0.587	0.816
1995	1.448	0.305	0.306	0.384	0.245	0.462	0.541	0.753
2000	1.401	0.295	0.296	0.371	0.237	0.447	0.523	0.728
2005	1.359	0.132	0.133	0.167	0.107	0.201	0.235	0.327
2006	1.351	0.132	0.132	0.166	0.106	0.199	0.234	0.325
2007	1.343	0.131	0.132	0.165	0.105	0.198	0.232	0.323
2008	1.338	0.130	0.131	0.164	0.105	0.198	0.232	0.322
2009	1.336	0.130	0.131	0.164	0.105	0.197	0.231	0.322
2010	1.333	0.130	0.131	0.164	0.105	0.197	0.231	0.321
2011	1.330	0.130	0.130	0.163	0.104	0.196	0.230	0.320
2012	1.325	0.129	0.130	0.163	0.104	0.196	0.229	0.319
2013	1.320	0.129	0.129	0.162	0.104	0.195	0.228	0.318
2014	1.316	0.128	0.129	0.162	0.103	0.194	0.228	0.317
2015	1.313	0.128	0.129	0.162	0.103	0.194	0.228	0.317
2016	1.316	0.128	0.129	0.162	0.103	0.194	0.228	0.317
2017	1.316	0.128	0.129	0.162	0.103	0.194	0.228	0.317

Table 4.25 continues

Year	NMVOC emissions by domestic solvent use categories, kt							Hg emissions, kg
	DIY/building: adhesives	DIY/building: paint thinner	DIY/building: paint and varnish removers, solvents	DIY/building: sealants, filling agents	Pharmaceutical products (SNAP 060411)	Pesticides	Total (SNAP 060408)	Fluorescent tubes
1990	0.126	0.339	0.112	0.038	0.079	0.126	4.068	8.795
1995	0.116	0.312	0.104	0.035	0.073	0.116	3.751	8.109
2000	0.112	0.302	0.100	0.034	0.071	0.112	3.629	7.847
2005	0.050	0.136	0.045	0.015	0.032	0.050	1.631	7.610
2006	0.050	0.135	0.045	0.015	0.032	0.050	1.621	7.564
2007	0.050	0.134	0.045	0.015	0.031	0.050	1.612	7.520
2008	0.050	0.134	0.044	0.015	0.031	0.050	1.606	7.495
2009	0.049	0.133	0.044	0.015	0.031	0.049	1.603	7.480
2010	0.049	0.133	0.044	0.015	0.031	0.049	1.600	7.466
2011	0.049	0.133	0.044	0.015	0.031	0.049	1.596	7.446
2012	0.049	0.132	0.044	0.015	0.031	0.049	1.590	7.421
2013	0.049	0.132	0.044	0.015	0.031	0.049	1.584	7.393
2014	0.049	0.131	0.044	0.015	0.031	0.049	1.579	7.369
2015	0.049	0.131	0.044	0.015	0.031	0.049	1.579	7.354
2016	0.049	0.131	0.044	0.015	0.031	0.049	1.579	7.369
2017	0.049	0.131	0.044	0.015	0.031	0.049	1.579	7.368

4.2.5.4. Source-Specific QA/QC and Verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions are compared to the previous years in order to detect calculation errors.

4.2.5.5. Source-Specific Planned Improvements

There is an ongoing investigation for acquiring detailed activity data from the Statistics Estonia so that it is possible to use a Tier 2 methodology for emission calculations, but it is not certain, that those emissions could be reported during the 2020 submission.

4.2.6. Coating Application (NFR 2D3d)

4.2.6.1. Source Category Description

The use of paint is a major source of NMVOC emissions; they comprise about 9% of total NMVOC emissions in the CORINAIR90 inventory. This number may have changed over time, but it is certain that paint use is still one of the main sources of NMVOC. The use of paints is generally not considered relevant for emissions of particulate matter or heavy metals and POPs.

Most paints contain organic solvent, which must be removed by evaporation after the paint has been applied to a surface in order for the paint to dry or 'cure'. Unless captured and either recovered or destroyed, these solvents can be considered to be emitted into the atmosphere. Some organic solvent may be added to coatings before application, which will also be emitted. Further solvent used for cleaning coating equipment is also emitted.

The proportion of organic solvent in paints can vary considerably. Traditional solvent based paints contain approximately 50% organic

solvents and 50% solids. In addition, more solvent may be added to further dilute the paint before application. High solids and water based paints both contain less organic solvent, typically less than 30%, while powder coatings and solvent free liquid coatings contain no solvent at all.

The most important pollutant released from painting activities is NMVOC. Particulate matter can also be emitted where spraying is used as an application technique; however, many spraying operations are carried out in spray booths fitted with some type of particulate arrestment device. As mentioned earlier, heavy metal compounds used as pigments could be emitted into the air; however, no emission factors are available.

Due to the wide range of paint applications and the even larger number of paint formulations available, there must be considerable scope for uncertainty in emission factors. Due to developments in paint formulation, the emission factors may only be valid for a short period. Therefore, improved emission factors are especially required for controlled processes.

Another aspect is the variation of paint types. This requires good activity data, which may not be present, particularly with the increasing use of alternatives to high solvent paints.

By 2017, NMVOC emissions from this sector had increased by 56.4% compared to 1990.

Coating application is divided into three major categories:

- 1) Decorative coating application;
- 2) Industrial coating application;
- 3) Other coating application.

Decorative coating application activity refers to two sub-categories of paint application:

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

This category refers to the use of paints for architectural application by construction enterprises and professional painters.

- Paint application: domestic use (SNAP activity 060104)

This category refers to the use of paints for architectural or furniture applications by private consumers. It is good practice not to include other domestic solvent use. However, it is sometimes difficult to distinguish between solvents used for thinning paints and solvents used for cleaning.

Industrial coating application describes the following sub-categories of paint application:

- manufacture of automobiles (SNAP activity 060101);
- car repairing (SNAP activity 060102);
- coil coating (SNAP activity 060105);
- boat building (SNAP activity 060106);
- wood (SNAP activity 060107) and
- other industrial paint application (SNAP activity 060108).

Most of the sub-categories are expected to be covered by air pollution or IPPC permits. The only sector not expected to be fully covered by air pollution permits is car repairing.

Other coating application (SNAP activity 060109 – other non-industrial paint application) refers to the use of high performance protective and/or anti corrosive paints applied to structural steel, concrete and other substrates together with any other non-industrial coatings not covered by any of the other SNAP codes described in the “Coating applications” section. The sector includes coatings for offshore drilling rigs, production platforms and similar structures as well as road marking paints and non-decorative floor paints. Most paint is applied in-situ by brushing, rolling or spraying, although a significant proportion of new-construction steelwork may be coated in-store.

It is estimated that this sector is not very important and emissions are estimated with decorative coating application because it is very complicated to distribute paint use between decorative coating and other coating application activities.

4.2.6.2. Methodological Issues and Activity Data

The quantity of paints and lacquers used in total in Estonia is estimated through the data that has been collected by Statistics Estonia (from the year 1995), and from the OSIS air emissions database for point sources (from the year 2006). The amounts of coatings used are distinguished between solvent and water-based paints, which means that a Tier 2 methodology has been applied for diffuse sources and a Tier 3 methodology for point sources.

The production data is collected from Statistics Estonia using the following combined nomenclature (CN) codes: 3208 (solvent-based), 3209 (water-based), and 3210.00.10 and 3210.00.90 (other paints and varnishes). The corresponding PRODCOM codes for import and export details are 20.30.12.00, 20.30.11.00, 20.30.22.13, and 20.30.22.15. Information which is related to imports and exports is not available for the years 1990-1994; therefore, these amounts were calculated using the change in current prices at that time in the industrial production of chemicals and chemical products.

The equations for calculating the amounts of coatings used is:

$$AR_{used} = AR_{import} - AR_{export} + AR_{production}$$

where:

AR_{used} = the amount of coatings used

AR_{import} = the amount of imported coatings

AR_{export} = the amount of exported coatings

$AR_{production}$ = the amount of produced coatings

As there is no information on stock data for the end of the year, it is assumed that all coatings have been used in the specific year.

When it comes to calculating emissions from diffuse sources, the activity data which was reported by facilities into the OSIS database has been subtracted from data collected by Statistics Estonia. Detailed activity data (involving class and type of chemical) for point sources in the OSIS database has been available since 2006. The

share of paint used in point sources against the entire amount of paint used in Estonia comprises between 4.5% in 2006 up to 26.8% in 2017. This is due to the fact that, over time, more solvent users were being permitted and thanks to that they have an annual reporting obligation. Emissions without activity data for the period of 1990-1999 are received from facilities via paper reports; emissions for the period of 2000-2005 were

submitted into the CollectER database by an ESTEA air specialist, but they are also based on paper reports which have been received from facilities.

Table 4.26 provides an overview of emission factors used in calculating NMVOC emissions from coating application activities.

Table 4.26. Emission factors used to calculate NMVOC emissions from coating applications (NFR 2D3d)

*PS - point sources

*DS - diffuse sources

*GB - guidebook

*SB - solvent-based

*WB - water-based

SNAP	SNAP name	Chemical Type	Value	Unit	Tier	Source	Comment
060100	Paint application	All types	400	g/kg paint applied	1	GB2016, Chapter 2.D.3.d Coating applications; Table 3-2	PS: to reverse calculate the amounts of coatings used in the 1990-2005 period
060102	Paint application: car repairing	SB	720	g/kg paint applied	2	GB2016, Chapter 2.D.3.d Coating applications; Table 3-7	DS: for the years 1990-2006. For 2007 and onwards, annual IEFs from point sources are applied.
060102	Paint application: car repairing	WB	216	g/kg paint applied	2	GB2016, Chapter 2.D.3.d Coating applications; Table 3-7 in combination with Table 3-17; Abatement efficiency is taken for "Substitution with dispersion/emulsion, water-based and high solids paints" (Efficiency 70%)	DS: for the years 1990-2007. For 2008 and onwards, annual IEFs from point sources are applied.
060103	Paint application: construction and buildings	SB	230	g/kg paint applied	2	GB2016, Chapter 2.D.3.d Coating applications; Table 3-4	DS: for the whole time series
060103	Paint application: construction and buildings	WB	69	g/kg paint applied	2	GB2016, Chapter 2.D.3.d Coating applications; Table 3-4 in combination with Table 3-17; Abatement efficiency is taken for "Substitution with dispersion/emulsion, water-based and high solids paints" (Efficiency 70%)	DS: for the whole time series
060103	Paint application: construction and buildings	Other paints and varnishes (SB; WB)	149.5	g/kg paint applied	2	Average taken from the sum of 230 g/kg and 69 g/kg	DS: for the whole time series. Expert estimate; calculated as an average of SB and WB emissions factors.

SNAP	SNAP name	Chemical Type	Value	Unit	Tier	Source	Comment
060104	Paint application: domestic use (except 060107)	SB	230	g/kg paint applied	2	GB2016, Chapter 2.D.3.d Coating applications; Table 3-5	DS: for the whole time series
060104	Paint application: domestic use (except 060107)	WB	69	g/kg paint applied	2	GB2016, Chapter 2.D.3.d Coating applications; Table 3-5 in combination with Table 3-17; Abatement efficiency is taken for "Substitution with dispersion/emulsion, water-based and high solids paints" (Efficiency 70%)	DS: for the whole time series
060104	Paint application: domestic use (except 060107)	Other paints and varnishes (SB; WB)	149.5	g/kg paint applied	2	Average taken from the sum of 230 g/kg and 69 g/kg	DS: for the whole time series. Expert estimate; calculated as an average of SB and WB emissions factors.

Decorative coating application

A decorative coating application (SNAP 060103 and 060104) only encompasses NMVOC emissions from diffuse sources. The paint used for a decorative coating application is estimated in the following way:

$$\text{Paint used for decorative coating application} = \text{Total paint used} - \text{Paint used by all point sources} - \text{Paint used in car repairs (diffuse sources)}$$

In order to divide paint between these groups, paint production companies and construction stores were contacted. The main paint production companies, some of which have no direct sales department, were not able to answer this question.

In addition, interviews conducted in large construction stores revealed that:

1. sales divisions by company and private customer depends upon the marketing policy of the store,
2. a change in the division between 1995 and 2017 also depends upon the marketing policy, and
3. in the years 2004-2007, an increase in paint use was caused mainly by a rapid increase in developments and construction; the increased use of paint was caused mainly by

professional painters and construction companies.

As a result of discussions, it is estimated that up to 60% of paint can be assigned to professional painters and the remaining 40% to private customers.

The EMEP/EEA Guidebook 2016 Tier 2 emissions factors (see [Table 4.26](#)) are used for NMVOC emission calculations. The general equation is:

$$E_{\text{NMVOC}} = AR_{\text{used}} \times EF_{\text{NMVOC,technology}}$$

where:

E_{NMVOC} = NMVOC emissions

AR_{used} = the amount of coatings used in diffuse sources

$EF_{\text{NMVOC,technology}}$ = the emissions factor for this technology and NMVOC

Tier 2 emission factors for solvent-based paints are taken from the Tables 3-4 and 3-5 of the EMEP/EEA Guidebook 2016, from the chapter '2.D.3.d Coating applications'. Emission factors for water-based paints are calculated from the emission factors for solvent-based paints using the abatement efficiencies default value of 70% which is shown in Table 3-17 and which describes the rate of substitution for solvent-based paints with water-based paints, calculated as follows:

$230 \text{ g/kg paint applied} \times (100\% - 70\%) = 69 \text{ g/kg paint applied}$. The emission factor for other paints and varnishes where it is impossible to distinguish between solvent and water-based products, when it comes to the amount of paint used, has an average emission factor calculated as follows: $(230 \text{ g/kg paint applied} + 69 \text{ g/kg paint applied}) / 2 = 149.5 \text{ g/kg paint applied}$. Emission factors are applied for the entire time series and, at the moment, they don't take into account the impact that EU Directive 2004/42/EC has had when it came into force on 1 January 2007. This is most especially valid for the time period before 2007, when VOC content in decorative and vehicle refinishing paint products was not regulated and NMVOC emissions from the use of those products was probably higher.

Industrial coating application

Industrial coating application mostly covers pollutant emissions from point sources and, therefore, is considered to be as a Tier 3 methodology. To a small degree, industrial coating application also includes diffuse sources emissions from car repairs. There is no statistical information regarding the amount of paint used

for car repairs. Therefore expert opinion was sought from a representative of the 'repair unit' at the Association of Estonian Automobile Sales and Maintenance Companies.

The expert opinion in question was supplied by Benefit AS, which is the leading car body and car paint shops technology and materials supplier in Estonia. The total amount of paint used for car repairs in Estonia is estimated to have risen from 100 tonnes in 1990 to 218.8 tonnes in 2017. As this is a rough estimate, the annual growth is estimated to be equal. The EMEP/EEA Guidebook 2016 Tier 2 emission factors are used for diffuse sources: 1) for solvent-based paints for the 1990-2006 period; 2) for water-based paints for the 1990-2007 period. For subsequent period, implied emission factors (see [Table 4.27](#)) are applied for emission calculations from diffuse sources.

Precisely how much paint has been used by all the permitted companies between 1990 and 2005 is unknown. Therefore, a reverse calculation is carried out by applying the EMEP/EEA Guidebook 2016 Tier 1 NMVOC emission factor of 400 g/kg paint applied for industrial coating application.

Table 4.27 Implied emission factors from point sources for solvent and water-based refinishing products in car repair coating applications (g/kg paint applied)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
WB	-	181	255	234	76	110	113	114	133	151	143
SB	569	443	448	341	349	332	364	421	449	456	453

Emissions

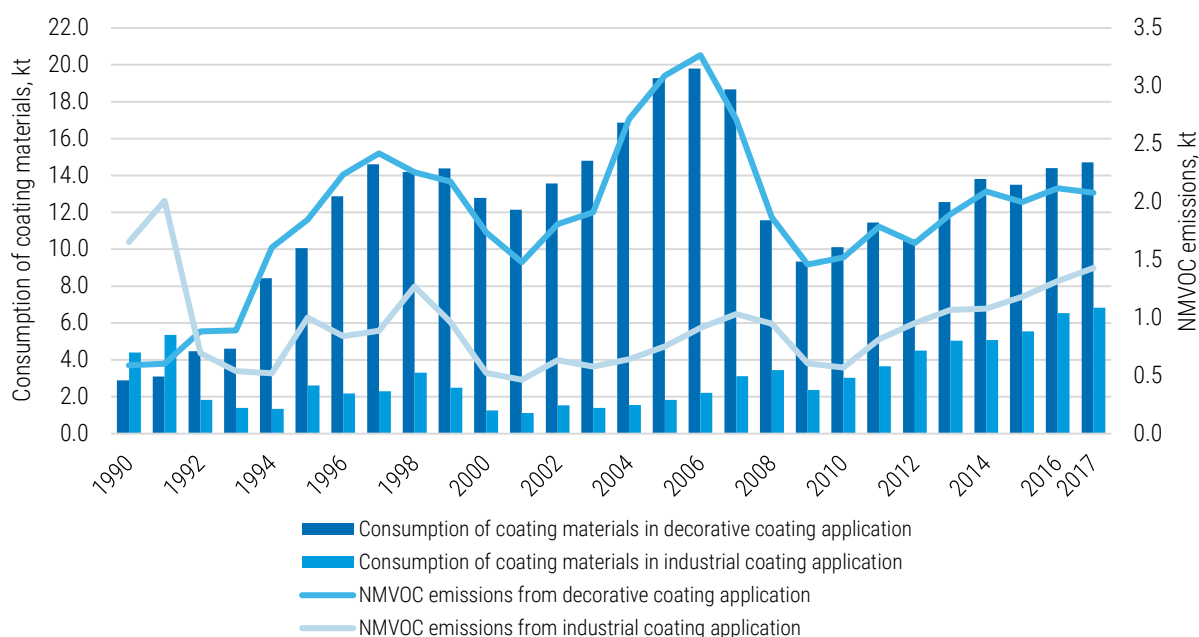


Figure 4.13 The consumption of coating materials and NMVOC emissions from decorative and industrial coating applications in the period of 1990-2017

The huge drop in industrial paint consumption and NMVOC emissions in 1992 (see [Figure 4.13](#)) was due to the renewed independence of the Estonian Republic and the cessation of large-scale production which was distinctive of the

Soviet Union. A huge restructuring took place in industry, and many of the large enterprises went bankrupt and were shut down due to inefficient operation.

Table 4.28 NMVOC emissions and the consumption of coating materials from decorative paint application by SNAP codes in the period of 1990-2017 (kt)

SNAP Year	060103		060104	
	NMVOC	Activity data	NMVOC	Activity data
1990	0.354	1.734	0.236	1.156
1995	1.108	6.034	0.739	4.023
2000	1.041	7.674	0.694	5.116
2005	1.854	11.563	1.236	7.709
2006	1.959	11.881	1.306	7.921
2007	1.626	11.205	1.084	7.470
2008	1.120	6.941	0.747	4.628
2009	0.876	5.598	0.584	3.732
2010	0.913	6.067	0.608	4.044
2011	1.071	6.869	0.714	4.579
2012	0.987	6.299	0.658	4.199
2013	1.136	7.533	0.757	5.022
2014	1.253	8.291	0.835	5.527
2015	1.199	8.096	0.799	5.398
2016	1.270	8.645	0.847	5.763
2017	1.247	8.829	0.832	5.886

Table 4.29 NMVOC emissions and consumption of coating materials from industrial paint application by SNAP codes in the period of 1990-2017 (kt)

SNAP	060100		060101		060102		060105		060106		060107		060108	
Year	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data
1990	1.575	4.229	NA	NA	0.052	0.100	NA	NA	IE	IE	IE	IE	0.025	0.063
1995	0.795	2.135	NA	NA	0.063	0.122	NA	NA	IE	IE	0.047	0.119	0.094	0.236
2000	--	--	NA	NA	0.075	0.144	NA	NA	0.117	0.292	0.119	0.298	0.211	0.528
2005	--	--	0.002	0.004	0.086	0.166	NA	NA	0.131	0.329	0.184	0.459	0.350	0.874
2006	--	--	0.003	0.006	0.088	0.168	NA	NA	0.171	0.505	0.400	0.883	0.250	0.650
2007	--	--	0.002	0.002	0.089	0.147	NA	NA	0.357	1.126	0.437	1.191	0.147	0.659
2008	--	--	NA	NA	0.074	0.182	NA	NA	0.335	1.024	0.369	1.188	0.170	1.050
2009	--	--	NA	NA	0.061	0.186	NA	NA	0.160	0.477	0.299	1.362	0.084	0.343
2010	--	--	NA	NA	0.052	0.192	NA	NA	0.157	0.575	0.239	1.526	0.122	0.730
2011	--	--	NA	NA	0.044	0.196	NA	NA	0.135	0.470	0.448	2.056	0.187	0.938
2012	--	--	NA	NA	0.052	0.207	0.002	0.005	0.109	0.385	0.527	2.723	0.263	1.193
2013	--	--	NA	NA	0.068	0.220	0.011	0.021	0.117	0.385	0.567	3.158	0.304	1.257
2014	--	--	NA	NA	0.081	0.234	0.013	0.024	0.101	0.355	0.589	3.228	0.295	1.259
2015	--	--	NA	NA	0.084	0.336	0.010	0.018	0.087	0.264	0.655	3.539	0.345	1.396
2016	--	--	NA	NA	0.107	0.469	0.008	0.014	0.083	0.303	0.672	3.776	0.444	1.978
2017	--	--	NA	NA	0.115	0.289	0.011	0.021	0.079	0.342	0.664	4.405	0.559	1.775

NMVOC emissions presented in the [Table 4.29](#) are collected from point sources. Emissions for the period of 1990-1999 are received from facilities on paper reports; emissions for the period of 2000-2005 were submitted into the CollectER database by an ESTEA air specialist, but they are also based on the paper reports received from facilities. Since 2006 detailed emissions and activity data are reported electronically by facilities directly into the OSIS database.

For some years the coating application sector also includes fine and ultra-fine particulate matter emissions which are collected from the OSIS point sources database.

Information on which sectors include the condensable component of PM₁₀ and PM_{2.5} can be found in Appendix 1 'Summary Information on Condensable in PM'.

4.2.6.3. Source-Specific QA/QC and Verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions and emission data from the OSIS database are compared to the

previous years in order to detect calculation errors, errors in the reported data or in allocation. The reasons behind any fluctuation in the emission figures are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by the specialists in the Estonian Environment Agency.

4.2.6.4. Source-Specific Planned Improvements

Some corrections and recalculations of the NMVOC emissions from the point sources for the years 1990-1999 are planned. Primarily, they will concern the emissions currently under SNAP 060100, which need to be distributed under the correct SNAP code. Also, the emissions under the SNAP codes 060107 and 060108 need to be revised for that period.

4.2.7. Degreasing (NFR 2D3e)

4.2.7.1. Source Category Description

The metalworking industries are the major users of solvent degreasing. Solvent degreasing is also

used in industries such as printing and in the production of chemicals, plastics, rubber, textiles, glass, paper, and electric power. Also, repair stations for transportation vehicles use solvent cleaning on occasion. Therefore, a wide range of activities is covered.

The contribution of metal degreasing to total NMVOC emissions (including natural sources) is about 1.8% in CORINAIR countries (CORINAIR 1990 inventory). In addition, metal degreasing could be a significant source of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) (ETC/AEM-CITEPA-RISOE, 1997¹¹).

Metal degreasing by using organic solvents takes place in either open top or closed tanks. The open top tanks, however, have been phased out in the European Union due to the Solvent Emissions Directive 1999/13/EC. Only small facilities which use no more than 1 or 2 tonnes of solvent per year (depending on the risk profile of the solvent) are still permitted to use open top tanks. Closed tanks offer much better opportunities for the recycling of solvents.

In 2017, NMVOC emissions from this sector had decreased by 48.3% in comparison to the year 1990.

Vapour Cleaning

The most common organic solvents for vapour cleaning are:

- methylene chloride (MC);
- tetrachloroethylene (PER);
- trichloroethylene (TRI);
- xylenes (XYL).

The use of chlorofluorocarbons (CFC) in the past is now displaced by HFCs or PFCs. The use of 1,1,1-trichloroethane (TCA) has been banned since the Montreal Protocol and replaced by TRI. Further details of the calculation of the emissions can be found in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The application of MC, PER and TRI normally requires a closed cleaning machine.

Cold Cleaning

The two basic types of cold cleaners are maintenance and manufacturing. Cold cleaners are batch loaded, non-boiling solvent degreasers, usually providing the simplest and least expensive method of metal cleaning. Maintenance cold cleaners are smaller, more numerous, and they generally use petroleum solvents as mineral spirits (petroleum distillates and Stoddard solvents).

Cold cleaner operations include spraying, brushing, flushing, and immersion. In a typical maintenance cleaner, dirty parts are cleaned manually by first spraying and then soaking in the tank. After cleaning, the parts are either suspended over the tank to drain or are placed on an external rack that directs the drained solvent back into the cleaner. The cover is intended to be closed whenever parts are not being handled in the cleaner. Typical manufacturing cold cleaners vary widely in design, but there are two basic tank designs: the simple spray sink and the dip tank. Of these, the dip tank provides more thorough cleaning through immersion, and often the cleaning efficiency is improved by agitation. Small cold cleaning operations may be numerous in urban areas.

4.2.7.2. Methodological Issues

The EMEP/EEA Guidebook 2016 Tier 2 emission factor 710 g/kg cleaning products for the open-top degreaser is used for NMVOC emission calculations taking into account the penetration of different technologies and replacing the technology-specific emission factor with an abated emission factor as given in the formula:

$$EF_{technology,abated} = (1 - \eta_{abated}) \times EF_{technology}$$

where,

$EF_{technology,abated}$ = emission factor for specific technology taking into account the abatement efficiency;

η_{abated} = abatement efficiency;

¹¹¹¹ ETC/AEM-CITEPA-RIOSE (1997). Selected nomenclature for air pollution for Corinair94 inventory (SNAP 94), version 0.3 (draft).

$EF_{\text{technology}}$ = emission factor for specific technology.

The general equation for emission calculations is:

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

where

$E_{\text{pollutant}}$ = the emission of the specified pollutant;
 $AR_{\text{production}}$ = the activity rate for the paint application (consumption of paint);

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

Five different process types (together called 'technologies') are taken into account which are:

- Open-top degreaser;

- Semi open-top degreaser;
- Sealed chamber system using chlorinated solvents;
- Cold cleaner.

As there is no information on emission factors for all of those technologies, it is assumed that the emission factor for those technologies is the same as presented in the EMEP/EEA Guidebook 2016 for the open-top degreasers. The [Table 4.30](#) below presents used emission factors and the reduction efficiencies for degreasing which are taken from the Table 3-2 presented in the Chapter '2.D.3.e Degreasing' of the EMEP/EEA Guidebook 2016.

Table 4.30 Tier 2 emission factors and abatement efficiencies for degreasing activities

Abatement technology	Pollutant	$EF_{\text{technology}}$, g/kg cleaning product	Efficiency, %	$EF_{\text{technology,abated}}$, g/kg cleaning product
Open-top degreaser	NMVOC	710	0	710
Semi open-top degreaser and good housekeeping	NMVOC	710	25	533
Semi open-top degreaser and good housekeeping with activated carbon	NMVOC	710	85	107
Sealed chamber system using chlorinated solvents	NMVOC	710	95	36
Cold cleaner	NMVOC	710	89	78

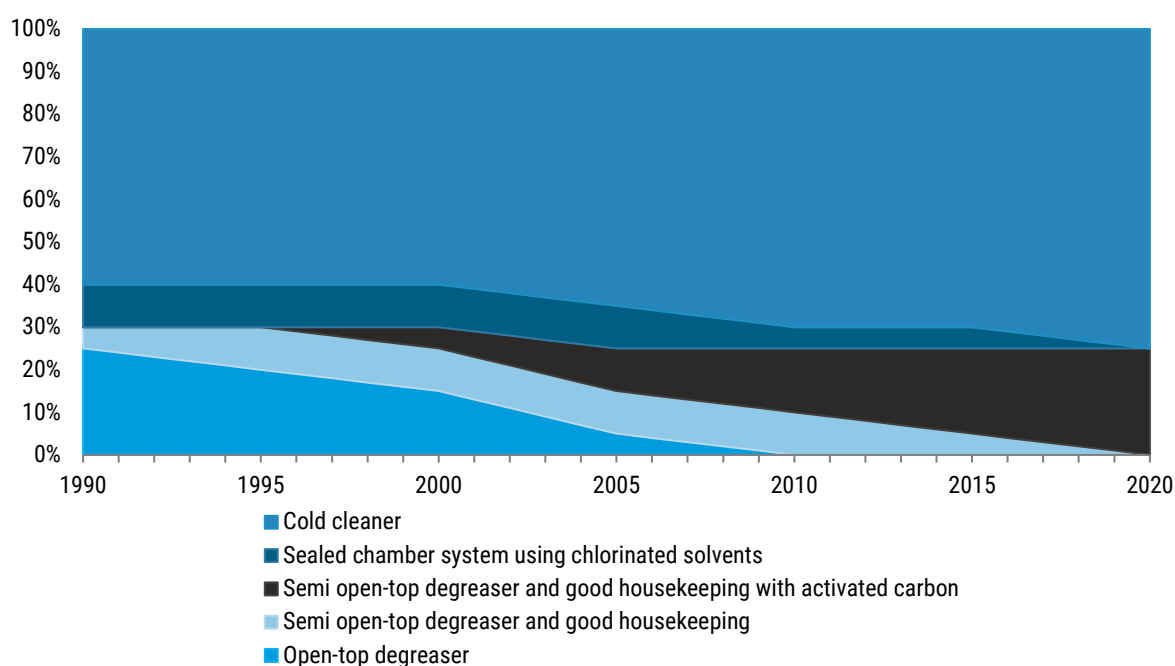
There is also no information available how different degreasing process types are stratified in Estonia, but an expert opinion has been formed in ESTEA how the penetration of different technologies within the degreasing industry could have been evolved (see

[Table 4.31](#)). The shares of different technologies within the pillar years have been interpolated (see

Figure 4.14).

Table 4.31 The shares of different technologies within the degreasing industry (for the pillar years)

Technology	1990	1995	2000	2005	2010	2015	2020
Open-top degreaser	25%	20%	15%	5%	0%	0%	0%
Semi open-top degreaser and good housekeeping	5%	10%	10%	10%	10%	5%	0%
Semi open-top degreaser and good housekeeping with activated carbon	0%	0%	5%	10%	15%	20%	25%
Sealed chamber system using chlorinated solvents	10%	10%	10%	10%	5%	5%	0%
Cold cleaner	60%	60%	60%	65%	70%	70%	75%

Figure 4.14 The shares of different technologies within the degreasing industry for the period of 1990-2020

For some years the degreasing sector also includes fine particulate matter emissions which are collected from the OSIS point sources database.

Information on which sectors include the condensable component of PM₁₀ and PM_{2.5} can be found in Appendix 1 'Summary Information on Condensable in PM'.

4.2.7.3. Activity Data

Consumption of the most common organic solvents for vapour cleaning methylene chloride (MC), tetrachloroethylene (PER), trichloroethylene (TRI) and xylenes (XYL) are used as a basis for emission calculations from degreasing.

As PER is also used for dry cleaning, this is not included as a degreaser.

The consumption of organic solvents is estimated by the import and export data from Statistics Estonia (by relevant CN codes) for the years 1995-2017. Data regarding import and export are not available for the years 1990-1994; therefore, these amounts were calculated by the change of percentage of the current prices in the industrial production of chemicals and chemical products in that period. There is no information available

regarding production data for the years 1990-2005. The OSIS database provides some information regarding xylenes production between 2006 and 2017.

As there is no information on stock data for the end of the year, it is assumed that all solvents have been used in the specific year.

4.2.7.4. Results

Part of the facilities report NMVOC emissions from degreasing operations as point sources. These are taken into account in the calculations of degreasing operations.

Between 2006 and 2017, the OSIS database received activity data regarding solvent use for degreasing in point sources.

For the years 2006-2017, activity data for calculations were calculated as follows:

$$\text{Solvent use in diffuse sources} = \text{Total solvent use} - \text{Solvent use in point sources}$$

Some companies reported emissions between 1995 and 2005, but without access to activity data. Emissions from point sources were subtracted from the total calculated NMVOC emission.

NMVOC emissions and the consumption of solvents from degreasing by SNAP codes in the

period of 1990-2017 are presented in the [Table 4.32](#).

Table 4.32 NMVOC emissions and the consumption of solvents from degreasing by SNAP codes in the period of 1990-2017

SNAP	060200		060201		060203		060204	
Year	NMVOC (vapour and cold cleaning), kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt
1990	0.180	0.705	NA	NA	NA	NA	NA	NA
1995	0.077	0.312	NA	NA	NA	NA	NA	NA
2000	0.084	0.389	NA	NA	0.001	0.001	NA	NA
2005	0.049	0.326	0.000	0.000	0.003	0.004	0.001	0.001
2006	0.048	0.388	0.002	0.003	0.018	0.056	0.005	0.006
2007	0.037	0.303	0.005	0.006	0.009	0.021	0.014	0.014
2008	0.023	0.229	0.001	0.001	0.013	0.026	0.032	0.038
2009	0.012	0.128	0.006	0.007	0.005	0.008	0.012	0.018
2010	0.015	0.159	0.011	0.012	0.005	0.008	0.016	0.020
2011	0.014	0.161	0.007	0.008	0.005	0.008	0.027	0.028
2012	0.009	0.129	0.005	0.006	0.003	0.008	0.040	0.036
2013	0.007	0.123	0.005	0.007	0.002	0.006	0.037	0.048
2014	0.000	0.081	0.011	0.013	0.005	0.009	0.035	0.057
2015	0.006	0.148	0.010	0.011	0.004	0.013	0.038	0.062
2016	0.008	0.173	0.008	0.009	0.003	0.005	0.056	0.077
2017	0.014	0.251	0.009	0.010	0.008	0.017	0.062	0.081

For the SNAP codes 060201, 060203 and 060204, emissions and solvent consumption are based only on the reported data from the point sources for the period 2000-2017.

4.2.7.5. Source-Specific QA/QC and Verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions and emission data from the OSIS database are compared to previous years in order to detect calculation errors, errors in the reported data or in allocation. The reasons behind any fluctuation in the emission figures are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by specialists from the ESTEA.

4.2.7.6. Source-Specific Planned Improvements

No major improvements are planned for the next submission.

4.2.8. Dry Cleaning (NFR 2D3f)

4.2.8.1. Source Category Description

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

Emissions arise from evaporative losses of solvent, primarily from the final drying of the clothes, known as deodorisation. Emissions may also arise from the disposal of wastes from the process.

The most widespread solvent used in dry cleaning, accounting for about 90% of total consumption, is tetrachloroethene (also called tetrachloroethylene or perchloroethylene (PER)). The most significant pollutants from dry cleaning are NMVOCs, including chlorinated solvents. Heavy metals and POPs emissions are unlikely to be significant.

4.2.8.2. Methodological Issues

In the Tier 1 approach, the emissions are estimated from solvent consumption data. Most of the solvent is recycled, but some is lost to the environment. This needs to be replaced and it can be assumed that the quantity of solvent used for replacement is equivalent to the quantity emitted plus the quantity taken away with the sludge.

Solvent emissions directly from the cleaning machine into the air represent about 80% of the solvent consumption (i.e. 80% of solvent used for the replacement of lost solvent) for open-circuit equipment and a little more than 40% for a closed-circuit machine. Open-circuit equipment, however, is no longer used within the EU following the European Solvents Directive coming into force. The remainder of the lost solvent is released into the environment in still residues or retained on cleaned clothes, but for the simpler methodology, it can be assumed that this eventually finds its way into the atmosphere (Passant, 1993¹²; UBA, 1989¹³). Also, a significant amount of the solvent goes back to the producers and to the recyclers, along with the sludge.

Solvent consumption data may be available from the industry and can be compared with a per capita emission factor. In addition, the proportion of solvent lost directly from the machine can also be estimated.

The Tier 1 default emission factors for NMVOC emissions from dry cleaning are a weighted

average, calculated from the sum of all activity and emission data from the GAINS model (IIASA, 2008¹⁴) – 40 g/kg textile treated.

Situation in Estonia

In order to understand the market situation, a descriptive interview with the representative of the main dry cleaning service provider, SOL Estonia, was carried out in 2010. SOL Estonia operates eight dry cleaning facilities in Tallinn, Pärnu, Kunda and Tartu.

Main findings for Estonia are:

- closed-circuit equipment is mainly used for dry cleaning;
- closed-circuit equipment was the main practice as far back as the 1990s;
- the main cleaning agent is PER (tetrachloroethylene / perchloroethylene);
- solvent waste (used solvent) is collected and given to hazardous waste companies;
- the quantity of cleaned textile is registered by cleaned items (for example, the number of cleaned coats or curtains), not by mass units.

In addition, four dry cleaning facilities were questioned by phone and e-mail. Questions and answers are presented in the [Table 4.33](#).

¹²12 Passant N.R. (1993). Emissions of Volatile Organic Compounds from Stationary Sources in the United Kingdom: A Review of Emission Data by Process.

¹³ UBA (1989). Luftreinhaltung '89 – Tendenzen – Probleme – Lösungen. Edited by the German Federal Protection Agency (Umweltbundesamt), Erich Schmidt Verlag GmbH, Berlin 1989.

¹⁴ IIASA (2008). Greenhouse Gas and Air Pollution Integrations and Synergies (GAINS) model, www.iiasa.ac.at/rains/gains-online.html.

Table 4.33 The results of the interviews with the dry cleaning operators

Question	Answers			
	Virumaa Puhastus	Euroclean	Pernau Pesumaja	Rea Pesumaja
Technology used?	Closed-circuit machines	Closed-circuit machines (automatic programs)	Closed-circuit machines with activated carbon	Closed-circuit machines
Cleaning agent used?	PER	PER	PER	PER
Quantity of cleaning agent?	30 kg per year	400 kg per year	165 kg per year	1,070 kg per year
Quantity of cleaned textiles?	ca 2,000 kg	Do not have statistics	Register by pieces (app. equal to 6.2 tonnes)	Register by pieces
Waste management?	Collected	Collected and given to hazardous waste company	Collected and given to hazardous waste company	Collected and given to hazardous waste company

4.2.8.3. Activity Data

As the quantity of textile treated is very difficult to estimate because even dry cleaning shops do not have the relevant statistics, solvent consumption is taken as a basis for NMVOC calculations.

Solvent emissions direct from the cleaning machine into the air represent about 80% of solvent consumption (i.e. 80% of solvent used for the replacement of lost solvent) for open-circuit equipment and a little more than 40% for a closed-circuit machine.

All dry cleaning facilities questioned have closed-circuit equipment and use PER as a cleaning agent. Used solvent goes to hazardous waste companies.

The quantity of PER used in Estonia can be estimated by import and export data. Data regarding import and export are not available for the years 1990-1994; therefore, these amounts were calculated by the change in percentage of the current prices in industrial production of chemicals and chemical products in that period.

As there is no information on stock data for the end of the year, it is assumed that all PER has been used in the specific year.

According to OSIS, no production of tetrachloroethylene/PER is reported for the years 2006-2017.

According to OSIS, a portion of PER emissions is reported as emissions from point sources. This is

also subtracted to determine the amount of PER emissions from diffuse sources.

4.2.8.4. Results

Perchloroethylene might also be used in the degreasing process. It is difficult to divide the consumption of PER between dry cleaning and degreasing, which is why all PER used in Estonia is deemed to be used for dry cleaning purposes.

The emission factor for degreasing is also 460 g/kg cleaning products, which is more or less about 40% of the used products. Because of that it is reasonable to use the emission factor 400 g/kg solvent use for dry cleaning activity.

Table 4.34 NMVOC emissions and the consumption of solvents from dry cleaning in the period of 1990-2017 (kt)

SNAP Year	060202	
	NMVOC	Activity data
1990	0.015	0.036
1995	0.025	0.062
2000	0.050	0.126
2005	0.062	0.149
2006	0.063	0.158
2007	0.054	0.131
2008	0.051	0.124
2009	0.022	0.052
2010	0.012	0.026
2011	0.019	0.042
2012	0.008	0.016
2013	0.039	0.093
2014	0.041	0.098
2015	0.030	0.071
2016	0.007	0.007
2017	0.007	0.013

For the dry cleaning sector for the years 1990 to 2001, only statistical data is used, whereas for the period of 2002 to 2017, both statistical and reported data are used.

4.2.8.5. Source-Specific QA/QC and Verification

Normal statistical quality checking related to the assessment of magnitude and trends has been carried out. Calculated emissions and emission data from the OSIS database are compared to previous years in order to detect calculation errors, errors in the reported data or in allocation. The reasons behind any fluctuation in the emission figures are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by specialists from the ESTEA.

4.2.8.6. Source-Specific Planned Improvements

No major improvements are planned for the next submission.

4.2.9. Chemical Products (NFR 2D3g)

4.2.9.1. Source Category Description

This chapter covers emissions from the use of chemical products. These include many activities

such as paints, inks, glues and adhesives manufacturing, polyurethane and polystyrene foam processing, tyre production, fat, edible and non-edible oil extraction and more. However, many of these activities are considered insignificant. For example, the total NMVOC emissions from these activities contributed just 0.6% to the total national NMVOC emissions in 2017 and only 1.9% to the whole solvent sector.

By 2017, NMVOC emissions from the chemical products sector had decreased by 74% compared to the year 1990.

4.2.9.2. Methodological Issues

This sector includes emissions from polyurethane, polystyrene foam and rubber processing, paints, inks and glues manufacturing, textile finishing, leather tanning and other chemical products manufacturing or processing activities under SNAP 060314. All emission estimates for the years 2006-2017 from the chemical products sector are based on emission data reported by operators in the OSIS database; hence they are divided by different SNAP codes. At present, only the total NMVOC emissions for the years 1990-2005 are known to be without any activity data. Also, for some activities within NFR 2D3h, the activity data is unknown for the period of 2006-2017.

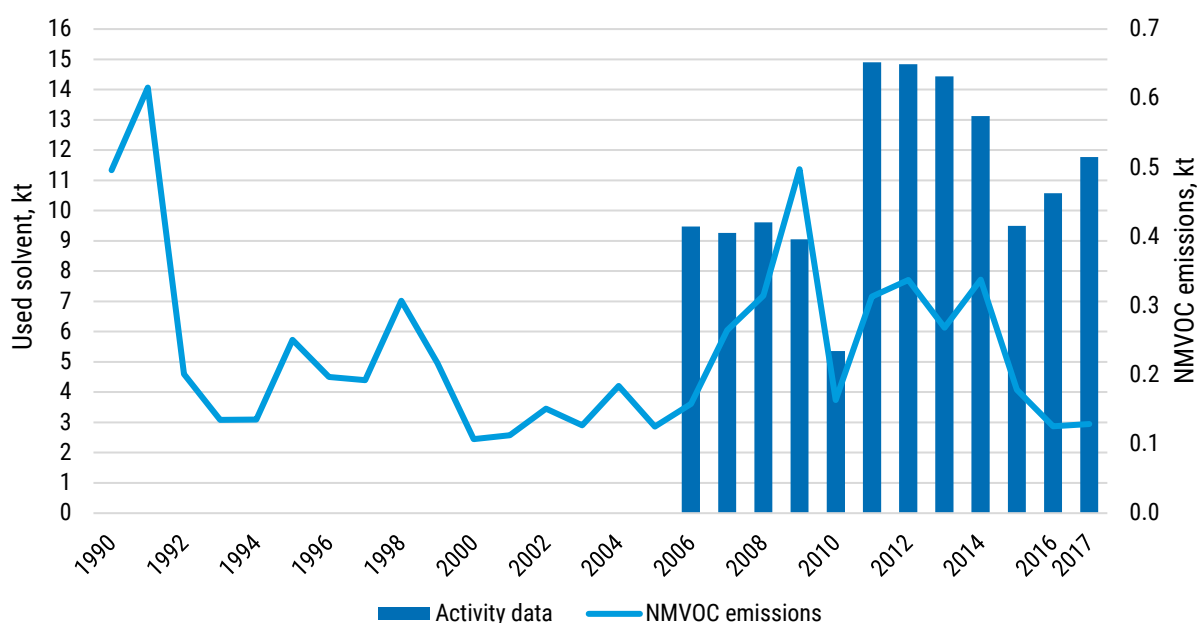


Figure 4.15 Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period of 1990-2017

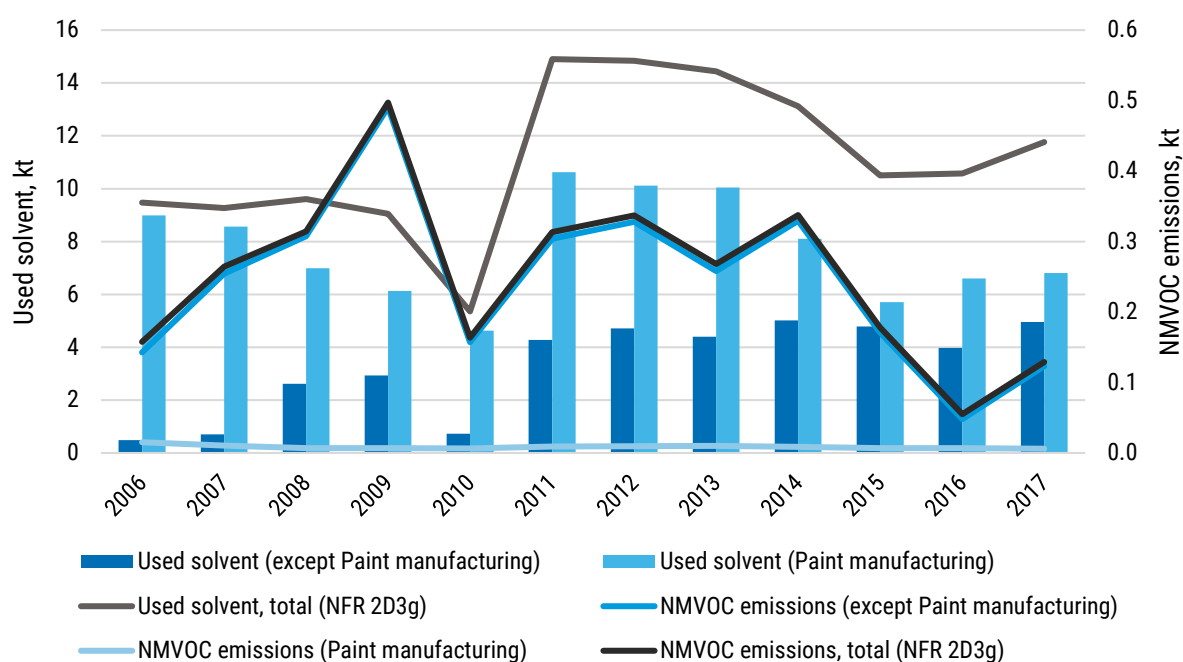


Figure 4.16 Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period of 2006-2017

Figure 4.16 explains quite well why Figure 4.15 indicates that NMVOC emissions still grew from 2006 to 2009, although the amount of used solvent remained almost constant through that period. It is clear that the dynamics of emissions are dependent on the changes in used solvent within the sector, except the solvent used in paint manufacturing. It is because the emissions in paint manufacturing are marginal and do not

affect the dynamics of the total NMVOC emissions in that sector.

NMVOC emissions for the period of 1990 to 2005 came only from point sources, but without the availability of the activity data for that period.

NMVOC emissions and the consumption of solvents from chemical production manufacturing or processing by SNAP codes in

the period of 1990-2017 are presented in the [Table 4.35](#).

Table 4.35 NMVOC emissions and the consumption of solvents from chemical products manufacturing or processing by SNAP codes in the period of 1990-2017 (kt)

SNAP	060300		060303		060304		060305		060307	
Year	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data
1990	0.496	NA	NA	NA	NA	NA	NA	NA	NA	NA
1995	0.250	NA	NA	NA	NA	NA	NA	NA	NA	NA
2000	0.107	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	0.125	NA	NA	NA	NA	NA	NA	NA	NA	NA
2006	--	--	0.0014	NA	0.079	0.136	0.032	0.022	0.015	8.987
2007	--	--	0.0001	0.001	0.123	0.089	0.019	0.326	0.010	8.560
2008	--	--	0.0039	0.001	0.109	2.165	0.008	0.014	0.007	6.988
2009	--	--	0.0061	0.004	0.043	1.680	0.006	0.021	0.007	6.126
2010	--	--	0.0082	0.005	0.052	0.073	0.014	0.010	0.006	4.628
2011	--	--	0.0126	3.421	0.062	0.106	0.019	0.019	0.009	10.628
2012	--	--	0.0104	3.892	0.060	0.091	0.019	0.011	0.009	10.120
2013	--	--	0.0100	3.590	0.057	0.079	0.021	0.018	0.010	10.046
2014	--	--	0.0100	3.791	0.058	0.109	0.023	0.016	0.008	8.103
2015	--	--	0.0079	3.023	0.055	0.102	0.021	0.013	0.007	5.709
2016	--	--	0.0078	3.091	0.071	0.060	0.019	0.016	0.007	6.605
2017	--	--	0.0088	3.600	0.076	0.036	0.014	0.011	0.006	6.811

Table 4.35 continues

SNAP	060308		060309		060312		060313		060314	
Year	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data
1990	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1995	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2006	NA	NA	0.00198	0.088	0.001727	NA	0.00004	0.001	0.026	0.236
2007	0.0005	0.041	0.00154	NA	0.000154	NA	0.00004	0.001	0.111	0.248
2008	0.0007	0.053	0.00064	NA	0.000005	NA	0.00006	0.003	0.186	0.383
2009	0.0003	0.026	0.00045	0.001	0.000002	NA	0.00025	0.008	0.434	1.187
2010	0.0003	0.026	0.00043	0.001	0.000001	NA	0.00030	0.014	0.082	0.601
2011	NA	NA	0.00004	NA	0.000356	0.0003	0.00018	0.013	0.210	0.714
2012	NA	NA	0.00001	NA	0.000350	0.0002	0.00017	0.018	0.238	0.703
2013	NA	NA	0.00007	NA	0.000330	0.0001	0.00001	0.018	0.170	0.688
2014	NA	NA	0.00003	NA	0.000373	0.0001	0.00012	0.010	0.238	1.090
2015	NA	NA	NA	NA	0.000214	0.0001	0.00016	0.009	0.087	0.642
2016	NA	NA	NA	NA	0.000554	0.3870	0.00019	0.007	0.020	0.413
2017	NA	NA	NA	NA	0.001305	0.6890	0.00016	0.008	0.023	0.611

4.2.9.3. Source-Specific QA/QC and Verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Emission data from the OSIS database is compared to the previous years in order to detect calculation errors, errors in the reported data or in

allocation. Reasons behind any fluctuation in the emission figures are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by specialists from the ESTEA.

4.2.9.4. Source-Specific Planned Improvements

As some activities are not included in this inventory (by the SNAP codes 060301, 060302, 060306, 060311), it is necessary to research whether the emissions from these activities are important for this inventory or whether they exist in Estonia at all. It is also necessary to review NMVOC emissions for the years 1990-2005 and to study the possibility of obtaining the activity data for these emissions.

4.2.10. Printing (NFR 2D3h)

4.2.10.1. Source Category Description

Printing involves the use of inks, which may contain a proportion of organic solvents. These inks may then be subsequently diluted before use. Different inks have different proportions of organic solvents and require dilution to varying extents. Printing can also require the use of cleaning solvents and organic dampeners. Ink solvents, diluents, cleaners and dampeners may all make a significant contribution to emissions from industrial printing and involve the application of inks using presses.

In the EMEP/EEA guidebook, the following printing categories are identified:

- Heat set offset printing

According to the RAINS model, at EU-25 level for 2000, NMVOC emissions from the heat set accounted for 40 kt representing 0.38% of the total NMVOC emissions. The total activity was 123.59 kt with an average emission factor of 3239 g NMVOC/kg, which indicates that this industry has already reduced some emissions (EGTEI, 2005¹⁵).

- Publication and packaging

At the EU-25 level for 2000, (according to the RAINS model) NMVOC emissions accounted for 61 kt representing 0.58% of the total NMVOC

emissions. The total activity was 191.48 kt of ink, with an average emission of 0.32 kg NMVOC/kg non-diluted ink, which means that this industry has already reduced emissions significantly (EGTEI, 2005).

- Rotogravure and Flexography

At the EU-25 level for 2000, (according to the RAINS model) NMVOC emissions accounted for 127.56 kt representing 1.2% of total NMVOC emissions. The total activity was 91.69 kt of non-diluted ink and an average emission of 1.4 kg NMVOC/kg non-diluted ink (EGTEI, 2005).

