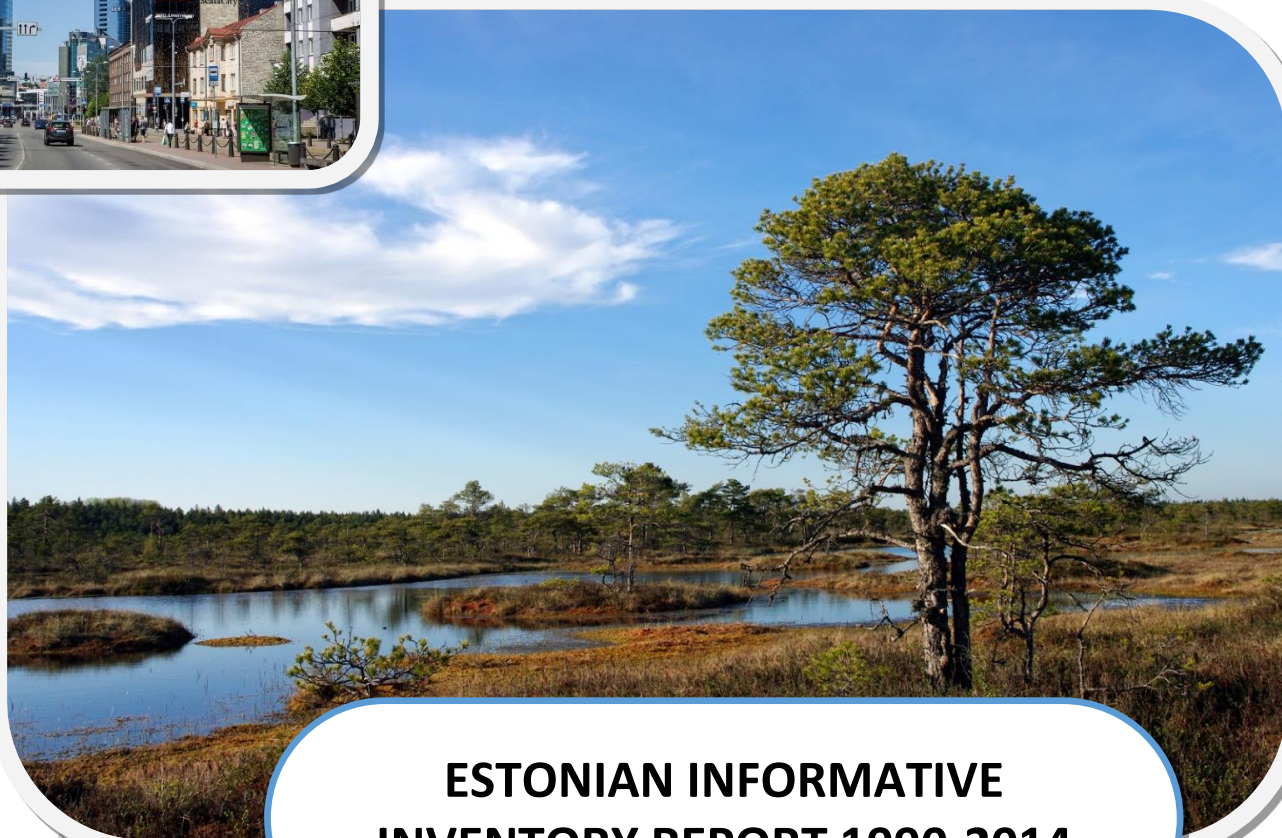
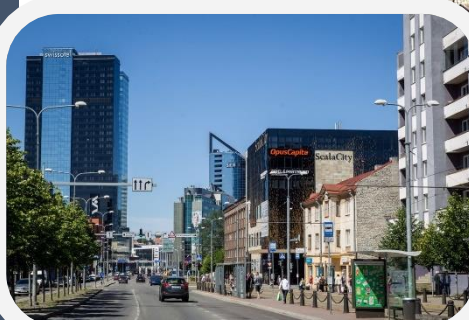




REPUBLIC OF ESTONIA
ENVIRONMENT AGENCY



ESTONIAN INFORMATIVE INVENTORY REPORT 1990-2014

**Submitted under the Convention on Long-Range
Transboundary Air Pollution**

Tallinn 2016

Data sheet

Title: Estonian Informative Inventory Report 1990-2014

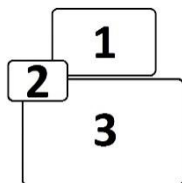
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Cover photos:



1. Tallinn medieval Old Town (source: www.traveloutthere.com);

2. Tallinn city centre (photo by Raul Mee);

3. Kakerdaja Fen (photo by Kalev Vask) - *It is one of the largest fens in Kõrvemaa. It covers an area of approximately 1000 hectares. The most unique feature of this picturesque fen is that it has two levels of different height. Thousands of water birds stop on the fen in spring and autumn. Lake Kakerdaja can be found right in the middle of the fen.*

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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 4	Road transport database
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 and Transfer Register
EstEA	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 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants, OJ L 309, 27 November 2001
NFR	Nomenclature for Reporting
OSIS	Web-interfaced air emissions data system for point sources at the Estonian Environment Agency (EstEA)
PP	Power Plant
RAINS	The Regional Air Pollution 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
HM	Heavy metals
I(1,2,3-cd)p	Indeno(1,2,3-cd)pyrene
NH ₃	Ammonia
Ni	Nickel
NM VOC	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 NM VOC.
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
POP	Persistent organic pollutants, (lindane, dichloro-diphenyl-trichloroethane (DDT), polychlorinated biphenyl (PCBs), pentabromodiphenyl ether (PeBDE), perfluorooctane sulfonate (PFOS), hexachlorobutadiene (HCB), 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.



Forest in the evening light (*photo by Kristjan Klementi*)

EXECUTIVE SUMMARY

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 1990-2014 together with projections were submitted on 12th February 2016. 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 2013. The reasons for the recalculations are specified in Table 0.1 below:

Table 0.1 The status of recalculations in the 2016 submission

NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
1A1a	Public electricity and heat production	Additionally calculated	BC	2000-2012
1A1c	Manufacture of solid fuels and other energy industries	Additionally calculated	BC	2000-2012
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Additionally calculated	BC	2000-2012
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Additionally calculated	BC	2002-2012
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	Additionally calculated	BC	2011-2012
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	Additionally calculated	BC	2011-2012
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Additionally calculated	BC	2011-2012
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Non-metallic mineral sector is extracted to NFR 1A2gviii	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn	2000-2012
		Additionally calculated	BC	
1A2gvii	Mobile Combustion in manufacturing industries and	Corrections in fuel consumption data	NO _x , NMVOC, SO _x , NH ₃ , CO, Pb	2008, 2011

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NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
	construction: (please specify in the IIR)		PM _{2.5} , PM ₁₀ , TSP, Cd, Cr, Cu, Ni, Se, Zn, PAHs	2011
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	Non-metallic mineral sector is extracted to NFR 1A2f	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn	2000-2012
		Additionally calculated	BC	
1A3ai(i)	International aviation LTO (civil)	Corrections of data presented in the NFR table	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1991, 2011
1A3aii(i)	Domestic aviation LTO (civil)	Corrections of data presented in the NFR table	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1991, 2011
1A3bi	Road transport: Passenger cars	New COPERT version 11.3 is used for emission calculations which includes renewed emission factors (1990-2013) and small corrections in annual mileage driven (2009-2013)	NO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	2010-2013
			NMVOC	2006-2013
			SO _x , Cd, Cr, Cu, Ni, PAHs	2011-2013
			BC	2013
			Pb	1990-1993, 2009, 2011-2013
			Zn	2009-2013
			PCDD/PCDF	1990-2013
1A3bii	Road transport: Light duty vehicles	New COPERT version 11.3 is used for emission calculations which includes renewed emission factors (1990-2013) and small corrections in annual mileage driven (2009-2013)	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, Pb, Cr, Cu, Ni, PAHs	2011-2013
			BC, Cd	2013
			Zn	2009-2013
			PCDD/PCDF	1990-2013
1A3biii	Road transport: Heavy duty vehicles and buses	New COPERT version 11.3 is used for emission calculations which includes renewed emission factors (1990-2013) and small corrections in annual mileage driven (2009-2013)	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, Zn	2009-2013
			SO _x , PAHs	2010-2013
			BC	2013
			Pb	1990-1992
			Cd	2009, 2011-2013
			Cr, Cu	2009, 2012-2013
			Ni	2012-2013
1A3biv	Road transport: Mopeds & motorcycles	New COPERT version 11.3 is used for emission calculations which includes renewed emission factors (1990-2013) and small corrections in annual mileage driven (2009-2013)	PCDD/PCDF	1990-2013
			NO _x	1990-1993, 2001, 2003-2004, 2006, 2011-2013
			NMVOC	1990-1993, 1995, 2002, 2008, 2010-2013
			CO	1990-1993, 2000, 2002-2005, 2007-2013

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NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
			Pb	1990-1993, 2012-2013
			BC, Cd	2013
			Cr, Cu, Ni, PAHs	2011-2013
			Zn	2012-2013
1A3bv	Road transport: Gasoline evaporation	New COPERT version 11.3 is used for emission calculations which includes renewed emission factors (1990-2013) and small corrections in annual mileage driven (2009-2013)	NMVOC	1990-2013
1A3bvi	Road transport: Automobile tyre and brake wear	New COPERT version 11.3 is used for emission calculations which includes renewed emission factors (1990-2013) and small corrections in annual mileage driven (2009-2013)	PM _{2.5} , PM ₁₀ , TSP, Cr, Cu, Zn	2009-2013
			Pb	2009-2011, 2013
			Cd, Se	2011, 2013
			Ni	2010-2013
1A3bvii	Road transport: Automobile road abrasion	New COPERT version 11.3 is used for emission calculations which includes renewed emission factors (1990-2013) and small corrections in annual mileage driven (2009-2013)	PM _{2.5} , PM ₁₀ , TSP	2009-2013
1A3c	Railways	Corrections in fuel consumption data	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, Cd, Cr, Cu, Ni, Se, Zn, PAHs	2012
1A3dii	National navigation (shipping)	Corrections in fuel consumption data	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, Cd, Cr, Cu, Ni, Se, Zn, PAHs	1999-2000, 2012
		Correction of BC calculations	BC	2013
1A4ai	Commercial/institutional: Stationary	Additionally calculated	BC	2000-2012
1A4aii	Commercial/institutional: Mobile	Corrected sulphur content in used fuel	SO _x	2012-2013
		Corrections of data presented in the NFR table	NMVOC, NH ₃	2012
1A4bi	Residential: Stationary	Corrections of emission factors on the basis of national measurements	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, PCDD/ PCDF, PAHs, HCB, PCB	1990-2013
		Additionally calculated	BC	2000-2012
1A4bii	Residential: Household and gardening (mobile)	Corrections in fuel consumption data	NO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, Cd, Cr, Cu, Ni, Se, Zn, PAHs	2002-2009
		Corrections in fuel consumption data (2002-2009) and correction of data	NMVOC	2002-2009, 2012

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NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
		presented in the NFR table (2012)		
1A4ci	Agriculture/Forestry/Fishing: Stationary	Additionally calculated	BC	2000-2012
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	Additionally calculated	BC	2010-2012
		Corrections in calculation		2013
1B2c	Venting and flaring (oil, gas, combined oil and gas)	Additionally calculated	BC	2009-2012
2A1	Cement production	Additionally calculated	BC	2003-2012
2A2	Lime production	Additionally calculated	BC	2008-2012
2A5b	Construction and demolition	Corrections of activity data	PM _{2.5} , PM ₁₀	2000-2013
			TSP	1990-2013
2B10a	Chemical industry: Other	Additionally calculated	BC	2000-2012
2B10b	Storage, handling and transport of chemical products	Additionally calculated	BC	2008-2012
2C1	Iron and steel production	Additionally calculated	BC	2008-2012
2C3	Aluminium production	Additionally calculated	BC	2009-2012
2C7c	Other metal production	Additionally calculated	BC	2000-2012
2D3b	Road paving with asphalt	Additionally calculated	BC	2000-2012
2D3d	Coating applications	Corrections in statistical data from Eurostat and Statistics Estonia	NMVOC	2004-2013
		Corrections in point sources data from OSIS database	TSP	2013
2D3e	Degreasing	Corrections in statistical data from Eurostat and Statistics Estonia	NMVOC	2000-2001, 2013
2D3f	Dry cleaning	Corrections in statistical data from Eurostat and Statistics Estonia	NMVOC	2002-2007, 2009-2013
2D3g	Chemical products	Corrections in point sources data from OSIS database	NH ₃ , TSP, CO	2013
2D3h	Printing	Corrections in statistical data from Eurostat and Statistics Estonia	NMVOC	1999-2001, 2007, 2013
2D3i	Other solvent use	Corrections in statistical data from Eurostat and Statistics Estonia	NMVOC	2000-2001, 2013
2G	Other product use	Corrections in statistical data from Eurostat and Statistics Estonia	NMVOC, PM _{2.5} , PM ₁₀ , TSP, CO	2000-2001, 2013
		Corrections of calculated emission	NH ₃	2013
		Corrections in statistical data from Eurostat	Cd	2000
		Correction of calculated emissions	PAHs	2000-2001, 2003, 2006, 2008-2011, 2013

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NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
		Additionally calculated emissions from tobacco combustion	BC	2000-2013
3B1a	Manure management - Dairy cattle	More detailed calculation method was used	NO _x , NH ₃	1990-2013
3B1b	Manure management - Non-dairy cattle	More detailed calculation method was used	NO _x , NH ₃	1990-2013
3B3	Manure management - Swine	Corrections in statistical data. More detailed calculation method was used for NO _x and NH ₃	NO _x , NMVOC, NH ₃ , PM ₁₀ , PM _{2.5} , TSP	1990-2013
3B4gii	Manure management - Broilers	Corrections in statistical data	NO _x , NMVOC, NH ₃ , PM ₁₀ , PM _{2.5} , TSP	1990-2013
5A	Biological treatment of waste – solid waste disposal on land	Emissions are recalculated according to the new activity data	NMVOC, TSP	1990-2013
			PM _{2.5} , PM ₁₀	2000-2013
5B1	Biological treatment of waste - composting	Corrections of activity data	NMVOC	2005-2013
		New emission sources from the OSIS database for point sources that were previously allocated under different NFR codes	NH ₃	1990-1991, 2005-2009, 2012-2013
		Additionally calculated emissions	CO	1990-2013
5C1bi	Industrial waste incineration	Emissions are calculated using EMEP/EEA Guidebook 2013 EF	PM _{2.5} , PM ₁₀	2008-2010, 2012-2013
			BC	2008-2013
		Corrections in point sources data from OSIS database	Cu	2008, 2012-2013
5C1biv	Sewage sludge incineration	Corrections of activity data; Emissions allocated under NFR 5D2	NO _x , NMVOC, SO _x	2013
5C1bv	Cremation	Emissions are calculated accordingly to the newly available activity data using EMEP/EEA Guidebook 2013 EF for cremation	NO _x , NMVOC, SO _x , PM _{2.5} , PM ₁₀ , TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs, HCB, PCBs	1993-2013
5C2	Open burning of waste	Emissions are calculated using EMEP/EEA Guidebook 2013 EF	BC	2000-2012
5D2	Industrial wastewater handling	Corrections of activity data	NO _x , NMVOC, SO _x	2013
5E	Other waste	Corrections of activity data	NO _x , NH ₃	2012-2013
		Correction of calculated emissions	PM _{2.5} , PM ₁₀ , TSP, Pb, Cd, Hg, As, Cr, Cu, PCDD/PCDF	2004

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

The differences in total emissions between the 2015 and 2016 submissions are presented in Table 0.2.

Table 0.2 Difference between the 2015 and 2016 submissions (%)

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb	Cd
1990	3.54	-5.00	-0.45	5.59	NR	NR	-1.68	NR	-5.21	0	0
1991	3.58	-4.34	-0.48	7.51	NR	NR	-1.56	NR	-4.88	0.00	0
1992	6.02	-3.80	-0.36	3.19	NR	NR	-1.49	NR	-5.12	0	0
1993	6.71	-3.61	-0.24	11.72	NR	NR	-1.67	NR	-1.05	0	0
1994	10.49	-6.48	-0.13	-1.16	NR	NR	-4.05	NR	5.33	0.00	0.00
1995	20.99	-13.18	-0.34	3.01	NR	NR	-6.33	NR	7.78	0.00	0.00
1996	21.92	-16.53	-0.36	2.48	NR	NR	-8.17	NR	7.46	0.00	0.00
1997	23.01	-15.24	-0.25	2.52	NR	NR	-9.90	NR	8.48	0.00	0.00
1998	18.74	-13.57	-0.17	1.19	NR	NR	-8.34	NR	7.98	0.00	0.00
1999	18.36	-13.22	0.16	3.00	NR	NR	-8.18	NR	7.09	0.00	0.00
2000	17.67	-14.21	0.13	3.81	-29.54	-16.39	-9.74	100.00	6.66	0.00	0.00
2001	15.34	-15.48	0.00	2.33	-28.35	-16.42	-9.94	100.00	4.53	0.00	0.00
2002	14.42	-16.12	0.03	6.30	-28.82	-19.05	-13.86	100.00	2.54	0.00	0.00
2003	14.04	-17.27	0.06	5.49	-33.25	-22.54	-15.99	100.00	1.25	0.00	0.00
2004	14.16	-18.08	-0.09	5.01	-32.13	-22.75	-17.10	100.00	-1.08	0.00	0.00
2005	12.32	-16.99	-0.06	5.13	-30.92	-22.03	-17.85	100.00	-2.79	0.00	0.00
2006	12.13	-17.43	-0.07	5.20	-38.92	-27.93	-22.63	100.00	-3.58	0.00	0.00
2007	14.09	-23.76	0.06	7.55	-39.43	-26.78	-24.17	100.00	-5.04	0.00	0.00
2008	14.97	-26.56	0.14	10.45	-42.39	-32.27	-29.27	100.00	-7.09	0.00	0.00
2009	18.01	-30.65	0.08	13.02	-49.26	-38.25	-35.27	100.00	-8.58	0.00	0.00
2010	14.55	-31.61	0.06	13.67	-41.11	-29.28	-28.05	100.00	-10.06	0.00	0.00
2011	12.20	-29.04	0.05	12.43	-31.74	-19.49	-18.79	100.00	-11.99	0.00	0.00
2012	14.04	-31.27	0.10	12.93	-52.78	-41.42	-36.89	100.00	-13.58	0.00	0.01
2013	13.90	-30.54	0.09	13.68	-45.31	-34.20	-33.13	-5.96	-15.38	0.00	0.00

Table 0.2 continues

Year	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ F	PAHs total	HCB	PCBs
1990	0	0	0	0	0	0	0	-6.16	-6.44	5.09	0.00
1991	0	0	0	0	0	0	0	-6.84	-6.98	7.17	0.00
1992	0	0	0	0	0	0	0	-2.73	-3.42	7.20	0.00
1993	0.01	0.00	0.00	0.00	0.00	0.01	0.00	-2.61	-2.12	8.86	0.00
1994	0.12	0.00	0.00	0.00	0.00	0.16	0.00	2.01	22.11	27.36	0.01
1995	0.21	0.00	0.00	0.00	0.00	0.15	0.00	-0.07	-0.93	4.82	0.01
1996	0.30	0.00	0.00	0.00	0.00	0.18	0.00	-1.46	-1.46	5.22	0.01
1997	0.44	0.00	0.00	0.00	0.00	0.26	0.00	-1.35	-1.48	5.87	0.02
1998	0.63	0.00	0.00	0.00	0.00	0.42	0.00	-0.38	-1.24	6.91	0.02
1999	0.79	0.00	0.00	0.01	0.00	0.49	0.00	-1.77	-2.24	7.91	0.03
2000	0.84	0.00	0.00	0.09	0.00	0.69	0.00	-1.10	-1.83	8.76	0.05
2001	1.00	0.00	0.00	0.00	0.00	0.61	0.23	0.10	-1.37	9.24	0.04
2002	1.12	0.00	0.00	0.01	0.00	0.65	0.00	0.20	-1.53	10.55	0.04
2003	1.07	-1.23	0.00	0.01	0.00	0.69	-0.80	2.99	-0.97	11.25	0.04
2004	1.28	0.00	0.00	0.01	0.00	0.75	0.00	0.89	-1.31	10.94	0.06
2005	1.31	0.00	0.00	0.01	0.00	0.83	0.00	1.45	-1.20	12.42	0.05
2006	1.93	0.00	0.00	0.01	0.00	0.95	0.00	2.68	-0.99	14.54	0.07
2007	1.24	0.00	0.00	0.02	0.00	0.90	0.00	2.97	-0.49	14.91	0.13
2008	1.42	0.00	0.00	0.08	0.00	0.82	0.00	2.63	-0.49	14.69	0.09
2009	1.86	0.00	0.00	0.00	0.00	0.87	0.00	3.08	-0.24	17.19	0.08

Year	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ F	PAHs total	HCB	PCBs
2010	1.44	0.00	0.00	0.01	0.00	0.88	0.00	3.11	-0.26	15.22	0.06
2011	1.61	0.00	0.00	0.01	0.00	1.10	0.00	3.02	-0.39	15.79	0.08
2012	1.92	0.00	0.00	0.21	0.00	1.20	0.00	4.72	-0.29	18.10	0.09
2013	1.62	0.00	0.00	0.24	0.00	1.23	0.00	6.03	-0.25	18.45	0.08

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

The main changes occurred in the emissions of NO_x, NMVOC, particulates and HCB due to the use of national emission factors for residential combustion. The main reason for the ammonia emission change is a transition from Tier 1 calculation method to Tier 2 calculation method in the agriculture sector.

In comparison with the NECD report there are insignificant distinctions in SO₂, NMVOC, NO_x and ammonia emissions (adjustment was made within the frame of CLRTAP report), which will be modified in the final NECD report in December 2016.

In this section, a short comparison with the UNFCCC report is presented. There isn't any detailed analysis about the exact differences between the data reported under CLRTAP and UNFCCC, because the last GHG inventory submission has been postponed due to the problems with the reporting tool and the GHG inventory report is still in draft version. At present two different databases are available in Estonia: air pollution (AP) and GHG. The differences in the emissions data mainly results from a different approach to inventories. The AP database is more complicated; it is built from the bottom to the top and contains data of the point sources (about 2,010 facility reports, not only LPS) and diffuse sources. Different tools are used for data collection: the national web interface point sources database OSIS and COPERT for the road transport. In GHG, inventory emissions of non-direct GHG pollutants are calculated only at the national level and by using IPCC methodology. The AP database uses data given by the facilities (measurements and calculations). Emission calculations from the point sources are based on the national emission factors. For emission calculations from diffuse sources, EMEP/EEA Guidebook emission factors are used, but it should be noted that some of the emission factors are different in the EMEP/EEA Guidebook from those in the IPCC Good Practice Guidance.

Estonia recognises that work is needed to integrate our activity data and emission factors for Air Pollution and GHG inventories into a single consistent database and we are working on streamlining the AP and GHG emission reporting requirements.

The inventory improvements made during 2015:

- Recalculation of main pollutants, particulate and POPs emissions by using the national methodology for the residential combustion sector;
- Additionally calculated BC emissions for the period of 2000-2012 for all the activities which have EF in the EMEP/EEA Guidebook 2013;
- For the road transport sector emissions calculations the new Copert version 11.3 was used which included renewed EFs for certain pollutants in certain activities;

- Recalculations done in the agriculture sector are due to the transition to the higher tier calculation method.

Despite strides towards inventory improvement, there are still activities for which emissions have not been estimated:

- 4F Field burning of agricultural residuals;
- 11B Forest fires.

Priorities for future inventory improvement:

- Check the POPs emissions from waste incineration;
- Provide detailed uncertainty analysis for all activities;
- Check the activities 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;
- Use the Tier 2 or Tier 3 methods for the estimation of emissions from agriculture.



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1. INTRODUCTION

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 2016. The report contains information on Estonian emission inventories from 1990 to 2014. The inventories detail the anthropogenic emissions of the main pollutants (SO_x , NO_x , NMVOC, NH_3 and CO), particulate matter (TSP, PM_{10} , $\text{PM}_{2.5}$), 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 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 Ambient 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 2,010 reports in 2014) 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 2013.

The Estonian Environment Agency (EstEA) is responsible for collecting, analysing, storing, reporting and publishing environment-related information and data. The EstEA 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 EstEA is a state agency administered by the Ministry of the Environment.

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 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 use 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 area sources. From 2000 to 2004, CollectER software was used to accumulate data (both point and area sources). In order to accumulate data on point sources, the Estonian Environment Information Centre created a new web-interface air emission data system for the point sources (OSIS) in 2004, where operators of point sources directly complete their annual air pollution reports. In 2000, the database contained data about 600 facilities; however, by 2014 the number had increased to 2,010.

The point sources information system contains data reported by the operators that have a pollution permit. Each facility submits data on the emissions of polluting substances together with data regarding burnt fuel, used solvents, liquid fuel distribution, etc. Operators are obliged to specify any data related to accidental releases where such information is available (deliberate, accidental, routine and non-routine). Data are presented on each source of pollution and on the facility as a whole. Emission data are available in SNAP (Source Nomenclature for Air Pollutants) and E-PRTR codes. The owners of point sources can directly add their calculated or measured annual emissions into the system or use OSIS calculation modules, which use legally regulated estimation methodologies. The operator can also calculate emissions through the use of other available methods, though this should be co-ordinated with the Ministry of the Environment (regulated by the Ambient Air Protection Act). The operator shall indicate the method of emission calculation.

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

After entering the report into the 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 are then ready for use in various reports (Figure 1.2).

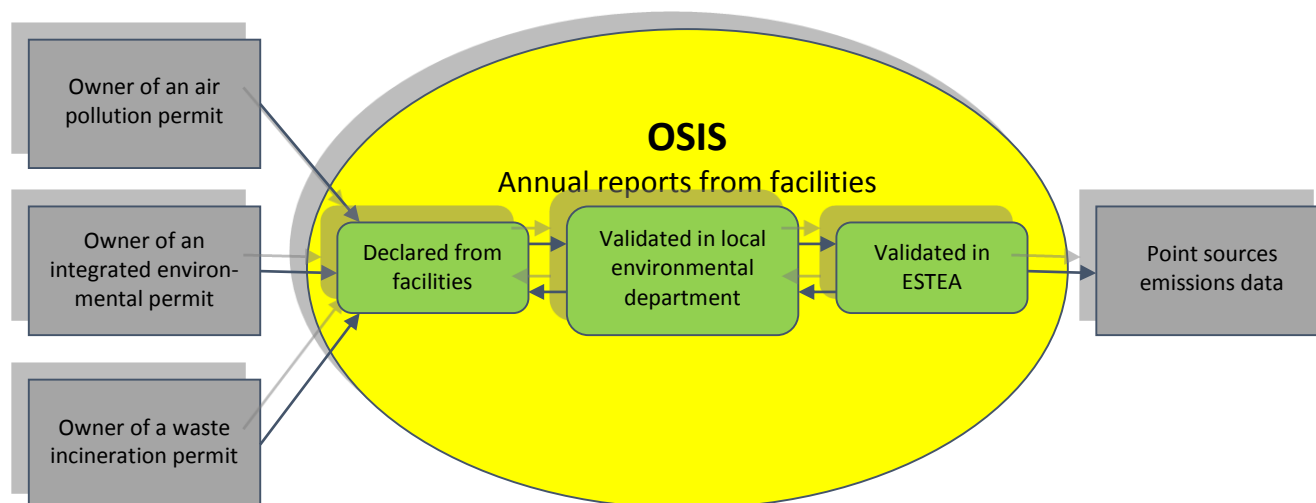


Figure 1.2 Validation of Estonian point sources data

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 and agriculture, parts of solvent use and industrial activities and fugitive emissions from fuel consumption.

The non-direct GHG emissions (SO_2 , NO_x , CO , NMVOC), also N_2O , CH_4 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 CO_2 Monitoring Mechanism.

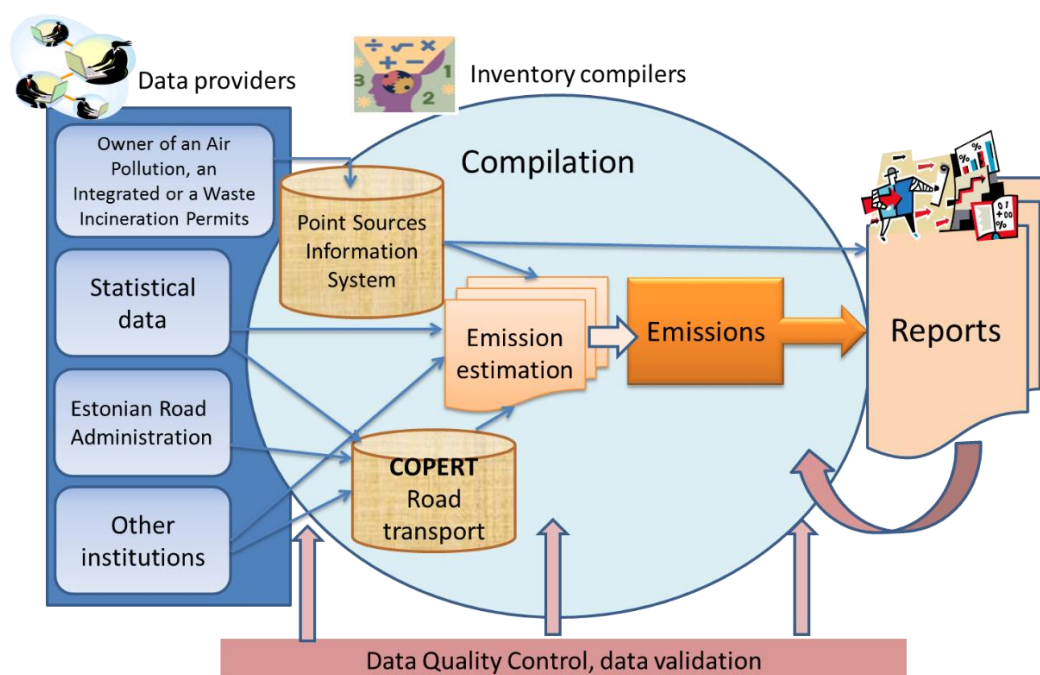


Figure 1.3 Air pollution inventory structure

1.4. Methods and data sources

The data reported by the operators and the national specific emission factors or EMEP/EEA 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 and fuel consumption by point sources 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 4 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 activities 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 Estonian Weather Service 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 2013.

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 2014, only the level assessment was chosen.

The results of the key source category analysis for main pollutants are presented in Annex I in ascending NFR category order. The results of all pollutants (including main pollutants), which are reported under CLRTAP, are in 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.

Combustion in residential plants (1A4bi) is also a main source of NMVOC (15.5%). Additionally, road transport (1A3bi) decorative coating application (2D3d), domestic solvent use (2D3a),

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 2014 from the energy sector are responsible for 84.5% of SO₂ emissions in 2014. 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) and the use of mineral fertilisers (3D1a), which are the main sources of pollution regarding ammonia.

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, 54.7% 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 source analysis

Pollutant	Key categories (Sorted from high to low from left to right)														Total (%)
SO _x	1A1a														84.1
	84.10%														
NO _x	1A1a	1A4bi	1A3biii	1A4cii	1A3bi	1A3c									81.3
	30.50%	15.00%	13.70%	9.90%	9.10%	3.20%									
NH ₃	3B1a	3Da1	3B3	3Da3	3B1b										82.8
	24.40%	23.10%	14.40%	10.50%	10.40%										
NMVOC	1A4bi	2D3d	3B3	2D3a	3B1a	3B1b	1B2av	1A3bi	2D3e	2H2	2D3i	1A1a	1A4bii	1A2gviii	82.0
	15.50%	14.10%	7.60%	7.00%	5.80%	5.60%	5.20%	5.00%	4.30%	3.10%	2.40%	2.20%	2.10%	2.10%	
CO	1A4bi	1A1c	1A3bi												83.8
	54.70%	20.50%	8.60%												
TSP	1A1a	1A4bi	1A2gviii	3Da1	1A1c	3B3	1A4ai	2A5b	1A3bvi						80.9
	41.70%	15.40%	8.40%	4.80%	3.20%	2.40%	2.00%	1.70%	1.40%						
PM ₁₀	1A1a	1A4bi	1A2gviii	3Da1	1A1c	1A4ai	1A2d								81.5
	41.70%	18.90%	7.80%	6.40%	3.20%	1.90%	1.60%								
PM _{2.5}	1A1a	1A4bi	1A2gviii	1A4ai	1A2d	1A1c									82.4
	34.70%	29.20%	11.00%	2.50%	2.50%	2.40%									
BC	1A4bi	1A1a	1A2gviii	1A3bi	1A4cii										82.1
	42.80%	16.73%	11.86%	5.84%	4.82%										
Pb	1A1a														93.9
	93.90%														
Hg	1A1a														92.5
	92.50%														
Cd	1A1a	1A4bi													92.9
	70.30%	22.60%													

Pollutant	Key categories (Sorted from high to low from left to right)														Total (%)
DIOX	1A1a	1A4bi	5E	5C1bi	1A2gviii										85.6
	28.40%	25.70%	19.40%	6.40%	5.60%										
PAH	1A4bi	1A1a													84.8
	45.50%	39.30%													
HCB	1A4bi	1A1a													86.6

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 2011 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/>).
- **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.
ESTEPA 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 first time for 2016 submission under LRTAP convention as part of the Estonian IIR 2016.

The uncertainty regarding the pollutants and sectors reflected in the inventory of Estonian ambient air was calculated. Herein, pollutants include sulphur dioxide (SO₂), nitrogen oxides

(NO_x), volatile organic compounds (VOC), 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, PCB). Activities are defined according to NFR categories.

1.7.1. Overview of the method

Evaluating the uncertainties was based on Tier 1 methodology as described in the guidance document of the EMEP/EEA air pollutant emission inventory. Tier 1 methodology calculations are based on the emissions of the base year and the so-called reference year, and on activity rate uncertainties and emission factors of every NFR sector. Firstly, the uncertainty was calculated pollutant by pollutant for every subcategory, then, the uncertainties of all subcategories were added together, thus finding the overall uncertainty of the inventory data. Uncertainty was evaluated also for aggregated sectors such as stationary combustion, aviation, road transport, other mobile, industrial processes, solvent use, 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}, in which case the appointed base year was 2000. The reference year is 2014.

The uncertainty values of emission factors were mainly based on the guidance document of EMEP/EEA. If the default values of uncertainty values of specific emissions of pollutants were not set out in the guidance document, expert evaluations were also used. Recommended range of error listed in the EMEP/EEA Guidebook for source data and emission factors are given in Table 1.3. The margins of error for source data and emission factors of this document are shown by sectors respectively in Tables 1.2 and 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 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	National statistics; operators data
2B1	2	Operators data
2C1	2	Operators data

NFR sector	Uncertainty, %	Data source
2C3	2	Operators data
2C5	2	Operators data
2C6	2	Operators data
2C7	2	Operators data
2D3	2	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
3I	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 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	5–200%
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	Dioxin	PAHs	HCB	PCB
1A1a	B	C	A	C	B	B	B	B	D	D	D	D	D
1A1c	B	C	A		B	B	B	B					
1A2a					B	B	B						
1A2gvii	C	C	C	C	C	C	C	C	D		C		
1A2gviii	B	C	A		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					
1A3bi	B	B	B	B	B	B	B	B	B	D	C	C	C
1A3bii	B	B	B	B	B	B	B	B	B	D	C	C	C
1A3biii	B	B	B	B	B	B	B	B	B	D	C	C	C
1A3biv	B	B	B	B	B	B	B	B	B	D	C	C	C
1A3bv		B											
1A3bvi					B	B	B		B				
1A3bvii					B	B	B						
1A3c	D	D	C	C	B	B	B	D	B	D	D	D	D
1A4ai	C	C	B		B	B	B	B	D	D	D	D	D
1A4aii	C	C	B	C	C	C	C	C	D		D	D	D
1A4bi (liquid fuels)	D	D	C	C	B	B	B	B	D		D		
1A4bi (solid fuels)	D	D	C	C	B	B	B	B	D		D		
1A4bi (gaseous fuels)	D	D	C	C	B	B	B	B	D		D		
1A4bi (biomass)	D	D	C	C	B	B	B	B	D		D		
1A4bii	C	C	B	C	C	C	C	C	C		D	D	D
1A4ci	C	C	B	C	C	C	C	C	C	D	D		D
1A4cii	C	C	B	C	C	C	C	C	C		D		D
1B1a	C				D	D	D	D					
1B2av		C											
1B2b		C											
2A5b					D	D	D						
2A5c													
2A6					D	D	D						
2B1	C												
2B10a		C		B	B	B	B	C					
2C7c	C			E	B	B	B						
2D3a		B							B (Hg)				
2D3b		D			D	D	D						
2D3d		C											
2D3e		D											
2D3f		B											
2D3g		B		D									
2D3h		C											
2D3i		C											

NFR sector	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	CO	Heavy metals	Dioxin	PAHs	HCB	PCB
2G	C	C	C	C	C	C	C	C	C	D	D		
2H1	C	C			D	D	D	C					
2H2		C			D	D	D						
2L				E									
3B1a	D	D		D	D	D	D						
3B1b	D	D		D	D	D	D						
3B2	D	D		D	D	D	D						
3B3	D	D		D	D	D	D						
3B4e	D	D		D	D	D	D						
3B4gi	D	D		D	D	D	D						
3B4gii	D	D		D	D	D	D						
3B4giv	D	D		D	D	D	D						
3B4h	D	D		D	D	D	D						
3Da1	D	D		D	D	D	D						
5B1				C									
5C1biii										D			
5C2	C	C	C		D	D	D	C	D	D	D	D	D
5E					D	D	D						

1.7.2. Result of uncertainty evaluation

Table 1.5 shows the results of uncertainty evaluation, which include the estimated emissions by pollutants for both 1990 and 2014, uncertainties of trends for the period of 1990–2014, and the whole uncertainty of 2014 national emissions.

Table 1.5 Summary of the uncertainty evaluation

Pollutant	Total emission, 1990	Total emission, 2014	Unit	Trend in 1990-2014, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	76.250	33.334	kt	-56.28	60.48	27.52
NM VOC	67.077	22.536	kt	-66.40	78.26	37.32
SO _x	272.392	40.839	kt	-85.01	32.33	7.90
NH ₃	27.040	13.042	kt	-51.77	99.03	32.58
PM _{2.5} ¹	15.296	7.777	kt	-49.16	53.12	28.76
PM ₁₀ ¹	31.765	12.496	kt	-60.66	60.17	30.15
TSP	274.421	16.650	kt	-93.93	60.95	13.80
CO	215.002	126.519	kt	-41.15	47.72	38.06
Pb	206.003	36.547	t	-82.26	138.86	54.22
Cd	4.505	0.898	t	-80.07	130.01	60.42
Hg	1.154	0.679	t	-41.14	138.00	34.81
PCDD/PCDF	8.069	3.932	g I-TEQ	-51.27	148.50	79.70

¹ For PM_{2.5} and PM₁₀ base year is 2000 and trend for the period of 2000-2014

Pollutant	Total emission, 1990	Total emission, 2014	Unit	Trend in 1990-2014, %	Uncertainty, %	Trend uncertainty 1990-2014, %
B(a)p	2.544	2.022	t	-20.51	126.71	96.17
B(b)f	2.837	2.297	t	-19.03	130.48	104.09
B(k)f	1.664	1.183	t	-28.94	124.21	88.79
I(1,2,3-cd)p	1.921	1.512	t	-21.27	119.02	95.93
HCb	0.193	0.278	kg	44.25	126.20	141.81
PCB	8.375	4.223	kg	-49.58	118.66	43.65

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

The uncertainty was highest for the all POPs and heavy metals. The main reason is high emission factors uncertainty for energy activities. Ammonia also showed a bit higher uncertainty than others did, with uncertainties about 100%. Uncertainties of the pollutant trend were highest for the PAHs.

1.8. General Assessment of Completeness

Next two tables present which sources of pollution in emissions inventory are not estimated or are included elsewhere.

Table 1.6 Sources not estimated (NE)

NFR14 code	Substance(s)	Reason for not estimated
1A3bi	Hg, As	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 11.3 generates and fills NFR table (including notation keys NE).
1A3bii	Hg, As	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 11.3 generates and fills NFR table (including notation keys NE).
1A3biii	Hg, As	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 11.3 generates and fills NFR table (including notation keys NE).
1A3biv	Hg, As	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 11.3 generates and fills NFR table (including notation keys NE).
1A3bv	PCDD/PCDF, PAHs, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 11.3 generates and fills NFR table (including notation keys NE).
1A3bvi	Hg, As, PAHs, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 11.3 generates and fills NFR table (including notation keys NE).
1A3bvii	Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PAHs, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 11.3 generates and fills NFR table (including notation keys NE).

NFR14 code	Substance(s)	Reason for not estimated
1A4ciii	NH ₃ , PAHs	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
2D3a	PM _{2.5} , PM ₁₀ , TSP	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
2D3e	PM _{2.5} , PM ₁₀ , TSP	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
2D3f	PM _{2.5} , PM ₁₀ , TSP	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
2D3h	PM _{2.5} , PM ₁₀	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
3F	All	Will be calculated for the next year's submission
5A	NH ₃ , CO, Hg	Will be calculated for the next year's submission
5B1	NO _x , NMVOC, PM _{2.5} , PM ₁₀ , TSP, BC	NO _x and NMVOC emissions will be calculated for the next year's submission. For the particulates emissions have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5B2	PM _{2.5} , PM ₁₀ , BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5C1bv	BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5C2	NH ₃ , Se, I(1,2,3-cd)p	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5E	BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
1A3di(i)	NH ₃	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013

Table 1.7 Sources included elsewhere (IE)

NFR14 code	Substance(s)	Included in NFR code
1A2a	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2b	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2c	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2d	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2e	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2f	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A3bii	HCB, PCBs	1A3bi
1A3biii	HCB, PCBs	1A3bi
1A3biv	HCB, PCBs	1A3bi
1A3bvi	BC	1A3bi-1A3biv
1A5a	All	1A4ai
1A5b	All	1A4aii
2A1	All, partially TSP, PM ₁₀ , PM _{2.5}	1A2f

NFR14 code	Substance(s)	Included in NFR code
2A2	All, partially TSP, PM ₁₀ , PM _{2.5}	1A2f
2A3	PM _{2.5} , PM ₁₀ , TSP	1A2f
3B4d	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP	3B2
3B4giii	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP	3B4giv
3Da2a	NH ₃	3B1a, 3B1b, 3B2, 3B3
5C1a	All	1A1a
5C1biii	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn	5C1bi



Source: www.mitramark.com

2. POLLUTANTS EMISSION TRENDS

Pollutants emission trends

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

Estimates are available as follows:

- NO_x, SO₂, NH₃, NMVOC, CO, TSP: 1990-2014
- PM₁₀ and PM_{2.5}: 2000-2014
- BC: 2000-2014
- All heavy metals: 1990-2014
- POPs: 1999-2014

Table 2.1 Main pollutant emissions in the period of 1990-2014 (kt)

Year	NO _x	NMVOC	SO ₂	NH ₃	CO	PM _{2.5}	PM ₁₀	BC	TSP
1990	76.250	67.077	272.392	27.040	215.002	NR	NR	NR	274.421
1991	70.379	64.348	250.097	24.301	215.150	NR	NR	NR	274.482
1992	45.431	43.790	190.995	20.759	120.695	NR	NR	NR	246.795
1993	41.529	36.152	155.543	16.287	122.460	NR	NR	NR	194.228
1994	45.807	38.552	150.048	13.396	157.647	NR	NR	NR	168.795
1995	46.919	43.401	115.736	12.196	212.389	NR	NR	NR	126.638
1996	51.369	43.858	124.705	11.019	235.815	NR	NR	NR	114.232
1997	50.371	46.146	115.933	11.269	248.316	NR	NR	NR	91.149
1998	45.210	40.002	104.158	11.304	195.739	NR	NR	NR	82.280
1999	43.235	39.602	97.779	9.921	203.911	NR	NR	NR	81.128
2000	44.067	38.603	97.108	10.048	194.893	15.296	31.765	3.418	68.596
2001	46.036	38.088	90.705	10.227	197.129	16.227	31.711	3.703	66.770
2002	46.743	37.248	87.029	9.952	186.495	16.597	27.606	3.890	46.292
2003	47.462	35.789	100.320	10.929	176.586	14.234	23.748	3.660	41.848
2004	44.460	35.383	88.175	11.159	169.493	15.334	23.887	3.780	39.015
2005	40.898	33.202	76.246	10.625	153.430	14.105	21.516	3.440	31.716
2006	39.464	31.531	69.900	10.905	138.767	9.657	15.206	2.486	22.742
2007	43.731	29.258	88.034	11.204	154.685	12.588	21.736	2.988	28.475
2008	40.852	27.159	69.477	12.516	155.011	11.802	17.705	3.072	23.275
2009	35.396	24.589	54.876	11.770	153.947	9.545	14.664	2.542	19.127
2010	41.748	24.217	83.273	12.093	154.769	13.852	22.858	3.147	27.795
2011	39.901	23.778	72.768	12.267	130.281	18.131	33.918	3.468	40.433
2012	36.563	23.465	40.626	12.799	140.410	8.127	12.548	2.136	17.289
2013	33.853	22.875	36.533	12.850	133.628	10.715	16.693	2.500	19.950
2014	33.334	22.536	40.839	13.042	126.519	7.777	12.496	1.937	16.650
Trend 1990-2014, %	-56.3	-66.4	-85.0	-51.8	-41.2	-49.2	-60.7	-43.3	-93.9

2.1. Sulphur dioxide

During the period of 1990-2014, the emissions of sulphur dioxide had decreased by about 85%, 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 185 PJ in 2014) (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 noticeably decreased. 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.

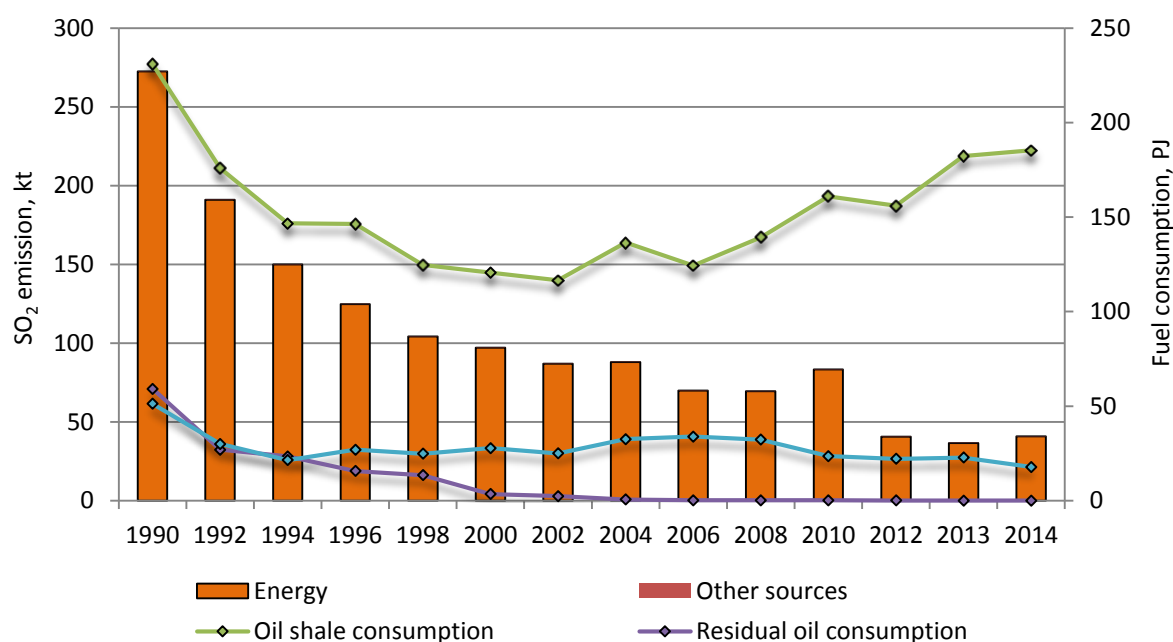


Figure 2.1 SO₂ emissions in the period of 1990-2014

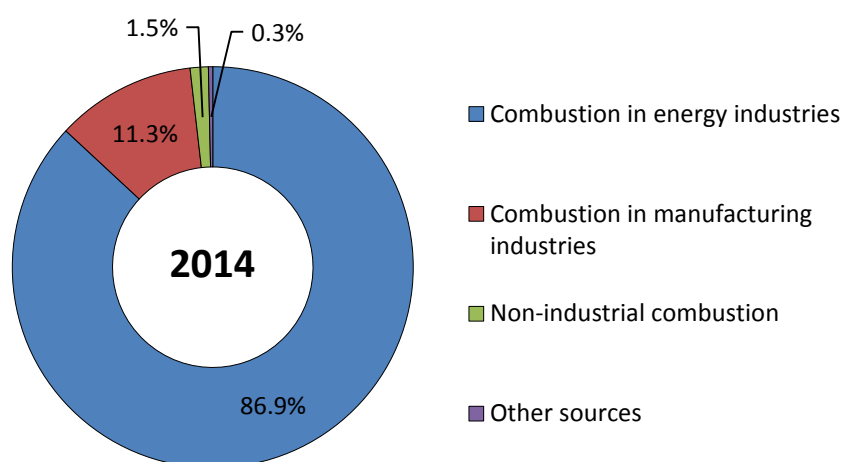


Figure 2.2 SO₂ emissions by sources of pollution in 2014

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.

When Estonia became a member of the EU in 2004, Estonia took the responsibility with the Accession Treaty to the EU to make all efforts to ensure that in 2012 SO₂ emissions from oil shale fired combustion plants do not exceed 25,000 tonnes and progressively decrease thereafter. Unique sulphur scrubbers designed in the course of five years of research and development were installed in the Narva PP 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 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 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 2012, SO₂ emissions from the oil shale power plants did not exceed 25 thousand tonnes.

In 2014, SO₂ emissions had increased about 12% compared to 2013. Increase in emissions has happened as a result of 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).

The share of energy sector in total SO₂ emission is 99.9%; the combustion in energy industry (NFR 1.A.1.a-c) is responsible for about 87% of total emissions in 2014 (Figure 2.2). The share of SO₂ emissions from the two large oil shale plants - Narva PP (Eesti and Balti) – accounts for approximately 59% of total emissions.

2.2. Nitrogen oxides

Emissions of nitrogen oxides have decreased by 56.3% compared to 1990 (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% and 25% respectively. The share of other mobile sources was 19% and non-industrial combustion – 16% in 2014 (Figure 2.4).

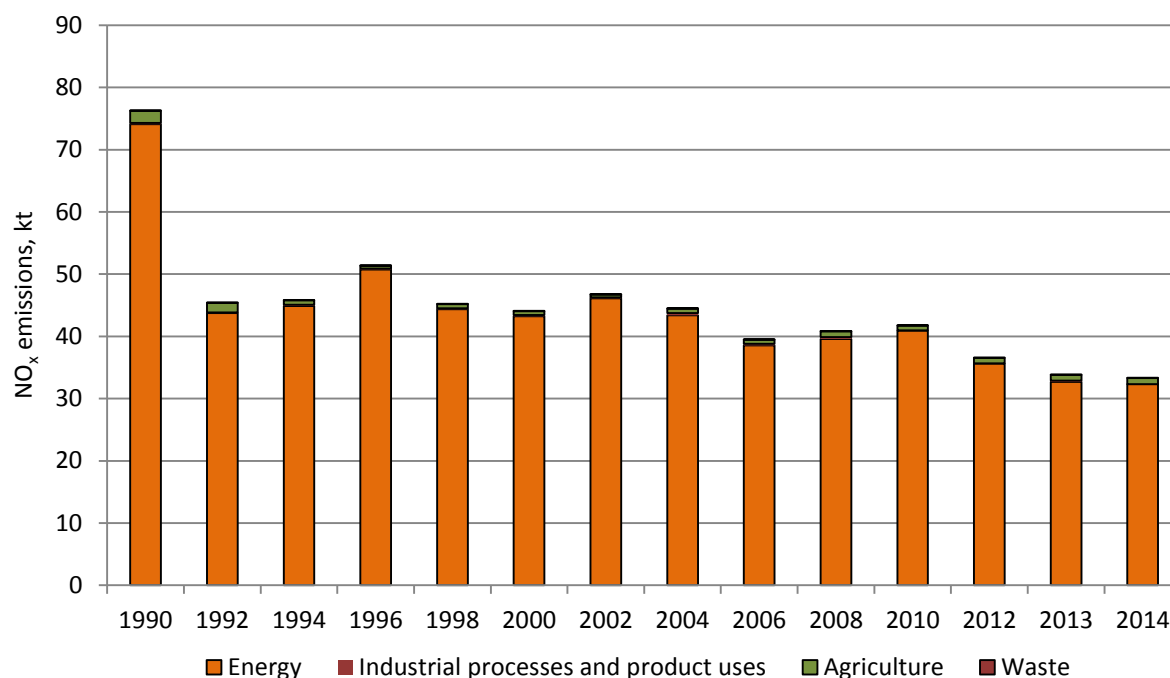


Figure 2.3 NO_x emissions in the period of 1990-2014

In 2014, NO_x emissions decreased 1.5% compared to 2013 mainly due to the small reduction in energy sector emission 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”)

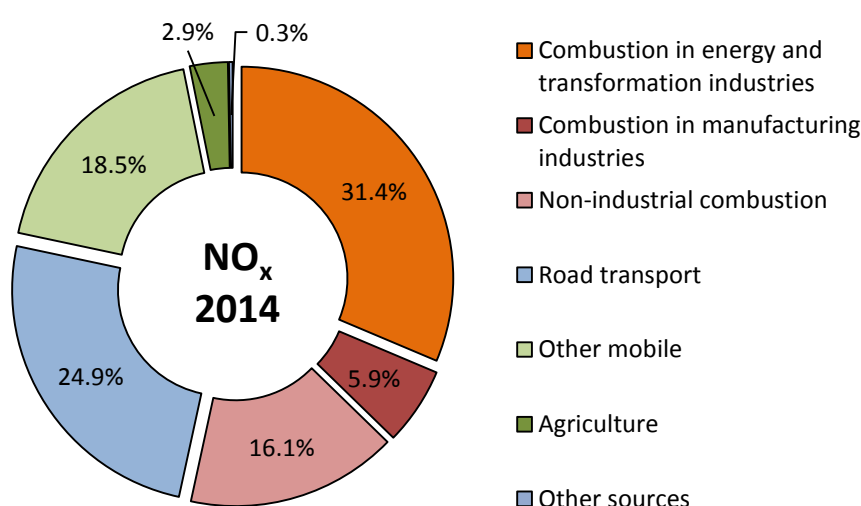


Figure 2.4 NO_x emissions by sources of pollution in 2014

2.3. Non-methane volatile compounds

In 2014, NMVOC emissions decreased 1.5% compared to 2013, mainly due to a decrease in biomass consumption in residential combustion plants. The decrease in emissions for the same period was observed in the road transport and stationary fuel combustion (20% and 8.7% respectively) (Figure 2.5). In the same time, the NMVOC emission from agriculture increased by 4.8% mainly due to the increase in non-dairy livestock.

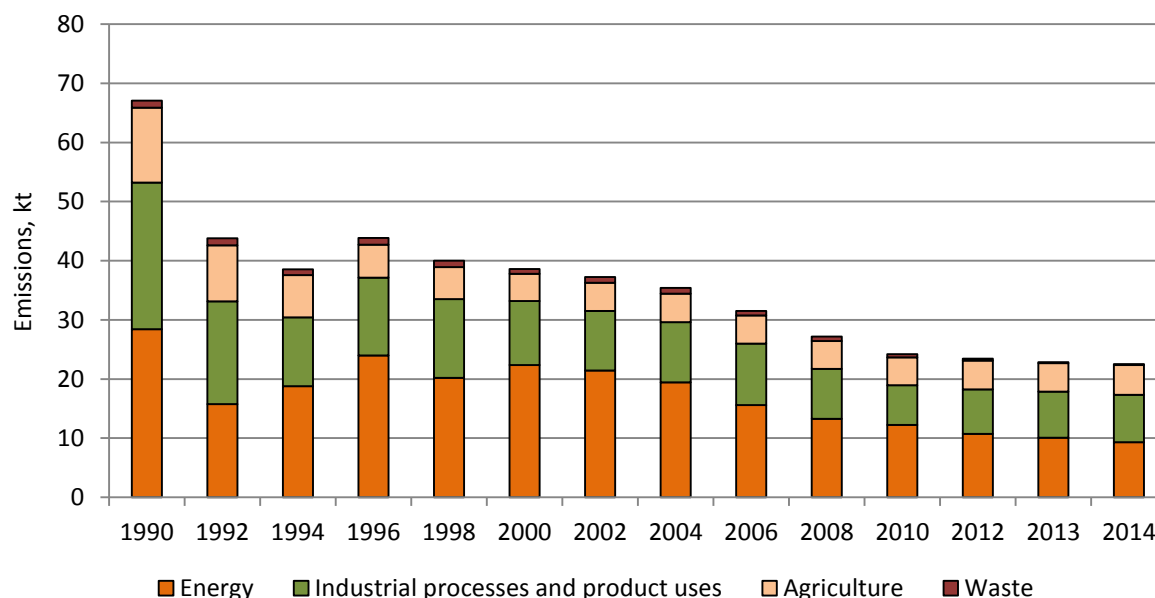


Figure 2.5 Emissions of non-methane volatile organic compounds in the period of 1990-2014

The total emissions of non-methane volatile organic compounds decreased by 66.4% between 1990 and 2014 (Table 2.1). In 1990, the main polluters of NMVOC were industrial processes and product uses (37%) and road transport (26%). In 2014, the dominant source was the same - industrial processes and product uses sector, but share of non-industrial combustion has increased from 6% to 16% and share of road transport has decreased from 26% to 8%. The primary reason for this change was a decline in the use of motor fuel in the transport sector and an increase in the consumption of diesel compared to petrol. Secondly, during the period of 1990–2013, 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).

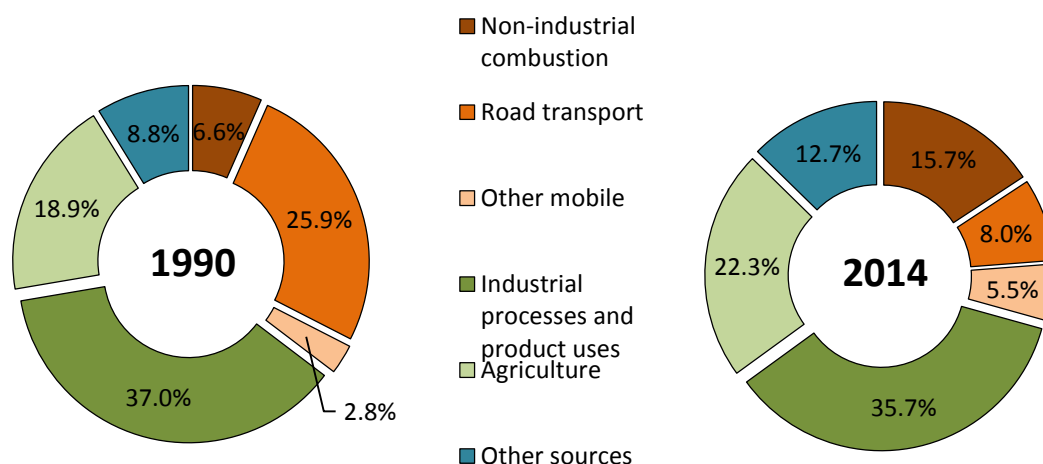


Figure 2.6 NMVOC emissions by sources of pollution in 1990 and 2014

2.4. Ammonia

Total NH_3 emissions decreased by 51.8% between the years 1990 to 2014 due to a reduction in the number of animals and the use of fertilisers (Figure 2.7). Livestock manure management and mineral fertiliser use are the main sources of pollution regarding ammonia (about 93.3%). The non-industrial combustion sector is responsible for the 2.6% of total emissions, road transport makes up 1.2% and fugitive emissions from solid fuels (oil shale open cast mining, mainly explosive works) account for approximately 1.5%. The ammonia emissions from road transport have increased in recent years due to a growth in new car usage. All other sectors (manufacturing industry, waste, energy industry) account for approximately 1.4% of total ammonia emissions (Figure 2.8).

In 2014, the emissions of NH_3 increased by 1.5% compared to 2013, mainly due to the increase in non-dairy livestock.

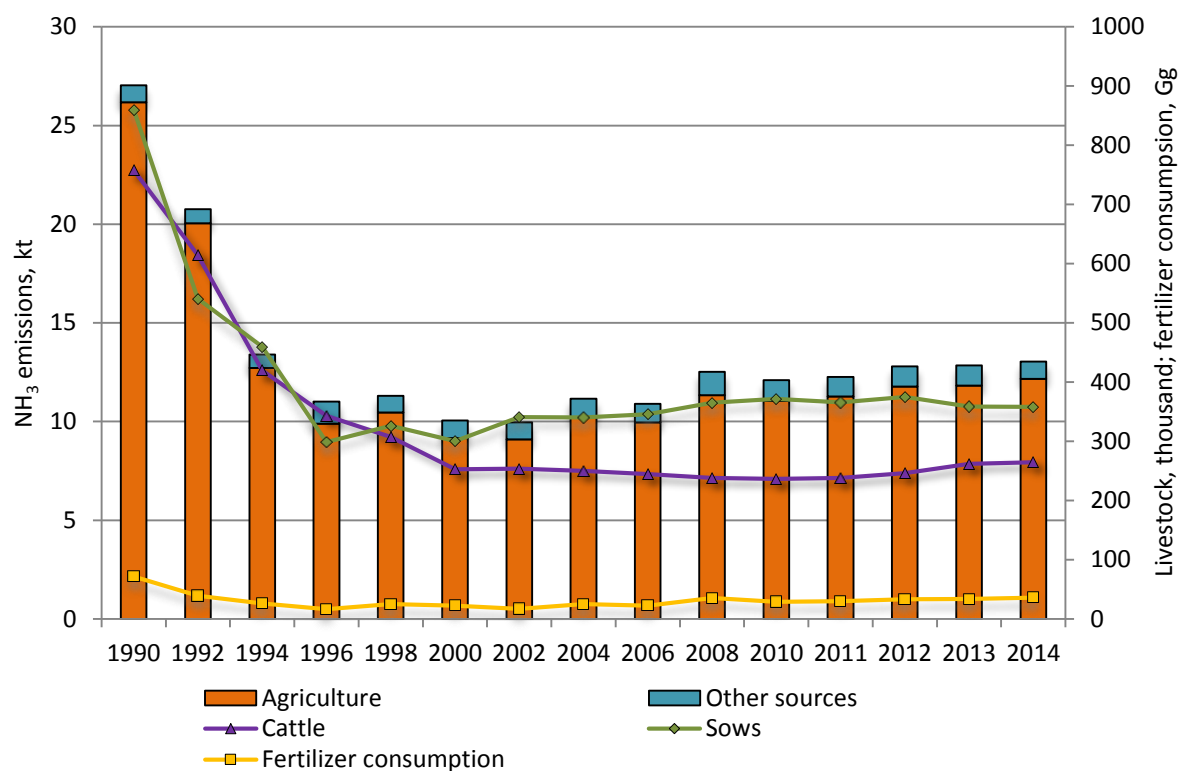


Figure 2.7 Emissions of ammonia in the period 1990-2014

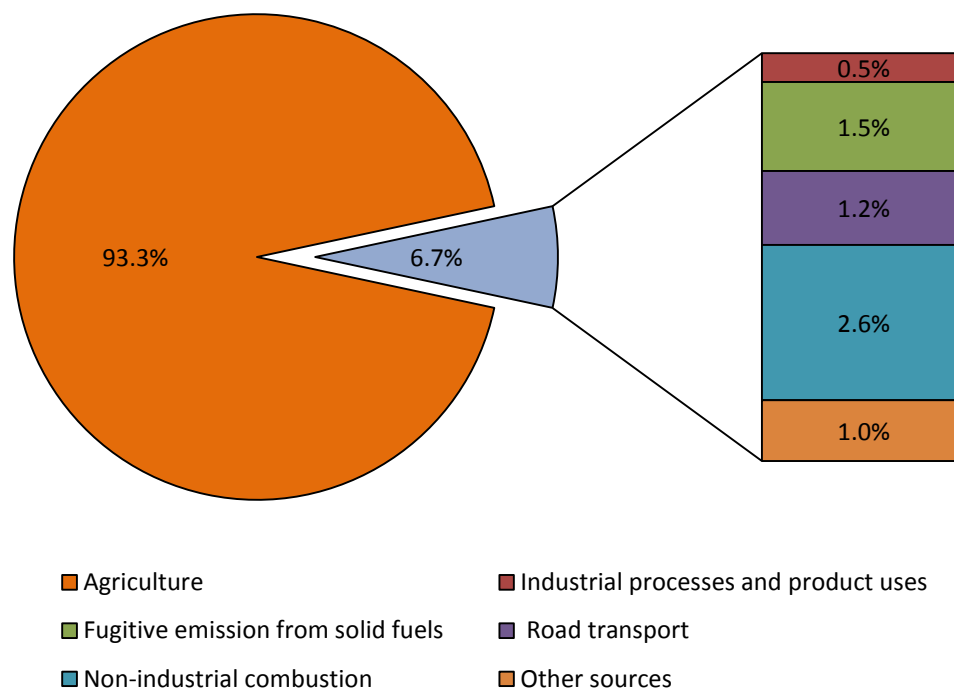


Figure 2.8 Ammonia emissions by sources of pollution in 2014

2.5. Carbon monoxide

In the period 1990-2014, the emissions of carbon monoxide decreased by 41.2%. 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 using petrol. The increase in emissions from 1994 to 1996 is caused by a growth in the burning of wood in the household sector (Figure 2.9).

In 1990, the main polluters of carbon monoxide were road transport (56.8%), while in 2014 the dominant source was non-industrial combustion (55.4%) (Figure 2.10). The primary reason for this change was a decrease in the use of motor fuel in the transport sector and an increase in the consumption of diesel compared to petrol. 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 8.4% to 25.6%, mainly due to an increase in shale oil production in Eesti Energia Õlitööstus AS (Eesti Energia Oil Industry) plant.

In 2014, the biggest polluters of CO were combustion in the non-industrial sector (about 55%, from which a large part is wood combustion in the domestic sector), combustion in the energy industry (26%, mainly from shale oil production industry) and road transport – 10% (Figure 2.10).

In 2014, carbon monoxide emissions decreased 5.3% compared to 2013 mainly due to a reduction in motor fuel and wood combustion in the energy sector.

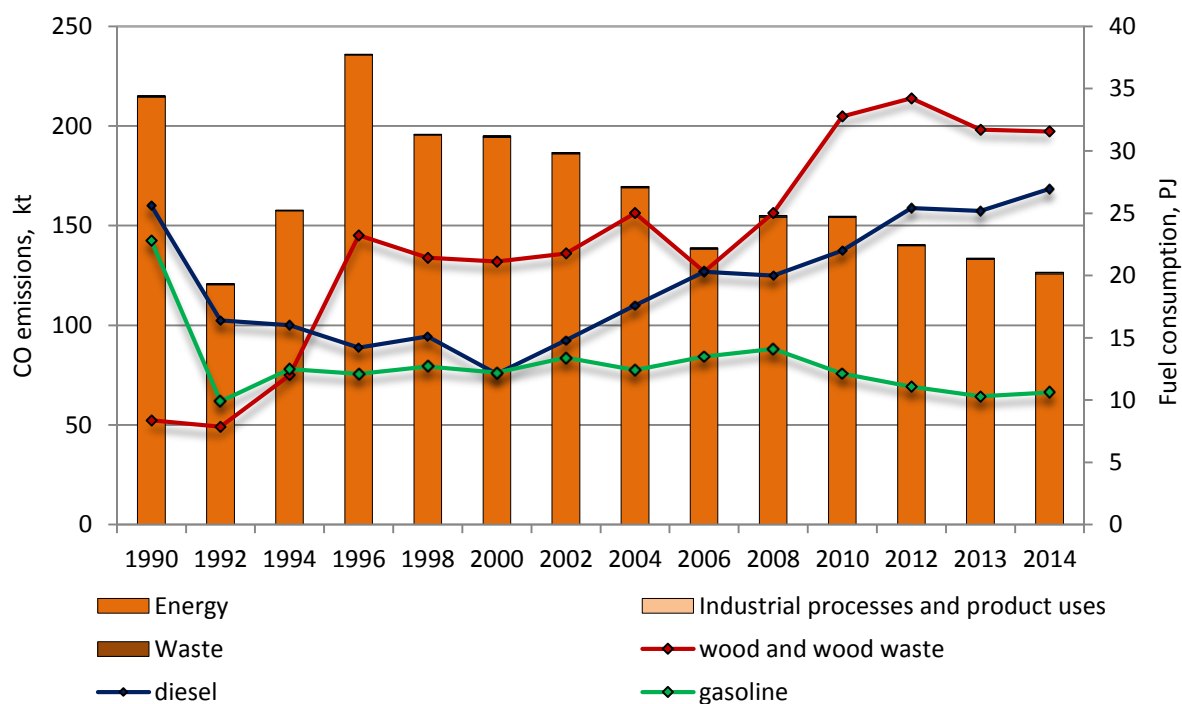


Figure 2.9 Emissions of carbon monoxide in the period 1990-2014

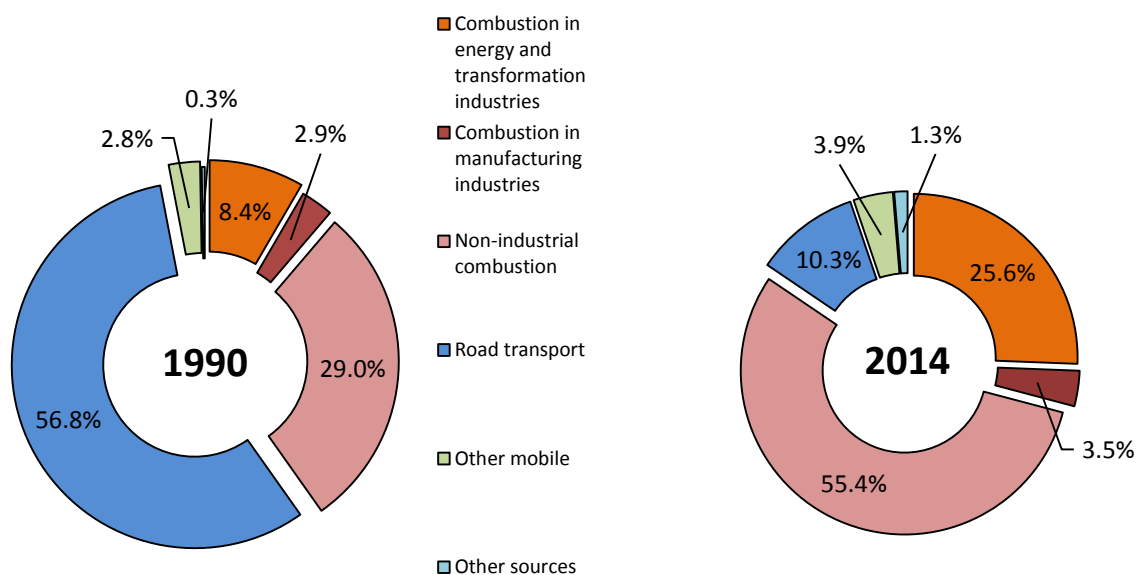


Figure 2.10 CO emissions by sources of pollution in 1990 and 2014

2.6. Particulates

The main source of particulate is the energy sector – 81.3%. The emissions of TSP by sectors of pollution are shown in Figure 2.12.

In 1990–2014, TSP emissions dropped significantly – by 93.9% (Figure 2.11 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 was the result of 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 2014, particulate emissions decreased 16.5% compared to 2013, mainly due to the decrease of emissions in Eesti Energia Narva Elektriijaamad AS and the decrease of non-industrial combustion at the same period.

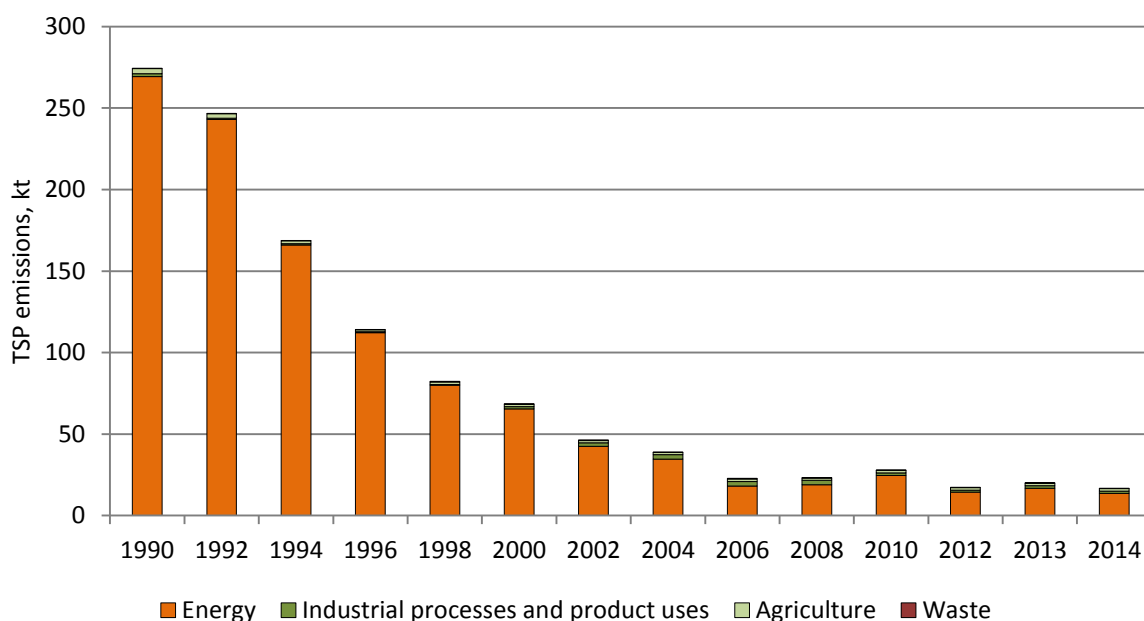


Figure 2.11 TSP emissions in the period 1990-2014

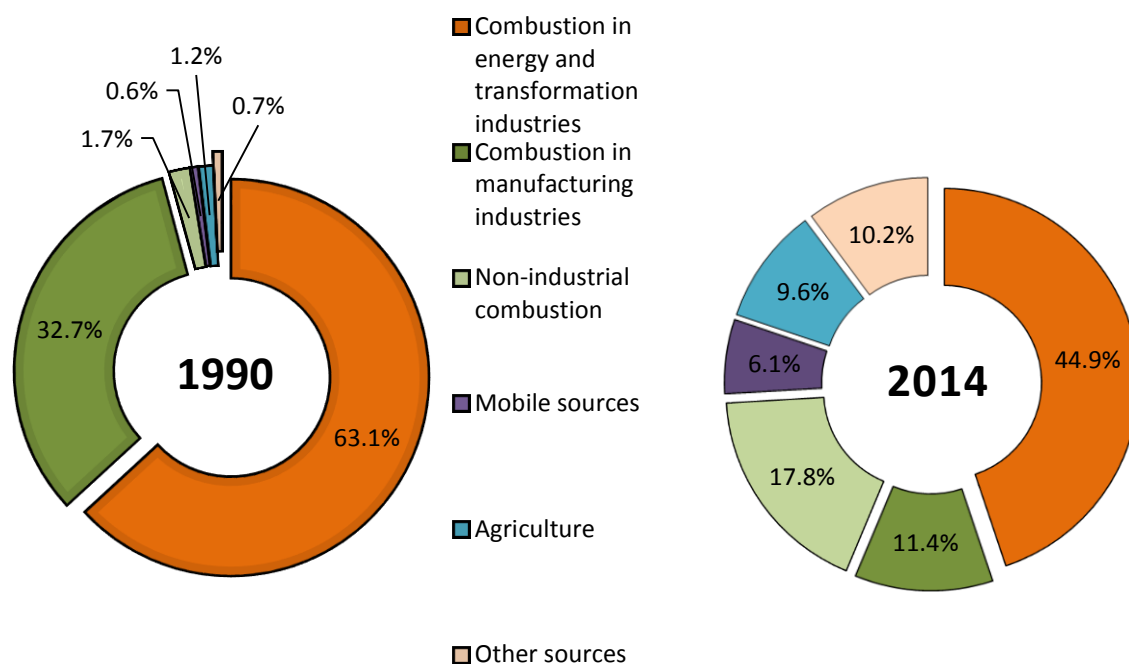


Figure 2.12 TSP emissions by sources of pollution in 1990 and 2014

In 1990, the main polluters of TSP were the energy industry (63%) and combustion in manufacturing industries (33%). In 2014, the dominant source was also combustion in energy industries, but it dropped to 45%, the share of industrial combustion has decreased by 20%, while the share of non-industrial combustion and mobile sources had increased by 16% and 9% respectively compared to 1990 (Figure 2.12). 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 one of the oil shale power plants. Other sources contribute to 20% of the total emissions from which approximately 50% is agriculture.

The emissions of fine particulates PM₁₀, PM_{2.5} and BC are shown in Figure 2.13.

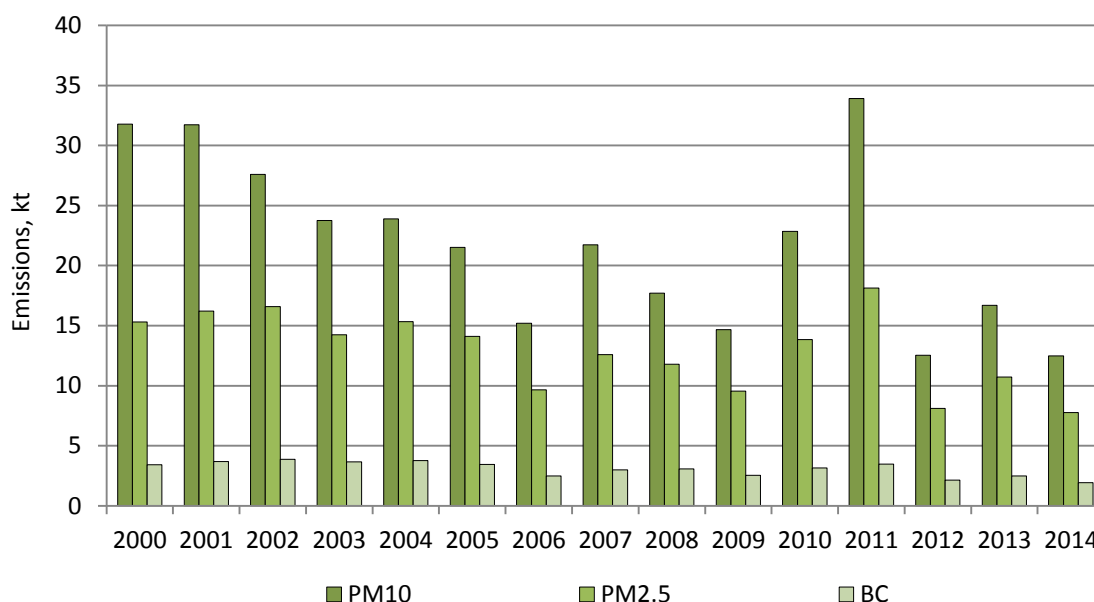


Figure 2.13 PM₁₀, PM_{2.5} and BC emissions in the period 2000-2014

Emission of black carbon for all activities was calculated in this submission for 2000–2014. The new EMEP/EEA Guidebook 2013 methodology was applied when making the calculations.

In the period of 2000–2014, the emissions of PM₁₀, PM_{2.5} and BC decreased by 60.7%, 49.2% and 43.3% respectively, despite the increase in electricity production at the same period.

The decrease in the PM₁₀, PM_{2.5} and BC emissions in 2014 compared to 2013 (25%, 27% and 23% respectively) was mainly due to the decrease in electricity production Eesti Energia Narva Elektriijaamad AS.

The primary sources of fine particulates (PM₁₀) emission in 2014 were combustion in energy and transformation industries (45%, mainly oil shale combustion) and non-industrial combustion (34%, mainly wood combustion) (Figure 2.14). The distribution of PM_{2.5} and BC emissions by sources of pollution is also visible in Figures 2.14 and 2.15. It is interesting to note that if the non-industrial combustion (generally wood combustion in domestic sector) share in TSP emissions makes up 18% of the total emissions, then share in emissions of BC is significantly higher and makes up 46%.

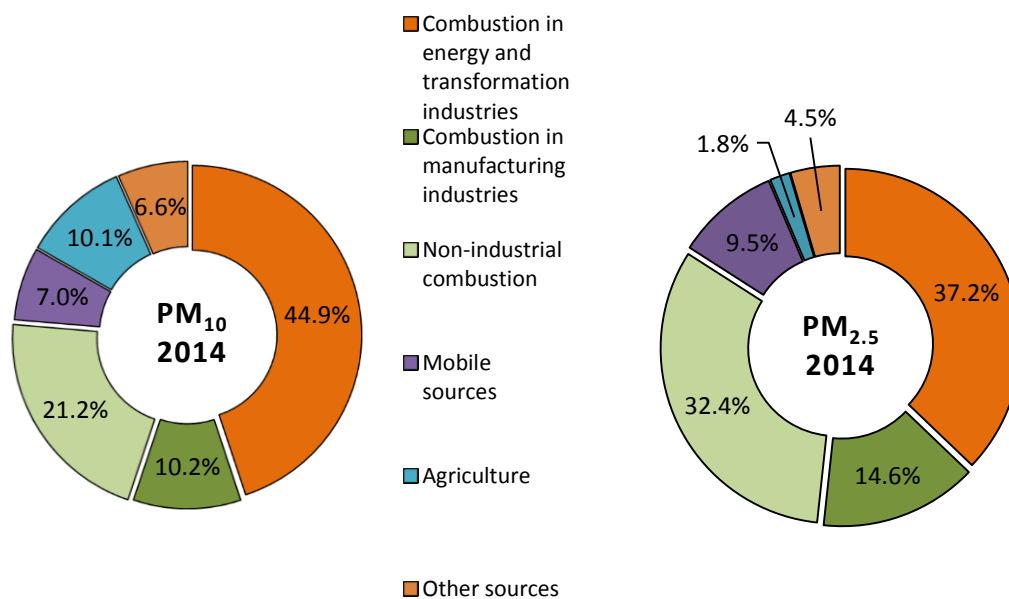


Figure 2.14 PM₁₀ and PM_{2.5} emission by activities in 2014

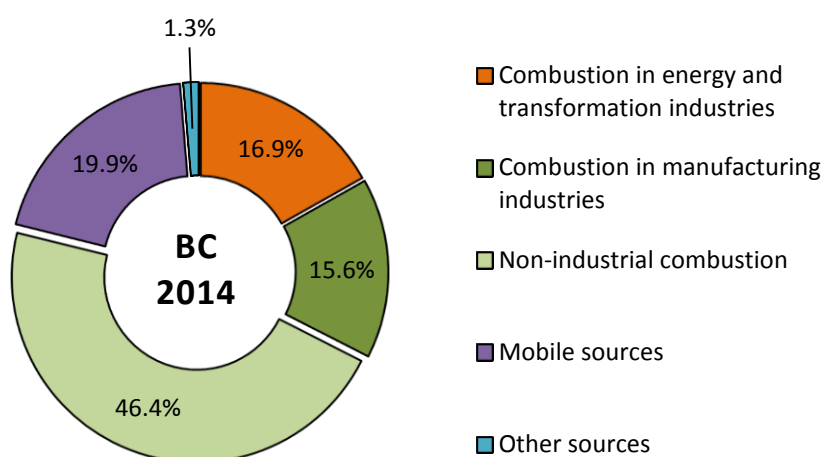


Figure 2.15 Black carbon emission by activities in 2014

The primary sources of black carbon emission in 2014 were non-industrial combustion (46.4%), mobile sources (20%), combustion in energy and transformation industries (17%, mainly oil shale combustion) and combustion in manufacturing industry (15.6%) (Figure 2.15). Other sources are mainly industrial processes.

2.7. Heavy metals

In 1990–2014 emissions of heavy metals dropped significantly as can be seen in Table 2.2 and Figure 2.16.

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 82.3% 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. (Figure 2.18)

Table 2.2 Heavy metal emissions in the period 1990-2014 (kt)

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
1990	206.003	4.505	1.154	18.867	18.395	10.059	27.325	106.843
1991	188.693	4.297	1.044	16.467	16.025	9.326	25.543	97.860
1992	124.688	3.089	0.857	14.048	13.798	6.658	16.953	79.791
1993	103.094	2.312	0.674	10.856	10.471	5.436	14.313	62.413
1994	123.334	2.975	0.676	10.698	10.324	5.934	12.835	65.582
1995	86.266	2.180	0.637	10.083	9.956	5.042	10.460	63.989
1996	66.746	1.306	0.633	10.376	10.225	4.593	10.824	62.499
1997	47.443	1.345	0.639	10.221	9.968	4.589	9.718	62.504
1998	40.115	1.223	0.572	9.166	8.905	4.184	8.765	55.719
1999	40.133	1.158	0.547	8.728	8.502	4.060	7.481	53.551
2000	36.944	0.774	0.550	8.607	8.354	3.728	6.448	49.900
2001	37.024	0.745	0.535	8.399	8.231	4.011	6.397	49.730
2002	36.351	0.771	0.539	8.372	8.351	4.172	6.163	49.124
2003	38.451	0.841	0.619	9.998	9.820	4.503	6.768	57.547
2004	36.770	0.786	0.569	9.794	9.386	4.549	6.650	57.766
2005	35.624	0.762	0.548	9.794	9.093	4.606	6.430	53.497
2006	32.127	0.729	0.550	8.603	8.464	4.517	5.749	49.057
2007	40.487	0.901	0.679	11.085	10.791	5.232	6.724	62.157
2008	35.363	0.829	0.598	9.416	9.329	4.741	5.902	55.386
2009	28.448	0.709	0.468	7.610	7.543	4.025	4.829	46.523
2010	39.030	0.897	0.653	10.971	10.594	4.966	6.587	62.733
2011	38.485	0.859	0.657	10.889	10.418	4.894	6.415	60.717
2012	33.979	0.793	0.579	9.605	9.178	4.724	5.637	55.047
2013	39.453	0.966	0.689	11.244	10.583	5.015	6.496	62.561
2014	36.547	0.898	0.679	10.254	9.849	5.048	6.023	57.481
Trend 1990-2014, %	-82.26	-80.07	-41.14	-45.65	-46.46	-49.82	-77.96	-46.20

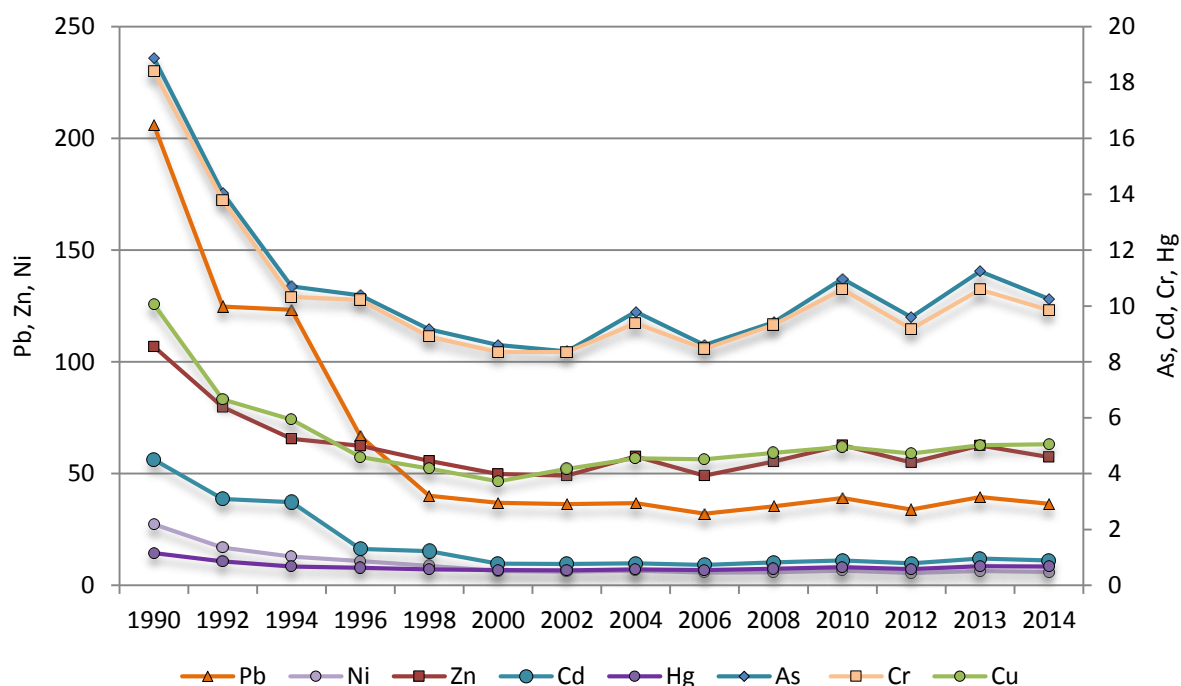


Figure 2.16 Heavy metals emissions in the period 1990-2014 (t)

The emissions of lead by sources of pollution in 1990 and 2014 are shown in Figure 2.17. The distribution of emissions by sector has considerably changed over the last 20 years. While in 1990 the main sources of lead pollution were almost equally transport, energy and industrial combustion (mainly cement manufacturing), in 2014 the main source of pollution by all heavy metals was the energy industry (mainly oil shale power plants).