The emissions of NMVOCs from printing have been significantly reduced following the introduction of the Solvent Emissions Directive 1999/13/EC in March 1999, which was adopted in Estonia in 2004. Larger facilities are now required to control their emissions in such a way that the emission limit value in the residual gas does not exceed a maximum concentration. The threshold is 15 tonnes/year for the heat set offset and flexography/rotogravure in packaging and 25 tonnes/year for the publication gravure (for the latter installations below, the thresholds are not likely to exist).

Situation in Estonia

The Association of Estonian Printing Industry collects information from about 100 printing facilities in Estonia. Based on their main field of activity, they are divided into four groups: printing houses for periodicals, books, etiquettes and labels, and advertisements.



(Photo by Mari Luud; The printing machine in Kroonpress Ltd.)

¹⁵ EGTEI (2005), Heatset Offset: synopsis sheet

The total number of printing houses is decreasing, and smaller facilities, in particular, will close down. The total capacity exceeds local market needs and any increase is connected with export.

4.2.10.2. Methodological Issues

The EMEP/EEA Guidebook 2016 Tier 1 emission factor 500 g/kg ink is used for the calculations of emissions from the printing sector for diffuse sources. The following equation is applied:

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

where

$E_{\text{pollutant}}$ = the emission of the specified pollutant;
 $AR_{\text{production}}$ = the activity rate for the paint application (consumption of paint);
 $EF_{\text{pollutant}}$ = the emission factor for this pollutant.

It involves either the use of solvent consumption data or combining ink consumption with emission factors for the industry. Unless solvent consumption data are used, the use of water based or low solvent inks as well as the extent of controls such as incineration are not considered.

An approach combining ink consumption with the emission factor is applied.

The emission factor has been estimated to be constant over the period. According to the revenues of the printing sector, the major part of printing is done for advertisements and the press. From Corinair¹⁶, it can be concluded that the following techniques are applied (with relevant emission factors) for press and edition/publication:

- cold set web offset – 54 kg/t (g/kg) ink consumed;
- heat set web offset – 82 kg/t (g/kg) ink consumed;
- rotogravure – 425 kg/t (g/kg) ink consumed.

As these stay below the current emission factor, it does not change over the period.

4.2.10.3. Activity Data

The quantity of ink (CN code 3215) used in Estonia can be estimated by the import and export data from Statistics Estonia (1995-2017). Data regarding import and export are not available for the years 1990-1994; therefore, these amounts were calculated by the change in percentage of the current prices in the industrial production of chemicals and chemical products in that period.

As there is no information on stock data for the end of the year, it is assumed that all ink has been used in the specific year.

4.2.10.4. Results

A number of printing facilities are permitted.

Between 2006 and 2017, activity data regarding ink use in point sources were collected in the OSIS database. For these years activity data for calculations was calculated as follows:

$$\text{Ink used in diffuse sources} = \text{Total ink used} - \text{Ink used in point sources}$$

In 2005, according to CollectER, five companies reported as point sources. No activity data was available. Emissions from point sources were subtracted from the total calculated NMVOC emissions.

Table 4.36 NMVOC emissions and the consumption of solvents from the printing industry by SNAP code in the period of 1990-2017 (kt)

SNAP	060403	
Year	NMVOC	Activity data
1990	0.080	0.160
1995	0.126	0.252
2000	0.248	0.497
2005	0.745	1.490
2006	0.658	1.745
2007	0.454	2.015
2008	0.766	2.317
2009	0.206	1.663
2010	0.354	2.150
2011	0.344	2.062
2012	0.456	2.385
2013	0.461	2.306
2014	0.439	2.491

¹⁶ Atmospheric Emission Inventory Guidebook. Second Edition. EEA 2000

SNAP	060403	
2015	0.473	2.493
2016	0.479	2.693
2017	0.662	2.424

4.2.10.5. Source-Specific QA/QC and Verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Emission data from the OSIS database are compared to the previous years in order to detect calculation errors, errors in the reported data or in allocation. Reasons behind any fluctuation in the emission figures are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by specialists from the ESTEA.

4.2.10.6. Source-Specific Planned Improvements

No major improvements are planned for the next submission.

4.2.11. Other Solvent Use (NFR 2D3i)

4.2.11.1. Source Category Description

This sector includes activities such as fat, edible and non-edible oil extraction, application of glues and adhesives, preservation of wood, underseal treatment and conservation of vehicles and vehicles dewaxing.

1) *Fat, edible and non-edible oil extraction*

This activity includes solvent extraction of edible oils from oilseeds and the drying of leftover seeds before resale as animal feed.

If the oil content of the seed is high, such as in olives, the majority of the oil is pressed out mechanically. Where the oil content is lower or the remaining oil is to be taken from material that

has already been pressed, solvent extraction is used.

Hexane has become a preferred solvent for extraction. In extracting oil from seeds, the cleaned and prepared seeds are washed several times in warm solvent. The remaining seed residue is treated with steam to capture the solvent and oil that remain in it.

The oil is separated from the oil-enriched wash solvent and from the steamed-out solvent. The solvent is recovered and re-used. The oil is further refined.

2) *Preservation of wood*

This activity encompasses industrial processes for the impregnation with or immersion of timber in organic solvent based preservatives, creosote or water based preservatives. Wood preservatives may be supplied for both industrial and domestic use. This activity covers only industrial use and does not include the domestic use of wood preservatives, which is covered under the NFR source category 2D3a, Domestic solvent use. Most of the information currently available on emissions relates to the industrial use of wood preservatives. This section is not intended to cover the surface coating of timber with paints, varnishes or lacquer.

3) *Vehicles dewaxing*

Some new cars have a protective covering applied to their bodies after painting to provide protection during transport. For example, in the UK this is usually only done on cars destined for export. Removal of the coating is usually only done at import centres. In continental Europe, cars are transported long distances on land as well as imported from overseas, so the driving forces affecting the use of such coatings may be different.

Transport protection coverings are not applied to the whole car body, but only to regions of the body considered vulnerable to damage during transport. The pattern of application varies from one manufacturer to another. Some manufacturers do only the bumper, while others

do only the driver's door; some do the horizontal surfaces while others do the sides as well.

There are various methods for applying coverings for protection during transport. Traditionally, a hydrocarbon wax was used, which had to be removed using a mixture of hot water, kerosene and detergent. Recently, two alternative methods have been introduced. The first of these is a water-soluble wax, which can be removed with hot water alone without the need for kerosene. The second is a self-adhesive polyethylene film called 'Wrap Guard'. This can be peeled off by hand and disposed of as ordinary commercial waste. Most European car manufacturers are currently either already using self-adhesive polyethylene film or are evaluating it. It is expected that within a few years all European manufacturers will be using self-adhesive polyethylene film as their only method of applying transportation protective coverings, as has been the case in the US for the past number of years.

4) Treatment of vehicles

This section addresses the application of protective coatings to the undersides of cars. It is only a very small source of emissions and can be considered negligible nowadays.

Before the early 1980s, car manufacturers did not apply any coating to the underside of their cars. If a car owner wanted to protect his car against rust and stone chip damage, he had to pay to have his car 'undersealed' at a garage or workshop. This involved the application of a bituminous coating. The market for this service is no longer very large in much of Western Europe. It may still occur in Eastern Europe, in countries that have cold climatic conditions, and in the restoration and maintenance of vintage cars, but this activity is likely to be insignificant.

5) Industrial application of adhesives

Sectors using adhesives are very diverse as are production processes and application techniques.

Relevant sectors include the production of adhesive tapes, composite foils, the transportation sector (passenger cars, commercial vehicles, mobile homes, rail vehicles and aircrafts), the manufacture of shoes and leather goods, the wood material and furniture industry (EGTEI, 2003¹⁷).

In 2017, NMVOC emissions from the NFR 2D3i sector had decreased by 35.9% compared to the year 1990.

4.2.11.2. Methodological Issues

NMVOC emissions and corresponding activity data for the following activities are presented in the next chapter in the [Table 4.38](#).

1) Glass and Mineral wool enduction (SNAP 060401, 060402)

This is not included in the emissions inventory due to the lack of information on whether these activities have been conducted in Estonia.

2) Fat, edible and non-edible oil extraction (SNAP 060404)

The major type of seed used for oil production in Estonia is rape. Some smaller units also press oil out from other seeds, such as flax.

The main oil extracting company in Estonia is Werol Industries plc.

An interview carried out in 2010 with a representative of the company determined that the company does not use solvents for oil extraction.

At Werol Industries, they use mechanical hot pressing for oil extraction, which leaves 8%-10% of the oil in rape cake. This technology has been in use since the factory was opened in 1999.

In the second largest oil producer, Oru Vegetable Oil Industry, the oil is only pressed out mechanically. The production began in 1985, but no solvents have ever been employed.

¹⁷ EGTEI (2003). Final background documents on the sectors 'Industrial application of adhesives' and 'Fat, Edible and Non-Edible Oil Extraction'. Prepared in the framework of EGTEI by CITEPA, Paris.

It was discovered that some small farms also produce small amounts of oil: Kaarli farm in Väike-Maarja, Raismiku farm in Vändra and in Mooste. The oil is mechanically cold pressed.

As solvents are not used in oil production in Estonia, the NMVOC emissions that have occurred in the process are of natural origin and are reported by operators who adhere to the environmental permit.

3) Application of glues and adhesives (SNAP 060405)

The Tier 2 emission factor is used for calculations: 780 g/kg adhesive¹⁸ for the period of 1990-2000, 522 g/kg adhesive¹⁹ for the period of 2005 and onward. The emission factors for the period of 2001-2004 are interpolated.

Activity Data

Solvent borne adhesives have the CN code 3506 91 00 (adhesives based on polymers of heading 3901 to 3913 or on rubber (excl. products suitable for use as glues or adhesives put up for retail sale as glues or adhesives, with a net weight of ≤ 1 kg)).

As this sector does not cover the domestic use of glues and adhesives, glues and adhesives for retail sale are not included.

The quantity of industrially used adhesives is estimated by import, export and production data (CN code 3506 91 00). Import and export data are available from Statistics Estonia and Eurostat. Production data are available from the OSIS database for the years 2006-2017. At present, there is no information available regarding adhesive production between 1990 and 1999.

As there is no information on stock data for the end of the year, it is assumed that all adhesive has been used in the specific year.

Results

A number of facilities using adhesives are permitted.

In the period from 2006 to 2017, activity data regarding adhesives use in point sources are collected in the OSIS database (SNAP 060405).

For the years 2006-2017, activity data for calculations are calculated as follows:

$$\text{Adhesives used in diffuse sources} = \text{Total adhesive used} - \text{Adhesive used in point sources}$$

In 2000-2005, according to CollectER, some companies reported as point sources, but no activity data are available. Emissions from point sources are subtracted from the total calculated NMVOC emissions.

4) Preservation of wood (SNAP 060406)

The Estonian Forest Industries Association was questioned in 2010 regarding wood preservation.

Most of the preservation operations are carried out using waterborne preservatives. Before it was banned in 2004, chromated copper arsenate (CCA) was used. CCA is a waterborne preservative. Some creosote and shale oil were used in the past. Nowadays, creosote is not believed to be used; hence, wood treated with creosote is imported.

In 2005, all wood impregnation companies in Estonia were listed by the Estonian Forest Industries Association.

The amount of wood impregnated accounted for ca. 135,000 fm (Festmeter²⁰). The largest wood impregnation companies were the following (only waterborne preservatives were used):

- Hansacom Ltd. – 33,000 m³;
- Kestvuspuut plc – 30,000 m³;
- Imprest plc – 15,000 m³;
- Kehra Wood Industries Ltd. – 8,000 m³;
- Natural plc – 5,000 m³.

¹⁸18 EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009

¹⁹19 EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016

²⁰20 The Festmeter is that amount of solid wood which is contained in a one-meter cube; it is therefore identical with one cubic meter of solid wood.

Solvent borne preservatives are used by some companies that produce windows, doors and log houses.

The major solvent borne supplier VBH was contacted, and it was discovered that companies that apply solvent borne preservatives use more than five tonnes a year. This is the threshold for an air pollution permit. Therefore, it is estimated that these installations are covered with permits (point sources) and are not subject to diffuse emissions.

5) Underseal treatment and conservation of vehicles (SNAP 060407)

There is no statistical information regarding the treatment of vehicles. Therefore, in 2010 expert opinion was sought from a representative of the Association of Estonian Automobile Sales and Maintenance Companies "repair unit". Expert opinion was received from Benefit AS, which is the leading car body and car paint shops technology and materials supplier.

Between 1990 and 2000, treatment with bituminous materials was widespread, but there are no statistics available. Nowadays, treatment with bituminous coating is negligible, and treatment is done by special polymers, if needed.

So, NMVOC emissions from this activity are calculated for the years 1990 to 2004, and emissions from the treatment of vehicles are considered negligible since 2005.

The Tier 2 emission factor is used for calculations: 0.2 kg/person/year.

As the number of cars in Estonia per inhabitant was lower than the number of cars per inhabitant in the European Union, a reduction coefficient for the emission factor is applied.

Table 4.37 Motorisation rate - cars per 1,000 inhabitants

Year	Number of vehicles per 1000 inhabitants		Coefficient, %
	Estonia	EU-15	
1990	153	386	40
1991	167	386	43
1992	182	401	45
1993	210	413	51

Year	Number of vehicles per 1000 inhabitants		Coefficient, %
	Estonia	EU-15	
1994	229	420	55
1995	265	427	62
1996	285	435	66
1997	304	436	70
1998	324	451	72
1999	333	461	72
2000	338	472	72
2001	298	480	62
2002	294	485	61
2003	320	489	65
2004	349	490	71

It means that, for example, in 1995 the number of cars per inhabitant accounted for 62% of the average European Union country value and in 2000 for 72%. Information for 1990 was not found and it was considered equal with the year 1991.

The customised emission factors were calculated by the following example:

Year 1995: $0.2 \times 62\% = 0.124$ kg/person/year;

Year 2000: $0.2 \times 72\% = 0.143$ kg/person/year.

Considering that NMVOC emissions from vehicles treatment since 2005 are considered negligible, emission factors for the years 2001-2004 are not calculated using the previous method and are reduced 10% per year from the year 2000.

6) Vehicles dewaxing (SNAP 060409)

The Association of Estonian Automobile Sales and Maintenance Companies and Toyota Baltic plc were interviewed in 2010 regarding this activity.

It was found that no dewaxing operations have been carried out in at least the last five years. If required, paint protection is provided by using polyethylene film. Waxing is only used in very rare cases, such as special deliveries by sea transport from long distances.

In the period from 1995 to 2005, dewaxing was carried out in rare cases, i.e. special delivery directly from Japan. For these cases, it is not known if dewaxing was carried out in Finland or in Estonia as it is difficult to obtain relevant data. Most dewaxing operations of imported cars are

conducted in a treatment centre located in the port of Hanko in Finland.

According to the information collected, NMVOC emissions from this source are considered to be approximately zero and historical emissions are considered negligible.

7) Other (SNAP 060412)

NMVOC emissions and activity data for the years 2000-2017 are gathered from OSIS and CollectER databases, and are reported by operators.

4.2.11.3. Results

Table 4.38 NMVOC emissions from other solvent use and the activity data by SNAP codes in the period of 1990-2017

SNAP	060400		060404		060405		060406		060407		060412	
Year	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, mln.inhab.	NMVOC, kt	Activity data, kt
1990	0.817	NA	NA	NA	0.324	0.415	NA	NA	0.124	1.571	NA	NA
1995	0.412	NA	NA	NA	0.218	0.279	NA	NA	0.180	1.448	NA	NA
2000	--	--	NA	NA	0.906	1.162	0.00050	NA	0.200	1.401	0.008	NA
2005	--	--	0.0018	NA	1.379	2.641	0.00001	NA	NO	--	0.003	NA
2006	--	--	0.0018	NA	1.517	3.353	0.00306	0.069	NO	--	0.028	0.238
2007	--	--	0.0017	NA	1.177	3.903	0.01457	0.029	NO	--	0.005	0.289
2008	--	--	0.0017	NA	1.068	2.516	0.00736	0.017	NO	--	0.020	0.353
2009	--	--	0.0016	NA	0.736	1.794	0.01376	0.026	NO	--	0.013	0.052
2010	--	--	0.0015	NA	0.398	1.259	0.01143	0.018	NO	--	0.012	0.069
2011	--	--	0.0009	NA	0.478	1.466	0.01075	0.022	NO	--	0.022	0.081
2012	--	--	0.0003	NA	0.585	1.684	0.01061	0.022	NO	--	0.034	0.137
2013	--	--	0.0012	NA	0.513	1.779	0.01128	0.029	NO	--	0.037	0.108
2014	--	--	0.0032	NA	0.499	1.789	0.01293	0.036	NO	--	0.036	0.132
2015	--	--	0.0021	NA	0.605	2.376	0.01321	0.030	NO	--	0.044	0.093
2016	--	--	0.0024	NA	0.652	2.281	0.00846	0.023	NO	--	0.042	0.084
2017	--	--	0.0021	NA	0.762	2.268	0.00584	0.025	NO	--	0.040	0.112

4.2.11.4. Source-Specific QA/QC and Verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions and emission data from the OSIS database are compared to the previous years in order to detect calculation errors, errors in the reported data or in allocation. Reasons behind any fluctuation in the emission figures are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Environmental Board and then by specialists in the ESTEA.

4.2.11.5. Source-Specific Planned Improvements

As some activities are not included in this inventory, there is a need for research to determine whether emissions from these activities are important for this inventory. Also, it is necessary to review NMVOC emissions for the years 1990-1999 and to study the possibility of obtaining activity data for these emissions.

4.2.12. Other Product Use (NFR 2G)

4.2.12.1. Source Category Description

This sector includes emissions from activities such as the use of fireworks, combustion (smoking) of tobacco and the use of shoes. The use of shoes is not currently included in the inventory, as it is not clear from the EMEP/EEA Guidebook 2016 to what kind of activity exactly the emission factor for the use of shoes applies. For this inventory it is assumed that all the NMVOC emission is emitted from the application of adhesives in the manufacture of shoes.

4.2.12.2. Methodological Issues

1) Use of fireworks (SNAP 060601)

The Tier 2 emission factors are used for pollutant emissions calculations (see [Table 4.39](#)).

Table 4.39 Emission factors from the EMEP/EEA Guidebook 2016 for calculating pollutant emissions from the use of fireworks

Pollutant	Emission Factor	Unit
SO ₂	3,020	g/t product
NO _x	260	g/t product
CO	7,150	g/t product
TSP	109,830	g/t product
PM ₁₀	99,920	g/t product
PM _{2.5}	51,940	g/t product
As	1.33	g/t product
Cd	1.48	g/t product
Cr	15.6	g/t product
Cu	444	g/t product
Hg	0.057	g/t product
Ni	30	g/t product
Pb	784	g/t product
Zn	260	g/t product

2) Use of tobacco (SNAP 060602)

The Tier 2 emission factors are used for pollutant emissions calculations (see [Table 4.40](#)).

Table 4.40 Emission factors from the EMEP/EEA Guidebook 2016 for calculating pollutant emissions from tobacco combustion

Pollutant	Emission Factor	Unit
NMVOC	4.84	kg/t tobacco
NO _x	1.80	kg/t tobacco
CO	55.1	kg/t tobacco
NH ₃	4.15	kg/t tobacco
TSP	27.0	kg/t tobacco
PM ₁₀	27.0	kg/t tobacco
PM _{2.5}	27.0	kg/t tobacco
BC	0.45	% of PM _{1.8}
PCDD/F	0.1	µg I-TEQ/t tobacco
B(a)p	0.111	g/t tobacco
B(b)f	0.045	g/t tobacco
B(k)f	0.045	g/t tobacco
I(1,2,3-cd)p	0.045	g/t tobacco
Cd	5.4	g/t tobacco
Ni	2.7	g/t tobacco
Zn	2.7	g/t tobacco
Cu	5.4	g/t tobacco

4.2.12.3. Results

1) Use of fireworks

The quantity of used fireworks in Estonia is estimated by the import and export data (CN code 3604) available from Statistics Estonia. Data regarding production of fireworks is not available.

Data regarding import and export are not available for the years 1990-1994. As a result, the amounts of used fireworks are calculated by multiplying each year the amount of used fireworks with 0.65 starting from 1995 back to 1990.

As there is no information on stock data for the end of the year, it is assumed that all fireworks has been used in the specific year.

The amounts of used fireworks and pollutant emissions for the period of 1990-2017 are presented in [Table 4.41](#).

Table 4.41 The use of fireworks and pollutant emissions in the period of 1990-2017

Year	Product, t	SO ₂	CO	NO _x	TSP	PM ₁₀	PM _{2.5}
		t					
1990	2.539	0.008	0.018	0.001	0.279	0.254	0.132
1995	21.880	0.066	0.156	0.006	2.403	2.186	1.136
2000	68.993	0.208	0.493	0.018	7.578	6.894	3.584
2005	332.275	1.003	2.376	0.086	36.494	33.201	17.258
2006	388.849	1.174	2.780	0.101	42.707	38.854	20.197
2007	492.507	1.487	3.521	0.128	54.092	49.211	25.581
2008	313.097	0.946	2.239	0.081	34.387	31.285	16.262
2009	127.661	0.386	0.913	0.033	14.021	12.756	6.631
2010	276.950	0.836	1.980	0.072	30.417	27.673	14.385
2011	293.392	0.886	2.098	0.076	32.223	29.316	15.239
2012	393.956	1.190	2.817	0.102	43.268	39.364	20.462
2013	439.705	1.328	3.144	0.114	48.293	43.935	22.838
2014	517.402	1.563	3.699	0.135	56.826	51.699	26.874
2015	367.391	1.110	2.627	0.096	40.351	36.710	19.082
2016	425.393	1.285	3.042	0.111	46.721	42.505	22.095
2017	468.853	1.416	3.352	0.122	51.494	46.848	24.352

Table 4.41 continues

Year	Product, t	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
		kg							
1990	2.539	0.003	0.004	0.040	1.127	0.000	0.076	1.990	0.660
1995	21.880	0.029	0.032	0.341	9.714	0.001	0.656	17.154	5.689
2000	68.993	0.092	0.102	1.076	30.633	0.004	2.070	54.091	17.938
2005	332.275	0.442	0.492	5.183	147.530	0.019	9.968	260.504	86.392
2006	388.849	0.517	0.575	6.066	172.649	0.022	11.665	304.858	101.101
2007	492.507	0.655	0.729	7.683	218.673	0.028	14.775	386.125	128.052
2008	313.097	0.416	0.463	4.884	139.015	0.018	9.393	245.468	81.405
2009	127.661	0.170	0.189	1.992	56.681	0.007	3.830	100.086	33.192
2010	276.950	0.368	0.410	4.320	122.966	0.016	8.309	217.129	72.007
2011	293.392	0.390	0.434	4.577	130.266	0.017	8.802	230.019	76.282
2012	393.956	0.524	0.583	6.146	174.916	0.023	11.819	308.862	102.429
2013	439.705	0.585	0.651	6.859	195.229	0.025	13.191	344.729	114.323
2014	517.402	0.688	0.766	8.071	229.726	0.030	15.522	405.643	134.525
2015	367.391	0.489	0.544	5.731	163.122	0.021	11.022	288.035	95.522
2016	425.393	0.566	0.630	6.636	188.874	0.024	12.762	333.508	110.602
2017	468.853	0.624	0.694	7.314	208.171	0.027	14.066	367.581	121.902

2) Use of tobacco

The quantity of tobacco combusted (smoked) in Estonia is estimated by the import and export data (CN code 2402) available from Statistics Estonia.

Data regarding import, export and production of tobacco products are not available for the years 1990-1994.

Tobacco products were produced in Estonia until 1996; as a result, the production and consumption amounts for the years 1990-1994 are considered equal.

As there is no information on stock data for the end of the year, it is assumed that all tobacco has been used in the specific year.

The amounts of used tobacco and pollutant emissions for the period of 1990-2017 are presented in [Table 4.42](#).

Table 4.42 The use of tobacco and pollutant emissions from tobacco combustion in the period of 1990-2017

Year	Use of tobacco, kt	NM VOC	NO _x	CO	NH ₃	TSP	PM ₁₀	PM _{2.5}	BC	PCDD/F
kt										g I-Teq
1990	4.165	0.020	0.007	0.229	0.017	0.112	NR	NR	NR	0.0004
1995	2.218	0.011	0.004	0.122	0.009	0.060	NR	NR	NR	0.0002
2000	1.949	0.009	0.004	0.107	0.008	0.053	0.053	0.053	0.024	0.0002
2005	2.598	0.013	0.005	0.143	0.011	0.070	0.070	0.070	0.032	0.0003
2006	2.461	0.012	0.004	0.136	0.010	0.066	0.066	0.066	0.030	0.0002
2007	3.552	0.017	0.006	0.196	0.015	0.096	0.096	0.096	0.043	0.0004
2008	1.548	0.007	0.003	0.085	0.006	0.042	0.042	0.042	0.019	0.0002
2009	2.389	0.012	0.004	0.132	0.010	0.064	0.064	0.064	0.029	0.0002
2010	1.231	0.006	0.002	0.068	0.005	0.033	0.033	0.033	0.015	0.0001
2011	1.884	0.009	0.003	0.104	0.008	0.051	0.051	0.051	0.023	0.0002
2012	1.798	0.009	0.003	0.099	0.007	0.049	0.049	0.049	0.022	0.0002
2013	1.825	0.009	0.003	0.101	0.008	0.049	0.049	0.049	0.022	0.0002
2014	1.880	0.009	0.003	0.104	0.008	0.051	0.051	0.051	0.023	0.0002
2015	1.879	0.009	0.003	0.104	0.008	0.051	0.051	0.051	0.023	0.0002
2016	1.903	0.009	0.003	0.105	0.008	0.051	0.051	0.051	0.023	0.0002
2017	1.819	0.009	0.003	0.100	0.008	0.049	0.049	0.049	0.022	0.0002

Table 4.42 continues

Year	Use of tobacco, kt	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Cd	Hg	As	Cu
kg									
1990	4.165	0.462	0.187	0.187	0.187	22.490	11.245	11.245	22.490
1995	2.218	0.246	0.100	0.100	0.100	11.980	5.990	5.990	11.980
2000	1.949	0.216	0.088	0.088	0.088	10.524	5.262	5.262	10.524
2005	2.598	0.288	0.117	0.117	0.117	14.027	7.013	7.013	14.027
2006	2.461	0.273	0.111	0.111	0.111	13.291	6.645	6.645	13.291
2007	3.552	0.394	0.160	0.160	0.160	19.182	9.591	9.591	19.182
2008	1.548	0.172	0.070	0.070	0.070	8.358	4.179	4.179	8.358
2009	2.389	0.265	0.107	0.107	0.107	12.899	6.449	6.449	12.899
2010	1.231	0.137	0.055	0.055	0.055	6.647	3.324	3.324	6.647
2011	1.884	0.209	0.085	0.085	0.085	10.173	5.087	5.087	10.173
2012	1.798	0.200	0.081	0.081	0.081	9.710	4.855	4.855	9.710
2013	1.825	0.203	0.082	0.082	0.082	9.854	4.927	4.927	9.854
2014	1.880	0.209	0.085	0.085	0.085	10.150	5.075	5.075	10.150
2015	1.879	0.209	0.085	0.085	0.085	10.145	5.072	5.072	10.145
2016	1.903	0.211	0.086	0.086	0.086	10.275	5.138	5.138	10.275
2017	1.819	0.202	0.082	0.082	0.082	9.825	4.912	4.912	9.825

4.2.12.4. Source-Specific QA/QC and Verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions are compared to the previous years in order to detect calculation errors, errors in the reported data or in allocation. Reasons behind any fluctuation in the emission figures are studied.

4.2.12.5. Source-Specific Planned Improvements

It is planned to include NMVOC emissions from lubricants and aeroplane de-icing agents into the inventory as soon as the activity data becomes available for the inventory team.



Source: www.public.delfi.ee

5. AGRICULTURE (NFR 3)

5.1. Overview of the Sector

animal husbandry and the application of fertilizers, compost, and sewage sludge as listed in [Table 5.1](#).

5.1.1. Source Category Description

The Estonian inventory of air pollutants from agriculture presently includes emissions from

Table 5.1 Reporting activities for the agriculture sector

NFR	Source	Description	Emissions reported	Method
3B1a	Cattle dairy	Includes emissions from dairy cows	NH ₃	Tier 3
			NO _x , NMVOC	Tier 2
			TSP, PM ₁₀ , PM _{2.5}	Tier 1
3B1b	Cattle non-dairy	Includes emissions from young cattle, beef cattle and suckling cows	NH ₃	Tier 3
			NO _x , NMVOC	Tier 2
			NMVOC, TSP, PM ₁₀ , PM _{2.5}	Tier 1
3B2	Sheep	Includes emissions from sheep	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}	Tier 1
3B3	Swine	Includes emissions from fattening pigs and sows	NH ₃	Tier 3
			NO _x , NMVOC	Tier 2
			NMVOC, TSP, PM ₁₀ , PM _{2.5}	Tier 1
3B4a	Manure management - Buffalo	Regarding Statistics from Estonian Agricultural Registers and Information Board the number of heads of mules and asses in Estonia is less than 10	NO	
3B4d	Goats	Includes emissions from goats	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}	Tier 1
3B4e	Horses	Includes emissions from horses	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}	Tier 1
3B4gi	Laying hens	Includes emissions from laying hens	NO _x , NH ₃	Tier 2
			NMVOC, TSP, PM ₁₀ , PM _{2.5}	Tier 1
3B4gii	Broilers	Includes emissions from broilers	NO _x , NH ₃	Tier 2
			NMVOC, TSP, PM ₁₀ , PM _{2.5}	Tier 1
3B4giii	Turkeys	Emissions from this sector are allocated to NFR 3B4giv	IE	Tier 1
3B4giv	Other poultry	Includes emission from cocks, ducks, geese and turkeys	NO _x , NH ₃	Tier 2
			NMVOC, TSP, PM ₁₀ , PM _{2.5}	Tier 1
3B4h	Manure management - Other animals	Includes emission from foxes, minks, racoons and chinchillas	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}	Tier 1
3Da1	Synthetic N-fertilizers	Includes emissions from application of nitrogen fertilizers and field preparation	NH ₃	Tier 2
3Da2a	Animal manure applied to soils	NH ₃ emissions from this sector are allocated to NFR 3B1a, 3B1b, 3B2, 3B4gi and 3B4gii	NO _x	Tier 1
			NH ₃	Tier 2
3Da2b	Sewage sludge applied to soils	Includes emission from sewage sludge applied into soils	NO _x , NH ₃	Tier 1
3Da2c	Other organic fertilisers applied to soils (including compost)	Includes emission from compost applied to soils	NO _x , NH ₃	Tier 1
3Da3	Urine and dung deposited by grazing animals	NH ₃ emissions from this sector are allocated to NFR 3B1a, 3B1b and 3B2	NH ₃	Tier 2
			NO _x	Tier 1
3Dc	Farm-level agricultural operations including storage,	Includes emissions from farm-level agricultural operations	TSP, PM ₁₀ , PM _{2.5}	Tier 1

NFR	Source	Description	Emissions reported	Method
	handling and transport of agricultural products			
3De	Cultivated crops	Includes emissions from cultivated crops	NMVOC	Tier 1
3Df	Use of pesticides	The use of organochlorine pesticides has been banned in Estonia since 1999. Before that the most organochlorine pesticides either were not used at all or were discontinued before 1990 years	NO	
3F	Field burning of agricultural residues	Since 2004, the burning of crop residues was prohibited	NO	

The share of agricultural sources in total emissions in 2017 was as follows: NO_x – 7%, NH₃ – 87.7%, NMVOC – 22.8%, PM_{2.5} and TSP – 8%. The share of other pollutants was not as significant.

The emissions of NO_x, TSP, NH₃ and NMVOC decreased by 51.2%, 49.9%, 56.8% and 52.5% compared to 1990, and the trend of the emissions of these categories is given in [Figure 5.1](#). The emissions from the agriculture sector are presented in [Table 5.2](#). The decrease in air pollution is mainly a result of rapid economic changes and due to the low profitability of milk and meat production in the 1990s. The existing Soviet-era large-scale production was liquidated and after land and ownership reform the land was returned to former owners. Only half a hundred large-scale producer remain the rest were all small-scale producers. The number of livestock on farms and the use of nitrogen fertilisers were significantly decreased. Since the end of the

nineties the number of agricultural holdings has started to decline and the share of large-scale production began to increase.²¹

After Estonia joined the EU in 2004, livestock numbers and the consumption of mineral N-fertilisers increased in comparison to mid-nineties due the free market and EU supporting mechanisms. In the past decade, the volume of emissions was also affected by changes in livestock housing and manure holding systems.

In 2017, NMVOC, NH₃, and NO_x emissions increased by 7%, 1.2%, and 0.9% respectively when compared to the results for 2016, mainly due to an increase in the number of non-dairy cattle, swine, and poultry. But this figure is still significantly less than that of a few years ago, with the number of swine having decreased by 10% when compared to 2014's figures for Estonia as a result of an outbreak of African swine fever.

²¹ Estonian University of Life Sciences. (2011). Maaelu arengu aruanne.

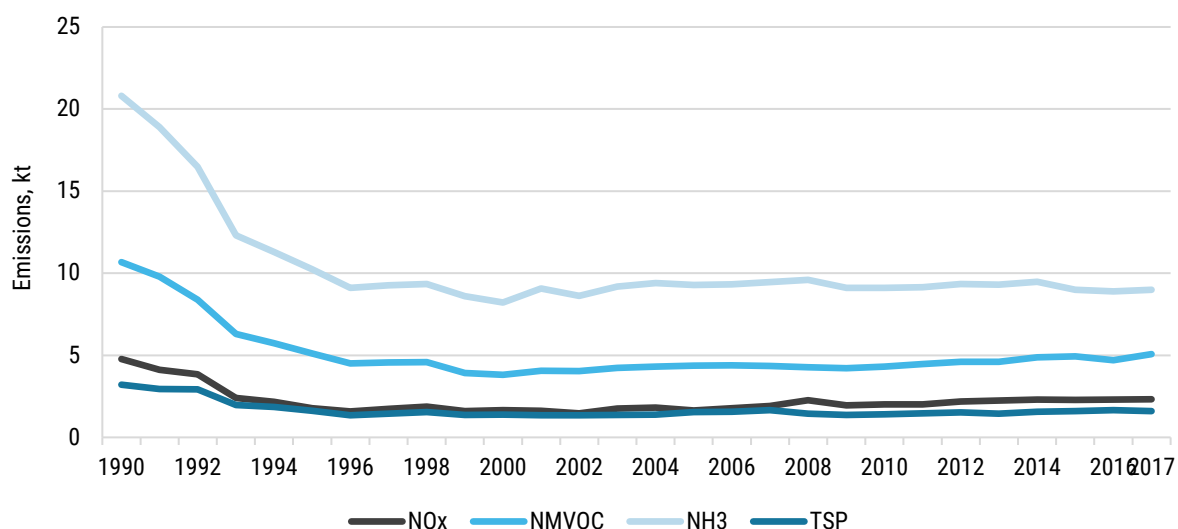


Figure 5.1 NO_x, NH₃, NMVOC and TSP emissions from the agriculture sector in the period of 1990-2017 (kt)

Table 5.2 Total emissions from the agriculture sector in the period of 1990-2017 (kt)

Year	NO _x	NMVOC	NH ₃	TSP	PM _{2.5}	PM ₁₀
1990	4.773	10.674	20.807	3.210	NR	NR
1995	1.768	5.117	10.245	1.620	NR	NR
2000	1.656	3.812	8.216	1.392	0.111	0.939
2005	1.639	4.367	9.289	1.541	0.111	1.065
2006	1.769	4.384	9.321	1.561	0.113	1.107
2007	1.916	4.344	9.465	1.656	0.110	1.175
2008	2.273	4.267	9.594	1.444	0.106	0.986
2009	1.954	4.223	9.108	1.375	0.101	0.906
2010	2.008	4.317	9.117	1.397	0.103	0.925
2011	2.009	4.466	9.145	1.471	0.108	1.002
2012	2.195	4.604	9.336	1.527	0.110	1.037
2013	2.238	4.605	9.306	1.437	0.106	0.967
2014	2.294	4.880	9.483	1.571	0.115	1.071
2015	2.285	4.944	8.987	1.605	0.119	1.123
2016	2.307	4.698	8.888	1.664	0.121	1.226
2017	2.328	5.075	8.998	1.609	0.109	1.167
trend 1990-2017, %	-51.2	-52.5	-56.8	-49.9	-1.8	24.2

More than half of NH₃ emissions comes from the agricultural soil sector (including animal manure application to soils and grazing) – 51% – and 49% is from the manure management (see [Figure 5.2](#)). The main source of pollution of PM₁₀ is

agricultural crop operations – 78% (see [Figure 5.3](#)).

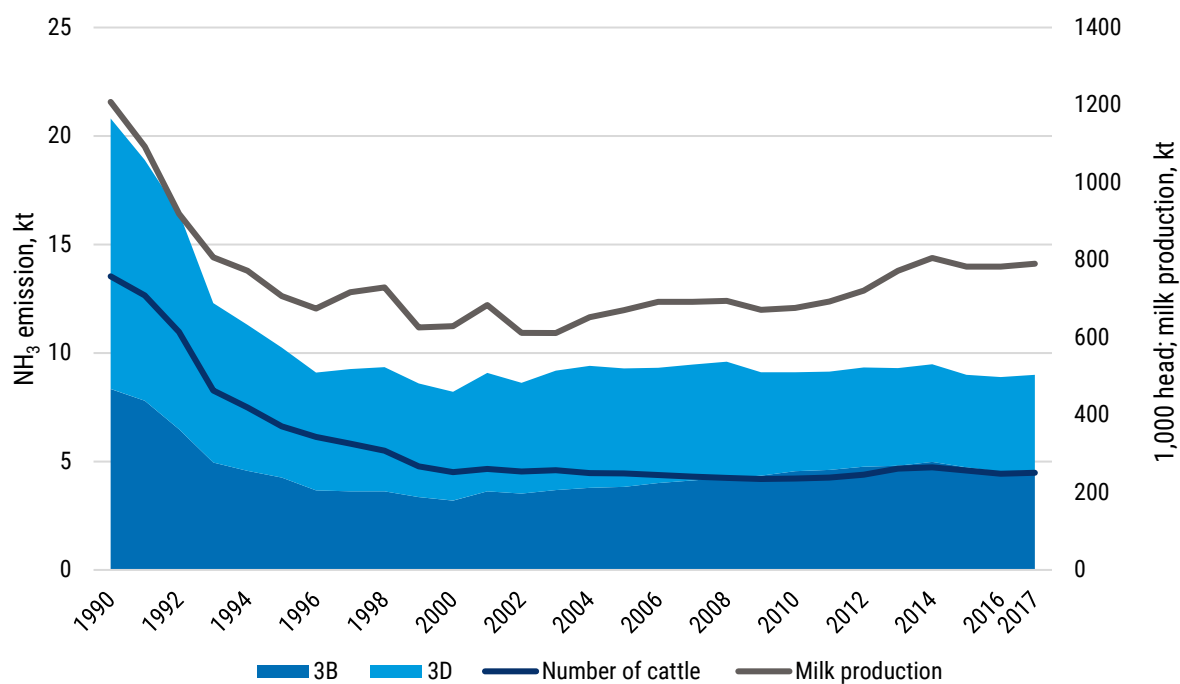


Figure 5.2 NH₃ emission distributions by the agriculture sector activities in the period of 1990-2017

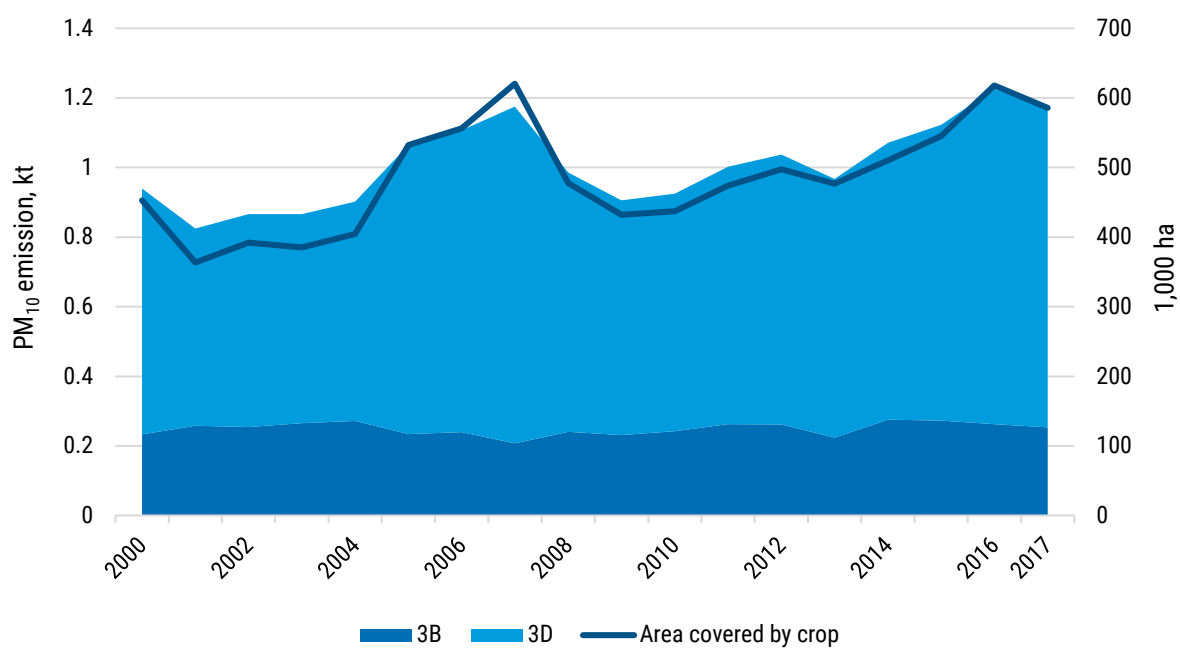


Figure 5.3 PM₁₀ emissions from livestock (3B) and agricultural soils (3D) in the period of 2000-2017

5.2. Manure Management (NFR 3b)

5.2.1. Source Category Description

Manure management is the main source of NH₃ emissions in Estonia. Almost half of the total NH₃ emissions was from manure management in 2017. The sector covers the management of manure from domestic livestock. Estonia reports emissions from the manure management of cattle, swine, horses, goats, sheep, poultry and fur animals. NH₃ and NO_x emissions from cattle-dairy, cattle non-dairy, laying hens, boilers, other poultry and swine animal manure applied to soils are reported under NFR 3D2a, and emissions from grazing under NFR 3Da3.



(Manure storage in Ekseko swine farm; source: www.arhliit.ee)

In addition to NH₃, NO_x, NMVOC, TSP, PM₁₀ and PM_{2.5} are generated from manure management.

All the emission time series are presented in [Table 5.3](#), [Table 5.4](#), [Table 5.5](#), [Table 5.6](#) and [Table 5.7](#).

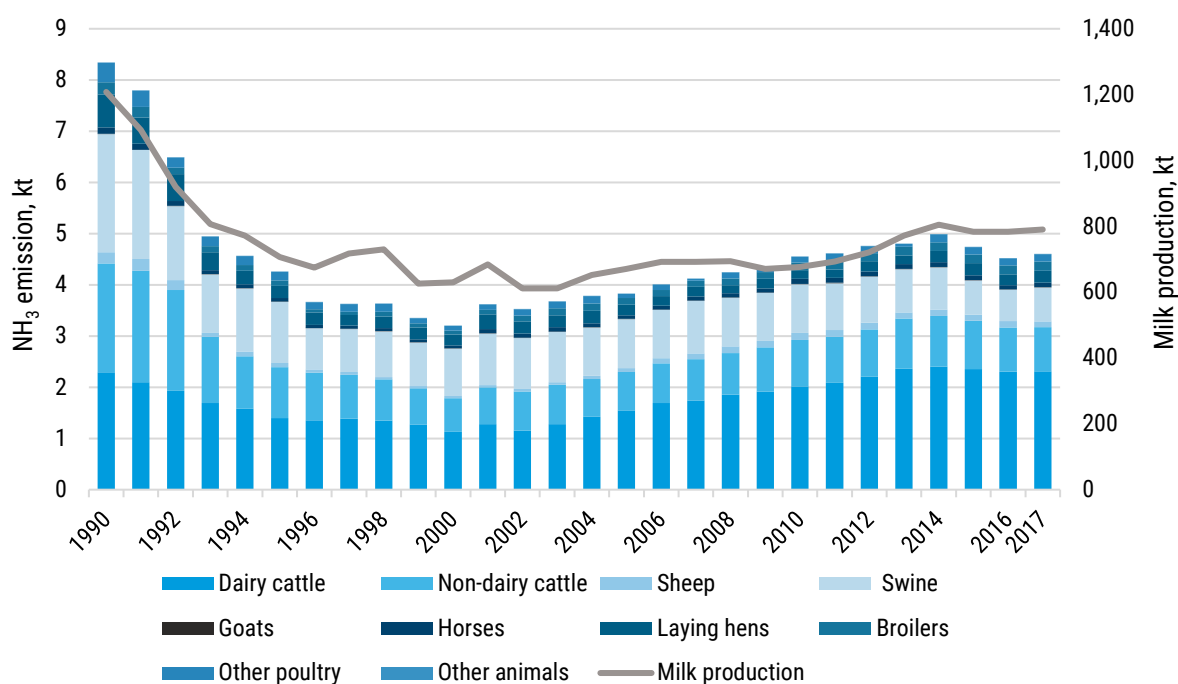


Figure 5.4 NH₃ emissions from manure management in the period of 1990-2017

During the period of 1990–2017, the emission of NH₃ decreased by 44.9% (see [Figure 5.4](#)). The reduction in air pollution was mainly due to the rapid economic changes in agriculture in the 1990s. Over the past decade, the volume of emissions was mainly affected by changes in livestock housing systems. Dairy cattle farmers adopted a loose-housing technology system instead of the older tie-stall housing technology and, due to this, liquid manure technology has

been used in place of solid manure technology. In 2015, most bovine animals were already free-range, being held in insulated or partially-insulated lairages. There have also been changes in the way in which animals graze. The dairy farming industry has largely been abandoned, with farmers moving to year-round rearing in the lairages.

Due to changes in housing technology, there have also been developments in manure storage. In 2015, the share of liquid manure in bovine animals was about 75%. Liquid manure storage technology has also changed significantly. In the 1990s, liquid manure was stored in lagoon-type reservoirs that remained uncovered and lacked any leakage capability. In 2015, liquid manure was mainly being stored in leak-proof ring tanks (for swine) or lagoons (for cattle), which were either covered with a natural crust (for cattle) or floating (for pigs).²² Changes in manure-handling technology have decreased the levels of ammonia emissions because liquid manure generates less ammonia than does solid manure.

At the same time the volumes of NH₃ and NO_x emissions in recent years have also been affected by improved animal productivity and nitrogen extraction. During the period of 1990-2017 the annual average nitrogen production per head of dairy cattle was increased by 45%.

In 2017, ammonia emissions increased by 2% in comparison to 2016 figures, due to the increase in the numbers of non-dairy cattle, swine and poultry during the same period.

Table 5.3 Total emissions of NO_x from manure management in the period of 1990-2017 (kt)

Year	Dairy cattle*	Non-dairy cattle*	Sheep	Swine*	Goats	Horses	Laying hens*	Broilers*	Other poultry*	Other animals
1990	0.070	0.034	0.001	0.006	0.00002	0.002	0.011	0.006	0.004	0.00007
1995	0.043	0.018	0.000	0.004	0.00002	0.001	0.004	0.003	0.002	0.00004
2000	0.035	0.012	0.000	0.004	0.00003	0.001	0.004	0.002	0.001	0.00002
2005	0.029	0.013	0.000	0.004	0.00003	0.001	0.004	0.003	0.001	0.00004
2006	0.028	0.013	0.001	0.004	0.00003	0.001	0.003	0.003	0.001	0.00003
2007	0.025	0.013	0.001	0.004	0.00004	0.001	0.003	0.003	0.000	0.00004
2008	0.024	0.013	0.001	0.004	0.00004	0.001	0.003	0.003	0.001	0.00003
2009	0.022	0.014	0.001	0.004	0.00004	0.001	0.003	0.003	0.001	0.00003
2010	0.020	0.014	0.001	0.004	0.00004	0.001	0.003	0.004	0.001	0.00003
2011	0.017	0.013	0.001	0.004	0.00004	0.001	0.003	0.004	0.001	0.00003
2012	0.015	0.013	0.001	0.003	0.00005	0.001	0.003	0.004	0.001	0.00003
2013	0.013	0.014	0.001	0.002	0.00005	0.001	0.003	0.004	0.001	0.00003
2014	0.010	0.013	0.001	0.002	0.00004	0.001	0.004	0.004	0.001	0.00003
2015	0.007	0.012	0.001	0.001	0.00004	0.001	0.004	0.004	0.001	0.00003
2016	0.007	0.010	0.001	0.001	0.00005	0.001	0.004	0.004	0.001	0.00002
2017	0.007	0.010	0.001	0.001	0.00005	0.001	0.004	0.005	0.001	0.00002
trend 1990-2017, %	-90.3	-70.6	-48.8	-82.3	150.0	-33.5	-63.2	-25.6	-62.2	-71.4

* NO_x emissions from animal manure applied to soils are reported under NFR 3D2a.

²²

https://www.envir.ee/sites/default/files/nh3_eriheite_ja_sonnikukaitlustehnoloogiate_ajaloolise_ulevaate_lopparuanne_0.pdf

Table 5.4 Total emissions of NMVOC from manure management in the period of 1990-2017 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Laying hens	Broilers	Other poultry	Other animals
1990	3.144	4.247	0.044	0.851	0.001	0.067	0.367	0.211	0.616	0.448
1995	1.857	1.647	0.015	0.443	0.001	0.036	0.137	0.093	0.274	0.256
2000	1.551	1.084	0.009	0.306	0.002	0.033	0.119	0.067	0.153	0.098
2005	1.663	1.217	0.015	0.363	0.002	0.037	0.120	0.112	0.137	0.245
2006	1.667	1.214	0.019	0.372	0.002	0.038	0.105	0.106	0.180	0.201
2007	1.626	1.224	0.023	0.393	0.003	0.041	0.106	0.103	0.062	0.231
2008	1.614	1.224	0.025	0.376	0.003	0.041	0.091	0.111	0.193	0.177
2009	1.595	1.228	0.025	0.380	0.003	0.042	0.106	0.117	0.154	0.201
2010	1.629	1.245	0.027	0.380	0.003	0.053	0.095	0.131	0.184	0.195
2011	1.637	1.265	0.026	0.375	0.003	0.051	0.094	0.140	0.251	0.217
2012	1.689	1.328	0.025	0.392	0.003	0.048	0.114	0.137	0.223	0.216
2013	1.764	1.453	0.023	0.373	0.003	0.049	0.097	0.147	0.094	0.191
2014	1.756	1.505	0.024	0.366	0.003	0.049	0.124	0.151	0.247	0.216
2015	2.127	1.251	0.024	0.308	0.003	0.049	0.136	0.149	0.233	0.226
2016	2.019	1.196	0.025	0.274	0.003	0.044	0.120	0.154	0.233	0.098
2017	2.339	1.207	0.023	0.325	0.003	0.044	0.135	0.157	0.240	0.098
trend 1990-2017, %	-25.6	-71.6	-49.0	-61.7	143.5	-33.7	-63.2	-25.6	-61.0	-78.2

Table 5.5 Total emissions of NH₃ from manure management in the period of 1990-2017 (kt)

Year	Dairy cattle*	Non-dairy cattle*	Sheep	Swine*	Goats	Horses	Laying hens*	Broilers*	Other poultry*	Other animals
1990	2.291	2.124	0.222	2.308	0.003	0.127	0.643	0.240	0.376	0.005
1995	1.399	0.996	0.078	1.198	0.003	0.068	0.239	0.106	0.168	0.003
2000	1.127	0.659	0.047	0.920	0.005	0.062	0.209	0.076	0.094	0.001
2005	1.545	0.751	0.078	0.955	0.004	0.071	0.210	0.127	0.084	0.003
2006	1.692	0.778	0.096	0.949	0.005	0.073	0.184	0.121	0.110	0.002
2007	1.739	0.809	0.114	1.027	0.006	0.078	0.186	0.118	0.038	0.002
2008	1.854	0.815	0.126	0.956	0.006	0.078	0.159	0.127	0.118	0.002
2009	1.920	0.858	0.128	0.938	0.007	0.080	0.186	0.133	0.094	0.002
2010	2.017	0.910	0.134	0.951	0.007	0.101	0.167	0.149	0.113	0.002
2011	2.088	0.896	0.132	0.918	0.007	0.096	0.164	0.160	0.153	0.002
2012	2.205	0.927	0.127	0.901	0.008	0.092	0.200	0.156	0.136	0.002
2013	2.358	0.984	0.116	0.845	0.007	0.093	0.171	0.168	0.057	0.002
2014	2.403	0.992	0.120	0.828	0.006	0.093	0.217	0.172	0.151	0.002
2015	2.357	0.939	0.120	0.667	0.007	0.093	0.238	0.170	0.142	0.002
2016	2.303	0.862	0.128	0.610	0.008	0.084	0.210	0.175	0.139	0.001
2017	2.311	0.863	0.113	0.661	0.007	0.084	0.237	0.179	0.142	0.001
trend 1990-2017, %	0.9	-59.4	-49.0	-71.3	142.9	-33.7	-63.2	-25.6	-62.2	-78.4

* NH₃ emissions from animal manure applied to soils and grazing are reported under NFR 3D2a and 3Da3.