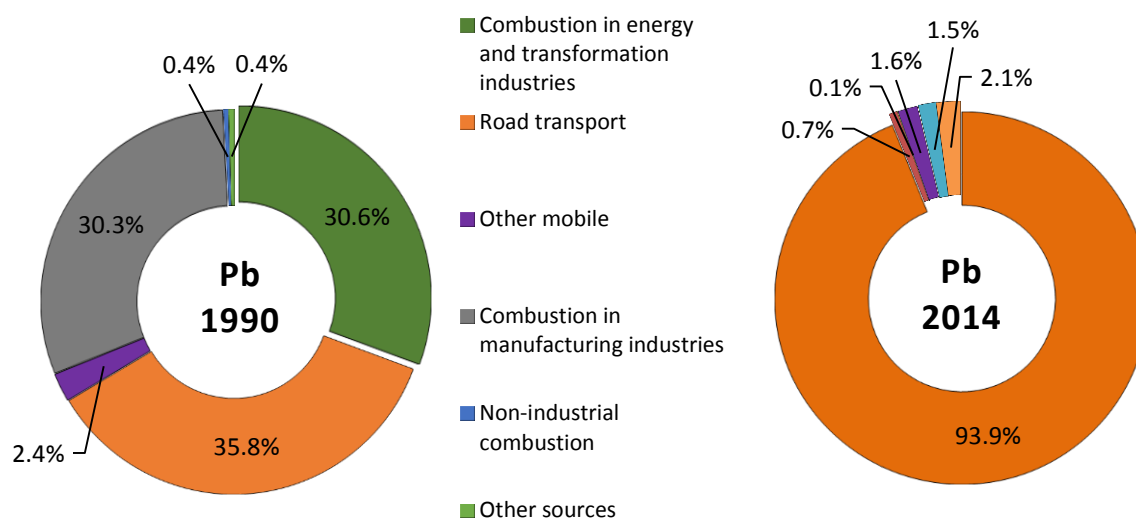


Figure 2.17 Lead emission by sources of pollution in 1990 and 2014

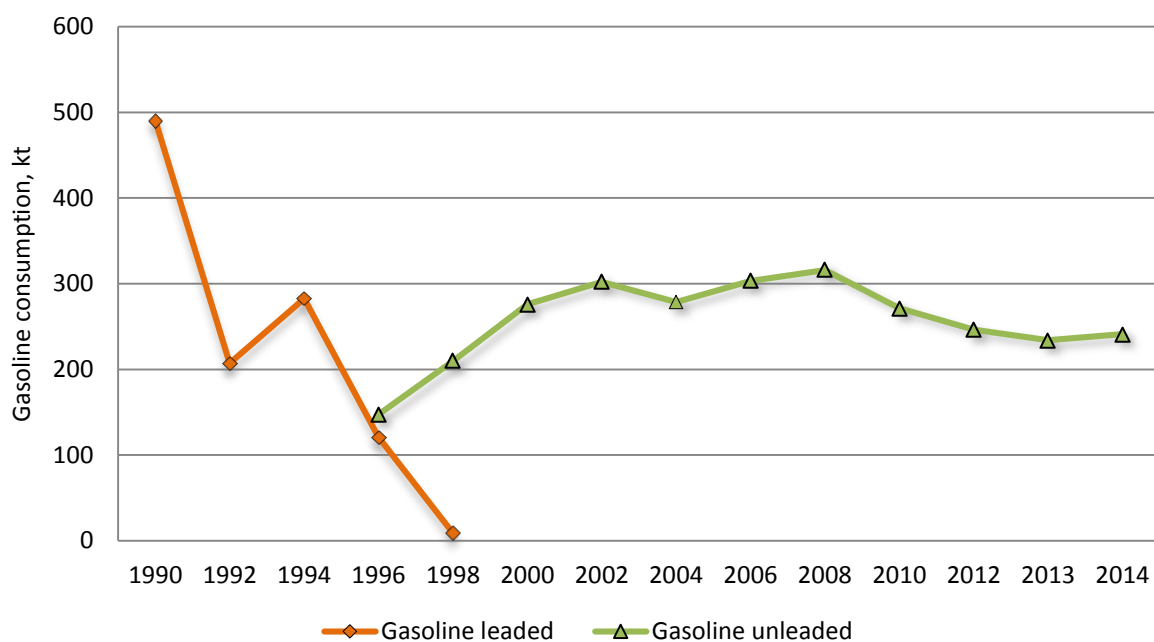


Figure 2.18 Gasoline consumption in 1990-2014

2.8. Persistent organic pollutants

The emissions of POPs are shown in Table 2.3 and Figure 2.19.

Table 2.3 POPs emission in the period 1990-2014

Year	PCDD/ PCDF	B(a) p	B(b)f	B(k)f	I(1,2,3- cd)p	PAHs, total	HCB	PCB
	g I-Teq	t					kg	
1990	8.069	2.544	2.837	1.664	1.921	8.967	0.193	8.375
1991	7.958	2.467	2.831	1.602	1.777	8.677	0.187	8.539
1992	5.334	1.651	1.807	1.040	1.206	5.705	0.164	5.609
1993	4.235	1.397	1.491	0.898	1.085	4.871	0.143	8.808
1994	4.199	1.748	1.778	1.128	1.510	6.164	0.214	5.149
1995	5.593	2.825	2.758	1.829	2.619	10.031	0.333	4.122
1996	6.303	3.253	3.213	2.130	3.050	11.646	0.370	4.725
1997	6.289	3.246	3.201	2.125	3.059	11.632	0.382	4.317
1998	7.082	2.648	2.663	1.713	2.422	9.446	0.330	4.350
1999	7.096	2.598	2.654	1.681	2.357	9.291	0.315	3.773
2000	6.737	2.446	2.478	1.571	2.241	8.736	0.317	2.620
2001	6.556	2.351	2.449	1.505	2.099	8.405	0.322	4.197
2002	6.885	2.340	2.426	1.502	2.096	8.365	0.305	4.002
2003	6.876	2.345	2.453	1.475	2.066	8.338	0.312	4.756
2004	6.177	2.437	2.601	1.513	2.030	8.581	0.341	3.711
2005	5.731	2.232	2.442	1.357	1.776	7.807	0.289	3.725
2006	5.041	2.236	2.063	1.186	1.475	6.960	0.257	3.046
2007	6.669	1.919	1.987	1.239	1.742	6.887	0.316	1.807
2008	6.704	2.039	2.112	1.275	1.801	7.227	0.333	2.803
2009	6.094	2.153	2.258	1.329	1.856	7.596	0.307	3.058

Year	PCDD/ PCDF	B(a) p	B(b)f	B(k)f	I(1,2,3- cd)p	PAHs, total	HCB	PCB
	g I-Teq	t					kg	
2010	6.410	2.400	2.607	1.443	1.955	8.405	0.347	4.176
2011	6.302	2.040	2.240	1.225	1.636	7.141	0.314	3.619
2012	4.733	2.055	2.255	1.243	1.652	7.204	0.329	3.480
2013	3.666	2.104	2.217	1.286	1.594	7.201	0.335	3.939
2014	3.932	2.022	2.297	1.183	1.512	7.014	0.278	4.223
Trend 1990-2014, %	-51.27	-20.51	-19.03	-28.94	-21.27	-21.77	44.25	-49.58

In the period 1990-2014 dioxin, PAHs total and PCB emissions decreased by approximately 51.3%, 21.8% and 49.6% respectively. Only HCB emissions increased for the same period by 44.2%, but decreased from 1995 to 2013 by 16.6% (Table 2.3). In this year's submission, all POPs emissions were recalculated for the Residential Stationary sector (the reasons and a detailed description are presented in the chapter on Energy).

The main source of PCB emission is oil shale combustion, which directly depends on the amount of burned fuel. The main sources of dioxin emission are the waste sector (31%, mainly industrial and clinical waste incineration), combustion in energy industries (29%, includes also waste combustion as fuel), non-industrial combustion sector (27%), road transport (8%) and combustion in the manufacturing industry (5%, includes also waste combustion as fuel, mainly in the cement manufacturing industry) (Figure 2.20).

The main contributor to the total PAHs and HCB emissions is the residential sector (48.7% and 59.1% respectively) (Figures 2.21 and 2.22), which is followed in second place by the energy sector. Currently, national POPs emission factors are being developed for the energy sector.

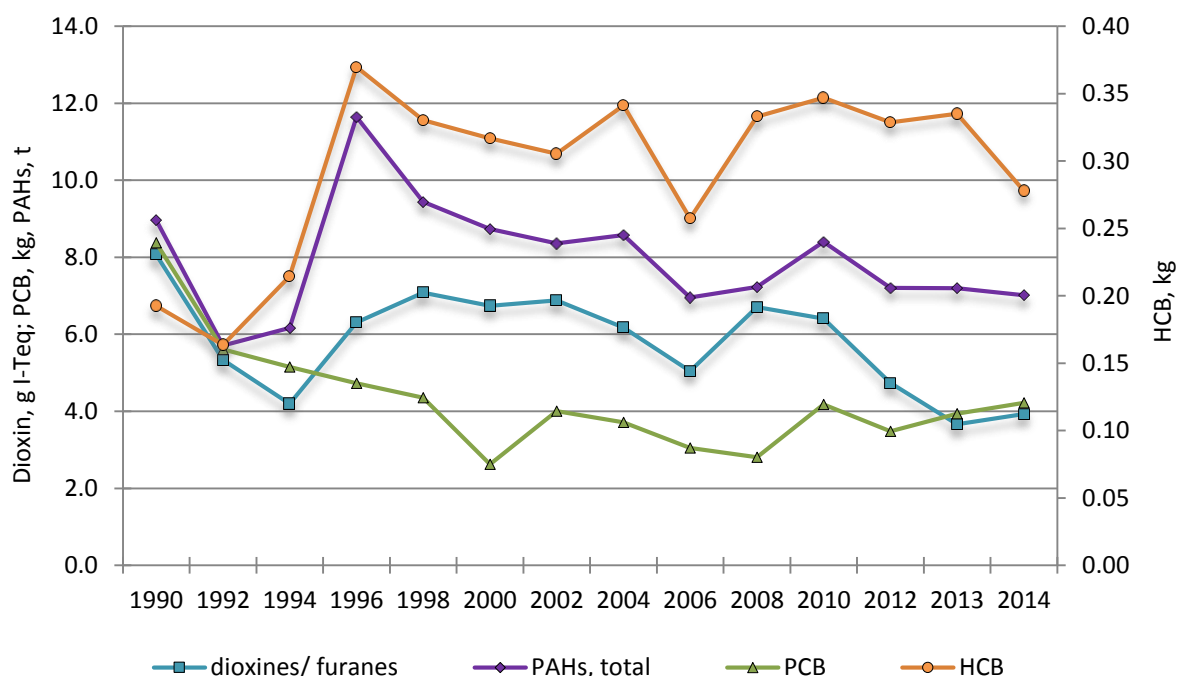


Figure 2.19 POPs emissions in the period 1990-2014

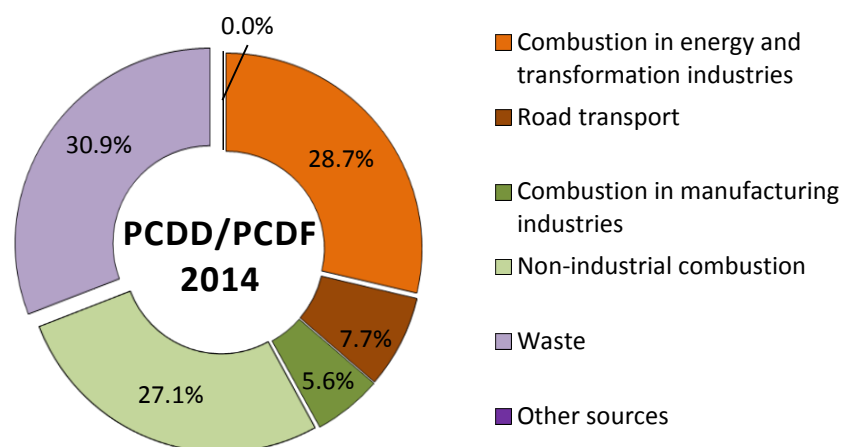


Figure 2.20 Dioxin (PCDD/PCDF) emissions by activities in 2014

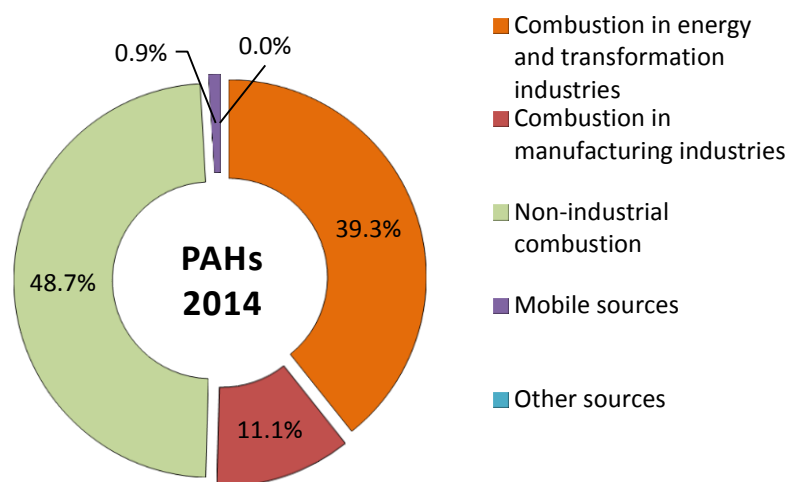


Figure 2.21 PAHs emissions by activities in 2014

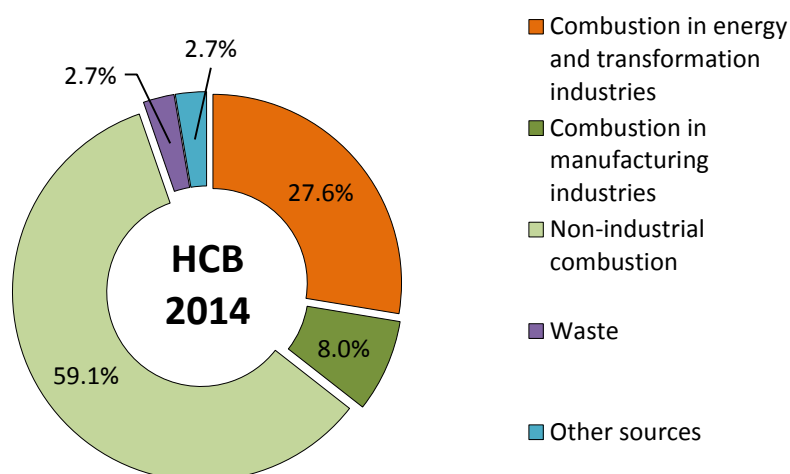
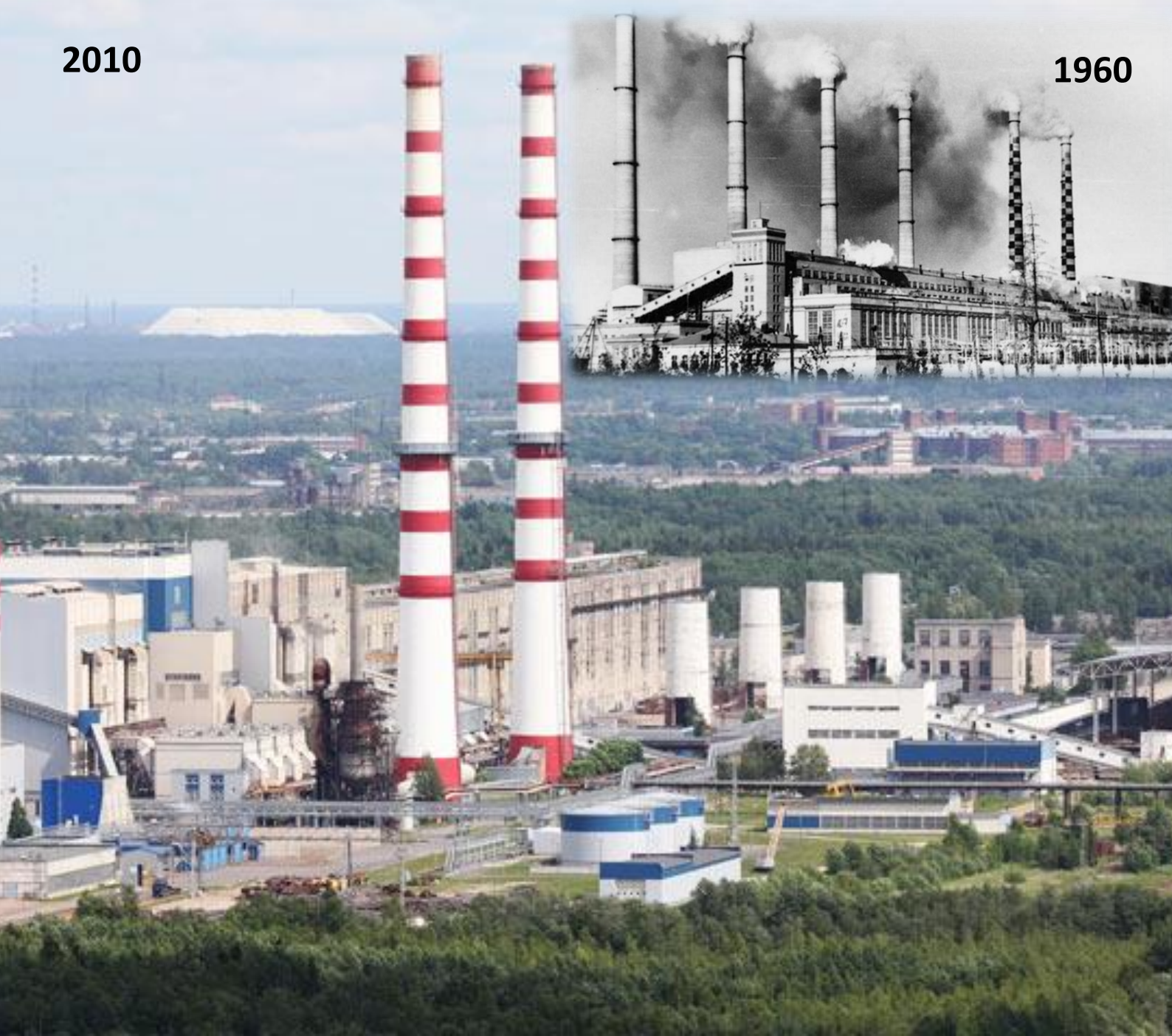


Figure 2.22 HCB emission by activities in 2014

2010

1960



Balti power plant in 1960 and in 2010 (Source: www.enerqia.ee)

3. ENERGY SECTOR (NFR 1)

Energy sector (NFR 1)

3.1. Overview of the sector

The energy sector is the main source of SO₂, NO_x, CO, particulates, HM and POPs in Estonia. In 2014, the energy sector contributed 99.9% of total SO₂ emissions, 96.9% of total NO_x emissions, 84% of PM₁₀ emissions, 58.7% of total NMVOC emissions, 99.5% of total CO emissions and 97.9% of Pb emissions (Figures 3.5, 3.6 and Table 3.1).

During the period 1990-2014, the emissions of sulphur dioxide from the energy sector decreased by approximately 85% and the emissions of nitrogen oxides by about 56% resulting from a decline in energy production (oil shale consumption as a main fuel in Estonia fell from 231 PJ in 1990 to 185 PJ in 2014) (Figures 3.1 and 3.2). 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 about 12% compared to 2013. Increase in emissions has happened as a result of 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 2014, NO_x emissions decreased 1.2% compared to 2013 mainly due to the small reduction in energy sector emission 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")

The TSP, PM₁₀ and PM_{2.5} emissions decreased in 2014 compared to 2013 by 19%, 28% and 28% respectively, which was mainly due to the decrease in electricity production in Eesti Energia Narva Elektriijaamad AS. Decrease in electricity production also was the reason of decrease in emissions of heavy metals and POPs. During the same period insignificant decrease in emissions in residential sector took place (Table 3.1).

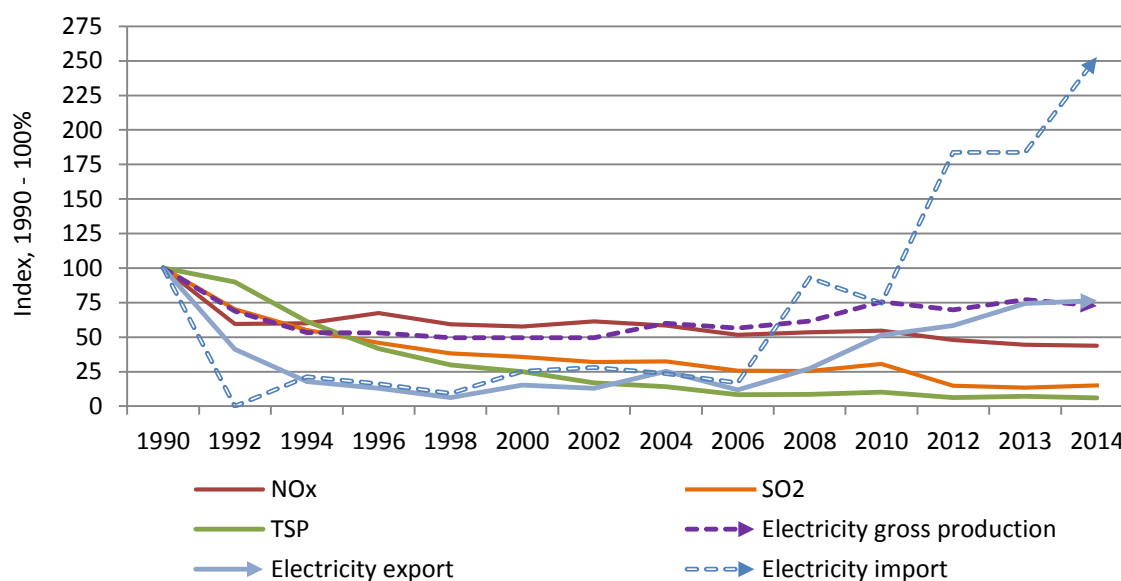


Figure 3.1 Pollutants emissions, electricity production and export in the period of 1990-2014

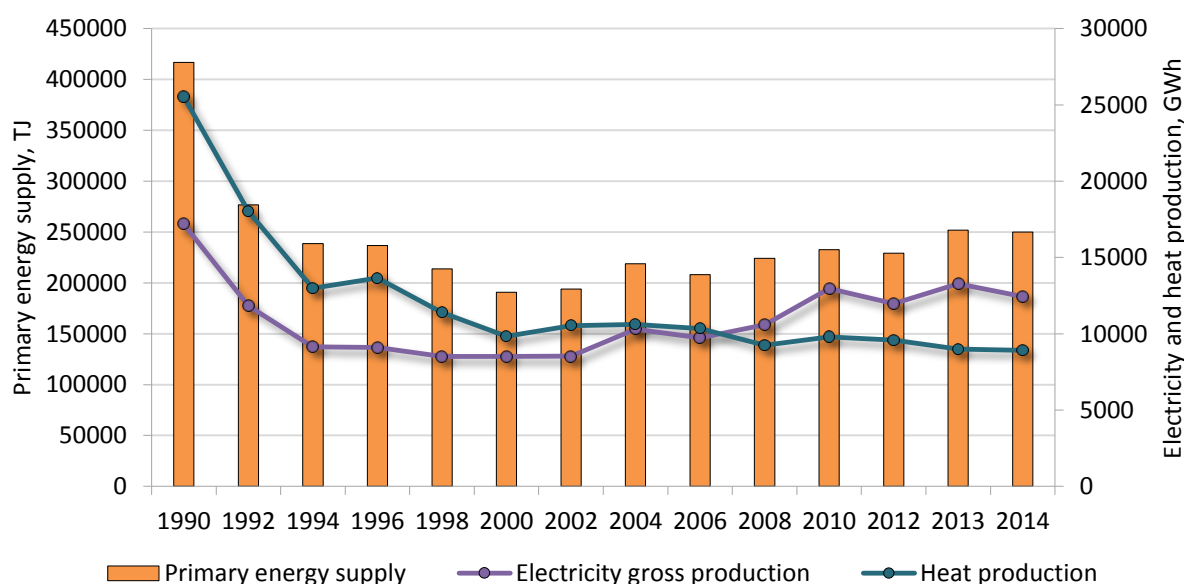


Figure 3.2 Total energy supply, electricity and heat production in the period of 1990-2014
(Source: Statistics Estonia)

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 2014, the share of domestic fuels – oil shale, wood and peat – accounted for approximately 85% (from which oil shale is about 72%) of the primary energy supply. Coal, natural gas and liquid fuels were imported in 2014 to Estonia. Imports of natural gas decreased about 22% compared to 2013. The imports of motor gasoline decreased 21% while imports of diesel decreased about 3% compared to the previous year. The imports of coal increased about 37.5% compared to 2013. Imported fuels (natural gas, fuel oils, coal and motor fuels) made up 13% (Figure 3.3).

According to the Estonian government, gas consumption fell from 1,003 mcm in 2007 to 632 mcm in 2012, a decrease of approximately 37%. This was partly due to the general

economic downfall, but the greatest impact came from the economic failure of the fertiliser producer Nitrofert AS in February 2009. In 2008 the share of industrial consumption was 39.7% of the total, while in 2009 it fell to 21.3%. The share of gas consumed by Nitrofert was close to 20% of the national consumption of gas. Nitrofert resumed operations in December 2012, although it remains to be seen whether it will scale up its ammonia and urea production to pre-2009 levels („Estonia 2013. Energy Policies Beyond IEA Countries. OECD/IEA 2013“). The main reason for the reduction of gas consumption by 22% in 2014 in comparison with 2013 was the termination of production of fertilizer.

Renewables formed 13.4% of the gross inland consumption in 2013, with wood fuel prevailing. 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. In 2014, the production of wind and hydro energy increased by 13.8% compared to 2013. The generation of hydro energy has been stable over the past three years. In 2005, electricity generated from renewable energy sources was only 1.3%, but in 2012 it accounted for 15.2%. The growth was due to the enlargement of the existing wind parks and the commissioning of new wood fuel-based combined heat and power plants. In 2012, the share of biofuels in total fuel consumption in transport was 0.84 % (Annual energy statistics, Statistical database). In 2014, 51% of the primary energy was used for the production of electricity and 15% for heat generation.

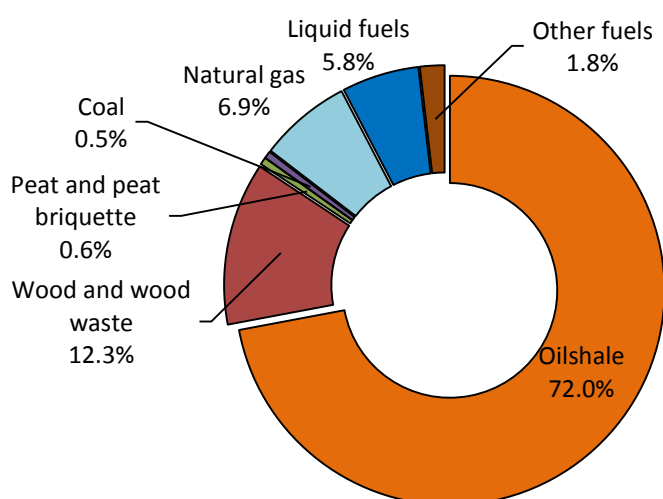


Figure 3.3 Structure of primary energy supply in Estonia in 2014

Domestic fuels have a large share in Estonia's total energy resources; and in the balance of primary energy they are mainly based on oil shale. In 2014, about 21 million tonnes of oil shale were produced, which is 2.4% more than in 2013. The majority of oil shale is consumed in power plants as a raw material for shale oil. The demand for shale oil in Estonia and in external markets increased the production of shale oil by about 5%. Nearly 87% of the production was exported in 2014 and about 11.4% more than in 2013. More than one third (34%) of this amount was exported to the Netherlands, followed by Belgium and Denmark. The production of peat fuels remained approximately at the level of the 2013. Compared to 2013, peat briquettes production increased by about 11%.

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 no. 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.

Upon joining the European Union, Estonia assumed the obligation to decrease annual SO₂ emissions to 25,000 tonnes in 2012. In order to meet the target, in the beginning of 2012 a five-year research and testing project was completed by installing unique desulphurisation systems on four generating units of the Eesti PP. The accepted obligations were fulfilled and the emission of sulphur dioxide from Narva PP did not exceed 25 thousand tonnes in 2012.

Table 3.1 Pollutant emissions from the energy sector in the period of 1990-2014

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	BC	TSP	CO	Pb
	kt									t
1990	74.09	28.40	272.38	0.32	NR	NR	NR	269.44	214.42	205.21
1991	68.66	27.48	250.08	0.29	NR	NR	NR	270.74	214.64	187.89
1992	43.74	15.74	190.98	0.27	NR	NR	NR	243.07	120.29	123.78
1993	40.63	15.69	155.53	0.28	NR	NR	NR	191.78	122.30	102.31
1994	44.87	18.77	150.03	0.45	NR	NR	NR	166.01	157.47	122.34
1995	46.30	22.08	115.72	0.83	NR	NR	NR	124.14	212.25	85.16
1996	50.73	23.98	124.69	0.95	NR	NR	NR	112.23	235.69	65.55
1997	49.62	26.02	115.91	0.97	NR	NR	NR	89.15	248.11	46.16
1998	44.36	20.20	104.14	0.74	NR	NR	NR	80.02	195.60	38.89
1999	42.47	21.99	97.76	0.71	NR	NR	NR	78.94	203.78	38.87
2000	43.23	22.38	97.05	0.74	14.54	29.69	3.39	65.52	194.24	35.69
2001	45.13	22.70	90.61	0.73	15.48	29.68	3.67	63.51	196.49	36.12
2002	46.12	21.46	86.85	0.72	15.67	25.23	3.85	42.42	186.06	35.37
2003	46.64	19.48	100.14	0.72	13.40	21.46	3.62	38.02	176.10	37.41
2004	43.40	19.44	87.99	0.76	14.40	21.28	3.74	34.68	168.96	35.89
2005	40.15	17.35	76.09	0.69	13.19	18.78	3.40	27.32	152.87	34.61
2006	38.56	15.61	69.77	0.70	8.73	12.37	2.45	18.07	138.20	31.12
2007	42.78	14.19	87.99	0.86	11.72	18.90	2.94	23.74	153.92	39.69
2008	39.58	13.28	69.44	0.86	10.89	15.00	3.04	18.89	154.32	34.73
2009	34.57	12.34	54.83	0.83	8.92	12.54	2.51	15.75	153.21	28.02
2010	40.91	12.25	83.23	0.83	13.28	20.84	3.13	24.55	154.10	38.50
2011	39.00	11.13	72.73	0.78	17.64	31.96	3.44	37.32	129.65	37.94
2012	35.60	10.70	40.57	0.81	7.67	10.62	2.11	14.29	139.88	33.37
2013	32.71	10.07	36.48	0.73	10.14	14.59	2.47	16.75	133.01	38.79
2014	32.30	9.30	40.82	0.73	7.30	10.50	1.91	13.54	125.89	35.79
Trend 1990-2014, %	-56.4	-67.2	-85.0	130.0	-49.8	-64.6	-43.5	-95.0	-41.3	-82.6

Table 3.1 continues

Year	Cd	Hg	As	Cr	Cu	Ni	Zn	PAHs total	PCDD/F	HCB	PCB
	t								g I-Teq	kg	
1990	4.46	1.11	18.84	18.39	10.03	27.32	106.84	8.97	7.29	0.18	8.33
1991	4.25	1.00	16.44	16.02	9.30	25.54	97.85	8.68	7.18	0.17	8.50
1992	3.05	0.82	14.02	13.80	6.64	16.95	79.78	5.70	4.53	0.15	5.56
1993	2.27	0.64	10.83	10.47	5.42	14.31	62.40	4.87	3.49	0.13	8.77
1994	2.93	0.63	10.67	10.32	5.91	12.83	65.57	6.16	3.38	0.20	5.10
1995	2.13	0.59	10.05	9.95	5.02	10.46	63.97	10.03	4.75	0.31	4.07
1996	1.26	0.59	10.35	10.22	4.57	10.82	62.48	11.65	5.42	0.35	4.66
1997	1.29	0.59	10.19	9.96	4.54	9.71	62.48	11.63	5.19	0.36	4.25
1998	1.17	0.52	9.13	8.90	4.13	8.76	55.69	9.45	3.97	0.31	4.29
1999	1.11	0.50	8.70	8.50	3.99	7.48	53.51	9.29	4.25	0.29	3.71
2000	0.72	0.50	8.58	8.34	3.67	6.44	49.85	8.73	3.87	0.29	2.56
2001	0.71	0.49	8.38	8.21	3.96	6.38	49.67	8.40	3.84	0.31	4.15
2002	0.73	0.49	8.35	8.31	4.09	6.12	48.95	8.36	3.83	0.29	3.95
2003	0.80	0.57	9.97	9.81	4.42	6.75	57.39	8.34	4.06	0.29	4.70
2004	0.76	0.53	9.78	9.38	4.45	6.64	57.71	8.58	3.70	0.33	3.68
2005	0.73	0.51	9.78	9.02	4.42	6.39	53.39	7.81	3.19	0.28	3.70
2006	0.70	0.51	8.58	8.40	4.31	5.72	48.94	6.96	3.06	0.25	3.02
2007	0.87	0.64	11.06	10.72	4.98	6.69	62.01	6.89	4.67	0.31	1.78
2008	0.81	0.57	9.40	9.25	4.58	5.85	55.30	7.23	4.70	0.32	2.78
2009	0.68	0.44	7.60	7.50	3.93	4.82	46.48	7.60	4.09	0.30	3.04
2010	0.88	0.62	10.96	10.51	4.82	6.57	62.66	8.41	4.97	0.34	4.16
2011	0.84	0.63	10.88	10.32	4.73	6.39	60.64	7.14	4.90	0.31	3.60
2012	0.77	0.55	9.59	9.16	4.52	5.62	54.94	7.20	3.49	0.32	3.46
2013	0.94	0.66	11.23	10.56	4.79	6.48	62.44	7.20	2.55	0.33	3.92
2014	0.88	0.65	10.24	9.83	4.80	6.00	57.33	7.01	2.72	0.27	4.20
Trend 1990-2014, %	-80.3	-41.9	-45.6	-46.5	-52.2	-78.0	-46.3	-21.8	-62.7	52.4	-49.6

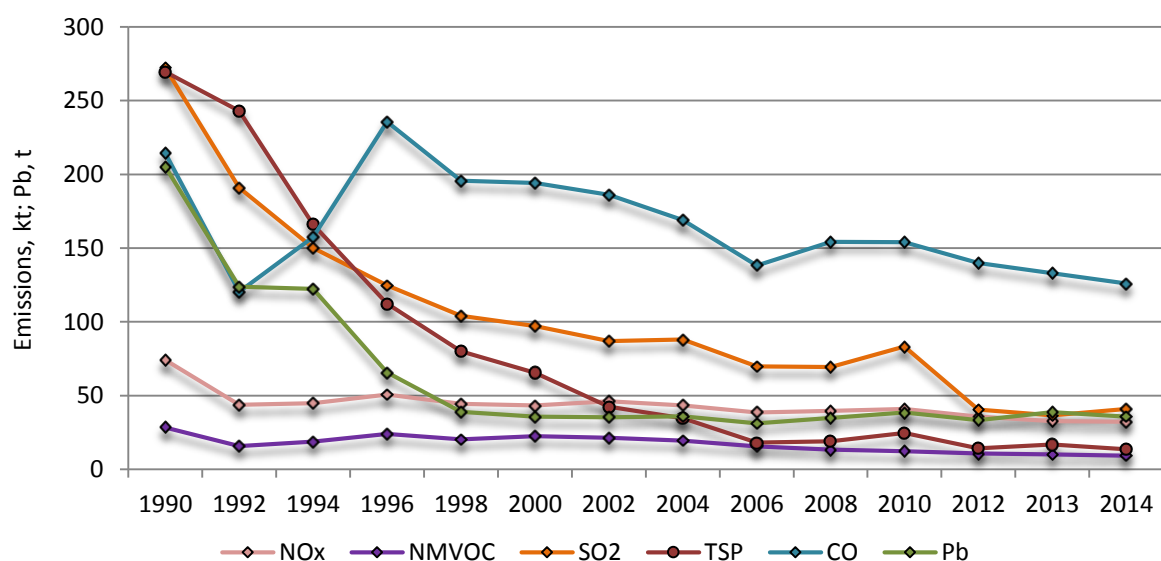


Figure 3.4 Pollutant emissions from the energy industry in the period of 1990-2014

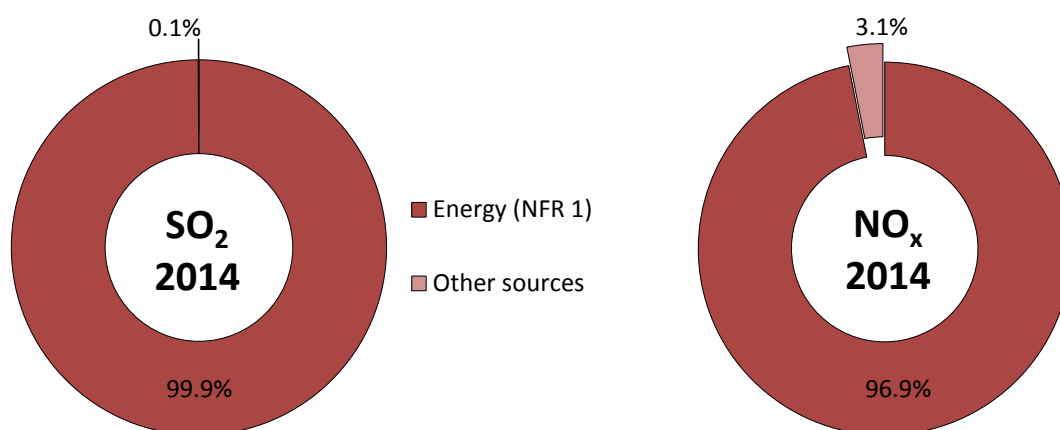


Figure 3.5 Share of SO₂ and NO_x emissions from the energy sector in total emissions in 2014

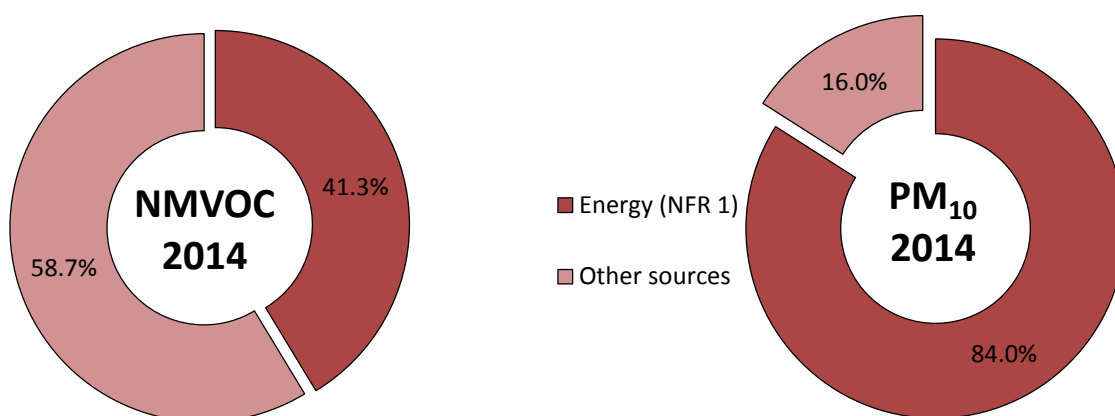


Figure 3.6 Share of NMVOC and PM₁₀ emissions from the energy sector in total emissions in 2014

3.2. Stationary fuel combustion

3.2.1. Sources category description

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, HM, PCDD/ PCDF, PAHs, HCB, PCB
	b. Petroleum refining	Includes emissions from process furnaces in the oil shale industry. Only two point sources data.	NMVOC, NO _x , CO, PCDD/ PCDF
	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, HM, PCDD/ PCDF, PAHs, HCB, PCB
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, Zn
	c. Chemicals	Includes emissions from combustion plants of this activity reported by 8 operators.	NO _x , SO _x , NMVOC, 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 14 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 60 operators.	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO, HM
	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 26 operators.	NO _x , SO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , BC, CO, HM
	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, HM, PCDD/ PCDF, PAHs, HCB, PCB
1A4	Non-industrial combustion plants		
	ai Commercial / institutional: Stationary	Includes emissions from boilers or other equipment in the commercial	NO _x , SO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , BC, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB

NFR	Source	Description	Emissions reported
		sector. Data of point and diffuse sources.	
	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, HM, PCDD/ PCDF, PAHs, HCB, PCB
	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, HM, PCDD/ PCDF, PAHs, HCB, PCB
1A5a	Other stationary (including military)		IE, reported under 1A4ai

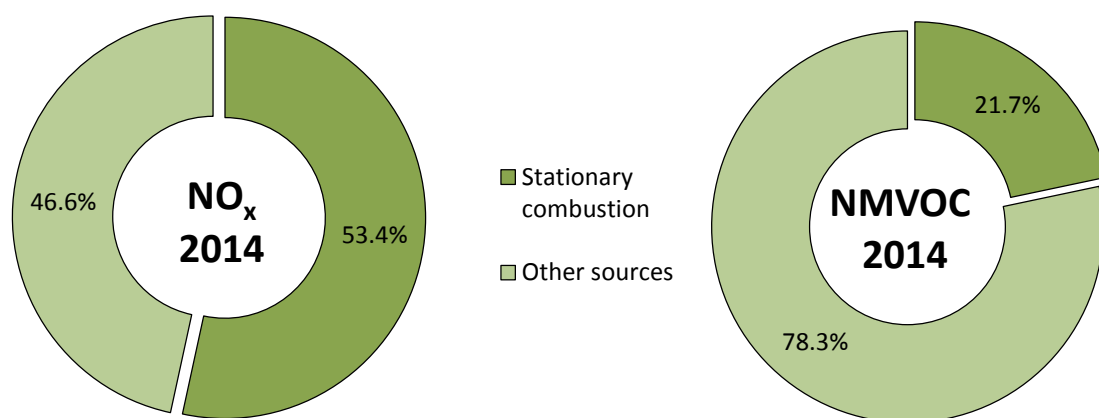


Figure 3.7 NO_x and NMVOC emissions from stationary fuel combustion and other sources in 2014

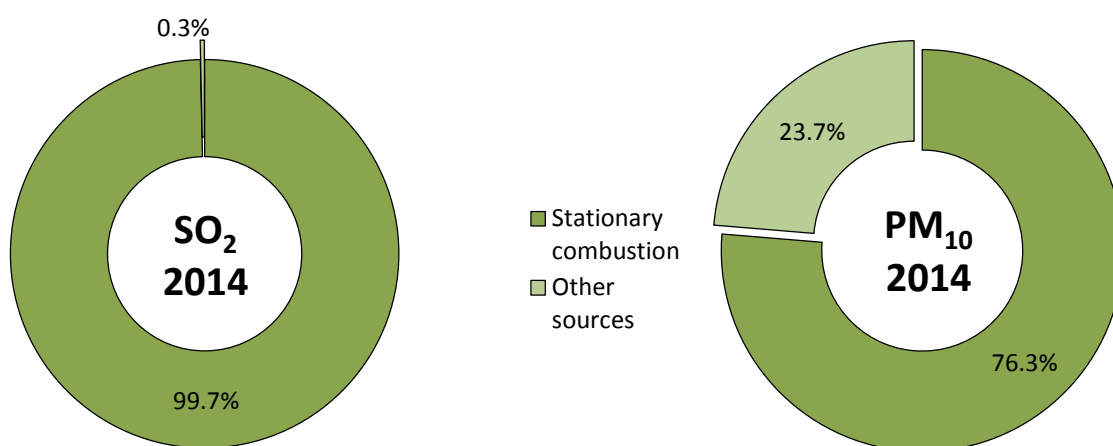


Figure 3.8 SO₂ and PM₁₀ emissions from stationary fuel combustion and other sources in 2014

Table 3.3 Pollutant emissions from stationary fuel combustion in the period of 1990-2014

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	BC	TSP	CO	Pb	Cd
	kt									t	
1990	36.06	6.65	265.48	0.30	NR	NR	NR	267.71	86.44	126.48	4.44
1991	32.97	6.69	243.46	0.28	NR	NR	NR	269.08	87.48	118.20	4.24
1992	24.11	4.95	187.04	0.26	NR	NR	NR	242.12	67.41	89.46	3.04
1993	19.38	4.06	151.24	0.27	NR	NR	NR	190.62	62.69	67.22	2.27
1994	22.45	5.24	145.96	0.43	NR	NR	NR	164.92	86.28	79.32	2.92
1995	26.43	8.86	112.07	0.80	NR	NR	NR	123.13	145.68	60.38	2.13
1996	29.14	10.40	120.82	0.91	NR	NR	NR	111.22	166.63	43.84	1.25
1997	27.73	10.25	112.03	0.92	NR	NR	NR	88.09	165.53	36.31	1.28
1998	24.08	8.26	100.15	0.69	NR	NR	NR	79.00	133.17	32.82	1.17
1999	22.82	7.97	94.24	0.65	NR	NR	NR	77.99	126.69	31.32	1.10
2000	23.68	7.10	93.89	0.63	13.63	28.65	2.94	64.30	125.79	30.67	0.72
2001	24.27	7.02	89.70	0.59	14.68	28.71	3.30	62.31	123.75	30.13	0.70
2002	23.43	7.35	85.74	0.57	14.69	24.07	3.37	41.04	123.17	29.82	0.72
2003	25.83	7.21	99.43	0.56	12.46	20.33	3.15	36.66	123.43	35.14	0.79
2004	23.76	7.43	87.37	0.53	13.41	20.13	3.24	33.32	123.66	33.78	0.75
2005	20.68	6.59	75.70	0.42	12.24	17.65	2.92	25.96	110.37	32.47	0.72
2006	18.94	5.73	69.43	0.40	7.78	11.20	1.96	16.65	97.36	29.65	0.69
2007	23.54	6.26	87.67	0.51	10.75	17.73	2.44	22.33	115.78	38.14	0.86
2008	21.90	6.51	69.16	0.50	10.00	13.89	2.59	17.52	121.60	33.14	0.80
2009	19.32	5.92	54.66	0.51	8.16	11.55	2.13	14.50	123.71	26.62	0.68
2010	24.32	6.17	83.08	0.50	12.47	19.77	2.72	23.20	127.34	37.98	0.87
2011	23.69	5.27	72.52	0.40	16.89	30.94	3.07	35.99	106.27	37.46	0.83
2012	20.38	5.12	40.42	0.41	6.89	9.58	1.73	12.95	115.79	32.88	0.76
2013	18.82	5.35	36.35	0.37	9.44	13.68	2.11	15.61	112.70	38.34	0.94
2014	17.80	4.88	40.70	0.38	6.54	9.54	1.53	12.33	106.86	35.49	0.87
Trend 1990-2014, %	-50.6	-26.6	-84.7	26.5	-52.0	-66.7	-48.1	-95.4	23.6	-71.9	-80.5

Table 3.3 continues

Year	Hg	As	Cr	Cu	Ni	Zn	PCDD/F	PAHs total	HCB	PCB
	t						g I-Teq	t	kg	
1990	1.11	18.84	18.26	7.28	27.27	104.24	6.94	8.87	0.18	8.31
1991	1.00	16.44	15.91	6.81	25.49	95.48	6.85	8.59	0.17	8.47
1992	0.82	14.02	13.73	5.27	16.92	78.54	4.37	5.66	0.15	5.55
1993	0.64	10.83	10.40	3.93	14.28	61.05	3.38	4.82	0.13	8.76
1994	0.63	10.67	10.24	4.28	12.81	63.98	3.14	6.11	0.20	5.09
1995	0.59	10.05	9.88	3.59	10.44	62.51	4.52	9.99	0.31	4.06
1996	0.59	10.35	10.14	3.03	10.80	60.92	5.19	11.60	0.35	4.65
1997	0.59	10.19	9.88	2.93	9.69	60.81	4.95	11.59	0.36	4.25
1998	0.52	9.13	8.83	2.65	8.74	54.22	3.77	9.41	0.31	4.29
1999	0.50	8.70	8.42	2.50	7.46	51.98	4.03	9.25	0.29	3.71
2000	0.50	8.58	8.26	2.14	6.42	48.30	3.64	8.70	0.29	2.56
2001	0.49	8.37	8.11	2.12	6.36	47.80	3.56	8.36	0.31	4.15
2002	0.49	8.35	8.21	2.09	6.09	46.97	3.53	8.31	0.29	3.95
2003	0.57	9.97	9.71	2.49	6.72	55.45	3.77	8.29	0.29	4.70
2004	0.53	9.78	9.28	2.48	6.61	55.74	3.40	8.53	0.33	3.68
2005	0.51	9.78	8.91	2.41	6.36	51.34	2.88	7.76	0.28	3.70
2006	0.51	8.58	8.29	2.15	5.68	46.74	2.72	6.90	0.25	3.02

Year	Hg	As	Cr	Cu	Ni	Zn	PCDD/F	PAHs total	HCB	PCB
	t						g I-Teq	t	kg	
2007	0.64	11.06	10.60	2.70	6.66	59.69	4.30	6.83	0.31	1.78
2008	0.57	9.40	9.13	2.34	5.81	53.03	4.36	7.17	0.32	2.78
2009	0.44	7.60	7.39	1.92	4.78	44.44	3.77	7.55	0.30	3.04
2010	0.62	10.96	10.40	2.67	6.53	60.52	4.65	8.35	0.34	4.16
2011	0.63	10.88	10.21	2.61	6.36	58.52	4.58	7.08	0.31	3.60
2012	0.55	9.59	9.05	2.31	5.59	52.74	3.16	7.14	0.32	3.46
2013	0.66	11.23	10.45	2.65	6.45	60.29	2.24	7.14	0.33	3.92
2014	0.65	10.24	9.71	2.55	5.97	55.10	2.42	6.95	0.27	4.20
Trend 1990-2014, %	-41.9	-45.6	-46.8	-64.9	-78.1	-47.1	-65.2	-21.7	52.5	-49.5

Energy related activities (without transport) are the most significant contributors to SO₂ emissions – 99.7% in 2014. The share of mobile sources of the total emissions is very small – 0.2% (Figure 3.8 and 3.9, includes in other sources). 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 pulverized 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 10% of the fuel used 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 in the Narva PP provides enough electricity to cover the annual consumption of 50,000 Estonian families.



(Photo by Lembit Michelson: Eesti power plant)

The oil shale power plants contribute about 59% 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.

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.

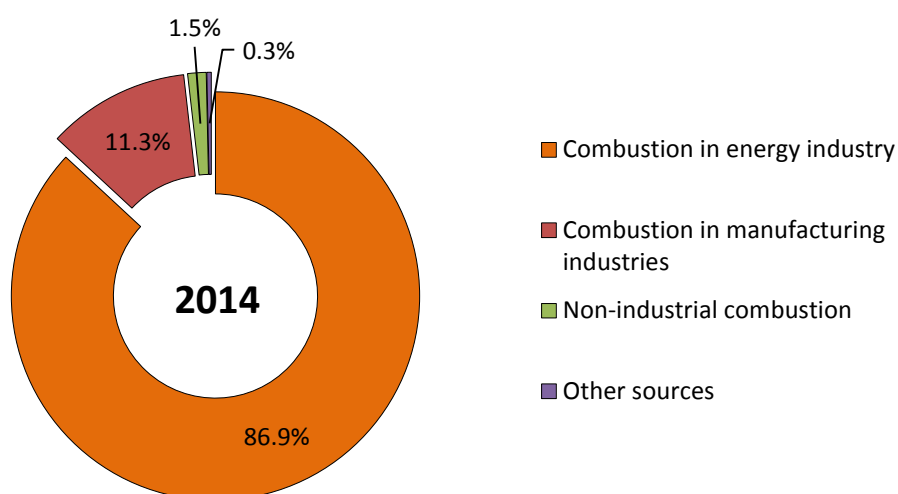


Figure 3.9 SO₂ emissions by sources of pollution in 2014

Non-industrial combustion is responsible for about 73% of the total NMVOC emissions in stationary combustion, for approximately 66% of CO and 24% of TSP emissions (Figures 3.10, 3.11, 3.13, 3.14). Combustion in energy and transformation industries is responsible for 87% of SO₂, for 61% of TSP and for the 30% of CO emissions in stationary combustion (thus the main part of carbon monoxide is emitted from Narva shale oil production plant, which increased during the last year as a result of growing shale oil production) (Figures 3.10, 3.12, 3.14).

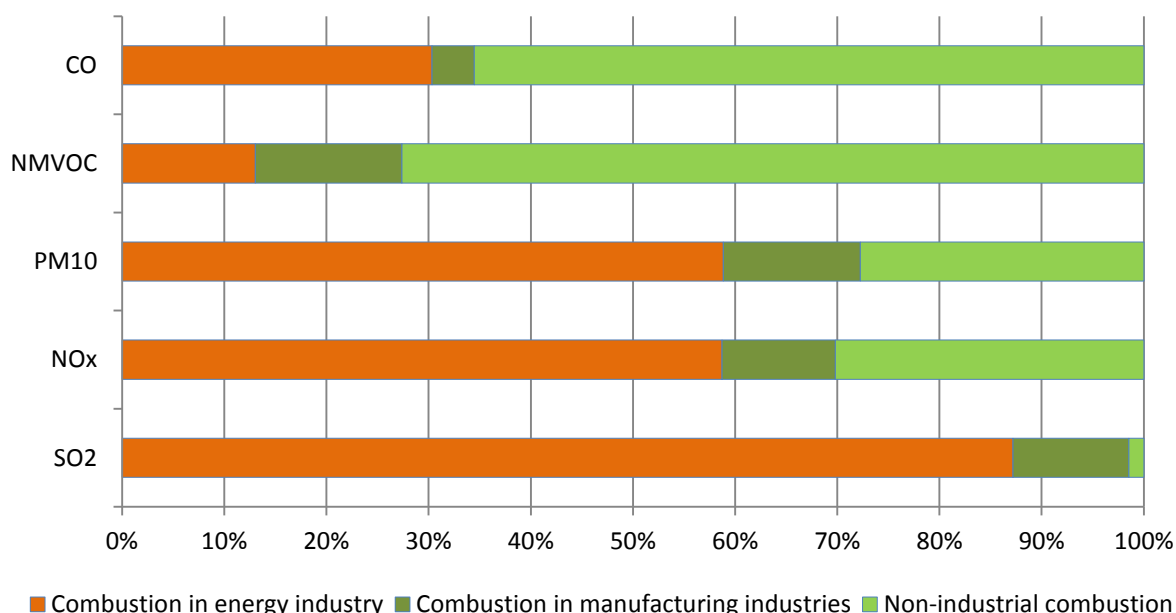


Figure 3.10 Distribution of pollutants emissions by sector in stationary combustion in 2014

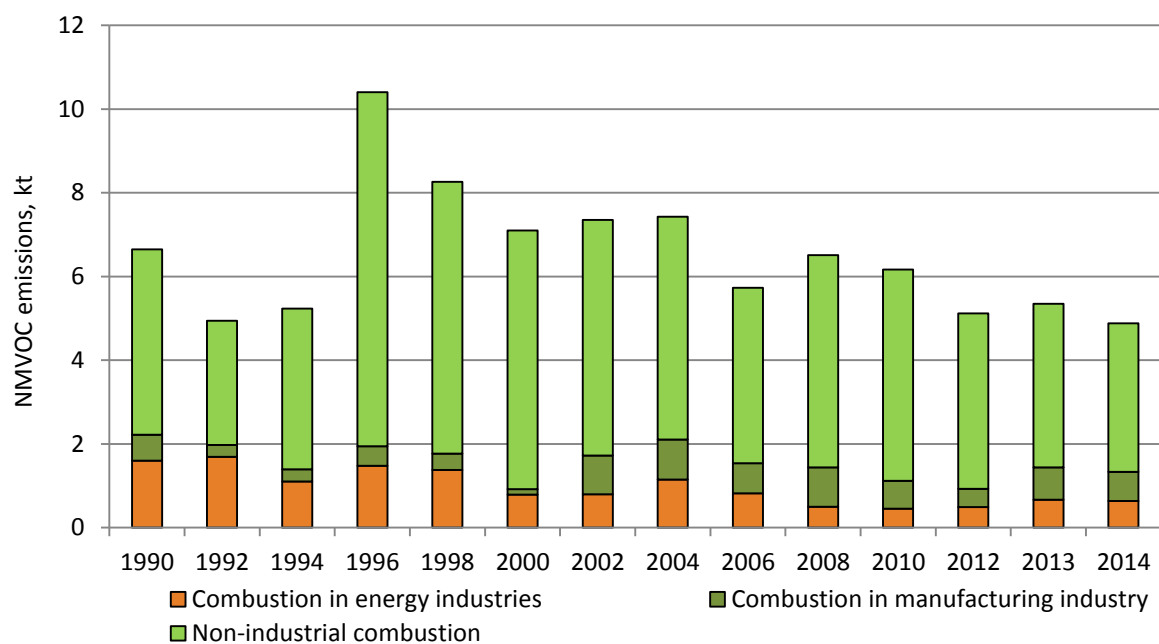


Figure 3.11 Distribution of NMVOC emissions by sector in stationary combustion in the period of 1990-2014

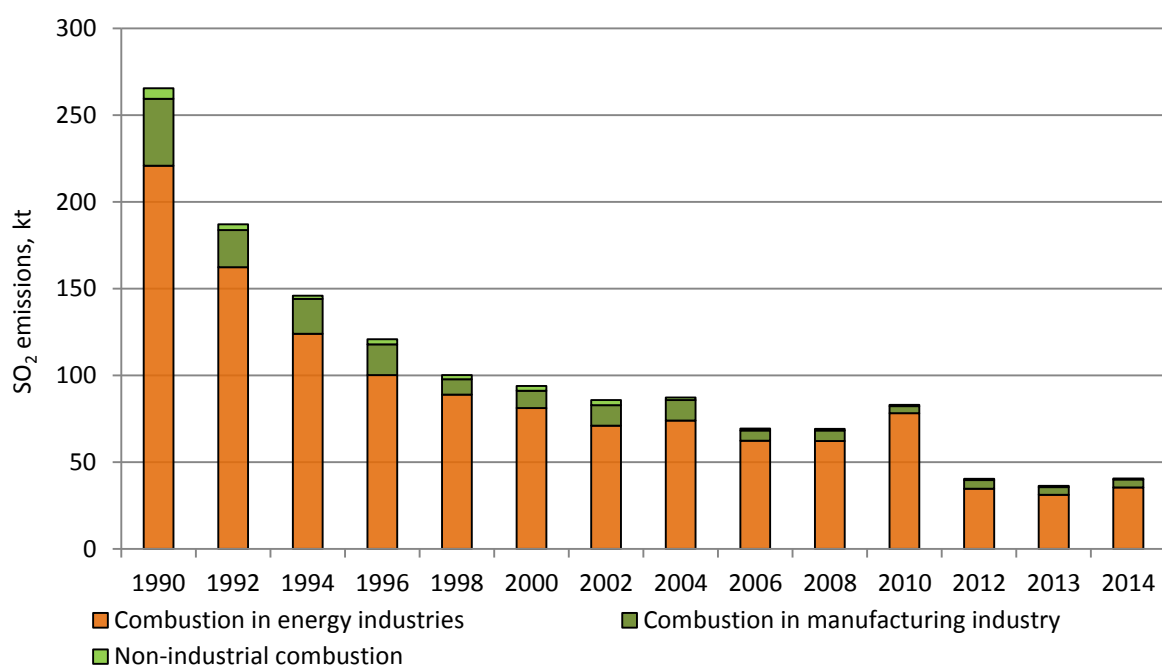


Figure 3.12 Distribution of SO₂ emissions by sector in stationary combustion in the period of 1990-2014

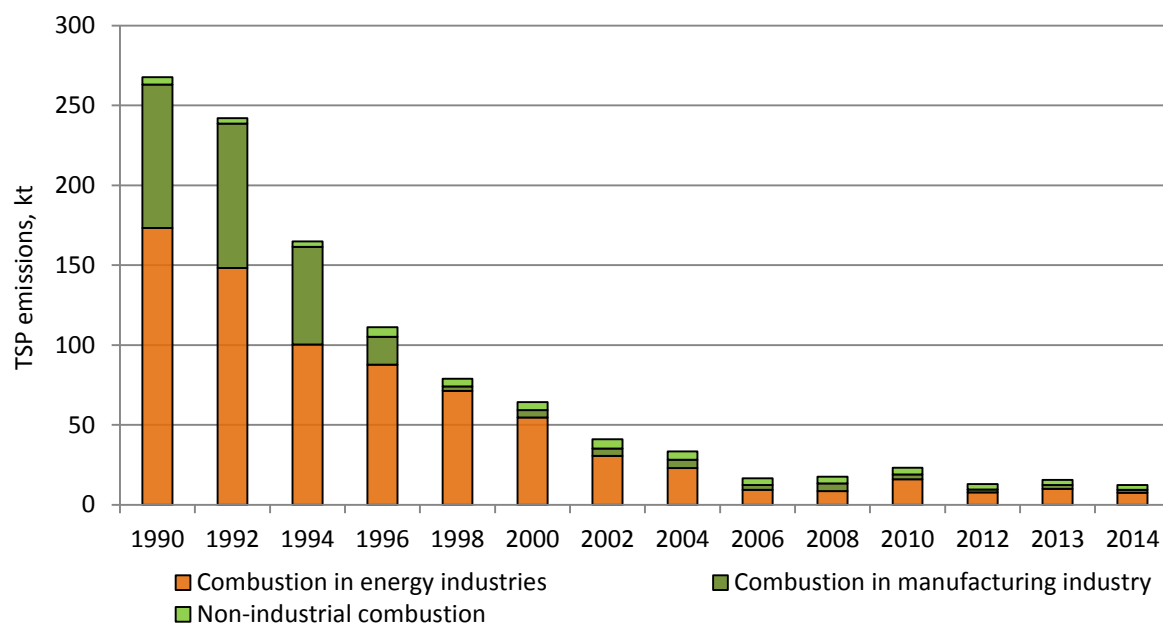


Figure 3.13 Distribution of TSP emissions by sector in stationary combustion in the period of 1990-2014

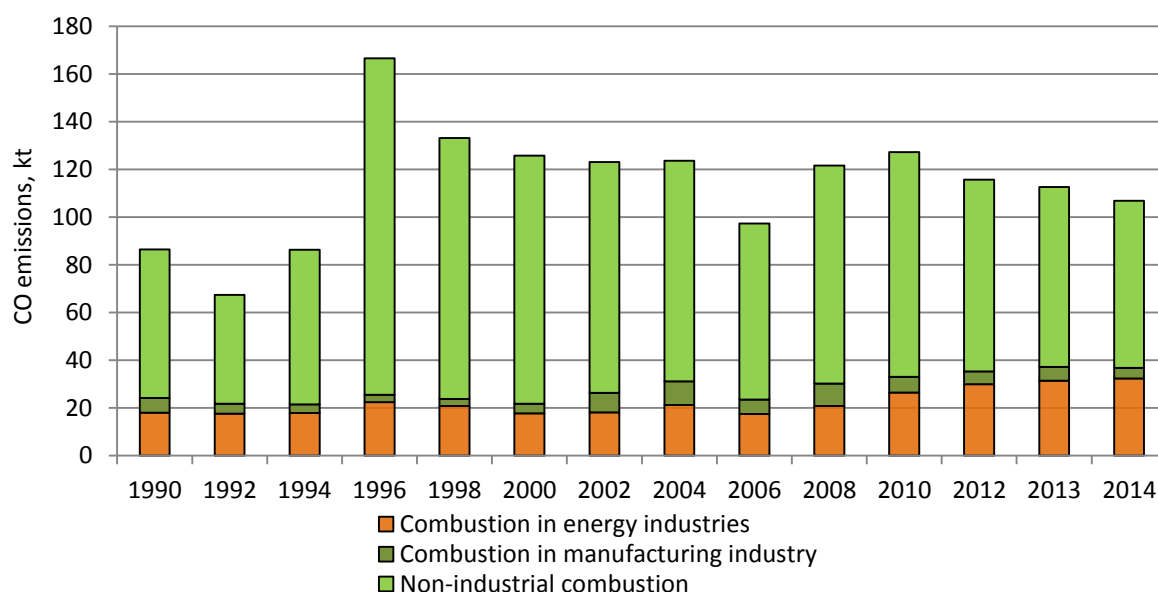


Figure 3.14 Distribution of CO emissions by sector in stationary combustion in the period of 1990-2014

3.2.2. Methodological issues

NFR 1A1a: Public electricity and heat production, **NFR 1A2f** Stationary combustion in manufacturing industries and construction: Non-metallic minerals, **NFR 1A2gviii** Stationary combustion in manufacturing industries and construction: Other, and **NFR 1A4ai, ci** Non-industrial combustion plants (stationary combustion related to commercial and agriculture)

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 is used.

NFR 1A1b: Petroleum refining: only two facilities reported emissions from process furnaces in the shale oil industry. Emissions are calculated on the basis of measurements, or the combined method (measurements plus calculations) is used.

NFR 1A1c: The manufacture of solid fuels includes pollutants emission data reported by shale oil production facilities (oil shale transformation processes). Emissions are calculated 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 or the combined method for emission estimations.

The production of shale oil in Estonia is carried out at three factories: Eesti Energia Õlitööstus AS (Narva Oil Plant AS), Kiviõli Keemiatööstuse OÜ (Kiviõli Oil Shale Processing & Chemicals Plant) 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 on the left 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 and VKG Oil plants, both these technologies are used.



(Photo on the left: Enefit technology. source: www.enefit.com)

Eesti Energia Õlitööstus AS 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. 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 (*in the right on the photo*) 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.

NFR 1A2a: Iron and steel include emissions from processes with contact and combustion plants of this activity reported by four 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 17 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 7 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 14 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 62 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. Emissions from the point sources are calculated on the basis of measurements, 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 for the first time calculated on the basis of measurements.

NFR 1A2gviii: Others include emissions from all boilers in the other manufacturing industry (excluding NFR 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, 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.

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

According to national legislation, all operators with boiler capacity from 0.3 MW 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 contains 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 are obliged to carry out continuous monitoring. 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 2004 (Tables 3.4-3.8).

Table 3.4 TSP emission factors for boilers (g/GJ)

	P < 10 MW				50 MW > P > 10 MW		
	burner	extended furnace	grate-fired furnace	fluidized	burner	extended furnace	fluidized
Coal			3000				
Oil shale			12000				
- cyclone					3000		
- electrostatic precipitator					1000		
Peat							
- no control		1000	2000				
- cyclone		220	230	700			700
- cyclone + multicyclone				80			
- electrostatic precipitator							80
Wood							
- no control			1000	1000	1000		1000
- cyclone		240	240	500		70	
- electrostatic precipitator						70	80
Heavy fuel oil	100				100		
Oil shale oil	100				100		
Light fuel oil	100				100		

Table 3.5 NO_x emission factors for boilers (g/GJ)

	P < 10 MW				50 MW > P > 10 MW	
	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 3.6 NMVOC emission factors for boilers (g/GJ)

	P < 10 MW	50 MW > P > 10 MW
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 3.7 Carbon monoxide emission factors for boilers (g/GJ)

	P < 10 MW				50 MW > P > 10 MW	
	burner	extended furnace	grate-fired furnace	fluidized	burner	fluidized
Coal		100	100			
Oil shale					100	
Peat		1200	500	100		200
Wood		1200	1000	400		200
Heavy fuel oil	100				100	
Oil shale oil	100				100	
Light fuel oil	100				100	
Gas	60				40	

Table 3.8 Heavy metal 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	290	24	3.5	8
Light fuel oil	0.03	0.04	10	11	6	6	2	4

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.

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 3.9.

Table 3.9 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

The national methodology is co-ordinated by the Ministry of the Environment, and at present the national methodology for boilers is being updated. Therefore, it was decided not to use this year new EMEP/EEA Guidebook 2013 for NFR 1A1, 1A2, 1A4ai and 1A4ci sectors. Most probably, the national methodology will be used next year.

This year, emissions for the residual stationary combustion sector were recalculated for the main pollutants, persistent organic pollutants and heavy metals. The calculation of main pollutants and POPs emissions 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 the 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 3.12. For the calculation of heavy metals emissions from wood combustion and POPs and HM from other fuels were used as emission factors for the new EMEP/EEA Guidebook 2013 and are presented in the Tables 3.10 and 3.11.

Calculations of emissions of POPs from the burning of waste in stoves were also made in addition. Emission factors were also defined within the project “Tööstuslikest allikatest ja koduahjustest eralduvate välisõhu saasteainete heitkoguste inventuuri metoodikate

täiendamise" (Table 3.13). Data on the amount of the burned waste were obtained on the basis of the Statistics Estonia questionnaire. 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 (Table 3.15). It might be considered that growing awareness and continuous notification concerning the quantities of waste incinerated will assist in its downward trend.

The emission factors for the main substances will be defined and emissions are calculated according to the next period of the reporting.

Table 3.10 Main pollutant emission factors for NFR 1A4bi (EMEP/EEA Guidebook 2013)

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	60	79	0.3	0.3
NH ₃	g/GJ	2.5	NA	NA	NA	NA	NA	NA
NM VOC	g/GJ	600	300	174	1.2	0.17	2	1.8
CO	g/GJ	5000	2000	4787	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	0.05	0.119	0.011
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
PCB	µg/GJ	170	170	170				
PCDD/F	ng/GJ	1000	500	500	10	1.8	1.5	1.5
B(a)p	mg/GJ	250	150	270	80	80	0.00056	0.00056
B(b)f	mg/GJ	400	180	250	40	40	0.00084	0.00084
B(k)f	mg/GJ	150	100	100	70	70	0.00084	0.00084
I(1,2,3-cd)p	mg/GJ	120	80	90	160	160	0.00084	0.00084
HCB	µg/GJ	0.62	0.62	0.62				

Table 3.11 HM and PCB emission factor for wood combustion for NFR 1A4bi (EMEP/EEA Guidebook 2013)

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
PCB	µg/GJ	0.060	0.060	0.007	0.01

Table 3.12 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	2382.816	74.512	176.21	45.875
SO ₂	g/GJ	11	10.91	26.647	0.833	10.89	12.34
NH ₃	g/GJ	70	2.629	9.869	0.308	2.497	0.933
NMVOC	g/GJ	66.763	60.625	1851.82	57.883	204.556	2.28
CO	g/GJ	3295.845	2574.958	24264.87	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
BC	g/GJ	120.702	11.436	140.638	4.396	326.075	10.859
PCDD/PCDF	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	591.640	0.027	2.181	2.137
HCb	µg/GJ	17.104	8.341	8.333	0.261	5.217	1.288

Table 3.13 National POPs 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
NMVOC	g/GJ	190.561
CO	g/GJ	2795.054
TSP	g/GJ	1167.613
PM ₁₀	g/GJ	1061.466
PM _{2.5}	g/GJ	1008.393
BC	g/GJ	77.349
PCDD/PCDF	µg/GJ	0.055
B(a)p	µg/GJ	10428.571
B(b)f	µg/GJ	10557.619
B(k)f	µg/GJ	4566.167
I(1,2,3-cd)p	µg/GJ	5637.013
HCB	µg/GJ	35.943

Activity data

Discrepancies in the data on fuels between energy balance and the point sources database are possible. These are the reasons for the distinction in the data regarding the consumed oil shale, whose operators are represented in the Statistical Office and to the Point Sources Information System (OSIS) (the data in tonnes are identical, but not in TJ).

Table 3.14 Fuel consumption in stationary fuel combustion in the period of 1990-2014 (PJ)

Year	Liquid fuels	Solid fuels	Biomass	Gas
1990	68.14	242.83	8.37	40.61
1991	64.99	226.34	8.21	42.36
1992	36.07	188.36	7.86	23.42
1993	34.97	148.61	7.38	11.79
1994	32.27	147.05	12	14.89
1995	22.62	142.65	20.01	17.32
1996	23.08	149.43	23.22	19.9
1997	20.67	147.28	24.27	19.24
1998	19.75	125.48	21.42	17.86
1999	18.26	115.4	20.5	17.44
2000	10.69	123.02	20.63	21.78
2001	11.28	119.11	21.94	23.33
2002	9.67	123.45	21.77	23.32
2003	9.13	138.39	23.85	24.05
2004	9.53	142.88	25.01	23.53
2005	8.26	138.48	24.22	23.55
2006	6.31	134.29	20.05	23.35

Year	Liquid fuels	Solid fuels	Biomass	Gas
2007	5.46	164.07	22.85	26.13
2008	5.22	141.09	25.02	27.41
2009	4.75	132	27.42	20.67
2010	5.94	167.58	32.79	23.48
2011	6.01	174.75	31.24	21.17
2012	5.69	151.42	34.22	21.38
2013	5.08	174.52	31.64	18.58
2014	3.88	171.98	32.44	17.8

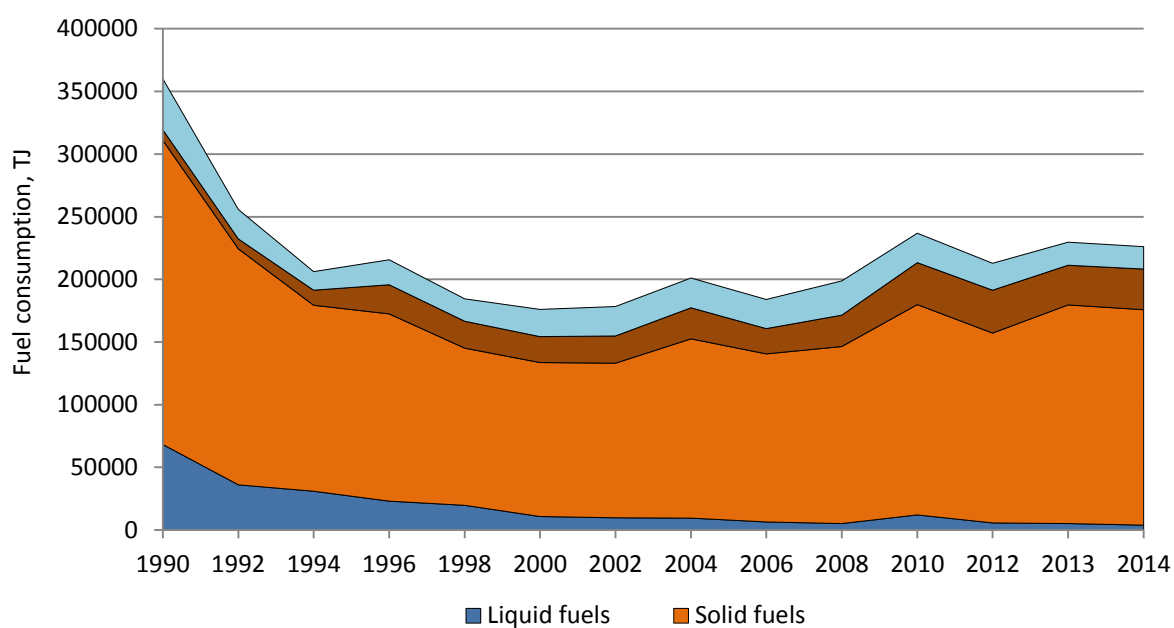


Figure 3.15 Fuel consumption by stationary combustion in the period of 1990-2014

Table 3.15 Amount of the waste incinerated in domestic stoves (tonnes)

Year	Amount of waste
1990	16757.7887
1991	18337.3905
1992	19785.1716
1993	20779.7546
1994	21824.9387
1995	22886.0485
1996	23105.1928
1997	23366.9625
1998	23716.4735
1999	24042.9748
2000	24996.0177
2001	23891.4338
2002	22793.7887
2003	21796.0366

Year	Amount of waste
2004	20760.9282
2005	19764.6890
2006	20547.8283
2007	21005.8103
2008	21200.3391
2009	21104.0397
2010	20701.4702
2011	20980.5529
2012	21270.6344
2013	21501.9304
2014	21501.9304

3.2.3. Uncertainty

An uncertainty analysis was carried out to the year 2014 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 3.16.

Table 3.16 Uncertainties in stationary combustion sector

Pollutant	Emission, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	17.802	kt	54.4	39.56	18.05
NMVOC	4.882	kt	21.66	41.24	17.01
SO _x	40.696	kt	99.65	32.12	7.18
NH ₃	0.375	kt	2.86	16.48	8.47
PM _{2.5}	6.537	kt	84.06	44.36	23.70
PM ₁₀	9.536	kt	76.31	42.59	21.49
TSP	12.333	kt	74.08	40.48	9.39
CO	106.864	kt	84.46	41.89	28.21
Pb	35.490	t	97.11	138.23	52.64
Cd	0.867	t	96.51	129.18	60.22
Hg	0.646	t	95.15	137.01	34.12
PCDD/PCDF	2.416	g I-TEQ	61.45	110.99	72.88
B(a)p	2.008	t	99.27	126.14	95.59
B(b)f	2.274	t	98.99	129.70	103.45
B(k)f	1.169	t	98.82	123.26	88.17
I(1,2,3-cd)p	1.502	t	99.34	118.47	95.63
HCB	0.270	kg	97.15	123.58	134.46
PCB	4.202	kg	99.52	118.35	43.44

3.2.4. Sources-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 that, for example, the industrial boiler is designated SNAP 03 not dependent on whether heat is sold or is used for its own needs.

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

3.2.5. Sources-specific planned improvements

- Improve the QA/QC procedure.
- Recalculate pollutants emissions from NFR 1A1, 1A2, 1A4ai and 1A4ci combustion sectors according to the updated national emission factors and EMEP/EEA Guidebook 2013.

3.3. Transport

3.3.1. Overview of the sector

Table 3.17 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

NFR	Source	Description	Method	Emissions
1A3bi-iv	Road transport	Road transport includes use of vehicles with combustion engines: passengers 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, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs total, HCB, PCBs
1A3bv	Road transport: Gasoline evaporation	Gasoline 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, Pb, Cd, Cr, Cu, Ni, Se, Zn,
1A3bvii	Road transport: Automobile road abrasion	PM emissions from road abrasion	Tier 1	PM _{2,5} , PM ₁₀ , TSP
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, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs total, HCB
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, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, PAHs total
1A4aii	Commercial/Institutional: Mobile	Commercial and institutional land based mobile machinery. This source category includes 1 A 5 b 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 , NH ₃ , PM _{2,5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs total, HCB, PCBs

NFR	Source	Description	Method	Emissions
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 , NH ₃ , PM _{2,5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs total, HCB, PCBs

Table 3.17 gives an overview of all the transport sectors and the methodologies used for calculating emissions from the transport 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.

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 3.16). The share of mobile sources in total national emissions in 2014 was the following: NO_x – 43.4%, NMVOC – 13.6% and CO – 14.2%. 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, non-methane volatile compounds and carbon monoxide have decreased compared to 1990 by 61.9%, 84.1% and 85.9% respectively. The trend of the emissions of these categories is given in Figures 3.17, Tables 3.18-20.

Some recalculations have been made for the following sectors: road transport, industrial machinery, railways, navigation, household and gardening machinery, commercial and agricultural sector. The main reasons for recalculations were the following: new COPERT 4 version 11.3, correction of statistical fuel consumption and emission factors. Recalculations led to a change in total emissions. A detailed overview is given in each transport subsector and Chapter 8.

During the compilation of the IIR minor errors were detected in emissions data represented in previous NFR table. Therefore, there has been made some changes in aviation sector, commercial machinery, household and gardening sector.

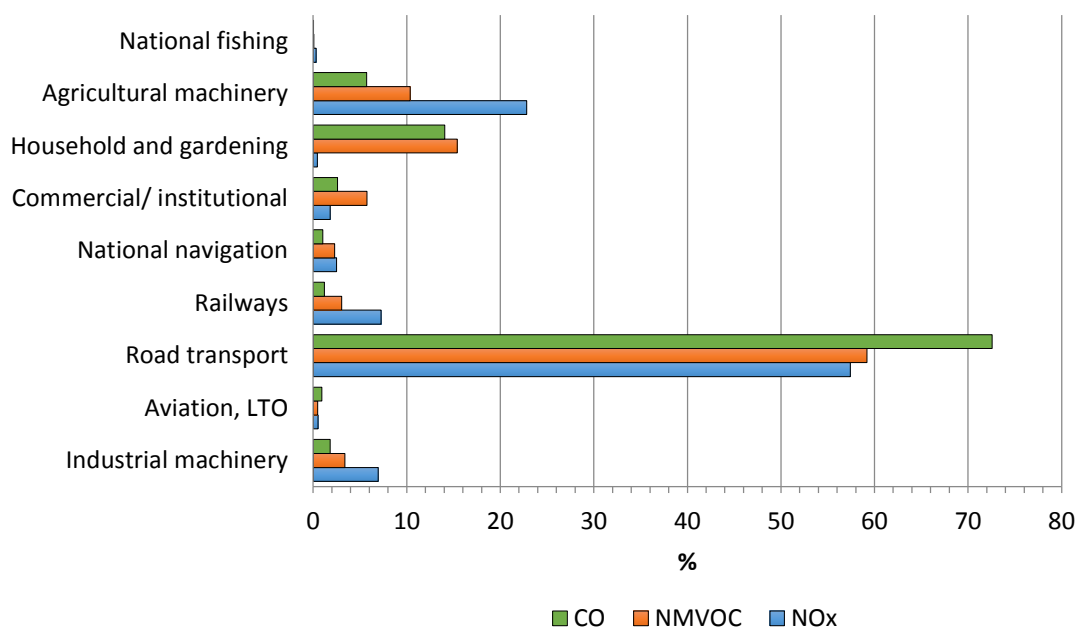


Figure 3.16 NO_x, NMVOC and CO emission shares in the transport sectors

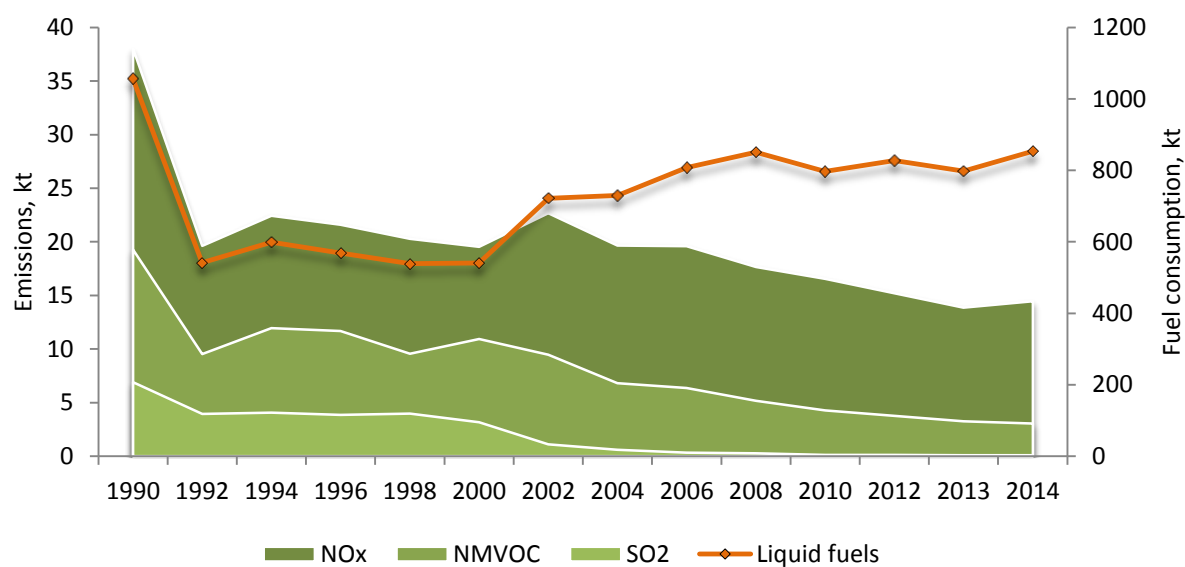


Figure 3.17 NO_x, NMVOC and CO emissions from the transport sector in the period of 1990-2014

Table 3.18 Total emissions from the transport sector in the period of 1990-2014 (kt)

Year	NO _x	NMVOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	38.030	19.275	6.899	0.019	NR	NR	1.721	NR	127.979
1991	35.699	18.552	6.620	0.018	NR	NR	1.653	NR	127.167
1992	19.630	9.523	3.942	0.009	NR	NR	0.955	NR	52.872
1993	21.254	10.349	4.287	0.013	NR	NR	1.158	NR	59.606
1994	22.429	11.946	4.075	0.024	NR	NR	1.093	NR	71.187
1995	19.860	11.592	3.647	0.030	NR	NR	1.013	NR	66.579
1996	21.588	11.669	3.869	0.040	NR	NR	1.014	NR	69.060
1997	21.892	13.047	3.885	0.051	NR	NR	1.058	NR	82.587

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1998	20.281	9.555	3.985	0.048	NR	NR	1.024	NR	62.426
1999	19.652	11.278	3.518	0.063	NR	NR	0.947	NR	77.094
2000	19.537	10.950	3.157	0.112	0.904	0.994	1.107	0.443	68.250
2001	20.853	10.489	0.908	0.141	0.781	0.890	1.025	0.373	72.556
2002	22.683	9.457	1.109	0.147	0.970	1.083	1.222	0.486	62.625
2003	20.801	7.863	0.711	0.161	0.923	1.032	1.162	0.472	52.325
2004	19.648	6.824	0.615	0.224	0.976	1.088	1.221	0.499	45.040
2005	19.455	6.479	0.382	0.214	0.932	1.047	1.180	0.479	42.331
2006	19.604	6.370	0.335	0.241	0.936	1.060	1.202	0.484	40.587
2007	19.232	6.009	0.309	0.256	0.951	1.081	1.230	0.493	37.918
2008	17.660	5.174	0.262	0.254	0.883	1.011	1.162	0.454	32.438
2009	15.206	4.733	0.139	0.228	0.732	0.848	0.982	0.380	29.337
2010	16.548	4.266	0.128	0.215	0.772	0.895	1.040	0.407	26.564
2011	15.279	3.684	0.134	0.206	0.711	0.833	0.979	0.367	22.563
2012	15.197	3.758	0.113	0.193	0.731	0.858	1.010	0.381	22.071
2013	13.866	3.249	0.081	0.168	0.683	0.807	0.953	0.357	18.962
2014	14.474	3.056	0.082	0.160	0.743	0.869	1.016	0.384	18.001
Trend 1990-2014, %	-61.9	-84.1	-98.8	732.6	-17.8	-12.6	-41.0	-13.3	-85.9

Table 3.19 Total emissions of heavy metals from the transport sector in the period of 1990-2014

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t		kg		t				
1990	78.727	0.012	0.940	0.476	0.131	2.754	0.050	0.006	2.591
1991	69.698	0.011	1.130	0.572	0.118	2.491	0.048	0.006	2.376
1992	34.327	0.006	0.387	0.196	0.064	1.380	0.027	0.003	1.237
1993	35.089	0.007	0.419	0.212	0.069	1.491	0.029	0.003	1.356
1994	43.019	0.007	0.435	0.220	0.080	1.637	0.027	0.003	1.593
1995	24.788	0.006	0.308	0.156	0.073	1.433	0.022	0.002	1.468
1996	21.707	0.007	0.466	0.236	0.077	1.537	0.024	0.003	1.561
1997	9.841	0.007	0.292	0.148	0.081	1.615	0.024	0.003	1.660
1998	6.064	0.006	0.111	0.056	0.074	1.480	0.023	0.002	1.462
1999	7.552	0.006	0.024	0.012	0.075	1.490	0.021	0.002	1.535
2000	5.027	0.007	0.047	0.024	0.077	1.531	0.022	0.002	1.549
2001	5.984	0.008	0.063	0.032	0.093	1.841	0.026	0.003	1.875
2002	5.542	0.008	0.008	0.004	0.100	1.998	0.030	0.003	1.985
2003	2.270	0.008	0.200	0.267	0.096	1.929	0.036	0.004	1.933
2004	2.108	0.008	0.141	0.188	0.099	1.972	0.034	0.004	1.974
2005	2.136	0.009	0.126	0.168	0.102	2.015	0.034	0.004	2.050
2006	1.470	0.009	0.064	0.085	0.109	2.159	0.034	0.004	2.201
2007	1.544	0.010	0.063	0.084	0.116	2.274	0.035	0.004	2.326
2008	1.592	0.009	0.131	0.174	0.114	2.246	0.037	0.004	2.271
2009	1.402	0.009	0.170	0.227	0.102	2.003	0.035	0.004	2.044
2010	0.516	0.009	0.103	0.137	0.108	2.143	0.035	0.004	2.135
2011	0.482	0.009	0.054	0.071	0.108	2.126	0.032	0.004	2.114
2012	0.486	0.009	0.057	0.076	0.114	2.215	0.033	0.004	2.203
2013	0.446	0.009	0.033	0.044	0.111	2.141	0.031	0.003	2.152
2014	0.298	0.009	0.016	0.022	0.114	2.243	0.033	0.004	2.230
Trend 1990-2014, %	-99.6	-23.1	-98.3	-95.4	-12.5	-18.6	-32.9	-36.0	-13.9

Table 3.20 Total emissions of POPs from the transport sector in the period of 1990-2014

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	0.355	0.022	0.040	0.017	0.012	0.091	0.276	20.432
1991	0.333	0.022	0.039	0.015	0.012	0.088	0.283	24.504
1992	0.162	0.012	0.022	0.008	0.005	0.047	0.116	8.416
1993	0.104	0.013	0.023	0.009	0.006	0.051	0.128	9.102
1994	0.236	0.012	0.021	0.010	0.008	0.050	0.168	9.477
1995	0.223	0.009	0.017	0.010	0.007	0.042	0.149	6.744
1996	0.233	0.010	0.019	0.010	0.008	0.047	0.180	10.157
1997	0.244	0.009	0.018	0.010	0.007	0.045	0.177	6.423
1998	0.202	0.008	0.016	0.010	0.006	0.040	0.128	2.477
1999	0.222	0.007	0.014	0.009	0.006	0.037	0.148	0.626
2000	0.225	0.007	0.014	0.009	0.006	0.037	0.167	1.125
2001	0.285	0.008	0.017	0.011	0.008	0.043	0.228	1.486
2002	0.292	0.011	0.020	0.012	0.008	0.050	0.229	0.282
2003	0.289	0.011	0.019	0.011	0.007	0.048	0.772	2.640
2004	0.302	0.011	0.019	0.012	0.008	0.049	0.614	1.883
2005	0.314	0.011	0.019	0.012	0.008	0.050	0.590	1.689
2006	0.345	0.012	0.021	0.013	0.009	0.055	0.466	0.908
2007	0.366	0.013	0.022	0.013	0.009	0.057	0.493	0.898
2008	0.347	0.012	0.021	0.013	0.009	0.055	0.663	1.744
2009	0.319	0.011	0.019	0.012	0.008	0.050	0.750	2.232
2010	0.327	0.013	0.021	0.013	0.009	0.056	0.582	1.380
2011	0.323	0.012	0.021	0.013	0.009	0.055	0.450	0.753
2012	0.332	0.013	0.022	0.014	0.010	0.059	0.469	0.798
2013	0.315	0.013	0.021	0.014	0.010	0.057	0.389	0.109
2014	0.302	0.014	0.023	0.014	0.010	0.061	0.333	0.271
Trend 1990-2014, %	-15.0	-33.2	-42.3	-18.8	-18.0	-32.5	20.7	-98.7

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

3.3.2.1. Source category description

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

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

- 1.A.3.a.ii (i) Civil aviation (Domestic, LTO);
- 1.A.3.a.i (i) International aviation (LTO);
- 1.A.3.a.ii (ii) Civil aviation (Domestic, Cruise);
- 1.A.3.a.i (ii) International aviation (Cruise).

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

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 were 0.5%, 0.5% and 0.9% respectively, in the transport sector in 2014. 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 1990-2014, the emission of NO_x, NMVOC and CO from LTO phase increased 44.6%, 23.9%, 40.5% respectively (Figure 3.18-20, Table 3.21), mainly due to changes in fuel consumption and number of landing and take-off operations. This is roughly in line with the trends in the number of air passengers and freight transported over the same period (Figure 3.21). Figures 3.18-20 illustrate the importance of international aviation sector which contributes majority of the emissions from aviation sector.