Table 5.6 Total emissions of PM_{2.5} from manure management in the period of 2000-2017 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Laying hens	Broilers	Other poultry	Other animals
2000	0.054	0.017	0.001	0.002	0.000	0.001	0.002	0.001	0.006	0.000
2005	0.046	0.019	0.001	0.002	0.000	0.001	0.002	0.002	0.006	0.001
2006	0.044	0.019	0.001	0.002	0.000	0.001	0.002	0.002	0.007	0.000
2007	0.042	0.020	0.002	0.002	0.000	0.001	0.002	0.002	0.003	0.000
2008	0.041	0.020	0.002	0.002	0.000	0.001	0.002	0.002	0.008	0.000
2009	0.040	0.020	0.002	0.002	0.000	0.001	0.002	0.002	0.006	0.000
2010	0.040	0.020	0.002	0.002	0.000	0.001	0.002	0.002	0.008	0.000
2011	0.039	0.021	0.002	0.002	0.000	0.001	0.002	0.003	0.010	0.000
2012	0.040	0.022	0.002	0.002	0.000	0.001	0.002	0.003	0.009	0.000
2013	0.040	0.024	0.002	0.002	0.000	0.001	0.002	0.003	0.004	0.000
2014	0.039	0.025	0.002	0.002	0.000	0.001	0.002	0.003	0.010	0.000
2015	0.047	0.020	0.002	0.002	0.000	0.001	0.002	0.003	0.010	0.000
2016	0.047	0.019	0.002	0.001	0.000	0.001	0.002	0.003	0.010	0.000
2017	0.035	0.019	0.002	0.001	0.000	0.001	0.002	0.003	0.010	0.000
trend 2000-2017, %	-34.0	10.4	141.8	-11.6	37.5	35.6	13.2	135.7	56.6	0.0

Table 5.7 Total emissions of PM₁₀ from manure management in the period of 2000-2017 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Laying hens	Broilers	Other poultry	Other animals
2000	0.083	0.026	0.002	0.036	0.000	0.001	0.029	0.012	0.044	0.000
2005	0.071	0.030	0.003	0.039	0.000	0.001	0.029	0.021	0.039	0.001
2006	0.068	0.030	0.004	0.039	0.000	0.001	0.026	0.020	0.052	0.001
2007	0.065	0.030	0.005	0.043	0.000	0.001	0.026	0.019	0.018	0.001
2008	0.063	0.030	0.005	0.042	0.000	0.001	0.022	0.021	0.055	0.001
2009	0.061	0.030	0.005	0.041	0.000	0.001	0.026	0.022	0.044	0.001
2010	0.061	0.031	0.006	0.043	0.000	0.002	0.023	0.024	0.053	0.001
2011	0.061	0.031	0.006	0.042	0.000	0.001	0.023	0.026	0.072	0.001
2012	0.061	0.033	0.005	0.042	0.000	0.001	0.028	0.025	0.064	0.001
2013	0.062	0.036	0.005	0.041	0.000	0.001	0.024	0.027	0.027	0.001
2014	0.060	0.038	0.005	0.041	0.000	0.001	0.030	0.028	0.071	0.001
2015	0.073	0.030	0.005	0.035	0.000	0.001	0.033	0.028	0.067	0.001
2016	0.072	0.029	0.005	0.030	0.000	0.001	0.029	0.028	0.067	0.000
2017	0.054	0.029	0.005	0.032	0.000	0.001	0.033	0.029	0.069	0.000
trend 2000-2017, %	-34.0	10.5	142.5	-9.8	37.5	35.5	13.3	135.6	56.6	0.0

5.2.2. Methodological Issues

NH₃ and NO_x emission calculations from manure management of swine, poultry and cattle are based on the Tier 3 and Tier 2 (for both mass flow approach) methods from the EMEP/EEA Guidebook 2016, and stem from country-specific values with abatement measures data whenever possible.

For particles and NMVOC (mainly with silage use) except for dairy cattle, the Tier 1 methods from the EMEP/EEA Guidebook 2016 were used in

calculations. Tier 1 was also used to calculate emissions from the manure management of sheep, goats, horses, other poultry, and fur animals.

The Tier 1 method uses readily available statistical data and default emission factors. The Tier 1 default emission factors also assume an average or typical process description.

The Tier 1 approach uses the following general equation:

$$E = AAP_{animal} \times EF_{pollutant_animal}$$

where

AAP_{animal} – the number of animals of a particular category present on average during the year
 $EF_{pollutant_animal}$ – the emission factor for this process and the technology.

Emissions from manure are calculated separately for each animal category; the separate calculation for a slurry or solid manure management system

depends on the animal category (see [Table 5.14](#)). According to the EMEP/EEA Guidebook 2016, there are different emission factors for solid and slurry manure types (see [Table 5.8](#)). Information on which sectors include the condensable component of PM_{10} and $PM_{2.5}$ can be found in Appendix 1 'Summary Information on Condensable in PM'.

Table 5.8 NO_x , NH_3 , NMVOC and PM emission factors for manure management

NFR	NO_x slurry	NO_x solid	NMVOC	NH_3 slurry	NH_3 solid	$PM_{2.5}$	PM_{10}	TSP
	kg/capita							
Cattle dairy	0.011	0.236	17.937	39.300	28.700	0.410	0.630	1.380
Cattle non-dairy	0.003	0.144	8.902	13.400	9.200	0.180	0.270	0.590
Calves						0.100	0.160	0.340
Sheep		0.008	0.279		1.400	0.020	0.060	0.140
Goats		0.008	0.624		1.400	0.017	0.056	0.139
Horses		0.201	7.781		14.800	0.140	0.220	0.480
Fattening pigs	0.002	0.069	0.551	6.700		0.060	0.340	0.750
Weaners						0.020	0.100	0.210
Sows	0.006	0.204	1.704	15.800		0.120	0.040	1.530
Laying hens		0.005	0.165		0.480	0.003	0.040	0.190
Broilers		0.002	0.108		0.220	0.002	0.020	0.040
Turkeys		0.008	0.489		0.950	0.020	0.110	0.110
Ducks		0.004	0.489		0.680	0.020	0.140	0.140
Geese		0.002	0.489		0.350	0.030	0.240	0.240
Fur animals		0.000	1.941		0.020	0.004	0.008	0.018

The Tier 2 methods from the EMEP/EEA Guidebook 2016 were used to calculate NMVOC emissions from the manure management of dairy cattle.

The Tier 2 approach uses the following general equation:

$$E_{NMVOC,i} = AAP_{animal,i} \times (E_{NMVOC,silage_store,i} + E_{NMVOC,silage_feeding,i} + E_{NMVOC,building,i} + E_{NMVOC,store,i} + E_{NMVOC,appl.,i} + E_{NMVOC,graz,i})$$

Where

MJ_i - is the gross feed intake in megajoules (MJ) per year

$AAP_{animal,i}$ - number of animals of a particular category present on average within the year

$E_{NMVOC,silage_store,i}$, $E_{NMVOC,silage_feeding,i}$, $E_{NMVOC,building,i}$,

$E_{NMVOC,store,i}$, $E_{NMVOC,appl.,i}$, $E_{NMVOC,graz,i}$ - NMVOC emissions from silage store, silage feeding, building, store and grazing.

For the calculation method for gross feed intake by dairy cattle, use was made of the Estonian GHG National Inventory Report 2019²³ (see [Table 5.11](#)) and the emission factor from the EMEP/EEA Guidebook 2016 (see

²³ Estonian GHG National Inventory Report 2019, Ch. 5 Agriculture (CFR 3)

Table 5.9).

Table 5.9 NMVOC emission factors for manure management of dairy cattle

NFR	Frac silage	Frac silage_store	EF NMVOC, silage-feeding	EF NMVOC, building	EF NMVOC, graz
			kg NMVOC kg/MJ feed intake		
Dairy cattle	0.500	0.250	0.0002002	0.0000353	0.0000069

The Tier 3 methods from the EMEP/EEA Guidebook 2016 were used to calculate NH₃ emissions from manure management, urine and dung deposited by grazing animals (NFR 3Da3), and from animal manure applied to soils (NFR 3D2a) by dairy cattle, non-dairy cattle and swine. The Tier 2 methods from the EMEP/EEA Guidebook 2016 were used to calculate NO and NH₃ emissions from manure management and NH₃ emissions from urine and dung deposited by grazing animals (NFR 3Da3), and from animal manure applied to soils (NFR 3D2a) by boilers, laying hens and other poultry also for NO emissions from non-dairy cattle, swine and dairy-cattle.

For non-dairy cattle and swine, category emissions were calculated separately for sub-categories as presented in [Table 5.11](#) and [Table 5.12](#). For other poultry the Tier 2 approach was used for the first time.

NH₃ emission from dairy cattle, non-dairy cattle, broilers, laying hens, other poultry and swine manure application to soils (NFR 3D2a) were calculated separately from sector 3B. In addition emissions from grazing of cattle (NFR 3D3) were calculated separately from sector 3B.

The Tier 2 and 3 methods use a mass flow approach which is based on the concept of the flow of Total Ammoniacal Nitrogen (TAN) through the manure management system. Calculations (Equations 5-41) were carried out with the Excel spreadsheet which was provided in the previous EMEP/EEA Guidebook, Appendix B, Chapter 3B - Manure management. For the calculation method involving total annual nitrogen levels, use was made of the method that covers excretion by dairy cattle and non-dairy cattle as described in the

Estonian GHG National Inventory Report 2019.²⁴

The results for nitrogen excretion estimations are presented in [Table 5.10](#) and [Table 5.11](#). For nitrogen excretion, use was made of the rates for swine (Regulation No 66 by the Minister of the Environment, 14.12.2016). For cattle and swine, slurry-based and solid-manure-based housing types are distinguished. For each stage of manure management, use was made of the Tier 2 default NH₃-N EFs, and default data for the proportions of TAN excreta. The separate implied emissions factor for dairy cattle, non-dairy cattle, and swine sub-categories were calculated for the first time for each year using a share of various technologies and the corresponding emissions reduction measures. The additional project, 'Loomakasvatusest eralduvate saasteainete heitkoguste inventuurimetoodikate täiendamise ja heite vähendamistehnoloogiate kaardistamine', was carried out by the Estonian University and the Estonian Environmental Research Centre to refine the historical technological data which covers housing, grazing, manure storage, and manure-spreading for the years 1990, 1995, 2000, 2005, 2010, and 2015.²⁵ The values in-between were interpolated. NH₃ emissions reductions in percentage terms were used first time from the United Nations Economic Commission for Europe's guidance document on preventing and abating ammonia emissions from agricultural sources.

According to the EMEP/EEA Guidebook 2016, there are different emissions factors for housing, manure storage, and grazing (see [Table 5.14](#)).

²⁴ Estonian GHG National Inventory Report 2019, Ch. 5 Agriculture (CFR 3)

²⁵

https://www.envir.ee/sites/default/files/nh3_eriheite_ja_sonnikukaitlustehnoloogiate_ajaloolise_ulevaate_lopparuanne_0.pdf

Table 5.10 Nitrogen excretion and gross energy intake by dairy cattle livestock in 1990-2017²⁶

Year	Nitrogen excretion rate, kg N/head/yr	Gross energy intake, MJ/head/year
1990	84.7	87,965
1995	81.6	79,205
2000	88.5	92,345
2005	104.6	103,660
2006	107.6	106,945
2007	108.1	108,770
2008	109.8	110,960
2009	110.5	111,690
2010	111.5	113,150
2011	111.8	114,245
2012	113.5	117,165
2013	116.4	120,815
2014	118.1	123,005
2015	119.0	123,005
2016	122.3	123,005
2017	122.9	123,005

Table 5.11 Nitrogen excretion rates of non-dairy cattle, kg N/head/year

Livestock category of non-dairy cattle	Nitrogen excretion rate, kg N/head/yr
Mature males (2 years and over)	80.3
Mature females (2 years and over)	44.8
Bovine animals (aged between 1 and 2 years)	58.5
Calves (6-12 months)	18.7
Calves (0-6 months)	4.4

Table 5.12 Average N excretion factors used in the estimates, kg N/head/year

Swine category	Nitrogen excretion rate, kg N/head/year
Piglets, live weight less than 20 kg	4.5
Young pigs, live weight 20–<50 kg	8.7
Fattening pigs	
...live weight 50–<80 kg	10.6
...live weight 80–<110 kg	10.6
...live weight 110 kg or more	10.6
Breeding pigs, live weight 50 kg or more	25.1

In terms of separately assessing the proportions of different manure management types for

different livestock categories, a country-specific manure management system (MMS) was used (involving liquid/slurry, solid storage, and pasture/range). Any MMS which was used to store animal waste that had been generated by cattle and swine is presented in Table 5.13. MMS data has also been updated with the results of the aforementioned project. The biggest difference when compared to the previous submission is a smaller share of grazing in the past few years.

In the early years of the twenty-first century a loose-housing technology system started to replace tie-stall housing technology on dairy farms. Thanks to this, liquid manure technology has been used in place of solid manure technology. At the same time tie stall housing technology with its solid storage is still used for mature non-dairy cattle. Calves are kept in individual boxes. Liquid manure technology is mainly used for swine.

The share of the proportion of pasture was used to calculate the period in which cattle had been housed (in days). In order to be able to calculate the bedding mass being used, EMEP/EEA Guidebook standards were employed. For the first time leaching from solid manure storage was taken into account. According to an expert opinion by the Estonian University of Life Sciences, leakage may be presumed to have taken place for 70% of solid manure storage in the 1990s as most manure was kept in manure stacks. The leak-proof levels of manure storage facilities were studied in a 2010 survey which was conducted by Estonian, Latvian, & Lithuanian Environment Ltd.²⁷ For further insight regarding leakage and N-excretion estimations, see the Estonian GHG National Inventory Report 2019. Detailed sector-by-sector explanations concerning the recalculations are presented in Chapter 8.

²⁶ <https://www.riigiteataja.ee/akt/122122016004>

²⁷ ELLE Manure management and storage inventory in nitrate vulnerable zone in farms with over 10 livestock units, 2010, pp. 56–58, <http://www.envir.ee/sites/default/files/ntas6nnikukitlusearuanneelle230710.pdf>

Table 5.13 Manure management system usage for swine and cattle in 1990 and 2017

Livestock category	Liquid/Slurry, %		Solid Storage +deep litter, %		Pasture/Range, %	
	1990	2017	1990	2017	1990	2017
Fattening pig	87.0	86.4	13.0	13.6		0.0
Piglets	87.0	100.0	13.0	0.0		0.0
Shows	85.5	100.0	14.5	0.0		0.0
Young pig	87.0	100.0	13.0	0.0		0.0
Dairy cattle		81.8	82.7	13.5	17.3	4.8
Bovine animals		28.9	67.1	42.0	32.9	29.1
Calvess		20.8	85.7	65.3	14.3	14.0
Mature females		0.5	51.3	55.2	48.7	44.3
Mature males		0.5	51.3	55.2	48.7	44.3

Table 5.14 NO and NH₃ emission factors for manure management from cattle and swine

NFR	NH ₃ house, slurry	NH ₃ house, solid	NH ₃ storage, slurry	NH ₃ storage, solid	NO storage, slurry	NO storage, solid	NH ₃ application, slurry	NH ₃ application, solid	NH ₃ grazing
Dairy cows	0.200	0.066	0.200	0.270	0	0.008	0.550	0.79	0.100
Other cattle	0.200	0.190	0.200	0.270	0	0.008	0.550	0.79	0.600
Fattening pigs	0.280	0.270	0.140	0.450	0	0.008	0.400	0.81	0.000
Sows	0.220	0.025	0.140	0.450	0	0.008	0.290	0.81	0.000

Activity data

Information regarding the numbers of livestock in agriculture is available from Statistics Estonia (www.stat.ee) for the years 1990-2017. For dairy and swine, the annual livestock number was still

used. For other livestock, the average annual population from livestock specific data (e.g. the production cycle, the proportion dying) was calculated.

Table 5.15 Number of livestock (1,000 head)

Year	Cattle dairy	Cattle non-dairy	Sheep	Goats	Horses	Fattening pigs	Sows	Laying hens	Broilers	Other poultry	Fur animals
1990	280.7	477.1	158.5	2.1	8.6	812.8	47.1	2,224.0	1,951.8	1,259.5	145.6
1995	185.4	185.0	55.4	2.0	4.6	425.4	23.4	828.3	862.2	561.0	38.5
2000	131.0	121.8	33.3	3.7	4.2	261.6	38.6	723.5	616.7	313.5	6.8
2005	112.8	136.7	55.4	3.1	4.8	312.2	34.3	725.7	1,033.8	279.8	87.2
2006	108.4	136.4	68.6	3.6	4.9	308.4	37.4	637.6	980.9	369.0	71.0
2007	103.0	137.5	81.1	4.5	5.3	343.3	35.7	643.3	956.0	125.9	80.1
2008	100.4	137.5	90.2	4.2	5.3	330.8	34.1	550.1	1,031.0	395.6	78.6
2009	96.7	138.0	91.2	4.6	5.4	331.0	34.1	644.8	1,083.2	314.4	90.6
2010	96.5	139.8	95.8	5.0	6.8	336.6	35.1	578.2	1,212.2	377.2	87.7
2011	96.2	142.1	94.0	4.8	6.5	330.1	35.6	568.9	1,298.3	513.7	97.6
2012	96.8	149.2	90.9	5.4	6.2	340.8	34.3	693.9	1,267.9	456.5	96.6
2013	97.9	163.5	82.7	5.1	6.3	325.4	33.3	590.8	1,361.5	191.5	98.4
2014	95.6	169.1	85.8	4.6	6.3	323.3	34.6	752.8	1,398.0	505.1	111.2
2015	115.7	140.5	85.9	5.0	6.3	279.4	25.1	825.0	1,376.9	475.6	116.5
2016	86.1	162.1	91.3	5.5	5.7	240.0	25.9	727.6	1,423.9	464.8	50.2
2017	86.4	164.5	80.8	5.1	5.7	262.6	26.5	819.4	1,452.8	491.0	50.2

5.2.3. Uncertainty

An uncertainty analysis was carried out for the 2017 inventory. The uncertainty in the emission factors for all pollutants from agriculture sector is estimated to be 100% and in the activity data 2%.

All uncertainty estimates for this source are given in

Table 5.16.

Table 5.16 Uncertainties in agriculture sector

Pollutant	Emission, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	2.3	kt	7.0	0.048	0.004
NMVOC	5.1	kt	22.8	0.122	0.020
NH ₃	9.0	kt	87.7	0.382	0.100
PM _{2.5}	0.1	kt	8.0	0.006	0.001
PM ₁₀	1.2	kt	1.2	0.066	0.019
TSP	1.6	kt	8.0	0.049	0.003

5.2.4. Source-Specific QA/QC and Verification

Common statistical quality control related to the assessment of trends was carried out.

5.2.5. Source-Specific Planned Improvements

Improve data quality to introduce other Tier 2 methods for emission estimation, which is based on detailed activities data and emission factors.

5.3. Agricultural Soils (NFR 3D)

5.3.1. Source Category Description

Direct NH₃ emissions from fertilisers are reported under NFR 3D1a. Particle emissions and NMVOC from grain fields are reported under NFR 3Dc and 3De respectively. NH₃ and NO_x emissions from animal manure applied to soils are reported under NFR 3Da2a, and emissions from grazing under NFR 3Da3.

The share of agricultural soils in the total NH₃ emissions in 2017 was at 54.7%.

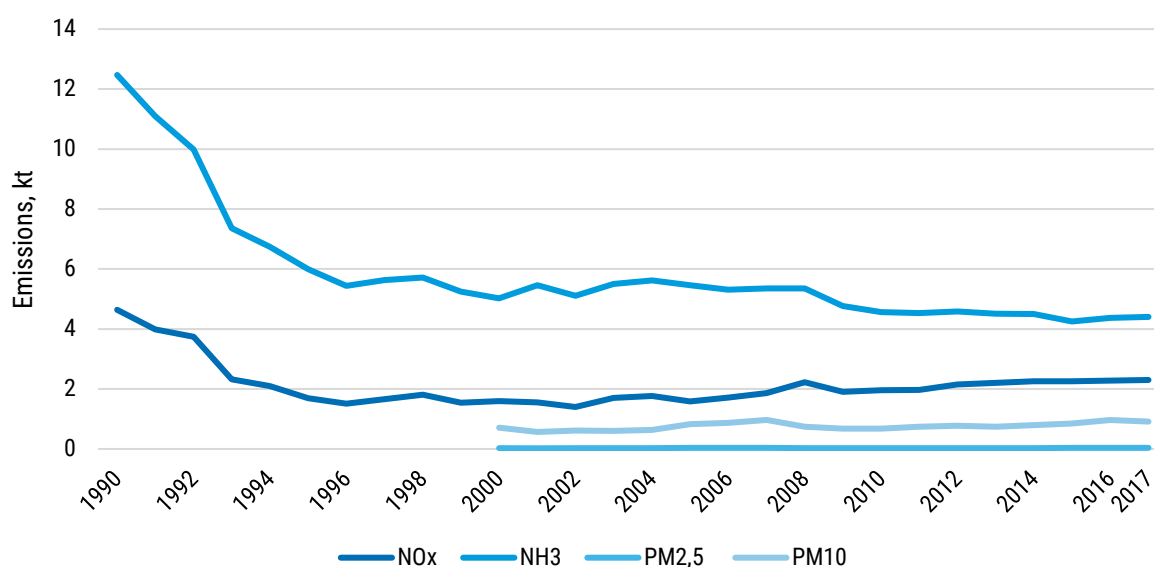


Figure 5.5 NO_x, NH₃ and PM₁₀ emissions from agricultural soils in the period of 1990-2017

During the 1990-2017 period, emissions of NH₃ decreased to 64.7% (see [Figure 5.5](#)), mainly due to changes in Estonian agriculture. The reduction of NH₃ emissions in recent years is mainly related to the development of manure-spreading technologies. In the 1990s, the spreading method was in use. Nowadays the main method of spreading liquid manure is through band spreading, although there has been a shortening of the manure spreading period.

All the emission time series are presented in [Table 5.17](#), [Table 5.18](#) and [Table 5.19](#).

In 2017, NH₃ emissions increased by 0.7% compared to 2016, mainly due to an increase in the cattle dairy and swine sectors.

Table 5.17 NMVOC, PM_{2.5}, PM₁₀ and TSP emissions from agricultural soils in the period 1990-2017 (kt)

Year	NMVOC	PM _{2.5}	PM ₁₀	TSP
1990	0.679	NR	NR	1.231
1995	0.358	NR	NR	0.649
2000	0.389	0.027	0.706	0.706
2005	0.458	0.032	0.830	0.830
2006	0.478	0.033	0.867	0.867
2007	0.534	0.037	0.968	0.968
2008	0.411	0.029	0.745	0.745
2009	0.372	0.026	0.674	0.674
2010	0.376	0.026	0.682	0.682
2011	0.408	0.028	0.740	0.740
2012	0.428	0.030	0.776	0.776
2013	0.410	0.029	0.744	0.744
2014	0.439	0.031	0.796	0.796
2015	0.439	0.033	0.850	0.850
2016	0.531	0.037	0.964	0.964
2017	0.504	0.035	0.914	0.914
trend 1990-2017, %	-25.8	29.4	29.4	-25.8

Table 5.18 NH₃ emissions from agricultural soils in the period 1990-2017 (kt)

Year	Inorganic N-fertilizers	Animal manure applied to soils	Sewage sludge applied to soils	Other organic fertilisers applied to soils	Urine and dung deposited by grazing animals
1990	2.966	8.897	0.010	0.010	0.585
1995	0.806	4.856	0.010	0.013	0.304
2000	0.934	3.838	0.009	0.028	0.207
2005	0.901	4.200	0.009	0.137	0.214
2006	0.963	4.013	0.009	0.142	0.184
2007	1.109	3.799	0.009	0.281	0.151
2008	1.447	3.513	0.009	0.262	0.120
2009	1.121	3.242	0.009	0.300	0.092
2010	1.160	3.026	0.009	0.285	0.086
2011	1.278	2.956	0.009	0.195	0.092
2012	1.315	2.940	0.009	0.217	0.101
2013	1.209	2.906	0.009	0.268	0.114
2014	1.399	2.780	0.009	0.188	0.122
2015	1.442	2.458	0.009	0.219	0.123
2016	1.431	2.501	0.009	0.298	0.130
2017	1.464	2.548	0.009	0.247	0.131
trend 1990-2017, %	-50.6	-71.4	-16.2	2 391.8	-77.6

Table 5.19 NO_x emissions from agricultural soils in the period 1990-2017 (kt)

Year	Inorganic N-fertilizers	Animal manure applied to soils	Sewage sludge applied to soils	Other organic fertilisers applied to soils	Urine and dung deposited by grazing animals
1990	2.868	1.337	0.003	0.005	0.426
1995	0.756	0.729	0.003	0.007	0.199
2000	0.896	0.550	0.003	0.014	0.136
2005	0.803	0.567	0.003	0.068	0.143
2006	0.904	0.611	0.003	0.071	0.125
2007	0.999	0.616	0.003	0.141	0.106
2008	1.418	0.583	0.003	0.131	0.088
2009	1.093	0.588	0.003	0.150	0.071
2010	1.145	0.601	0.003	0.143	0.068
2011	1.192	0.599	0.003	0.098	0.073
2012	1.319	0.643	0.003	0.109	0.080
2013	1.346	0.626	0.003	0.134	0.091
2014	1.432	0.631	0.003	0.094	0.098
2015	1.451	0.591	0.003	0.110	0.099
2016	1.456	0.565	0.003	0.149	0.106
2017	1.493	0.565	0.003	0.123	0.114
trend 1990-2017, %	-47.9	-57.8	-16.2	2 391.8	-73.3

5.3.2. Methodological Issues

Emission calculations from sewage sludge and other organic fertilizers on soils and NO_x emissions from grazing and animal manure application on soils are based on the Tier 1 method.

Emissions from the use of mineral fertilizers are based conditionally on the Tier 2 method. Statistics Estonia can only separately submit data covering the use of urea fertilizers (a detailed description is included in the activity data chapter). There are no statistics available for the whole data series on the distribution of other fertilizer types. With that in mind, two different emission factors were implemented in order to calculate NH₃ emissions. For urea EF 0.155 (kg kg⁻¹ fertilizer-N applied) was used and for others the EF 0.0405 (kg kg⁻¹ fertilizer-N applied) was used with an arithmetical mean of Tier 2 emission factors (except urea) as represented in Table 3.2 of the EMEP/EEA Guidebook 2016 crop production and agricultural soils chapter.

Emissions from grazing and animal manure applied to soils (a detailed description is available in Chapter 5.2.2) are based on the Tier 2 method from the EMEP/EEA Guidebook 2016. For calculating NH₃ emissions from other poultry

manure which is applied to soils, the Tier 2 methodology was used instead of Tier 1 for the first time. Detailed sector by sector explanations concerning the recalculations are presented in Chapter 8. Information on which sectors include the condensable component of PM₁₀ and PM_{2.5} can be found in Appendix 1 'Summary Information on Condensable in PM'.

The Tier 1 method uses readily available statistical data (see Table 5.21) and default emission factors (see Table 5.20).

The Tier 1 approach uses the general equation:

$$E = AD \times EF_{\text{pollutant}}$$

where

AD = activity data of a particular category present within the year;

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

Table 5.20 NO_x, NH₃, NMVOC and PM emission factors for agricultural soils

NFR Code	Pollutant	Unit	Value
3Da1	NO _x	kg kg ⁻¹ fertilizer-N applied	0.040
	NH ₃	kg NH ₃ kg ⁻¹ urea-N applied	0.115
	NH ₃	kg NH ₃ kg ⁻¹ fertilizer-N applied	0.0405
3Da2a	NO _x	NO kg kg ⁻¹ fertiliser and manure N applied	0.040
3Da2b	NH ₃	kg NH ₃ capita ⁻¹	0.0066
	NO _x	kg NO ₂ capita ⁻¹	0.002
3Da2c	NH ₃	kg kg ⁻¹ waste-N applied	0.080
	NO _x	kg kg ⁻¹ waste-N applied	0.040
3Da3	NO _x	NO kg kg ⁻¹ fertiliser and manure N applied	0.040
3Dc	PM _{2.5}	kg ha ⁻¹	0.060
	PM ₁₀	kg ha ⁻¹	1.560
3De	TSP	kg ha ⁻¹	1.560
	NMVOC	kg ha ⁻¹	0.860

Activity Data

Information regarding synthetic N-fertilizer use, the area covered by these crops and population is available from Statistics Estonia (www.stat.ee) for the years 1990-2017.

In 2015 the Statistics Estonia stopped gathering mineral fertilizer data by their own and started to use data gathered by the Estonian Rural Economy Research in the framework of the Centre Farm Accounting Data Network (FADN).

Information regarding urea fertilizer is available also from Statistics Estonia. In 2014-2017 there was no production of urea fertilizers in Estonia therefore using urea fertilizer marketing data provided by the Estonian Agricultural Board was used.

In addition, Information regarding compost application from Estonian Environment Agency were used.

Table 5.21 Active data for agricultural soil sector in the period of 1990-2017

Year	Synthetic N-fertilizers	Urea N	Area covered by crop	Compost applied on soils	Population mln.inhab
	tonnes	tonnes	ha	tonnes	mln.inhab
1990	58,360	544.097	952,103	6,775	1.571
1995	18,905	349.209	415,952	8,899	1.448
2000	22,396	237.165	452,538	19,010	1.401
2005	20,083	767.864	532,319	93,578	1.359
2006	22,610	416.432	556,083	97,332	1.351
2007	24,982	846.980	620,449	192,256	1.343
2008	35,455	100.691	477,786	179,204	1.338
2009	27,328	121.600	432,051	204,876	1.336
2010	28,628	4.661	437,302	195,002	1.333
2011	29,803	618.040	474,102	133,383	1.330
2012	32,978	1501.800	497,269	148,362	1.325
2013	33,659	199.564	476,623	183,237	1.320
2014	35,803	1344.800	510,317	128,368	1,316
2015	36,276	1607.972	545,071	149,984	1,313
2016	36,390	1462,560	617,919	203,611	1,316
2017	37,333	1462,560	585,712	168,825	1,316

5.3.3. Uncertainty

An uncertainty analysis was carried for to the year 2017 inventory. The uncertainty in the emission factors for NO_x, NMVOC, NH₃, PM_{2.5}, PM₁₀ and TSP from agricultural soils is estimated to be 100%, and in the activity data 2%. Uncertainty estimates for agricultural soils are described

together with manure management sector in Table 5.16.

5.3.4. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends was carried out.

5.3.5. Source-Specific Planned Improvements

- Improve data quality to introduce other Tier methods for emissions estimating which is based on detailed activities data and emission factors.

5.4. Field Burning of Agricultural Residues (NFR 3F)

In 2004, the burning of crop residues was prohibited by an Estonian act (Regulation of the Minister of Agriculture no. 5, 20.04.2004, no. 57, 20.04.2007, and no. 20, 23.02.2011).

As no other official records of agricultural burning of crop residues exist in Estonia, then for the reporting period of 1990–2004, an inquiry was made to the Estonian Ministry of Agriculture and according to their best knowledge, no widespread practice of agricultural residues burning has taken place during the reporting period or it has been marginal, as the generation of agricultural residues in the form of litter is scant and often insufficient to cover the demand for it. In the 2018 submission, notation key NO was applied to the entire time-series.



Source: www.bioneer.ee

6. WASTE (NFR 5)

6.1. Overview of the Sector

Emissions from solid waste disposal on land (landfills), waste incineration, cremation, waste water treatment and other waste sources are included in this category. Emissions from the waste sector are based on point sources (facilities) while area sources data are included for some sectors.

Emissions from point sources are taken from the OSIS database and the emissions for diffuse

sources are calculated from the data received from Statistics Estonia, Estonian Rescue Board and the waste management information system in ESTEA. The emission factors given in EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 and expert opinions are used in the additional calculations.

Used methods and reported emissions for the waste sector are presented in the [Table 6.1](#).

Table 6.1 Used methods and reported emissions for the waste sector (NFR 5)

NFR	Source	Description	Method	Emissions reported
5A	Solid waste disposal on land	Includes point and diffuse sources emissions from treatment and disposal of municipal, industrial and other solid waste at landfills	Tier 1 / Tier 3	NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP
5B1	Compost production	Includes point and diffuse sources emissions from the biological treatment of waste – composting	Tier 2 / Tier 3	NMVOC, NH ₃
5B2	Anaerobic digestion at biogas facilities	Includes point sources emissions from anaerobic digestion at biogas facilities	Tier 3	NO _x , NMVOC, SO _x , NH ₃ , TSP, CO
5C1a	Municipal waste incineration	Includes point source emissions from municipal solid waste (MSW) incineration process with heat recovery	Tier 3	IE under NFR 1A1a Public electricity and heat production
5C1bi	Industrial waste incineration	Includes point sources emissions from flaring in chemical industry and waste oil incineration	Tier 1 / Tier 3	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, As, Cr, Cu, Ni, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs Total
5C1bii	Hazardous waste incineration	--	--	NA
5C1biii	Clinical waste incineration	Includes point sources emissions from the incineration of hospital wastes	Tier 2	PCDD/F (<i>expert estimation</i>)
5C1biv	Sewage sludge incineration	--	--	NA
5C1bv	Cremation	Includes point and diffuse sources emissions from the incineration of human bodies in a crematorium and animal carcass incineration	Tier 1 / Tier 3	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs Total, HCB, PCBs
5C1bvi	Other waste incineration	--	--	NA
5C2	Open burning of waste	Includes diffuse sources emissions from the open burning of MSW	Tier 2	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, PAHs Total, HCB, PCBs
5D1	Domestic wastewater handling	Includes point sources emissions from domestic wastewater handling	Tier 1 / Tier 3	NO _x , NMVOC, SO _x , NH ₃
5D2	Industrial wastewater handling	Includes point sources emissions from industrial wastewater handling	Tier 3	NO _x , NMVOC, SO _x , NH ₃
5D3	Other wastewater handling	--	--	NA

NFR	Source	Description	Method	Emissions reported
5E	Other waste handling	Includes point sources emissions from other waste and diffuse sources emissions from unwanted car and house fires	Tier 2 / Tier 3	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs Total

The waste sector in the emission inventory is mostly an insignificant sector, except dioxins emissions, which in 2017 comprised about 37.2% of the total dioxins emissions. Over the years that share has been decreasing, reaching the peak of 44.9% in 2002. The main reason for that decrease is over 3 times less unintentional car and building fires in 2017 compared to the year 2002, which is one of the main sources for dioxins emissions in the waste sector beside industrial waste incineration.

6.2. Uncertainty

An uncertainty analysis was carried out to the year 2017 inventory. The uncertainty in the emission factors for NO_x, NMVOC and particulates from waste sector use is estimated to be 100%, for SO₂ and CO 50%, for ammonia 50-100%; in the activity data in the range from 2% to 10%. Uncertainty estimates for waste sector are given in [Table 6.2](#).

Table 6.2 Uncertainty estimation of the waste sector

Pollutant	Emission, 2017	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2017, %
NO _x	0.020327	kt	0.061	0.03	0.001
NMVOC	0.318225	kt	1.431	1.24	0.22
SO _x	0.008062	kt	0.021	0.01	0.001
NH ₃	0.060448	kt	0.589	0.29	0.14
PM _{2.5}	0.085736	kt	0.930	0.68	0.47
PM ₁₀	0.101042	kt	0.726	0.51	0.12
TSP	0.117183	kt	0.595	0.42	0.03
CO	0.011325	kt	0.008	0.003	0.002
Pb	0.341141	t	1.001	1.00	0.10
Cd	0.011503	t	1.431	1.39	0.15
Hg	0.021513	t	3.664	1.88	0.18
PCDD/F	1.606176	g I-TEQ	37.213	57.79	29.80
B(a)p	0.000014107	t	0.001	0.001	0.001
B(b)f	0.000010058	t	0.0004	0.001	0.001
B(k)f	0.000010052	t	0.001	0.002	0.001
I(1,2,3-cd)p	0.000000056	t	0.000004	0.00001	0.00001
HCB	0.007763	kg	2.507	5.31	22.54
PCBs	0.020672	kg	0.410	0.53	0.14

6.3. Solid Waste Disposal on Land (NFR 5A)

6.3.1. Source Category Description

This chapter includes emissions from treatment and disposal of municipal, industrial and other solid waste at landfills and mainly causes greenhouse gas emissions. This sector, however, is only a minor source of air pollutant emissions.

Small quantities of NMVOC and NH₃ had been emitted. Also, particulate emissions from waste handling are generated (see [Table 6.3](#)).

During the period of 1990-2015 the disposal of solid waste at landfills has decreased quite drastically (see [Figure 6.1](#)) because of better knowledge how to recycle and reuse waste. Also, in 2013 Eesti Energia finished building the modern and efficient waste-to-energy power unit at the Iru Power Plant to generate heat and electricity from

mixed municipal solid waste (MSW), which also reduced depositing of mixed MSW in landfills.

In 2016 and 2017 the amounts of landfilled MSW has started to grow because of higher gate-tax for

waste carriers at the Iru Power Plant and lower tax for landfilling waste. Also, Iru Power Plant imports more waste from abroad which has less organic waste in it and because of that has a higher calorific value.

Table 6.3 Emissions from solid waste disposal on land in the period of 1990-2017

Year	NMVOC kt	NH ₃	PM _{2.5}	PM ₁₀	TSP
			t		
1990	1.213	NE	NR	NR	0.360
1995	1.107	NE	NR	NR	0.329
2000	0.810	NE	0.017	0.114	0.240
2005	0.789	NE	0.017	0.111	0.234
2006	0.766	NE	0.016	0.108	0.227
2007	0.817	0.036	0.017	0.115	0.243
2008	0.699	0.038	0.015	0.098	0.485
2009	0.545	0.038	0.012	0.077	0.173
2010	0.508	0.025	0.011	0.071	0.209
2011	0.493	0.025	0.010	0.311	0.920
2012	0.318	0.025	0.007	0.287	0.868
2013	0.168	0.025	0.004	0.306	0.907
2014	0.130	0.025	0.003	0.285	0.984
2015	0.122	0.025	0.003	0.327	0.943
2016	0.158	0.025	0.003	0.428	1.095
2017	0.274	0.006	0.006	0.552	1.530

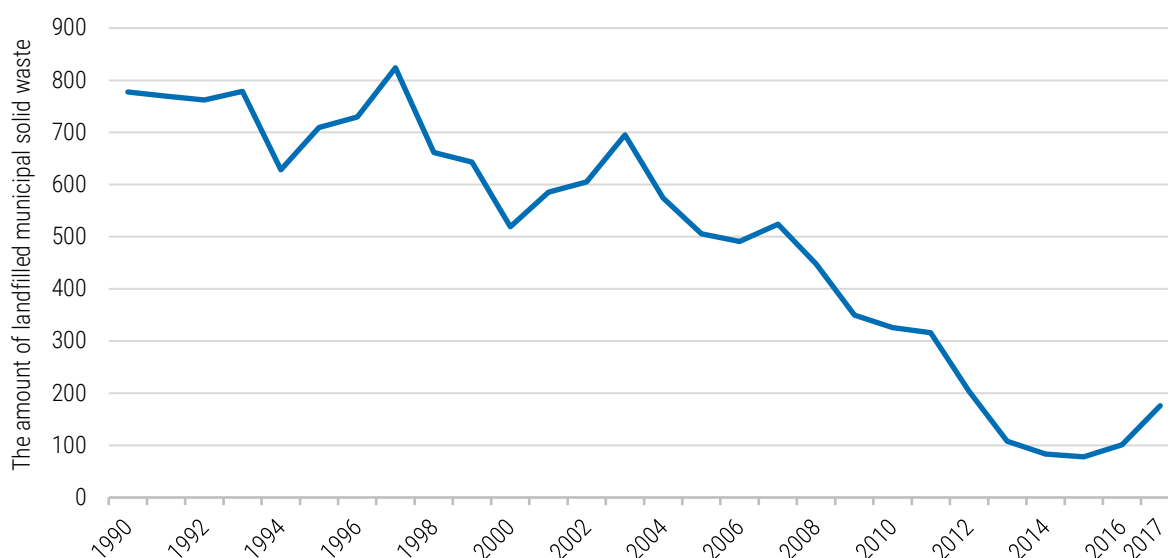


Figure 6.1 The amount of landfilled solid waste in the period of 1990-2017 (kt)

6.3.2. Methodological Issues

For diffuse sources the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 Tier 1 methodology is used for calculating NMVOC and

particulate emissions. The annual amount of landfilled solid waste is gathered from the waste management information system in ESTEA.

Also some point sources emissions from OSIS database, reported by operators, are used. In 2017 there were 6 operators.

6.3.3. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends has been carried out.

6.3.4. Source-Specific Planned Improvements

It is planned to differentiate the amounts of organic and inorganic waste so that NMVOC and NH₃ emissions would be calculated from organic wastes and particulate matter emissions from inorganic wastes.

6.4. Biological Treatment of Waste (NFR 5B)

6.4.1. Source Category Description

This chapter covers the emissions from the biological treatment of waste – compost production (NFR 5B1, see [Table 6.4](#)) and anaerobic digestion at biogas facilities (NFR 5B2, see [Table 6.5](#)).

Table 6.4 The amount of organic waste composted and NMVOC and NH₃ emissions from compost production in the period of 1990-2017 (kt)

Year	Amount of organic waste composted	NMVOC	NH ₃
1990	6.775	NE	0.002
1995	8.901	NE	0.002
2000	19.010	NE	0.005
2005	105.216	0.001	0.025
2006	115.327	0.003	0.028
2007	185.529	0.004	0.045
2008	207.259	0.003	0.050
2009	230.810	0.004	0.055
2010	217.633	0.004	0.052
2011	157.165	0.004	0.038
2012	148.086	0.004	0.036
2013	180.038	0.004	0.043
2014	140.086	0.004	0.031
2015	172.575	0.003	0.039
2016	248.490	0.003	0.058
2017	247.299	0.003	0.059

Table 6.5 Emissions from anaerobic digestion at biogas facilities in the period of 2011-2017

Year	NO _x	CO	NMVOC	SO ₂	NH ₃	TSP
	kt			t		
2011	0.002	0.001	0.077	0.068	0.344	0.002
2012	0.002	0.001	0.077	0.068	0.344	0.002
2013	0.008	0.008	0.676	0.348	0.344	0.011
2014	0.007	0.008	0.590	0.290	0.344	0.012
2015	0.008	0.008	1.498	4.644	0.344	0.017
2016	0.006	0.006	0.499	0.216	0.344	0.008
2017	0.007	0.007	0.554	0.201	0.010	0.046

6.4.2. Methodological Issues

Point sources emissions are based on operator reports. In 2017 there were reports from 7 anaerobic digestion operators and 3 composting operators.

Additional data to calculate diffuse sources emission of NH₃ in compost production sector is obtained from the waste management information system in ESTEA. Different waste codes for wood, sludge, paper and organic wastes are taken into account. For these calculations, the Tier 2 method is used. Default emission factor for NH₃ is taken from the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 (see [Table 6.6](#)).

Table 6.6 Emission factor for composting

Pollutant	Unit	Value
NH ₃	kg/Mg waste	0.24

6.4.3. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends has been carried out.

6.4.4. Source-Specific Planned Improvements

It is planned to check in more detail the data reported by point sources, specify activity data and make recalculations, if necessary.

6.5. Waste Incineration (NFR 5C)

6.5.1. Source Category Description

This sector includes the volume reduction, by combustion, of different kind of wastes. In Estonia, the following waste treatments take place: municipal, industrial and clinical waste incineration, cremation, clinical and open burning of waste.

In 2013 Eesti Energia finished building the modern and efficient waste-to-energy power unit at the Iru Power Plant to generate heat and electricity from mixed municipal solid waste (MSW). With the

completion of the Iru waste-to-energy unit, the large-scale depositing of mixed MSW in landfills decreased because for the first time the waste that previously went into landfills could be used as a fuel. The Iru waste-to-energy unit is a new solution for Estonia, for both energy production and waste handling. Because of mixed MSW is incinerated to generate heat and electricity, all the emissions that occur in the process are reported in the combustion sector (NFR 1A1a).

The [Table 6.7](#) will give overview of emissions from industrial waste incineration in the period of 1990-2017.

Table 6.7 Emissions from industrial waste incineration in the period of 2000-2017

Year	NO _x	NM VOC	SO ₂	CO	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC
	kt				t				
2000	NA	NA	NA	NA	NE	NA	NA	NA	NA
2001	NA	NA	NA	NA	NE	NA	NA	NA	NA
2002	NA	NA	NA	NA	NE	NA	NA	NA	NA
2003	NA	NA	0.010	0.020	NE	NA	NA	4.000	NA
2004	NA	0.0100	0.050	NA	NE	NA	NA	NA	NA
2005	NA	0.0100	0.020	NA	NE	NA	NA	NA	NA
2006	NA	NA	NA	NA	NE	NA	NA	NA	NA
2007	NA	NA	0.010	NA	NE	NA	NA	NA	NA
2008	0.00644	0.0004	0.005	0.003	NE	0.022	0.039	0.055	0.001
2009	0.01565	0.0010	0.017	0.013	0.118	0.042	0.074	0.106	0.001
2010	0.01602	0.0049	0.010	0.015	0.229	0.065	0.113	0.162	0.002
2011	0.01378	0.0278	0.010	0.015	0.108	0.324	0.402	0.583	0.011
2012	0.01137	0.0006	0.050	0.005	0.300	0.076	0.133	0.190	0.003
2013	0.00601	0.0006	0.039	0.002	0.137	0.031	0.053	0.076	0.001
2014	0.00705	0.0005	0.006	0.003	0.246	0.052	0.092	0.131	0.002
2015	0.00415	0.0003	0.019	0.001	0.110	0.032	0.055	0.079	0.001
2016	0.00893	0.0004	0.041	0.002	0.152	0.049	0.085	0.122	0.002
2017	0.00003	0.0002	NE	0.001	0.123	0.020	0.036	0.051	0.001

Table 6.7 continues

Year	Pb	As	Cr	Cu	Ni	Zn	PAHs Total	PCDD/F
	kg				g I-Teq			
2000	NA	NA	NE	NE	NA	NE	NE	0.116
2001	NA	NA	NE	NE	NA	NE	NE	0.136
2002	NA	NA	NE	NE	NA	NE	NE	0.134
2003	NA	NA	NE	NE	NA	NE	NE	0.129
2004	240.000	NA	NE	NE	NA	NE	NE	0.160
2005	270.000	NA	NE	NE	NA	NE	NE	0.117
2006	210.000	NA	NE	NE	NA	NE	NE	0.013
2007	NA	NA	NE	NE	NA	NE	NE	0.263
2008	NA	NA	NE	3.000	NA	NE	NE	0.426
2009	NA	NA	NE	24.000	NA	NE	NE	0.508
2010	NA	NA	NE	9.400	NA	NE	NE	0.255
2011	0.048	0.029	0.010	8.923	0.019	0.029	0.085	0.295
2012	NA	NA	NE	7.200	NA	NE	NE	0.140

Year	Pb	As	Cr	Cu	Ni	Zn	PAHs Total	PCDD/F
	kg							g I-Teq
2013	NA	NA	NE	9.500	NA	NE	NE	0.220
2014	NA	NA	NE	6.000	NA	NE	NE	0.250
2015	NA	NA	NE	4.100	NA	NE	NE	0.638
2016	NA	NA	NE	1.300	NA	NE	NE	0.639
2017	NA	NA	NE	NE	NA	NE	NE	0.802

The **Table 6.8** will give an overview of dioxins emissions from clinical waste incineration in the period of 1990-2017.

Table 6.8 PCDD/F emissions from clinical waste incineration in the period of 1990-2017 (g I-TEQ)

Year	PCDD/F
1990	0.470
1995	0.430
2000	0.280
2005	0.520
2006	0.040
2007	0.040
2008	0.026
2009	0.074
2010	0.066
2011	0.066
2012	0.068
2013	0.017
2014	0.073
2015	0.085
2016	0.086
2017	0.109

The first crematorium was established in Estonia in 1993. By the year 2017 there were already 8 crematoriums. One new crematorium has started working in 2018 and will be included in the inventory in the next year submission. As in 1993 there were only 39 cremations then in 2017 the number of cremations was over 8,000 which is about 52% of deceased people in that year. For pollutants emissions calculation the EMEP/EEA Guidebook 2016 Tier 1 emission factors are used and calculated emissions are presented in the following **Table 6.9**.

Table 6.9 Pollutants emissions from cremation in the period of 1993-2017

Year	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
	t								
1993	0.032	0.001	0.004	NA	NR	NR	0.002	NR	0.005
1995	0.723	0.011	0.099	NA	NR	NR	0.034	NR	0.123
2000	2.527	0.040	0.346	NA	0.106	0.106	0.118	NE	0.429
2005	3.934	0.062	0.539	NA	0.165	0.165	0.184	NE	0.668
2006	4.407	0.069	0.604	NA	0.185	0.185	0.206	NE	0.748
2007	4.622	0.073	0.633	NA	0.194	0.194	0.216	NE	0.784
2008	4.622	0.073	0.633	NA	0.194	0.194	0.216	NE	0.784
2009	4.731	0.075	0.648	1.543	0.199	0.199	0.221	NE	0.803
2010	5.124	0.081	0.702	1.619	0.216	0.216	0.239	NE	0.870
2011	5.623	0.089	0.770	1.678	0.237	0.237	0.263	NE	0.954
2012	5.749	0.091	0.787	0.004	0.242	0.242	0.269	NE	0.976
2013	6.108	0.096	0.837	0.007	0.257	0.257	0.285	NE	1.037
2014	6.283	0.099	0.861	0.007	0.264	0.264	0.294	NE	1.066
2015	6.455	0.102	0.884	0.013	0.271	0.271	0.302	NE	1.095
2016	6.485	0.102	0.888	0.008	0.273	0.273	0.303	NE	1.101
2017	6.654	0.105	0.911	0.008	0.280	0.280	0.311	NE	1.129

Table 6.9 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
kg									
1993	0.001	0.000	0.058	0.001	0.001	0.000	0.001	0.001	0.006
1995	0.026	0.004	1.305	0.012	0.012	0.011	0.015	0.017	0.140
2000	0.092	0.015	4.564	0.042	0.042	0.038	0.053	0.061	0.490
2005	0.143	0.024	7.104	0.065	0.065	0.059	0.083	0.094	0.763
2006	0.160	0.027	7.960	0.073	0.072	0.066	0.093	0.106	0.855
2007	0.168	0.028	8.348	0.076	0.076	0.070	0.097	0.111	0.897
2008	0.168	0.028	8.347	0.076	0.076	0.070	0.097	0.111	0.897
2009	0.172	0.029	8.545	0.078	0.078	0.071	0.099	0.113	0.918
2010	0.187	0.031	9.254	0.085	0.084	0.077	0.108	0.123	0.995
2011	0.205	0.034	10.156	0.093	0.092	0.085	0.118	0.135	1.091
2012	0.209	0.035	10.384	0.095	0.094	0.087	0.121	0.138	1.116
2013	0.222	0.037	11.032	0.101	0.100	0.092	0.128	0.146	1.186
2014	0.229	0.038	11.348	0.104	0.103	0.095	0.132	0.151	1.219
2015	0.235	0.039	11.658	0.106	0.106	0.097	0.136	0.155	1.253
2016	0.236	0.040	11.713	0.107	0.107	0.098	0.136	0.155	1.259
2017	0.242	0.041	12.017	0.110	0.109	0.100	0.140	0.160	1.291

Table 6.9 continues

Year	PCDD/F	PAHs				HCB	PCBs
		B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p		
	mg I-TEQ	g					
1993	0.001	0.001	0.000	0.000	0.000	0.006	0.016
1995	0.024	0.012	0.006	0.006	0.006	0.131	0.359
2000	0.083	0.040	0.022	0.020	0.021	0.459	1.256
2005	0.129	0.063	0.034	0.031	0.033	0.715	1.955
2006	0.144	0.071	0.039	0.034	0.037	0.801	2.190
2007	0.151	0.074	0.040	0.036	0.039	0.840	2.297
2008	0.151	0.074	0.040	0.036	0.039	0.840	2.297
2009	0.155	0.076	0.041	0.037	0.040	0.860	2.351
2010	0.168	0.082	0.045	0.040	0.043	0.932	2.547
2011	0.184	0.090	0.049	0.044	0.048	1.022	2.795
2012	0.188	0.092	0.050	0.045	0.049	1.045	2.857
2013	0.200	0.098	0.053	0.048	0.052	1.111	3.036
2014	0.206	0.101	0.055	0.049	0.053	1.142	3.123
2015	0.211	0.103	0.056	0.050	0.055	1.174	3.208
2016	0.212	0.104	0.057	0.051	0.055	1.179	3.223
2017	0.218	0.106	0.058	0.052	0.056	1.210	3.307

This chapter also covers emissions from open waste burning in households. This is a poorly quantified sector. Uncontrolled domestic waste burning should include all instances where waste is burned with no pollution controls and therefore includes burning in the open: in piles, in barrels or in home fires. Activity data and emissions are shown in the [Table 6.10](#) and [Table 6.11](#). The share of this sector into total emission for all pollutants is not significant compared to other pollution sources.