The emissions of NO_x, NMVOC and CO increased in 2014 compared to 2013 by 0.8, 10.9 and 2.8% respectively, due to an increase in fuel consumption (1.7%). Although, at the same time the number of landing and take-off operations decreased 1.3%. This increase in emissions can be explained by the fact that the share of different aircraft types varies every year and therefore average emission factor (Table 3.23) changes from year to year.

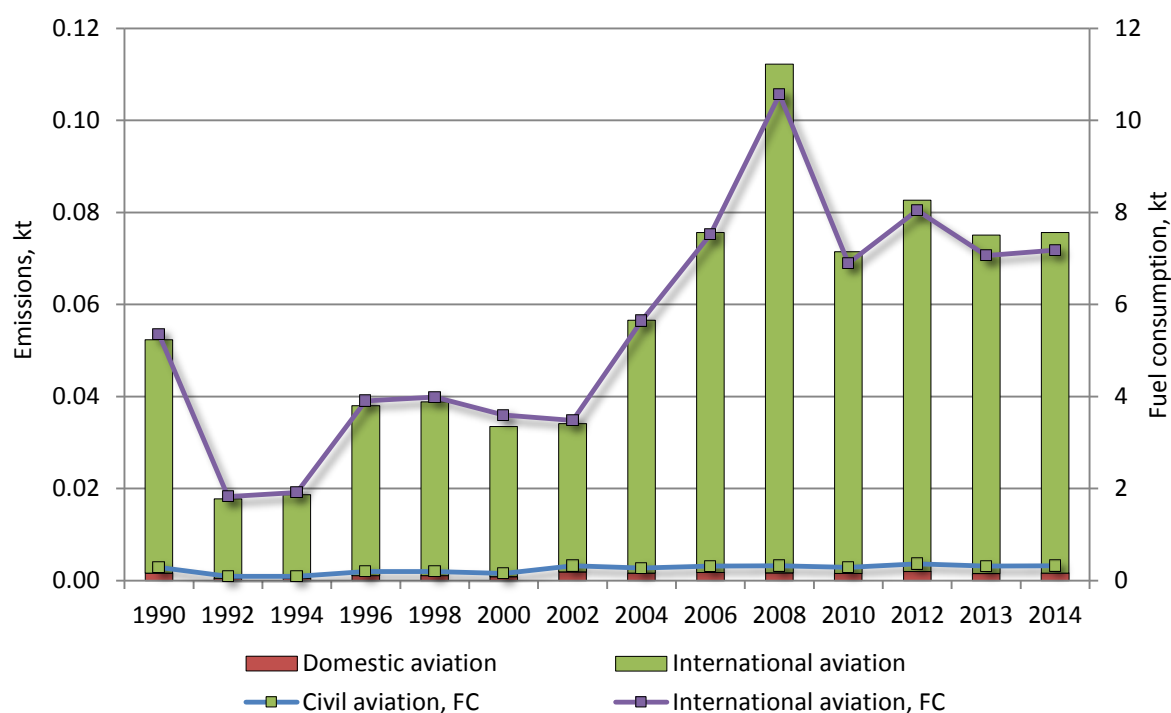


Figure 3.18 NO_x emissions from the LTO-cycle

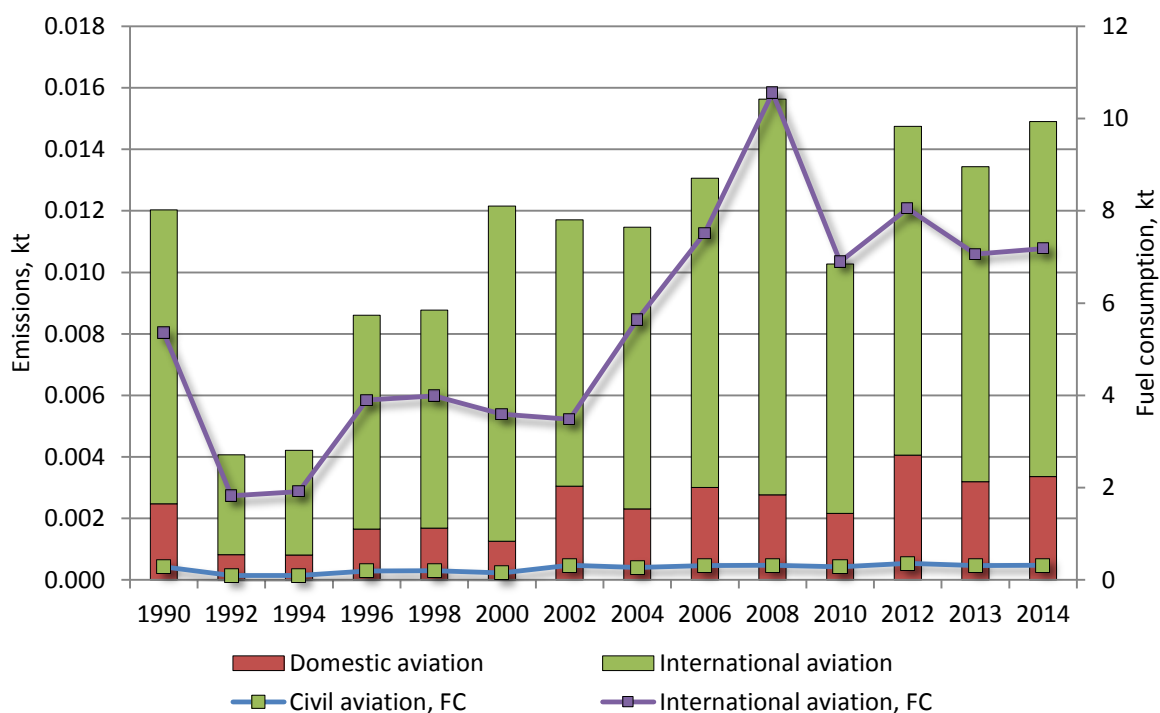


Figure 3.19 NMVOC emissions from the LTO-cycle

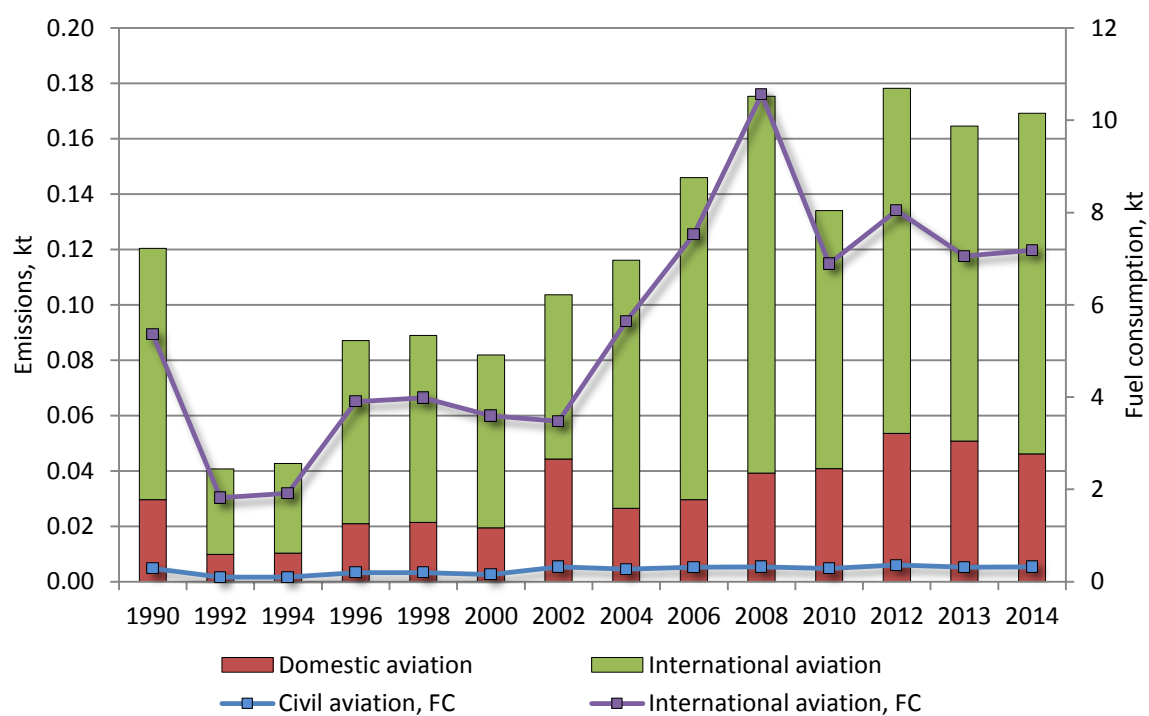


Figure 3.20 CO emissions from the LTO-cycle

Table 3.21 Emissions from the LTO-cycle in aviation sector in the period of 1990-2014

Year	NO _x	NM VOC	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
1991	0.052	0.012	0.006	NR	NR	0.392	NR	0.120
1992	0.018	0.004	0.002	NR	NR	0.133	NR	0.041
1993	0.019	0.004	0.002	NR	NR	0.141	NR	0.043
1994	0.019	0.004	0.002	NR	NR	0.139	NR	0.043
1995	0.030	0.007	0.003	NR	NR	0.221	NR	0.068
1996	0.038	0.009	0.004	NR	NR	0.283	NR	0.087
1997	0.036	0.008	0.004	NR	NR	0.265	NR	0.082
1998	0.039	0.009	0.004	NR	NR	0.289	NR	0.089
1999	0.037	0.008	0.004	NR	NR	0.275	NR	0.084
2000	0.033	0.012	0.004	0.314	0.314	0.314	0.152	0.082
2001	0.033	0.010	0.004	0.282	0.282	0.282	0.137	0.078
2002	0.034	0.012	0.004	0.272	0.272	0.272	0.132	0.104
2003	0.042	0.010	0.004	0.330	0.330	0.330	0.160	0.103
2004	0.057	0.011	0.006	0.441	0.441	0.441	0.213	0.116
2005	0.078	0.015	0.008	0.652	0.652	0.652	0.314	0.155
2006	0.076	0.013	0.008	0.642	0.642	0.642	0.310	0.146
2007	0.090	0.013	0.009	0.780	0.780	0.780	0.376	0.156
2008	0.112	0.016	0.010	0.941	0.941	0.941	0.453	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	0.307	0.165
2012	0.083	0.015	0.008	0.465	0.465	0.465	0.223	0.178
2013	0.075	0.013	0.007	0.463	0.463	0.463	0.221	0.165
2014	0.076	0.015	0.007	0.482	0.482	0.482	0.231	0.169
Trend 1990-2014, %	44.6	23.9	25.5	53.6	53.6	23.0	51.6	40.5

Table 3.22 Emissions from the cruise phase in the aviation sector in the period of 1990-2014 (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
1991	0.385	0.015	0.030	NR	NR	0.006	NR	0.035
1992	0.128	0.005	0.010	NR	NR	0.002	NR	0.012
1993	0.206	0.008	0.016	NR	NR	0.003	NR	0.019
1994	0.165	0.006	0.013	NR	NR	0.003	NR	0.015
1995	0.190	0.007	0.015	NR	NR	0.003	NR	0.017
1996	0.153	0.006	0.012	NR	NR	0.002	NR	0.014
1997	0.237	0.009	0.019	NR	NR	0.004	NR	0.021
1998	0.147	0.006	0.012	NR	NR	0.002	NR	0.013
1999	0.230	0.009	0.018	NR	NR	0.004	NR	0.021
2000	0.224	0.009	0.018	0.004	0.004	0.004	0.002	0.020
2001	0.158	0.006	0.012	0.002	0.002	0.002	0.001	0.014
2002	0.187	0.007	0.015	0.003	0.003	0.003	0.001	0.017
2003	0.177	0.007	0.014	0.003	0.003	0.003	0.001	0.016
2004	0.298	0.011	0.023	0.005	0.005	0.005	0.002	0.027
2005	0.501	0.020	0.039	0.008	0.008	0.008	0.004	0.043
2006	0.301	0.012	0.024	0.005	0.005	0.005	0.002	0.026
2007	0.511	0.020	0.040	0.008	0.008	0.008	0.004	0.044

Year	NO _x	NM VOC	SO ₂	PM _{2.5}	PM ₁₀	TSP	BC	CO
2008	0.216	0.008	0.017	0.003	0.003	0.003	0.002	0.019
2009	0.321	0.012	0.025	0.005	0.005	0.005	0.002	0.028
2010	0.376	0.015	0.029	0.006	0.006	0.006	0.003	0.033
2011	0.320	0.012	0.025	0.005	0.005	0.005	0.002	0.028
2012	0.369	0.014	0.029	0.006	0.006	0.006	0.003	0.032
2013	0.269	0.010	0.021	0.004	0.004	0.004	0.002	0.023
2014	0.415	0.016	0.032	0.006	0.006	0.006	0.001	0.036
Trend 1990-2014, %	7.8	11.1	6.8	84.0	84.0	8.1	-42.5	2.8

3.3.2.2. Methodological issues

Emissions calculations from the LTO cycle are based on the Tier 2 method and cruise emission calculations Tier 1 (EMEP/EEA Guidebook 2013).

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 aircraft is calculated for both domestic and international LTOs by multiplying the LTO fuel consumption factor for each representative aircraft type (Table 3.23) 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 emissions 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 (Table 3.24). Fuel-based cruise emission factors are taken from the 13uidebook as a single set for an average aircraft (Table 3.23). 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:

$$LTO\ Emissions = Number\ of\ LTOs * Emission\ Factor\ LTO$$

$$LTO\ Fuel\ Consumption = Number\ of\ LTOs * Fuel\ Consumption\ per\ LTO$$

$$Cruise\ Emissions = (Total\ Fuel\ Consumption - LTO\ Fuel\ Consumption) * Emission\ Factor\ Cruise$$

All flights to and from Estonia's airports are separated into domestic and international flights. Separate emission estimates are made for domestic and international civil aircraft, which are divided into emissions from the landing and take-off (LTO) phase and the cruise phase.

Detailed aircraft type data with take-off and landing activity is supplied by 7 Estonian airports. Estonian aircraft movement statistics count landing and take-off as two different activities. However methodology defines both one landing and one take-off as a full LTO cycle. Therefore statistical aircraft movement data is divided in two (Figure 3.21).

The methodology requires information on the number of LTO's grouped by representative aircraft types (Table 3.22). This kind of detailed knowledge is hard to obtain (individual aircraft with their specific engines) and therefore data is an aggregated level for practical reasons (Figure 3.22). Assumptions are made if missing data exist in some situations.

In spite of the different levels of aviation statistics it is possible to divide the 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 2013 (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 2014. Extrapolation has been done for 1990 and 1991.

Table 3.23 Emission factors for the LTO-cycle (kg/LTO)

	NO _x	NM VOC	SO ₂	PM _{2.5}	CO	Fuel consumption
Turbofans (Jets)^{1,2,3}						
Airbus A310	23.2	5	1.5	0.14	25.8	1540.5
Airbus A320	10.8	1.7	0.8	0.09	17.6	802.3
Bae 111	4.9	19.3	0.7	0.17	37.7	681.6
Bae 146	4.2	0.9	0.6	0.08	9.7	569.5
B727	12.6	6.5	1.4	0.22	26.4	1412.8
B737-100	8	0.5	0.9	0.1	4.8	919.7
B737-400	8.3	0.6	0.8	0.07	11.8	825.4
B747-100-300	55.9	33.6	3.4	0.47	78.2	3413.9
B747-400	56.6	1.6	3.4	0.32	19.5	3402.2
B757	19.7	1.1	1.3	0.13	12.5	1253
B767-300	26	0.8	1.6	0.15	6.1	1617.1
B777	53.6	20.5	2.6	0.2	61.4	2562.8
Fokker 100	5.8	1.3	0.7	0.14	13.7	744.4
Fokker 28	5.2	29.6	0.7	0.15	32.7	666.1
2XB737-100	16	1	1.8	0.2	9.6	1839.4
McDonnell Douglas DC-9	7.3	0.7	0.9	0.16	5.4	876.1
McDonnell Douglas DC-10	41.7	20.5	2.4	0.32	61.6	2381.2
McDonnell Douglas	12.3	1.4	1	0.12	6.5	1003.1
C525	0.74	3.01	0.34	0	34.07	340
EC RJ_100ER	2.27	0.56	0.33	0	6.7	330
ERJ-145	2.69	0.5	0.31	0	6.18	310
GLF4	5.63	1.23	0.68	0	8.88	680
GLF5	5.58	0.28	0.6	0	8.42	600
RJ85	4.34	1.21	0.6	0	11.21	600
Turboprop³						
turboprop, <1000sph/engine	0.3	0.58	0.07	0	2.97	70
turboprop, 1000-2000 sph/engine	1.51	0	0.2	0	2.24	200
turboprop, >2000sph/engine	1.82	0.26	0.2	0	2.33	200
Piston engine⁴						
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
Helicopters⁵						
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
ALO3	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

	NO _x	NM VOC	SO ₂	PM _{2.5}	CO	Fuel consumption
AS35	0.18	0.22	0.01	0.01	0.32	27.5
AS50	0.15	0.24	0.01	0.01	0.35	25.2
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 3.24 Emission factors for the cruise phase (kg/t)

	NO _x	CO	NM VOC	SO ₂	PM _{2.5}
Domestic aviation	3150	2	0.1	1	0.2
International aviation	3150	1.1	0.5	1	0.2

*BC fractions of PM (f-BC) for piston engine aircraft = 0.15, for other aircraft 0.48 (EMEP/EEA Guidebook 2013)

Table 3.25 Fuel consumption in the aviation sector (kt)

Year	Domestic LTO	Domestic cruise	International LTO	International cruise	Total
1990	0.285	1.515	5.358	28.842	36.000
1991	0.285	1.515	5.358	28.842	36.000
1992	0.095	0.505	1.821	9.579	12.000
1993	0.096	1.124	1.943	15.157	18.320
1994	0.095	0.725	1.917	12.333	15.070
1995	0.150	0.971	3.041	14.059	18.221
1996	0.194	0.817	3.902	11.298	16.211
1997	0.181	0.952	3.657	17.750	22.540
1998	0.198	0.616	3.987	10.987	15.788
1999	0.188	0.672	3.784	17.418	22.062
2000	0.153	0.638	3.596	16.982	21.369
2001	0.170	0.608	3.562	11.871	16.211
2002	0.322	0.480	3.480	14.253	18.535
2003	0.333	0.415	4.142	13.478	18.368
2004	0.273	0.792	5.640	22.651	29.356
2005	0.308	0.239	7.568	38.987	47.102
2006	0.314	0.090	7.523	23.436	31.363
2007	0.291	0.126	8.966	39.791	49.174
2008	0.321	0.402	10.560	16.539	27.822
2009	0.284	0.267	7.134	24.901	32.586
2010	0.287	0.277	6.893	29.138	36.595
2011	0.339	0.532	8.319	24.536	33.726
2012	0.360	0.731	8.046	28.216	37.353
2013	0.313	0.072	7.060	20.966	28.411
2014	0.320	0.075	7.181	32.352	39.928

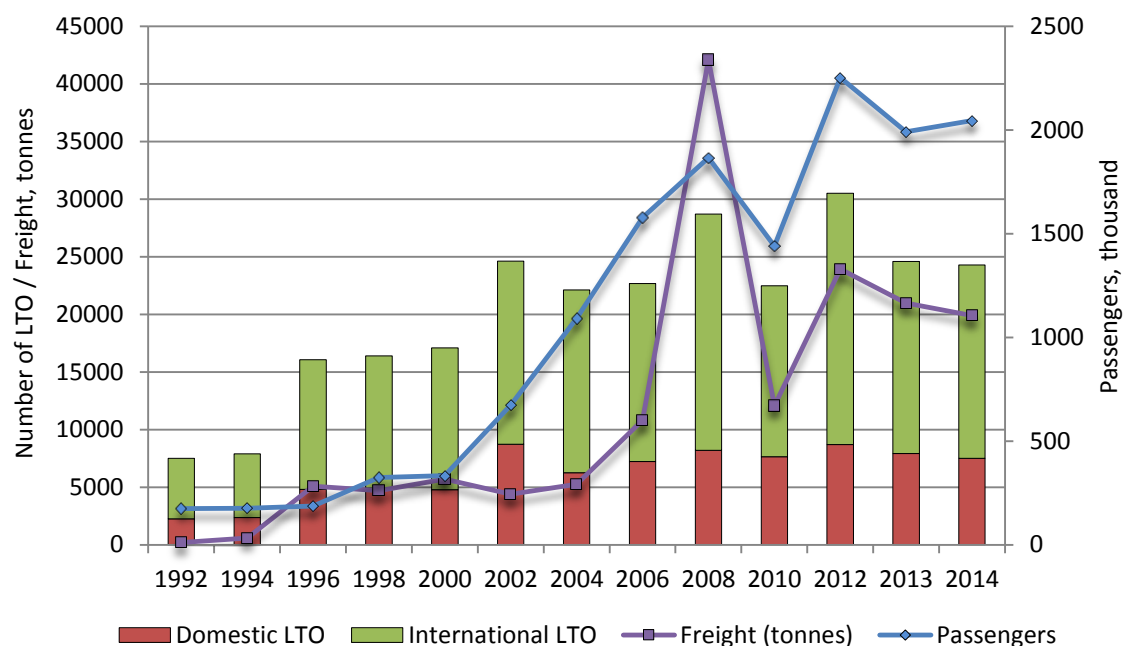


Figure 3.21 The number of LTO-cycles, passengers carried and freight transported

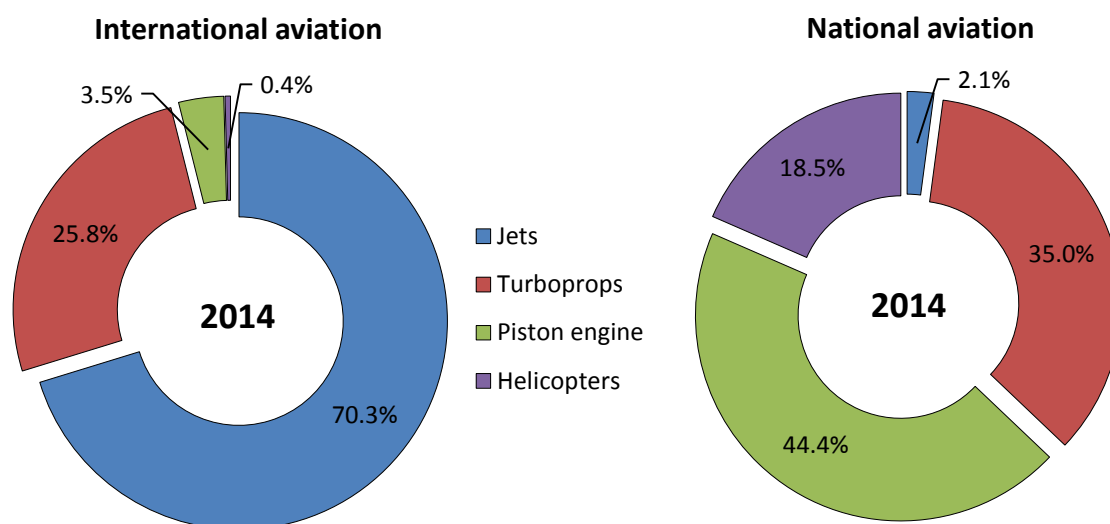


Figure 3.22 The share of different aircraft types in domestic and international civil aviation

3.3.2.3. Uncertainty

An uncertainty analysis was carried out to the year 2014 inventory. The uncertainty in the emission factors for all pollutants from aviation (LTO) sector is estimated to be 30% and in the activity data 2%. All uncertainty estimates for this source are given in Table 3.26. No uncertainty estimation for cruise phase has been carried out.

Table 3.26 Uncertainties in aviation (LTO) sector

Pollutant	Emission, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	0.075632	kt	0.23	2.61	1.45
NM VOC	0.014907	kt	0.07	1.41	0.70
SO _x	0.006928	kt	0.02	0.71	0.26
PM _{2.5}	0.000483	kt	0.01	0.43	0.25
PM ₁₀	0.000483	kt	0.00	0.34	0.18
TSP	0.000483	kt	0.00	0.30	0.07
CO	0.169182	kt	0.13	2.01	1.18

3.3.2.4. Source-specific QA/QC and verification

Common statistical quality checking 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 drive occasionally on the roads because they are included in other sectors, such as off-roads (agricultural and industrial machinery, etc.).

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

The road transport sector includes emissions from fuel combustion, road abrasion, tyre and brake wear and NMVOC emissions from gasoline evaporation.

Road transport contributed to the total national emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide by 24.9%, 8.0% and 10.3% respectively and 57.4%, 59.2% and 72.6% respectively in the transport sector in 2014 (Figure 3.16). 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 has mainly been caused by the stricter emission standards for road vehicles. The lead emissions from road transport have decreased about 99.6% since 1990 (Figure 3.27). The reduction of emissions is connected with the prohibition on leaded gasoline in 2000. The share of road transport in total Pb emissions was 0.7% in 2014. Reduction of sulphur content in fuels has given a substantial decrease of SO_2 emissions in the road transport sector (Figure 3.26). In 2001, the sulphur content was reduced from 5000 ppm (diesel) and 1000 ppm (gasoline) to 500 ppm and since that, sulphur content in fuel was reduced step by step even more. Currently, all road transport fuels are sulphur free (sulphur content less than 10 ppm). Therefore, SO_x emissions have decreased by 99.7% between 1990 and 2014.

Although there have been an increase in number of vehicles (1.1%), average annual mileage driven (3.3%) and fuel consumption (2.1%), the total emissions from road transport decreased in 2014 compared to 2013. Therefore there has no big change in emissions due to the number of new vehicles which are designed to reduce both energy consumption and pollutant emissions.

In the figures below (Figures 3.23-27), a detailed overview of NO_x , NMVOC, CO, SO_x and Pb emission sources in the road transport sector is provided. All the emission trends are presented in Tables 3.27-29.

Fuel consumption has changed over the decades in the road transport sector. In the 1990s, gasoline consumption dominated, but from 2003 we can see the continuous growth in diesel consumption in road transport (Figure 3.28). This trend can be explained by the fact that the popularity of vehicles with gasoline engines has declined in recent years, and diesel engines dominate due to their greater fuel efficiency and torque compared to gasoline engines. Since 1990, the number of gasoline passenger cars and light duty vehicles equipped with catalytic converters has increased, resulting in decreasing emissions of e.g. NO_x and NMVOC by 95% and 90% respectively between 1990 and 2014. 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 were a 43% decrease in gasoline consumption during the period 1990-2014 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, over the last few years, there has been taken steps to use biofuels in road transport. The share of biofuels used for road transport accounted for 0.03% in 2005 and increased to 1.1% in 2014 (Table 3.34).

Recalculations

All the emissions from the transport sector for period 1990-2013 are recalculated. Recalculations mainly concern using an improved new edition of the COPERT 4 programme (version 11.3) which includes updated emission factors. An overview of the updated data is given in Chapter 8.

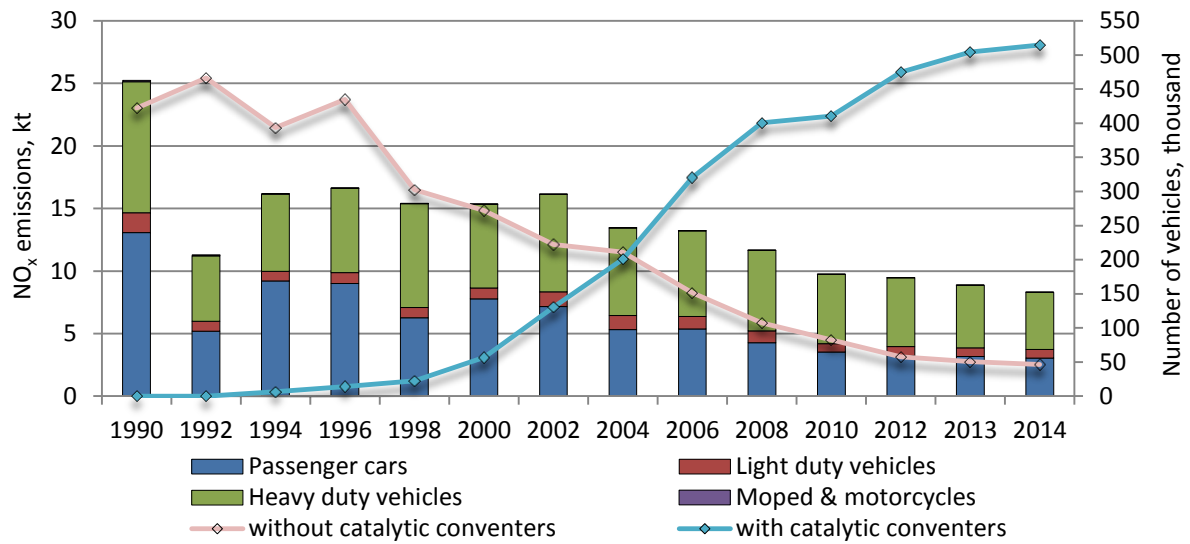


Figure 3.23 NO_x emissions from road transport

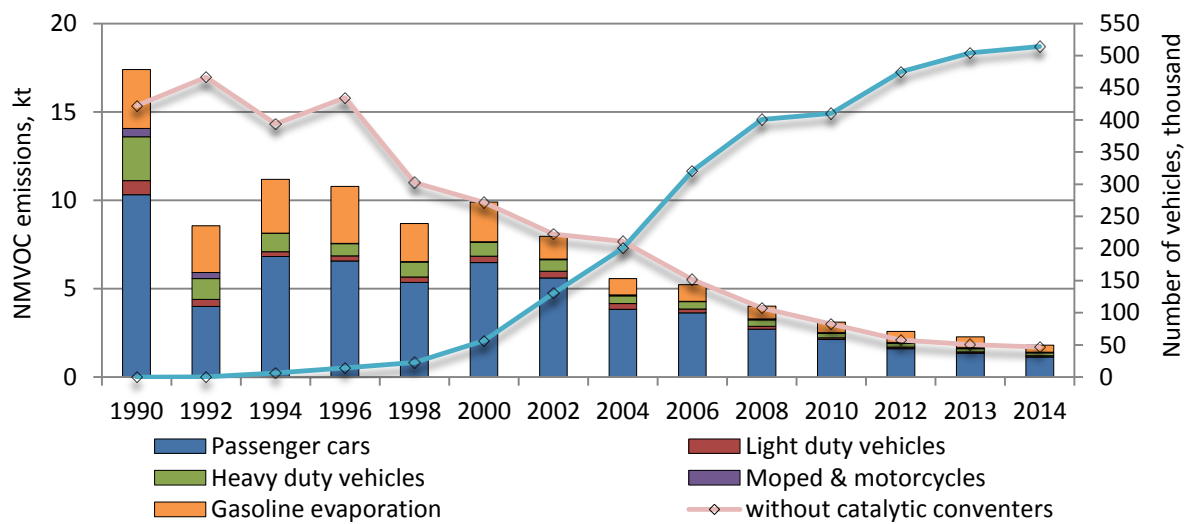


Figure 3.24 NMVOC emissions from road transport

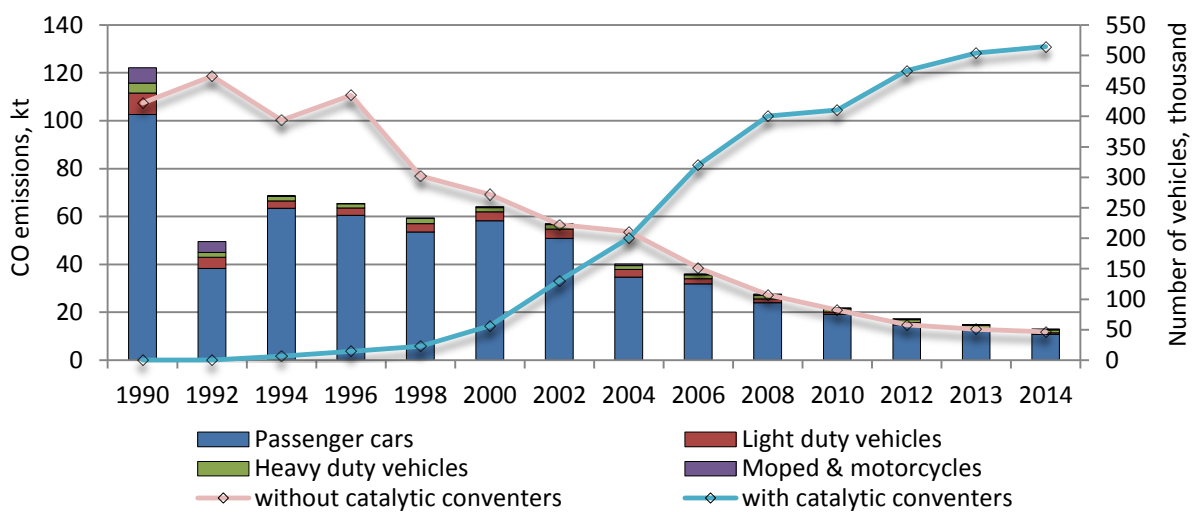


Figure 3.25 CO emissions from road transport

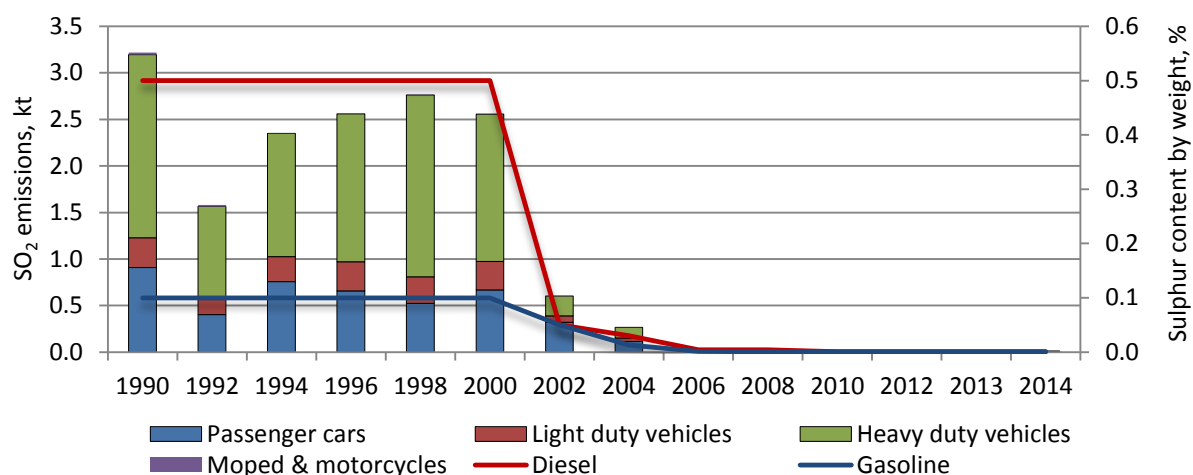


Figure 3.26 SO₂ emissions from road transport

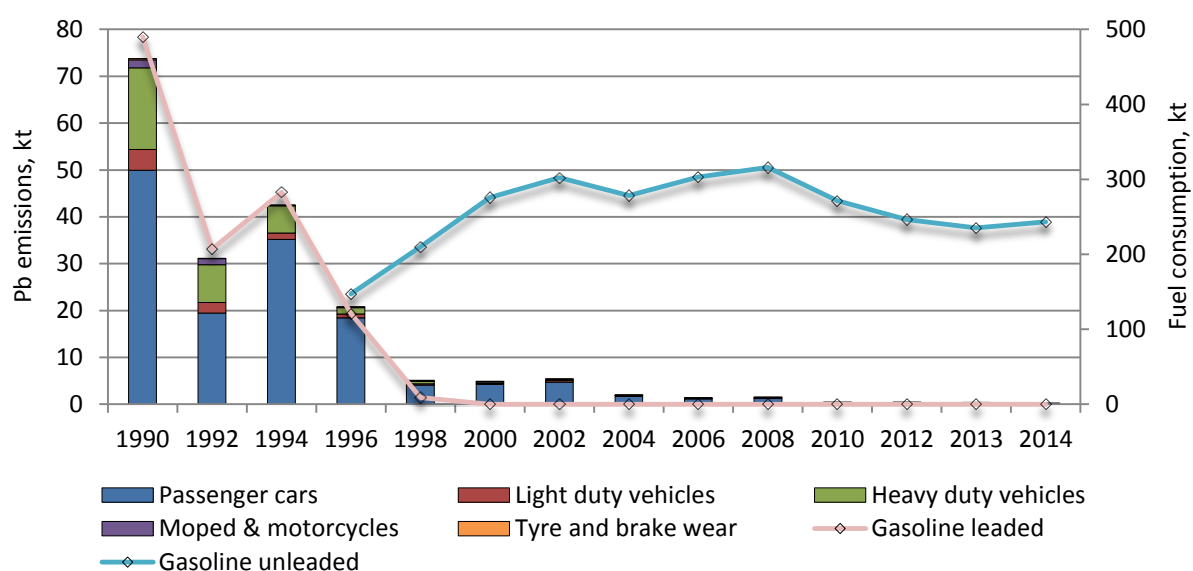


Figure 3.27 Pb emissions from road transport

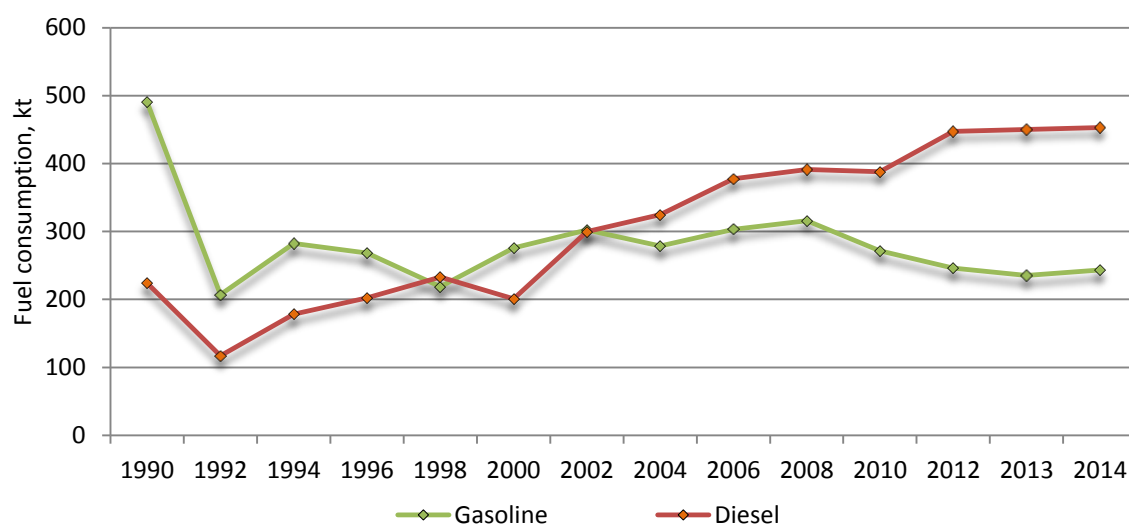


Figure 3.28 Gasoline and diesel consumption in the road transport sector

Table 3.27 Emissions from road transport in the period of 1990-2014, (kt)

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	25.250	17.389	3.220	0.016	NR	NR	1.018	NR	122.056
1991	22.949	16.651	2.930	0.015	NR	NR	0.942	NR	121.144
1992	11.294	8.554	1.583	0.007	NR	NR	0.509	NR	49.562
1993	12.446	8.965	1.859	0.011	NR	NR	0.608	NR	55.237
1994	16.147	11.181	2.350	0.022	NR	NR	0.759	NR	68.550
1995	15.786	10.678	2.598	0.029	NR	NR	0.812	NR	63.319
1996	16.632	10.785	2.561	0.039	NR	NR	0.759	NR	65.492
1997	17.350	12.184	2.700	0.050	NR	NR	0.825	NR	79.040
1998	15.387	8.686	2.765	0.047	NR	NR	0.790	NR	59.370
1999	15.632	10.382	2.587	0.062	NR	NR	0.767	NR	73.653
2000	15.350	9.905	2.558	0.111	0.713	0.800	0.910	0.334	64.102
2001	16.780	9.332	0.581	0.140	0.587	0.694	0.826	0.263	67.794
2002	16.150	7.964	0.602	0.146	0.657	0.767	0.901	0.307	57.005
2003	13.905	6.440	0.293	0.160	0.603	0.708	0.835	0.287	46.869
2004	13.453	5.571	0.267	0.223	0.683	0.792	0.923	0.331	40.176
2005	13.283	5.387	0.063	0.213	0.646	0.758	0.888	0.313	37.946
2006	13.212	5.220	0.036	0.240	0.626	0.746	0.885	0.303	35.965
2007	12.858	4.821	0.037	0.255	0.617	0.744	0.890	0.301	33.096
2008	11.672	4.009	0.036	0.253	0.554	0.680	0.829	0.266	27.628
2009	9.536	3.481	0.012	0.227	0.464	0.576	0.707	0.226	24.403
2010	9.754	3.110	0.006	0.213	0.459	0.578	0.719	0.223	21.915
2011	9.454	2.597	0.008	0.205	0.438	0.558	0.701	0.211	18.101
2012	9.471	2.573	0.009	0.192	0.456	0.581	0.731	0.223	17.285
2013	8.871	2.271	0.008	0.167	0.441	0.563	0.707	0.218	14.844
2014	8.309	1.809	0.008	0.159	0.414	0.539	0.684	0.198	13.065
Trend 1990-2014, %	-67.1	-89.6	-99.7	865.7	-41.9	-32.6	-32.8	-40.9	-89.3

Table 3.28 Emissions of heavy metals from road transport in the period of 1990-2014, (t)

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	73.785	0.008	NE	NE	0.112	2.152	0.024	0.002	2.214
1991	66.237	0.008	NE	NE	0.098	1.887	0.021	0.002	1.994
1992	31.167	0.004	NE	NE	0.051	0.991	0.011	0.001	0.999
1993	33.265	0.004	NE	NE	0.057	1.087	0.012	0.001	1.108
1994	42.559	0.005	NE	NE	0.071	1.351	0.015	0.001	1.414
1995	24.026	0.005	NE	NE	0.067	1.258	0.014	0.001	1.357
1996	20.813	0.005	NE	NE	0.070	1.320	0.015	0.001	1.422
1997	8.922	0.006	NE	NE	0.075	1.416	0.016	0.001	1.536
1998	5.104	0.005	NE	NE	0.068	1.273	0.014	0.001	1.338
1999	6.743	0.005	NE	NE	0.070	1.329	0.015	0.001	1.440
2000	4.944	0.005	NE	NE	0.072	1.359	0.015	0.001	1.446
2001	5.902	0.007	NE	NE	0.088	1.669	0.018	0.002	1.773
2002	5.445	0.007	NE	NE	0.091	1.717	0.019	0.002	1.819
2003	2.127	0.007	NE	NE	0.088	1.644	0.018	0.002	1.761
2004	2.065	0.007	NE	NE	0.092	1.712	0.019	0.002	1.818
2005	2.112	0.007	NE	NE	0.094	1.758	0.019	0.002	1.896
2006	1.444	0.008	NE	NE	0.101	1.887	0.021	0.002	2.040
2007	1.516	0.008	NE	NE	0.107	1.998	0.022	0.002	2.162
2008	1.569	0.008	NE	NE	0.107	1.988	0.022	0.002	2.116
2009	1.372	0.007	NE	NE	0.095	1.770	0.019	0.002	1.904

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2010	0.490	0.007	NE	NE	0.100	1.861	0.020	0.002	1.967
2011	0.459	0.007	NE	NE	0.101	1.875	0.020	0.002	1.966
2012	0.459	0.008	NE	NE	0.106	1.965	0.021	0.002	2.055
2013	0.424	0.008	NE	NE	0.104	1.922	0.021	0.002	2.023
2014	0.271	0.008	NE	NE	0.106	1.959	0.021	0.002	2.063
Trend 1990-2014, %	-99.6	-8.8	NE	NE	-4.9	-8.9	-9.9	-2.8	-6.8

Table 3.29 Total emissions of POPs from road transport in the period of 1990-2014

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	0.331	0.006	0.015	0.013	0.009	0.043	0.202	0.202
1991	0.304	0.005	0.013	0.010	0.009	0.037	0.194	0.194
1992	0.152	0.003	0.007	0.006	0.004	0.020	0.086	0.086
1993	0.171	0.003	0.008	0.007	0.005	0.022	0.095	0.092
1994	0.225	0.004	0.010	0.008	0.006	0.027	0.134	0.127
1995	0.215	0.004	0.009	0.007	0.006	0.027	0.125	0.114
1996	0.222	0.004	0.009	0.007	0.006	0.027	0.143	0.127
1997	0.237	0.004	0.010	0.008	0.007	0.029	0.154	0.133
1998	0.199	0.003	0.009	0.008	0.005	0.026	0.119	0.097
1999	0.221	0.004	0.009	0.008	0.006	0.027	0.146	0.116
2000	0.224	0.004	0.009	0.008	0.006	0.026	0.163	0.105
2001	0.283	0.005	0.011	0.009	0.007	0.032	0.223	0.126
2002	0.292	0.005	0.012	0.010	0.007	0.034	0.228	0.112
2003	0.288	0.006	0.011	0.010	0.007	0.033	0.237	0.101
2004	0.302	0.006	0.012	0.010	0.007	0.035	0.237	0.092
2005	0.313	0.007	0.012	0.010	0.008	0.037	0.254	0.094
2006	0.344	0.007	0.013	0.011	0.009	0.040	0.296	0.099
2007	0.366	0.008	0.014	0.012	0.009	0.043	0.325	0.100
2008	0.346	0.008	0.013	0.012	0.009	0.042	0.315	0.089
2009	0.318	0.007	0.012	0.011	0.008	0.038	0.297	0.080
2010	0.326	0.008	0.013	0.012	0.008	0.041	0.308	0.078
2011	0.323	0.008	0.013	0.012	0.009	0.042	0.307	0.074
2012	0.331	0.009	0.015	0.013	0.009	0.046	0.316	0.072
2013	0.315	0.009	0.015	0.013	0.009	0.046	0.301	0.067
2014	0.301	0.009	0.015	0.013	0.010	0.047	0.289	0.064
Trend 1990-2014, %	-8.8	68.7	-3.5	4.1	2.5	9.4	42.8	-68.6

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 using a combination of reliable technical and detailed activity data. Tier 3 is implemented in COPERT 4 programme (Computer Programme to calculate Emissions from Road Transport, Copert 4 version 11.3), which is used for the calculations and is 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.

Calculations demand annual mileage per vehicle category (Table 3.33) and the number of vehicles (Table 3.34), which is supplied by the Estonian Road Administration. These improved statistics are available from 2001 and data for the years 1990-2000 is extrapolated. Meteorological data is obtained from the Meteorological and Hydrological Institute and fuel consumption data from Statistics Estonia.

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.

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 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 (Table 3.35) by emission factors (Table 3.30-32). 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. Equation:

$$E_{SO2} = 2 \times k \times FC$$

where

E_{SO2} – emissions of SO₂;

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

FC – fuel consumption.

Table 3.30 Sulphur content of fuel (by weight), %

Fuel	1990	2001	2003	2004	2005	2006	2007	2009	2010	2011	2012	2013-2014
Gasoline	0.1	0.05	0.015	0.013	0.005	0.001	0.0008	0.0008	0.00051	0.00055	0.00065	0.0006
Diesel	0.5	0.05	0.035	0.030	0.005	0.004	0.0040	0.0010	0.00048	0.00062	0.00071	0.00061

- **Pb** emissions are estimated according to the calculation that 75 % of lead contained in gasoline is emitted into the air. Equation:

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

where

E_{Pb} – emissions of Pb;

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

FC – fuel consumption.

Table 3.31 Lead content in gasoline (g/l)

Fuel	1990	2003	2006	2010
Leaded gasoline	0.15	-	-	-
Unleaded gasoline	0.013	0.005	0.003	0.0001

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

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

where

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

FC – fuel consumption.

Table 3.32 Heavy metals content in fuel (mg/kg)

Fuel	Cd	Cu	Cr	Ni	Se	Zn
Gasoline/Bioethanol	0.0108	0.0418	0.0159	0.0130	0.0002	2.1640
Diesel/Biodiesel	0.0087	0.0212	0.0300	0.0088	0.0001	1.7380

Table 3.33 Average annual mileage in the road transport sector (million km per year)

Year	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1990	5,601.3	687.2	1,584.3	317.1	8,189.9
1991	5,612.3	668.1	1,195.8	230.5	7,706.7
1992	2,278.0	346.9	783.4	230.0	3,638.3
1993	2,619.9	377.9	831.4	223.3	4,052.6
1994	4,224.7	421.8	843.9	5.1	5,495.4
1995	3,880.1	446.8	842.7	7.7	5,177.3
1996	4,172.4	494.9	850.3	10.0	5,527.6
1997	4,396.3	555.4	923.7	12.8	5,888.3
1998	3,165.2	455.9	1,064.4	10.5	4,696.0

Year	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1999	4,012.0	512.2	902.4	14.5	5,441.1
2000	4,125.7	505.5	899.8	15.9	5,546.9
2001	5,271.2	729.3	1,011.3	16.2	7,028.1
2002	5,176.5	872.8	1,053.0	17.3	7,119.6
2003	5,219.5	825.3	941.0	19.3	7,005.1
2004	5,419.8	958.5	942.1	32.8	7,353.2
2005	5,801.9	958.9	898.4	10.7	7,669.8
2006	6,451.1	950.0	939.1	19.2	8,359.4
2007	6,989.5	978.3	960.7	28.1	8,956.6
2008	6,829.0	965.6	995.8	29.8	8,820.2
2009	6,546.7	727.4	818.6	26.6	8,119.3
2010	6,455.7	763.6	981.5	28.0	8,227.8
2011	6,460.2	777.8	998.5	25.1	8,261.7
2012	6,714.8	859.8	1,042.3	33.9	8,650.8
2013	6,737.3	852.5	962.4	44.0	8,596.2
2014	7,028.9	887.2	932.7	27.6	8,876.5

Table 3.34 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
1991	261.1	35.4	50.3	100.2	447.0
1992	283.5	34.2	48.8	100.0	466.5
1993	317.4	34.0	48.8	97.1	497.3
1994	337.8	24.7	35.4	2.2	400.1
1995	383.4	30.1	42.5	3.3	459.3
1996	378.3	28.4	37.9	4.2	448.8
1997	381.5	27.9	36.8	5.4	451.6
1998	264.8	19.6	36.3	4.4	325.1
1999	295.7	21.2	31.1	6.1	354.2
2000	273.1	19.5	29.1	6.7	328.5
2001	273.9	26.4	30.9	6.8	338.0
2002	285.8	29.6	29.9	7.3	352.5
2003	314.4	32.5	30.0	8.1	385.0
2004	335.1	36.8	30.5	9.1	411.5
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	6.0	507.9
2009	424.0	36.9	27.0	6.7	494.7
2010	422.1	36.3	26.9	7.4	492.7
2011	440.2	37.9	27.2	8.1	513.4
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	9.8	560.8

Table 3.35 Fuel consumption in the road transport sector (kt)

Year	Gasoline	Diesel	Bioethanol	Biodiesel
1990	490.16	223.95	-	-
1991	440.05	205.00	-	-
1992	206.98	116.86	-	-
1993	220.89	141.70	-	-
1994	282.63	178.45	-	-
1995	242.96	211.25	-	-
1996	268.09	202.46	-	-
1997	298.91	210.25	-	-
1998	218.62	232.76	-	-
1999	274.61	203.74	-	-
2000	275.70	200.65	-	-
2001	328.79	251.76	-	-
2002	302.07	299.76	-	-
2003	288.95	294.77	-	-
2004	278.49	324.74	-	-
2005	284.61	347.73	0.00	0.17
2006	303.29	376.55	0.00	1.23
2007	317.94	404.25	0.02	0.57
2008	313.76	387.96	2.15	3.15
2009	287.71	346.47	0.15	1.82
2010	264.64	384.63	6.86	3.57
2011	251.77	401.07	5.93	0.72
2012	240.55	447.38	5.63	0.00
2013	230.50	450.07	4.78	0.00
2014	235.51	453.08	7.98	0.00

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, and also 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).

Automobile tyre and brake wear calculations are based on the Tier 2 method and using the COPERT model (EMEP/EEA Guidebook 2013).

The road abrasion sector is not included in the COPERT model and therefore these emissions are calculated separately using Tier 1 default emission factors from the EMEP/EEA Guidebook 2013.

3) Gasoline evaporation

This sector includes NMVOC evaporative fuel-related emissions from gasoline vehicles, which are not derived from fuel combustion. Most evaporative emissions of VOCs emanate from the

fuel systems (tanks, injection systems and fuel lines) of petrol vehicles. Evaporative emissions from diesel vehicles are considered negligible.

Gasoline evaporation calculations are based on the Tier 3 method and using the COPERT model (EMEP/EEA Guidebook 2013).

3.3.3.3. Uncertainty

An uncertainty analysis was carried out to the year 2014 inventory. The uncertainty in the emission factors for main pollutants, particulate matter and heavy metals from 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 3.36.

Table 3.36 Uncertainties in road transport sector

Pollutant	Emissions, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	8.309	kt	24.93	22.38	9.57
NM VOC	1.809	kt	8.03	12.71	10.96
SO _x	0.008	kt	0.02	0.64	1.87
NH ₃	0.159	kt	1.22	4.94	3.36
PM _{2.5}	0.414	kt	5.32	10.34	6.55
PM ₁₀	0.539	kt	4.31	9.31	4.94
TSP	0.684	kt	4.11	9.09	2.14
CO	13.065	kt	10.33	14.41	23.34
Pb	0.271	t	0.74	4.63	11.35
Cd	0.008	t	0.86	4.29	1.71
PCDD/PCDF	0.301	g I-TEQ	7.67	43.78	21.45
B(a)p	0.009	t	0.46	9.63	6.73
B(b)f	0.015	t	0.64	11.33	6.82
B(k)f	0.013	t	1.11	14.88	8.93
I(1,2,3-cd)p	0.010	t	0.64	11.33	6.12
HCB	0.0003	kg	0.10	5.10	0.72
PCB	0.0001	kg	0.00	0.39	0.21

3.3.3.4. Source-specific QA/QC and verification

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

3.3.3.5. Source-specific planned improvements

Include more detailed vehicle subsectors into calculations: mopeds, hybrid and LPG/CNG vehicles. Specify activity data and make recalculations, if necessary.

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.

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

The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were

7.3%, 3.1% and 1.1% respectively, in the transport sector in 2014.

The emissions of NO_x, NMVOC and CO have decreased compared to 1990 by 56.8%, 58.5 and 64.4% respectively. The trend of all the emissions is given in Tables 3.37-39.

Emissions from rail originate primarily from the combustion of diesel and light fuel oil by locomotives. Since emissions from railway sector are calculated by Tier 1 method which takes into account the amount of fuel consumed and default emission factors, the deviations of time series can be explained by statistical fuel consumption deviations in the railway sector. As shown in Figure 3.29 freight turnover shows similar changes in trend and therefore all the emissions are directly influenced by freight rail activity.

Fuel consumption decreased 23.2% in 2014 compared to 2013 and therefore all the emissions have decreased also by the same percentage.

Recalculations

All the emissions for the year 2012 are recalculated. Recalculations concern using corrected fuel consumption data. An overview of the updated data is given in Chapter 8.

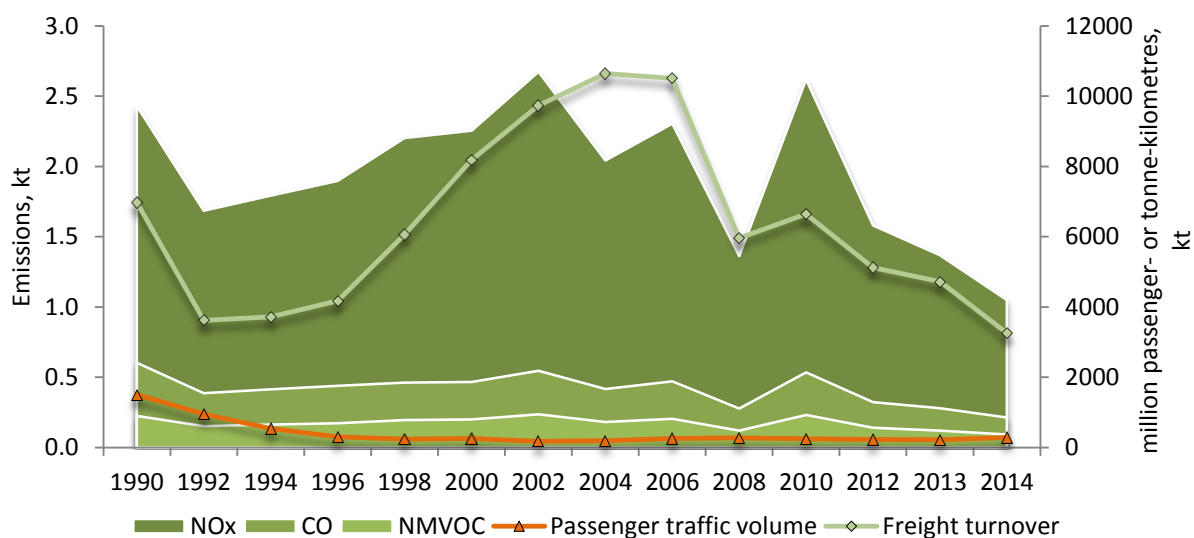


Figure 3.29 NO_x, NMVOC and CO emissions from the railway sector

Table 3.37 Emissions from railway transport in the period of 1990-2014 (kt)

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
1991	2.278	0.213	0.559	0.301	NR	NR	0.083	NR	0.593
1992	1.685	0.153	0.364	0.224	NR	NR	0.055	NR	0.388
1993	1.791	0.163	0.388	0.238	NR	NR	0.058	NR	0.413
1994	1.791	0.163	0.390	0.238	NR	NR	0.059	NR	0.415
1995	1.736	0.157	0.365	0.231	NR	NR	0.055	NR	0.389
1996	1.897	0.173	0.413	0.252	NR	NR	0.062	NR	0.440
1997	1.736	0.157	0.363	0.231	NR	NR	0.055	NR	0.388
1998	2.203	0.197	0.433	0.294	NR	NR	0.066	NR	0.462
1999	2.411	0.214	0.463	0.322	NR	NR	0.070	NR	0.495
2000	2.254	0.200	0.177	0.301	0.060	0.063	0.066	0.038	0.466
2001	2.097	0.187	0.167	0.280	0.056	0.059	0.062	0.036	0.435
2002	2.673	0.237	0.199	0.357	0.070	0.074	0.078	0.045	0.547
2003	2.358	0.209	0.170	0.315	0.062	0.065	0.068	0.040	0.482
2004	2.044	0.181	0.153	0.273	0.053	0.056	0.059	0.035	0.417
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	0.068	0.238	0.047	0.049	0.052	0.030	0.364
2012	1.581	0.140	0.060	0.211	0.041	0.043	0.046	0.027	0.323
2013	1.368	0.121	0.052	0.183	0.036	0.038	0.040	0.023	0.279
2014	1.050	0.093	0.040	0.140	0.027	0.029	0.030	0.018	0.215
Trend 1990-2014, %	-56.8	-58.5	-92.9	-56.4	-53.9	-53.9	-64.0	-53.5	-64.4

Table 3.38 Emissions of heavy metals from railway transport in the period of 1990-2014

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
1991	0.019	0.687	1.130	0.572	0.004	0.076	0.005	0.687	0.072
1992	0.007	0.408	0.387	0.196	0.002	0.055	0.003	0.408	0.042
1993	0.007	0.435	0.419	0.212	0.002	0.059	0.003	0.435	0.045
1994	0.007	0.439	0.435	0.220	0.002	0.059	0.003	0.439	0.045
1995	0.005	0.400	0.308	0.156	0.002	0.057	0.003	0.400	0.041
1996	0.008	0.466	0.466	0.236	0.003	0.062	0.003	0.466	0.048
1997	0.005	0.397	0.292	0.148	0.002	0.057	0.003	0.397	0.040
1998	0.002	0.445	0.111	0.056	0.002	0.072	0.003	0.445	0.045
1999	0.000	0.465	0.024	0.012	0.002	0.078	0.003	0.465	0.047
2000	0.001	0.441	0.047	0.024	0.002	0.073	0.003	0.441	0.044
2001	0.001	0.414	0.063	0.032	0.002	0.068	0.003	0.414	0.042
2002	0.000	0.512	0.008	0.004	0.003	0.087	0.004	0.512	0.051
2003	0.000	0.450	0.000	0.000	0.002	0.077	0.003	0.450	0.045
2004	0.000	0.390	0.000	0.000	0.002	0.066	0.003	0.390	0.039
2005	0.000	0.420	0.000	0.000	0.002	0.071	0.003	0.420	0.042
2006	0.000	0.440	0.000	0.000	0.002	0.075	0.003	0.440	0.044
2007	0.000	0.370	0.000	0.000	0.002	0.063	0.003	0.370	0.037
2008	0.000	0.260	0.000	0.000	0.001	0.044	0.002	0.260	0.026
2009	0.000	0.350	0.000	0.000	0.002	0.060	0.002	0.350	0.035
2010	0.000	0.500	0.000	0.000	0.003	0.085	0.004	0.500	0.050
2011	0.000	0.340	0.000	0.000	0.002	0.058	0.002	0.340	0.034
2012	0.000	0.302	0.000	0.000	0.002	0.051	0.002	0.302	0.030
2013	0.000	0.261	0.000	0.000	0.001	0.044	0.002	0.261	0.026
2014	0.000	0.200	0.000	0.000	0.001	0.034	0.001	0.200	0.020
Trend 1990-2014, %	-100.0	-70.3	-100.0	-100.0	-74.3	-57.6	-70.6	-70.3	-71.3

Table 3.39 Emissions of POPs from railway transport in the period of 1990-2014

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
1991	0.029	0.008	0.011	0.005	0.003	0.026	0.089	0.024
1992	0.010	0.003	0.004	0.002	0.001	0.011	0.030	0.008
1993	0.011	0.003	0.005	0.002	0.001	0.012	0.033	0.009
1994	0.011	0.004	0.005	0.002	0.001	0.012	0.034	0.009
1995	0.008	0.003	0.004	0.002	0.001	0.010	0.024	0.007
1996	0.012	0.004	0.005	0.003	0.001	0.013	0.037	0.010
1997	0.008	0.003	0.004	0.002	0.001	0.009	0.023	0.006
1998	0.003	0.002	0.003	0.002	0.001	0.007	0.009	0.002
1999	0.001	0.002	0.002	0.002	0.000	0.006	0.002	0.001
2000	0.001	0.002	0.003	0.002	0.000	0.006	0.004	0.001
2001	0.002	0.002	0.002	0.002	0.000	0.006	0.005	0.001
2002	0.000	0.002	0.003	0.002	0.000	0.006	0.001	0.000
2003	0.000	0.001	0.002	0.002	0.000	0.006	0.000	0.000
2004	0.000	0.001	0.002	0.001	0.000	0.005	0.000	0.000
2005	0.000	0.001	0.002	0.001	0.000	0.005	0.000	0.000
2006	0.000	0.001	0.002	0.002	0.000	0.005	0.000	0.000
2007	0.000	0.001	0.002	0.001	0.000	0.005	0.000	0.000

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
2008	0.000	0.001	0.001	0.001	0.000	0.003	0.000	0.000
2009	0.000	0.001	0.002	0.001	0.000	0.004	0.000	0.000
2010	0.000	0.002	0.003	0.002	0.000	0.006	0.000	0.000
2011	0.000	0.001	0.002	0.001	0.000	0.004	0.000	0.000
2012	0.000	0.001	0.002	0.001	0.000	0.004	0.000	0.000
2013	0.000	0.001	0.001	0.001	0.000	0.003	0.000	0.000
2014	0.000	0.001	0.001	0.001	0.000	0.002	0.000	0.000
Trend 1990-2014, %	-100.0	-91.1	-89.2	-84.3	-93.8	-89.4	-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 (Table 3.42) 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 Tables 3.40-42.

Emissions of SO₂ are dependent on fuel consumption and fuel type. SO₂ emissions are calculated by multiplying statistical fuel use (Table 3.44) by emission factors (Table 3.43). 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 3.40 Emission factors for railway transport

Fuel	Unit	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	f-BC	CO
Light fuel oil/ Diesel	kg/t	52.4	4.65	equation	0.007	1.37	1.44	1.52	6.4	10.7
Coal	g/GJ	173	88.8	900	-	108	117	124	6.4	931

Table 3.41 Emission factors for heavy metals

Fuel	Unit	Pb	Cd	Hg	As	Cu	Cr	Ni	Se	Zn
Light fuel oil/ Diesel	g/t	-	0.01	-	-	1.7	0.05	0.07	0.01	1
Coal	mg/GJ	134	1.8	7.9	4	17.5	13.5	13	1.8	200

Table 3.42 Emission factors for POPs

Fuel	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	HCB	PCBs
	TEQµg /t	g/t				mg/t	
Light fuel oil/ Diesel	-	0.03	0.05	-	-	-	-
	ng I- TEQ/GJ	mg/GJ	mg/GJ	mg/GJ	mg/GJ	mg/GJ	mg/GJ
Coal	203	45.5	58.9	23.7	18.5	0.00062	0.17

Table 3.43 Sulphur content of fuel (by weight)

Fuel	1990	2000	2001	2003	2004	2005	2006	2008	2009	2011
Light fuel oil	0.5%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%
Diesel	0.5%	0.5%	0.05%	0.035%	0.030%	0.005%	0.004%	0.004%	0.001%	0.1%

Table 3.44 Fuel consumption in the railway sector

Year	Coal	Diesel	Light fuel oil
	TJ	kt	
1990	119	0	46
1991	143	0	43
1992	49	0	32
1993	53	0	34
1994	55	0	34
1995	39	0	33
1996	59	0	36
1997	37	0	33
1998	14	0	42
1999	3	0	46
2000	6	0	43
2001	8	0	40
2002	1	2	49
2003	0	3	42
2004	0	1	38
2005	0	0	42
2006	0	2	42
2007	0	7	30
2008	0	1	25
2009	0	10	25
2010	0	15	35
2011	0	34	0
2012	0	30	0.163
2013	0	26	0.116
2014	0	20	0.047

3.3.4.3. Uncertainty

An uncertainty analysis was carried out to the year 2014 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 3.60.

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 and other inland vessels.

(Photo on the left 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 2014 was: NO_x – 2.5%, NMVOC – 2.3%, CO – 1.0%. Detailed emission data are

provided in Tables 3.45-47.

Deviations of time series can be explained by changing statistical fuel consumption in the national navigation sector (Figure 3.30). Fuel consumption increased 112.6% in 2014 compared to 2013, therefore all the emissions increased also in same extent.

Recalculations

All the emissions for the years 1999, 2000 and 2012 are recalculated. Recalculations concern using corrected fuel consumption data and emission factor for BC. An overview of the updated data is given in Chapter 8.

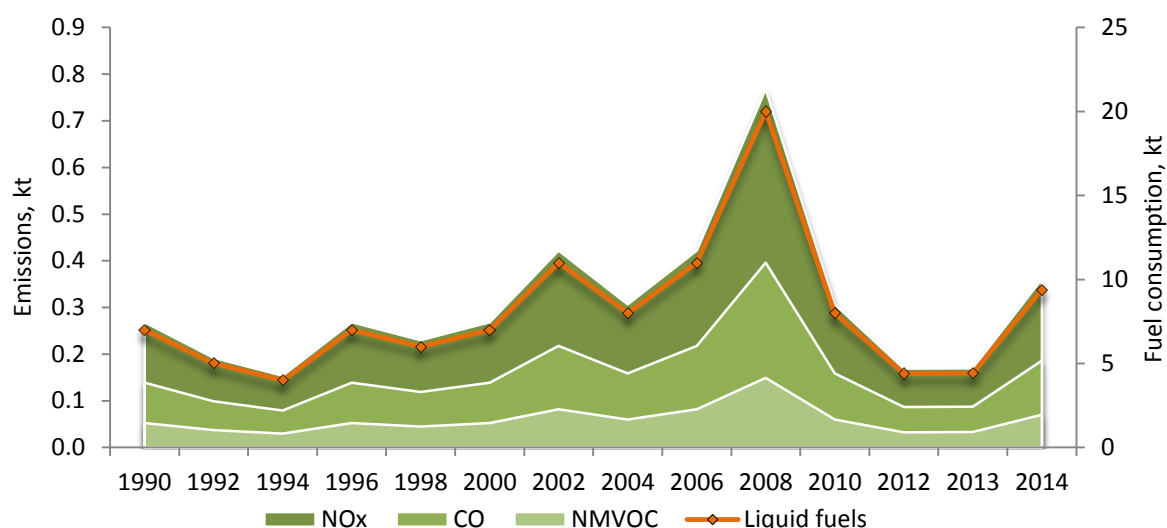


Figure 3.30 NO_x, NMVOC and CO emissions from the national navigation sector

Table 3.45 Emissions from national navigation in the period of 1990-2014

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
1991	0.269	0.052	0.070	0.049	NR	NR	0.032	NR	0.139
1992	0.192	0.037	0.050	0.035	NR	NR	0.023	NR	0.099
1993	1.421	0.276	0.370	0.259	NR	NR	0.170	NR	0.733
1994	0.154	0.030	0.040	0.028	NR	NR	0.018	NR	0.079
1995	0.154	0.030	0.040	0.028	NR	NR	0.018	NR	0.079
1996	0.269	0.052	0.070	0.049	NR	NR	0.032	NR	0.139
1997	0.230	0.045	0.060	0.042	NR	NR	0.028	NR	0.119
1998	0.230	0.045	0.060	0.042	NR	NR	0.028	NR	0.119
1999	0.202	0.039	0.053	0.037	NR	NR	0.024	NR	0.104
2000	0.269	0.052	0.028	0.049	0.032	0.032	0.032	0.018	0.139
2001	0.269	0.052	0.028	0.049	0.032	0.032	0.032	0.018	0.139
2002	0.422	0.082	0.044	0.077	0.051	0.051	0.051	0.028	0.218
2003	0.346	0.067	0.036	0.063	0.041	0.041	0.041	0.023	0.178
2004	0.307	0.060	0.032	0.056	0.037	0.037	0.037	0.020	0.158
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	0.361	0.070	0.019	0.066	0.043	0.043	0.043	0.024	0.186
Trend 1990-2014, %	34.2	34.2	-73.2	34.2	34.2	34.2	34.2	34.2	34.2

Table 3.46 Emissions of heavy metals from national navigation in the period of 1990-2014

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	kg					t	kg		t
1990	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
1991	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
1992	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
1993	NA	0.370	NA	NA	1.850	0.063	2.590	0.370	0.037
1994	NA	0.040	NA	NA	0.200	0.007	0.280	0.040	0.004
1995	NA	0.040	NA	NA	0.200	0.007	0.280	0.040	0.004
1996	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
1997	NA	0.060	NA	NA	0.300	0.010	0.420	0.060	0.006
1998	NA	0.060	NA	NA	0.300	0.010	0.420	0.060	0.006
1999	NA	0.053	NA	NA	0.263	0.009	0.368	0.053	0.005
2000	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
2001	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
2002	NA	0.110	NA	NA	0.550	0.019	0.770	0.110	0.011
2003	NA	0.090	NA	NA	0.450	0.015	0.630	0.090	0.009
2004	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2005	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2006	NA	0.110	NA	NA	0.550	0.019	0.770	0.110	0.011
2007	NA	0.170	NA	NA	0.850	0.029	1.190	0.170	0.017
2008	NA	0.200	NA	NA	1.000	0.034	1.400	0.200	0.020
2009	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2010	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2011	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
2012	NA	0.044	NA	NA	0.220	0.007	0.308	0.044	0.004
2013	NA	0.044	NA	NA	0.221	0.008	0.309	0.044	0.004
2014	NA	0.094	NA	NA	0.470	0.016	0.658	0.094	0.009
Trend 1990-2014, %	NA	34.2	NA	NA	34.2	34.2	34.2	34.2	34.2

Table 3.47 Emissions of POPs from national navigation in the period of 1990-2014

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	kg						
1990	NA	0.210	0.350	NA	NA	0.560	NA	NA
1991	NA	0.210	0.350	NA	NA	0.560	NA	NA
1992	NA	0.150	0.250	NA	NA	0.400	NA	NA
1993	NA	1.110	1.850	NA	NA	2.960	NA	NA
1994	NA	0.120	0.200	NA	NA	0.320	NA	NA
1995	NA	0.120	0.200	NA	NA	0.320	NA	NA
1996	NA	0.210	0.350	NA	NA	0.560	NA	NA
1997	NA	0.180	0.300	NA	NA	0.480	NA	NA
1998	NA	0.180	0.300	NA	NA	0.480	NA	NA
1999	NA	0.158	0.263	NA	NA	0.420	NA	NA
2000	NA	0.210	0.350	NA	NA	0.560	NA	NA
2001	NA	0.210	0.350	NA	NA	0.560	NA	NA
2002	NA	0.330	0.550	NA	NA	0.880	NA	NA
2003	NA	0.270	0.450	NA	NA	0.720	NA	NA
2004	NA	0.240	0.400	NA	NA	0.640	NA	NA
2005	NA	0.240	0.400	NA	NA	0.640	NA	NA
2006	NA	0.330	0.550	NA	NA	0.880	NA	NA
2007	NA	0.510	0.850	NA	NA	1.360	NA	NA

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	kg						
2008	NA	0.600	1.000	NA	NA	1.600	NA	NA
2009	NA	0.240	0.400	NA	NA	0.640	NA	NA
2010	NA	0.240	0.400	NA	NA	0.640	NA	NA
2011	NA	0.150	0.250	NA	NA	0.400	NA	NA
2012	NA	0.132	0.220	NA	NA	0.352	NA	NA
2013	NA	0.133	0.221	NA	NA	0.354	NA	NA
2014	NA	0.282	0.470	NA	NA	0.752	NA	NA
Trend 1990-2014, %	NA	34.2	34.2	NA	NA	34.2	NA	NA

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 (Table 3.50) by respective emission factors. Default emission factors for the main pollutants are taken from EMEP/EEA Guidebook 2013 and are presented in Tables 3.48-49.

Emissions of SO₂ are dependent on fuel consumption and fuel type. SO₂ emissions are calculated by multiplying statistical fuel use (Table 3.51) by emission factors (Table 3.50). 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 3.48 Emission factors for national navigation transport (kg/t)

	NO _x	NM VOC	NH ₃	PM _{2.5}	PM ₁₀	TSP	f-BC	CO
Marine diesel oil/ marine gas oil	38.4	7.45	0.007	4.6	4.6	4.6	0.55	19.8

Table 3.49 Emission factors for heavy metals and PAHs

	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f
	g/t						mg/t	
Marine diesel oil/ marine gas oil	0.01	0.05	1.7	0.07	0.01	1	0.03	0.05

Table 3.50 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 3.51 Fuel consumption in the navigation sector in the period of 1990-2014 (kt)

Year	Marine gas oil	Marine diesel oil
1990	0	7
1991	0	7
1992	0	5
1993	32	5
1994	0	4
1995	0	4
1996	0	7
1997	0	6
1998	0	6
1999	0.256	5
2000	2	5
2001	2	5
2002	4	7
2003	2	7
2004	2	6
2005	0	8
2006	5	6
2007	12	5
2008	13	7
2009	2	6
2010	2	6
2011	0	5
2012	0.395	4
2013	0.419	4
2014	0.395	9

3.3.5.3. Uncertainty

An uncertainty analysis was carried out to the year 2014 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 3.60.

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 on the left: 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 gasoline 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 32.3%, 35.0% and 24.3% respectively, in the transport sector in 2014.

All the emissions have decreased in the period 1990 to 2014, but slightly increased in 2014 compared to 2013 due to small increase in fuel consumption that year. Deviations of time series can be explained by changing statistical fuel consumption in non-road machinery sector (Figures 3.31-33) and the share of some specific sector in total non-road machinery emissions. Detailed emission data are provided in Tables 3.52-54.

The most important deployment of mobile machinery is the use in agricultural and industrial sector, which are responsible for approximately 89.9% of total energy use, where diesel is the dominant fuel type, with 95% of energy use in 2014.

Recalculations

Recalculations mainly concern using corrected statistical fuel consumption data and emission factors for SO_x and BC. An overview of the updated data is given in Chapter 8.

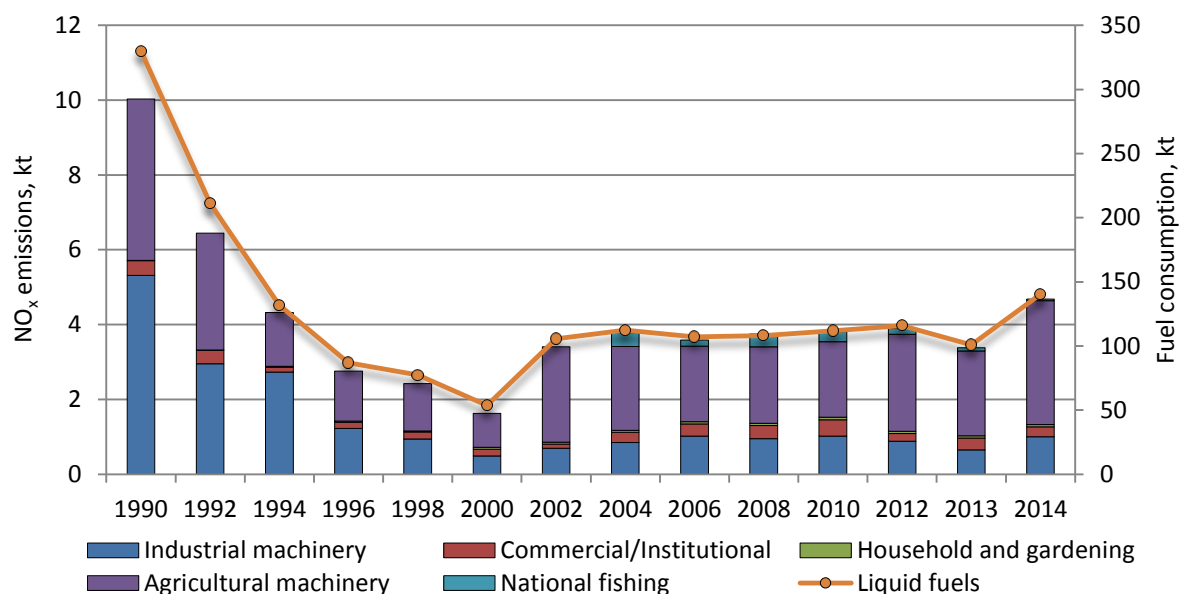


Figure 3.31 NO_x emissions from other non-road machinery

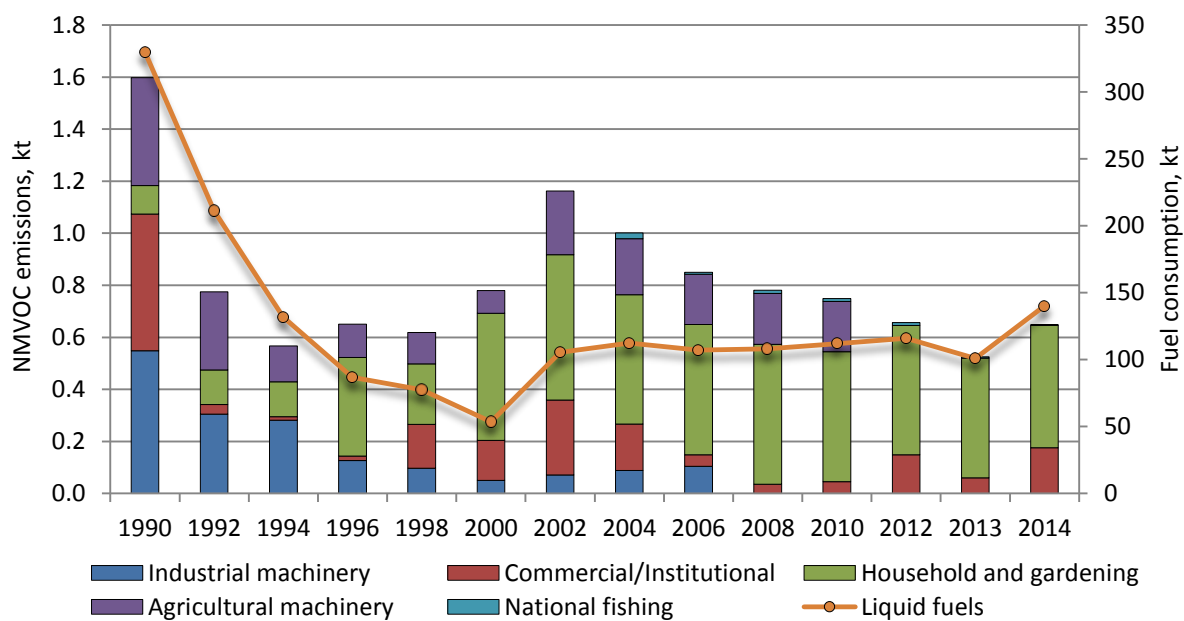


Figure 3.32 NMVOC emissions from other non-road machinery

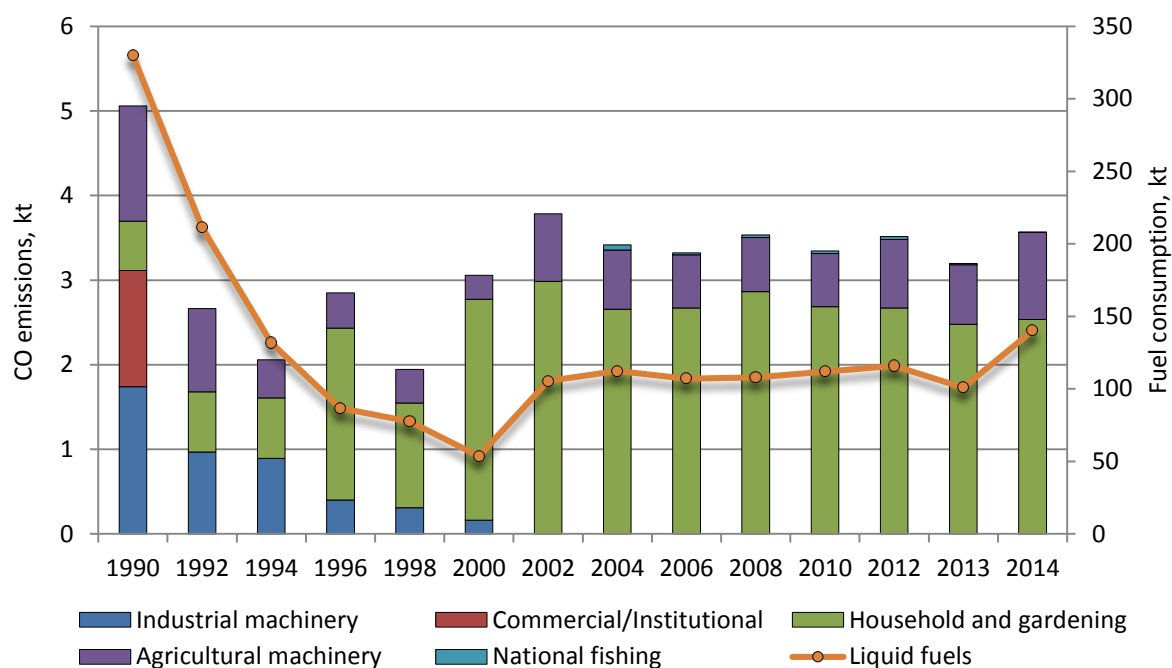


Figure 3.33 CO emissions from other non-road machinery

Table 3.52 Emissions from other non-road machinery in the period of 1990-2014 (kt)

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	10.028	1.597	3.036	0.002	NR	NR	0.586	NR	5.061
1991	10.151	1.625	3.056	0.002	NR	NR	0.596	NR	5.171
1992	6.441	0.775	1.943	0.002	NR	NR	0.368	NR	2.783
1993	5.577	0.942	1.668	0.001	NR	NR	0.321	NR	3.180
1994	4.319	0.568	1.293	0.001	NR	NR	0.256	NR	2.100
1995	2.155	0.720	0.640	0.001	NR	NR	0.127	NR	2.724
1996	2.753	0.651	0.821	0.001	NR	NR	0.161	NR	2.902
1997	2.540	0.653	0.758	0.001	NR	NR	0.149	NR	2.959
1998	2.421	0.619	0.723	0.001	NR	NR	0.141	NR	2.385
1999	1.370	0.634	0.412	0.000	NR	NR	0.085	NR	2.758
2000	1.630	0.780	0.390	0.000	0.099	0.099	0.099	0.053	3.461
2001	1.673	0.909	0.129	0.000	0.105	0.105	0.105	0.056	4.110
2002	3.404	1.162	0.261	0.001	0.192	0.192	0.192	0.105	4.752
2003	4.151	1.137	0.207	0.001	0.217	0.218	0.218	0.121	4.693
2004	3.787	1.001	0.157	0.001	0.201	0.202	0.202	0.113	4.172
2005	3.586	0.822	0.111	0.001	0.191	0.191	0.191	0.108	3.623
2006	3.588	0.850	0.079	0.001	0.199	0.199	0.199	0.113	3.787
2007	3.692	0.877	0.074	0.001	0.205	0.205	0.205	0.116	3.934
2008	3.745	0.879	0.086	0.001	0.201	0.201	0.201	0.114	3.960
2009	3.455	1.019	0.038	0.001	0.183	0.184	0.184	0.102	4.272
2010	3.809	0.854	0.028	0.001	0.208	0.208	0.208	0.118	3.822
2011	3.764	0.878	0.040	0.001	0.202	0.202	0.202	0.113	3.834
2012	3.894	0.997	0.027	0.001	0.213	0.213	0.213	0.119	4.198
2013	3.381	0.810	0.005	0.001	0.186	0.186	0.186	0.104	3.587
2014	4.678	1.069	0.008	0.001	0.258	0.258	0.258	0.145	4.367
Trend 1990-2014, %	-53.3	-33.0	-99.7	-54.6	159.9	160.0	-56.0	173.1	-13.7

Table 3.53 Emissions of heavy metals from other non-road machinery in the period of 1990-2014

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t		kg		t				
1990	4.926	0.003	0.000	0.000	0.015	0.510	0.021	0.003	0.300
1991	3.443	0.003	0.000	0.000	0.015	0.517	0.021	0.003	0.304
1992	3.153	0.002	0.000	0.000	0.010	0.325	0.013	0.002	0.191
1993	1.817	0.002	0.000	0.000	0.008	0.283	0.012	0.002	0.167
1994	0.453	0.001	0.000	0.000	0.006	0.221	0.009	0.001	0.130
1995	0.756	0.001	0.000	0.000	0.003	0.112	0.005	0.001	0.066
1996	0.887	0.001	0.000	0.000	0.004	0.142	0.006	0.001	0.084
1997	0.914	0.001	0.000	0.000	0.004	0.132	0.005	0.001	0.078
1998	0.958	0.001	0.000	0.000	0.004	0.125	0.005	0.001	0.073
1999	0.809	0.000	0.000	0.000	0.002	0.074	0.003	0.000	0.044
2000	0.082	0.001	0.000	0.000	0.003	0.088	0.004	0.001	0.052
2001	0.081	0.001	0.000	0.000	0.003	0.092	0.004	0.001	0.054
2002	0.096	0.001	0.000	0.000	0.005	0.176	0.007	0.001	0.104
2003	0.143	0.001	0.200	0.267	0.006	0.193	0.014	0.002	0.118
2004	0.043	0.001	0.141	0.188	0.005	0.180	0.012	0.002	0.109
2005	0.024	0.001	0.126	0.168	0.005	0.171	0.011	0.001	0.103
2006	0.026	0.001	0.064	0.085	0.005	0.178	0.009	0.001	0.106
2007	0.028	0.001	0.063	0.084	0.005	0.184	0.010	0.001	0.109
2008	0.023	0.001	0.131	0.174	0.005	0.179	0.012	0.001	0.109
2009	0.030	0.001	0.170	0.227	0.005	0.160	0.012	0.001	0.098
2010	0.026	0.001	0.103	0.137	0.005	0.183	0.011	0.001	0.110
2011	0.022	0.001	0.054	0.071	0.005	0.184	0.009	0.001	0.110
2012	0.028	0.001	0.057	0.076	0.006	0.191	0.010	0.001	0.114
2013	0.022	0.001	0.033	0.044	0.005	0.167	0.008	0.001	0.099
2014	0.027	0.001	0.016	0.022	0.007	0.234	0.010	0.001	0.138
Trend 1990-2014, %	-99.4	-54.1	NA	NA	-54.1	-54.2	-51.7	-52.5	-54.1

Table 3.54 Emissions of POPs from other non-road machinery in the period of 1990-2014

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	0.000	0.009	0.015	NA	NA	0.024	0.000	0.000
1991	0.000	0.009	0.015	NA	NA	0.024	0.000	0.000
1992	0.000	0.006	0.010	NA	NA	0.015	0.000	0.000
1993	0.000	0.005	0.008	NA	NA	0.013	0.000	0.000
1994	0.000	0.004	0.006	NA	NA	0.010	0.000	0.000
1995	0.000	0.002	0.003	NA	NA	0.005	0.000	0.000
1996	0.000	0.003	0.004	NA	NA	0.007	0.000	0.000
1997	0.000	0.002	0.004	NA	NA	0.006	0.000	0.000
1998	0.000	0.002	0.004	NA	NA	0.006	0.000	0.000
1999	0.000	0.001	0.002	NA	NA	0.003	0.000	0.000
2000	0.000	0.002	0.003	NA	NA	0.004	0.000	0.000
2001	0.000	0.002	0.003	NA	NA	0.004	0.000	0.000
2002	0.000	0.003	0.005	NA	NA	0.008	0.000	0.000
2003	0.869	0.003	0.005	NA	NA	0.009	0.535	2.539
2004	0.613	0.003	0.005	NA	NA	0.008	0.377	1.791
2005	0.546	0.003	0.005	NA	NA	0.008	0.336	1.595

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		
2006	0.277	0.003	0.005	NA	NA	0.008	0.170	0.809
2007	0.273	0.003	0.005	NA	NA	0.009	0.168	0.798
2008	0.566	0.003	0.005	NA	NA	0.008	0.348	1.655
2009	0.736	0.003	0.005	NA	NA	0.007	0.453	2.152
2010	0.445	0.003	0.005	NA	NA	0.008	0.274	1.302
2011	0.232	0.003	0.005	NA	NA	0.009	0.143	0.679
2012	0.248	0.003	0.006	NA	NA	0.009	0.153	0.726
2013	0.144	0.003	0.005	NA	NA	0.008	0.088	0.420
2014	0.071	0.004	0.007	NA	NA	0.011	0.044	0.207
Trend 1990-2014, %	NA	-54.0	-54.5	NA	NA	-54.3	NA	NA

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 (Table 3.60) 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 Tables 3.55-57.

Emissions of SO₂ are dependent on fuel consumption and fuel type. SO₂ emissions are calculated by multiplying statistical fuel use (Table 3.60) by emission factors (Table 3.58). 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_{SO₂} – emissions of SO₂;

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

S – percentage sulphur content in fuel (%);

FC – fuel consumption.