Table 6.10 Amount of domestic waste burned in the period of 1990- 2017 (tonnes)

Year	Total MSW	MSW burned
1990	382,150.6	7643.0
1995	522,097.2	10,441.9
2000	570,582.4	11,411.6
2005	465,437.9	4654.4
2006	470,257.1	4702.6
2007	395,304.7	3953.0
2008	365,630.1	3656.3
2009	310,382.1	3103.8
2010	289,423.3	2894.2
2011	292,716.2	2927.2

Year	Total MSW	MSW burned
2012	277,826.1	2778.3
2013	294,720.2	2947.2
2014	304,835.4	3048.4
2015	317,428.8	3174.3
2016	324,850.5	3248.5
2017	327,633.5	3276.3

Table 6.11 Pollutants emissions from domestic waste burning in the period of 1990-2017

Year	NO _x	NM VOC	SO ₂	PM _{2.5}	PM ₁₀	TSP	BC	CO
t								
1990	13.757	0.153	12.993	NR	NR	139.867	NR	5.350
1995	18.795	0.209	17.751	NR	NR	191.088	NR	7.309
2000	20.541	0.228	19.400	104.987	156.340	208.833	3.675	7.988
2005	8.378	0.093	7.912	42.820	63.765	85.175	1.499	3.258
2006	8.465	0.094	7.994	43.264	64.425	86.057	1.514	3.292
2007	7.115	0.079	6.720	36.368	54.157	72.341	1.273	2.767
2008	6.581	0.073	6.216	33.638	50.091	66.910	1.177	2.559
2009	5.587	0.062	5.276	28.555	42.522	56.800	0.999	2.173
2010	5.210	0.058	4.920	26.627	39.651	52.964	0.932	2.026
2011	5.269	0.059	4.976	26.930	40.102	53.567	0.943	2.049
2012	5.001	0.056	4.723	25.560	38.062	50.842	0.895	1.945
2013	5.305	0.059	5.010	27.114	40.377	53.934	0.949	2.063
2014	5.487	0.061	5.182	28.045	41.762	55.785	0.982	2.134
2015	5.714	0.063	5.396	29.203	43.488	58.089	1.022	2.222
2016	5.847	0.065	5.522	29.886	44.505	59.448	1.046	2.274
2017	5.897	0.066	5.570	30.142	44.886	59.957	1.055	2.293

Table 6.11 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
kg								
1990	794.873	25.986	21.400	16.356	1.414	0.711	0.917	6.879
1995	1,085.962	35.503	29.237	22.346	1.932	0.971	1.253	9.398
2000	1,186.811	38.800	31.953	24.421	2.111	1.061	1.369	10.270
2005	484.055	15.825	13.032	9.960	0.861	0.433	0.559	4.189
2006	489.067	15.989	13.167	10.064	0.870	0.437	0.564	4.232
2007	411.117	13.440	11.069	8.460	0.731	0.368	0.474	3.558
2008	380.255	12.431	10.238	7.824	0.676	0.340	0.439	3.291
2009	322.797	10.553	8.691	6.642	0.574	0.289	0.372	2.793
2010	301.000	9.840	8.104	6.194	0.535	0.269	0.347	2.605
2011	304.425	9.952	8.196	6.264	0.542	0.272	0.351	2.634
2012	288.939	9.446	7.779	5.945	0.514	0.258	0.333	2.500
2013	306.509	10.020	8.252	6.307	0.545	0.274	0.354	2.652
2014	317.029	10.364	8.535	6.523	0.564	0.283	0.366	2.744
2015	330.126	10.793	8.888	6.793	0.587	0.295	0.381	2.857
2016	337.844	11.045	9.096	6.952	0.601	0.302	0.390	2.924
2017	340.739	11.140	9.174	7.011	0.606	0.305	0.393	2.949

Table 6.11 continues

Year	PCDD/ F g I-TEQ	B(a)p	B(b)f	B(k)f kg	HCB	PCB
1990	0.306	0.032	0.024	0.024	0.015	0.041
1995	0.418	0.044	0.033	0.032	0.021	0.055
2000	0.456	0.048	0.037	0.035	0.023	0.060
2005	0.186	0.020	0.015	0.014	0.009	0.025
2006	0.188	0.020	0.015	0.015	0.009	0.025
2007	0.158	0.017	0.013	0.012	0.008	0.021
2008	0.146	0.015	0.012	0.011	0.007	0.019
2009	0.124	0.013	0.010	0.010	0.006	0.016
2010	0.116	0.012	0.009	0.009	0.006	0.015
2011	0.117	0.012	0.009	0.009	0.006	0.016
2012	0.111	0.012	0.009	0.009	0.006	0.015
2013	0.118	0.012	0.009	0.009	0.006	0.016
2014	0.122	0.013	0.010	0.009	0.006	0.016
2015	0.127	0.013	0.010	0.010	0.006	0.017
2016	0.130	0.014	0.010	0.010	0.006	0.017
2017	0.131	0.014	0.010	0.010	0.007	0.017

6.5.2. Methodological Issues

Emissions from clinical and industrial waste incineration are based on data from facilities. Emissions are calculated by operators on the basis of measurements, and the combined method (measurements plus calculations) is also used.

In addition to the facility data, PCDD/F emissions from clinical and industrial waste incineration are calculated. In these calculations, data from the waste data management information system was used.

UNEP Standardized Toolkit emission factors were used in the calculation of dioxins emissions from clinical and industrial waste incineration:

- Clinical waste incineration 525 µg/Mg of waste;
- Industrial waste incineration 350 µg/Mg of waste.

The pollutant emissions from the open domestic waste burning are calculated based on an expert judgement about the amount of burned waste (before 2004 - 2% from the total amount of municipal waste and since 2004 - 1% of MSW) and the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 emission factors. Unfortunately, in Guidebook there is no emission factor applicable for this category and therefore

the calculation method is applied for uncontrolled municipal waste incineration (NFR 5C1a). Emission factors are presented in mass per unit mass of waste burned (see Table 6.12).

Table 6.12 Emission factors for domestic waste incineration

Pollutant	Unit	Value
NO _x	kg/Mg waste	1.8
NM VOC	kg/Mg waste	0.02
SO ₂	kg/Mg waste	1.7
CO	kg/Mg waste	0.7
TSP	kg/Mg waste	18.3
PM ₁₀	kg/Mg waste	13.7
PM _{2.5}	kg/Mg waste	9.2
BC	kg/Mg waste	0.322
Pb	g/Mg waste	104.0
Cd	g/Mg waste	3.4
Hg	g/Mg waste	2.8
As	g/Mg waste	2.14
Cr	g/Mg waste	0.185
Cu	g/Mg waste	0.093
Ni	g/Mg waste	0.12
Zn	g/Mg waste	0.9
PCDD/F	µg/Mg waste	40.0
B(a)p	mg/Mg waste	4.2
B(b)f	mg/Mg waste	3.2
B(k)f	mg/Mg waste	3.1
HCB	g/Mg waste	0.002
PCB	mg/Mg waste	5.3

6.5.3. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends has been carried out.

6.5.4. Source-Specific Planned Improvements

It is planned to specify activity data and make recalculations, if necessary.

6.6. Waste Water Handling (NFR 5D)

6.6.1. Source Category Description

This chapter covers emissions from domestic and industrial wastewater handling (see [Table 6.13](#) and [Table 6.14](#)). In general, emissions of NO_x, NMVOC, SO_x, NH₃ and CO occur from waste water treatment plants, but are largely insignificant in terms of total national emissions.

Table 6.13 Emissions from domestic wastewater handling in the period of 1994-2017 (tonnes)

Year	NO _x	NMVOC	SO _x	NH ₃
1994	NA	29.427	NA	NE
1995	NA	27.735	NA	NE
2000	NA	22.428	NA	NE
2005	NA	24.296	NA	NE
2006	NA	24.225	NA	NE
2007	NA	28.204	NA	NE
2008	0.128	24.886	0.068	NE
2009	0.128	22.173	0.068	0.096
2010	0.128	28.490	0.068	0.077
2011	0.128	28.995	0.068	0.014
2012	0.128	25.478	0.068	0.014
2013	0.128	26.936	0.068	0.173
2014	0.128	26.432	0.068	0.032
2015	0.128	24.625	0.068	0.042
2016	0.128	27.301	0.068	0.191
2017	NE	28.059	NE	NE

Table 6.14 Emissions from industrial wastewater handling in the period of 1994-2017 (tonnes)

Year	NO _x	NMVOC	SO _x	NH ₃
1994	NA	IE	NA	NE
1995	NA	IE	NA	NE
2000	NA	IE	NA	NE
2005	NA	IE	NA	NE
2006	NA	IE	NA	NE
2007	NA	IE	NA	NE
2008	1.234	5.753	0.124	0.979
2009	0.444	4.663	0.124	1.074
2010	0.441	6.216	0.126	0.426
2011	0.444	4.145	0.124	0.229
2012	0.441	4.145	0.125	0.318
2013	1.236	1.144	1.763	0.149
2014	1.486	1.098	2.183	0.134
2015	0.317	0.883	0.056	0.530
2016	1.085	4.539	1.833	0.522
2017	1.205	8.211	1.380	0.949

6.6.2. Methodological Issues

NO_x, NMVOC, SO_x and NH₃ emissions from waste water handling are based on data from facilities. In 2017 the annual reports were received from 7 operators.

In addition to the facility data, NMVOC emissions from diffuse sources are based on the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 Tier 1 method, whereby emissions are calculated using a default emission factor (NMVOC 15 mg/m³ waste water). In this calculation, data from Statistics Estonia was used. Data is available from the year 1994 and those NMVOC emissions are reported under NFR 5D1. It is assumed that diffuse sources NMVOC emissions from industrial wastewater handling for the years 1994 to 2007 are already included in the domestic wastewater handling NMVOC emissions for the same period.

6.6.3. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends has been carried out.

6.6.4. Source-Specific Planned Improvements

To recalculate emissions from waste water treatment by using data from the waste management information system and to compare the data with the GHG inventory data. Also, specify data for latrines and include those emissions in the inventory in future submissions.

6.7. Other Waste (NFR 5E)

6.7.1. Source Category Description

This chapter covers emissions from other waste sector, which includes data from facilities (2 operators in 2017) and from car fires, detached and undetached house fires, apartment and industrial building fires. Detailed data about fires is obtained from the Estonian Rescue Board and is available since 1998 (see [Figure 6.2](#)).

Pollutants emissions are presented in the following [Table 6.15](#).

Table 6.15 Emissions from other waste in the period of 1998-2017

Year	NO _x	NM VOC	SO _x	NH ₃	CO	PM _{2.5}	PM ₁₀	TSP
	t					kt		
1998	NE	NE	NE	NE	NE	NR	NR	0.209
2000	NE	NE	NE	NE	NE	0.200	0.200	0.200
2005	NE	NE	NE	NE	NE	0.170	0.170	0.170
2006	NE	NE	NE	NE	NE	0.172	0.172	0.172
2007	NE	NE	NE	NE	NE	0.153	0.153	0.153
2008	NE	5.409	NE	NE	NE	0.138	0.138	0.138
2009	NE	3.692	NE	NE	NE	0.129	0.129	0.129
2010	0.475	5.035	NE	NE	0.475	0.099	0.099	0.099
2011	1.329	6.022	0.068	NE	1.444	0.091	0.091	0.091
2012	3.534	6.786	0.276	1.280	3.727	0.091	0.091	0.091
2013	1.797	4.878	0.018	1.137	0.247	0.075	0.075	0.075
2014	0.317	3.523	NE	1.780	NE	0.083	0.083	0.083
2015	0.388	2.727	NE	0.165	NE	0.065	0.065	0.065
2016	0.135	5.592	NE	0.009	0.112	0.067	0.067	0.067
2017	NE	3.113	NE	NE	NE	0.055	0.055	0.055

Table 6.15 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
	kg							
1998	0.611	1.230	1.230	1.947	1.857	4.318	NE	NE
2000	0.583	1.175	1.175	1.860	1.775	4.126	NE	NE
2005	0.496	0.998	0.998	1.580	1.508	3.505	NE	NE
2006	0.503	1.013	1.013	1.604	1.531	3.559	NE	NE
2007	0.449	0.904	0.904	1.432	1.366	3.175	NE	NE
2008	0.403	0.811	0.811	1.284	1.225	2.849	NE	NE
2009	0.376	0.756	0.756	1.197	1.142	2.656	NE	NE
2010	0.288	0.580	0.580	0.919	0.877	2.038	NE	NE
2011	0.264	0.532	0.532	0.842	0.803	1.867	NE	NE
2012	0.865	0.531	0.690	0.840	0.802	1.865	0.0007	0.0010
2013	0.906	0.497	0.581	0.689	0.658	1.529	0.0004	0.0006
2014	0.217	0.439	0.439	0.771	0.735	1.710	NE	NE
2015	0.189	0.380	0.380	0.602	0.575	1.336	NE	NE
2016	0.195	0.392	0.392	0.621	0.593	1.378	NE	NE
2017	0.160	0.322	0.322	0.510	0.487	1.132	NE	NE

Table 6.15 continues

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p
	g I-TEQ	g			
1998	2.101	NE	NE	NE	NE
2000	2.012	NE	NE	NE	NE
2005	1.711	NE	NE	NE	NE
2006	1.740	NE	NE	NE	NE
2007	1.545	NE	NE	NE	NE
2008	1.396	NE	NE	NE	NE
2009	1.301	NE	NE	NE	NE
2010	0.999	NE	NE	NE	NE
2011	0.920	NE	NE	NE	NE
2012	0.919	1.100	1.400	0.900	0.500
2013	0.757	0.553	0.659	0.425	0.234
2014	0.843	NE	NE	NE	NE
2015	0.662	NE	NE	NE	NE
2016	0.684	NE	NE	NE	NE
2017	0.563	NE	NE	NE	NE

6.7.2. Methodological Issues

Emissions from the other waste sector are based on data from facilities and additional calculations.

In addition to the facility data, emissions of particulate matter, heavy metals and dioxins are

calculated according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 Tier 2 method default emission factors (see [Table 6.16](#)). In these calculations, data from the Estonian Rescue Board were used.

Table 6.16 Emission factors for unwanted fires in cars and various types of houses

Category	PM _{2.5}	PM ₁₀	TSP	Pb	Cd	Hg	As	Cr	Cu	PCDD/F
	kg/fire			mg/fire						
Car fire	2.3	2.3	2.3							48
Detached house fire	143.82	143.82	143.82	420	850	850	1,350	1,290	2,990	1,440
Undetached house fire	61.62	61.62	61.62	180	360	360	580	550	1,280	620
Apartment building fire	43.78	43.78	43.78	130	260	260	410	390	910	440
Industrial building fire	27.23	27.23	27.23	80	160	160	250	240	570	270

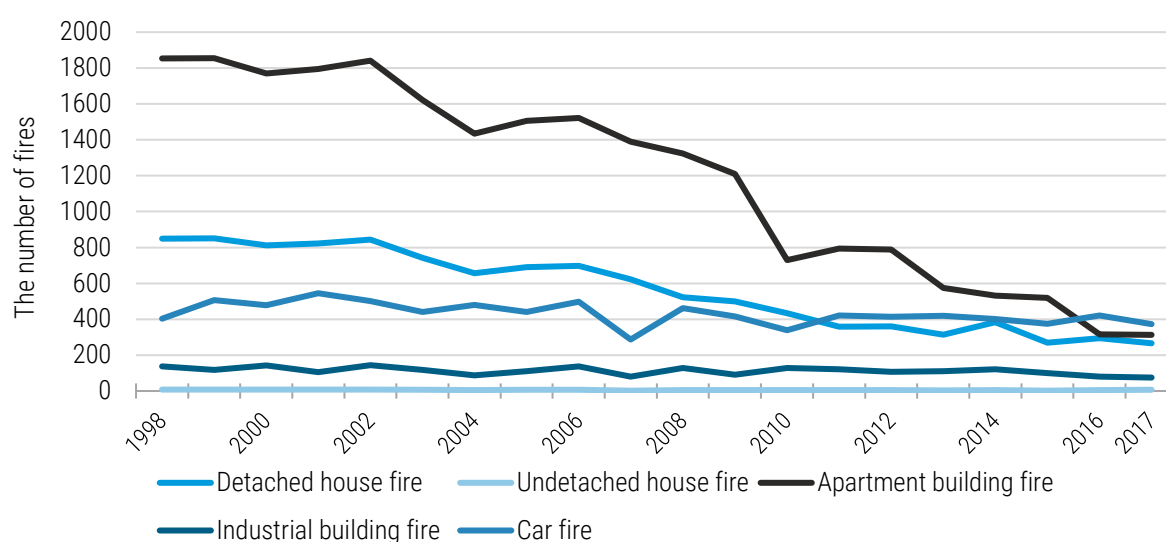


Figure 6.2 The number of fires according to the Estonian Rescue Board in the period of 1998-2017

6.7.3. Source-Specific QA/QC and Verification

Common statistical quality checking related to the assessment of trends has been carried out.

6.7.4. Source-Specific Planned Improvements

Specify activity data and make recalculations if necessary.



Golden Spring Morning (Photo by Sven Začek)

Nature Year Photo 2011

7. NATURAL EMISSIONS (NFR 11)

7.1. Overview of the Sector

7.1.1. Source Category Description

The Estonian inventory of air pollutants from natural sources includes emissions from forest fires and NMVOC emission from non-managed deciduous/coniferous forests and managed

deciduous/coniferous forests, as well as emissions of grassland and other low vegetation including crops.

These emissions are reported as memo items and are not included in the national total amount of pollutant emissions. Nevertheless it should be noted that emissions of NMVOC from this sector exceeds the anthropogenic emissions by 67%.

Table 7.1 Natural sources

NFR	Source	Description	Emissions reported
11	B. Forest fires	Includes emissions from naturally or man-induced burning of managed and non-managed forests	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO
	C. Other natural emissions (please specify in the IIR)	Includes all types of foliar forest emissions: managed and non-managed, deciduous and coniferous.	NMVOC

7.2. Forest Fires (NFR 11B)

7.2.1. Source Category Description

A forest fire is an uncontrolled fire occurring in nature. Many forest fires are due to human activity.

The number of forest fires varies from year to year, and quite a long time may elapse between forest fires that are considered to be large. Climatic conditions are the factor that has

greatest impact on the extent of forest fires. The forest is most vulnerable in spring and summer seasons when there are long dry spells. Weather conditions such as precipitation and wind, as well as the layout of the terrain, are important factors in determining the size of the forest fire (see [Figure 7.1](#)). The figures it is clear there is a tendency of forest fires depending on weather conditions - in the years with the highest temperature and lower precipitations amount the greatest number of fires.

Table 7.2 Pollutant emissions from forest fires in the period of 1990–2017

Year	NO _x	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	0.019	0.058	0.004	0.004	0.269	0.329	0.509	0.024	0.582
1995	0.019	0.056	0.004	0.004	0.258	0.315	0.488	0.023	0.558
2000	0.068	0.205	0.014	0.014	0.931	1.138	1.759	0.084	2.051
2005	0.009	0.026	0.002	0.002	0.122	0.149	0.230	0.011	0.260
2006	0.310	0.929	0.062	0.062	4.422	5.405	8.353	0.398	9.287
2007	0.029	0.088	0.006	0.006	0.423	0.518	0.800	0.038	0.877
2008	0.128	0.384	0.026	0.026	1.904	2.327	3.596	0.171	3.839
2009	0.006	0.018	0.001	0.001	0.090	0.110	0.169	0.008	0.178
2010	0.002	0.007	0.000	0.000	0.038	0.046	0.071	0.003	0.074
2011	0.002	0.006	0.000	0.000	0.029	0.036	0.055	0.003	0.058
2012	0.000	0.001	0.000	0.000	0.004	0.005	0.007	0.000	0.008
2013	0.008	0.024	0.002	0.002	0.119	0.145	0.224	0.011	0.236
2014	0.008	0.023	0.002	0.002	0.116	0.142	0.220	0.010	0.233
2015	0.008	0.025	0.002	0.002	0.124	0.151	0.234	0.011	0.249
2016	0.012	0.037	0.002	0.002	0.183	0.224	0.346	0.016	0.369
2017	0.003	0.010	0.001	0.001	0.049	0.060	0.092	0.004	0.099

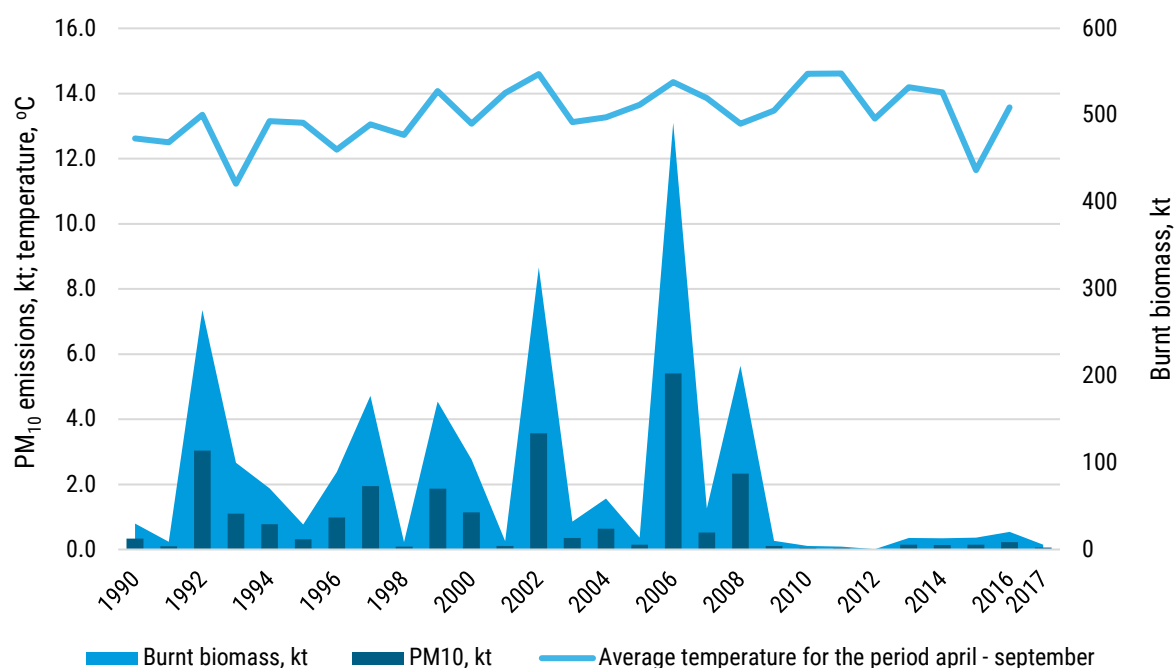


Figure 7.1 Burnt biomass, particulates emission and average temperature in the period 1990-2017

All forest fires in 2017 began with a direct or indirect human activity. Natural factors (lightning) did not cause any forest fires this year. 16% of forest fires in 2017 were caused by the carelessness or negligence of forest visitors (campers, children, etc.). These fires were mainly caused due to smoking and campfires. Other causes of fires in 2017 were transport and power transmission lines. If we analyse the causes of fires in the period of 1999–2017, it appears that, on average, 1.4% of forest fires started due to natural factors (lightning), and the rest of the forest fires were, to a greater or lesser extent, the result of human activity.²⁸

The emissions of NO_x, NMVOC, SO_x, NH₃ and CO are calculated using EMEP/EEA Guidebook 2016 Tier 1 emission factors (see Table 7.3) and burnt forest area (1990–2017) received from the Yearbook Forest 2017 (see Table 7.4).

The emissions of particulates are calculated on the base of EMEP/EEA Guidebook 2016 Tier 1 emission factors and biomass burnt. Data about biomass amount are available in statistical database only for the years 2000-2017. Data for 1990-1999 are expert estimates on the base of surrogate data.

7.2.2. Methodological Issues

The forest fires category isn't key category therefore for calculation the Tier 1 method was used for calculation of emissions.

Table 7.3 Tier 1 emission factors for category 11B Forest fires

Pollutant	NO _x	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
Unit	kg/ha area burned	kg/ha area burned	kg/ha area burned	kg/ha area burned	g/kg wood burned	g/kg wood burned	g/kg wood burned	g/kg wood burned	kg/ha area burned
Value	100.000	300.000	20.000	20.000	9.000	11.000	17.000	0.81	3000.000

²⁸ Yearbook Forest 2017, Estonian Environment Agency, 2018, <https://www.keskkonnaagentuur.ee/et/aastaraamat-mets-2017>

Activity Data

Table 7.4 Forest burnt area and burnt biomass in the period 1990-2017

Year	Forest burnt area	Burnt biomass
	ha	t
1990	194.0	29928.9
1995	185.9	28679.3
2000	683.8	103481.5
2005	86.5	13556.8
2006	3095.6	491334.9
2007	292.4	47051.0
2008	1279.8	211535.3
2009	59.3	9962.9
2010	24.8	4188.7
2011	19.3	3261.1
2012	2.5	421.7
2013	78.5	13168.4
2014	77.8	12924.3
2015	83.1	13744.8
2016	122.9	20345.7
2017	33.0	5419.7

7.2.3. Source-Specific QA/QC and Verification

Common statistical quality control related to the assessment of trends has been carried out.

7.2.4. Source-Specific Planned Improvements

Improve the activity data (burnt biomass) for the 1990-1999.

7.3. Other Natural Sources (NFR 11C)

7.3.1. Source Category Description

The Estonian inventory of air pollutants from natural emissions includes NMVOC emission from non-managed deciduous/coniferous forests and managed deciduous/coniferous forests, as well as emissions of grassland and other low vegetation including crops. The emissions natural sources sector are presented in [Table 7.5](#).

Table 7.5 NMVOC emission from other natural sources in the period of 1990–2015 (kt)

Year	NMVOC
1990	35.438
1995	34.730
2000	39.621
2005	38.348
2006	38.166
2007	38.281
2008	38.163
2009	37.567
2010	37.313
2011	37.821
2012	37.889
2013	38.541
2014	39.312
2015	39.840
trend 1990-2015, %	12.421

7.3.2. Methodological Issues

All methodologies for calculating biogenic emissions essentially involve multiplying an emissions factor for a type of vegetation by a statistic providing for the amount of vegetation in the country or grid square. Two major alternatives for this are:

- to perform these calculations at a general or preferably species-specific level (applied to forests in this report), or
- to perform the calculations for different ecosystem types (applied to grassland and crops).

Based on the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016, in conclusion, total VOC emissions per year from these activities can be calculated based on the following equation:

$$\text{Emission of VOC per vegetation type}$$

$$= F \times A$$

$$= (\varepsilon \times D \times \Gamma) \times A$$

$$= D.A. [\Gamma - iso \times \varepsilon_{iso} + \Gamma - mts/ovoc \times (\varepsilon_{mts} + \varepsilon_{ovoc})]$$

where

A (m²) – area used per vegetation type;

D (g/m²) – foliar biomass density per vegetation type;

Γ – the integrated value of a unitless environmental correction factor over the growing season of the vegetation concerned;
 ϵ -iso ($\mu\text{g/g.h}$) – isoprenes standard emission potential²⁹ per vegetation type;
 ϵ -mts ($\mu\text{g/g.h}$) – monoterpenes standard emission potential per vegetation type;
 ϵ -ovoc ($\mu\text{g/g.h}$) – other VOC standard emission potential per vegetation type.

Average data on Γ , D , and ϵ for European trees and other vegetation are given in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016.

By using meteorological data from the EMEP MSC-W models, the integrated values, Γ -iso and

Γ -mts, have been calculated for both six monthly (May–October) and 12 monthly growing seasons, as averages over Estonia:

- Γ -mts = Γ -ovoc – 565 hours (6-month) and 669 hours (12-month);
- Γ -iso – 422 hours (6-month) and 491 hours (12-month).

Table 7.6 gives an overview of the input parameters for trees and ecosystem types used to calculate emission factors. There are also emission factors for Estonia included in the table.

Table 7.6 The input parameters for trees and ecosystem types used to calculate emission factors

Common name	Latin name	Type*	Biomass density D , g/m^2	Isoprenes ϵ -iso, $\mu\text{g/g.h}$	Monoterpenes ϵ -mts, $\mu\text{g/g.h}$	o-VOC ϵ -ovoc, $\mu\text{g/g.h}$	Emission factor, t/km^2
Pine	<i>Pinus sylvestris</i>	E	700	0	1.5	1.5	1.41
Spruce	<i>Picea abies</i>	E	1 400	1	1.5	1.5	3.50
Birch	<i>Betula</i>	D	320	0	0.2	1.5	0.31
Asp	<i>Populus</i>		320	60	0.0	1.5	8.37
Common Alder	<i>Alnus</i>	D	320	0	1.5	1.5	0.54
Ash	<i>Fraxinus</i>	D	320	0	0.0	1.5	0.27
Oak	<i>Quercus robur</i>	D	320	60	0.2	1.5	8.41
Grassland (meadows/pastures)	-	-	400	0	0.1	1.5	0.36
Grass related crops	-	-	800	0.002	0.1	1.5	0.72

*D=deciduous; E=evergreen

Activity Data

The area used per vegetation type can be obtained from Statistics Estonia. For the years 1990 and 1995, information on forest land is not available, therefore the information from the Yearbook Forests 2008 was used. From this reference, the available information about the closest years – 1988 and 1994 – was applied accordingly for the years 1990 and 1995. The distribution of forest land area by dominant tree species in counties is performed by using

information from the forest register (Centre of Forest Protection and Silviculture).

Statistics on agricultural lands obtained from Statistics Estonia contain information on crop fields and cereal field area for the years 1990–2015. These data were used for calculating the total emission. Information on permanent grasslands is available for the years 2005–2015. There is no information in the statistical database for the years 1990–2000. For calculating the total emission, areas were calculated by using data from CORINE Land Cover 1990 and 2000.

²⁹ Emission potential at 30 °C and PAR (photosynthetically active radiation) = $1,000 \mu\text{mol.m}^{-2}.\text{s}^{-1}$

Table 7.7 Activity data used for NMVOC emission calculation in 1990-2015, thousand ha

Year	Pine-woods	Spruce-woods	Birch-woods	Aspen-woods	Alder-woods	Grey alder-woods	Other stands
1990	749.6	454.2	540.4	30.1	28.9	90.1	23.1
1995	731.7	457.6	585.3	31.5	28.2	82.9	20.6
2000	707.1	366.1	616.8	116.6	64.8	181.3	35.8
2005	692.0	360.7	649.9	110.7	64.6	193.5	35.3
2006	710.6	354.5	639.0	111.6	62.7	196.5	38.3
2007	733.6	345.0	637.0	109.6	65.6	185.7	38.9
2008	724.7	340.6	628.2	112.4	65.5	174.5	35.6
2009	718.2	327.3	637.5	111.1	65.5	175.4	35.1
2010	711.0	331.9	645.6	111.7	65.3	178.6	35.9
2011	692.7	338.2	665.1	116.0	67.9	175.8	33.5
2012	690.6	339.5	664.0	114.9	70.7	185.8	35.1
2013	699.2	343.2	661.0	113.0	70.7	192.3	35.4
2014	707.0	360.4	652.0	116.4	68.9	194.9	35.4
2015	701.8	364.5	654.2	120.2	72.3	197.8	34.8

Table 7.8 Activity data used for NMVOC emission calculation in 1990-2015, thousand ha

Year	Area of cereals	Area of permanent grasslands
1990	397.000	278.900
1995	304.300	257.900
2000	329.300	257.900
2005	282.100	23.000
2006	280.300	193.600
2007	292.300	215.700
2008	309.300	196.600
2009	316.412	195.381
2010	275.295	187.262
2011	296.949	162.812
2012	290.473	191.529
2013	311.032	218.605
2014	332.949	197.579
2015	350.376	192.295

7.3.3. Source-Specific QA/QC and Verification

Common statistical quality control related to the assessment of trends has been carried out.

7.3.4. Sources-Specific Planned Improvements

Improve data quality through calculating activity data for the 1990s by using data from CORINE Land Cover or other possible sources.



Source: www.drivelayer.com

8. RECALCULATIONS AND IMPROVEMENTS

The latest recalculations in the emission inventory were done for the time period from 1990 to 2016. The reason for the recalculations is specified in the Summary.

The main objective of recalculation is to improve the emissions inventory and the quality of reports.

The following changes have been carried out in comparison with the last year's report.

8.1. Energy Sector (NFR 1)

8.1.1. Stationary Combustion in Energy Sector

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2018 and 2019 are made by using exact calculation numbers.

1A1a Public electricity and heat production

In comparison with the previous submission, the emissions of NO_x, SO_x, PM_{2.5}, PM₁₀, BC and TSP from NFR 1A1a were recalculated for period 2012 – 2016. The recommendations which were made by the expert team following the 2017/2018 review ('A comprehensive technical review of

national emissions inventories') were the cause of carrying out calculations.

The TERT noted that for category 1A1 there was a potential under-estimate due to the use of annual emissions reported by operators on the basis of stack measurements, which may subtract the confidential interval for validated average values. In response to a question raised during the review, Estonia explained that one operator was using validated average values since the 4th quarter 2012. Estonia provided the emissions from these stack measurements and provided revised estimates for years 2012-2016. Recalculations in this sector were carried out by basing them on the correction in emissions (added 20 % of SO₂, and NO_x, 30 % of TSP, PM_{2.5}, PM₁₀ and BC) which was provided by operator (for 3 oil shale power plants and one municipal waste incineration plant). The TERT agreed with the revised estimate provided by Estonia. It will be noted that 2019 submission includes recalculated, correct emission data.

The differences in the public electricity and heat production sector emissions between the 2018 and 2019 submissions are presented in [Table 8.1](#).

Table 8.1 The differences in the sector NFR 1A1a emissions (kt) between 2018 and 2019 submissions (%)

Year	PM _{2.5}				PM ₁₀				BC			
	2018	2019	Difference		2018	2019	Difference		2018	2019	Difference	
			kt	%			kt	%			kt	%
2012	2.642	3.131	0.489	18.49	4.850	5.918	1.068	22.02	0.321	0.332	0.011	3.34
2013	4.639	5.961	1.321	28.48	8.386	11.286	2.900	34.58	0.573	0.602	0.029	5.07
2014	2.704	3.703	1.000	36.97	5.214	7.391	2.177	41.76	0.324	0.346	0.022	6.78
2015	2.462	3.029	0.567	23.02	4.016	5.205	1.188	29.59	0.380	0.393	0.012	3.28
2016	1.979	2.308	0.330	16.65	2.943	3.648	0.705	4.35	0.383	0.390	0.007	1.89

Table 8.1 continues

Year	TSP				SO _x				NO _x			
	2018	2019	Difference		2018	2019	Difference		2018	2019	Difference	
			kt	%			kt	%			kt	%
2012	7.248	8.443	1.195	16.48	33.507	35.841	2.335	6.97	11.960	12.530	0.570	4.76
2013	9.597	12.844	3.247	33.84	30.114	35.311	5.197	17.26	10.378	12.454	2.076	20.00
2014	6.939	9.372	2.433	35.06	34.337	40.362	6.025	17.55	10.167	12.200	2.033	20.00
2015	4.543	5.858	1.315	28.94	24.861	29.168	4.307	17.32	7.577	8.980	1.403	18.52
2016	3.359	4.144	0.785	23.37	22.807	27.928	5.121	33.05	8.332	9.845	1.514	9.85

1A1c Manufacture of solid fuels and other energy industries

In comparison with the 2018 submission heavy metals emissions from the sector 1A1c for 1990-1999 have been recalculated.

According to an observation which was made by the expert team following the 2018 review ('A comprehensive technical review of national emission inventories'), heavy metals emissions calculations were checked for the manufacture of solid fuels and other energy industries sector. There was an underestimation of Pb, As, Cr and Ni emissions for 1990-1992 and Cd, Hg, Cu and

Zn emissions for 1990-1999. Heavy metals emissions were not calculated and reported as '0' on NA in previous submissions.

An expert estimate was used to calculate emissions, since heavy metals emissions from NFR 1A1c are insignificant and sector is not key sources.

The differences in the manufacture of solid fuels and other energy industries sector emissions between the 2018 and 2019 submissions are presented in Table 8.2.

Table 8.2 The differences in the sector NFR 1A1c emissions (t) between 2018 and 2019 submissions (%)

Year	Pb			As			Cr			Ni		
	2018	2019	%	2018	2019	%	2018	2019	%	2018	2019	%
1990	0	0.022	100	0	0.01	100	0	0.01	100	0	0.036	100
1991	0	0.022	100	0	0.01	100	0	0.01	100	0	0.036	100
1992	0	0.022	100	0	0.01	100	0	0.01	100	0	0.036	100

Table 8.2 continues

Year	Cd			Hg			Cu			Zn		
	2018	2019	%	2018	2019	%	2018	2019	%	2018	2019	%
1990	0	0.0012	100	0	0.0012	100	0	0.0024	100	0	0.0314	100
1991	0	0.0012	100	0	0.0012	100	0	0.0024	100	0	0.0314	100
1992	0	0.0012	100	0	0.0012	100	0	0.0024	100	0	0.0314	100
1993	0	0.0012	100	0	0.0012	100	0	0.0024	100	0	0.0314	100
1994	0	0.0012	100	0	0.0012	100	0	0.0024	100	0	0.0314	100
1995	0	0.0012	100	0	0.0012	100	0	0.0024	100	0	0.0314	100
1996	0	0.0016	100	0	0.0016	100	0	0.0032	100	0	0.0412	100
1997	0	0.0016	100	0	0.0016	100	0	0.0032	100	0	0.0412	100
1998	0	0.0016	100	0	0.0016	100	0	0.0032	100	0	0.0412	100
1999	0	0.0016	100	0	0.0016	100	0	0.0032	100	0	0.0412	100

1A2b Stationary combustion in manufacturing industries and construction: Non-ferrous metals

Heavy metals emissions (Cr, Ni and Zn) from one facility which have been mistakenly given under a SNAP code 030308 (NFR 1A2b) in 2010-2016 are considered under a NFR 2C7c (with a SNAP

040307) in this year submission. The differences are presented in [Table 8.3](#).

Table 8.3 The differences in the sector NFR 1A2b emissions for 2010-2016 between 2018 and 2019 submissions (%)

Year	Cr			Ni			Zn		
	2018	2019	%	2018	2019	%	2018	2019	%
2010	0.04744	NA	-100	NA	NA	-100	0.02241	NA	-100
2011	0.05564	NA	-100	0.00049	NA	-100	0.02487	NA	-100
2012	0.05970	NA	-100	0.01019	NA	-100	0.02373	NA	-100
2013	0.05942	0.00007	-99.9	0.01070	0.00008	-99.3	0.02468	0.00160	-93.5
2014	0.06767	0.00006	-99.9	0.01015	0.00008	-99.2	0.02838	0.00140	-95.1
2015	0.06755	NA	-100	0.01020	NA	-100	0.02700	NA	-100
2016	0.04675	NA	-100	0.01018	NA	-100	0.02539	NA	-100

1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals

In comparison with the previous submission, the emissions of particulates from cement production facility were reallocated from NFRs 1A2f and 2A6 to NFR 2A1 for period 2000–2003 and 2006–2008.

This year, an analysis of particle emissions from a cement factory for the period from 2000 to 2008 was carried out. Some sources were with incorrect SNAP codes and, after correction, emissions were allocated to the correct 2A1 NFR code.

Table 8.4 The differences in the sector NFR 1A2f emissions (kt) for 2006–2008 between 2018 and 2019 submissions (%)

Year	PM _{2.5}			PM ₁₀			TSP		
	2018	2019	%	2018	2019	%	2018	2019	%
2006	0.14308	0.14184	-0.9	0.22789	0.22459	-1.4	0.40641	0.39818	-2.0
2007	0.11824	0.11696	-1.1	0.18725	0.18383	-1.8	0.40356	0.39500	-2.1
2008	0.13674	0.13598	-0.6	0.22208	0.22005	-0.9	0.36062	0.35554	-1.4

1A2giii Stationary combustion in manufacturing industries and construction: Other

At the 2018 year submission SO₂ emissions for 2008–2009 were removed from NFR 2B1 and emission was replaced with notation key 'NA'. According to the TERT recommendations it is more correctly to include SO₂ emissions from combustion activity in 1A2c. Due to the fact that emissions from the chemical industry for 2008–2009 are included under the NFR 1A2giii, recalculation was made for the code 1A2giii.

The differences in the stationary combustion in manufacturing industries and construction: other sector emissions between the 2018 and 2019 submissions are presented in [Table 8.5](#).

Table 8.5 The differences in the sector NFR 1A2giii emissions (kt) between 2018 and 2019 submissions (%)

Year	BC		
	2018	2019	%
2008	4.942	4.944	0.03
2009	4.551	4.551	0.01

1A4ai Commercial/institutional: Stationary

In comparison with the previous submission, the emissions of HCB from wood, wood waste and coal combustion were firstly calculated for period 1990–2007.

HCB emission factors are presented in the [Table 8.6](#) below. The differences in the Commercial/institutional: Stationary sector emissions between the 2018 and 2019 submissions are presented in [Table 8.7](#).

Table 8.6 HCB emission factor, mg/GJ

Coal	0.0006
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Wood and wood waste	0.00634
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Table 8.7 The differences in the sector NFR 1A4ai emissions (kg) between 2018 and 2019 submissions (%)

Year	HCB		
	2017	2018	%
1990	NA	0.002489	100
1991	NA	0.002496	100
1992	NA	0.002576	100
1993	NA	0.000105	100
1994	NA	0.000902	100
1995	NA	0.000694	100
1996	NA	0.000447	100
1997	NA	0.000509	100
1998	NA	0.000496	100
1999	NA	0.00091	100
2000	NA	0.001458	100
2001	NA	0.002692	100
2002	0.01000	0.003718	-63
2003	0.00300	0.003148	5
2004	NA	0.00255	100
2005	NA	0.002657	100
2006	NA	0.003202	100
2007	NA	0.005194	100

1A4bi Residential: Stationary

NH₃ emissions from residential sector have been recalculated for the period between 1990-2016. Recalculations entail the use of updated national emission factors for wood combustion in conventional stoves (Guidebook EF 70 g/GJ instead of national 2.629 g/GJ).

The differences in the residential sector emissions between the submissions for 2018 and 2019 are presented in [Table 8.8](#).

Table 8.8 The differences in the sector NFR 1A4bi emissions between 2018 and 2019 submissions (%)

Year	NH ₃		
	2018	2019	%
1990	0.296	0.025	-91.6
1991	0.276	0.023	-91.5
1992	0.259	0.022	-91.7
1993	0.270	0.022	-91.7
1994	0.428	0.035	-91.9
1995	0.804	0.064	-92.0
1996	0.911	0.074	-91.9
1997	0.921	0.076	-91.8
1998	0.694	0.058	-91.6
1999	0.646	0.056	-91.4
2000	0.632	0.055	-91.2

Year	NH ₃		
	2018	2019	%
2001	0.591	0.053	-91.0
2002	0.563	0.052	-90.8
2003	0.557	0.053	-90.5
2004	0.526	0.052	-90.2
2005	0.425	0.044	-89.8
2006	0.401	0.042	-89.5
2007	0.509	0.054	-89.4
2008	0.502	0.055	-89.1
2009	0.509	0.057	-88.8
2010	0.497	0.057	-88.5
2011	0.401	0.049	-87.8
2012	0.410	0.051	-87.6
2013	0.372	0.048	-87.1
2014	0.349	0.047	-86.6
2015	0.329	0.045	-86.3
2016	0.334	0.047	-85.9

1B1c Other fugitive emissions from solid fuels

In 2019 reporting year, additional calculations for some year for NO_x and NH₃ were made for the sector 1B1c, using expert judgment

The differences in the other fugitive emissions from solid fuels sector emissions between the submissions for 2018 and 2019 are presented in [Table 8.9](#).

Table 8.9 The differences in the sector NFR 1B1c emissions (kt) between 2018 and 2019 submissions (%)

Year	NH ₃			NO _x		
	2018	2019	%	2018	2019	%
2000	NA	0.010	100			
2001	NA	0.010	100			
2002	NA	0.010	100			
2003	NA	0.010	100			
2004				0	0.010	100

8.1.2. Transport Sector

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2018 and 2019 are made by using exact calculation numbers.

1A3ai-ii(i-ii) Aviation

All emissions have been recalculated for the 1A3ai(ii) and 1A3aii(ii) sector for the period between 2001-2016 due to a correction in

statistical fuel consumption data which was provided by airports and Statistics Estonia (see [Table 8.10](#)). In addition, BC emission factors were adjusted using corrected values for 2016.

Recalculations led to a significant change in total emissions. The differences in the aviation sector emissions between the submissions for 2018 and 2019 are presented in [Table 8.11](#) and [Table 8.12](#).

Table 8.10 The differences in aviation fuel consumption data (kt) between the 2018 and 2019 submissions (%)

Year	1A3ai(i)	1A3aii(i)	1A3ai(ii)			1A3aii(ii)			Total		
	Difference	Difference	2018	2019	Difference	2018	2019	Difference	2018	2019	Difference
	%	%	TJ	TJ	%	TJ	TJ	%	TJ	TJ	%
2001	0.0	0.0	503.8	557.6	10.7	25.8	28.5	10.5	688.0	746.7	8.5
2002	0.0	0.0	612.9	596.8	-2.6	20.6	19.9	-3.6	797.0	780.1	-2.1
2003	0.0	0.0	576.8	688.7	19.4	17.8	22.5	26.7	786.0	903.6	15.0
2004	0.0	0.0	954.5	1,052.8	10.3	33.4	52.0	55.8	1,237.0	1,359.0	9.9
2005	0.0	0.0	1,687.7	1,576.6	-6.6	10.3	52.8	410.8	2,039.0	1,968.1	-3.5
2006	0.0	0.0	1,008.0	1,716.7	70.3	3.9	52.0	1,242.5	1,349.0	2,105.7	56.1
2007	0.0	0.0	1,711.4	2,089.2	22.1	5.4	60.4	1,013.9	2,115.0	2,547.5	20.5
2008	0.0	0.0	707.4	2,374.1	235.6	17.2	65.5	281.2	1,190.0	2,907.6	144.3
2009	0.0	0.0	1,070.6	1,228.8	14.8	11.5	32.2	180.5	1,401.0	1,580.0	12.8
2010	0.0	0.0	1,253.3	1,112.1	-11.3	11.9	26.8	124.7	1,574.0	1,447.6	-8.0
2011	0.0	0.0	1,054.9	1,542.4	46.2	22.9	51.8	126.7	1,450.0	1,966.6	35.6
2012	0.0	0.0	1,213.9	2,154.4	77.5	31.4	39.7	26.2	1,607.0	2,555.6	59.0
2013	0.0	0.0	897.4	1,691.3	88.5	3.1	41.1	1,238.1	1,216.0	2,049.4	68.5
2014	0.0	0.0	1,391.2	1,687.1	21.3	3.2	41.3	1,181.1	1,717.0	2,050.9	19.4
2015	0.0	0.0	696.5	1,767.2	153.7	3.2	44.3	1,269.5	1,039.0	2,150.8	107.0
2016	0.0	0.0	557.3	1,580.2	183.6	6.5	34.5	428.7	917.0	1,966.3	114.4

Table 8.11 The differences in the 1A3ai(ii) sector emissions between 2018 and 2019 submissions (%)

Year	NO _x	NM _{VOC}	SO _x	PM _{2.5}	PM ₁₀	TSP	BC	CO
2001	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
2002	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6
2003	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8
2004	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
2005	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
2006	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
2007	22.1	22.1	22.1	22.1	22.1	22.1	22.1	2.1
2008	233.8	233.8	233.8	233.8	233.8	233.8	233.8	233.8
2009	14.8	14.8	14.8	14.8	14.8	14.8	14.7	14.8
2010	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2
2011	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2
2012	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6
2013	87.6	87.6	87.6	87.6	87.6	87.6	87.6	87.6
2014	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3
2015	153.7	153.7	153.7	153.7	153.7	153.7	153.7	153.7
2016	184.8	184.8	184.8	184.8	184.8	184.8	811.5	184.8

Table 8.12 The differences in the 1A3a(ii) sector emissions between 2018 and 2019 submissions (%)

Year	NO _x	NM VOC	SO _x	PM _{2.5}	PM ₁₀	TSP	BC	CO
2001	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
2002	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5
2003	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
2004	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8
2005	414.2	414.2	414.2	414.2	414.2	414.2	414.2	414.2
2006	1,242.4	1,242.4	1,242.4	1,242.4	1,242.4	1,242.4	1,242.4	1,242.4
2007	1,013.4	1,013.4	1,013.4	1,013.4	1,013.4	1,013.4	1,013.4	1,013.4
2008	279.0	279.0	279.0	279.0	279.0	279.0	279.0	279.0
2009	180.5	180.5	180.5	180.5	180.5	180.5	180.5	180.5
2010	124.7	124.7	124.7	124.7	124.7	124.7	124.7	124.7
2011	126.6	126.6	126.6	126.6	126.6	126.6	126.6	126.6
2012	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3
2013	1,231.9	1,231.9	1,231.9	1,231.9	1,231.9	1,231.9	1,231.9	1,231.9
2014	1,181.4	1,181.4	1,181.4	1,181.4	1,181.4	1,181.4	1,181.4	1,181.4
2015	1,269.4	1,269.4	1,269.4	1,269.4	1,269.4	1,269.4	1,269.4	1,269.4
2016	431.1	431.1	431.1	431.1	431.1	431.1	1,599.5	431.1

1A3b Road transport

All emissions from road transport have been recalculated for the period between 1990-2016. Recalculations entail the use of corrected activity data and taking into use an improved new edition of the COPERT 5 programme for emission calculations.

There has been a correction in fuel consumption for 2016. In the 2019 submission, petrol consumption levels as used in emissions calculations was at 10.6 PJ, which is 2.9% higher than the figure used in the 2018 submission (10.3 PJ). RVP values were corrected for the 2006-2016 period according to the FQMS report data, and Pb emission factors were adjusted using corrected values for the 2010-2013 period.

Additionally, according to a recommendation which was made by the expert team following the 2018 review ('A comprehensive technical review of national emissions inventories'), the number of mopeds was corrected for the period between 2005-2014, thanks to the Estonian Road Administration. However, there is no official data on vehicle numbers for the period between 1990-2004.

Furthermore, recalculations have entailed the use of the new COPERT 5 program, version 5.2.0. There was a need to correct vehicle mileages to a small extent in order to maintain a balance between calculated and statistical fuel consumption levels as calculated by COPERT 5. Therefore these small changes have led to a minor change in total emissions, with the exception of NH₃. There has been an update in NH₃ emissions factors (for the rural and highway share of some petrol-driven Euro vehicles), which explains the decrease in NH₃ emissions. Therefore the fluctuation in NH₃ emissions in the 1990-2016 period depends upon the share of different Euro classes in the vehicle stock and their annual activity levels, considering the fact that the main source of road-transport-emitted NH₃ is small passenger-carrying vehicles with a three-way catalytic converter (Euro 1 and Euro 2).