Pb emissions are estimated by assuming that 75% of the lead contained in gasoline is emitted into the air. Equation:

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

Table 3.55 Emission factors for other mobile sources

NFR	Fuel	Unit	NO _x	NM VOC	NH ₃	PM _{2.5}	PM ₁₀	TSP	f-BC	CO
1A2gvii	Diesel	kg/t	32.792	3.385	0.008	2.086	2.086	2.086	0.57-0.62	10.722
1A4aii	Gasoline: 2-stroke	kg/t	2.765	242.197	0.003	3.762	3.762	3.762	0.05	620.793
1A4bii										
1A4cii	Gasoline: 4-stroke	kg/t	7.117	17.602	0.004	0.157	0.157	0.157	0.05	770.368
1A4cii	Diesel/ Light fuel oil	kg/t	35.043	3.366	0.008	1.738	1.738	1.738	0.57	10.939

NFR	Fuel	Unit	NO _x	NMVOC	NH ₃	PM _{2.5}	PM ₁₀	TSP	f-BC	CO
1A4ciii	Diesel/ Light fuel oil	kg/t	78.500	2.800	-	1.400	1.500	1.500	0.65	7.400
	Gasoline	kg/t	9.400	181.500	-	9.500	9.500	9.500	0.05	573.900

Table 3.56 Emission factors for heavy metals

NFR	Fuel	Unit	Cd	Hg	As	Cu	Cr	Ni	Se	Zn
1A2gvii 1A4aii	Gasoline	g/t	0.010	-	-	1.700	0.050	0.070	0.010	1.000
1A4bii 1A4cii	Diesel/ Light fuel oil	g/t	0.010	-	-	1.700	0.050	0.070	0.010	1.000
1A4ciii	Diesel/ Light fuel oil	g/t	0.010	0.030	0.040	0.88	0.050	1.000	0.100	1.200

Table 3.57 Emission factors for POPs

NFR	Fuel	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	HCB	PCBs
		TEQµg /t	g/t				mg/t	
1A2gvii 1A4aii	Gasoline	-	0.040	0.040	-	-	-	-
1A4bii 1A4cii	Diesel/ Light fuel oil	-	0.030	0.050	-	-	-	-
1A4ciii	Diesel/ Light fuel oil	0.130	-	-	-	-	0.080	0.038

Table 3.58 Sulphur content of fuel (by weight)

NFR	Fuel	1990	2000	2001	2003	2004	2005	2006	2009	2010
1A2gvii 1A4aii	Gasoline	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 3.59 Lead content in fuel

NFR	Fuel	Unit	1990	2000	2004
1A2gvii 1A4aii 1A4bii 1A4cii 1A4ciii	Gasoline	g/l	0.150	0.013	0.005
1A4ciii	Diesel/ Light fuel oil	g/t	0.130	0.130	0.130

Table 3.60 Total fuel consumption in other mobile sectors for the period of 1990-2014 (kt)

Year	Diesel	Light fuel oil	Gasoline	Total
1990	288.050	9.000	32.840	329.890
1991	293.000	8.000	22.950	323.950
1992	183.140	7.000	21.020	211.160
1993	158.300	6.104	12.110	176.514
1994	124.550	4.184	3.020	131.754
1995	59.750	3.255	5.040	68.045
1996	76.540	4.353	5.910	86.803
1997	70.750	3.840	6.090	80.680
1998	63.236	7.814	6.385	77.435
1999	32.264	7.881	5.393	45.538
2000	31.351	15.969	6.296	53.616
2001	24.243	24.519	6.214	54.976
2002	46.242	51.852	7.418	105.512
2003	78.235	33.564	11.040	122.839
2004	80.262	23.641	8.424	112.327
2005	77.266	21.672	4.694	103.632
2006	85.319	16.609	5.129	107.057
2007	89.271	15.682	5.556	110.509
2008	86.862	16.667	4.215	107.744
2009	88.019	5.139	5.880	99.038
2010	95.959	10.891	5.063	111.913
2011	89.773	16.425	4.457	110.655
2012	99.796	10.581	5.487	115.864
2013	96.185	0.407	4.339	100.931
2014	132.845	1.992	5.393	140.230

3.3.6.3. Uncertainty

An uncertainty analysis was carried out to the year 2014 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 3.61.

Table 3.61 Uncertainties in non-road mobile machinery sector

Pollutant	Emission, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	6.090	kt	18.27	42.28	20.23
NM VOC	1.233	kt	5.48	20.36	9.76
SO _x	0.067	kt	0.16	2.76	2.64
NH ₃	0.001	kt	0.01	0.71	0.38
PM _{2.5}	0.328	kt	4.22	13.56	8.48
PM ₁₀	0.330	kt	2.64	10.71	6.06
TSP	0.331	kt	1.99	9.29	2.13
CO	4.767	kt	3.77	14.30	9.59

Pollutant	Emission, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
Pb	0.027	t	0.07	1.93	4.54
Cd	0.002	t	0.19	3.05	1.03
Hg	0.00002	t	0.00	0.34	1.55
PCDD/PCDF	0.00007	g I-TEQ	0.00	0.67	6.04
B(a)p	0.005	t	0.25	7.06	8.02
B(b)f	0.008	t	0.36	8.49	9.30
B(k)f	0.001	t	0.06	3.42	5.41
I(1,2,3-cd)p	0.0002	t	0.01	1.45	4.40
HCB	0.00004	kg	0.02	1.33	2.35
PCB	0.0002	kg	0.01	8.47	2.45

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



This source category covers 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 Port)

The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have increased

approximately 77.4%, 88.3% and 86.0% compared to 1990. Sulphur oxide emissions have increased 1.3% during the same period. Although there has stricter rules for sulphur content in fuels used by ships, the fuel consumption and emissions have increased in recent years. Detailed emission data are provided in Tables 3.62-64.

Deviations of time series can be explained by changing statistical fuel consumption in the international navigation sector (Figure 3.34).

Recalculations

All the NO_x, NMVOC, PM_{2.5}, PM₁₀, TSP and BC emissions are recalculated for the period 2005-2013. Recalculations in the international maritime sector were made based on the correction of the average gross tonnage of vessels by Statistics Estonia. An overview of the updated data is given in Chapter 8.

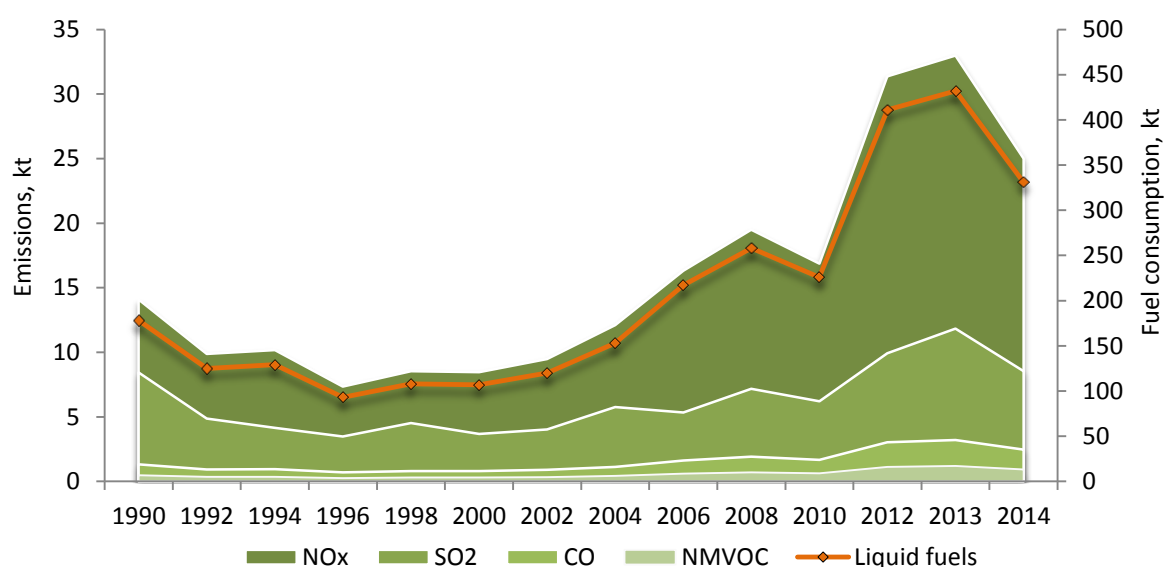


Figure 3.34 NO_x, NMVOC, SO_x and CO emissions from the international navigation sector

Table 3.62 Emissions from the international maritime navigation sector in the period of 1990-2014 (kt)

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	14.094	0.483	8.424	NE	NR	NR	0.977	NR	1.317
1991	16.627	0.570	9.888	NE	NR	NR	1.147	NR	1.554
1992	9.878	0.342	4.858	NE	NR	NR	0.573	NR	0.925
1993	12.075	0.420	5.094	NE	NR	NR	0.610	NR	1.132
1994	10.179	0.355	4.150	NE	NR	NR	0.499	NR	0.955
1995	7.105	0.247	3.100	NE	NR	NR	0.370	NR	0.666
1996	7.347	0.255	3.482	NE	NR	NR	0.412	NR	0.688
1997	8.064	0.279	4.144	NE	NR	NR	0.487	NR	0.755
1998	8.540	0.295	4.512	NE	NR	NR	0.529	NR	0.799
1999	8.931	0.309	4.474	NE	NR	NR	0.527	NR	0.836
2000	8.452	0.293	3.678	NE	0.423	0.466	0.466	0.062	0.792
2001	8.053	0.280	3.258	NE	0.382	0.421	0.421	0.058	0.755
2002	9.477	0.329	4.030	NE	0.466	0.514	0.514	0.069	0.888
2003	9.005	0.312	3.956	NE	0.454	0.500	0.500	0.066	0.844
2004	12.093	0.418	5.762	NE	0.647	0.714	0.714	0.091	1.132
2005	8.810	0.345	4.338	NE	0.491	0.522	0.522	0.071	0.903
2006	16.330	0.602	5.340	NE	1.023	1.110	1.110	0.135	1.606
2007	19.140	0.697	6.784	NE	1.283	1.397	1.397	0.163	1.872
2008	19.496	0.708	7.180	NE	1.355	1.477	1.477	0.168	1.909
2009	17.319	0.633	6.480	NE	1.220	1.329	1.329	0.151	1.702
2010	16.864	0.623	6.192	NE	1.173	1.274	1.274	0.147	1.672
2011	14.218	0.535	5.118	NE	0.975	1.055	1.055	0.124	1.428
2012	31.365	1.130	9.922	NE	1.934	2.112	2.112	0.256	3.041
2013	32.975	1.182	11.840	NE	2.244	2.455	2.455	0.281	3.197
2014	25.009	0.910	8.530	NE	1.637	1.783	1.783	0.210	2.449
Trend 1990-2014, %	77.4	88.3	1.3	NE	287.2	282.7	82.6	239.8	86.0

Table 3.63 Emissions of heavy metals from the international maritime navigation sector in the period of 1990-2014(t)

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	0.031	0.003	0.004	0.104	0.110	0.213	4.859	0.034	0.214
1991	0.036	0.004	0.005	0.122	0.129	0.250	5.697	0.040	0.252
1992	0.020	0.002	0.003	0.057	0.061	0.140	2.667	0.022	0.150
1993	0.024	0.002	0.004	0.058	0.062	0.165	2.664	0.024	0.184
1994	0.020	0.002	0.003	0.047	0.050	0.138	2.144	0.020	0.155
1995	0.014	0.001	0.002	0.036	0.038	0.098	1.640	0.015	0.108
1996	0.015	0.002	0.002	0.041	0.044	0.103	1.891	0.016	0.112
1997	0.017	0.002	0.002	0.050	0.053	0.116	2.303	0.018	0.122
1998	0.018	0.002	0.002	0.054	0.058	0.124	2.526	0.019	0.130
1999	0.018	0.002	0.003	0.053	0.057	0.128	2.469	0.020	0.136
2000	0.017	0.002	0.003	0.046	0.049	0.118	2.122	0.018	0.128
2001	0.016	0.002	0.002	0.041	0.043	0.111	1.869	0.016	0.122
2002	0.019	0.002	0.003	0.050	0.054	0.132	2.321	0.020	0.144
2003	0.018	0.002	0.003	0.049	0.053	0.126	2.284	0.019	0.137
2004	0.025	0.003	0.004	0.072	0.077	0.173	3.346	0.027	0.184
2005	0.020	0.002	0.003	0.054	0.058	0.136	2.509	0.021	0.146
2006	0.037	0.004	0.005	0.119	0.126	0.255	5.549	0.041	0.260
2007	0.044	0.005	0.005	0.152	0.161	0.305	7.135	0.050	0.304

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2008	0.045	0.005	0.005	0.163	0.172	0.315	7.636	0.052	0.310
2009	0.041	0.004	0.005	0.147	0.156	0.282	6.895	0.047	0.276
2010	0.040	0.004	0.005	0.140	0.149	0.275	6.581	0.045	0.271
2011	0.034	0.004	0.004	0.116	0.123	0.232	5.432	0.038	0.232
2012	0.070	0.007	0.009	0.224	0.238	0.482	10.486	0.077	0.493
2013	0.076	0.008	0.009	0.268	0.284	0.525	12.584	0.086	0.518
2014	0.057	0.006	0.007	0.193	0.205	0.395	9.042	0.064	0.397
Trend 1990-2014, %	86.0	86.0	85.9	86.1	86.1	86.0	86.1	86.0	86.0

Table 3.64 Emissions of POPs from the international maritime navigation in the period of 1990-2014

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	0.074	NA	NA	NA	NA	NA	0.023	0.096
1991	0.087	NA	NA	NA	NA	NA	0.027	0.113
1992	0.044	NA	NA	NA	NA	NA	0.015	0.063
1993	0.047	NA	NA	NA	NA	NA	0.017	0.074
1994	0.039	NA	NA	NA	NA	NA	0.014	0.061
1995	0.029	NA	NA	NA	NA	NA	0.010	0.044
1996	0.032	NA	NA	NA	NA	NA	0.011	0.046
1997	0.037	NA	NA	NA	NA	NA	0.012	0.052
1998	0.041	NA	NA	NA	NA	NA	0.013	0.056
1999	0.041	NA	NA	NA	NA	NA	0.014	0.057
2000	0.036	NA	NA	NA	NA	NA	0.012	0.053
2001	0.033	NA	NA	NA	NA	NA	0.012	0.050
2002	0.040	NA	NA	NA	NA	NA	0.014	0.059
2003	0.039	NA	NA	NA	NA	NA	0.013	0.057
2004	0.055	NA	NA	NA	NA	NA	0.018	0.078
2005	0.042	NA	NA	NA	NA	NA	0.014	0.061
2006	0.087	NA	NA	NA	NA	NA	0.028	0.115
2007	0.108	NA	NA	NA	NA	NA	0.034	0.138
2008	0.114	NA	NA	NA	NA	NA	0.035	0.143
2009	0.103	NA	NA	NA	NA	NA	0.031	0.128
2010	0.099	NA	NA	NA	NA	NA	0.030	0.125
2011	0.083	NA	NA	NA	NA	NA	0.026	0.105
2012	0.164	NA	NA	NA	NA	NA	0.052	0.218
2013	0.189	NA	NA	NA	NA	NA	0.058	0.239
2014	0.139	NA	NA	NA	NA	NA	0.043	0.179
Trend 1990-2014, %	86.1	NA	NA	NA	NA	NA	86.0	86.0

3.3.7.2. Methodological issues

All the emission calculations are based on the Tier 1 method for period 1990-2004. Detailed activity data (annual number of vessels per vessel category) is available from 2005. Therefore, emissions calculations from hotelling and maneuvering of the ships are included to submission from 2005.

Cruise emissions are calculated by the Tier 1, where the statistical fuel consumption (Table 3.67) is multiplied by respective emission factors (Table 3.65-67). Default emission factors for the main pollutants and heavy metals are taken from EMEP/EEA Guidebook 2013.

Emissions of SO₂ are dependent on fuel consumption and fuel type. SO₂ emissions are calculated by multiplying statistical fuel use (Table 3.68) by emission factors (Table 3.67). SO₂ emissions are estimated according to the assumption that all sulphur in the fuel is completely transformed into SO₂. Equation:

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

Table 3.65 Emission factors for the international maritime navigation sector, (kg/t)

	NO _x	NM VOC	PM _{2.5}	PM ₁₀	TSP	f-BC	CO
Bunker fuel oil	79.3	2.7	5.6	6.2	6.2	0.12	7.4
Marine diesel oil	78.5	2.8	1.4	1.5	1.5	0.31	7.4

Table 3.66 Emission factors for heavy metals and PAHs

	Pb	Cd	Cu	Cr	As	Hg	Ni	Se	Zn	PCDD/F	HCB	PCB's
	g/t									TEQµg /t	mg/t	
Bunker fuel oil	0.18	0.02	1.25	0.72	0.68	0.02	32	0.21	1.2	0.47	0.14	0.57
Marine diesel oil	0.13	0.01	0.88	0.05	0.04	0.03	1	0.1	1.2	0.13	0.08	0.38

Table 3.67 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 3.68 Fuel consumption in the international maritime navigation sector in the period of 1990-2014 (kt)

Year	Bunker fuel oil	Marine diesel oil
1990	151	27
1991	177	33
1992	82	43
1993	81	72
1994	65	64
1995	50	40
1996	58	35
1997	71	31
1998	78	30
1999	76	37
2000	65	42
2001	57	45
2002	71	49
2003	70	44

Year	Bunker fuel oil	Marine diesel oil
2004	103	50
2005	77	45
2006	172	45
2007	222	31
2008	238	20
2009	215	15
2010	205	21
2011	169	24
2012	325	86
2013	392	40
2014	281	50

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 checking 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 1.B)

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 HM emissions from the following activities:

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

Table 3.69 Fugitive emissions activities

NFR	Source	Description	Emissions reported
1B	Fugitive emissions from fuel		
	1a Fugitive emission from solid fuels: Coal mining and handling	Includes emissions from open oil shale mining activity, mainly explosive works. Only point sources data.	NO _x , 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.	NO _x , SO _x , NH ₃ , 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/ PCDF, PAHs total

NMVOC emissions from this sector contribute about 6% to total national emissions and have decreased by 44.8% up to 2014 compared to 1990 and by 7% compared to 2013 due to decreasing emissions from terminals (Figure 3.35 and Table 3.71). Emissions of other pollutants are very small compared to the emissions from the other sectors (Table 3.70).

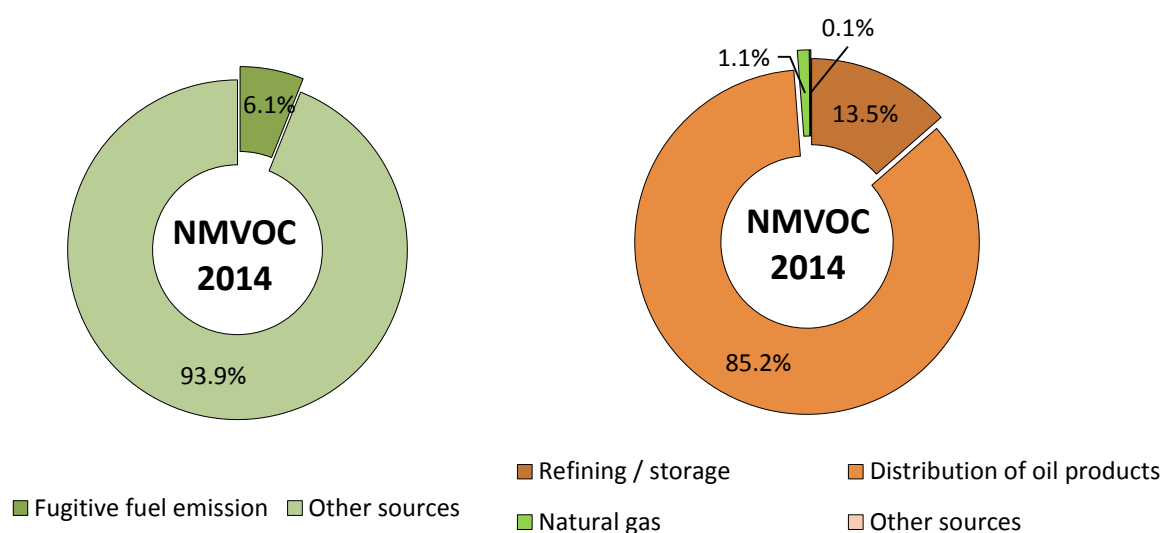
**Figure 3.35** NMVOC emission distribution in 2014**Figure 3.36** NMVOC emission distribution within the fuel fugitive emission sector in 2014

Figure 3.36 shows that the distribution of oil products is a main source of NMVOC emissions in the fuel fugitive emissions sector (85.2%).

Table 3.70 Fugitive emission in the period of 1990-2014 (kt)

Year	NMVOC	PM _{2.5}	PM ₁₀	TSP	BC	NO _x	CO	NH ₃	SO ₂
1990	2.474	NR	NR	NR	NR	NA	NA	NA	NA
1991	2.239	NR	NR	NR	NR	NA	NA	NA	NA
1992	1.275	NR	NR	NR	NR	NA	NA	NA	NA
1993	1.275	NR	NR	NR	NR	NA	NA	NA	NA
1994	1.583	NR	NR	NR	NR	NA	NA	NA	NA
1995	1.632	NR	NR	NR	NR	NA	NA	NA	NA
1996	1.911	NR	NR	NR	NR	NA	NA	NA	NA
1997	2.721	NR	NR	NR	NR	NA	NA	NA	NA
1998	2.380	NR	NR	NR	NR	NA	NA	NA	NA
1999	2.740	NR	NR	NR	NR	NA	NA	NA	NA
2000	4.326	0.010	0.050	0.110	NA	0.010	0.200	NA	NA
2001	5.197	0.021	0.085	0.170	NA	0.010	0.180	NA	NA
2002	4.649	0.010	0.080	0.160	NA	0.010	0.270	NA	NA
2003	4.404	0.010	0.097	0.198	NA	0.010	0.350	NA	NA
2004	5.184	0.010	0.070	0.140	NA	0.000	0.260	0.010	NA
2005	4.284	0.010	0.090	0.180	NA	0.010	0.170	0.050	NA
2006	3.516	0.010	0.110	0.220	NA	0.010	0.250	0.060	NA
2007	1.922	0.010	0.090	0.180	NA	0.010	0.220	0.090	0.010
2008	1.593	0.014	0.102	0.202	NA	0.017	0.276	0.102	0.013
2009	1.684	0.031	0.141	0.267	0.0001	0.036	0.168	0.089	0.026
2010	1.818	0.034	0.170	0.309	0.0002	0.035	0.188	0.115	0.018
2011	2.179	0.042	0.187	0.351	0.0002	0.032	0.813	0.175	0.076
2012	1.824	0.051	0.182	0.329	0.0001	0.019	2.011	0.212	0.038
2013	1.471	0.021	0.103	0.190	0.0003	0.024	1.353	0.192	0.051
2014	1.366	0.020	0.096	0.187	0.0002	0.025	1.028	0.191	0.038
Trend 1990-2014, %	-44.8	96.8	92.0	70.4	43.8	150.3	414.0	1811.9	278.7

The emission data for 1B1a Fugitive emission from solid fuels: Coal mining and handling, 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 2000 m³ per year². That means only the smallest service stations are regarded as diffuse sources. Emissions from oil terminals are based on the facilities data. 16 terminals presented reports on emissions in 2014. In the table below, NMVOC emissions from gasoline distribution and terminals are presented.

Table 3.71 NMVOC emissions from liquid fuel distribution in the period of 1990-2014 (kt)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Gasoline distribution	2.055	1.820	0.896	0.924	1.124	0.971	1.100	1.199	1.159	1.100	1.108	1.122	0.856
Terminals	0.323	0.323	0.323	0.323	0.418	0.625	0.771	1.483	1.184	1.594	3.157	4.012	3.645
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
Gasoline distribution	0.657	0.628	0.467	0.482	0.514	0.508	0.467	0.447	0.478	0.511	0.460	0.427	
Terminals	3.695	3.910	3.199	2.626	1.200	0.629	0.799	0.644	1.265	0.854	0.740	0.737	

² Emission levels of pollutants and capacities of plants used, beyond which an ambient air pollution and special pollution permit are required. Regulation No. 101 of the Minister of Environment of 2 August 2004

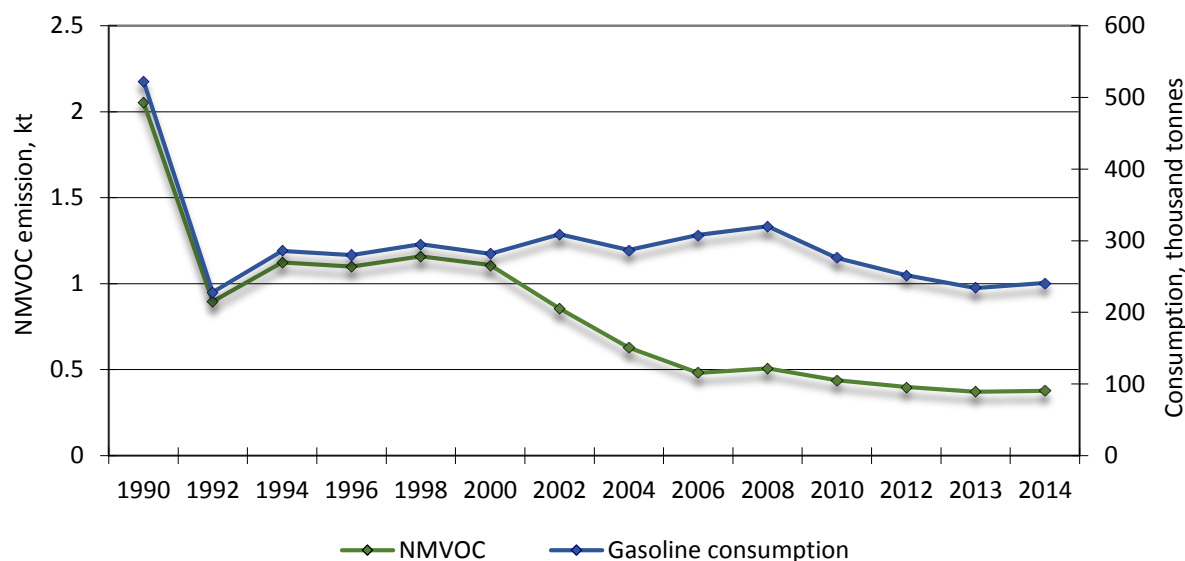


Figure 3.37 NMVOC emission and gasoline distribution in the period of 1990-2014

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.

It is likely that the majority of the non-permitted gasoline stations have a turnover between 100 and 2000 m³. Since 2005, these must have vapour collection and recovery equipment.

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 92.1% from total gasoline distribution in 2013). Facilities are obligate to use the national method for NMVOC emission calculation [Naftasaaduste laadimisel välisõhku eralduvate lenduvate orgaaniliste ühendite heitkoguste määramismeetodid - Elektrooniline Riigi Teataja](#)

In the period 2005-2013, activity data relating to point sources is available and activity data for emission calculations from diffuse sources is calculated using the following method:

Gasoline distribution in diffuse sources = total gasoline consumption – 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 2005-2014, the Tier 2 technology specific emission factors for Service Stations from the EMEP/EEA Guidebook 2013 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:

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

The Abatement efficiencies ($\eta_{abatement}$) for source category 1B2av Distribution of oil products, Service stations, Storage tank filling from the EMEP/EEA Guidebook 2009 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

$A = 0.000007047 \cdot RVP + 0.0132$ and $B = 0.0002311 \cdot RVP - 0.5236$, 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 °C³.

The RVP for gasoline (gasoline 95) in Estonia according to the Register of Fuel Monitoring in the period 2005-2008 is presented in the following Table 3.72.

³ www.ilmateenistus.ee

Table 3.72 Annual average RVP of gasoline 95 in Estonia in the period 2005-2008

Year	Annual average RVP, kPa
2008	75.3
2007	74.8
2006	75.8
2005	72.3
Average	74.6

RVP for gasoline is up to 74.6 kPa.

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

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 3.73 Total emission factor for emissions from gasoline handling in service stations

Tier 2 emission factors for source category 1.B.2.a.v Distribution of Oil Products					
Category	Emission source	NM VOC emission factor, g/m ³ throughput/kPa TVP	Abatement efficiency (η _{abatement}), %	True Vapour Pressure (TVP), kPa	NM VOC 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

Activity data

Activity data on the subject of gasoline consumption is available from Statistics Estonia (Table 3.74).

Table 3.74 Consumption of motor gasoline in the period of 1990-2014 (kt)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Gasoline consumption	523	463	228	235	286	247	280	305	295	280	282	335	309
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
Gasoline consumption	300	287	290	308	323	320	293	276	261	252	234	241	

3.4.2.3. Sources-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. Sources-specific planned improvements

It is planned to check the annual average RVP of gasoline.

3.4.3. Natural gas (NFR 1.B.2.b)

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 (Figure 3.38).

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.⁴

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.

⁴ Eesti Gaas. Annual Report 2006

The gas network in Estonia is 2,314 km long, of which 878 km are for transmission and 1,436 km 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 use.⁵ Nitrofert halted operations since 2014.



Figure 3.38 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.

Table 3.75 NMVOC emissions from gas distribution in the period of 1990-2014 (kt)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
NMVOC	0.096	0.096	0.056	0.028	0.041	0.036	0.040	0.039	0.037	0.036	0.031	0.033	0.028
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
NMVOC	0.032	0.036	0.028	0.028	0.028	0.027	0.018	0.019	0.018	0.019	0.019	0.015	

⁵ Estonia 2013. Energy Policies Beyond IEA Countries. OECD/IEA 2013

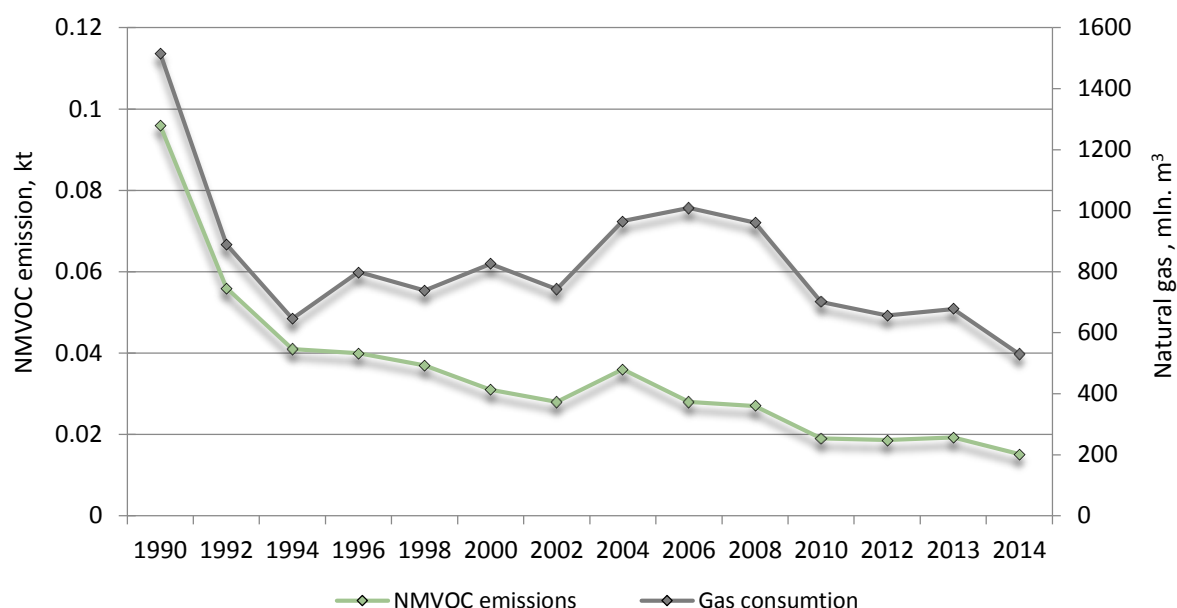


Figure 3.39 NMVOC emission from natural gas distribution in the period of 1990-2014

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 Tables 3.76-77. 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 3.76 Tier 1 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
				NMVOC		NMVOC		
				Value	Uncertainty value (% of value)	Value	Uncertain ty value (% of value)	
Gas transmission & Storage	Transmission	Fugitives	1.B.2.b.i ii.4	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.i	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.i ii.5	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

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.

Table 3.77 Tier 1 emission factors for fugitive emissions (including venting and flaring) from gas operations for different years

Category	Sub-category	Emission source	IPCC Code	NMVOC				Units of measure
				1990	1995	2000	2005-2014	
Gas transmission & Storage	Transmission	Fugitives	1.B.2.b.iii.4	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.i	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.iii.5	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

Activity data

Activity data on the subject of annual natural gas consumption are available from Statistics Estonia.

Table 3.78 Gas consumption in the period 1990-2014 (mln m³)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Gas consumption	1516	1521	890	441	646	723	799	778	738	719	826	887	743
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
Gas consumption	847	966	997	1009	1003	961	653	701	632	657	678	530	

3.4.3.3. Uncertainty

An uncertainty analysis was carried out to the year 2014 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 3.79.

Table 3.79 Uncertainties in fugitive emission sector

Pollutant	Emission, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	0.025	kt	0.08	1.938	1.238
NM VOC	1.366	kt	6.06	16.207	5.384
SO _x	0.038	kt	0.09	1.365	0.510
NH ₃	0.191	kt	1.47	10.181	NA
PM _{2.5}	0.020	kt	0.25	5.032	1.156
PM ₁₀	0.096	kt	0.77	8.766	3.972
TSP	0.187	kt	1.13	10.610	2.278
CO	1.028	kt	0.81	9.015	2.796

3.4.3.4. Sources-specific QA/QC and verification

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

3.4.3.4. Sources-specific planned improvements

The next planned improvement is to provide uncertainty analysis.



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

4. INDUSTRIAL PROCESSES AND PRODUCT USE (NFR 2)

Industrial processes and product use (NFR 2)

4.1. Industrial processes – overview of the sector

4.1.1. Description

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 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.	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}
	2A3	Glass production	Particles emissions from this sector are allocated to 1A2f.	IE
	2.A.3	Limestone and dolomite use	Includes emissions from limestone and dolomite use. Data reported by operators.	TSP, PM ₁₀ , PM _{2.5}
	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}
	2A5c	Storage, handling and transport of mineral products	Emissions from this sector are allocated to 2L. Data reported by operators.	IE
2B	2A6	Other Mineral products	Includes emissions from class production. Data reported by operators.	TSP, PM ₁₀ , PM _{2.5}
	Chemical industry			
	2B1	Ammonia production	Includes emission from ammonia production. Data reported by one operator.	NO _x , NMVOC, NH ₃ , SO _x , CO
	2B10a	Other chemical industry	Includes emission from urea and formaldehyde production. Data reported by two operators.	NO _x , NMVOC, NH ₃ , SO _x , TSP, PM ₁₀ , PM _{2.5} , CO, BC
	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

NFR	Source		Description	Emissions reported
2C	Metal Production			
	2C1	Iron and steel production	Includes emission from Iron and steel production. Data reported by operators.	NO _x , NMVOC, NH ₃ , SO _x , TSP, PM ₁₀ , PM _{2.5} , CO, Cr, Ni, Zn
	2C3	Aluminium production	Includes emission from secondary aluminium production. Data reported by operators.	NO _x , NMVOC, TSP, PM ₁₀ , PM _{2.5} , CO, BC
	2C7a	Copper production	Includes emission from secondary copper production. Data reported by operators.	TSP, PM ₁₀ , PM _{2.5}
	2C5	Lead production	Includes emission from lead battery and accumulators recycling plant. Data reported by operators.	NO _x , NH ₃ , SO _x , TSP, PM ₁₀ , PM _{2.5} , CO, 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, NH ₃ , TSP, PM ₁₀ , PM _{2.5} , CO, BC, Pb, Cr, Cu, 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 and paper production. Data reported by two operators.	NO _x , NMVOC, SO _x , TSP, PM ₁₀ , PM _{2.5} , 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, BC
2I	2I	Wood processing	Includes emission from wood processing. Data reported by 95 operators.	NO _x , NMVOC, SO _x , TSP, PM ₁₀ , PM _{2.5}
2K	2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	Includes emission from consumption of POPs and heavy metals.	NMVOC, NH ₃
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.	NO _x , NMVOC, NH ₃ , SO _x , TSP, PM ₁₀ , PM _{2.5} , CO

Emissions data from the manufacturing industry are based on the facilities data (Tier 3 method) and only NMVOC emissions from the food industry and from road paving with asphalt are calculated as diffuse sources on the basis of statistical data and the EMEP/EEA Guidebook 2013 emission factors (Tier 2 and Tier 1 method).

PM₁₀ and PM_{2.5} emissions from constructions and demolition are also calculated as diffuse sources (Tier 1 method).

BC emissions from industry are calculated for the period 2000–2014. PM₁₀ and PM_{2.5} emissions from Construction and demolition sector are recalculated due to the correction of the activity data (see Chapter 8).

The share of industry sources in total emissions in 2014 was: NMVOC – 4%, NH₃ – 0.4%, PM_{2.5} – 2%, PM₁₀ – 4.1% and TSP – 7.5%. The shares of other pollutants were not so significant. The emissions of NMVOC, NH₃ and NO_x have decreased in comparison with 1990 by 94.1%, 90.2% and 83.4%, respectively. The emissions of NO_x, NH₃, PM_{2.5}, PM₁₀ and TSP decreased in 2014 compared to 2013 by 84%, 68%, 42%, 29% and 14% mainly due to the fact that Estonia's only producer of fertiliser Nitrofert AS halted operations in 2014.

The trend of NMVOC and PM emissions in these categories are given in Figure 4.1 and 4.4. The distribution of NMVOC and PM₁₀ emissions by sources of pollution inside of manufacturing industry sector in 2014 are shown in Figures 4.2 and 4.3. The biggest polluter of NMVOC emissions were Pulp, paper and food industries – 84% (mainly food production), the chemistry industry is responsible for the 8% of emission and share of other activities are not significant.

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 1990-2014

Year	NO _x	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb
	kt									t
1990	0.190	15.335	NA	0.530	NR	NR	1.547	NR	0.340	NA
1991	0.100	13.894	NA	0.460	NR	NR	0.561	NR	0.300	NA
1992	0.090	9.600	NA	0.440	NR	NR	0.675	NR	0.300	NA
1993	0.050	4.405	NA	0.120	NR	NR	0.339	NR	0.010	NA
1994	0.190	3.513	NA	0.220	NR	NR	0.723	NR	0.040	NA
1995	0.070	4.377	NA	0.240	NR	NR	0.637	NR	0	NA
1996	0.150	3.191	NA	0.160	NR	NR	0.434	NR	0	NA
1997	0.150	3.142	NA	0.120	NR	NR	0.301	NR	0.010	NA
1998	0.140	2.400	NA	0.100	NR	NR	0.269	NR	0.020	NA
1999	0.190	1.457	NA	0.140	NR	NR	0.375	NR	0	NA
2000	0.200	2.080	0.040	0.120	0.267	0.581	1.238	0.005	0.530	0.010
2001	0.340	1.449	0.080	0.140	0.268	0.642	1.515	0.004	0.510	0.010
2002	0.130	1.513	0.160	0.110	0.426	0.916	2.053	0.008	0.280	0.010
2003	0.161	1.932	0.150	0.120	0.369	0.863	2.033	0.006	0.290	0
2004	0.360	1.846	0.130	0.120	0.522	1.219	2.601	0.010	0.360	0
2005	0.180	1.573	0.130	0.200	0.469	1.131	2.453	0.009	0.340	0
2006	0.270	1.303	0.120	0.157	0.493	1.220	2.709	0.009	0.380	0.001
2007	0.250	1.072	0.020	0.138	0.421	1.102	2.645	0.007	0.440	0.001
2008	0.298	0.959	0.022	0.181	0.549	1.287	2.615	0.012	0.481	0.001
2009	0.058	0.881	0.025	0.083	0.264	0.781	1.684	0.005	0.424	0.006
2010	0.037	0.861	0.029	0.070	0.270	0.712	1.584	0.005	0.461	0.014
2011	0.062	0.919	0.022	0.093	0.170	0.570	1.345	0.003	0.420	0.011
2012	0.047	0.909	0.001	0.103	0.132	0.484	1.170	0.002	0.336	0.010
2013	0.200	0.892	0.0001	0.162	0.264	0.721	1.458	0.006	0.381	0.011
2014	0.032	0.904	0.001	0.052	0.153	0.512	1.248	0.002	0.413	0.017
Trend 1990-2014, %	-83.35	-94.11		-90.19	-42.67	-11.90	-19.36	-67.05	21.50	

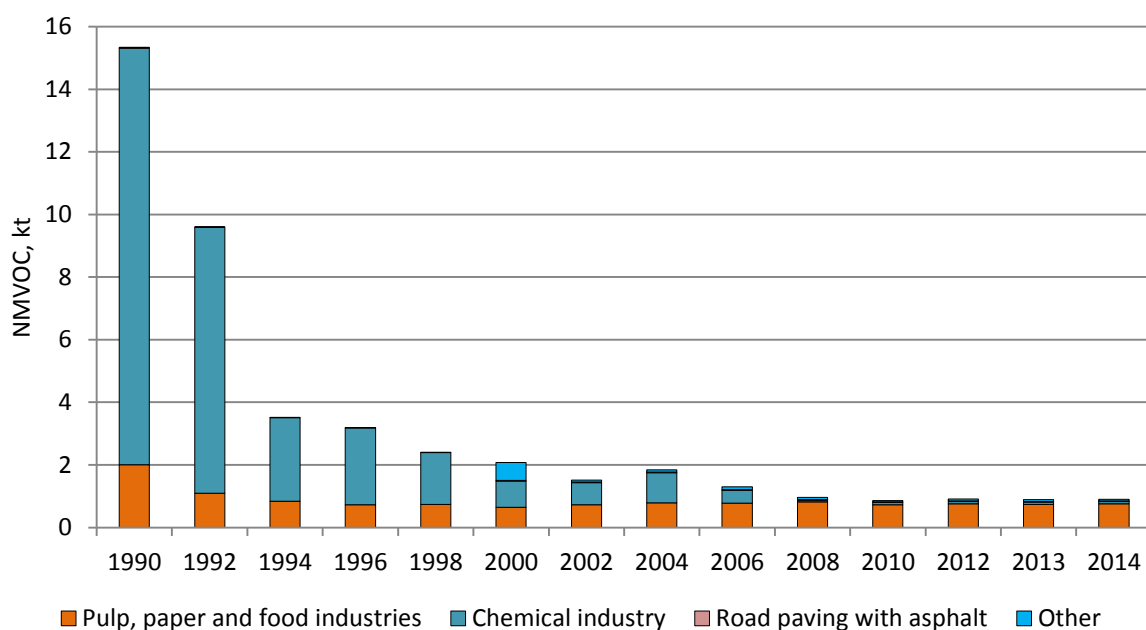


Figure 4.1 NMVOC emissions and oil shale production from the industrial sector in the period of 1990-2014

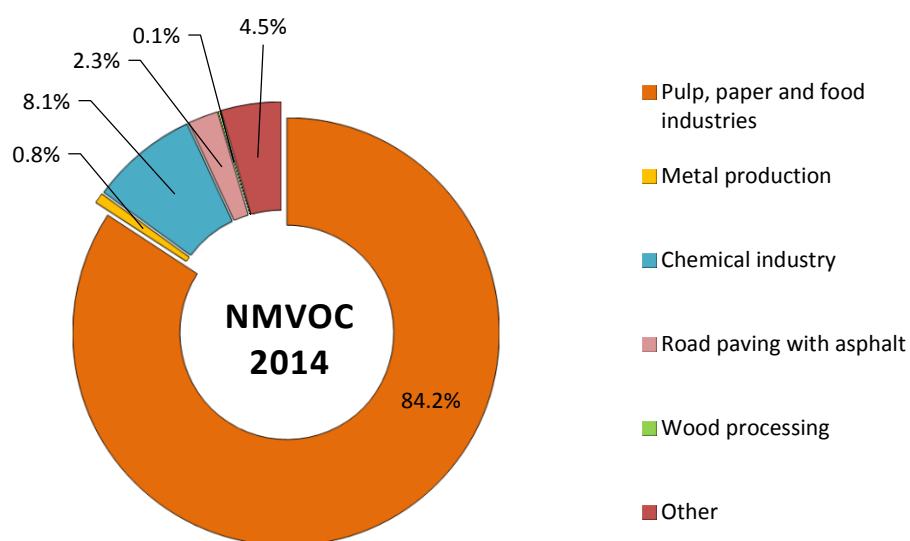


Figure 4.2 Distribution of NMVOC emissions by activities in industry in 2014

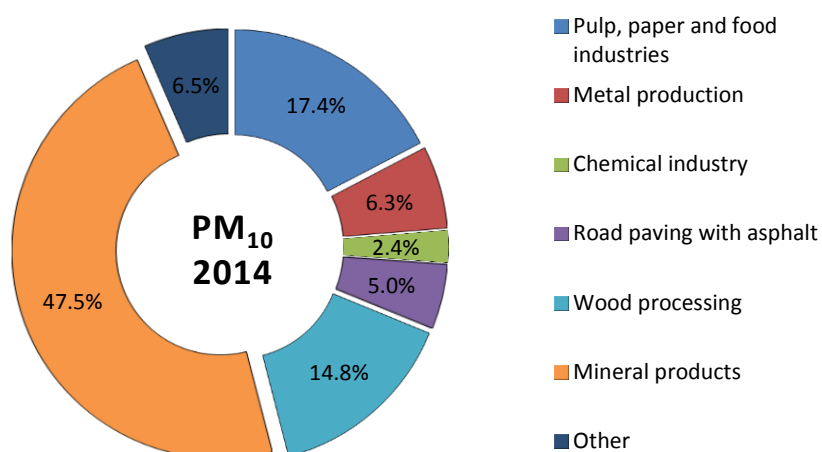


Figure 4.3 Distribution of PM₁₀ emissions by activities in industry in 2014

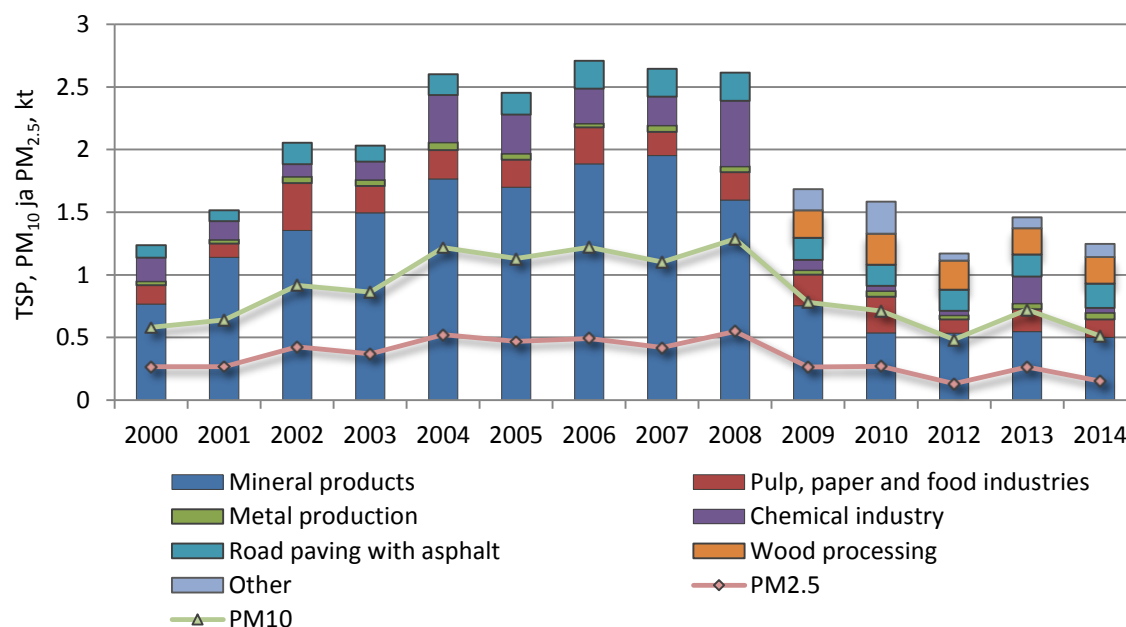


Figure 4.4 Particulates emissions from the industrial sector in the period of 2000-2014

4.1.2. Mineral Products (NFR 2A)

4.1.2.1. Sources 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).

(Photo by Ilmar Saabas: Limestone excavation in Vão quarry)

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.