In comparison with the previous submission, the emissions have change to a small extent with the exception of NH₃ and Pb for some individual years. The differences in road transport emissions between the submissions for 2018 and 2019 are presented in [Table 8.13](#).

Table 8.13 The differences in road transport emissions between the 2018 and 2019 submissions (%)

Year	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb	Cd	Hg	As
1990	0.0	-0.1	0.0	-0.5	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
1991	0.0	-0.1	0.0	-0.5	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
1992	0.0	-0.1	0.0	-0.6	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
1993	0.0	-0.1	0.0	-5.4	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
1994	0.0	-0.1	0.0	-8.9	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
1995	0.0	-0.2	0.0	-10.7	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
1996	0.0	-0.2	0.0	-11.7	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
1997	0.0	-0.2	0.0	-11.4	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
1998	0.0	-0.2	0.0	-11.1	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
1999	0.0	-0.2	0.0	-11.7	NR	NR	0.0	NR	0.0	0.0	0.0	0.0	0.0
2000	0.0	-0.3	0.0	-12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	-0.4	0.0	-12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	-0.5	0.0	-12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	-0.7	0.0	-12.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	0.0	-0.9	0.0	-12.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	0.0	-1.1	0.0	-5.3	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	0.0	-2.0	0.0	-4.4	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2007	0.0	-1.8	0.0	-4.3	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	-2.0	0.0	-4.2	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	-2.0	0.0	-4.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.0	-1.8	0.0	-4.0	-0.1	-0.1	0.0	0.0	0.0	-55.7	0.0	0.0	0.0
2011	0.0	-1.3	0.0	-4.0	0.0	0.0	0.0	0.0	0.2	-53.7	0.2	0.0	0.0
2012	-0.1	-3.7	0.0	-3.9	-0.1	-0.1	0.0	0.0	0.0	-52.4	0.0	0.0	0.0
2013	-0.1	-3.3	0.0	-3.6	-0.1	-0.1	0.0	0.0	0.0	-51.4	0.0	0.0	0.0
2014	-0.1	-2.6	0.0	-3.4	-0.1	-0.1	0.0	0.0	0.0	-0.4	0.0	0.0	0.0
2015	-0.1	-2.4	0.0	-3.3	-0.1	-0.1	0.0	0.0	0.0	-0.4	0.0	0.0	0.0
2016	0.2	-0.4	1.0	-0.7	0.2	0.4	0.5	0.2	2.5	0.5	1.1	1.3	1.7

Table 8.13 continues

Year	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	B(k)f	I(1.2.3-cd)p	PAHs total	HCB	PCBs
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	-0.3	-0.3	0.0	0.0	-0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.1	0.1
2006	-0.3	-0.2	0.0	0.0	-0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
2007	-0.3	-0.3	0.0	0.0	-0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
2008	-0.3	-0.2	0.0	0.0	-0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
2009	-0.3	-0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2010	-0.3	-0.2	0.0	0.0	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2011	-0.2	-0.2	0.1	0.2	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2012	-0.3	-0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Year	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	B(k)f	I(1.2.3-cd)p	PAHs total	HCB	PCBs
2013	-0.3	-0.2	0.0	0.0	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2014	-0.3	-0.2	0.0	0.0	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2015	-0.3	-0.2	0.0	0.0	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2016	0.7	0.8	1.1	1.1	1.0	0.6	0.4	0.4	0.3	0.5	0.4	0.6	1.2

1A3dii National navigation (shipping)

In the national navigation sector, all emissions have been recalculated for the period between 2014-2016. Heavy metals and persistent organic pollutant emissions have been recalculated for the period between 1990-2016.

Recalculations in this sector were carried out by basing them on the correction in fuel consumption data for the 2014-2016 period which was provided by Statistics Estonia. Emissions have been decreased due to the decrease in fuel consumption levels. [Table 8.14](#) provides an overview of such fuel consumption data that have changed.

According to an observation which was made by the expert team following the 2018 review ('A comprehensive technical review of national emission inventories'), heavy metals, and persistent organic pollutant emission factors and emissions calculations were checked for the national navigation sector. There was an overestimation of Cu emissions and an underestimation of Ni, Se, and Zn emissions. In addition, Pb, Hg, and POPs emissions were not calculated or reported as NE/NA in previous submissions.

Therefore emissions factors and emissions calculations have been corrected and recalculated. [Table 8.15](#) provides a short overview of emissions factors that have changed, where older emissions factors were used to

calculate emissions in the 2018 submission, and with emissions factors in the updated EMEP/EEA Guidebook 2016 being used in the 2019 submission.

The differences in the national navigation sector emissions between the 2018 and 2019 submissions are presented in [Table 8.16](#).

Table 8.14 The differences in national navigation fuel consumption data (TJ) between the 2018 and 2019 submissions (%)

Year	Fuel consumption		
	2018	2018	%
2014	413.0	270.8	-34.4
2015	552.0	279.9	-49.3
2016	620.0	240.5	-61.2

Table 8.15 Emission factors for the national navigation sector

Pollutant	Unit	Diesel / Light fuel oil	
		2018	2019
Pb	g/t	NA	0.13
Hg	g/t	NA	0.03
As	g/t	NA	0.04
Cu	g/t	1.70	0.88
Ni	g/t	0.07	1.00
Se	g/t	0.01	0.10
Zn	g/t	1.00	1.20
PCDD/F	TEQmg /tonne	NA	0.13
HCB	g/t	NA	0.08
PCBs	g/t	NA	0.038

Table 8.16 The differences in national navigation emissions between the 2018 and 2019 submissions (%)

Year	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb	Cd	Hg
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
2014	-31.9	-31.9	-31.9	-31.9	-31.9	-31.9	-31.9	-31.9	-31.9	100.0	-31.9	100.0
2015	-48.3	-31.9	-48.4	-48.1	-46.3	-46.3	-46.3	-48.2	-34.5	100.0	-48.4	100.0
2016	-62.4	-39.3	-62.5	-62.0	-59.4	-59.4	-59.4	-62.2	-42.8	100.0	-62.5	100.0

Table 8.16 continues

Year	As	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	PAHs total	HCB	PCBs
1990	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
1991	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
1992	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
1993	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
1994	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
1995	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
1996	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
1997	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
1998	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
1999	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2000	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2001	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2002	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2003	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2004	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2005	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2006	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2007	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2008	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2009	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2010	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2011	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2012	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0

Year	As	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	PAHs total	HCB	PCBs
2013	100.0	0.0	-48.2	1,328.6	900.0	20.0	100.0	0.0	0.0	0.0	100.0	100.0
2014	100.0	-31.9	-64.8	872.4	580.7	-18.3	100.0	-31.9	-31.9	-31.9	100.0	100.0
2015	100.0	-48.4	-73.3	637.1	415.9	-38.1	100.0	-48.4	-48.4	-48.4	100.0	100.0
2016	100.0	-62.5	-80.6	435.4	274.8	-55.0	100.0	-62.5	-62.5	-62.5	100.0	100.0

1A4bii Residential: Household and gardening (mobile)

All emissions from road transport for the household and gardening sector have been recalculated for 2016. Recalculations in this sector were carried out by basing them on the correction in fuel consumption data which was provided by Statistics Estonia. In the 2019 submission, fuel consumption levels as used in emissions calculations were at 225.3 TJ, which is 1.5% higher than the figure that was used in the 2018 submission (221.9 PJ). Therefore all of the emissions have increased in 2016. [Table 8.17](#) provides a short overview of emissions that have changed.

The differences in the household and gardening sector emissions between the submissions for 2018 and 2019 are presented in [Table 8.17](#).

Table 8.17 The differences in the household and gardening sector emissions for 2016 between the 2018 and 2019 submissions (%)

Pollutant	Unit	2018	2019	%
NO _x	kt	0.066	0.067	0.6
NM VOC	kt	0.451	0.460	2.2
SO ₂	t	0.053	0.054	1.6
NH ₃	t	0.025	0.025	1.1
PM _{2.5}	kt	0.010	0.010	1.5
PM ₁₀	kt	0.010	0.010	1.5
TSP	kt	0.010	0.010	1.5
BC	kt	0.002	0.002	0.3
CO	kt	2.534	2.590	2.2
Pb	kg	18.191	18.593	2.2
Cd	kg	0.051	0.052	1.6
Cr	kg	0.255	0.259	1.6
Cu	kg	8.670	8.806	1.6
Ni	kg	0.357	0.363	1.6
Se	kg	0.051	0.052	1.6
Zn	kg	5.100	5.180	1.6
B(a)p	kg	0.189	0.192	1.7
B(b)f	kg	0.219	0.222	1.5
PAHs total	kg	0.408	0.414	1.6

1A4ciii Agriculture/Forestry/Fishing: National fishing

In the national fishing sector, SO₂ emissions calculations were corrected. In the previous submission there were mistakes that were made in the calculation of emissions in the 2003-2016 period. For the 2018 submission, pollutant emissions were reported as being one hundred times lower for that period than they should have been. This mistake has been corrected in the 2019 submissions and SO₂ emissions have been shown to have increased by approximately a hundred times.

The differences in the national fishing sector emissions between the submissions for 2018 and 2019 are presented in [Table 8.18](#).

Table 8.18 The differences in the national fishing sector emissions (kt) between the 2018 and 2019 submissions (%)

Year	SO ₂		
	2018	2019	%
2003	0.000268	0.026756	9,883.6
2004	0.000189	0.018860	9,878.8
2005	0.000168	0.016788	9,892.9
2006	0.000085	0.008516	9,918.8
2007	0.000084	0.008396	9,895.2
2008	0.000174	0.017424	9,913.8
2009	0.000227	0.022657	9,881.1
2010	0.000069	0.006852	9,830.4
2011	0.000036	0.003573	9,825.0
2012	0.000038	0.003823	9,960.5
2013	0.000022	0.002210	9,945.5
2014	0.000011	0.001090	9,809.1
2015	0.000014	0.001386	9,800.0
2016	0.000029	0.002949	10,069.0

8.2. Industry Sector (NFR 2)

8.2.1. Industrial Processes

2A1 Cement Production

In comparison with the previous submission, the emissions of particulates from cement production facility were reallocated from NFRs 1A2f and 2A6 to NFR 2A1 for period 2000–2003 and 2006–2008.

This year, an analysis of particle emissions from a cement factory for the period from 2000 to 2008 was carried out. Some sources were with incorrect SNAP codes and, after correction, emissions were allocated to the correct 2A1 NFR code.

The differences in the cement production (2A1) and other mineral products (2A6) sectors emissions between the submissions for 2018 and 2019 are presented in [Table 8.19](#) and [Table 8.20](#).

Table 8.19 The differences in NFR 2A1 emissions between 2018 and 2019 submissions (%)

Year	PM _{2.5}			PM ₁₀			TSP			BC		
	2018	2019	%	2018	2019	%	2018	2019	%	2018	2019	%
2000	IE	0.0075	100	IE	0.0135	100	IE	0.0150	100	IE	0.0002	100
2001	IE	0.0083	100	IE	0.0149	100	IE	0.0166	100	IE	0.0002	100
2002	IE	0.0064	100	IE	0.0115	100	IE	0.0128	100	IE	0.0002	100
2003	0.0005	0.0078	1462	0.0009	0.0141	1462	0.0010	0.0146	1362	0.00002	0.0002	1460
2006	0.0050	0.0096	91.1	0.0090	0.0172	91.1	0.0100	0.0191	91.1	0.00015	0.0003	91.3
2007	IE	0.0044	100	IE	0.0080	100	IE	0.0089	100	IE	0.0003	100
2008	0.0006	0.0033	402.5	0.0012	0.0059	402.7	0.0013	0.0065	402.9	0.00002	0.0001	415.8

Table 8.20 The differences in NFR 2A6 emissions between 2018 and 2019 submissions (%)

Year	PM _{2.5}			PM ₁₀			TSP		
	2018	2019	%	2018	2019	%	2018	2019	%
2000	0.07260	0.07095	-2.3	0.21780	0.21285	-2.3	0.66000	0.64501	-2.3
2001	0.11000	0.10817	-1.7	0.33000	0.32452	-1.7	1.01000	0.99340	-1.6
2002	0.12430	0.12289	-1.1	0.37290	0.36868	-1.1	1.13000	1.11722	-1.1
2003	0.14289	0.14139	-1.0	0.42867	0.42418	-1.0	1.29900	1.28538	-1.0
2006	0.15180	0.15170	-0.1	0.45540	0.45511	-0.1	1.38000	1.37913	-0.1
2007	0.16000	0.15996	-0.02	0.48000	0.47989	-0.02	1.50000	1.49967	-0.02
2008	0.11734	0.11732	-0.01	0.35202	0.35197	-0.01	1.06672	1.06658	-0.01

2A5b Construction and Demolition

Particulates emissions have been recalculated for the 2A5b sector for the 2015 and 2016 due to a correction in statistical data about non-residential

buildings completed dwelling and demolition (see [Table 8.21](#)).

Table 8.21 The differences in NFR 2A5b sector activity data (m²) between 2018 and 2019 submissions (%)

Year	Completed dwelling of non-residential buildings			Demolition of non-residential buildings		
	2018	2019	%	2018	2019	%
2015				1055600	240200	-77,2
2016	770977	661600	-14,2			

The differences in the construction and demolition sector emissions between the

submissions for 2018 and 2019 are presented in [Table 8.22](#).

Table 8.22 The differences in NFR 2A5b emissions (kt) between 2018 and 2019 submissions (%)

Year	PM _{2.5}			PM ₁₀			TSP		
	2018	2019	%	2018	2019	%	2018	2019	%
2015	0.1753	0.0938	-46.5	1.7535	0.9381	-46.5	5.7897	3.0989	-46.5
2016	0.1097	0.0987	-10.0	1.0966	0.9872	-10.0	3.6225	3.2616	-10.0

NFR 2B1 Ammonia production and 2B10a Chemical industry: Other.

In Estonia, the only fertilizer producer (ammonia and urea), Nitrofert Ltd. Nitrofert Ltd stopped operations since 2014. NH₃ emissions (both – from ammonia and urea production) were reported from 1990 to 2002 under NFR 2B10a, because only summary emissions for all activities were provided.

According to a recommendation which was made by the expert team following the 2018 review ('A comprehensive technical review of national emissions inventories'), the ammonia emissions for 1990-1999 were split between NFR 2B1 and 2B10a by using extrapolations.

The differences in emissions between 2018 and 2019 submissions are presented in [Table 8.23](#).

Table 8.23 The differences in NFR 2B1 and 2B10a NH₃ emissions (kt) for the year 1990-2015 between 2018 and 2019 submissions (%)

Year	2B10a			2B1		
	2018	2019	%	2018	2019	%
1990	0.370	0.348	-5.9	NA	0.022	100
1991	0.300	0.282	-5.9	NA	0.018	100
1992	0.280	0.263	-5.9	NA	0.017	100
1993	0.080	0.075	-5.9	NA	0.005	100
1994	0.140	0.132	-5.9	NA	0.008	100
1995	0.140	0.132	-5.9	NA	0.008	100
1996	0.070	0.066	-5.9	NA	0.004	100
1997	0.060	0.056	-5.9	NA	0.004	100
1998	0.060	0.056	-5.9	NA	0.004	100
1999	0.090	0.085	-5.9	NA	0.005	100

NFR 2C7c Other metal production

Heavy metals emissions (Cr, Ni and Zn) from one facility which have been mistakenly given under a

SNAP code 030308 (NFR 1A2b) in 2010-2016 are considered under a NFR 2C7c (with a SNAP 040307) in this year submission. The differences are presented in [Table 8.24](#).

Table 8.24 The differences in NFR 2C7c emissions (t) for the year 2010-2016 between 2018 and 2019 submissions (%)

Year	Cr			Ni			Zn		
	2018	2019	%	2018	2019	%	2018	2019	%
2010	0.07070	0.11814	67.1	0.0087	0.0087	0.0	0.00030	0.022714	7561.3
2011	0.07487	0.13051	74.3	0.011265	0.011759	4.4	0.00029	0.025152	8815.3
2012	0.00292	0.06262	2043.0	0.001925	0.012117	529.5	0.00027	0.02399	9042.8
2013	0.00995	0.06930	596.5	0.00493	0.015552	215.5	0.00014	0.02322	16575.7
2014	0.00587	0.07348	1151.8	0.003527	0.013591	285.3	0.00014	0.027115	19782.0
2015	0.00002	0.06757	375300.0	0.010442	0.020641	97.7	0.00014	0.02714	19375.7
2016	0.00000	0.04675		0.000001	0.010182	1018100.0	0.00013	0.025511	20236.8

8.2.2. Solvent and Other Product Use

2D3d Coating applications

NMVOC emission for the year 2016 was recalculated due to the correction of statistical data for import and production of solvent and water-borne paints. For particulate matter emissions from the OSIS point sources database were corrected (see [Table 8.25](#)).

Table 8.25 The differences (%) in NFR 2D3d pollutants emissions (kt) for the year 2016 between 2018 and 2019 submissions

Year	2018 kt	2019 kt	Difference %
NMVOC	3.430195	3.431507	0.04
PM _{2.5}	0.000017	NA	-100.00
PM ₁₀	0.000189	0.000190	0.53
TSP	0.001712	0.001359	-20.62

2D3e Degreasing

NMVOC emissions for the whole sector were recalculated due to the correction of emission calculation methodology (see [Table 8.26](#)). Mistakenly a wrong Tier 1 emission factor was used for NMVOC emission calculations from cold cleaning activity. New emission calculation methodology is described in Chapter 4.2.7.2.

For the years 2007 and 2008 NO_x and PM_{2.5} emissions from the OSIS point sources database were corrected (see [Table 8.27](#)).

Table 8.27 The differences (%) in NFR 2D3e NO_x and PM_{2.5} emissions (kt) for the years 2007 and 2008 between 2018 and 2019 submissions

Year	NO _x			PM _{2.5}		
	2018 kt	2019 kt	Difference %	2018 kt	2019 kt	Difference %
2007				0.000013	NE	-100.00
2008	0.00003	0.00002	-33.33			

For Pb and Cu (2004), CO (2008) and Cr (2010, 2012) zero (0) emissions were replaced with the notation key NA.

2D3f Dry cleaning

NMVOC emissions for the years 2004–2016 were recalculated due to the correction of statistical

Table 8.26 The differences (%) in NFR 2D3e NMVOC emissions (kt) for the years 1990-2016 between 2018 and 2019 submissions

Year	2018 kt	2019 kt	Difference %
1990	1.183413	0.179541	-84.83
1991	1.168879	0.178292	-84.75
1992	1.149202	0.097197	-91.54
1993	1.124498	0.063215	-94.38
1994	1.136338	0.071303	-93.73
1995	1.157059	0.076598	-93.38
1996	1.258127	0.135722	-89.21
1997	1.223132	0.121358	-90.08
1998	1.177720	0.100232	-91.49
1999	1.172702	0.099825	-91.49
2000	1.160005	0.084173	-92.74
2001	1.118040	0.064029	-94.27
2002	1.139341	0.072657	-93.62
2003	1.114783	0.060908	-94.54
2004	1.108907	0.057596	-94.81
2005	1.104809	0.053050	-95.20
2006	1.145364	0.072802	-93.64
2007	1.116097	0.065067	-94.17
2008	1.100280	0.068206	-93.80
2009	1.021642	0.036019	-96.47
2010	1.050511	0.047139	-95.51
2011	1.055768	0.054071	-94.88
2012	1.045472	0.057674	-94.48
2013	1.033149	0.050586	-95.10
2014	1.018940	0.050795	-95.01
2015	1.050808	0.057908	-94.49
2016	1.092955	0.075257	-93.11

data for import and export of Tetrachloroethylene (see

Table 8.28).

Table 8.28 The differences (%) in NFR 2D3f NMVOC emissions (kt) for the years 2004-2016 between 2018 and 2019 submissions

Year	2018 kt	2019 kt	Difference %
2004	0.064304	0.064350	0.07
2005	0.062404	0.062370	-0.05
2006	0.064591	0.063389	-1.86
2007	0.053916	0.053909	-0.01
2008	0.051377	0.051377	0.00
2009	0.022381	0.022398	0.08
2010	0.012440	0.012292	-1.19
2011	0.018480	0.018522	0.23
2012	0.008205	0.008076	-1.57
2013	0.039074	0.039000	-0.19
2014	0.041161	0.041123	-0.09
2015	0.030218	0.030232	0.05
2016	0.004448	0.006700	50.64

2D3g Chemical products

For the years 2015 and 2016 NMVOC and TSP emissions from the OSIS point sources database were corrected (see [Table 8.29](#)).

Table 8.29 The differences (%) in NFR 2D3g NMVOC and TSP emissions (kt) for the years 2015 and 2016 between 2018 and 2019 submissions

Year	NMVOC			TSP		
	2018 kt	2019 kt	Difference %	2018 kt	2019 kt	Difference %
2015	0.178376	0.178626	0.14			
2016				0.001590	0.001591	0.06

For NO_x and SO_x (1990-2005), NH₃ (1990-2004), PM_{2.5}, PM₁₀ and TSP (2004), CO (1990-2000, 2003-2004), Zn (2005) and Cr (2009) zero (0) emissions were replaced with the notation key NE.

2D3h Printing

NMVOC emissions for the years 2004–2016 were recalculated due to the correction of statistical data for import and export of printing ink (see [Table 8.30](#)).

Table 8.30 The differences (%) in NFR 2D3h NMVOC emissions (kt) for the years 2004-2016 between 2018 and 2019 submissions

Year	2018 kt	2019 kt	Difference %
2004	0.474350	0.474472	0.03
2005	0.743950	0.745115	0.16
2006	0.655357	0.657782	0.37
2007	0.451862	0.453718	0.41
2008	0.764615	0.766337	0.23
2009	0.204063	0.205536	0.72
2010	0.353789	0.353911	0.03
2011	0.344297	0.344020	-0.08
2012	0.456239	0.456304	0.01
2013	0.461318	0.461384	0.01
2014	0.458042	0.438714	-4.22
2015	0.473064	0.473204	0.03
2016	0.478626	0.478504	-0.03

2D3i Other solvent use

NMVOC emissions for the years 2004–2016 were recalculated due to the correction of statistical data for import and export of glues and adhesives (see [Table 8.31](#)).

Table 8.31 The differences (%) in NFR 2D3i NMVOC emissions (kt) for the years 2004–2016 between 2018 and 2019 submissions

Year	2018 kt	2019 kt	Difference %
2004	1.303080	1.303373	0.02
2005	1.384096	1.383757	-0.02
2006	1.587507	1.549664	-2.38
2007	1.215906	1.199139	-1.38
2008	1.097460	1.097741	0.03
2009	0.763599	0.763345	-0.03
2010	0.424724	0.422868	-0.44
2011	0.517056	0.511743	-1.03
2012	0.629545	0.629799	0.04
2013	0.562260	0.562633	0.07
2014	0.550559	0.550649	0.02
2015	0.664593	0.664559	-0.01
2016	0.704514	0.704838	0.05

2G Other product use

Slight corrections of NO_x emissions for the years 1990, 1993, 1996 and 1999 were due to the rounding corrections of those emissions. Pollutants emissions for the period of 2004–2016 were recalculated due to the correction of statistical data for import and export of tobacco (see [Table 8.32](#)).

Table 8.32 The differences (%) in NFR 2G pollutants emissions for the years 1990–2016 between 2018 and 2019 submissions

Year	NO _x	NMVOC	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Cd
1990	-0.01								
1992	-0.03								
1996	-0.03								
1999	-0.03								
2005					0.001	0.001		0.001	0.01
2006				0.001	0.001				
2007		0.01	0.01	0.002	0.001	0.002	0.01	0.003	0.01
2009				0.001	0.001			0.001	
2011				0.002	0.001	0.001		0.001	
2012	0.18	0.16	0.16	0.12	0.09	0.09	0.16	0.16	0.16
2013		-0.01							
2014	3.59	3.74	3.76	2.42	1.82	1.74	3.75	3.62	3.48
2015	0.06	0.02	0.03	0.01	0.01	0.01	0.02	0.02	0.02
2016		0.01	0.01	0.003	0.002	0.002	0.004	0.003	0.01

Table 8.32 continues

Year	Hg	As	Cu	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs total
2004		-0.02							
2006			0.001						
2009	-0.02								
2010	0.03								
2011	0.02								
2012	0.16	0.15	0.01		0.50				0.23
2014	3.72	3.28	0.15	3.87	3.98	3.66	3.66	3.66	3.80
2015	0.02	0.02	0.001		0.48				0.22
2016		0.02							

8.3. Agriculture Sector (NFR 4)

8.3.1. Manure Management

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2019 and 2018 are made by using exact calculation numbers.

3B1a Manure management - dairy cattle

NH₃ and NO_x emissions from dairy cattle have been recalculated for the years 1990-2016. Recalculations entail using corrected activity data, including corrected the livestock figures for

the years 2015 and 2016 and updated manure management data. The separate implied emissions factors were calculated first time for each year using share of different technologies and the corresponding emissions reduction measures. The percentage of NH₃ emissions reduction from the United Nations Economic Commission for Europe's guidance document on preventing and abating ammonia emissions from agricultural sources were used for the first time. Leaching from solid manure storage was also taken into account.

Table 8.33 The differences in dairy cattle manure management NO_x and NH₃ emissions (kt) for the years 1990–2016 between 2018 and 2019 submissions (%)

Year	NO _x			NH ₃		
	Old	Recalc.	Difference	Old	Recalc.	Difference
1990	0.030	0.070	136.5	2.818	2.291	-18.7
1991	0.027	0.064	137.9	2.585	2.097	-18.9
1992	0.025	0.059	139.3	2.392	1.930	-19.3
1993	0.022	0.051	133.7	2.140	1.691	-21.0
1994	0.020	0.048	134.2	1.997	1.581	-20.8
1995	0.018	0.043	131.1	1.780	1.399	-21.4
1996	0.018	0.041	129.0	1.717	1.355	-21.1
1997	0.019	0.043	125.7	1.757	1.385	-21.1
1998	0.018	0.042	130.7	1.676	1.351	-19.4
1999	0.017	0.040	127.4	1.572	1.274	-19.0
2000	0.015	0.035	134.2	1.380	1.127	-18.3
2001	0.015	0.040	175.1	1.354	1.280	-5.5
2002	0.018	0.036	106.2	1.421	1.155	-18.8
2003	0.016	0.034	107.7	1.549	1.282	-17.2
2004	0.016	0.032	96.5	1.592	1.424	-10.6
2005	0.016	0.029	82.5	1.600	1.545	-3.4
2006	0.015	0.028	86.4	1.584	1.692	6.9
2007	0.014	0.025	83.6	1.534	1.739	13.4
2008	0.013	0.024	78.5	1.496	1.854	23.9
2009	0.012	0.022	85.3	1.483	1.920	29.5
2010	0.011	0.020	78.3	1.501	2.017	34.3
2011	0.011	0.017	53.7	1.492	2.088	40.0
2012	0.012	0.015	30.7	1.504	2.205	46.6
2013	0.012	0.013	5.8	1.558	2.358	51.4
2014	0.012	0.010	-17.7	1.545	2.403	55.6
2015	0.015	0.007	-54.0	1.895	2.357	24.4
2016	0.024	0.007	-71.4	1.689	2.303	36.4

3B1b Manure management - non-dairy cattle

NH₃ and NO_x emissions from non-dairy cattle have been recalculated for the years 1990-2016. Recalculations entail using corrected activity

data, including the corrected livestock figures for the years 2014-2016 and updated manure management data. The separate implied emissions factors were calculated for the first time for each year using a share of different

technologies and the corresponding emissions reduction measures. The percentage of NH₃ emissions reductions was used first time, being taken from the United Nations Economic Commission for Europe's guidance document on

preventing and abating ammonia emissions from agricultural sources. Leaching from solid manure storage was also taken into account.

Table 8.34 The differences in non-dairy cattle manure management NO_x and NH₃ emissions (kt) for the years 1990–2016 between 2018 and 2019 submissions (%)

Year	NO _x			NH ₃		
	Old	Recalc.	Difference	Old	Recalc.	Difference
1990	0.030	0.034	13.2	2.194	2.124	-3.2
1991	0.029	0.039	33.4	2.107	2.179	3.4
1992	0.024	0.035	48.7	1.719	1.968	14.5
1993	0.016	0.023	48.7	1.128	1.292	14.6
1994	0.014	0.018	35.4	0.978	1.023	4.6
1995	0.012	0.018	51.8	0.858	0.996	16.1
1996	0.011	0.017	52.5	0.799	0.933	16.7
1997	0.010	0.015	50.3	0.744	0.858	15.4
1998	0.010	0.014	51.0	0.693	0.801	15.7
1999	0.009	0.013	48.8	0.615	0.704	14.6
2000	0.008	0.012	48.1	0.578	0.659	14.0
2001	0.008	0.013	52.6	0.614	0.716	16.7
2002	0.009	0.014	50.7	0.659	0.764	15.9
2003	0.012	0.014	17.2	0.819	0.766	-6.4
2004	0.008	0.013	59.2	0.586	0.734	25.4
2005	0.009	0.013	42.2	0.656	0.751	14.4
2006	0.009	0.013	55.2	0.614	0.778	26.7
2007	0.009	0.013	48.7	0.652	0.809	24.2
2008	0.009	0.013	50.2	0.640	0.815	27.4
2009	0.009	0.014	52.7	0.647	0.858	32.7
2010	0.010	0.014	46.3	0.646	0.910	40.7
2011	0.010	0.013	35.6	0.651	0.896	37.6
2012	0.010	0.013	28.8	0.675	0.927	37.3
2013	0.011	0.014	19.6	0.734	0.984	34.2
2014	0.010	0.013	26.2	0.671	0.992	47.7
2015	0.010	0.012	26.8	0.606	0.939	55.0
2016	0.009	0.010	11.1	0.579	0.862	48.9

3B3 Manure management - swine

NH₃ and NO_x emissions from swine have been recalculated for the years 1990-2016. Recalculations entail using corrected activity data, including the corrected livestock figure for the year 2016 and updated manure management data. The separate implied emissions factors were calculated for the first time for each year using a share of different technologies and the

corresponding emissions reductions measures. The percentage of NH₃ emissions reductions was used first time, being taken from the United Nations Economic Commission for Europe's guidance document on preventing and abating ammonia emissions from agricultural sources. Leaching from solid manure storage was also taken into account.

Table 8.35 The differences in swine manure management NO_x and NH₃ emissions (kt) for the years 1990–2016 between 2018 and 2019 submissions (%)

Year	NO _x			NH ₃		
	Old	Recalc.	Difference	Old	Recalc.	Difference
1990	0.008	0.006	-30.2	2.355	2.308	-2.0
1991	0.008	0.006	-23.9	2.177	2.132	-2.0
1992	0.005	0.004	-17.8	1.473	1.443	-2.1
1993	0.004	0.004	-11.2	1.170	1.147	-2.0
1994	0.005	0.004	-5.3	1.256	1.230	-2.1
1995	0.004	0.004	8.8	1.225	1.198	-2.1
1996	0.004	0.003	-22.3	0.820	0.805	-1.8
1997	0.003	0.003	-0.6	0.858	0.840	-2.0
1998	0.004	0.004	-0.6	0.913	0.895	-2.0
1999	0.004	0.004	-0.6	0.866	0.852	-1.6
2000	0.004	0.004	3.4	0.935	0.920	-1.6
2001	0.004	0.004	0.9	1.029	1.005	-2.4
2002	0.004	0.004	0.5	1.027	0.994	-3.2
2003	0.004	0.004	0.5	1.023	0.984	-3.9
2004	0.004	0.004	-1.0	0.991	0.944	-4.7
2005	0.004	0.004	-4.3	1.008	0.955	-5.2
2006	0.005	0.004	-13.9	1.015	0.949	-6.5
2007	0.005	0.004	-16.6	1.113	1.027	-7.8
2008	0.005	0.004	-18.3	1.051	0.956	-9.0
2009	0.005	0.004	-15.6	1.047	0.938	-10.4
2010	0.005	0.004	-16.1	1.076	0.951	-11.7
2011	0.005	0.004	-28.9	1.063	0.918	-13.7
2012	0.004	0.003	-34.8	1.075	0.901	-16.2
2013	0.004	0.002	-49.2	1.037	0.845	-18.5
2014	0.005	0.002	-61.2	1.047	0.828	-20.9
2015	0.004	0.001	-72.4	0.874	0.667	-23.7
2016	0.003	0.001	-72.8	0.782	0.610	-22.0

3B4gi and 3B4gii Manure management – laying hens and broilers

Emissions from laying hens and broilers have been recalculated for the year 2016. Recalculations entail using corrected activity data, including the corrected livestock figure for the year 2016. In addition, leaching from solid manure storage was also taken into account for the entire time series, this particular influence could be seen to be somewhat non-existent.

Table 8.36 The differences in laying hens and broiler manure management emissions (kt) in 2016 between 2018 and 2019 submissions (%)

Pollutant	Submission year, Difference	3B4gi	3B4gii
NO _x	Old	0.003	0.004
	Recalc.	0.004	0.004
	Difference	41.9	0.5
NH ₃	Old	0.148	0.174

Pollutant	Submission year, Difference	3B4gi	3B4gii
NMVOC	Recalc.	0.210	0.175
	Difference	41.9	0.5
	Old	0.085	0.153
	Recalc.	0.120	0.154
	Difference	42.0	0.5
	Old	0.002	0.003
PM _{2.5}	Recalc.	0.002	0.003
	Difference	42.4	0.5
	Old	0.021	0.028
PM ₁₀	Recalc.	0.029	0.028
	Difference	42.0	0.5
	Old	0.097	0.057
TSP	Recalc.	0.138	0.057
	Difference	41.9	0.5

3B4giv Manure management - other poultry

Emissions from other poultry have been recalculated for the years 1990-2016. For calculating NH₃ and NO_x emissions from other poultry manure management, the tier 2 methodology was used instead of Tier 1 for the

first time. Additionally, leaching from solid manure storage was taken into account for the entire time series, although its influence was rather non-existent.

Table 8.37 The differences in other poultry manure management emissions (kt) for the years 1990–2016 between 2018 and 2019 submissions (%)

Year	NO _x			NH ₃		
	Old	Recalc.	Difference	Old	Recalc.	Difference
1990	0.005	0.004	-29.1	1.197	0.376	-68.6
1991	0.004	0.003	-29.1	1.014	0.319	-68.6
1992	0.003	0.002	-28.9	0.626	0.197	-68.6
1993	0.002	0.002	-29.1	0.591	0.186	-68.6
1994	0.002	0.002	-29.0	0.573	0.180	-68.6
1995	0.002	0.002	-28.9	0.533	0.168	-68.6
1996	0.002	0.001	-28.9	0.426	0.134	-68.6
1997	0.002	0.001	-29.2	0.476	0.150	-68.6
1998	0.002	0.001	-29.0	0.482	0.152	-68.6
1999	0.001	0.001	-29.1	0.332	0.104	-68.6
2000	0.001	0.001	-28.8	0.298	0.094	-68.6
2001	0.001	0.001	-29.2	0.341	0.107	-68.6
2002	0.002	0.001	-29.1	0.384	0.121	-68.6
2003	0.002	0.001	-29.0	0.428	0.134	-68.6
2004	0.002	0.001	-28.9	0.471	0.148	-68.6
2005	0.001	0.001	-29.1	0.266	0.084	-68.6
2006	0.001	0.001	-29.2	0.351	0.110	-68.6
2007	0.001	0.000	-28.4	0.120	0.038	-68.6
2008	0.002	0.001	-28.9	0.376	0.118	-68.6
2009	0.001	0.001	-29.1	0.299	0.094	-68.6
2010	0.002	0.001	-29.1	0.358	0.113	-68.6
2011	0.002	0.001	-28.9	0.488	0.153	-68.6
2012	0.002	0.001	-29.2	0.434	0.136	-68.6
2013	0.001	0.001	-29.4	0.182	0.057	-68.6
2014	0.002	0.001	-29.0	0.480	0.151	-68.6
2015	0.002	0.001	-28.9	0.452	0.142	-68.6
2016	0.002	0.001	-30.5	0.452	0.139	-69.3

8.3.2. Agricultural Soils

3Da1 Inorganic N-fertilizers (includes also urea application)

NH₃ from inorganic N-fertilizer have been recalculated for the years 2012-2016. Recalculations entail using corrected activity data for the years 2014-2016. The percentage of NH₃ emissions reduction was used for the first time, being taken from the United Nations Economic

Commission for Europe's guidance document on preventing and abating ammonia emissions from agricultural sources. Reduction measures have been used on the assumption that according to date taken from the project, '*Peamiste tootmisressursside kasutamise efektiivsus Eesti põllumajanduses*', a total of 16% of N is applied directly to the soil during sowing.

Table 8.38 The differences in fertilizer application emissions (kt) for the years 2012–2016 between 2018 and 2019 submissions (%)

Year	NO _x			NH ₃		
	Old	Recalc.	Difference	Old	Recalc.	Difference
2012	1.319	1.319	0.0	1.508	1.315	-12.8
2013	1.346	1.346	0.0	1.386	1.209	-12.8
2014	1.432	1.432	0.0	1.604	1.399	-12.8
2015	1.432	1.451	1.3	1.634	1.442	-11.8
2016	1.432	1.456	1.6	1.617	1.431	-11.5

3Da2a Animal manure applied to soils

NH₃ and NO_x emissions from animal manure which was applied to soils have been recalculated for the years 1990-2016. Recalculations entail using corrected activity data, including the corrected livestock figure and updated manure management data. The separate implied emissions factors were calculated for the first time for each year using the share of different technologies and the corresponding emissions reduction measures. The percentage of NH₃

emissions reduction was used for the first time, being taken from the United Nations Economic Commission for Europe's guidance document on preventing and abating ammonia emissions from agricultural sources. In the absence of data which covered technological developments (involving the method being used in spreading manure and the time at which soil placement takes place), a time series which used the default values was carried out in the previous calculations.

Table 8.39 The differences in animal manure applied to soils category emissions (kt) for the years 1990–2016 between 2018 and 2019 submissions (%)

Year	NO _x			NH ₃		
	Old	Recalc.	Difference	Old	Recalc.	Difference
1990	1.061	1.337	25.9	6.025	8.897	47.7
1991	0.989	1.237	25.0	5.592	8.097	44.8
1992	0.827	1.080	30.6	4.554	7.124	56.4
1993	0.667	0.869	30.3	3.610	5.750	59.3
1994	0.627	0.799	27.4	3.401	5.256	54.5
1995	0.566	0.729	28.8	3.095	4.856	56.9
1996	0.498	0.658	32.0	2.744	4.429	61.4
1997	0.495	0.653	31.8	2.754	4.470	62.3
1998	0.483	0.638	32.1	2.716	4.410	62.4
1999	0.443	0.587	32.6	2.579	4.162	61.4
2000	0.419	0.550	31.2	2.405	3.838	59.6
2001	0.432	0.605	40.0	2.518	4.374	73.7
2002	0.442	0.574	29.8	2.645	4.163	57.4
2003	0.469	0.577	23.1	2.932	4.209	43.5
2004	0.441	0.572	29.7	2.845	4.246	49.3
2005	0.451	0.567	25.5	2.993	4.200	40.3
2006	0.456	0.611	34.0	2.970	4.013	35.1
2007	0.462	0.616	33.2	3.077	3.799	23.5
2008	0.439	0.583	32.7	3.016	3.513	16.5
2009	0.435	0.588	35.1	3.058	3.242	6.0
2010	0.443	0.601	35.6	3.142	3.026	-3.7
2011	0.446	0.599	34.2	3.171	2.956	-6.8
2012	0.466	0.643	38.0	3.250	2.940	-9.5
2013	0.473	0.626	32.3	3.383	2.906	-14.1
2014	0.463	0.631	36.5	3.327	2.780	-16.4
2015	0.484	0.591	22.1	3.506	2.458	-29.9
2016	0.481	0.565	17.3	3.250	2.501	-23.0

3Da3 Urine and dung deposited by grazing animal

NH₃ and NO_x emissions from grazing have been recalculated for the years 1990-2016. Recalculations entail using corrected activity data, including the corrected livestock figure and

updated manure management data. The biggest difference when compared to the previous submission is a smaller share of grazing in the past few years.

Table 8.40 The differences in grazing emissions (kt) for the years 1990–2016 between 2018 and 2019 submissions (%)

Year	NO _x			NH ₃		
	Old	Recalc.	Difference	Old	Recalc.	Difference
1990	0.721	0.426	-40.9	4.073	0.585	-85.6
1991	0.677	0.402	-40.6	3.885	0.553	-85.8
1992	0.597	0.313	-47.5	3.247	0.451	-86.1
1993	0.477	0.243	-49.1	2.287	0.364	-84.1
1994	0.434	0.244	-43.9	2.010	0.361	-82.0
1995	0.384	0.199	-48.2	1.769	0.304	-82.8
1996	0.365	0.187	-48.8	1.660	0.284	-82.9
1997	0.361	0.179	-50.3	1.584	0.275	-82.6
1998	0.341	0.168	-50.9	1.486	0.258	-82.6
1999	0.313	0.152	-51.4	1.335	0.233	-82.5
2000	0.282	0.136	-51.9	1.235	0.207	-83.3
2001	0.283	0.147	-48.1	1.282	0.226	-82.4
2002	0.295	0.143	-51.5	1.359	0.216	-84.1
2003	0.274	0.145	-47.1	1.216	0.219	-82.0
2004	0.283	0.146	-48.5	1.293	0.221	-82.9
2005	0.283	0.143	-49.5	1.310	0.214	-83.7
2006	0.280	0.125	-55.2	1.325	0.184	-86.1
2007	0.273	0.106	-61.0	1.321	0.151	-88.6
2008	0.268	0.088	-67.3	1.297	0.120	-90.7
2009	0.261	0.071	-72.6	1.292	0.092	-92.9
2010	0.261	0.068	-74.0	1.303	0.086	-93.4
2011	0.263	0.073	-72.4	1.321	0.092	-93.0
2012	0.271	0.080	-70.4	1.377	0.101	-92.7
2013	0.287	0.091	-68.4	1.494	0.114	-92.4
2014	0.278	0.098	-64.9	1.412	0.122	-91.4
2015	0.310	0.099	-68.1	1.392	0.123	-91.1
2016	0.306	0.106	-65.4	1.345	0.130	-90.3

3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products

Particles emissions from farm-level agricultural operation have been recalculated for the years

2015-2016. Recalculations entailed using corrected activity data.

Table 8.41 The differences in Farm-level agricultural operations emissions (kt) for the years 2015–2016 between 2018 and 2019 submissions (%)

Year	PM _{2.5}			PM ₁₀			TSP		
	Old	Recalc.	Difference	Old	Recalc.	Difference	Old	Recalc.	Difference
2015	0.031	0.033	6.8	0.796	0.850	6.8	0.796	0.850	6.8
2016	0.031	0.037	21.1	0.796	0.964	21.1	0.796	0.964	21.1

8.4. Waste Sector (NFR 5)

5A Solid waste disposal on land

Slight correction of NMVOC emission for the year 2016 was due to the rounding correction of this

emission. For particulate matter emission calculation errors were corrected for the years 2012, 2013 and 2016 (see [Table 8.42](#)).

Table 8.42 The differences (%) in NFR 5A pollutants emissions for the years 2012, 2013 and 2016 between 2018 and 2019 submissions

Year	NMVOC	PM _{2.5}	PM ₁₀	TSP
2012			-12.23	-8.82
2013			14.61	9.94
2016	-0.0001	-10.17	-0.04	0.01

5C1bi Industrial waste incineration

For the year 1996 and thereafter corrected activity data was used to recalculate PCDD/F emissions from the industrial waste incineration activity. For the years 1990-1995 PCDD/F emissions were calculated using the amount of population and the implied emission factor from

the year 1996. The recalculated PCDD/F emissions and the difference between 2018 and 2019 submissions are presented in the following

Table 8.43.

Table 8.43 The differences (%) for NFR 5C1bi PCDD/F emissions (g I-TEQ) for the years 1990–2008, 2010–2011 and 2013 between 2018 and 2019 submissions

Year	2018 g I-TEQ	2019 g I-TEQ	Difference %
1990	NA	0.053352	100.00
1991	NA	0.053085	100.00
1992	NA	0.052125	100.00
1993	NA	0.050800	100.00
1994	NA	0.049725	100.00
1995	NA	0.048846	100.00
1996	NA	0.048742	100.00
1997	NA	0.025771	100.00
1998	NA	0.055290	100.00
1999	NA	0.040850	100.00
2000	0.120000	0.115946	-3.38
2001	0.140000	0.136412	-2.56
2002	0.080000	0.133756	67.20
2003	0.130000	0.129087	-0.70
2004	0.160000	0.160073	0.05
2005	0.120000	0.117460	-2.12
2006	0.010000	0.012575	25.75
2007	0.260000	0.263305	1.27
2008	0.429500	0.425894	-0.84
2010	0.255155	0.255125	-0.01
2011	0.295396	0.295355	-0.01
2013	0.219867	0.219608	-0.12

PM_{2.5}, PM₁₀ and BC emissions were recalculated due to the error in emissions calculations in last year's submission (see [Table 8.44](#)).

Table 8.44 The differences (%) for NFR 5C1bi PM_{2.5}, PM₁₀ and BC emissions for the year 2016 between 2018 and 2019 submissions

Year	PM _{2.5}	PM ₁₀	BC
2016	1367.19	-80.15	100.00

5C1biii Clinical waste incineration

For clinical waste incineration PCBs emission for the year 2003 was replaced with the notation key NE to match the whole time-series.

Table 8.45 The differences (%) for NFR 5C1biii PCBs emission for the year 2003 between 2018 and 2019 submissions

Year	2018 kg	2019 kg	Difference %
2003	0.001000	NE	-100.00

5C1bv Cremation

In 2018 all the crematoriums in Estonia were contacted and asked to provide their historic data on cremations. According to the data received recalculations of pollutants emissions were carried out for the period of 1996-2016 (see [Table 8.46](#)).

Table 8.46 The differences (%) for NFR 5C1bv pollutants emissions for the years 1996–2016 between 2018 and 2019 submissions

Year	NO _x	NM VOC	SO _x	PM _{2.5}	PM ₁₀	TSP	CO	Pb	Cd	Hg	As	Cr
2001	-0.92		-0.75	-1.61	-1.61	-0.73	-0.80	-0.93		-0.92		
2002	-3.39	-3.85	-3.53	-3.60	-3.60	-3.25	-3.39	-3.33	-5.00	-3.40	-3.64	-3.70
2003	-0.52		-0.60				-0.48	-0.75		-0.52		
2004	-0.60	-1.59	-0.74	-0.60	-0.60	-0.54	-0.59			-0.63		
2005	0.36		0.37			0.55	0.45			0.35		1.56
2006	1.90	1.47	2.03	1.65	1.65	1.98	1.91	1.91	3.85	1.91	2.82	1.41
2011	-2.67	-2.20	-2.65	-2.47	-2.47	-2.59	-2.65	-2.38	-2.86	-2.66	-2.11	-3.16
2012	-4.91	-4.21	-4.95	-4.72	-4.72	-4.95	-4.87	-5.00	-5.41	-4.90	-5.00	-5.05
2013	0.61		0.60	0.78	0.78	0.35	0.68	0.45		0.61	1.00	
2014	1.31	1.02	1.29	1.15	1.15	1.38	1.23	1.33		1.30	1.96	0.98
2015	0.86	0.99	0.80	0.74	0.74	1.00	0.83	0.86		0.86		0.95
2016	1.32	1.14	1.29	1.41	1.41	1.29	1.37	1.30	2.50	1.33	1.34	1.71

Table 8.46 continues

Year	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs Total	HCB	PCBs
1996								-1.23	2.27			
1998											-2.47	
1999											1.02	
2000											3.00	
2001		-1.61		-0.88	-1.04	-6.00	-3.85				-0.94	-0.96
2002	-4.00	-2.90	-2.53	-3.28	-3.70	2.00	-6.67	-3.85	-3.57	-6.43	-3.33	-3.35
2003				-0.56		-3.33	6.67	-6.67	3.33	-0.67	-0.45	-0.55
2004	-1.67			-0.65	-0.77	5.00	13.33	3.33	10.00	0.62	-0.69	-0.61
2005		1.22		0.26	0.78	5.00	13.33	3.33	10.00	0.62	0.28	0.36
2006	1.54	2.20	1.92	1.91	1.41	1.43	-2.50	13.33	-7.50	0.56	1.91	1.91
2007						5.71		-10.00	-2.50	-5.50		
2008				0.001		5.71		-10.00	-2.50	-5.50		
2009						-5.00	2.50	-7.50		-3.00		
2010						2.50	12.50		7.50			
2011	-2.30	-2.48	-2.88	-2.68	-2.65		-2.00	-2.22	-4.00	-3.75	-2.67	-2.65
2012	-4.40	-4.72	-4.83	-4.86	-5.05	-8.00		-10.00	-2.00	-5.60	-4.91	-4.89
2013	1.10			0.68	0.50	-2.00	6.00	-4.00	4.00	0.40	0.63	0.63
2014	2.15	1.54	1.34	1.25	1.48	1.00	10.00	-2.00	6.00	3.20	1.24	1.33

2015	1.04	1.49	1.31	0.89	0.96	3.00	-6.67		10.00	1.54	0.86	0.85
2016	1.63	1.16	1.01	1.35	1.21	1.56	1.90	2.08	1.42	1.70	1.31	1.33

5C2 Open burning of waste

For the years 2011, 2013 and 2016 some emission calculation errors were corrected for NO_x, NMVOC, SO_x and PAHs total emissions (see [Table 8.47](#)).

Table 8.47 The differences (%) for NFR 5C2 pollutants emissions for the years 2011, 2013 and 2016 between 2018 and 2019 submissions

Year	NO _x	NMVOC	SO _x	PAHs total
2011				-3.23
2013				-3.23
2016	2.33	3.17	2.34	

5D1 Domestic wastewater handling

NMVOC emissions for the period of 1994–2016 were moved from the NFR 5D2 under 5D1 according to the recommendations given by the TERT during the NECD Review 2018. New NO_x, SO_x (2008–2012) and NH₃ (2009–2012) emissions were included in the inventory. Slight correction of NO_x and SO_x emission for the year 2016 was due to the rounding correction of these emissions. The differences of the pollutants emissions are presented in the following [Table 8.48](#).

Table 8.48 The differences (%) for NFR 5D1 pollutants emissions for the years 1994–2016 between 2018 and 2019 submissions

Year	NO _x	NMVOC	SO _x	NH ₃
1994		100.00		
1995		100.00		
1996		100.00		
1997		100.00		
1998		100.00		
1999		100.00		
2000		100.00		
2001		100.00		
2002		100.00		
2003		100.00		
2004		100.00		
2005		100.00		
2006		100.00		
2007		100.00		
2008	100.00	100.00	100.00	
2009	100.00	100.00	100.00	100.00
2010	100.00	100.00	100.00	100.00
2011	100.00	100.00	100.00	100.00
2012	100.00	100.00	100.00	100.00
2013	-0.02	52488.83	-0.08	-0.05
2014		79996.97		
2015	-0.07	80127.41	-0.33	-0.54
2016	-0.07	43234.92	-0.33	

5D2 Industrial wastewater handling

NMVOC emissions for the period of 1994–2016 were moved from the NFR 5D2 under 5D1 according to the recommendations given by the

TERT during the NECD Review 2018 (see [Table 8.49](#)).

Table 8.49 The differences (%) for NFR 5D2 NMVOC emissions (kt) for the years 1994–2016 between 2018 and 2019 submissions

Year	2018 kt	2019 kt	Difference %
1994	0.029427	IE	-100.00
1995	0.027735	IE	-100.00
1996	0.025373	IE	-100.00
1997	0.025296	IE	-100.00
1998	0.025059	IE	-100.00
1999	0.022984	IE	-100.00
2000	0.022428	IE	-100.00
2001	0.022628	IE	-100.00
2002	0.021408	IE	-100.00
2003	0.024411	IE	-100.00
2004	0.027123	IE	-100.00
2005	0.024296	IE	-100.00
2006	0.024225	IE	-100.00
2007	0.028204	IE	-100.00
2008	0.024886	0.005753	-76.88
2009	0.022173	0.004663	-78.97
2010	0.028490	0.006216	-78.18
2011	0.028995	0.004145	-85.70
2012	0.025478	0.004145	-83.73
2013	0.026936	0.001144	-95.75
2014	0.026432	0.001098	-95.85
2015	0.024625	0.000883	-96.41
2016	0.027301	0.004539	-83.37

5E Other waste

Slight correction of PM₁₀ (see [Table 8.50](#)) and PAHs (see [Table 8.51](#)) emissions for the years 2012 and 2013 was due to the rounding correction of these emissions.

Table 8.50 The differences (%) for NFR 5E PM₁₀ emission (kt) for the year 2013 between 2018 and 2019 submissions

Year	2018 kt	2019 kt	Difference %
2013	0.074516	0.074515	-0.001

Table 8.51 The differences (%) for NFR 5E PAHs emissions for the years 2012–2013 between 2018 and 2019 submissions

Year	B(a)p	B(b)f	B(k)f	PAHs Total
2012	10.00	40.00	-10.00	30.00
2013				-6.45



Source: <http://lofciam.pl>

9. PROJECTIONS

Estonia's emission projections included in Annex IV have been calculated based on national strategy documents, legislation, and sector-specific studies (incl. economic and population forecasts). Where possible, long term action plans of relevant companies have been taken into account in the projection compiling process. In parallel with the projection compilation, working groups of relevant stakeholders representatives were assembled, to receive additional input in the energy (incl. transport), industrial processes and product use (incl. solvents) and agriculture sector. Waste sector projections are based on the national strategy documents and legislation.

More detailed information on the projections activity data, methodology and measures can be found in the Estonian National Air Pollution Control Programme pursuant to Article 6 of Directive 2016/2284, submitted to the Commission by 1 April 2019.

Projected emissions with measures and additional measures for 2020, 2025 and 2030 and reduction compared with a base 2005 year are presented in the following tables.

Table 9.1 National emission projection for 2020

Pollutant	2005	2017	WM	Reduction compared with 2005, %	WaM	Reduction compared with 2005, %
NO _x	41.862	33.200	30.395	-27.4	30.522	-27.1
NMVOC	32.313	22.245	19.813	-38.7	19.742	-38.9
SO _x	76.257	38.653	22.987	-69.9	22.500	-70.5
NH ₃	10.256	10.255	10.955	6.8	10.513	2.5
PM _{2.5}	14.224	9.222	6.403	-55.0	6.376	-55.2

Table 9.2 National emission projection for 2025

Pollutant	2005	2017	WM	Reduction compared with 2005, %	WaM	Reduction compared with 2005, %
NO _x	41.862	33.200	30.014	-28.3	26.994	-35.5
NMVOC	32.313	22.245	19.973	-38.2	18.741	-42.0
SO _x	76.257	38.653	17.985	-76.4	16.181	-78.8
NH ₃	10.256	10.255	11.386	11.0	10.395	1.4
PM _{2.5}	14.224	9.222	6.339	-55.4	5.838	-59.0

Table 9.3 National emission projection for 2030

Pollutant	2005	2017	WM	Reduction compared with 2005, %	WaM	Reduction compared with 2005, %
NO _x	41.862	33.200	27.889	-33.4	23.214	-44.5
NMVOC	32.313	22.245	19.998	-38.1	18.409	-43.0
SO _x	76.257	38.653	11.949	-84.3	10.829	-85.8
NH ₃	10.256	10.255	12.025	17.2	10.506	2.4
PM _{2.5}	14.224	9.222	6.616	-53.5	5.451	-61.7

ANNEX I – Inclusion/exclusion of the condensable component from PM₁₀ and PM_{2.5} emission factors

NFR	Source/sector name	PM emissions: the condensable component is		EF reference and comments
		included	excluded	
1A1a	Public electricity and heat production		X	National emission factors of TSP for the calculation of emissions from boilers were adopted by a Regulation of the Minister of the Environment: https://www.riigiteataja.ee/aktilisa/1291/1201/6006/KKM_m59_Lisa_3.pdf# In the text of the regulation there is no reference what include emissions, but within the discussion with the company which was carrying out measurements it became clear that particles excluded condensable component. Some facilities calculate emissions from boilers or other combustion activities using their own specific EF (base on the measurements or combine methods). It is not known if the condensable part is included or not. In the next reporting year, Estonia will organize a survey among operators to determine which methodology is used particulates emissions calculation.
1A1c	Manufacture of solid fuels and other energy industries		X	See comment for NFR 1A1a
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel		X	See comment for NFR 1A1a
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals		X	See comment for NFR 1A1a
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals		X	See comment for NFR 1A1a
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print		X	See comment for NFR 1A1a

NFR	Source/sector name	PM emissions: the condensable component is		EF reference and comments
		included	excluded	
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco		X	See comment for NFR 1A1a
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals		X	See comment for NFR 1A1a
1A2gvii	Mobile Combustion in manufacturing industries and construction: (specified in the IIR)	X		EMEP/EEA Guidebook 2016: PM factors represent total PM emissions (filterable and condensable fractions)
1A2gviii	Stationary combustion in manufacturing industries and construction: Other (specified in the IIR)		X	See comment for NFR 1A1a
1A3ai(i)	International aviation LTO (civil)	–	–	EMEP/EEA Guidebook 2016
1A3aii(i)	Domestic aviation LTO (civil)	–	–	EMEP/EEA Guidebook 2016
1A3bi	Road transport: Passenger cars	X		EMEP/EEA Guidebook 2016: Road transport PM mass emission factors in this chapter are considered to include both filterable and condensable material
1A3bii	Road transport: Light duty vehicles	X		EMEP/EEA Guidebook 2016: Road transport PM mass emission factors in this chapter are considered to include both filterable and condensable material
1A3biii	Road transport: Heavy duty vehicles and buses	X		EMEP/EEA Guidebook 2016: Road transport PM mass emission factors in this chapter are considered to include both filterable and condensable material
1A3biv	Road transport: Mopeds & motorcycles	X		EMEP/EEA Guidebook 2016: Road transport PM mass emission factors in this chapter are considered to include both filterable and condensable material
1A3bvi	Road transport: Automobile tyre and brake wear	–	–	EMEP/EEA Guidebook 2016
1A3bvii	Road transport: Automobile road abrasion	–	–	EMEP/EEA Guidebook 2016
1A3c	Railways	–	–	EMEP/EEA Guidebook 2016
1A3dii	National navigation (shipping)	–	–	EMEP/EEA Guidebook 2016
1A4ai	Commercial/institutional: Stationary			See comment for NFR 1A1a
1A4aii	Commercial/institutional: Mobile	X		EMEP/EEA Guidebook 2016: PM factors represent total PM emissions (filterable and condensable fractions)
1A4bi	Residential: Stationary		X	EMEP/EEA Guidebook 2016 for the solid, liquid and gaseous fuels.

NFR	Source/sector name	PM emissions: the condensable component is		EF reference and comments
		included	excluded	
				Emissions from wood burning are calculated using national factors derived from measurements: https://www.envir.ee/sites/default/files/clrtap_pos_protokolli_nouete_taitmine.pdf In the text there is no reference what include emissions, but within the discussion with the company which was carrying out measurements it became clear that particles excluded condensable component.
1A4bii	Residential: Household and gardening (mobile)	X		EMEP/EEA Guidebook 2016: PM factors represent total PM emissions (filterable and condensable fractions)
1A4ci	Agriculture/Forestry/Fishing: Stationary			See comment for NFR 1A1a
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	X		EMEP/EEA Guidebook 2016: PM factors represent total PM emissions (filterable and condensable fractions)
1A4ciii	Agriculture/Forestry/Fishing: National fishing	–	–	EMEP/EEA Guidebook 2016
1B1b	Fugitive emission from solid fuels: Solid fuel transformation			Facility specific EF. It is not known if the condensable part is included or not.
1B1c	Other fugitive emissions from solid fuels			Facility specific EF. It is not known if the condensable part is included or not.
1B2aiv	Fugitive emissions oil: Refining / storage			Facility specific EF. It is not known if the condensable part is included or not.
1B2c	Venting and flaring (oil, gas, combined oil and gas)			Facility specific EF. It is not known if the condensable part is included or not.
2A1	Cement production			Facility specific EF. It is not known if the condensable part is included or not.
2A2	Lime production			Facility specific EF. It is not known if the condensable part is included or not.
2A5a	Quarrying and mining of minerals other than coal			Facility specific EF. It is not known if the condensable part is included or not.
2A5b	Construction and demolition			EMEP/EEA Guidebook 2016
2A6	Other mineral products (specified in the IIR)			Facility specific EF. It is not known if the condensable part is included or not.
2B10a	Chemical industry: Other (specified in the IIR)			Facility specific EF. It is not known if the condensable part is included or not.

NFR	Source/sector name	PM emissions: the condensable component is		EF reference and comments
		included	excluded	
2B10b	Storage, handling and transport of chemical products (specified in the IIR)			Facility specific EF. It is not known if the condensable part is included or not.
2C1	Iron and steel production			Facility specific EF. It is not known if the condensable part is included or not.
2C3	Aluminium production			Facility specific EF. It is not known if the condensable part is included or not.
2C5	Lead production			Facility specific EF. It is not known if the condensable part is included or not.
2C6	Zinc production			Facility specific EF. It is not known if the condensable part is included or not.
2C7a	Copper production			Facility specific EF. It is not known if the condensable part is included or not.
2C7c	Other metal production (specified in the IIR)			Facility specific EF. It is not known if the condensable part is included or not.
2D3b	Road paving with asphalt	–	–	EMEP/EEA Guidebook 2016
2D3d	Coating applications	–	–	Facility specific EF. It is not known if the condensable part is included or not.
2D3e	Degreasing	–	–	Facility specific EF. It is not known if the condensable part is included or not.
2D3g	Chemical products	–	–	Facility specific EF. It is not known if the condensable part is included or not.
2D3h	Printing	–	–	Facility specific EF. It is not known if the condensable part is included or not.
2D3i	Other solvent use (specified in the IIR)	–	–	Facility specific EF. It is not known if the condensable part is included or not.
2G	Other product use (specified in the IIR)	–	–	EMEP/EEA Guidebook 2016
2H1	Pulp and paper industry			Facility specific EF. It is not known if the condensable part is included or not.
2H2	Food and beverages industry			Facility specific EF. It is not known if the condensable part is included or not.
2I	Wood processing			Facility specific EF. It is not known if the condensable part is included or not.

NFR	Source/sector name	PM emissions: the condensable component is		EF reference and comments
		included	excluded	
2L	Other production, consumption, storage, transportation or handling of bulk products (specified in the IIR)			Facility specific EF. It is not known if the condensable part is included or not.
3B1a	Manure management - Dairy cattle			EMEP/EEA Guidebook 2016
3B1b	Manure management - Non-dairy cattle			EMEP/EEA Guidebook 2016
3B2	Manure management – Sheep			EMEP/EEA Guidebook 2016
3B3	Manure management – Swine			EMEP/EEA Guidebook 2016
3B4d	Manure management - Goats			EMEP/EEA Guidebook 2016
3B4e	Manure management - Horses			EMEP/EEA Guidebook 2016
3B4gi	Manure management - Laying hens			EMEP/EEA Guidebook 2016
3B4gii	Manure management - Broilers			EMEP/EEA Guidebook 2016
3B4giv	Manure management - Other poultry			EMEP/EEA Guidebook 2016
3B4h	Manure management - Other animals (specified in the IIR)			EMEP/EEA Guidebook 2016
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products			EMEP/EEA Guidebook 2016
5A	Biological treatment of waste - Solid waste disposal on land	–	–	The combination of facility specific and the EMEP/EEA Guidebook 2016 EFs. It is not known if the condensable part is included or not.
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	–	–	Facility specific EF. It is not known if the condensable part is included or not.
5C1bi	Industrial waste incineration	–	–	Facility specific EF. It is not known if the condensable part is included or not.
5C1bv	Cremation	–	–	EMEP/EEA Guidebook 2016
5C2	Open burning of waste	–	–	EMEP/EEA Guidebook 2016
5E	Other waste (please specify in IIR)	–	–	EMEP/EEA Guidebook 2016
6A	Other (included in national total for entire territory) (specified in the IIR)			

ANNEX II – Recommendations from the NECD Review 2017, considering revised estimates (RE), technical corrections (TC) and their status of implementation in Estonia

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-1A1-2018-0001		1A1 Energy Production, PM2.5, 2005-2015	For category 1A1 Energy Production, 1A2 Stationary Combustion in Manufacturing Industries and Construction and 1A4 Small Combustion and Non-Road Mobile Machinery, PM2.5 of natural gas for the whole period, the TERT noted that there is no PM2.5 estimate made by Estonia despite there being emission factors available in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review, Estonia confirming that emissions of particles from combustion of natural gas are not estimated (except for households). Estonia agreed that it is an under-estimate of PM2.5 emissions. Estonia indicated that it had completed preliminary estimates using Tier 2 methods from the 2016 EMEP/EEA Guidebook. The TERT noted that the preliminary revised estimate calculated by Estonia is below the threshold of significance for technical correction. The TERT recommends that Estonia includes the revised estimate in its next submission.	For category 1A1, 1A2, 1A4 and pollutant PM2.5 the TERT noted that there is a lack of transparency regarding the emission factors for natural gas, emissions of which were estimated following the recommendation EE-1A1-2017-0004 from the 2017 NECD review. In response to a question raised during the review, Estonia confirmed the EFs and stated that these will be included in the sector chapters in the 2019 submission. Estonia also stated that LCP emissions will be calculated using more appropriate EFs for the next submission. The TERT recommends that Estonia includes the methodology information in the sector chapter in the 2019 submission and estimates PM2.5 emissions from natural gas from LCPs using the appropriate EFs.	No	The information about particulates and heavy metals added in Energy chapter. Emissions of particulates from natural gas combustions have been calculated for the small and large combustion plants with capacity > 50 MW separately only for the 2017. The difference in emissions, calculated using the same EF, and appropriate EFs (for small boilers and LCP) is only 1.8 tons in 2017. Due to a insignificant difference in emissions, in this reporting year no calculations were made for previous years using different EF.	Chapter 3.2.2 Energy Industries (NFR 1A1), Table 3.15

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-1A1-2018-0002	Yes	1A1 Energy Production, SO ₂ , NO _x , PM _{2.5} , 2005-2015	For NFR 1A1 Energy Production (including waste incineration with energy recovery) and 1A2 Stationary Combustion in Manufacturing Industries and Construction, for years 2005-2015, the TERT noted that Estonia is estimating NO _x , SO ₂ and TSP emissions using annual emissions reported by operators on the basis of stack measurements. When continuously measurements are used to estimate annual emissions, there is a risk that operators have misinterpreted the IED and have used validated average values (after having subtracted the value of the confidence interval) although this subtraction must not be applied in the context of reporting annual emissions. In response to a question raised during the review, Estonia explained that at this time the national legislation does not regulate the use of those continuously measured validated average values in the context of reporting annual emissions. Estonia also explained from first contact with operators, some are calculating emissions based on validated average values. In the opinion of the TERT, bottom-up data based on the "validated average values" defined in the IED cannot be used by the inventory team without adjustment in the framework of a national inventory. The TERT notes that this issue relates to an under-estimate, which could correspond to 20 % of SO ₂ , 20 % of NO _x , 30 % of dust of the sector (depending on the fraction of the operators subtracting confidence interval). The TERT recommends that Estonia organise a survey among operators to identify whether any are reporting emissions on the basis of the validated average values and try to derive a methodology to adjust the national emissions over the time series in order to compensate for any under reporting.	For category 1A1 the TERT noted that there was a potential under-estimate due to the use of annual emissions reported by operators on the basis of stack measurements, which may subtract the confidential interval for validated average values. In response to a question raised during the review, Estonia explained that one operator was using validated average values since the 4th quarter 2012. Estonia provided the emissions from these stack measurements and provided revised estimates for years 2012-2016 and stated that it will be further revised if the operator provides more accurate uncertainty data. The TERT agreed with the revised estimate provided by Estonia. The TERT recommends that Estonia includes the revised estimate in its next submission and continues to work with the operator to obtain more accurate data.	Re	The revised estimate for the 2012-2016 for sector 1A1a included in 2019 submissions. Explanation provided in the Chapter 8.	Chapters 3 and 8

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-1A1c-2018-0002	No	1A1c Manufacture of Solid Fuels and Other Energy Industries, SO ₂ , NO _x , NH ₃ , NMVOC, PM _{2.5} , 2005-2015	For 1A1c Manufacture of Solid Fuels and Other Energy Industries, SO ₂ , NO _x , NH ₃ , NMVOC, PM _{2.5} , 2005-2015, the TERT noted in the NFR tables that activity data (AD) for NFR 1A1c shows significant consumptions of solid fuels (approx. 60,000 TJ in 2015). When comparing this AD to the Eurostat energy balance ("consumption in the energy branch"), the TERT noted only a solid fuel consumption of about 500 TJ for year 2015. This observation is relevant for all years from 2005. In response to a question raised during the review, Estonia explained that the AD for this sector includes fuel consumption in conversion industry, namely oil shale consumption for the oil shale, oil production. The TERT acknowledged the explanation provided by Estonia and understood that all emissions are taken into account in the inventory, but some fuel consumption needs to be reallocated if not used for combustion purposes. The TERT recommends that Estonia only reports energy use of fuels in the NFR tables for the subcategories of NFR 1A Energy (the consumption of oil shale can be considered as a non-energy use of fuel or a raw material).	For category 1A1c Solid Fuels, the TERT noted that there was a lack of transparency regarding the implementation of the previous 2017 NECD review recommendation EE-1A1c-2017-0002 concerning the reallocation of oil shale consumption for oil shale production. In response to a question raised during the review, Estonia explained that the oil shale used for shale oil production had been removed for 2016 but remains included in the activity data for previous years, and stated that 1A1c activity data will be corrected in the next submission. The TERT recommends that Estonia corrects the activity data for the full time series and documents the changes transparently in the 2019 submission.	No	This year, the data corrected for the period 2010 – 2015. Activity data for the full time series will be corrected in the next submission.	NFR tables

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-1A4bi-2018-0001	Yes	1A4bi Residential: Stationary, SO ₂ , 2005-2015	In the 2016 in-depth CLRTAP review of Estonia, for NFR 1A4bi Residential: Stationary Wood Combustion, recommendation 51 "encouraged Estonia to provide an explanation of the technical equipment of advanced small boilers in the IIR to confirm low SO ₂ EF for these equipment, to include information on the use of the different stoves in the IIR and to explain how the emissions were calculated from the EFs presented in the IIR". The TERT did not notice any of these explanations in the 2017 IIR. In response to a question raised during the review, Estonia explained that after checking the measurement results, the conclusion was made that SO ₂ emission factor from the wood gasification technology has been calculated incorrectly. Estonia provided a revised estimate for SO ₂ emissions from the wood combustion in advanced boilers and stated that it will be included in the next submission. Estonia also mentioned that a detailed description of the activity data for the residential sector will be provided in the next submission of the IIR. The TERT agreed with the explanation and the revised estimate provided by Estonia. The TERT noted that the issue is below the threshold of significance for technical correction. The TERT recommends that Estonia includes the revised estimate in its next submission along with the explanations in the IIR.	The TERT reiterates recommendation EE-1A4bi-2017-0001 from the 2017 NECD Review that Estonia includes a detailed description of the activity data for the residential sector in the IIR. During the 2018 NECD Review, Estonia confirmed that the recommendation would be addressed by the 2019 submission.	No	The fuel consumption for residential combustion plants included in chapter 3.2.4 Non-industrial combustion (NFR 1A4).	Chapter 3.2.4 Non-industrial combustion (NFR 1A4), Table 3.32.

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-1A4cii-2018-0001	No	1A4cii Agriculture/ Forestry/ Fishing: Off-Road Vehicles and Other Machinery, NOX, 2001,2002	For 1A4cii Agriculture/ Forestry/ Fishing: Off-Road Vehicles and Other Machinery/ all pollutants/ years: 2000-2015 the TERT noted that the activity data is very variable across the time series. For example, in 2002 activity levels are 3 times those in 2001 and in 2011 activity is ~32% higher than in 2010. In response to a question raised during the review, Estonia explained that fuel consumption data is taken from the Energy Balance, prepared by Estonian Statistics and that the variability in the time series can be explained by statistical fuel consumption deviations in the agricultural sector. The TERT notes that this issue does not relate to an over- or under-estimate and is likely to be due to an allocation issue. The TERT recommends that this issue is looked into further to ensure that this variability is reasonable.	For 1A4cii Agriculture/ Forestry/ Fishing: Off-Road Vehicles and Other Machinery /liquid fuels/ all years the TERT notes that improvements to address the variability in activity data from years 2000-2015 and the separation of emissions from 1A4cii as a response to previous review observations (EE-1A4cii-2017-0001) are mentioned in the IIR and planned in coming years. In response to a question raised during the review, Estonia explained that it is working to improve the transparency of the inventory by double-checking fuel consumption data presented in the energy balance for category 1A4cii with Statistics Estonia and try to explain emission fluctuations for this period. Estonia also plans to calculate emissions from 1A4cii (1990-2012) and report them separately in the next submission. The TERT notes that this issue does not relate to an over or under-estimate and recommends that these improvements are carried out for the next 2019 submission.	No	These issues will be discussed and investigated more deeply in collaboration with Statistics Estonia and all necessary improvements are carried out for the next 2020 submission.	
EE-1B-2018-0001	No	1B Fugitive Emission from Fuels, SO2, NOX, NH3, NMVOC, PM2.5, 2005-2015	For category 1B Fugitive Emission from Fuels, all pollutants and all years the TERT noted that the use of notation keys is inconsistent, and in many cases incorrect. For instance, in 1B1b Fugitive Emission from Solid Fuels: Solid Fuel Transformation NMVOC emissions are 'NA' during part of the time series. In response to a question raised during the review, Estonia explained some of the background for choosing the notation keys. The TERT noted that the proposed use of notation keys is not in line with the reporting guidelines. The TERT recommends that Estonia reviews the use of notation keys throughout the inventory and reports notation keys in accordance with the reporting guidelines for NECD and LRTAP.	The TERT reiterates recommendation EE-1B-2017-0001 from the 2017 NECD Review, that Estonia reviews the use of notation keys throughout the inventory and reports notation keys in accordance with the reporting guidelines for NECD. For example, NFR 1B1b NMVOC emissions are 'IE' between 2005-2009 and 'NA' from 2010 onwards, while other pollutants keep emitting. During the 2018 NECD Review, Estonia confirmed that the recommendation would be addressed by the 2019 submission.	No	NFR 1B1b: Notation key IE was replaced with the notation key NA for 1990-2008 NFR 1B1c: In 2019 reporting year, additional calculations for some year for NOx and NH3 were made for some years. For SO2 for the years 2000-2007 '0' value was replaced with NA.	NFR tables Chapter 8, 1B1c Other fugitive emissions from solid fuels, Table 8.9.

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-2A1-2018-0001	No	2A1 Cement Production, PM2.5, 2005-2015	For category 2A1 Cement Production and pollutant PM2.5 for all years the TERT noted that the IIR does not clearly explain how emissions were calculated and the NFR uses for some years the notation key 'IE' instead of an emission value. In response to a question raised during the review, Estonia explained that combustion activities are reported under NFR 1A2f Stationary Combustion in Manufacturing Industries and Construction: Non-Metallic Minerals. Estonia also indicated that fugitive emissions, for example from the cement mill are usually reported under NFR 2A1. Estonia also explained that in some years diffuse PM emissions are reported in NFR 2A6 Other Mineral Products. Estonia confirmed it will try to correct this for the next submission. The TERT recommends that Estonia reviews the allocation of emissions, ensures time series consistency and to document clearly in the IIR how emissions have been allocated between different NFR source categories.	The TERT reiterates recommendation EE-2A1-2017-0001 from the 2017 NECD Review. The TERT recommends that Estonia allocates PM2.5 emissions to the NFR 2A1 and 2A6 in its next submission.	No	The emissions of particulates from cement production facility were reallocated from NFRs 1A2f and 2A6 to NFR 2A1 for period 2000 – 2003 and 2006-2008. Explanation provided in IIR chapter 8 for Industry.	IIR chapter 8, Industry sector
EE-2A5a-2018-0001	No	2A5a Quarrying and Mining of Minerals Other than Coal, SO2, NOX, NMVOC, PM2.5, 2005-2015	For category 2A5a Quarrying and Mining of Minerals Other than Coal and pollutant PM2.5 the TERT noted that for the years prior to 2009, emissions were reported as 'NA' (Not Applicable). In response to a question raised during the review, Estonia explained that before 2009 emissions from this source are included in 2A6 Other Mineral Products and 'IE' would be the more appropriate notation key to use. The TERT agreed with the explanation provided by Estonia. The TERT recommends that Estonia reports all emissions from quarrying and mining of minerals other than coal in 2A5a (also prior to 2009), or, in case that is not possible, use the notation key 'IE' when emissions are allocated elsewhere. In the latter case, this should be clearly documented in the IIR.	The TERT reiterates recommendation EE-2A5a-2017-0001 from the 2017 NECD Review. The TERT recommends that Estonia reports all emissions from quarrying and mining of minerals other than coal in 2A5a (also prior to 2009), or, in case that is not possible, use the notation key 'IE' when emissions are allocated elsewhere. In the latter case, this should be clearly documented in the IIR. During the 2018 NECD Review, Estonia confirmed that the recommendation would be addressed by the 2019 submission.	No	Notation keys corrections: TSP:1990-2008; PM2.5 and PM10: 2000-2008	NFR tables

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-2A5c-2018-0001	No	2A5c Storage, Handling and Transport of Mineral Products, PM2.5, 2005-2015	For category 2A5c Storage, Handling and Transport of Mineral Products and pollutant PM2.5, for 2005 - 2015 the TERT noted that emissions are reported as 'IE' for some of the years, and as 'NA' for all other years. In response to a question raised during the review, Estonia explained that these emissions are reported under NFR 2L Other Production, Consumption, Storage, Transportation or Handling of Bulk Products and partly under 2A6 Other Mineral Products, and that emissions do not exceed the threshold. The TERT agreed that emissions are below the threshold but disagrees with the allocation of emissions. The TERT recommends that Estonia reports emissions from this source consistently in 2A5c. In case emissions are allocated to other sectors, this should be clearly documented in the IIR.	The TERT reiterates recommendation EE-2A5c-2017-0001 from the 2017 NECD Review. The TERT recommends that Estonia reports emissions from this source consistently in 2A5c. In case emissions are allocated to other sectors, this should be clearly documented in the IIR. During the 2018 NECD Review, Estonia confirmed that the recommendation would be addressed by the 2019 submission.	No	Notation key IE was replaced with the notation key NA for 2002 and 2008-2009	NFR tables

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-2B1-2018-0001	No	2B1 Ammonia Production, SO ₂ , NH ₃ , NMVOC, PM _{2.5} , 1990-2013	For 2B1 Ammonia Production, SO ₂ , NH ₃ , NMVOC, PM _{2.5} , 1990-2013, in response to a question raised during the review Estonia explained that no production occurred in 2011-2012 (the TERT suspects that Estonia meant 2010-2011). The TERT recommends that the notation key is corrected to the proper 'NO' for these years for the next submission. Estonia also explained that SO ₂ emissions are reported from the operator, but only for the years 2008-2009. The TERT notes that it is likely that the SO ₂ emissions reported by Nitrofert in 2008-2009 are related to energy consumption and thus belongs under 1A2c Stationary Combustion in Manufacturing Industries and Construction: Chemicals. Before SO ₂ emissions are removed from 2B1, the TERT recommends that Estonia ensures that SO ₂ emissions are included in 1A2c. Finally, Estonia explained that NH ₃ emissions in 2006 were omitted from the inventory by mistake. The TERT recommends that this NH ₃ emission is included in the next submission. The TERT also notes that emissions should be estimated using extrapolations, IEFs, surrogate data or expert judgements to complete any gaps in the time series 2005-2015, preferably 2000-2004 also. The TERT recommends that Estonia estimates PM _{2.5} emissions to complete the time series. The TERT recommends that a split of the NH ₃ emissions from ammonia and urea productions in 1990-2002 is estimated as best possible to complete the time series reported under 2B1. If urea production continued after 2002 with separate NH ₃ emissions available, then estimation of this split should be possible. The TERT noted that the all the identified issues are below the threshold of significance for a technical correction.	The TERT reiterates recommendation EE-2B1-2017-0001 from the 2017 NECD Review. The TERT recommends that Estonia split the ammonia emission between NFRs 2B1 and 2B10a in its next submission. During the 2018 NECD Review, Estonia confirmed that the recommendation would be addressed by the 2019 submission.	No	The ammonia emissions for 1990-1999 were splited between NFR 2B1 and 2B10a by using extrapolations. SO ₂ emission for 2008-2009, which was removed in 2018 submission from NFR 2B1. In this year submission emission of SO ₂ included under NFR 1A2giii.	IIR chapter 8, Industry sector IIR chapter 8, energy sector NFR 1A2giii

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-2C-2018-0001	No	2C Metal Industry, SO ₂ , NO _x , NH ₃ , NMVOC, PM _{2.5} , 2009-2015	For NFR categories 2C3 Aluminium Production, 2C5 Lead Production, 2C6 Zinc Production and 2C7a Copper Production for 1990 - 2008, the in response to a question raised during the review Estonia explained that emissions are estimated using Tier 3 and that emissions prior to 2009 are estimated differently and reported inconsistently in different categories in energy and waste. Estonia explained that it will attempt to allocate emissions correctly for the next submission. The TERT noted that the issue regards transparency/allocation and does not relate to under- or over-estimation. The TERT recommends that Estonia implements its intent to estimate and report emissions under the correct NFR categories for the full time series for its next submission.	The TERT reiterates recommendation EE-2C-2017-0002 from the 2017 NECD Review. The TERT recommends that Estonia reports emissions from this source consistently in 2C under the correct NFR categories for the full time series before and after 2009. During the 2018 NECD Review, Estonia confirmed that the recommendation would be addressed by the 2020 submission.	No	The TERT recommendation would be addressed by the 2020 submission.	
EE-2C1-2018-0004	No	2C1 Iron and Steel Production, SO ₂ , NO _x , NH ₃ , NMVOC, PM _{2.5} , 2007-2015	For 2C1 Iron and Steel Production, SO ₂ , NO _x , NH ₃ , NMVOC, PM _{2.5} , 2007-2015 in response to a question raised during the review Estonia explained that production (SNAP 040210) ceased from 2013 causing a sharp decrease in emissions. Estonia also explained that emissions from 2C1 in 2000-2006 are reported under NFR 2C7c Other Metal Production. Furthermore, Estonia explained that they agree with the TERT that data from 2000-2006 should be allocated to NFR 2C1 for the next submission as well as a more detailed description of all activities included in the IIR. The TERT noted that the issue is a matter of allocation and transparency only. The TERT recommends that Estonia follows through on its intent to improve the data and descriptions of the iron and steel production source category.	The TERT reiterates recommendation EE-2C1-2018-0004 from the 2017 NECD Review. The TERT recommends that Estonia allocate data from 2000-2006 to NFR 2C1 instead of 2C7c and to improve the data and descriptions of the iron and steel production source category. During the 2018 NECD Review, Estonia confirmed that the recommendation would be addressed by the 2020 submission.		The TERT recommendation would be addressed by the 2020 submission.	

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-2D3a-2018-0001	Yes	2D3a Domestic Solvent Use Including Fungicides, NMVOC, 1990-2015	For Key Category 2D3a Domestic Solvent Use Including Fungicides, NMVOC (whole time series) the TERT noted that there is a lack of transparency regarding the used EF. In response to a question raised during the review, the Member State explained that no AD are available other than population (2016 EMEP/EEA Guidebook: Tier 1 EF of 1.2 kg NMVOC/capita is used). Estonia suggested that the methodology could be improved by using Tier 2 per capita EFs for specific product types, to derive more differentiated emissions into product types. These estimates will be included in the next submission. The TERT recommends that Estonia investigates the possibilities to find AD from national statistics and Eurostat in order to perform a Tier 2 level assessment in the future.	The TERT reiterates recommendation EE-2D3a-2017-0001 from the 2017 NECD Review. During the 2018 NECD Review, Estonia noted that it was unsure when it will acquire sufficient amount of data to move from Tier 1 to Tier 2 methodology, but efforts for that will be made depending on resources available. The TERT recommends that Estonia acquire detailed activity data so that it is possible to use a Tier 2 methodology for emission calculations.	No		
EE-5B2-2018-0001	No	5B2 Biological Treatment of Waste - Anaerobic Digestion at Biogas Facilities, NH3, 2005;2010;2015	For NH3 emissions from 5B2 Biological Treatment of Waste - Anaerobic Digestion at Biogas Facilities the TERT noted that in response to a question raised during the review Estonia explained that emissions are estimated using emission values reported by 1 facility although there are more facilities in the country. The TERT noted that this issue is expected to be below the threshold of significance for a technical correction and that this category has been added in the 2016 EMEP/EEA Guidebook. The TERT recommends that Estonia increases the completeness of its inventory by including all emissions related to biogas production facilities. The TERT recommends that Estonia compare the Tier 1 approach to data reported by facilities and to check out if the methodology used by facilities to report their emissions is relevant.	In the 2017 review report, the TERT recommended that Estonia increase the completeness of its inventory by considering all the biogas production facilities for the determination of national activity data and also recommended that Estonia includes this information in its IIR. The TERT noted that the recommendation was not implemented for the 2018 submission. In response to a question raised during the 2018 review, Estonia explained that the implementation of the 2017 recommendation is dependent on the current workload and prioritisation and that improvements were planned for no later than for the 2020 submission. The TERT notes that this issue is expected to be below the threshold of significance for a technical correction. The TERT recommends that Estonia includes all biogas facilities in its estimates to increase completeness and avoid under-estimation) and provide the resulting Activity Data in the IIR (to improve transparency). In addition, the TERT encourages Estonia to compare the Tier 1 approach with emission data reported by facilities, to check if the methodology used by facilities to report their emissions is relevant and to consider if a Tier 2 or 3 method can be developed.	No		

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation made in previous review report	Assessment of Implementation	RE or TC in 2018	Improvement made	IIR Chapter, page
EE-5D2-2018-0001	No	5D2 Industrial Wastewater Handling, NMVOC, 2005;2010;2015	For 5D Wastewater Handling the TERT noted that there is a dip of NMVOC from 5D2 Industrial Wastewater Handling emissions between the 1990-2013 period (around 0.03 kt/year) and 2014-2015 (around 0.001 kt/year). Over the 1990-2013 period NMVOC from 5D1 Domestic Wastewater Handling emissions were reported as 'IE' and emissions are reported starting from 2013 (around 0.001 kt/year). In response to a question raised during the review Estonia acknowledges that there was an error in NMVOC emission calculations under 5D2 for the years 2014 and 2015 and provided a file illustrating that this error was well below the threshold of significance. The TERT recommends that Estonia includes the updated estimate in its next submission.	For category 5D2 Industrial Wastewater Handling, NMVOC for the complete time series, the TERT noted that, for 2015, emissions are, uncommonly, almost 800 times higher than 5D1 Domestic Wastewater Handling emissions. In response to a question raised during the review, Estonia explained that AD used to estimate emissions from 5D2 using the Tier 1 proposed in the 2016 EMEP/EEA Guidebook corresponds to the total volume of wastewater treated in WWTP including domestic wastewater. Emissions reported under 5D1 correspond to emissions reported by WWTP in the OSIS point sources database. The TERT notes that the estimates for 5D1 using the OSIS point source database are not consistent with the Tier 1 estimates based on the total volume of wastewater treated in WWTP including domestic wastewater. It is more common that emissions of NMVOC from domestic waste water treatment are larger than from industrial waste water treatment. Without further transparency on the OSIS database estimates, TERT recommends Estonia to report emissions from WWTP using the Tier 1 methodology under the 5D1 category and the notation key 'IE' for the category 5D2. The TERT also recommends Estonia to check with WWTP operators on the methodology used for reported NMVOC from diffuse emissions in the OSIS database to see if this could be used to estimate future Tier 2/3 emissions for 5D1 and 5D2.	No		

ANNEX III – Recommendations from the NECD Review 2018 concerning the first phase of the in-depth review of national emission inventories of POPs and heavy metals

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	Improvement made	IIR Chapter, page
EE-1A2gviii-2018-0001	Yes	1A2gviii Stationary Combustion in Manufacturing Industries and Construction: Other, PCBs, PCDD/F, 1990-2016	The TERT notes that, 1A2gviii Stationary Combustion in Manufacturing Industries and Construction: Other, is a key category for PCDD/F and PCB for 2016. Estonia currently uses a Tier 1 methodology when it is considered good practice to use Tier 2 for key categories. In response to a question raised during the review, Estonia explained that improvement to Tier 2 methodology is possible but that resource issues mean it will take at least two years to implement. The TERT recommends that Estonia pursues the implementation of a Tier 2 methodology as soon as resources allow.	National methodology under developing For use the Tier 2 methodology, a detailed analysis of the activity data for the point sources is necessary, which requires additional time and resources. The TERT recommendation would be addressed by the 2020 or 2021 submission.	
EE-1A1a-2018-0002	Yes	1A1a Public Electricity and Heat Production, PAHs, PCBs, HCB, PCDD/F, 1990-2016	The TERT notes that 1A1a Public Electricity and Heat Production is a key category for PCDD/F, PAH, PCB, HCB for 2016. Estonia currently uses a Tier 1 methodology when it is considered good practice to use Tier 2 for key categories. In response to a question raised during the review, Estonia explained that improvement to Tier 2 methodology is possible but that resource issues mean it will take at least two years to implement. The TERT recommends that Estonia pursues the implementation of a Tier 2 methodology as soon as resources allow.	National methodology under developing For use the Tier 2 methodology, a detailed analysis of the activity data for the point sources is necessary, which requires additional time and resources. The TERT recommendation would be addressed by the 2020 or 2021 submission.	
EE-1A1c-2018-0001	No	1A1c Manufacture of Solid Fuels and Other Energy Industries, Hg, 1990	For category 1A1c Manufacture of Solid Fuels and Other Energy Industries and pollutant Hg for years 1990-1992 the TERT noted that there was a potential under-estimate of emissions and a lack of transparency of the time series as these were reported as 'NA'. In response to a question raised during the review, Estonia explained that emissions for these years are included in 1A1a and agreed that the notation key should be 'IE'. The TERT recommends that Estonia correct the notation key and include the transparency information in the 2019 submission, including the explanation for the use of notation keys for 1990-1992 and emission estimates for the rest of the time series.	The heavy metals emissions calculations were checked for the manufacture of solid fuels and other energy industries sector. There was an underestimation of Pb, As, Cr and Ni emissions for 1990-1992 and Cd, Hg, Cu and Zn emissions for 1990-1999. Emissions of HM were additionally calculated.	Chapter 8, Energy, 1A1c Manufacture of solid fuels and other energy industries, Table 8.2

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	Improvement made	IIR Chapter, page
EE-1A2f-2018-0001	No	1A2f Stationary Combustion in Manufacturing Industries and Construction: Non-metallic Minerals, Hg, 1990-2016	For category 1A2f Stationary Combustion in Manufacturing Industries and Construction: Non-metallic Minerals and pollutant Hg the TERT noted that there was a lack of transparency regarding the time series consistency, and a lack of transparency regarding the use of 'IE' for 1A2f activity data. In response to a question raised during the review, Estonia explained that 1A2f activity is included in 1A2giii, and plans to move this to 1A2f no later than the 2020 submission. Estonia provided information on the method change across the time series and agreed the use of notation key 'NE' rather than 0 where no emissions were provided, and that Estonia would calculate these emissions for the 2019 submission. The TERT recommends that Estonia includes this transparency information concerning 1A2f activity data in the 2019 submission until the activity data are moved to 1A2f in future submissions. The TERT recommends that Estonia includes the transparency information regarding the method change across the time series, and to develop a method to calculate emissions for years when operators do not provide emissions and include this in the next submission.	The TERT recommendation would be addressed by the 2020 submission.	
EE-1A3biv-2018-0001	No	1A3biv Road Transport: Mopeds & Motorcycles, PCBs, HCB, Cd, 2012-2016	For 1A3biv Road Transport: Mopeds & Motorcycles /liquid fuels the TERT noted a sudden increase by a factor of 9 in the emissions and IEFs for Cd in 2012. Emissions remain high to 2016. The TERT also noted an apparent very erratic trend in the IEFs and emissions for PCBs and HCBs from 1A3biv across the time series 1990-2016 with emission factors falling to zero in 1994-2000 and again in 2005 and 2012-2014. In response to a question raised during the review, Estonia explained that for the period 1990-2011, emission calculations for 1A3biv cover only emissions from motorcycles whereas from 2012 onwards, the calculations also include emissions from mopeds. This is the year from which all the mopeds have to be registered in the Estonian vehicle register. Estonia explained that they are aware that mopeds were also in use during the period 1990-2011 and that it needs to get activity information in order to account for their emissions. Estonia plan to include emissions from mopeds for the period 1990-2011 in the 2020 submission. Estonia also explained that the HCB and PCB emissions for this source are very small and are rounded to the sixth decimal place and that it is this rounding that causes these apparent erratic trends in the IEFs. Estonia demonstrated this with a spreadsheet of calculated emissions and activity data. The TERT recommends that mopeds are included in the 1A3biv calculations for the period 1990-2012 in order to report a consistent time series by getting the relevant activity data.	According to a recommendation made by TERT, the number of mopeds was corrected for the period between 2005-2014, thanks to the Estonian Road Administration. However, there is no official data on vehicle numbers for the period between 1990-2004.	
EE-1A3dii-2018-0001	No	1A3dii National Navigation (Shipping), PCBs, HCB, Hg, Pb, PCDD/F, 1990-2016	For 1A3dii National Navigation/liquid fuels/all years, the TERT noted that emissions of Pb and Hg are reported as NE and dioxins and PCBs/HCBs as 'NE' or 'NA' in the NFR tables across the time series 1990-2016 although Tier 1 emission factors for these pollutants are provided in the 2016 EMEP/EEA Guidebook (Tables 3-1 to 3-3). In response to a question raised during the review, Estonia explained that it will include these estimates into next year 2019 submission. The TERT welcomes this and recommends that these improvements are carried out for the next 2019 submission.	Completed. Heavy metals, and persistent organic pollutant emission factors and emissions calculations were checked for the national navigation sector. Updated emission factors and emissions data have been added to Chapter 3.3.5. Recalculations have been explained in Chapter 8.	

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	Improvement made	IIR Chapter, page
EE-1A4ai-2018-0001	No	1A4ai Commercial/ Institutional: Stationary, HCB, 1990, 2005	For category 1A4ai Commercial/ Institutional: Stationary and pollutant HCB for years 1990-2001 and 2004-2005 the TERT noted that there was a potential under-estimate of emissions as these were reported as 'NA' but emission estimates provided for the rest of the time series. In response to a question raised during the review, Estonia explained that emissions were calculated but there was an error in the output only showing to 2 decimal places. Estonia stated that the emissions will be recalculated and included in the 2019 submission. The TERT recommends that Estonia review the calculations and include the emission estimates in the 2019 submission, including transparency information on the method and time series.	The HCB emission have been additionally calculated for the years 1990-2007	Chapter 8, Energy, 1A4ai Commercial/institutional: Stationary
EE-1A4aii-2018-0001	No	1A4aii Commercial/ Institutional: Mobile, NOX, NH3, NMVOC, PM2.5, PAHs, Cd, 2016	For 1A4aii Commercial/ Institutional: Mobile, liquid fuels the TERT noted that there is a large decrease in activity data from 2015 to 2016 in NFR tables (from 336 to 22 TJ) not seen in previous years. Emission estimates are themselves not showing such large changes implying a large increase in IEF between these years. In response to a question raised during the review, Estonia explained that there is a mistake in the NFR table for 2016 and the fuel consumption should be 218.808 TJ instead of 21.808 TJ. Estonia explained that it will correct this mistake in the next year submission (2019). The TERT notes that this issue does not relate to an over or under-estimate and recommends that these improvements are carried out for the next 2019 submission.	The necessary correction has been made in the NFR table for 2016.	
EE-1B2aiv-2018-0001	No	1B2aiv Fugitive Emissions Oil: Refining / Storage, Cd, Hg, PCDD/F, 1990, 2005, 2016	In response to a question raised in the review the TERT concluded that the emission factors for crude oil in the 2016 EMEP/EEA Guidebook would not be relevant for the shale oil activities in Estonia, and that no emission factors for shale oil are provided in the 2016 EMEP/EEA Guidebook, in which case the TERT agrees with Estonia reporting 'NA'. The TERT recommends that Estonia provide this added transparency in its future IIRs.	In 2019 submission zero values for some pollutants of this activity were replaced by NA notation key	
EE-2C1-2018-0006	No	2C1 Iron and Steel Production, Hg, HCB, PCBs, 1990, 2005, 2016	The TERT noted that for Hg, HCB, PCB for 2C1 Iron and Steel Production for the entire time series Estonia reported 'NA' in its NFR tables and no reference to an estimate of Hg, HCB and PCB is included in its IIR. While there exists a Tier 1 method and EF and a Tier 2 method and EF for several technologies/processes in the 2016 EMEP/EEA Guidebook. In response to a question during the review Estonia agreed that the notation keys used ('NA') are incorrect. Estonia plans to analyse its facility data for improvement of inventory and to make corresponding changes to the report, but not earlier than in submission 2020. The TERT recommends Estonia to include an emission estimate for Hg, HCB and PCB for 2C1 Iron and steel production as soon as possible and to include an explanation of the issue in its next IIR.	The activity data and emissions of point source for the metal industry for whole time series need careful analysis which will be launched this year The TERT recommendation would be addressed by the 2020 submission.	
EE-2C1-2018-0001	No	2C1 Iron and Steel Production, Pb, 1990, 2005	The TERT noted that for Pb for 2C1 Iron and Steel Production Estonia reported 'NA' in its NFR tables while for 2010-2012 and for 2016 Pb emissions are reported. In the IIR no explanation for the use of 'NA' for 1990-2009 and for 2013-2015 is provided. In response to a question raised during the review Estonia agreed that reported notation keys are not correct and that the problem is not under-estimation, but in the distribution of emissions between NFR categories 2C1 and 2C7c. Estonia confirmed that they are planning to update the emission estimates but not earlier than in submission 2020. The TERT recommends Estonia to include an emission estimate for Pb for 2C1 Iron and steel production as soon as possible and to include an explanation of the issue in its next IIR.	The activity data and emissions of point source for the metal industry for whole time series need careful analysis which will be launched this year The TERT recommendation would be addressed by the 2020 submission.	

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	Improvement made	IIR Chapter, page
EE-2C1-2018-0005	No	2C1 Iron and Steel Production, Cd, PCDD/F, 1990, 2005, 2016	For 2C1 Iron and Steel Production for Cd, PCDD/F for the entire time series the TERT noted that there may be an under-estimate of emissions. Estonia reported 'NA' in its NFR tables but no justification for this was included in its IIR, while there exists a Tier 1 method and EF and a Tier 2 method and EF for several technologies/processes in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review, Estonia explained that this sector is not a key category in Estonia and that the processes connected with contact are included under 1A2a and POPs and heavy metals are calculated under 1A2giii. Estonia also noted that under 2C1 the processes connected with welding and cutting of metals are mainly included. Estonia confirmed that it is planning to analyse facilities' data for the whole period, to review reported data or notation keys for 2C1, to make corrections if necessary and to include its findings in the inventory, but not earlier than in submission 2020. The TERT notes that this issue may relate to an under-estimate and recommends that Estonia includes in its next submission a) how it is determined that this source is not key for Estonia; b) in anticipation of actions planned to be realized for submission 2020, an estimate for those processes for which there exists a Tier 1 method, AD and EF and that Estonia documents this in its IIR.	The activity data and emissions of point source for the metal industry for whole time series need careful analysis which will be launched this year The TERT recommendation would be addressed by the 2020 submission.	
EE-2C3-2018-0001	No	2C3 Aluminium Production, PCDD/F, HCB, 1990, 2005, 2016	The TERT noted that for PCDD/F and HCB for 2C3 Aluminium Production, for the entire time series, there may be an under-estimate of emissions. Estonia reported 'NA' in its NFR tables and no reference to an estimate of PCDD/F and HCB is included in its IIR. While there exists a Tier 2 method and EF in the 2016 EMEP/EEA Guidebook for secondary aluminium production, from the IIR it is not clear whether or not secondary production takes place in Estonia. In response to a question raised during the review Estonia confirmed that secondary aluminium production takes place in Estonia at one facility and indicated plans to include this emission source in the inventory. The TERT recommends Estonia to include an emission estimate for PCDD/F and HCB for 2C3 Aluminium Production in its next submission.	The activity data and emissions of point source for the metal industry for whole time series need careful analysis which will be launched this year. The TERT recommendation would be addressed by the 2020 submission.	
EE-2C5-2018-0001	No	2C5 Lead Production, PCBs, 1990, 2005, 2016	The TERT noted that for PCB emissions from 2C5 Lead Production for the entire time series that there may be an under-estimate of emissions. Estonia reported 'NA' and in its NFR tables no reference to an estimate of PCB is included, while there exists a Tier 1 method and EF in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review Estonia confirmed that secondary lead production takes place in Estonia at one facility and indicated plans to include this emission source in the inventory submission 2020. The TERT recommends Estonia to include an emission estimate for PCB emissions from 2C5 Lead Production in its next submission.	The activity data and emissions of point source for the metal industry for whole time series need careful analysis which will be launched this year The TERT recommendation would be addressed by the 2020 submission.	
EE-2C7a-2018-0001	No	2C7a Copper Production, Cd, Pb, 1990, 2005, 2016	The TERT noted that, for Cd and Pb emissions from 2C7a Copper Production for the entire time series, there may be an under-estimate of emissions. Estonia reported 'NA' in its NFR tables and no reference to an estimate of Cd and Pb is included in its IIR. While there exists a Tier 1 method and EF in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review Estonia confirmed that only one enterprise submits data under 2C7a. The TERT recommends Estonia to include an emission estimate for Cd and Pb emissions from 2C7a Copper Production in its next submission.	The activity data and emissions of point source for the metal industry for whole time series need careful analysis which will be launched this year The TERT recommendation would be addressed by the 2020 submission.	

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	Improvement made	IIR Chapter, page
EE-3Df-2018-0001	No	3Df Use of Pesticides, HCB, 1990-2016	For category 3Df Use of Pesticides and pollutants HCB the TERT noted that Estonia did not provide and explanation for the use of the notation key 'NO' in its IIR. In response to a question raised during the review, Estonia explained that the use of HCB containing pesticide was discontinued before 1990 and cites country specific information in relation to the implementation of the Stockholm Convention in its response. The TERT agreed with the explanation provided by Estonia. The TERT recommends that Estonia includes the information provided to the TERT in the IIR of future submissions to enhance transparency.	The corresponding comment is included in the IIR.	Ch5
EE-5C1bi-2018-0001	No	5C1bi Industrial Waste Incineration, PCDD/F, 1990	For category 5C1bi Industrial Waste Incineration, the TERT noted that the notation key 'NA' is reported concerning the 1990-1999 PCDD/F emissions although an EF is proposed in the 2016 EMEP/EEA Guidebook. In response to a question raised during the Review, Estonia indicated that using the notation key 'NA' for PCDD/F emissions in 1990-1999 is a reporting mistake and provided calculated emissions. The TERT agrees with the estimates and recommends that Estonia includes the PCDD-F emissions on the 1990-1999 period in its NFR tables.		
EE-5C1biii-2018-0001	No	5C1biii Clinical Waste Incineration, Hg, 1990, 2005	For 5C1biii Clinical Waste Incineration, the TERT noted that the notation key 'IE' and 'NA' are used while default EFs are available in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review Estonia explained that the necessary investigation has not been conducted as this is a minor source of pollution. Estonia also indicated that they are planning to conduct these investigations for all the pollutants that have EFs in the 2016 EMEP/EEA Guidebook and that these improvements will be included in the inventory no later than for the 2020 submission. The TERT agrees that these emissions are expected to be far below the threshold of significance and recommends that Estonia uses 'NE' for this category and pollutants while it develops its estimates. In cases where there is evidence that this activity does not occurs, then 'NO' should be reported. The TERT also recommends that Estonia continue its work to estimate emissions by 2020.		
EE-5C1biv-2018-0001	No	5C1biv Sewage Sludge Incineration, PCDD/F, HCB, 1990, 2005, 2016	For 5C1biv Sewage Sludge Incineration, the TERT noted that the notation key 'NA' is reported for all pollutants and the complete time series, although default EFs are proposed in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review Estonia indicated that they are planning to conduct these investigations for all the pollutants that have EFs in the 2016 EMEP/EEA Guidebook and that these improvements will be included in the inventory no later than 2020 submission. The TERT noted that these emissions are expected to be far below the threshold of significance for a technical correction and recommends that Estonia investigate further on AD related to this activity and to estimate emissions. Where emissions cannot be estimated Estonia should use the notation key 'NE' unless there is evidence that the activity does not occur, when 'NO' should be reported.		

ANNEX IV – The results of the uncertainty calculations by air pollutants and NFR codes

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	NOx	25.6900	10.2413	2%	20%	20.10%	0.003844	-0.00693	0.12957	-0.14%	0.37%	0.00%
1A1c	Manufacture of solid fuels and other energy industries	NOx	0.0000	0.3048	2%	20%	20.10%	0.000003	0.00386	0.00386	0.08%	0.01%	0.00%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	NOx	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	NOx	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	NOx	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	NOx	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	NOx	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	NOx	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2gvii	Mobile Combustion in manufacturing industries and construction	NOx	5.3286	1.1064	2%	100%	100.02%	0.001111	-0.01431	0.01400	-1.43%	0.04%	0.02%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	NOx	5.6000	2.1144	2%	20%	20.10%	0.000164	-0.00301	0.02675	-0.06%	0.08%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A3ai(i)	International aviation LTO (civil)	NOx	0.0507	0.0873	2%	30%	30.07%	0.000001	0.00084	0.00110	0.03%	0.00%	0.00%
1A3aii(i)	Domestic aviation LTO (civil)	NOx	0.0016	0.0017	2%	30%	30.07%	0.000000	0.00001	0.00002	0.00%	0.00%	0.00%
1A3bi	Road transport: Passenger cars	NOx	12.9894	3.1716	2%	20%	20.10%	0.000369	-0.02886	0.04013	-0.58%	0.11%	0.00%
1A3bii	Road transport: Light duty vehicles	NOx	1.5728	1.0502	2%	20%	20.10%	0.000040	0.00493	0.01329	0.10%	0.04%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	NOx	10.4207	3.2733	2%	20%	20.10%	0.000393	-0.01395	0.04141	-0.28%	0.12%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	NOx	0.1173	0.0142	2%	20%	20.10%	0.000000	-0.00044	0.00018	-0.01%	0.00%	0.00%
1A3c	Railways	NOx	2.4310	0.8177	2%	100%	100.02%	0.000607	-0.00257	0.01034	-0.26%	0.03%	0.00%
1A3dii	National navigation (shipping)	NOx	0.2688	0.2514	2%	100%	100.02%	0.000057	0.00175	0.00318	0.18%	0.01%	0.00%
1A4ai	Commercial/institutional: Stationary	NOx	0.3000	0.2931	2%	50%	50.04%	0.000020	0.00211	0.00371	0.11%	0.01%	0.00%
1A4aii	Commercial/institutional: Mobile	NOx	0.3971	0.4503	2%	50%	50.04%	0.000046	0.00359	0.00570	0.18%	0.02%	0.00%
1A4bi	Residential: Stationary, liquid fuels	NOx	0.1526	0.0059	3%	50%	50.09%	0.000000	-0.00074	0.00007	-0.04%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	NOx	0.3496	0.0145	2%	50%	50.04%	0.000000	-0.00167	0.00018	-0.08%	0.00%	0.00%
1A4bi	Residential: Stationary, gaseous fuels	NOx	0.1181	0.1257	2%	50%	50.04%	0.000004	0.00096	0.00159	0.05%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	NOx	3.4491	4.6948	5%	50%	50.25%	0.005049	0.04105	0.05940	2.05%	0.42%	0.04%
1A4bi	Residential: Stationary, waste	NOx	0.0722	0.0907	50%	50%	70.71%	0.000004	0.00076	0.00115	0.04%	0.08%	0.00%
1A4bii	Residential: Household and gardening (mobile)	NOx	0.0058	0.0677	2%	50%	50.04%	0.000001	0.00083	0.00086	0.04%	0.00%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	NOx	0.3300	0.1143	2%	50%	50.04%	0.000003	-0.00031	0.00145	-0.02%	0.00%	0.00%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	NOx	4.4090	2.3763	2%	50%	50.04%	0.001283	0.00663	0.03006	0.33%	0.09%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	NOx	0.0000	0.1001	2%	50%	50.04%	0.000002	0.00127	0.00127	0.06%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	NOx	0.0000	0.0019	2%	50%	50.04%	0.000000	0.00002	0.00002	0.00%	0.00%	0.00%
1B1c	Other fugitive emissions from solid fuels	NOx	0.0000	0.0239	2%	50%	50.04%	0.000000	0.00030	0.00030	0.02%	0.00%	0.00%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	NOx	0.0000	0.0002	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2A5a	Quarrying and mining of minerals other than coal	NOx	0.0000	0.0062	2%	50%	50.04%	0.000000	0.00008	0.00008	0.00%	0.00%	0.00%
2A6	Other mineral products (please specify in the IIR)	NOx	0.0000	0.0005	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2B1	Ammonia production	NOx	0.1900	0.0000	2%	50%	50.04%	0.000000	-0.00101	0.00000	-0.05%	0.00%	0.00%
2B10a	Chemical industry: Other	NOx	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2C1	Iron and steel production	NOx	0.0000	0.0311	2%	50%	50.04%	0.000000	0.00039	0.00039	0.02%	0.00%	0.00%
2C7c	Other metal production	NOx	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2D3d	Coating applications	NOx	0.0000	0.0000	5%	50%	50.25%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2G	Other product use (please specify in the IIR)	NOx	0.0075	0.0034	5%	50%	50.25%	0.000000	0.00000	0.00004	0.00%	0.00%	0.00%
2H1	Pulp and paper industry	NOx	0.0000	0.0125	2%	50%	50.04%	0.000000	0.00016	0.00016	0.01%	0.00%	0.00%
2H2	Food and beverages industry	NOx	0.0000	0.0025	2%	50%	50.04%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
2I	Wood processing	NOx	0.0000	0.0026	2%	50%	50.04%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
3B1a	Manure management - Dairy cattle	NOx	0.0703	0.0068	2%	100%	100.02%	0.000000	-0.00029	0.00009	-0.03%	0.00%	0.00%
3B1b	Manure management - Non-dairy cattle	NOx	0.0343	0.0101	2%	100%	100.02%	0.000000	-0.00005	0.00013	-0.01%	0.00%	0.00%
3B2	Manure management - Sheep	NOx	0.0013	0.0007	2%	100%	100.02%	0.000000	0.00000	0.00001	0.00%	0.00%	0.00%
3B3	Manure management - Swine	NOx	0.0059	0.0010	2%	100%	100.02%	0.000000	-0.00002	0.00001	0.00%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
3B4d	Manure management - Goats	NOx	0.0000	0.0001	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
3B4e	Manure management - Horses	NOx	0.0017	0.0012	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
3B4gi	Manure mangement - Laying hens	NOx	0.0109	0.0040	2%	100%	100.02%	0.000000	-0.00001	0.00005	0.00%	0.00%	0.00%
3B4gii	Manure mangement - Broilers	NOx	0.0061	0.0045	2%	100%	100.02%	0.000000	0.00002	0.00006	0.00%	0.00%	0.00%
3B4giv	Manure management - Other poultry	NOx	0.0036	0.0014	2%	100%	100.02%	0.000000	0.00000	0.00002	0.00%	0.00%	0.00%
3B4h	Manure management - Other animals (please specify in IIR)	NOx	0.0001	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
3Da1	Inorganic N-fertilizers (includes also urea application)	NOx	2.8680	1.4933	2%	100%	100.02%	0.002024	0.00365	0.01889	0.37%	0.05%	0.00%
3Da2a	Animal manure applied to soils	NOx	1.3366	0.5646	2%	100%	100.02%	0.000289	0.00004	0.00714	0.00%	0.02%	0.00%
3Da2b	Sewage sludge applied to soils	NOx	0.0031	0.0026	2%	100%	100.02%	0.000000	0.00002	0.00003	0.00%	0.00%	0.00%
3Da2c	Other organic fertilisers applied to soils (including compost)	NOx	0.0050	0.1235	2%	100%	100.02%	0.000014	0.00154	0.00156	0.15%	0.00%	0.00%
3Da3	Urine and dung deposited by grazing animals	NOx	0.4260	0.1139	2%	100%	100.02%	0.000012	-0.00082	0.00144	-0.08%	0.00%	0.00%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	NOx	0.0000	0.0065	2%	100%	100.02%	0.000000	0.00008	0.00008	0.01%	0.00%	0.00%
5C1bi	Industrial waste incineration	NOx	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C1bv	Cremation	NOx	0.0000	0.0067	2%	100%	100.02%	0.000000	0.00008	0.00008	0.01%	0.00%	0.00%
5C2	Open burning of waste	NOx	0.0138	0.0059	10%	100%	100.50%	0.000000	0.00000	0.00007	0.00%	0.00%	0.00%
5D2	Industrial wastewater handling	NOx	0.0000	0.0012	2%	100%	100.02%	0.000000	0.00002	0.00002	0.00%	0.00%	0.00%
TOTAL			79.0386	33.2003				0.015339					0.0008
% uncertainty in total inventory								12.39%			Trend uncertainty:		2.74%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	NMVOC	0.9000	0.4468	2%	50%	50.04%	0.000101	0.00213	0.00689	0.00106	0.00019	0.00000
1A1c	Manufacture of solid fuels and other energy industries	NMVOC	0.8627	0.6345	2%	50%	50.04%	0.000204	0.00522	0.00978	0.00261	0.00028	0.00001
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	NMVOC	IE	IE	2%	50%	50.04%	IE	IE	IE	IE	IE	IE
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	NMVOC	IE	IE	2%	50%	50.04%	IE	IE	IE	IE	IE	IE
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	NMVOC	IE	IE	2%	50%	50.04%	IE	IE	IE	IE	IE	IE
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	NMVOC	IE	IE	2%	50%	50.04%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	NMVOC	IE	IE	2%	50%	50.04%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	NMVOC	IE	IE	2%	50%	50.04%	IE	IE	IE	IE	IE	IE
1A2gvii	Mobile Combustion in manufacturing industries and construction	NMVOC	0.6604	0.1871	2%	50%	50.04%	0.000018	-0.00061	0.00289	-0.00030	0.00008	0.00000
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	NMVOC	0.6200	0.8087	2%	50%	50.04%	0.000331	0.00919	0.01247	0.00459	0.00035	0.00002
1A3ai(i)	International aviation LTO (civil)	NMVOC	0.0096	0.0131	2%	30%	30.07%	0.000000	0.00015	0.00020	0.00005	0.00001	0.00000

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A3aii(i)	Domestic aviation LTO (civil)	NMVOC	0.0025	0.0033	2%	30%	30.07%	0.000000	0.00004	0.00005	0.00001	0.00000	0.00000
1A3bi	Road transport: Passenger cars	NMVOC	10.3293	0.9855	2%	20%	20.10%	0.000079	-0.03936	0.01519	-0.00787	0.00043	0.00006
1A3bii	Road transport: Light duty vehicles	NMVOC	0.7870	0.0604	2%	20%	20.10%	0.000000	-0.00323	0.00093	-0.00065	0.00003	0.00000
1A3biii	Road transport: Heavy duty vehicles and buses	NMVOC	2.4884	0.1062	2%	20%	20.10%	0.000001	-0.01152	0.00164	-0.00230	0.00005	0.00001
1A3biv	Road transport: Mopeds & motorcycles	NMVOC	0.4667	0.0619	2%	20%	20.10%	0.000000	-0.00151	0.00095	-0.00030	0.00003	0.00000
1A3bv	Road transport: Gasoline evaporation	NMVOC	3.4747	0.2512	2%	20%	20.10%	0.000005	-0.01449	0.00387	-0.00290	0.00011	0.00001
1A3c	Railways	NMVOC	0.2245	0.0726	2%	100%	100.02%	0.000011	-0.00007	0.00112	-0.00007	0.00003	0.00000
1A3dii	National navigation (shipping)	NMVOC	0.0522	0.0488	2%	100%	100.02%	0.000005	0.00048	0.00075	0.00048	0.00002	0.00000
1A4ai	Commercial/institutional: Stationary	NMVOC	0.0600	0.0564	2%	50%	50.04%	0.000002	0.00055	0.00087	0.00028	0.00002	0.00000
1A4aii	Commercial/institutional: Mobile	NMVOC	0.4951	0.2369	2%	50%	50.04%	0.000028	0.00103	0.00365	0.00052	0.00010	0.00000
1A4bi	Residential: Stationary, liquid fuels	NMVOC	0.0004	0.0000	3%	50%	50.09%	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
1A4bi	Residential: Stationary, solid fuels	NMVOC	1.7563	0.0382	2%	50%	50.04%	0.000001	-0.00870	0.00059	-0.00435	0.00002	0.00002
1A4bi	Residential: Stationary, gaseous fuels	NMVOC	0.0041	0.0044	2%	50%	50.04%	0.000000	0.00005	0.00007	0.00002	0.00000	0.00000
1A4bi	Residential: Stationary, biomass	NMVOC	2.5062	3.2429	5%	50%	50.25%	0.005366	0.03673	0.05000	0.01837	0.00354	0.00035
1A4bi	Residential: Stationary, waste	NMVOC	0.0612	0.0770	50%	50%	70.71%	0.000006	0.00086	0.00119	0.00043	0.00084	0.00000
1A4bii	Residential: Household and gardening (mobile)	NMVOC	0.1036	0.4728	2%	100%	100.02%	0.000452	0.00674	0.00729	0.00674	0.00021	0.00005
1A4ci	Agriculture/Forestry/Fishing: Stationary	NMVOC	0.0400	0.0458	2%	50%	50.04%	0.000001	0.00049	0.00071	0.00025	0.00002	0.00000
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	NMVOC	0.8891	0.2624	2%	50%	50.04%	0.000035	-0.00066	0.00405	-0.00033	0.00011	0.00000
1A4ciii	Agriculture/Forestry/Fishing: National fishing	NMVOC	0.0000	0.0036	2%	50%	50.04%	0.000000	0.00006	0.00006	0.00003	0.00000	0.00000

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1B2aiv	Fugitive emissions oil: Refining / storage	NMVOC	0.0000	0.1819	2%	50%	50.04%	0.000017	0.00280	0.00280	0.00140	0.00008	0.00000
1B2av	Distribution of oil products	NMVOC	2.3780	0.9477	2%	50%	50.04%	0.000454	0.00204	0.01461	0.00102	0.00041	0.00000
1B2b	Fugitive emissions from natural gas	NMVOC	0.0960	0.0138	2%	50%	50.04%	0.000000	-0.00030	0.00021	-0.00015	0.00001	0.00000
1B2c	Venting and flaring (oil, gas, combined oil and gas)	NMVOC	0.0000	0.0001	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
2A6	Other mineral products (please specify in the IIR)	NMVOC	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
2B1	Ammonia production	NMVOC	0.0052	0.0000	2%	50%	50.04%	0.000000	-0.00003	0.00000	-0.00001	0.00000	0.00000
2B10a	Chemical industry: Other	NMVOC	13.3000	0.0236	2%	50%	50.04%	0.000000	-0.06982	0.00036	-0.03491	0.00001	0.00122
2B10b	Storage, handling and transport of chemical products	NMVOC	0.0000	0.0178	2%	50%	50.04%	0.000000	0.00027	0.00027	0.00014	0.00001	0.00000
2C1	Iron and steel production	NMVOC	0.0000	0.0100	2%	50%	50.04%	0.000000	0.00015	0.00015	0.00008	0.00000	0.00000
2C3	Aluminium production	NMVOC	0.0000	0.0023	2%	50%	50.04%	0.000000	0.00004	0.00004	0.00002	0.00000	0.00000
2C7c	Other metal production	NMVOC	0.0000	0.0007	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00001	0.00000	0.00000
2D3a	Domestic solvent use including fungicides	NMVOC	4.0679	1.5788	2%	50%	50.04%	0.001261	0.00283	0.02434	0.00141	0.00069	0.00000
2D3b	Road paving with asphalt	NMVOC	0.0270	0.0264	2%	100%	100.02%	0.000001	0.00026	0.00041	0.00026	0.00001	0.00000
2D3d	Coating applications	NMVOC	2.2421	3.5075	2%	50%	50.04%	0.006225	0.04221	0.05408	0.02110	0.00153	0.00045
2D3e	Degreasing	NMVOC	0.1795	0.0933	10%	30%	31.62%	0.000002	0.00049	0.00144	0.00015	0.00020	0.00000
2D3f	Dry cleaning	NMVOC	0.0146	0.0074	10%	50%	50.99%	0.000000	0.00004	0.00011	0.00002	0.00002	0.00000
2D3g	Chemical products	NMVOC	0.4959	0.1291	2%	20%	20.10%	0.000001	-0.00063	0.00199	-0.00013	0.00006	0.00000
2D3h	Printing	NMVOC	0.0798	0.6624	2%	100%	100.02%	0.000887	0.00979	0.01021	0.00979	0.00029	0.00010

A		B	C	D	E	F	G	H	I	J	K	L	M
NFR sector		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
2D3i	Other solvent use (please specify in the IIR)	NMVOC	1.2644	0.8103	5%	50%	50.25%	0.000335	0.00581	0.01249	0.00290	0.00088	0.00001
2G	Other product use (please specify in the IIR)	NMVOC	0.0202	0.0088	5%	50%	50.25%	0.000000	0.00003	0.00014	0.00001	0.00001	0.00000
2H1	Pulp and paper industry	NMVOC	0.2200	0.0137	2%	50%	50.04%	0.000000	-0.00095	0.00021	-0.00048	0.00001	0.00000
2H2	Food and beverages industry	NMVOC	1.7884	0.6940	2%	50%	50.04%	0.000244	0.00124	0.01070	0.00062	0.00030	0.00000
2I	Wood processing	NMVOC	0.0000	0.0018	2%	50%	50.04%	0.000000	0.00003	0.00003	0.00001	0.00000	0.00000
2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	NMVOC	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
3B1a	Manure management - Dairy cattle	NMVOC	3.1439	2.3390	2%	100%	100.02%	0.011060	0.01943	0.03606	0.01943	0.00102	0.00038
3B1b	Manure management - Non-dairy cattle	NMVOC	4.2472	1.2071	2%	100%	100.02%	0.002946	-0.00384	0.01861	-0.00384	0.00053	0.00002
3B2	Manure management - Sheep	NMVOC	0.0442	0.0226	2%	100%	100.02%	0.000001	0.00011	0.00035	0.00011	0.00001	0.00000
3B3	Manure management - Swine	NMVOC	0.8506	0.3255	2%	100%	100.02%	0.000214	0.00052	0.00502	0.00052	0.00014	0.00000
3B4d	Manure management - Goats	NMVOC	0.0013	0.0032	2%	100%	100.02%	0.000000	0.00004	0.00005	0.00004	0.00000	0.00000
3B4e	Manure management - Horses	NMVOC	0.0669	0.0444	2%	100%	100.02%	0.000004	0.00033	0.00068	0.00033	0.00002	0.00000
3B4gi	Manure mangement - Laying hens	NMVOC	0.3670	0.1352	2%	100%	100.02%	0.000037	0.00014	0.00208	0.00014	0.00006	0.00000
3B4gii	Manure mangement - Broilers	NMVOC	0.2108	0.1569	2%	100%	100.02%	0.000050	0.00130	0.00242	0.00130	0.00007	0.00000
3B4giv	Manure management - Other poultry	NMVOC	0.6159	0.2401	2%	100%	100.02%	0.000117	0.00044	0.00370	0.00044	0.00010	0.00000
3B4h	Manure management - Other animals (please specify in IIR)	NMVOC	0.4480	0.0975	2%	100%	100.02%	0.000019	-0.00087	0.00150	-0.00087	0.00004	0.00000
3De	Cultivated crops	NMVOC	0.6788	0.5037	2%	100%	100.02%	0.000513	0.00418	0.00777	0.00418	0.00022	0.00002
5A	Biological treatment of waste - Solid waste disposal on land	NMVOC	1.2128	0.2744	2%	100%	100.02%	0.000152	-0.00218	0.00423	-0.00218	0.00012	0.00000

A		B	C	D	E	F	G	H	I	J	K	L	M
NFR sector		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
5B1	Biological treatment of waste - Composting	NMVOC	0.0000	0.0035	2%	100%	100.02%	0.000000	0.00005	0.00005	0.00005	0.00000	0.00000
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	NMVOC	0.0000	0.0006	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00001	0.00000	0.00000
5C1bi	Industrial waste incineration	NMVOC	0.0000	0.0002	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
5C1bv	Cremation	NMVOC	0.0000	0.0001	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
5C2	Open burning of waste	NMVOC	0.0002	0.0001	10%	100%	100.50%	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
5D1	Domestic wastewater handling	NMVOC	0.0000	0.0281	2%	100%	100.02%	0.000002	0.00043	0.00043	0.00043	0.00001	0.00000
5D2	Industrial wastewater handling	NMVOC	0.0000	0.0082	2%	100%	100.02%	0.000000	0.00013	0.00013	0.00013	0.00000	0.00000
5E	Other waste	NMVOC	0.0000	0.0031	2%	100%	100.02%	0.000000	0.00005	0.00005	0.00005	0.00000	0.00000
TOTAL			64.8602	22.2453				0.031189					0.0027
% uncertainty in total inventory								17.66%	Trend uncertainty:				5.21%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	SOx (SO2)	220.4000	30.7443	2%	10%	10.20%	0.006579	-0.00194	0.11287	-0.02%	0.32%	0.00%
1A1c	Manufacture of solid fuels and other energy industries	SOx (SO2)	0.4800	1.7219	2%	10%	10.20%	0.000021	0.00607	0.00632	0.06%	0.02%	0.00%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	SOx (SO2)	IE	IE	2%	10%	10.20%	IE	IE	IE	IE	IE	IE
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	SOx (SO2)	IE	IE	2%	10%	10.20%	IE	IE	IE	IE	IE	IE
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	SOx (SO2)	IE	IE	2%	10%	10.20%	IE	IE	IE	IE	IE	IE
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	SOx (SO2)	IE	IE	2%	10%	10.20%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	SOx (SO2)	IE	IE	2%	10%	10.20%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	SOx (SO2)	IE	IE	2%	10%	10.20%	IE	IE	IE	IE	IE	IE
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	SOx (SO2)	38.5100	5.6781	2%	10%	10.20%	0.000224	0.00078	0.02085	0.01%	0.06%	0.00%
1A2gvii	Mobile Combustion in manufacturing industries and construction	SOx (SO2)	1.6320	0.0007	2%	50%	50.04%	0.000000	-0.00085	0.00000	-0.04%	0.00%	0.00%
1A3ai(i)	International aviation LTO (civil)	SOx (SO2)	0.0053	0.0086	2%	30%	30.07%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
1A3aii(i)	Domestic aviation LTO (civil)	SOx (SO2)	0.0003	0.0003	2%	30%	30.07%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A3bi	Road transport: Passenger cars	SOx (SO2)	0.9011	0.0058	2%	20%	20.10%	0.000000	-0.00045	0.00002	-0.01%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A3bii	Road transport: Light duty vehicles	SOx (SO2)	0.3209	0.0011	2%	20%	20.10%	0.000000	-0.00016	0.00000	0.00%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	SOx (SO2)	1.9670	0.0024	2%	20%	20.10%	0.000000	-0.00102	0.00001	-0.02%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	SOx (SO2)	0.0235	0.0000	2%	20%	20.10%	0.000000	-0.00001	0.00000	0.00%	0.00%	0.00%
1A3c	Railways	SOx (SO2)	0.5671	0.0003	2%	50%	50.04%	0.000000	-0.00029	0.00000	-0.01%	0.00%	0.00%
1A3dii	National navigation (shipping)	SOx (SO2)	0.0700	0.0131	2%	50%	50.04%	0.000000	0.00001	0.00005	0.00%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	SOx (SO2)	1.3000	0.0713	2%	20%	20.10%	0.000000	-0.00042	0.00026	-0.01%	0.00%	0.00%
1A4aii	Commercial/institutional: Mobile	SOx (SO2)	0.1240	0.0002	2%	20%	20.10%	0.000000	-0.00006	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, liquid fuels	SOx (SO2)	0.3051	0.0117	3%	20%	20.22%	0.000000	-0.00012	0.00004	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	SOx (SO2)	2.6205	0.0675	2%	20%	20.10%	0.000000	-0.00112	0.00025	-0.02%	0.00%	0.00%
1A4bi	Residential: Stationary, gaseous fuels	SOx (SO2)	0.0006	0.0007	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	SOx (SO2)	0.0776	0.1988	5%	20%	20.62%	0.000001	0.00069	0.00073	0.01%	0.01%	0.00%
1A4bi	Residential: Stationary, waste	SOx (SO2)	0.0063	0.0080	50%	50%	70.71%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
1A4bii	Residential: Household and gardening (mobile)	SOx (SO2)	0.0022	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	SOx (SO2)	1.7800	0.0716	2%	20%	20.10%	0.000000	-0.00066	0.00026	-0.01%	0.00%	0.00%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	SOx (SO2)	1.2780	0.0053	2%	20%	20.10%	0.000000	-0.00065	0.00002	-0.01%	0.00%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	SOx (SO2)	0.0000	0.0026	2%	20%	20.10%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
1B1c	Other fugitive emissions from solid fuels	SOx (SO2)	0.0000	0.0287	2%	20%	20.10%	0.000000	0.00011	0.00011	0.00%	0.00%	0.00%
1B2aiv	Fugitive emissions oil: Refining / storage	SOx (SO2)	0.0000	0.0005	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%

A		B	C	D	E	F	G	H	I	J	K	L	M	
NFR sector		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions	
			kt	kt	%	%	%		%	%	%	%	%	
1B2c	Venting and flaring (oil, gas, combined oil and gas)	SOx (SO2)	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
2A5a	Quarrying and mining of minerals other than coal	SOx (SO2)	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
2A6	Other mineral products (please specify in the IIR)	SOx (SO2)	0.0000	0.0000	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
2C5	Lead production	SOx (SO2)	0.0000	0.0000	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
2C7c	Other metal production	SOx (SO2)	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
2D3d	Coating applications	SOx (SO2)	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
2G	Other product use (please specify in the IIR)	SOx (SO2)	0.0000	0.0014	5%	50%	50.25%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%	
2H2	Food and beverages industry	SOx (SO2)	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
2I	Wood processing	SOx (SO2)	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	SOx (SO2)	0.0000	0.0002	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
5C1bv	Cremation	SOx (SO2)	0.0000	0.0009	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
5C2	Open burning of waste	SOx (SO2)	0.0130	0.0056	10%	50%	50.99%	0.000000	0.00001	0.00002	0.00%	0.00%	0.00%	
5D2	Industrial wastewater handling	SOx (SO2)	0.0000	0.0014	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%	
TOTAL			272.3845	38.6532				0.006826						0.00001
% uncertainty in total inventory								8.26%	Trend uncertainty:				0.34%	

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	NH ₃	0.0806	0.2461	2%	50%	50.04%	0.000144	0.00965	0.01144	0.48%	0.03%	0.00%
1A1c	Manufacture of solid fuels and other energy industries	NH ₃	0.0000	0.1983	2%	50%	50.04%	0.000094	0.00922	0.00922	0.46%	0.03%	0.00%
1A2gvii	Mobile Combustion in manufacturing industries and construction	NH ₃	0.0013	0.0003	2%	50%	50.04%	0.000000	-0.00002	0.00001	0.00%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	NH ₃	0.0095	0.2538	2%	50%	50.04%	0.000153	0.01159	0.01180	0.58%	0.03%	0.00%
1A3bi	Road transport: Passenger cars	NH ₃	0.0102	0.1341	2%	20%	20.10%	0.000007	0.00601	0.00624	0.12%	0.02%	0.00%
1A3bii	Road transport: Light duty vehicles	NH ₃	0.0007	0.0048	2%	20%	20.10%	0.000000	0.00021	0.00022	0.00%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	NH ₃	0.0039	0.0050	2%	20%	20.10%	0.000000	0.00015	0.00023	0.00%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	NH ₃	0.0006	0.0001	2%	20%	20.10%	0.000000	-0.00001	0.00001	0.00%	0.00%	0.00%
1A3c	Railways	NH ₃	0.0003	0.0001	2%	50%	50.04%	0.000000	0.00000	0.00001	0.00%	0.00%	0.00%
1A3dii	National navigation (shipping)	NH ₃	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	NH ₃	0.0144	0.0360	2%	50%	50.04%	0.000003	0.00136	0.00167	0.07%	0.00%	0.00%
1A4aii	Commercial/institutional: Mobile	NH ₃	0.0001	0.0001	2%	50%	50.04%	0.000000	0.00000	0.00001	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, liquid fuels	NH ₃	0.0000	0.0000	3%	100%	100.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	NH ₃	0.0011	0.0000	2%	100%	100.02%	0.000000	-0.00002	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, gaseous fuels	NH ₃	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	NH ₃	0.0227	0.0457	5%	100%	100.12%	0.000020	0.00162	0.00212	0.16%	0.02%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
			Pollutant	1990 emissions	2017 emissions								
				kt	kt	%	%	%	%	%	%	%	Uncertainty in trend in national emissions introduced into the trend in total national emissions
1A4bi	Residential: Stationary, waste	NH ₃		0.0010	0.0012	50%	50%	70.71%	0.000000	0.00004	0.00006	0.00%	0.00%
1A4bii	Elamud: majapidamine ja aiandus (liikuvad)	NH ₃		0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	NH ₃		0.0073	0.0105	2%	50%	50.04%	0.000000	0.00032	0.00049	0.02%	0.00%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	NH ₃		0.0011	0.0006	2%	50%	50.04%	0.000000	0.00000	0.00003	0.00%	0.00%
1B1c	Other fugitive emissions from solid fuels	NH ₃		0.0000	0.1676	2%	50%	50.04%	0.000067	0.00779	0.00779	0.39%	0.02%
1B2aiv	Fugitive emissions oil: Refining / storage	NH ₃		0.0000	0.0001	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%
2B1	Ammonia production	NH ₃		0.0218	0.0000	2%	20%	20.10%	0.000000	-0.00048	0.00000	-0.01%	0.00%
2B10a	Chemical industry: Other	NH ₃		0.3482	0.0000	2%	20%	20.10%	0.000000	-0.00771	0.00000	-0.15%	0.00%
2B10b	Storage, handling and transport of chemical products	NH ₃		0.0000	0.0073	2%	20%	20.10%	0.000000	0.00034	0.00034	0.01%	0.00%
2C7c	Other metal production	NH ₃		0.1600	0.0660	2%	200%	200.01%	0.000166	-0.00048	0.00307	-0.10%	0.01%
2D3g	Chemical products	NH ₃		0.0000	0.0030	2%	100%	100.02%	0.000000	0.00014	0.00014	0.01%	0.00%
2D3i	Other solvent use	NH ₃		0.0000	0.0000	5%	100%	100.12%	0.000000	0.00000	0.00000	0.00%	0.00%
2G	Other product use	NH ₃		0.0173	0.0076	5%	50%	50.25%	0.000000	-0.00003	0.00035	0.00%	0.00%
2L	Pakendamata toodete tootmine. tarbimine. ladustamine. transport ja käsitlemine (täpsustada inventuuris)	NH ₃		0.0000	0.0082	2%	200%	200.01%	0.000003	0.00038	0.00038	0.08%	0.00%
3B1a	Manure management - Dairy cattle	NH ₃		2.2906	2.3113	2%	100%	100.02%	0.050816	0.05662	0.10745	5.66%	0.30%
3B1b	Manure management - Non-dairy cattle	NH ₃		2.1243	0.8627	2%	100%	100.02%	0.007079	-0.00697	0.04010	-0.70%	0.11%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
3B2	Manure management - Sheep	NH ₃	0.2219	0.1131	2%	100%	100.02%	0.000122	0.00034	0.00526	0.03%	0.01%	0.00%
3B3	Manure management - Swine	NH ₃	2.3080	0.6614	2%	100%	100.02%	0.004161	-0.02038	0.03074	-2.04%	0.09%	0.04%
3B4d	Manure management - Goats	NH ₃	0.0029	0.0071	2%	100%	100.02%	0.000000	0.00027	0.00033	0.03%	0.00%	0.00%
3B4e	Manure management - Horses	NH ₃	0.1273	0.0844	2%	100%	100.02%	0.000068	0.00110	0.00392	0.11%	0.01%	0.00%
3B4gi	Manure management - Laying hens	NH ₃	0.6425	0.2367	2%	100%	100.02%	0.000533	-0.00323	0.01101	-0.32%	0.03%	0.00%
3B4gii	Manure management - Broilers	NH ₃	0.2403	0.1789	2%	100%	100.02%	0.000304	0.00299	0.00832	0.30%	0.02%	0.00%
3B4giv	Manure management - Other poultry	NH ₃	0.3761	0.1420	2%	100%	100.02%	0.000192	-0.00173	0.00660	-0.17%	0.02%	0.00%
3B4h	Manure management - Other animals (please specify in IIR)	NH ₃	0.0046	0.0010	2%	100%	100.02%	0.000000	-0.00006	0.00005	-0.01%	0.00%	0.00%
3Da1	Inorganic N-fertilizers (includes also urea application)	NH ₃	2.9662	1.4645	2%	100%	100.02%	0.020402	0.00234	0.06808	0.23%	0.19%	0.00%
3Da2a	Animal manure applied to soils	NH ₃	8.8971	2.5480	2%	100%	100.02%	0.061761	-0.07840	0.11845	-7.84%	0.34%	0.62%
3Da2b	Sewage sludge applied to soils	NH ₃	0.0104	0.0087	2%	100%	100.02%	0.000001	0.00017	0.00040	0.02%	0.00%	0.00%
3Da2c	Other organic fertilisers applied to soils (including compost)	NH ₃	0.0099	0.2470	2%	100%	100.02%	0.000580	0.01126	0.01148	1.13%	0.03%	0.01%
3Da3	Urine and dung deposited by grazing animals	NH ₃	0.5853	0.1312	2%	100%	100.02%	0.000164	-0.00687	0.00610	-0.69%	0.02%	0.00%
5A	Biological treatment of waste - Solid waste disposal on land	NH ₃	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5B1	Biological treatment of waste - Composting	NH ₃	0.0016	0.0594	2%	50%	50.04%	0.000008	0.00272	0.00276	0.14%	0.01%	0.00%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	NH ₃	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
5C1bi	Industrial waste incineration	NH ₃	0.0000	0.0001	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
5C1bv	Cremation	NH ₃	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5D2	Other wastewater handling	NH ₃	0.0000	0.0009	2%	50%	50.04%	0.000000	0.00004	0.00004	0.00%	0.00%	0.00%
TOTAL			21.5112	10.2551				0.146848					0.0102
					% uncertainty in total inventory			38.32%			Trend uncertainty:		10.07%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	PM2.5	7.3066	2.3249	2%	20%	20.10%	0.002568	-0.13411	0.15154	-2.68%	0.43%	0.07%
1A1c	Manufacture of solid fuels and other energy industries	PM2.5	0.3600	0.0048	2%	20%	20.10%	0.000000	-0.01379	0.00031	-0.28%	0.00%	0.00%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	PM2.5	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	PM2.5	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	PM2.5	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	PM2.5	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	PM2.5	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	PM2.5	0.5946	0.0248	2%	20%	20.10%	0.000000	-0.02167	0.00162	-0.43%	0.00%	0.00%
1A2gvii	Mobile Combustion in manufacturing industries and construction	PM2.5	0.0317	0.0701	2%	50%	50.04%	0.000014	0.00333	0.00457	0.17%	0.01%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	PM2.5	1.0675	2.8037	2%	20%	20.10%	0.003734	0.14082	0.18275	2.82%	0.52%	0.08%
1A3ai(i)	International aviation LTO (civil)	PM2.5	0.0003	0.0005	2%	30%	30.07%	0.000000	0.00002	0.00004	0.00%	0.00%	0.00%
1A3aii(i)	Domestic aviation LTO (civil)	PM2.5	0.0000	0.0000	2%	30%	30.07%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A3bi	Road transport: Passenger cars	PM2.5	0.1105	0.1431	2%	20%	20.10%	0.000010	0.00500	0.00933	0.10%	0.03%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A3bii	Road transport: Light duty vehicles	PM2.5	0.2041	0.0329	2%	20%	20.10%	0.000001	-0.00586	0.00214	-0.12%	0.01%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	PM2.5	0.2952	0.0555	2%	20%	20.10%	0.000001	-0.00795	0.00362	-0.16%	0.01%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	PM2.5	0.0003	0.0010	2%	20%	20.10%	0.000000	0.00005	0.00007	0.00%	0.00%	0.00%
1A3bvi	Road transport: Automobile tyre and brake wear	PM2.5	0.0621	0.1028	2%	20%	20.10%	0.000005	0.00427	0.00670	0.09%	0.02%	0.00%
1A3bvii	Road transport: Automobile road abrasion	PM2.5	0.0368	0.0540	2%	20%	20.10%	0.000001	0.00208	0.00352	0.04%	0.01%	0.00%
1A3c	Railways	PM2.5	0.0596	0.0214	2%	20%	20.10%	0.000000	-0.00094	0.00139	-0.02%	0.00%	0.00%
1A3dii	National navigation (shipping)	PM2.5	0.0322	0.0301	2%	20%	20.10%	0.000000	0.00070	0.00196	0.01%	0.01%	0.00%
1A4ai	Commercial/institutional: Stationary	PM2.5	0.3302	0.2689	2%	20%	20.10%	0.000034	0.00458	0.01752	0.09%	0.05%	0.00%
1A4aii	Commercial/institutional: Mobile	PM2.5	0.0136	0.0320	2%	50%	50.04%	0.000003	0.00156	0.00209	0.08%	0.01%	0.00%
1A4bi	Residential: Stationary, liquid fuels	PM2.5	0.0008	0.0001	3%	20%	20.22%	0.000000	-0.00002	0.00001	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	PM2.5	0.3917	0.0284	2%	20%	20.10%	0.000000	-0.01349	0.00185	-0.27%	0.01%	0.00%
1A4bi	Residential: Stationary, gaseous fuels	PM2.5	0.0031	0.0039	2%	20%	20.10%	0.000000	0.00014	0.00026	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	PM2.5	2.9495	1.8772	5%	20%	20.62%	0.001761	0.00678	0.12236	0.14%	0.87%	0.01%
1A4bi	Residential: Stationary, waste	PM2.5	0.4833	0.4074	50%	50%	70.71%	0.000976	0.00761	0.02655	0.38%	1.88%	0.04%
1A4bii	Residential: Household and gardening (mobile)	PM2.5	0.0092	0.0106	2%	50%	50.04%	0.000000	0.00033	0.00069	0.02%	0.00%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	PM2.5	0.1501	0.2314	2%	20%	20.10%	0.000025	0.00920	0.01508	0.18%	0.04%	0.00%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	PM2.5	0.0499	0.1317	2%	50%	50.04%	0.000051	0.00663	0.00858	0.33%	0.02%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	PM2.5	0.0000	0.0018	2%	50%	50.04%	0.000000	0.00012	0.00012	0.01%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	PM2.5	0.0000	0.0006	2%	100%	100.02%	0.000000	0.00004	0.00004	0.00%	0.00%	0.00%
1B1c	Other fugitive emissions from solid fuels	PM2.5	0.0100	0.0060	2%	100%	100.02%	0.000000	0.00000	0.00039	0.00%	0.00%	0.00%
1B2aiv	Fugitive emissions oil: Refining / storage	PM2.5	0.0000	0.0072	2%	100%	100.02%	0.000001	0.00047	0.00047	0.05%	0.00%	0.00%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	PM2.5	0.0000	0.0001	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2A1	Cement production	PM2.5	0.0075	0.0043	2%	100%	100.02%	0.000000	-0.00001	0.00028	0.00%	0.00%	0.00%
2A2	Lime production	PM2.5	0.0000	0.0002	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2A5a	Quarrying and mining of minerals other than coal	PM2.5	0.0000	0.0061	2%	100%	100.02%	0.000000	0.00040	0.00040	0.04%	0.00%	0.00%
2A5b	Construction and demolition	PM2.5	0.0496	0.1202	5%	100%	100.12%	0.000170	0.00589	0.00783	0.59%	0.06%	0.00%
2A6	Other mineral products	PM2.5	0.0710	0.0032	2%	100%	100.02%	0.000000	-0.00257	0.00021	-0.26%	0.00%	0.00%
2B10a	Chemical industry: Other	PM2.5	0.0892	0.0004	2%	20%	20.10%	0.000000	-0.00347	0.00003	-0.07%	0.00%	0.00%
2B10b	Storage, handling and transport of chemical products	PM2.5	0.0000	0.0005	2%	20%	20.10%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
2C1	Iron and steel production	PM2.5	0.0000	0.0760	2%	20%	20.10%	0.000003	0.00496	0.00496	0.10%	0.01%	0.00%
2C3	Aluminium production	PM2.5	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2C5	Lead production	PM2.5	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2C6	Zinc production	PM2.5	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2C7a	Copper production	PM2.5	0.0000	0.0000	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2C7c	Other metal production	PM2.5	0.0140	0.0008	2%	20%	20.10%	0.000000	-0.00049	0.00005	-0.01%	0.00%	0.00%
2D3b	Road paving with asphalt	PM2.5	0.0007	0.0017	2%	100%	100.02%	0.000000	0.00008	0.00011	0.01%	0.00%	0.00%

A		B	C	D	E	F	G	H	I	J	K	L	M
NFR sector		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt									%
2G	Other product use (please specify in the IIR)	PM2.5	0.0562	0.0735	5%	50%	50.25%	0.000016	0.00259	0.00479	0.13%	0.03%	0.00%
2H1	Pulp and paper industry	PM2.5	0.0840	0.0267	2%	100%	100.02%	0.000008	-0.00155	0.00174	-0.16%	0.00%	0.00%
2H2	Food and beverages industry	PM2.5	0.0011	0.0055	2%	100%	100.02%	0.000000	0.00031	0.00036	0.03%	0.00%	0.00%
2I	Wood processing	PM2.5	0.0000	0.0241	2%	100%	100.02%	0.000007	0.00157	0.00157	0.16%	0.00%	0.00%
2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	PM2.5	0.0000	0.0073	2%	100%	100.02%	0.000001	0.00048	0.00048	0.05%	0.00%	0.00%
3B1a	Manure management - Dairy cattle	PM2.5	0.0537	0.0354	2%	100%	100.02%	0.000015	0.00020	0.00231	0.02%	0.01%	0.00%
3B1b	Manure management - Non-dairy cattle	PM2.5	0.0170	0.0188	2%	100%	100.02%	0.000004	0.00056	0.00123	0.06%	0.00%	0.00%
3B2	Manure management - Sheep	PM2.5	0.0007	0.0016	2%	100%	100.02%	0.000000	0.00008	0.00011	0.01%	0.00%	0.00%
3B3	Manure management - Swine	PM2.5	0.0016	0.0015	2%	100%	100.02%	0.000000	0.00003	0.00009	0.00%	0.00%	0.00%
3B4d	Manure management - Goats	PM2.5	0.0001	0.0001	2%	100%	100.02%	0.000000	0.00000	0.00001	0.00%	0.00%	0.00%
3B4e	Manure management - Horses	PM2.5	0.0006	0.0008	2%	100%	100.02%	0.000000	0.00003	0.00005	0.00%	0.00%	0.00%
3B4gi	Manure mangement - Laying hens	PM2.5	0.0022	0.0025	2%	100%	100.02%	0.000000	0.00008	0.00016	0.01%	0.00%	0.00%
3B4gii	Manure mangement - Broilers	PM2.5	0.0012	0.0029	2%	100%	100.02%	0.000000	0.00014	0.00019	0.01%	0.00%	0.00%
3B4giv	Manure management - Other poultry	PM2.5	0.0063	0.0098	2%	100%	100.02%	0.000001	0.00039	0.00064	0.04%	0.00%	0.00%
3B4h	Manure management - Other animals (please specify in IIR)	PM2.5	0.0002	0.0002	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	PM2.5	0.0272	0.0351	2%	100%	100.02%	0.000015	0.00123	0.00229	0.12%	0.01%	0.00%
5A	Biological treatment of waste - Solid waste disposal on land	PM2.5	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt									
5C1bi	Industrial waste incineration	PM2.5	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C1bv	Cremation	PM2.5	0.0001	0.0003	2%	100%	100.02%	0.000000	0.00001	0.00002	0.00%	0.00%	0.00%
5C2	Open burning of waste	PM2.5	0.1050	0.0301	10%	100%	100.50%	0.000011	-0.00215	0.00196	-0.21%	0.03%	0.00%
5E	Other waste	PM2.5	0.1995	0.0553	2%	100%	100.02%	0.000036	-0.00421	0.00360	-0.42%	0.01%	0.00%
TOTAL			15.3416	9.2221				0.009475					0.00214
					% uncertainty in total inventory			9.73%			Trend uncertainty:		4.62%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	PM10	20.5766	4.0491	2%	20%	20.10%	0.003423	-0.15087	12.62%	-3.02%	0.36%	0.09%
1A1c	Manufacture of solid fuels and other energy industries	PM10	0.8200	0.0057	2%	20%	20.10%	0.000000	-0.01090	0.02%	-0.22%	0.00%	0.00%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	PM10	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	PM10	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	PM10	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	PM10	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	PM10	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	PM10	1.4013	0.0322	2%	20%	20.10%	0.000000	-0.01792	0.10%	-0.36%	0.00%	0.00%
1A2gvii	Mobile Combustion in manufacturing industries and construction	PM10	0.0317	0.0701	2%	50%	50.04%	0.000006	0.00176	0.22%	0.09%	0.01%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	PM10	1.2778	3.0592	2%	30%	30.07%	0.004372	0.07804	9.53%	2.34%	0.27%	0.06%
1A3ai(i)	International aviation LTO (civil)	PM10	0.0003	0.0005	2%	30%	30.07%	0.000000	0.000001	0.00%	0.00%	0.00%	0.00%
1A3aii(i)	Domestic aviation LTO (civil)	PM10	0.0000	0.0000	2%	20%	20.10%	0.000000	0.000000	0.00%	0.00%	0.00%	0.00%
1A3bi	Road transport: Passenger cars	PM10	0.1105	0.1431	2%	20%	20.10%	0.000004	0.00297	0.45%	0.06%	0.01%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A3bii	Road transport: Light duty vehicles	PM10	0.2041	0.0329	2%	20%	20.10%	0.000000	-0.00173	0.10%	-0.03%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	PM10	0.2952	0.0555	2%	20%	20.10%	0.000001	-0.00226	0.17%	-0.05%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	PM10	0.0003	0.0010	2%	20%	20.10%	0.000000	0.00003	0.00%	0.00%	0.00%	0.00%
1A3bvi	Road transport: Automobile tyre and brake wear	PM10	0.1167	0.1908	2%	20%	20.10%	0.000008	0.00437	0.59%	0.09%	0.02%	0.00%
1A3bvii	Road transport: Automobile road abrasion	PM10	0.0681	0.1000	2%	20%	20.10%	0.000002	0.00220	0.31%	0.04%	0.01%	0.00%
1A3c	Railways	PM10	0.0626	0.0225	2%	20%	20.10%	0.000000	-0.00015	0.07%	0.00%	0.00%	0.00%
1A3dii	National navigation (shipping)	PM10	0.0322	0.0301	2%	20%	20.10%	0.000000	0.00050	0.09%	0.01%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	PM10	0.4502	0.2905	2%	20%	20.10%	0.000018	0.00297	0.91%	0.06%	0.03%	0.00%
1A4aii	Commercial/institutional: Mobile	PM10	0.0136	0.0320	2%	50%	50.04%	0.000001	0.00081	0.10%	0.04%	0.00%	0.00%
1A4bi	Residential: Stationary, liquid fuels	PM10	0.0008	0.0001	3%	20%	20.22%	0.000000	-0.00001	0.00%	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	PM10	0.4023	0.0301	2%	20%	20.10%	0.000000	-0.00450	0.09%	-0.09%	0.00%	0.00%
1A4bi	Residential: Stationary, gaseous fuels	PM10	0.0031	0.0039	2%	20%	20.10%	0.000000	0.00008	0.01%	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	PM10	3.0557	1.9448	5%	20%	20.62%	0.000831	0.01930	6.06%	0.39%	0.43%	0.00%
1A4bi	Residential: Stationary, waste	PM10	0.5088	0.4288	50%	50%	70.71%	0.000475	0.00649	1.34%	0.32%	0.95%	0.01%
1A4bii	Residential: Household and gardening (mobile)	PM10	0.0092	0.0106	2%	50%	50.04%	0.000000	0.00021	0.03%	0.01%	0.00%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	PM10	0.1601	0.2664	2%	20%	20.10%	0.000015	0.00614	0.83%	0.12%	0.02%	0.00%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	PM10	0.0499	0.1317	2%	50%	50.04%	0.000022	0.00343	0.41%	0.17%	0.01%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	PM10	0.0000	0.0019	2%	50%	50.04%	0.000000	0.00006	0.01%	0.00%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	PM10	0.0000	0.0015	2%	100%	100.02%	0.000000	0.00005	0.00%	0.00%	0.00%	0.00%
1B1c	Other fugitive emissions from solid fuels	PM10	0.0500	0.0591	2%	100%	100.02%	0.000018	0.00117	0.18%	0.12%	0.01%	0.00%
1B2aiv	Fugitive emissions oil: Refining / storage	PM10	0.0000	0.0167	2%	100%	100.02%	0.000001	0.00052	0.05%	0.05%	0.00%	0.00%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	PM10	0.0000	0.0001	2%	100%	100.02%	0.000000	0.00000	0.00%	0.00%	0.00%	0.00%
2A1	Cement production	PM10	0.0135	0.0076	2%	100%	100.02%	0.000000	0.00005	0.02%	0.01%	0.00%	0.00%
2A2	Lime production	PM10	0.0000	0.0009	2%	100%	100.02%	0.000000	0.00003	0.00%	0.00%	0.00%	0.00%
2A5a	Quarrying and mining of minerals other than coal	PM10	0.0000	0.0313	2%	100%	100.02%	0.000005	0.00097	0.10%	0.10%	0.00%	0.00%
2A5b	Construction and demolition	PM10	0.4956	1.2016	5%	100%	100.12%	0.007479	0.03075	3.74%	3.07%	0.26%	0.10%
2A6	Other mineral products	PM10	0.2129	0.0091	2%	100%	100.02%	0.000000	-0.00259	0.03%	-0.26%	0.00%	0.00%
2B10a	Chemical industry: Other	PM10	0.1626	0.0012	2%	20%	20.10%	0.000000	-0.00216	0.00%	-0.04%	0.00%	0.00%
2B10b	Storage, handling and transport of chemical products	PM10	0.0000	0.0020	2%	20%	20.10%	0.000000	0.00006	0.01%	0.00%	0.00%	0.00%
2C1	Iron and steel production	PM10	0.0000	0.0996	2%	20%	20.10%	0.000002	0.00310	0.31%	0.06%	0.01%	0.00%
2C3	Aluminium production	PM10	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00%	0.00%	0.00%	0.00%
2C5	Lead production	PM10	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00%	0.00%	0.00%	0.00%
2C6	Zinc production	PM10	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00%	0.00%	0.00%	0.00%
2C7a	Copper production	PM10	0.0000	0.0000	2%	20%	20.10%	0.000000	0.00000	0.00%	0.00%	0.00%	0.00%
2C7c	Other metal production	PM10	0.0180	0.0011	2%	20%	20.10%	0.000000	-0.00021	0.00%	0.00%	0.00%	0.00%
2D3b	Road paving with asphalt	PM10	0.0133	0.0330	2%	100%	100.02%	0.000006	0.00085	0.10%	0.08%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
2D3d	Coating applications	PM10	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00%	0.00%	0.00%	0.00%
2D3i	Other solvent use (please specify in the IIR)	PM10	0.0000	0.0001	5%	50%	50.25%	0.000000	0.00000	0.00%	0.00%	0.00%	0.00%
2G	Other product use (please specify in the IIR)	PM10	0.0595	0.0960	5%	50%	50.25%	0.000012	0.00219	0.30%	0.11%	0.02%	0.00%
2H1	Pulp and paper industry	PM10	0.1120	0.0356	2%	100%	100.02%	0.000007	-0.00040	0.11%	-0.04%	0.00%	0.00%
2H2	Food and beverages industry	PM10	0.0033	0.0164	2%	100%	100.02%	0.000001	0.00047	0.05%	0.05%	0.00%	0.00%
2I	Wood processing	PM10	0.0000	0.0723	2%	100%	100.02%	0.000027	0.00225	0.23%	0.23%	0.01%	0.00%
2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	PM10	0.0000	0.0246	2%	100%	100.02%	0.000003	0.00077	0.08%	0.08%	0.00%	0.00%
3B1a	Manure management - Dairy cattle	PM10	0.0825	0.0544	2%	100%	100.02%	0.000015	0.00058	0.17%	0.06%	0.00%	0.00%
3B1b	Manure management - Non-dairy cattle	PM10	0.0262	0.0289	2%	100%	100.02%	0.000004	0.00055	0.09%	0.05%	0.00%	0.00%
3B2	Manure management - Sheep	PM10	0.0020	0.0049	2%	100%	100.02%	0.000000	0.00012	0.02%	0.01%	0.00%	0.00%
3B3	Manure management - Swine	PM10	0.0359	0.0324	2%	100%	100.02%	0.000005	0.00052	0.10%	0.05%	0.00%	0.00%
3B4d	Manure management - Goats	PM10	0.0001	0.0001	2%	100%	100.02%	0.000000	0.00000	0.00%	0.00%	0.00%	0.00%
3B4e	Manure management - Horses	PM10	0.0009	0.0013	2%	100%	100.02%	0.000000	0.00003	0.00%	0.00%	0.00%	0.00%
3B4gi	Manure mangement - Laying hens	PM10	0.0289	0.0328	2%	100%	100.02%	0.000006	0.00063	0.10%	0.06%	0.00%	0.00%
3B4gii	Manure mangement - Broilers	PM10	0.0123	0.0291	2%	100%	100.02%	0.000004	0.00074	0.09%	0.07%	0.00%	0.00%
3B4giv	Manure management - Other poultry	PM10	0.0439	0.0687	2%	100%	100.02%	0.000024	0.00155	0.21%	0.15%	0.01%	0.00%
3B4h	Manure management - Other animals (please specify in IIR)	PM10	0.0004	0.0004	2%	100%	100.02%	0.000000	0.00001	0.00%	0.00%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	PM10	0.7060	0.9137	2%	100%	100.02%	0.004316	0.01893	2.85%	1.89%	0.08%	0.04%
5A	Biological treatment of waste - Solid waste disposal on land	PM10	0.0001	0.0006	2%	100%	100.02%	0.000000	0.00002	0.00%	0.00%	0.00%	0.00%
5C1bi	Industrial waste incineration	PM10	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00%	0.00%	0.00%	0.00%
5C1bv	Cremation	PM10	0.0001	0.0003	2%	100%	100.02%	0.000000	0.00001	0.00%	0.00%	0.00%	0.00%
5C2	Open burning of waste	PM10	0.1563	0.0449	10%	100%	100.50%	0.000011	-0.00071	0.14%	-0.07%	0.02%	0.00%
5E	Other waste	PM10	0.1995	0.0553	2%	100%	100.02%	0.000016	-0.00097	0.17%	-0.10%	0.00%	0.00%
TOTAL			32.0871	13.9114				0.021142					0.00297
% uncertainty in total inventory								14.54%	Trend uncertainty:		5.45%		

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	TSP	172.7961	4.5609	2%	20%	20.10%	0.002166	-0.02718	0.01634	-0.54%	0.05%	0.00%
1A1c	Manufacture of solid fuels and other energy industries	TSP	0.4900	0.3594	2%	20%	20.10%	0.000013	0.00116	0.00072	0.02%	0.00%	0.00%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	TSP	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	TSP	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	TSP	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	TSP	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	TSP	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	TSP	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2gvii	Mobile Combustion in manufacturing industries and construction	TSP	0.3418	0.0701	2%	50%	50.04%	0.000003	0.00016	0.00025	0.01%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	TSP	89.7911	3.4584	2%	20%	20.10%	0.001246	-0.01028	0.01239	-0.21%	0.04%	0.00%
1A3ai(i)	International aviation LTO (civil)	TSP	0.0004	0.0005	2%	30%	30.07%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A3aii(i)	Domestic aviation LTO (civil)	TSP	0.0000	0.0000	2%	30%	30.07%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A3bi	Road transport: Passenger cars	TSP	0.1306	0.1431	2%	20%	20.10%	0.000002	0.00048	0.00051	0.01%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A3bii	Road transport: Light duty vehicles	TSP	0.1413	0.0329	2%	20%	20.10%	0.000000	0.00008	0.00012	0.00%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	TSP	0.2724	0.0555	2%	20%	20.10%	0.000000	0.00013	0.00020	0.00%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	TSP	0.0063	0.0010	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A3bvi	Road transport: Automobile tyre and brake wear	TSP	0.2345	0.2522	2%	20%	20.10%	0.000007	0.00084	0.00090	0.02%	0.00%	0.00%
1A3bvii	Road transport: Automobile road abrasion	TSP	0.2155	0.2000	2%	20%	20.10%	0.000004	0.00066	0.00072	0.01%	0.00%	0.00%
1A3c	Railways	TSP	0.0847	0.0237	2%	20%	20.10%	0.000000	0.00006	0.00008	0.00%	0.00%	0.00%
1A3dii	National navigation (shipping)	TSP	0.0322	0.0301	2%	20%	20.10%	0.000000	0.00010	0.00011	0.00%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	TSP	0.6502	0.3274	2%	20%	20.10%	0.000011	0.00101	0.00117	0.02%	0.00%	0.00%
1A4aii	Commercial/institutional: Mobile	TSP	0.0328	0.0320	2%	50%	50.04%	0.000001	0.00011	0.00011	0.01%	0.00%	0.00%
1A4bi	Residential: Stationary, liquid fuels	TSP	0.0033	0.0001	3%	20%	20.22%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	TSP	1.3580	0.0326	2%	20%	20.10%	0.000000	-0.00023	0.00012	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, gaseous fuels	TSP	0.0037	0.0039	2%	20%	20.10%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	TSP	1.5239	2.1076	5%	20%	20.62%	0.000487	0.00717	0.00755	0.14%	0.05%	0.00%
1A4bi	Residential: Stationary, waste	TSP	0.3752	0.4717	50%	50%	70.71%	0.000287	0.00160	0.00169	0.08%	0.12%	0.00%
1A4bii	Residential: Household and gardening (mobile)	TSP	0.0018	0.0106	2%	50%	50.04%	0.000000	0.00004	0.00004	0.00%	0.00%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	TSP	0.7400	0.3552	2%	20%	20.10%	0.000013	0.00109	0.00127	0.02%	0.00%	0.00%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	TSP	0.2391	0.1317	2%	50%	50.04%	0.000011	0.00041	0.00047	0.02%	0.00%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	TSP	0.0000	0.0019	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%

A		B	C	D	E	F	G	H	I	J	K	L	M
NFR sector		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	TSP	0.0000	0.0035	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
1B1c	Other fugitive emissions from solid fuels	TSP	0.0000	0.1207	2%	100%	100.02%	0.000038	0.00043	0.00043	0.04%	0.00%	0.00%
1B2aiv	Fugitive emissions oil: Refining / storage	TSP	0.0000	0.0269	2%	100%	100.02%	0.000002	0.00010	0.00010	0.01%	0.00%	0.00%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	TSP	0.0000	0.0002	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2A1	Cement production	TSP	0.0000	0.0094	2%	100%	100.02%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
2A2	Lime production	TSP	0.0000	0.0023	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2A5a	Quarrying and mining of minerals other than coal	TSP	0.0000	0.1245	2%	100%	100.02%	0.000040	0.00045	0.00045	0.04%	0.00%	0.00%
2A5b	Construction and demolition	TSP	4.9751	3.9696	5%	100%	100.12%	0.040724	0.01296	0.01422	1.30%	0.10%	0.02%
2A6	Other mineral products	TSP	0.0000	0.0287	2%	100%	100.02%	0.000002	0.00010	0.00010	0.01%	0.00%	0.00%
2B10a	Chemical industry: Other	TSP	0.9400	0.0037	2%	20%	20.10%	0.000000	-0.00022	0.00001	0.00%	0.00%	0.00%
2B10b	Storage, handling and transport of chemical products	TSP	0.0000	0.0044	2%	20%	20.10%	0.000000	0.00002	0.00002	0.00%	0.00%	0.00%
2C1	Iron and steel production	TSP	0.0000	0.2627	2%	20%	20.10%	0.000007	0.00094	0.00094	0.02%	0.00%	0.00%
2C3	Aluminium production	TSP	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2C5	Lead production	TSP	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2C6	Zinc production	TSP	0.0000	0.0001	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2C7a	Copper production	TSP	0.0000	0.0000	2%	20%	20.10%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2C7c	Other metal production	TSP	0.0000	0.0018	2%	20%	20.10%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2D3b	Road paving with asphalt	TSP	0.2567	0.2477	2%	100%	100.02%	0.000158	0.00082	0.00089	0.08%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
2D3d	Coating applications	TSP	0.0000	0.0007	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2D3e	Degreasing	TSP	0.0000	0.0000	10%	100%	100.50%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2D3g	Chemical products	TSP	0.0000	0.0032	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2D3h	Printing	TSP	0.0000	0.0010	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2D3i	Other solvent use	TSP	0.0000	0.0102	5%	100%	100.12%	0.000000	0.00004	0.00004	0.00%	0.00%	0.00%
2G	Other product use (please specify in the IIR)	TSP	0.1127	0.1006	5%	50%	50.25%	0.000007	0.00033	0.00036	0.02%	0.00%	0.00%
2H1	Pulp and paper industry	TSP	0.0000	0.0445	2%	100%	100.02%	0.000005	0.00016	0.00016	0.02%	0.00%	0.00%
2H2	Food and beverages industry	TSP	0.0000	0.0497	2%	100%	100.02%	0.000006	0.00018	0.00018	0.02%	0.00%	0.00%
2I	Wood processing	TSP	0.0000	0.2205	2%	100%	100.02%	0.000125	0.00079	0.00079	0.08%	0.00%	0.00%
2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	TSP	0.0000	0.0695	2%	100%	100.02%	0.000012	0.00025	0.00025	0.02%	0.00%	0.00%
3B1a	Manure management - Dairy cattle	TSP	0.3874	0.1192	2%	100%	100.02%	0.000037	0.00033	0.00043	0.03%	0.00%	0.00%
3B1b	Manure management - Non-dairy cattle	TSP	0.2185	0.0625	2%	100%	100.02%	0.000010	0.00017	0.00022	0.02%	0.00%	0.00%
3B2	Manure management - Sheep	TSP	0.0222	0.0113	2%	100%	100.02%	0.000000	0.00003	0.00004	0.00%	0.00%	0.00%
3B3	Manure management - Swine	TSP	0.6647	0.2154	2%	100%	100.02%	0.000120	0.00060	0.00077	0.06%	0.00%	0.00%
3B4d	Manure management - Goats	TSP	0.0003	0.0007	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
3B4e	Manure management - Horses	TSP	0.0041	0.0027	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
3B4gi	Manure mangement - Laying hens	TSP	0.4226	0.1557	2%	100%	100.02%	0.000063	0.00045	0.00056	0.05%	0.00%	0.00%
3B4gii	Manure mangement - Broilers	TSP	0.0781	0.0581	2%	100%	100.02%	0.000009	0.00019	0.00021	0.02%	0.00%	0.00%
3B4giv	Manure management - Other poultry	TSP	0.1763	0.0687	2%	100%	100.02%	0.000012	0.00020	0.00025	0.02%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
3B4h	Manure management - Other animals (please specify in IIR)	TSP	0.0042	0.0009	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	TSP	1.2313	0.9137	2%	100%	100.02%	0.002153	0.00296	0.00327	0.30%	0.01%	0.00%
5A	Farm-level agricultural operations including storage, handling and transport of agricultural products	TSP	0.0004	0.0015	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
5B2	Biological treatment of waste - Solid waste disposal on land	TSP	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C1bi	Industrial waste incineration	TSP	0.0000	0.0001	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C1bv	Cremation	TSP	0.0000	0.0003	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C2	Open burning of waste	TSP	0.1399	0.0600	10%	100%	100.50%	0.000009	0.00018	0.00021	0.02%	0.00%	0.00%
5E	Other waste	TSP	0.0000	0.0553	2%	100%	100.02%	0.000008	0.00020	0.00020	0.02%	0.00%	0.00%
TOTAL			279.0990	19.6953				0.047800					0.0002
					% uncertainty in total inventory			21.86%			Trend uncertainty:		1.48%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	CO	11.5300	6.1752	2%	20%	20.10%	0.000081	-0.00240	0.02611	-0.05%	0.07%	0.00%
1A1c	Manufacture of solid fuels and other energy industries	CO	6.4900	31.1958	2%	20%	20.10%	0.002056	0.11584	0.13192	2.32%	0.37%	0.06%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	CO	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	CO	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	CO	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	CO	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	CO	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	CO	IE	IE	2%	20%	20.10%	IE	IE	IE	IE	IE	IE
1A2gvii	Mobile Combustion in manufacturing industries and construction	CO	6.3676	3.4374	2%	50%	50.04%	0.000155	-0.00121	0.01454	-0.06%	0.04%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	CO	6.1800	9.4365	2%	20%	20.10%	0.000188	0.02462	0.03991	0.49%	0.11%	0.00%
1A3ai(i)	International aviation LTO (civil)	CO	0.0907	0.1572	2%	30%	30.07%	0.000000	0.00044	0.00066	0.01%	0.00%	0.00%
1A3aii(i)	Domestic aviation LTO (civil)	CO	0.0296	0.0388	2%	30%	30.07%	0.000000	0.00009	0.00016	0.00%	0.00%	0.00%
1A3bi	Road transport: Passenger cars	CO	100.9409	9.7644	2%	20%	20.10%	0.000201	-0.20746	0.04129	-4.15%	0.12%	0.17%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A3bii	Road transport: Light duty vehicles	CO	8.9237	0.6035	2%	20%	20.10%	0.000001	-0.01951	0.00255	-0.39%	0.01%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	CO	4.0972	0.8419	2%	20%	20.10%	0.000001	-0.00657	0.00356	-0.13%	0.01%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	CO	6.4007	0.5605	2%	20%	20.10%	0.000001	-0.01346	0.00237	-0.27%	0.01%	0.00%
1A3c	Railways	CO	0.6030	0.1670	2%	100%	100.02%	0.000001	-0.00079	0.00071	-0.08%	0.00%	0.00%
1A3dii	National navigation (shipping)	CO	0.1386	0.1296	2%	100%	100.02%	0.000001	0.00021	0.00055	0.02%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	CO	0.7000	0.9192	2%	20%	20.10%	0.000002	0.00216	0.00389	0.04%	0.01%	0.00%
1A4aii	Commercial/institutional: Mobile	CO	1.3709	0.6683	2%	50%	50.04%	0.000006	-0.00056	0.00283	-0.03%	0.01%	0.00%
1A4bi	Residential: Stationary, liquid fuels	CO	0.0082	0.0003	3%	20%	20.22%	0.000000	-0.00002	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	CO	17.3189	0.3742	2%	20%	20.10%	0.000000	-0.04122	0.00158	-0.82%	0.00%	0.01%
1A4bi	Residential: Stationary, gaseous fuels	CO	0.0596	0.0634	2%	20%	20.10%	0.000000	0.00012	0.00027	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	CO	42.7493	67.0925	5%	20%	20.62%	0.010004	0.17769	0.28373	3.55%	2.01%	0.17%
1A4bi	Residential: Stationary, waste	CO	0.8982	1.1292	50%	20%	53.85%	0.000019	0.00255	0.00478	0.05%	0.34%	0.00%
1A4bii	Residential: Household and gardening (mobile)	CO	0.5848	2.6594	2%	50%	50.04%	0.000093	0.00980	0.01125	0.49%	0.03%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	CO	0.5100	0.5634	2%	20%	20.10%	0.000001	0.00112	0.00238	0.02%	0.01%	0.00%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	CO	19.8995	1.5589	2%	50%	50.04%	0.000032	-0.04258	0.00659	-2.13%	0.02%	0.05%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	CO	0.0000	0.0094	2%	50%	50.04%	0.000000	0.00004	0.00004	0.00%	0.00%	0.00%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	CO	0.0000	0.0004	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1B1c	Other fugitive emissions from solid fuels	CO	0.0000	0.1662	2%	100%	100.02%	0.000001	0.00070	0.00070	0.07%	0.00%	0.00%
1B2aiv	Fugitive emissions oil: Refining / storage	CO	0.0000	0.0043	2%	100%	100.02%	0.000000	0.00002	0.00002	0.00%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	CO	0.0000	0.0002	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2A5a	Quarrying and mining of minerals other than coal	CO	0.0000	0.0064	2%	100%	100.02%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
2A6	Other mineral products (please specify in the IIR)	CO	0.0000	0.0020	2%	100%	100.02%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2B10a	Chemical industry: Other	CO	0.3400	0.4204	2%	50%	50.04%	0.000002	0.00094	0.00178	0.05%	0.01%	0.00%
2C1	Iron and steel production	CO	0.0000	0.0101	2%	50%	50.04%	0.000000	0.00004	0.00004	0.00%	0.00%	0.00%
2C7c	Other metal production	CO	0.0000	0.0006	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2D3d	Coating applications	CO	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2D3g	Chemical products	CO	0.0000	0.0030	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2G	Other product use	CO	0.2295	0.1036	5%	50%	50.25%	0.000000	-0.00013	0.00044	-0.01%	0.00%	0.00%
2H1	Pulp and paper industry	CO	0.0000	0.0017	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
2H2	Food and beverages industry	CO	0.0000	0.0095	2%	50%	50.04%	0.000000	0.00004	0.00004	0.00%	0.00%	0.00%
2I	Wood processing	CO	0.0000	0.0001	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	CO	0.0000	0.0068	2%	50%	50.04%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
5C1bi	Industrial waste incineration	CO	0.0000	0.0011	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C1bv	Cremation	CO	0.0000	0.0011	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C2	Open burning of waste	CO	0.0054	0.0023	10%	50%	50.99%	0.000000	0.00000	0.00001	0.00%	0.00%	0.00%
TOTAL			236.4662	138.2858				0.012847					0.0045
% uncertainty in total inventory								11.33%			Trend uncertainty:		6.74%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	Pb	63.1201	31.7036	2%	200%	200.01%	3.462262	0.10303	0.15430	20.61%	0.44%	4.25%
1A1c	Manufacture of solid fuels and other energy industries	Pb	0.0220	0.0028	2%	200%	200.01%	0.000000	0.00000	0.00001	0.00%	0.00%	0.00%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Pb	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Pb	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	Pb	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	Pb	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Pb	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Pb	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2gvii	Mobiilsed põletusseadmed töötlevas tööstuses ja ehituses (vajalik täpsustada inventuuris)	Pb	0.9000	0.0201	2%	50%	50.04%	0.000000	-0.00063	0.00010	-0.03%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	Pb	62.4600	0.7521	2%	100%	100.02%	0.000487	-0.04662	0.00366	-4.66%	0.01%	0.22%
1A3bi	Road transport: Passenger cars	Pb	49.3978	0.0005	2%	20%	20.10%	0.000000	-0.03978	0.00000	-0.80%	0.00%	0.01%
1A3bii	Road transport: Light duty vehicles	Pb	4.4025	0.0001	2%	20%	20.10%	0.000000	-0.00355	0.00000	-0.07%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A3biii	Road transport: Heavy duty vehicles and buses	Pb	17.4123	0.0001	2%	20%	20.10%	0.000000	-0.01404	0.000000	-0.28%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	Pb	1.7592	0.0000	2%	20%	20.10%	0.000000	-0.00142	0.000000	-0.03%	0.00%	0.00%
1A3bvi	Road transport: Automobile tyre and brake wear	Pb	0.2598	0.2570	2%	30%	30.07%	0.000005	0.00104	0.00125	0.03%	0.00%	0.00%
1A3c	Railways	Pb	0.0159	0.0000	2%	50%	50.04%	0.000000	-0.00001	0.000000	0.00%	0.00%	0.00%
1A3dii	National navigation (shipping)	Pb	0.0009	0.0009	2%	50%	50.04%	0.000000	0.000000	0.000000	0.00%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	Pb	0.1400	0.0688	2%	100%	100.02%	0.000004	0.00022	0.00033	0.02%	0.00%	0.00%
1A4aii	Commercial/institutional: Mobile	Pb	0.3000	0.0042	2%	50%	50.04%	0.000000	-0.00022	0.00002	-0.01%	0.00%	0.00%
1A4bi	Residential: Stationary, liquid fuels	Pb	0.0000	0.0000	3%	100%	100.04%	0.000000	0.000000	0.000000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	Pb	0.4343	0.0134	2%	100%	100.02%	0.000000	-0.00029	0.00007	-0.03%	0.00%	0.00%
1A4bi	Residential: Stationary, gaseous fuels	Pb	0.0000	0.0000	2%	100%	100.02%	0.000000	0.000000	0.000000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	Pb	0.1443	0.4413	5%	100%	100.12%	0.000168	0.00203	0.00215	0.20%	0.02%	0.00%
1A4bii	Residential: Household and gardening (mobile)	Pb	0.1260	0.0191	2%	50%	50.04%	0.000000	-0.00001	0.00009	0.00%	0.00%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	Pb	0.1800	0.0801	2%	100%	100.02%	0.000006	0.00024	0.00039	0.02%	0.00%	0.00%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Pb	3.6000	0.0050	2%	50%	50.04%	0.000000	-0.00288	0.00002	-0.14%	0.00%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	Pb	0.0000	0.0002	2%	50%	50.04%	0.000000	0.000000	0.000000	0.00%	0.00%	0.00%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	Pb	0.0000	0.0000	2%	50%	50.04%	0.000000	0.000000	0.000000	0.00%	0.00%	0.00%
2C1	Iron and steel production	Pb	0.0000	0.0003	2%	50%	50.04%	0.000000	0.000000	0.000000	0.00%	0.00%	0.00%
2C5	Lead production	Pb	0.0000	0.0000	2%	50%	50.04%	0.000000	0.000000	0.000000	0.00%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
2C7c	Other metal production	Pb	0.0000	0.0001	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2D3e	Degreasing	Pb	0.0000	0.0001	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2G	Other product use	Pb	0.0020	0.3676	5%	50%	50.25%	0.000029	0.00179	0.00179	0.09%	0.01%	0.00%
5C1bv	Cremation	Pb	0.0000	0.0002	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C2	Open burning of waste	Pb	0.7949	0.3407	10%	100%	100.50%	0.000101	0.00102	0.00166	0.10%	0.02%	0.00%
5E	Other waste	Pb	0.0000	0.0002	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
TOTAL			205.4718	34.0785				3.463063					0.0447
					% uncertainty in total inventory			186.09%			Trend uncertainty:		21.15%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	Cd	1.1300	0.5340	2%	200%	200.01%	1.766461	0.07362	0.11856	14.72%	0.34%	2.17%
1A1c	Manufacture of solid fuels and other energy industries	Cd	0.0010	0.0000	2%	200%	200.01%	0.000000	-0.00004	0.00000	-0.01%	0.00%	0.00%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Cd	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	Cd	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Cd	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Cd	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2gvii	Mobiilsed põletusseadmed töötlevas tööstuses ja ehituses (vajalik täpsustada inventuuris)	Cd	0.0017	0.0004	2%	50%	50.04%	0.000000	0.00002	0.00008	0.00%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	Cd	3.2300	0.0212	2%	100%	100.02%	0.000699	-0.12236	0.00471	-12.24%	0.01%	1.50%
1A3bi	Road transport: Passenger cars	Cd	0.0038	0.0053	2%	20%	20.10%	0.000002	0.00102	0.00117	0.02%	0.00%	0.00%
1A3bii	Road transport: Light duty vehicles	Cd	0.0005	0.0007	2%	20%	20.10%	0.000000	0.00014	0.00016	0.00%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	Cd	0.0012	0.0006	2%	20%	20.10%	0.000000	0.00009	0.00014	0.00%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	Cd	0.0001	0.0001	2%	20%	20.10%	0.000000	0.00002	0.00002	0.00%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A3bvi	Road transport: Automobile tyre and brake wear	Cd	0.0012	0.0012	2%	30%	30.07%	0.000000	0.00022	0.00027	0.01%	0.00%	0.00%
1A3c	Railways	Cd	0.0007	0.0002	2%	50%	50.04%	0.000000	0.00001	0.00003	0.00%	0.00%	0.00%
1A3dii	National navigation (shipping)	Cd	0.0001	0.0001	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	Cd	0.0000	0.0017	2%	100%	100.02%	0.000005	0.00039	0.00039	0.04%	0.00%	0.00%
1A4aii	Commercial/institutional: Mobile	Cd	0.0001	0.0001	2%	50%	50.04%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, liquid fuels	Cd	0.0000	0.0000	3%	100%	100.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	Cd	0.0045	0.0002	2%	100%	100.02%	0.000000	-0.00014	0.00003	-0.01%	0.00%	0.00%
1A4bi	Residential: Stationary, gaseous fuels	Cd	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	Cd	0.0695	0.2125	5%	100%	100.12%	0.070091	0.04442	0.04718	4.44%	0.33%	0.20%
1A4bii	Residential: Household and gardening (mobile)	Cd	0.0000	0.0001	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	Cd	0.0100	0.0026	2%	100%	100.02%	0.000010	0.00017	0.00057	0.02%	0.00%	0.00%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Cd	0.0015	0.0007	2%	50%	50.04%	0.000000	0.00010	0.00015	0.00%	0.00%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	Cd	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2G	Other product use	Cd	0.0225	0.0105	5%	50%	50.25%	0.000043	0.00144	0.00234	0.07%	0.02%	0.00%
5C1bv	Cremation	Cd	0.0000	0.0000	2%	50%	50.04%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
5C2	Open burning of waste	Cd	0.0260	0.0111	10%	100%	100.50%	0.000194	0.00144	0.00247	0.14%	0.03%	0.00%
5E	Other waste	Cd	0.0000	0.0003	2%	100%	100.02%	0.000000	0.00007	0.00007	0.01%	0.00%	0.00%
TOTAL			4.5041	0.8036				1.837505					0.0386
% uncertainty in total inventory								135.55%			Trend uncertainty:		19.66%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	Hg	1.0136	0.5314	2%	200%	200.01%	3.276183	0.01642	0.45722	3.28%	1.29%	0.12%
1A1c	Manufacture of solid fuels and other energy industries	Hg	0.0010	0.0000	2%	200%	200.01%	0.000000	-0.00042	0.00002	-0.08%	0.00%	0.00%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Hg	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Hg	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Hg	IE	IE	2%	100%	100.02%	IE	IE	IE	IE	IE	IE
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	Hg	0.0802	0.0061	2%	100%	100.02%	0.000106	-0.02965	0.00521	-2.97%	0.01%	0.09%
1A3bi	Road transport: Passenger cars	Hg	0.0030	0.0034	2%	20%	20.10%	0.000001	0.00159	0.00289	0.03%	0.01%	0.00%
1A3bii	Road transport: Light duty vehicles	Hg	0.0004	0.0005	2%	20%	20.10%	0.000000	0.00023	0.00040	0.00%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	Hg	0.0019	0.0009	2%	20%	20.10%	0.000000	-0.00003	0.00081	0.00%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	Hg	0.0001	0.0000	2%	20%	20.10%	0.000000	-0.00003	0.00002	0.00%	0.00%	0.00%
1A3bvi	Road transport: Automobile tyre and brake wear	Hg	0.0000	0.0000	2%	30%	30.07%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A3c	Railways	Hg	0.0009	0.0000	2%	50%	50.04%	0.000000	-0.00041	0.00000	-0.02%	0.00%	0.00%
1A3dii	National navigation (shipping)	Hg	0.0002	0.0002	2%	50%	50.04%	0.000000	0.00008	0.00017	0.00%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	Hg	0.0000	0.0006	2%	100%	100.02%	0.000001	0.00046	0.00047	0.05%	0.00%	0.00%
1A4bi	Residential: Stationary, liquid fuels	Hg	0.0003	0.0000	3%	100%	100.04%	0.000000	-0.00011	0.00001	-0.01%	0.00%	0.00%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A4bi	Residential: Stationary, solid fuels	Hg	0.0158	0.0005	2%	100%	100.02%	0.000001	-0.00640	0.00047	-0.64%	0.00%	0.00%
1A4bi	Residential: Stationary, gaseous fuels	Hg	0.0002	0.0002	2%	100%	100.02%	0.000000	0.00010	0.00019	0.01%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	Hg	0.0030	0.0092	5%	100%	100.12%	0.000244	0.00658	0.00788	0.66%	0.06%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	Hg	0.0000	0.0004	2%	100%	100.02%	0.000000	0.00035	0.00035	0.03%	0.00%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	Hg	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00003	0.00003	0.00%	0.00%	0.00%
2D3a	Domestic solvent use including fungicides	Hg	0.0088	0.0074	2%	20%	20.10%	0.000006	0.00252	0.00634	0.05%	0.02%	0.00%
2G	Other product use	Hg	0.0112	0.0049	5%	50%	50.25%	0.000018	-0.00064	0.00425	-0.03%	0.03%	0.00%
5C1bv	Cremation	Hg	0.0000	0.0120	2%	50%	50.04%	0.000105	0.01034	0.01034	0.52%	0.03%	0.00%
5C2	Open burning of waste	Hg	0.0214	0.0092	10%	100%	100.50%	0.000247	-0.00141	0.00789	-0.14%	0.11%	0.00%
5E	Other waste	Hg	0.0000	0.0003	2%	100%	100.02%	0.000000	0.00028	0.00028	0.03%	0.00%	0.00%
TOTAL			1.1621	0.5872				3.276912					0.0022
					% uncertainty in total inventory			181.02%			Trend uncertainty:		4.73%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	PCDD/PCDF	2.3300	0.9829	2%	250%	250.01%	0.324132	-0.03136	0.12102	-7.84%	0.34%	0.62%
1A1c	Manufacture of solid fuels and other energy industries	PCDD/PCDF	0.0000	0.0213	2%	250%	250.01%	0.000152	0.00262	0.00262	0.66%	0.01%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	PCDD/PCDF	1.4400	0.5200	2%	250%	250.01%	0.090709	-0.03015	0.06402	-7.54%	0.18%	0.57%
1A3bi	Road transport: Passenger cars	PCDD/PCDF	0.1883	0.2123	2%	250%	250.01%	0.015118	0.01381	0.02614	3.45%	0.07%	0.12%
1A3bii	Road transport: Light duty vehicles	PCDD/PCDF	0.0310	0.0299	2%	250%	250.01%	0.000301	0.00166	0.00369	0.41%	0.01%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	PCDD/PCDF	0.0994	0.0359	2%	250%	250.01%	0.000432	-0.00209	0.00442	-0.52%	0.01%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	PCDD/PCDF	0.0100	0.0013	2%	250%	250.01%	0.000001	-0.00049	0.00016	-0.12%	0.00%	0.00%
1A3c	Railways	PCDD/PCDF	0.0242	0.0000	2%	250%	250.01%	0.000000	-0.00158	0.00000	-0.40%	0.00%	0.00%
1A3dii	National navigation (shipping)	PCDD/PCDF	0.0009	0.0009	2%	250%	250.01%	0.000000	0.00005	0.00010	0.01%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	PCDD/PCDF	0.0200	0.0435	2%	250%	250.01%	0.000635	0.00405	0.00536	1.01%	0.02%	0.01%
1A4bi	Residential: Stationary, liquid fuels	PCDD/PCDF	0.0040	0.0002	3%	250%	250.02%	0.000000	-0.00024	0.00002	-0.06%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	PCDD/PCDF	2.4316	0.0617	2%	250%	250.01%	0.001277	-0.15107	0.00760	-37.77%	0.02%	14.26%
1A4bi	Residential: Stationary, gaseous fuels	PCDD/PCDF	0.0032	0.0034	2%	250%	250.01%	0.000004	0.00021	0.00042	0.05%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	PCDD/PCDF	0.6717	0.7585	5%	100%	100.12%	0.030962	0.04940	0.09340	4.94%	0.66%	0.25%
1A4bi	Residential: Stationary, waste	PCDD/PCDF	0.0177	0.0223	50%	100%	111.80%	0.000033	0.00158	0.00274	0.16%	0.19%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	PCDD/PCDF	0.0200	0.0157	2%	250%	250.01%	0.000083	0.00063	0.00193	0.16%	0.01%	0.00%

A		B	C	D	E	F	G	H	I	J	K	L	M
NFR sector		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A4cii	Agriculture/Forestry/Fishing: National fishing	PCDD/PCDF	0.0000	0.0002	2%	250%	250.01%	0.000000	0.00002	0.00002	0.01%	0.00%	0.00%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	PCDD/PCDF	0.0000	0.0000	2%	250%	250.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2G	Other product use	PCDD/PCDF	0.0004	0.0002	5%	250%	250.05%	0.000000	0.00000	0.00002	0.00%	0.00%	0.00%
5C1bi	Industrial waste incineration	PCDD/PCDF	0.0534	0.8022	2%	250%	250.01%	0.215938	0.09528	0.09878	23.82%	0.28%	5.68%
5C1biii	Clinical waste incineration	PCDD/PCDF	0.4700	0.1095	2%	250%	300.00%	0.005788	-0.01727	0.01348	-4.32%	0.04%	0.19%
5C1bv	Cremation	PCDD/PCDF	0.0000	0.0002	2%	250%	300.00%	0.000000	0.00003	0.00003	0.01%	0.00%	0.00%
5C2	Open burning of waste	PCDD/PCDF	0.3057	0.1311	10%	250%	250.20%	0.005771	-0.00387	0.01614	-0.97%	0.23%	0.01%
5E	Other waste	PCDD/PCDF	0.0000	0.5632	2%	250%	250.01%	0.106427	0.06935	0.06935	17.34%	0.20%	3.01%
TOTAL			8.1214	4.3161				0.797764					0.2472
% uncertainty in total inventory								89.32%	Trend uncertainty:				49.71%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	B(a)p	0.6200	0.9306	2%	200%	200.01%	0.689142	0.14473	0.39290	28.95%	1.11%	8.39%
1A1c	Manufacture of solid fuels and other energy industries	B(a)p	0.0000	0.0025	2%	200%	200.01%	0.000005	0.00104	0.00104	0.21%	0.00%	0.00%
1A2gvii	Mobile Combustion in manufacturing industries and construction	B(a)p	0.0051	0.0012	2%	200%	200.01%	0.000001	-0.00155	0.00049	-0.31%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	B(a)p	0.2262	0.4191	2%	200%	200.01%	0.139742	0.08646	0.17693	17.29%	0.50%	2.99%
1A3bi	Road transport: Passenger cars	B(a)p	0.0032	0.0082	2%	200%	200.01%	0.000054	0.00217	0.00346	0.43%	0.01%	0.00%
1A3bii	Road transport: Light duty vehicles	B(a)p	0.0007	0.0017	2%	200%	200.01%	0.000002	0.00044	0.00073	0.09%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	B(a)p	0.0014	0.0008	2%	200%	200.01%	0.000000	-0.00025	0.00032	-0.05%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	B(a)p	0.0002	0.0000	2%	200%	200.01%	0.000000	-0.00005	0.00001	-0.01%	0.00%	0.00%
1A3c	Railways	B(a)p	0.0068	0.0005	2%	200%	200.01%	0.000000	-0.00252	0.00020	-0.50%	0.00%	0.00%
1A3dii	National navigation (shipping)	B(a)p	0.0002	0.0002	2%	200%	200.01%	0.000000	0.00000	0.00008	0.00%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	B(a)p	0.0300	0.0610	2%	200%	200.01%	0.002960	0.01376	0.02575	2.75%	0.07%	0.08%
1A4aii	Commercial/institutional: Mobile	B(a)p	0.0004	0.0004	2%	200%	200.01%	0.000000	0.00001	0.00019	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, liquid fuels	B(a)p	0.0002	0.0000	3%	200%	200.02%	0.000000	-0.00007	0.00000	-0.01%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	B(a)p	0.6937	0.0201	2%	200%	200.01%	0.000321	-0.26798	0.00848	-53.60%	0.02%	28.73%
1A4bi	Residential: Stationary, gaseous fuels	B(a)p	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	B(a)p	0.7420	0.7691	5%	100%	100.12%	0.117941	0.02808	0.32469	2.81%	2.30%	0.13%
1A4bi	Residential: Stationary, waste	B(a)p	0.0034	0.0042	50%	100%	111.80%	0.000004	0.00044	0.00178	0.04%	0.13%	0.00%
1A4bii	Residential: Household and gardening (mobile)	B(a)p	0.0000	0.0002	2%	200%	200.01%	0.000000	0.00007	0.00008	0.01%	0.00%	0.00%

A		B	C	D	E	F	G	H	I	J	K	L	M	
NFR sector		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions	
			kt	kt									%	%
1A4ci	Agriculture/Forestry/Fishing: Stationary	B(a)p	0.0300	0.0202	2%	200%	200.01%	0.000324	-0.00347	0.00852	-0.69%	0.02%	0.00%	
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	B(a)p	0.0047	0.0021	2%	200%	200.01%	0.000004	-0.00097	0.00089	-0.19%	0.00%	0.00%	
1B2c	Venting and flaring (oil. gas. combined oil and gas)	B(a)p	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
2G	Other product use	B(a)p	0.0005	0.0002	5%	200%	200.06%	0.000000	-0.00010	0.00009	-0.02%	0.00%	0.00%	
5C1bv	Cremation	B(a)p	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%	
5C2	Open burning of waste	B(a)p	0.0000	0.0000	10%	200%	200.25%	0.000000	-0.00001	0.00001	0.00%	0.00%	0.00%	
TOTAL			2.3687	2.2422				0.950500						0.4033
% uncertainty in total inventory								97.49%			Trend uncertainty:	63.50%		

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	B(b)f	0.7400	1.2395	2%	200%	200.01%	0.896560	0.19400	0.45070	38.80%	1.27%	15.07%
1A1c	Manufacture of solid fuels and other energy industries	B(b)f	0.0000	0.0032	2%	200%	200.01%	0.000006	0.00118	0.00118	0.24%	0.00%	0.00%
1A2gvii	Mobile Combustion in manufacturing industries and construction	B(b)f	0.0083	0.0018	2%	200%	200.01%	0.000002	-0.00223	0.00066	-0.45%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	B(b)f	0.2766	0.5579	2%	200%	200.01%	0.181608	0.10699	0.20284	21.40%	0.57%	4.58%
1A3bi	Road transport: Passenger cars	B(b)f	0.0054	0.0093	2%	200%	200.01%	0.000050	0.00151	0.00337	0.30%	0.01%	0.00%
1A3bii	Road transport: Light duty vehicles	B(b)f	0.0009	0.0019	2%	200%	200.01%	0.000002	0.00038	0.00071	0.08%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	B(b)f	0.0086	0.0046	2%	200%	200.01%	0.000012	-0.00131	0.00166	-0.26%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	B(b)f	0.0003	0.0000	2%	200%	200.01%	0.000000	-0.00008	0.00001	-0.02%	0.00%	0.00%
1A3c	Railways	B(b)f	0.0093	0.0008	2%	200%	200.01%	0.000000	-0.00294	0.00028	-0.59%	0.00%	0.00%
1A3dii	National navigation (shipping)	B(b)f	0.0004	0.0003	2%	200%	200.01%	0.000000	0.00000	0.00012	0.00%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	B(b)f	0.0400	0.0811	2%	200%	200.01%	0.003834	0.01562	0.02947	3.12%	0.08%	0.10%
1A4aii	Commercial/institutional: Mobile	B(b)f	0.0007	0.0007	2%	200%	200.01%	0.000000	0.00003	0.00026	0.01%	0.00%	0.00%
1A4bi	Residential: Stationary, liquid fuels	B(b)f	0.0001	0.0000	3%	200%	200.02%	0.000000	-0.00003	0.00000	-0.01%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	B(b)f	0.9722	0.0244	2%	200%	200.01%	0.000347	-0.32652	0.00887	-65.30%	0.03%	42.65%
1A4bi	Residential: Stationary, gaseous fuels	B(b)f	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	B(b)f	0.6366	0.6584	5%	100%	100.12%	0.063401	0.01899	0.23942	1.90%	1.69%	0.06%
1A4bi	Residential: Stationary, waste	B(b)f	0.0034	0.0043	50%	100%	111.80%	0.000003	0.00038	0.00155	0.04%	0.11%	0.00%
1A4bii	Residential: Household and gardening (mobile)	B(b)f	0.0000	0.0002	2%	200%	200.01%	0.000000	0.00007	0.00008	0.01%	0.00%	0.00%

A		B	C	D	E	F	G	H	I	J	K	L	M
NFR sector		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt									
1A4ci	Agriculture/Forestry/Fishing: Stationary	B(b)f	0.0400	0.0262	2%	200%	200.01%	0.000401	-0.00431	0.00953	-0.86%	0.03%	0.01%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	B(b)f	0.0071	0.0035	2%	200%	200.01%	0.000007	-0.00120	0.00126	-0.24%	0.00%	0.00%
1B2c	Venting and flaring (oil. gas. combined oil and gas)	B(b)f	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2G	Other product use	B(b)f	0.0002	0.0001	5%	200%	200.06%	0.000000	-0.00003	0.00003	-0.01%	0.00%	0.00%
5C1bv	Cremation	B(b)f	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C2	Open burning of waste	B(b)f	0.0000	0.0000	10%	200%	200.25%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
TOTAL			2.7502	2.6182				1.146236					0.6248
% uncertainty in total inventory								107.06%			Trend uncertainty:		79.04%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	B(k)f	0.3800	0.4750	2%	200%	200.01%	0.552941	0.10135	0.31466	20.27%	0.89%	4.12%
1A1c	Manufacture of solid fuels and other energy industries	B(k)f	0.0000	0.0013	2%	200%	200.01%	0.000004	0.00087	0.00087	0.17%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	B(k)f	0.1455	0.2108	2%	200%	200.01%	0.108850	0.05800	0.13961	11.60%	0.39%	1.35%
1A3bi	Road transport: Passenger cars	B(k)f	0.0022	0.0071	2%	200%	200.01%	0.000124	0.00347	0.00471	0.69%	0.01%	0.00%
1A3bii	Road transport: Light duty vehicles	B(k)f	0.0006	0.0015	2%	200%	200.01%	0.000006	0.00067	0.00101	0.13%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	B(k)f	0.0096	0.0051	2%	200%	200.01%	0.000064	-0.00200	0.00339	-0.40%	0.01%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	B(k)f	0.0001	0.0000	2%	200%	200.01%	0.000000	-0.00004	0.00001	-0.01%	0.00%	0.00%
1A3c	Railways	B(k)f	0.0044	0.0005	2%	200%	200.01%	0.000001	-0.00211	0.00036	-0.42%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	B(k)f	0.0200	0.0309	2%	200%	200.01%	0.002335	0.00923	0.02045	1.85%	0.06%	0.03%
1A4bi	Residential: Stationary, liquid fuels	B(k)f	0.0002	0.0000	3%	200%	200.02%	0.000000	-0.00008	0.00000	-0.02%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	B(k)f	0.4197	0.0116	2%	200%	200.01%	0.000331	-0.22697	0.00770	-45.39%	0.02%	20.61%
1A4bi	Residential: Stationary, gaseous fuels	B(k)f	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	B(k)f	0.5057	0.5216	5%	100%	100.12%	0.167074	0.06180	0.34552	6.18%	2.44%	0.44%
1A4bi	Residential: Stationary, waste	B(k)f	0.0015	0.0018	50%	100%	111.80%	0.000003	0.00040	0.00122	0.04%	0.09%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	B(k)f	0.0200	0.0103	2%	200%	200.01%	0.000258	-0.00442	0.00679	-0.88%	0.02%	0.01%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	B(k)f	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2G	Other product use	B(k)f	0.0002	0.0001	5%	200%	200.06%	0.000000	-0.00005	0.00005	-0.01%	0.00%	0.00%
5C1bv	Cremation	B(k)f	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
5C2	Open burning of waste	B(k)f	0.0000	0.0000	10%	200%	200.25%	0.000000	-0.00001	0.00001	0.00%	0.00%	0.00%
TOTAL			1.5097	1.2777				0.831991					0.2656
% uncertainty in total inventory								91.21%	Trend uncertainty:				51.54%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	I(1.2.3-cd)p	0.2600	0.4625	2%	200%	200.01%	0.339613	0.12686	0.29512	25.37%	0.83%	6.44%
1A1c	Manufacture of solid fuels and other energy industries	I(1.2.3-cd)p	0.0000	0.0012	2%	200%	200.01%	0.000002	0.00077	0.00077	0.15%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	I(1.2.3-cd)p	0.0930	0.2090	2%	200%	200.01%	0.069317	0.07320	0.13333	14.64%	0.38%	2.14%
1A3bi	Road transport: Passenger cars	I(1.2.3-cd)p	0.0060	0.0081	2%	200%	200.01%	0.000104	0.00128	0.00516	0.26%	0.01%	0.00%
1A3bii	Road transport: Light duty vehicles	I(1.2.3-cd)p	0.0009	0.0016	2%	200%	200.01%	0.000004	0.00046	0.00104	0.09%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	I(1.2.3-cd)p	0.0022	0.0012	2%	200%	200.01%	0.000002	-0.00068	0.00075	-0.14%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	I(1.2.3-cd)p	0.0003	0.0000	2%	200%	200.01%	0.000000	-0.00019	0.00002	-0.04%	0.00%	0.00%
1A3c	Railways	I(1.2.3-cd)p	0.0026	0.0001	2%	200%	200.01%	0.000000	-0.00158	0.00008	-0.32%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	I(1.2.3-cd)p	0.0200	0.0303	2%	200%	200.01%	0.001461	0.00643	0.01935	1.29%	0.05%	0.02%
1A4bi	Residential: Stationary, liquid fuels	I(1.2.3-cd)p	0.0004	0.0000	3%	200%	200.02%	0.000000	-0.00022	0.00001	-0.04%	0.00%	0.00%
1A4bi	Residential: Stationary, solid fuels	I(1.2.3-cd)p	0.3439	0.0095	2%	200%	200.01%	0.000145	-0.21568	0.00609	-43.14%	0.02%	18.61%
1A4bi	Residential: Stationary, gaseous fuels	I(1.2.3-cd)p	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A4bi	Residential: Stationary, biomass	I(1.2.3-cd)p	0.8260	0.8517	5%	100%	100.12%	0.288575	0.00954	0.54344	0.95%	3.84%	0.16%
1A4bi	Residential: Stationary, waste	I(1.2.3-cd)p	0.0018	0.0023	50%	100%	111.80%	0.000003	0.00028	0.00145	0.03%	0.10%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	I(1.2.3-cd)p	0.0100	0.0098	2%	200%	200.01%	0.000151	-0.00024	0.00622	-0.05%	0.02%	0.00%
1B2c	Venting and flaring (oil. gas. combined oil and gas)	I(1.2.3-cd)p	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
2G	Other product use	I(1.2.3-cd)p	0.0002	0.0001	5%	200%	200.06%	0.000000	-0.00007	0.00005	-0.01%	0.00%	0.00%
5C1bv	Cremation	I(1.2.3-cd)p	0.0000	0.0000	2%	200%	200.01%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
TOTAL			1.5673	1.5875				0.699376					0.2737
% uncertainty in total inventory								83.63%	Trend uncertainty:				52.32%

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	HCB	0.0200	0.0883	2%	250%	250.01%	0.508545	0.28942	0.45153	72.35%	1.28%	52.37%
1A1c	Manufacture of solid fuels and other energy industries	HCB	0.0000	0.0002	2%	250%	250.01%	0.000003	0.00118	0.00118	0.29%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	HCB	0.0636	0.0425	2%	250%	250.01%	0.117741	-0.29630	0.21726	-74.08%	0.61%	54.88%
1A3bi	Road transport: Passenger cars	HCB	0.0002	0.0002	2%	250%	250.01%	0.000003	-0.00024	0.00107	-0.06%	0.00%	0.00%
1A3bii	Road transport: Light duty vehicles	HCB	0.0000	0.0000	2%	250%	250.01%	0.000000	0.00005	0.00015	0.01%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	HCB	0.0000	0.0000	2%	250%	250.01%	0.000000	0.00001	0.00015	0.00%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	HCB	0.0000	0.0000	2%	250%	250.01%	0.000000	-0.00008	0.00001	-0.02%	0.00%	0.00%
1A3c	Railways	HCB	0.0001	0.0000	2%	100%	100.02%	0.000000	-0.00060	0.00000	-0.06%	0.00%	0.00%
1A3dii	National navigation (shipping)	HCB	0.0006	0.0005	2%	100%	100.02%	0.000003	-0.00185	0.00268	-0.19%	0.01%	0.00%
1A4ai	Commercial/institutional: Stationary	HCB	0.0025	0.0052	2%	100%	100.02%	0.000287	0.00666	0.02680	0.67%	0.08%	0.00%
1A4bi	Residential: Stationary, solid fuels	HCB	0.0022	0.0001	2%	250%	250.01%	0.000000	-0.01737	0.00035	-4.34%	0.00%	0.19%
1A4bi	Residential: Stationary, biomass	HCB	0.0797	0.1495	5%	100%	100.12%	0.233500	0.11859	0.76398	11.86%	5.40%	1.70%
1A4bi	Residential: Stationary, waste	HCB	0.0115	0.0145	50%	100%	111.80%	0.002748	-0.01922	0.07422	-1.92%	5.25%	0.31%
1A4ci	Agriculture/Forestry/Fishing: Stationary	HCB	0.0000	0.0007	2%	100%	100.02%	0.000005	0.00342	0.00342	0.34%	0.01%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	HCB	0.0000	0.0001	2%	100%	100.02%	0.000000	0.00052	0.00052	0.05%	0.00%	0.00%
5C1bv	Cremation	HCB	0.0000	0.0012	2%	100%	100.02%	0.000015	0.00618	0.00618	0.62%	0.02%	0.00%
5C2	Open burning of waste	HCB	0.0153	0.0066	10%	250%	250.20%	0.002803	-0.09012	0.03349	-22.53%	0.47%	5.08%
TOTAL			0.1956	0.3097				0.865653					1.1453
% uncertainty in total inventory								93.04%	Trend uncertainty:		107.02%		

NFR sector	A	B	C	D	E	F	G	H	I	J	K	L	M
		Pollutant	1990 emissions	2017 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Contribution to Variance by Category in Year 2017	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty in trend in national emissions introduced into the trend in total national emissions
			kt	kt	%	%	%		%	%	%	%	%
1A1a	Public electricity and heat production	PCB	5.2437	3.2829	2%	150%	150.01%	0.953889	0.01494	0.39197	2.24%	1.11%	0.06%
1A1c	Manufacture of solid fuels and other energy industries	PCB	0.0000	0.0119	2%	150%	150.01%	0.000012	0.00142	0.00142	0.21%	0.00%	0.00%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	PCB	2.0000	1.3689	2%	100%	100.02%	0.073730	0.01963	0.16344	1.96%	0.46%	0.04%
1A3bi	Road transport: Passenger cars	PCB	0.0000	0.0001	2%	100%	100.02%	0.000000	0.00000	0.00001	0.00%	0.00%	0.00%
1A3bii	Road transport: Light duty vehicles	PCB	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A3biii	Road transport: Heavy duty vehicles and buses	PCB	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A3biv	Road transport: Mopeds & motorcycles	PCB	0.0000	0.0000	2%	100%	100.02%	0.000000	0.00000	0.00000	0.00%	0.00%	0.00%
1A3c	Railways	PCB	0.0202	0.0000	2%	100%	100.02%	0.000000	-0.00145	0.00000	-0.15%	0.00%	0.00%
1A3dii	National navigation (shipping)	PCB	0.0003	0.0002	2%	100%	100.02%	0.000000	0.00001	0.00003	0.00%	0.00%	0.00%
1A4ai	Commercial/institutional: Stationary	PCB	0.2500	0.2310	2%	150%	150.01%	0.004721	0.00960	0.02758	1.44%	0.08%	0.02%
1A4bi	Residential: Stationary, solid fuels	PCB	0.6003	0.0185	2%	150%	150.01%	0.000030	-0.04091	0.00221	-6.14%	0.01%	0.38%
1A4bi	Residential: Stationary, biomass	PCB	0.0003	0.0004	5%	150%	150.08%	0.000000	0.00003	0.00005	0.00%	0.00%	0.00%
1A4ci	Agriculture/Forestry/Fishing: Stationary	PCB	0.2200	0.1078	2%	150%	150.01%	0.001029	-0.00294	0.01287	-0.44%	0.04%	0.00%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	PCB	0.0000	0.0000	2%	150%	150.01%	0.000000	0.00001	0.00001	0.00%	0.00%	0.00%
5C1bv	Cremation	PCB	0.0000	0.0033	2%	150%	150.01%	0.000001	0.00039	0.00039	0.06%	0.00%	0.00%
5C2	Open burning of waste	PCB	0.0405	0.0174	10%	150%	150.33%	0.000027	-0.00084	0.00207	-0.13%	0.03%	0.00%
TOTAL			8.3754	5.0424				1.033439					0.00503
% uncertainty in total inventory								101.66%	Trend uncertainty:				7.09%