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).

Estonia's construction industry has largely been oriented to the internal market and therefore, its development is closely linked to overall economic development. In economically good times volumes are growing faster and during a slowdown of economy, construction volumes decrease significantly. The economic crisis affected very strongly the economic performance of the construction sector and the dependent areas such as spatial planning, design, real estate development, etc. More than 8,000 construction companies, of whom 90% are micro enterprises with less than 10 employees, operate in Estonia. Larger companies carrying out general building works in Estonia are OÜ Astlanda Ehitus, AS Maru Ehitus, AS YIT Ehitus and AS Ehitusfirma Rand and Tuulberg. In road building, greater contribution is made by AS MERKO EHITUS, Nordecon AS, AS TREF, AS Teede REV-2, and Lemminkäinen Eesti AS. (Overview of Economy 2014. The Ministry of Economic Affairs and Communications, the Ministry of Finance 2015. Tallinn 2015)

Compared to 2013, the volume of construction work performed in Estonia decreased by 1.1%; the volume of construction work performed outside Estonia decreased by another 3%.

Emissions from the mineral product industry are presented in Table 4.3.

Table 4.3 Pollutant emissions from mineral products in the period of 1990-2014 (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	0.350	NR	NA
1991	NA	NA	NA	NA	NR	NR	0.246	NR	NA
1992	NA	NA	NA	NA	NR	NR	0.180	NR	NA
1993	NA	NA	NA	NA	NR	NR	0.136	NR	NA
1994	NA	NA	NA	NA	NR	NR	0.061	NR	NA
1995	NA	NA	NA	NA	NR	NR	0.076	NR	NA
1996	NA	NA	NA	NA	NR	NR	0.083	NR	NA
1997	NA	NA	NA	NA	NR	NR	0.098	NR	NA
1998	NA	NA	NA	NA	NR	NR	0.113	NR	NA
1999	NA	NA	NA	NA	NR	NR	0.089	NR	NA
2000	NA	0.570	NA	0.010	0.078	0.272	0.768	0.00000	0.040
2001	0.010	0.010	0.010	0.010	0.116	0.395	1.140	0.00000	0.040
2002	NA	0.040	NA	0.010	0.136	0.485	1.354	0.00000	NA
2003	NA	0.090	NA	0.010	0.153	0.527	1.494	0.00002	0.010
2004	0.010	0.070	NA	NA	0.181	0.655	1.766	0.00030	0.010
2005	0.010	0.080	NA	NA	0.171	0.640	1.698	0.00030	0.020
2006	0.010	0.080	NA	NA	0.182	0.713	1.887	0.00015	NA
2007	0.010	NA	NA	NA	0.183	0.706	1.952	0.00000	NA
2008	0.003	0.000	0.002	0.000	0.148	0.605	1.597	0.00006	0.003
2009	0.007	NA	0.001	NA	0.042	0.370	0.754	0.00010	0.006
2010	0.006	0.000	0.000	NA	0.031	0.265	0.536	0.00011	0.005
2011	0.010	NA	0.001	NA	0.034	0.290	0.589	0.00012	0.008
2012	0.008	NA	0.001	NA	0.034	0.266	0.533	0.00021	0.007
2013	0.008	NA	0.000	NA	0.034	0.279	0.547	0.00017	0.007
2014	0.006	NA	0.000	NA	0.030	0.243	0.502	0.00013	0.006

4.1.2.2. Methodological issues

As 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 excavations and storage and handling activities. In recent years, the mineral product enterprises have not been the key sources 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 (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 Dioxin emission factors for the cement 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	0.060	0.563	185.000	0.07	0.0130	541.401	0.2	0.108
1991	905.000	0.060	0.543	207.000	0.07	0.0140	592.206	0.2	0.118
1992	483.000	0.060	0.290	92.000	0.07	0.0060	350.444	0.2	0.071
1993	354.000	0.060	0.212	21.000	0.07	0.0010	139.217	0.2	0.028
1994	402.500	0.060	0.242	18.000	0.07	0.0010	128.283	0.2	0.026
1995	417.600	0.060	0.251	16.800	0.07	0.0010	81.343	0.2	0.016
1996	387.700	0.060	0.233	17.400	0.07	0.0010	68.009	0.2	0.014

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
1997	422.500	0.070	0.030	19.500	0.07	0.0010	62.674	0.2	0.013
1998	321.300	0.070	0.022	32.100	0.07	0.0020	54.674	0.2	0.011
1999	357.700	0.070	0.025	23.300	0.07	0.0020	46.139	0.2	0.009
2000	329.100	0.070	0.023	21.200	0.07	0.0010	45.072	0.2	0.009
2001	404.600	0.070	0.028	20.000	0.07	0.0010	54.140	0.2	0.011
2002	465.900	0.070	0.033	21.200	0.07	0.0010	61.608	0.2	0.012
2003	506.300	0.070	0.035	32.000	0.07	0.0020	63.741	0.2	0.013
2004	506.300	0.070	0.035	32.000	0.07	0.0020	63.741	0.2	0.013
2005	726.000	0.070	0.051	37.200	0.07	0.0020	69.342	0.2	0.014
2006	848.900	0.070	0.059	39.700	0.07	0.0027	82.667	0.2	0.016
2007	936.200	0.070	0.065	43.500	0.07	0.0030	143.485	0.2	0.029
2008	806.100	0.070	0.056	59.400	0.07	0.0041	113.081	0.2	0.023
2009	326.000	0.070	0.023	30.200	0.07	0.0021	38.938	0.2	0.007
2010	536.700	0.070	0.037	27.200	0.07	0.0019	56.500	0.2	0.011
2011	719.002	0.004	0.003	36.100	0.07	0.0025	84.544	0.2	0.017
2012	714.600	0.006	0.004	72.000	0.07	0.005	107.213	0.2	0.021
2013	691.400	0.011	0.007	69.600	0.07	0.0049	118.148	0.2	0.024
2014	720.480	0.007	0.005	69.600	0.07	0.0049	118.148	0.2	0.024

Emission calculations from construction and demolition (2A5b) sectors are based on the Tier 1 method from the renewed EMEP/EEA Guidebook 2013.

The Tier 1 method uses readily available statistical data and default emission factors (Table 4.6).

Table 4.6 PM emission factors for construction and demolition

NFR	Unit	PM ₁₀	PM _{2.5}	TSP
2A7b Construction and demolition	kg/m ² /year	0.0812	0.00812	0.162

4.1.2.3. Activity data

Information regarding building permits for dwelling and non-residential construction for the years 2000-2014 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 (Table 4.7).

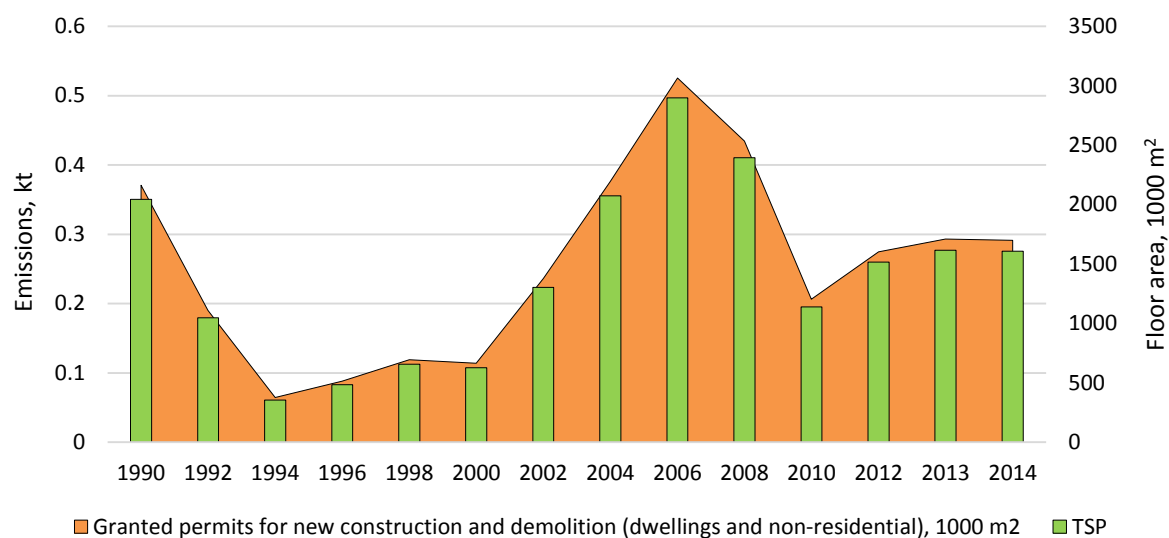


Figure 4.5 The granted permits for construction and demolition and TSP emission in the period of 1990-2014

Table 4.7 Activity data for PM emission calculations from the construction sector in the period of 1990-2014 (1000 m² floor area)

Year	Granted permits for new construction and demolition (dwelling), 1000 m²	Granted permits for new construction and demolition (non-residential), 1000 m²	Granted permits for new construction and demolition (dwelling and non-residential), 1000 m²
1990	572.9	1590.3	2163.2
1991	402.7	1118.0	1520.7
1992	293.8	815.6	1109.3
1993	221.6	615.1	836.6
1994	99.9	277.4	377.3
1995	123.4	342.6	466.1
1996	142.5	371.3	513.9
1997	162.7	444.6	607.3
1998	159.6	535.1	694.7
1999	133.2	414.3	547.5
2000	142.5	522.9	665.5
2001	175.3	625.0	800.2
2002	357.3	1023.0	1380.3
2003	427.9	768.2	1196.1
2004	989.4	1205.8	2195.2
2005	957.0	1501.4	2458.4
2006	1349.9	1716.0	3065.9
2007	1043.5	1743.6	2787.1
2008	627.1	1907.2	2534.3
2009	291.6	1102.1	1393.7
2010	303.2	901.0	1204.3
2011	331.7	1127.3	1459.0
2012	345.5	1257.8	1603.3
2013	382.5	1327.2	1709.7
2014	440.8	1259.9	1700.7

4.1.3. Chemical industry (NFR 2B)

4.1.3.1. Sources 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 Eesti Energia Õlitööstus AS (production of shale oil), Akzo Nobel Baltics AS, AS Tikkurila and AS Eskaro (paints and varnishes), Molycorp Silmet AS (rare metals), AS Novotrade Invest (reprocessing of petroleum products), OÜ Krimelte and Henkel Makroflex AS (installation foams), Eastman Specialties AS (benzoic acid, sodium benzoate, plasticizers), AS Nitrofert (fertilizers, ammonia and urea), Orica Eesti OÜ (explosives), AS Takeda Pharma (drugs) and Interchemie Werken De Adelaar Eesti AS (veterinary medicinal products and veterinary products). (Overview of Economy 2014. The Ministry of Economic Affairs and Communications, the Ministry of Finance 2015. Tallinn 2015)

In 2014, production in the chemical industry grew only in the oil industry; the falling oil affected significantly the income of the sub-sector. Economic results were poorer also in other sectors. In 2015, developments will be affected by the economic situation in Russia and low oil price.



Production volume of the chemical industry fell by a few percent in 2014. 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 22% in 1990, and 0.3%

in 2014 (Figure 4.6). 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.

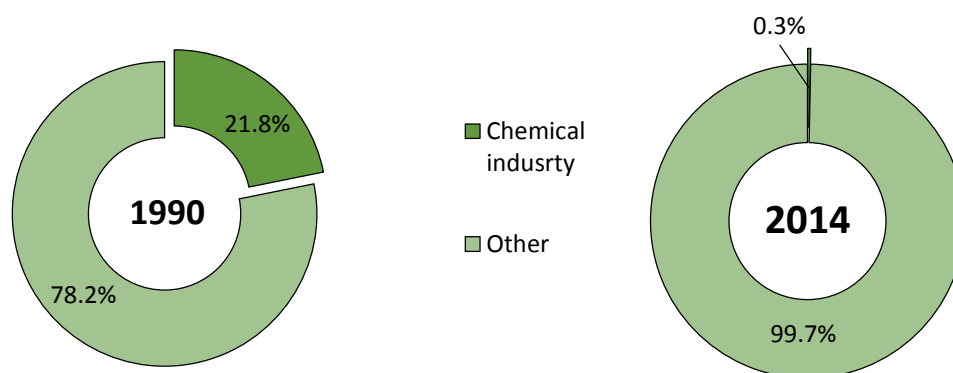


Figure 4.6 Distribution of NMVOC emissions by activities in 1990 and 2014

Table 4.8 Emissions from the chemical industry in the period of 1990-2014 (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
1991	0.100	12.330	NA	0.300	NR	NR	0.100	NR	0.300
1992	0.090	8.500	0	0.280	NR	NR	0.470	NR	0.300
1993	0.050	3.500	0	0.080	NR	NR	0.150	NR	0.010
1994	0.190	2.670	NA	0.140	NR	NR	0.610	NR	0.040
1995	0.070	3.530	NA	0.140	NR	NR	0.490	NR	NA
1996	0.150	2.460	NA	0.070	NR	NR	0.280	NR	NA
1997	0.150	2.390	NA	0.060	NR	NR	0.140	NR	0.010
1998	0.140	1.650	NA	0.060	NR	NR	0.080	NR	0.020
1999	0.190	0.790	NA	0.090	NR	NR	0.180	NR	NA
2000	0.190	0.840	NA	0.040	0.090	0.163	0.190	0.0027	0.340
2001	0.310	0.770	0.010	0.030	0.071	0.129	0.150	0.0021	0.320
2002	0.100	0.710	NA	0.020	0.043	0.079	0.100	0.0016	0.230
2003	0.130	1.065	0.010	0.030	0.067	0.122	0.146	0.0020	0.270
2004	0.320	0.960	0.010	0.040	0.179	0.326	0.380	0.0053	0.330
2005	0.160	0.720	0	0.080	0.146	0.266	0.310	0.0044	0.290
2006	0.230	0.410	NA	0.060	0.126	0.232	0.280	0.0037	0.330
2007	0.200	0.120	0	0.070	0.099	0.184	0.230	0.0029	0.360
2008	0.255	0.041	0.002	0.116	0.246	0.447	0.522	0.0073	0.398
2009	0.025	0.068	0.0003	0.009	0.026	0.052	0.082	0.0007	0.364
2010	NA	0.071	0.000005	0.010	0.005	0.014	0.042	0.0001	0.405
2011	3E-07	0.073	0.000006	0.017	0.004	0.013	0.038	0.0001	0.374
2012	0.024	0.073	0.000006	0.021	0.004	0.012	0.036	0.0001	0.305
2013	0.134	0.074	0.000005	0.066	0.092	0.171	0.213	0.0027	0.327
2014	0.000	0.073	0.000005	0.008	0.004	0.012	0.037	0.0001	0.367
Trend 1990-2014, %	-100	-99.45		-97.80	-95.43	-92.44	-96.04	-97.22	7.80

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 2013 emission factors.

Production in the Estonian chemical industry is given in Table 4.9.

Table 4.9 Main chemicals and fuel production in the period of 1990-2013 (kt)

Year	Ammonia	Oil shale	Benzene	Toluene	Coke
1990	294	..	91.5	40.1	..
1991	270	..	..	..	..
1992	140	..	..	..	..
1993	55	..	..	..	..
1994	180	..	..	..	..
1995	201	..	49.3	21.1	..
1996	203	..	34.3	11.2	..
1997	206	..	37.5	10.8	..
1998	211	..	23.8	4.6	..
1999	199	..	14.5	4.5	..
2000	177	169.3	13.5	4.6	23.0
2001	183	281.7	6.5	1.5	27.0
2002	47	301.8	0	0	30.0
2003	98	317.6	0	0	30.0
2004	202	340.0	0	0	35.6
2005	213	367.4	0	0	38.7
2006	211	389.2	0	0	40.0
2007	202	436.6	0	0	39.7
2008	209	444.8	0	0	34.6
2009	..	489.3	0	0	21.4
2010	..	524.3	0	0	22.4
2011	..	559.9	0	0	24.4
2012	17	598.9	0	0	26.3
2013	121	629.6	0	0	22.0

4.1.4. Metal Production (NFR 2C)

4.1.4.1. Sources 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 wood 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). Larger companies are AS Kohimo, Fortaco Estonia AS, OÜ BLRT Marketex, AS Remeksi Keskus, AS E-Profiil (metal structures), Ruukki Products AS, AS Saku Metall (building structures), AS HANZA Mechanics Tartu, AS FAVOR, AQ Lasertool OÜ, Metalliset Eesti AS



(metalworking) and AS Metaprint (metal packaging manufacturing). In the long run, growth of production volume is expected to continue in the metals industry, fuelled mainly by exports. (Overview of Economy 2014. The Ministry of Economic Affairs and Communications, the Ministry of Finance 2015. Tallinn 2015)

In 2014, production in the metals industry grew to a small extent.

(Machine-building plant of BLRT Masinaehitus OÜ; source: www.masinaehitus.ee)

Emissions from the metal industry are presented in Table 4.10.

Table 4.10 Emissions from the metal production sector in the period of 1990-2014 (kt)

Year	NO _x	SO _x	NMVOC	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	NA	NA	NA	0.160	NR	NR	NA	NR	NA
1991	NA	NA	0	0.160	NR	NR	NA	NR	NA
1992	NA	NA	0	0.160	NR	NR	NA	NR	NA
1993	NA	NA	NA	0.040	NR	NR	NA	NR	NA
1994	NA	NA	NA	0.080	NR	NR	NA	NR	NA
1995	NA	NA	NA	0.100	NR	NR	NA	NR	NA
1996	NA	NA	0	0.090	NR	NR	NA	NR	NA
1997	NA	NA	NA	0.060	NR	NR	NA	NR	NA
1998	NA	NA	NA	0.040	NR	NR	NA	NR	NA
1999	NA	NA	NA	0.050	NR	NR	NA	NR	NA
2000	NA	NA	0.010	0.040	0.014	0.018	0.030	0.0001	0.010
2001	0.010	NA	0.010	0.080	0.014	0.018	0.030	0.0001	0.010
2002	0.010	NA	0.020	0.060	0.023	0.030	0.050	0.0001	0.010
2003	0.011	NA	0.015	0.050	0.022	0.029	0.048	0.0001	0.010
2004	0.010	NA	0.010	0.030	0.028	0.036	0.060	0.0001	0.020

Year	NO _x	SO _x	NMVOC	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
2005	0.010	NA	0.010	0.060	0.023	0.030	0.050	0.0001	0.010
2006	0.030	NA	0.010	0.080	0.014	0.018	0.030	0.0001	0.020
2007	0.000	NA	0.010	0.060	0.005	0.006	0.050	0.0000	0.020
2008	0.000	0.0002	0.008	0.033	0.002	0.002	0.048	0.0001	0.023
2009	0.000	0.00002	0.004	0.0001	0.001	0.001	0.035	0.0001	0.012
2010	0.000	0.000	0.006	0.000	0.001	0.002	0.044	0.0001	0.009
2011	0.000	0.0001	0.008	0.070	0.001	0.002	0.033	0.0001	0.009
2012	0.001	0.0001	0.007	0.072	0.001	0.001	0.034	0.0001	0.009
2013	0.015	0.0001	0.008	0.074	0.019	0.025	0.045	0.0001	0.012
2014	0.020	0.0001	0.007	0.043	0.023	0.033	0.056	0.0001	0.021

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 2013 emission factors.

4.1.5. Road paving with asphalt (NFR 2D3b)

4.1.5.1. Sources category description



Emission calculations from road paving with asphalt (NFR 2D3b) sectors are based on the Tier 1 method from the EMEP/EEA Guidebook 2013. Emissions from the road paving with asphalt are presented in Table 4.11 and figure 4.7.

(Photo on the left: Road paving with asphalt; source: Scanpix)

Table 4.11 Emissions from the road paving with asphalt in the period of 1990-2014 (kt)

Year	NMVOC	PM _{2.5}	PM ₁₀	TSP	BC
1990	0.027	NR	NR	0.257	NR
1991	0.023	NR	NR	0.215	NR
1992	0.003	NR	NR	0.025	NR
1993	0.006	NR	NR	0.054	NR

Year	NMVOC	PM _{2.5}	PM ₁₀	TSP	BC
1994	0.006	NR	NR	0.052	NR
1995	0.008	NR	NR	0.071	NR
1996	0.008	NR	NR	0.071	NR
1997	0.007	NR	NR	0.063	NR
1998	0.008	NR	NR	0.076	NR
1999	0.011	NR	NR	0.106	NR
2000	0.011	0.001	0.013	0.100	0.0003
2001	0.009	0.001	0.011	0.085	0.0003
2002	0.018	0.001	0.023	0.170	0.0006
2003	0.014	0.001	0.017	0.130	0.0004
2004	0.018	0.001	0.022	0.165	0.0006
2005	0.019	0.001	0.023	0.175	0.0006
2006	0.024	0.001	0.030	0.222	0.0008
2007	0.024	0.001	0.030	0.223	0.0008
2008	0.024	0.002	0.030	0.226	0.0008
2009	0.016	0.001	0.023	0.176	0.0006
2010	0.018	0.001	0.022	0.168	0.0006
2011	0.020	0.001	0.026	0.192	0.0006
2012	0.018	0.001	0.023	0.169	0.0006
2013	0.019	0.001	0.024	0.177	0.0006
2014	0.021	0.001	0.026	0.193	0.0007
Trend 1990-2014, %	-23.6	92.5	93.4	-24.6	93.4

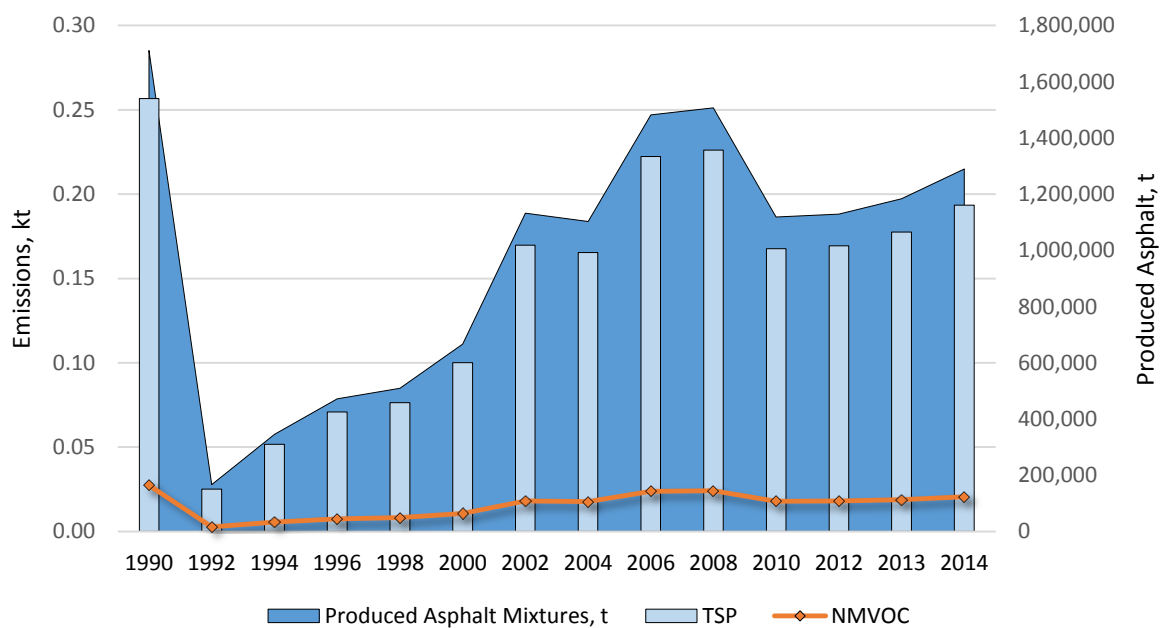


Figure 4.7 Emissions of NMVOC and TSP from road paving with asphalt and asphalt production in the period of 1990-2014

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 (Table 4.12). For particles 99% abatement efficiencies are used.

Table 4.12 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	2000	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 1990-2014 (Table 4.13). 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 4.13 Activity data for NMVOC emission calculations from asphalt production in the period of 1990-2014 (tonnes)

Year	Produced Asphalt Mixtures
1990	1,711.000
1991	1,433.000
1992	167.000
1993	359.000
1994	345.000
1995	475.000
1996	472.000
1997	419.000
1998	509.000
1999	707.000
2000	667.000
2001	568.000
2002	1,132.000
2003	865.000
2004	1,103.000
2005	1,164.000
2006	1,481.908
2007	1,486.572

Year	Produced Asphalt Mixtures
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

4.1.6. Pulp, paper and food industries (NFR 2H)

4.1.6.1. Sources category description

This chapter includes the pollutant emissions from pulp and paper, food and drink and wood, furniture.

The pulp and paper industry in Estonia has a long tradition, having been established as far back as the 17th century. There are about 60 companies in Estonia that manufacture paper, pulp or paper products. Over 80% 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 which made 70 million euros of turnover in the year 2014 and the paper and board manufacturer Horizon Tselluloosi ja Paberi AS with a slightly smaller turnover. Together they provide more than two-thirds of the sector's revenue. Both companies have made large investments in the past year in order to stay competitive and this should be continued in the future. (Overview of Economy 2014. The Ministry of Economic Affairs and Communications, the Ministry of Finance 2015. Tallinn 2015)

In 2014 the sales volumes of paper industry showed a nearly 3% increase.

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 on the left 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.

Nearly 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 2014. The Ministry of Economic Affairs and Communications, the Ministry of Finance 2015. Tallinn 2015)

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 450 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 economic crisis, however, has also affected this sector.

The emissions from sector NFR 2H are presented in Table 4.14.

Table 4.14 Pollutant emissions from the pulp, paper and food industries in the period of 1990-2014 (kt)

Year	NO _x	NMVOC	SO _x	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	NA	2.008	NA	NR	NR	NA	NR	NA
1991	NA	1.541	NA	NR	NR	NA	NR	NA
1992	NA	1.097	NA	NR	NR	NA	NR	NA
1993	NA	0.899	NA	NR	NR	NA	NR	NA
1994	NA	0.837	NA	NR	NR	NA	NR	NA
1995	NA	0.839	NA	NR	NR	NA	NR	NA
1996	NA	0.723	NA	NR	NR	NA	NR	NA
1997	NA	0.745	NA	NR	NR	NA	NR	NA
1998	NA	0.742	NA	NR	NR	NA	NR	NA
1999	NA	0.656	NA	NR	NR	NA	NR	NA
2000	0.010	0.649	0.040	0.085	0.115	0.150	0.002	0.140
2001	0.010	0.650	0.060	0.066	0.088	0.110	0.002	0.140
2002	0.020	0.725	0.160	0.223	0.299	0.380	0.006	0.040
2003	0.020	0.748	0.140	0.126	0.169	0.215	0.003	0.000
2004	0.020	0.788	0.120	0.133	0.179	0.230	0.003	0.000
2005	0	0.744	0.130	0.127	0.171	0.220	0.003	0.020
2006	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

Year	NO _x	NMVOC	SO _x	PM _{2.5}	PM ₁₀	TSP	BC	CO
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

The emissions of NMVOC and particulates are presented in Table 4.15; 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 4.15 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

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 2013 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 (Table 4.16). 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 4.16 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 spirits	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

Information regarding food and drink production is available from Statistics Estonia (www.stat.ee) for the years 1990-2014 (Tables 4.17-18).

Table 4.17 Activity data for the food industries in the period of 1990-2014 (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
1991	149.4	10.4	151.8			5.6	631.6
1992	138.6	5.0	107.9	132.00		0	303.5

Year	Bread and pastry	Flour confectionery	Meat total (slaughter weight)	Fish total	Solid cooking fats	Margarine	Concentrated feeding stuffs
1993	111.7	4.2	83.7	133.00		0.6	200.7
1994	109.3	5.5	69.4	120.80		0.1	184.6
1995	99.7	5.0	67.7	132.00	3.6	0.1	162.8
1996	93.9	5.6	58.6	108.70	4.8	0.1	97.6
1997	86.8	5.2	53.4	123.90	7.0		131.3
1998	81.6	4.3	60.0	119.30	7.2		151.7
1999	77.3	4.6	61.1	111.90	3.5		131.8
2000	76.5	4.4	53.3	113.40	0.8		133.3
2001	76.3	6.0	57.3	103.40	0.9		150.2
2002	77.2	7.4	68.3	101.00	0.9		167.1
2003	72.4	7.9	67.5	79.40	1.0		199.5
2004	72.8	9.0	71.3	84.50	1.6		207.3
2005	72.4	..	67.1	99.30	1.2		177.0
2006	74.4	9.4	69.4	90.60	..	..	208.9
2007	78.8	9.7	70.5	98.50	..	..	214.2
2008	77.6	8.9	74.6	101.70	..	..	229.5
2009	74.1	7.1	76.0	98.20	..	..	203.1
2010	73.7	8.4	75.4	95.95	..	..	203.0
2011	77.0	9.5	80.6	81.30	..	..	216.2
2012	76.7	8.1	78.4	67.80	..	..	198.8
2013	79.2	8.6	79.8	70.10	..	..	161.9
2014	79.2	8.7	80.7	69.19			161.9

Table 4.18 Activity data for the drinks industries in the period of 1990-2014 (thousand hl)

Year	Wine of fruits and berries	Beer	Crude spirits	Distilled spirits
1990	37.0	769.0	82.0	147.0
1991	50.9	675.5	83.4	160.5
1992	20.5	425.7	70.7	120.9
1993	13.0	419.3	94.1	168.4
1994	12.8	476.9	76.1	123.0
1995	14.0	499.6	91.0	176.0
1996	22.0	459.0	79.0	96.0
1997	21.5	543.0	77.0	109.0
1998	31.0	744.0	59.0	102.0
1999	24.0	957.0	32.0	66.0
2000	32.6	950.1	20.4	86.4
2001	30.4	1,015.2	24.1	115.2
2002	34.3	1,044.1	33.1	142.4
2003	34.5	1,040.2	38.3	173.1
2004	60.7	1,202.8	40.0	187.9
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
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

Year	Wine of fruits and berries	Beer	Crude spirits	Distilled spirits
2013	106.6	1,472.7	1.8	157.7
2014	106.6	1,472.7	1.8	157.7

4.1.7. Uncertainty

An uncertainty analysis was carried out to the year 2014 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 4.19.

Table 4.19 Uncertainties in industrial processes sector

Pollutant	Emission, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	0.032	kt	0.09	2.179	2.665
NMVOC	0.904	kt	4.01	14.334	18.479
SO _x	0.001	kt	0.001	0.243	0.090
NH ₃	0.052	kt	0.40	8.276	6.277
PM _{2.5}	0.153	kt	1.97	13.078	6.983
PM ₁₀	0.512	kt	4.10	19.522	9.310
TSP	1.248	kt	7.49	26.549	5.715
CO	0.413	kt	0.33	4.042	1.989
Pb	0.017	t	0.05	1.527	NA

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. Sources-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.

No major improvements are planned for the next submission.

4.2. Solvent and other product use – overview of the sector

4.2.1. 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.



(Source: www.hdwallpapersos.com)

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 emissions 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 Guidebook 2013.

This sector covers emissions from the use of solvents and other products: 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).

Air pollutants under NFR 3 in the Estonian inventory are presented in Table 4.20.

Table 4.20 Activities and emissions reported from the solvent and other product use sector

NFR	Source	Description	Method	Emissions reported
2D3a	Domestic solvent use including fungicides	NMVOC emissions from domestic solvent use	Tier 1	NMVOC, Hg
2D3d	Coating application	Includes emissions from domestic and industrial paint application	Tier 1 / Tier 3	NMVOC, TSP, Pb, Cu, Zn
2D3e	Degreasing	Includes emissions from degreasing (vapour and cold cleaning), electronic components manufacturing and other industrial cleaning	Tier 1 / Tier 3	NMVOC, Pb
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,	Tier 3	NMVOC, NH ₃ , TSP, CO, Cr, Zn

NFR	Source	Description	Method	Emissions reported
		textile finishing, leather tanning and other use of solvents		
2D3h	Printing	Emissions from solvents in printing houses	Tier 1 / Tier 3	NMVOC, TSP
2D3i	Other solvent use		Tier 2 / Tier 3	NMVOC, NH ₃ , TSP, Pb Cu
2G	Other product use		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

4.2.2. Quantitative overview of NMVOCs

In 2014, the solvent and other product use sector, which was the largest pollution source of NMVOC emissions in Estonia, accounted for 31.6% of total NMVOC emissions. The largest share was for coating application at 44.5%, with the others being domestic solvent use at 22.2%, degreasing 13.7%, other solvent use 7.7%, printing 6.4%, chemical products 4.7%, dry cleaning 0.6% and other product use 0.1% (Figure 4.8).

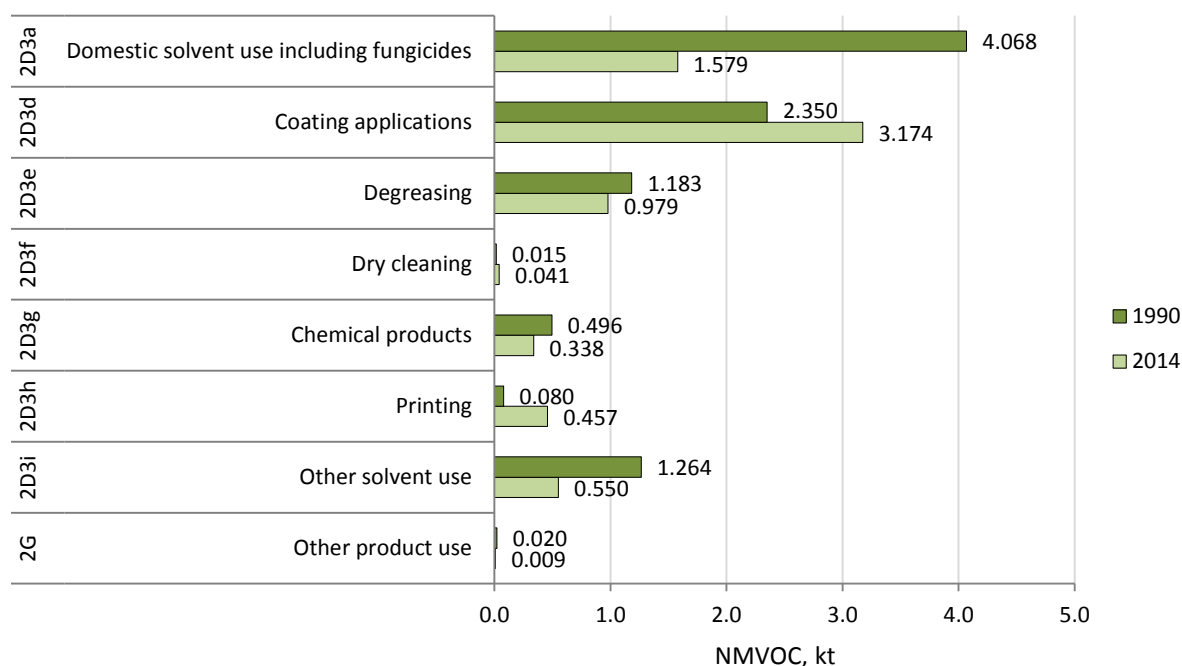


Figure 4.8 NMVOC emissions by sectors in 1990 and 2014

There has been a slight increase in trends in NMVOC emissions from solvent and other product use in recent years. Since 1990, NMVOC emissions have decreased in the solvent sector by 24.8% (Figure 4.9). 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 1990-2014 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 Estonian Republic 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 36% in comparison with 2006 (Figure 4.10). In 2011 there was a slight increase in NMVOC emissions by 8.9%, which means that the bottom of the emissions was reached, and henceforward, the emissions have been started to rise again.

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.

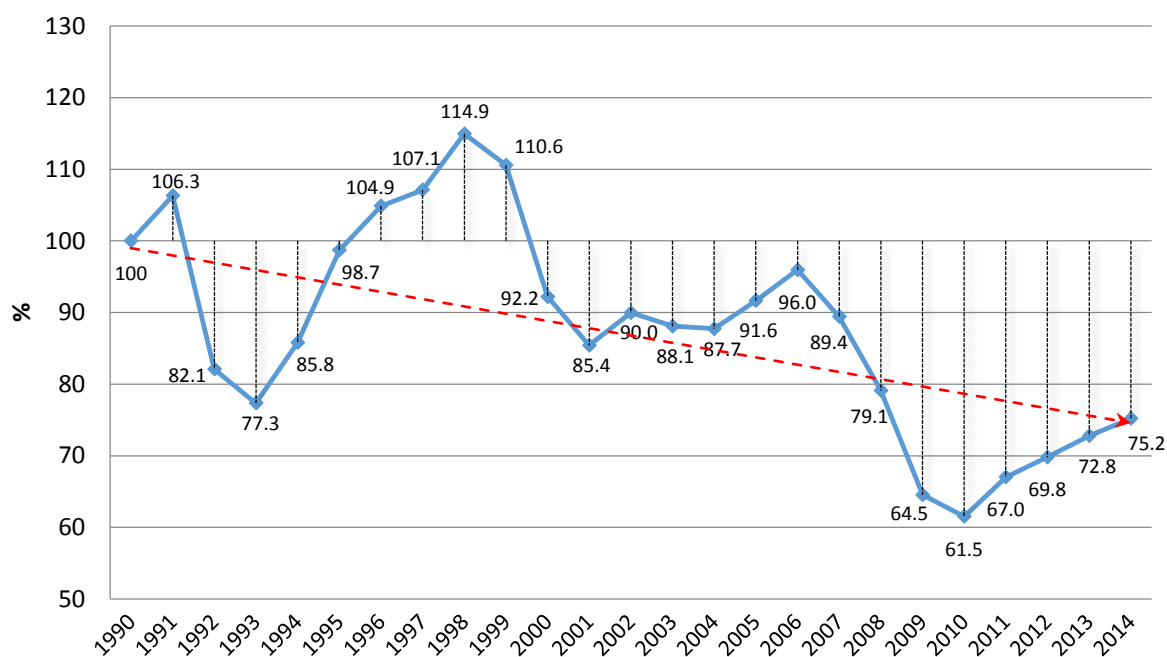


Figure 4.9 The dynamics of NMVOC emissions from the solvent and other product use sector in the period of 1990-2014 (base year is 1990)

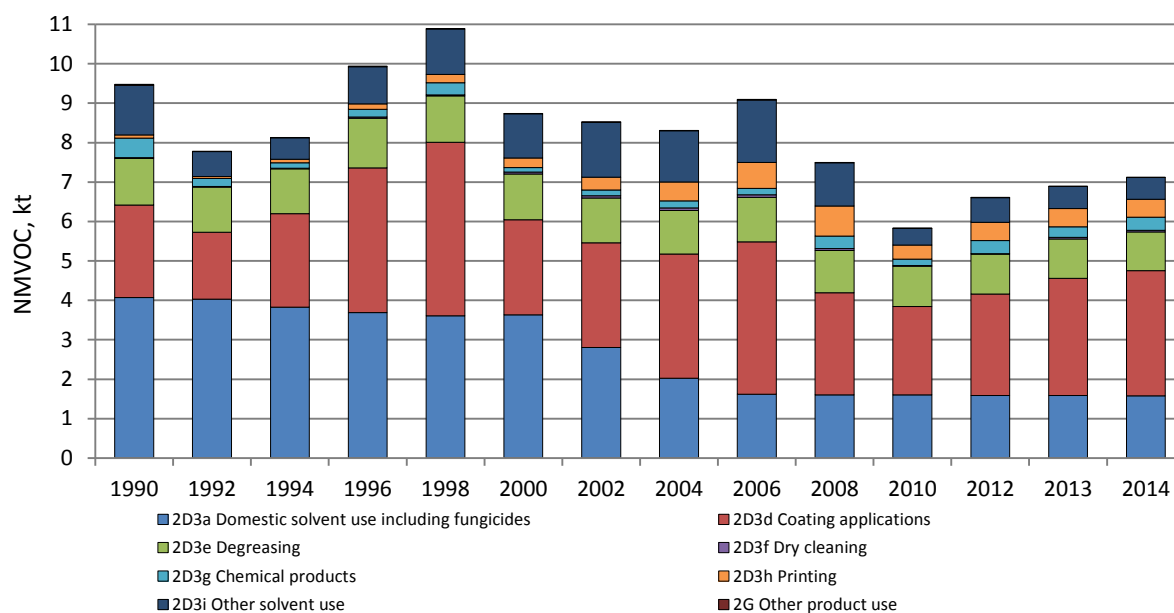


Figure 4.10 NMVOC emissions from the solvent and other product use sector in the period of 1990-2014

Table 4.21 NMVOC emissions from the solvent and other product use sector in the period of 1990-2014 (kt)

Sector	2D3a	2D3d	2D3e	2D3f	2D3g	2D3h	2D3i	2G
1990	4.068	2.350	1.183	0.015	0.496	0.080	1.264	0.020
1991	4.060	2.768	1.169	0.012	0.615	0.066	1.365	0.017
1992	4.027	1.700	1.149	0.011	0.201	0.054	0.628	0.009
1993	3.914	1.568	1.124	0.012	0.135	0.058	0.505	0.013
1994	3.825	2.374	1.136	0.018	0.135	0.090	0.540	0.011
1995	3.751	3.225	1.157	0.025	0.250	0.126	0.810	0.011
1996	3.691	3.668	1.258	0.030	0.197	0.134	0.949	0.010
1997	3.642	4.094	1.223	0.005	0.192	0.172	0.808	0.015
1998	3.608	4.398	1.178	0.024	0.307	0.214	1.154	0.010
1999	3.572	4.124	1.173	0.050	0.217	0.223	1.111	0.010
2000	3.629	2.418	1.159	0.050	0.107	0.248	1.115	0.009
2001	3.217	2.264	1.115	0.047	0.113	0.273	1.055	0.009
2002	2.809	2.651	1.134	0.056	0.151	0.323	1.393	0.011
2003	2.420	2.778	1.110	0.064	0.127	0.392	1.446	0.011
2004	2.022	3.151	1.103	0.064	0.184	0.474	1.303	0.011
2005	1.631	3.624	1.101	0.062	0.125	0.744	1.384	0.013
2006	1.621	3.867	1.128	0.065	0.158	0.655	1.588	0.012
2007	1.612	3.764	1.095	0.054	0.265	0.452	1.216	0.017
2008	1.606	2.588	1.067	0.051	0.314	0.765	1.097	0.007
2009	1.603	2.012	1.003	0.022	0.497	0.204	0.764	0.012
2010	1.600	2.246	1.023	0.012	0.164	0.354	0.425	0.006
2011	1.596	2.526	1.026	0.018	0.313	0.344	0.517	0.009
2012	1.590	2.569	1.016	0.008	0.337	0.456	0.630	0.009
2013	1.584	2.974	1.000	0.039	0.268	0.461	0.562	0.009
2014	1.579	3.174	0.979	0.041	0.338	0.457	0.550	0.009
Trend 1990-2014, %	-61.1	9.1	-15.5	-63.2	-46.0	428.2	-68.2	-55.9

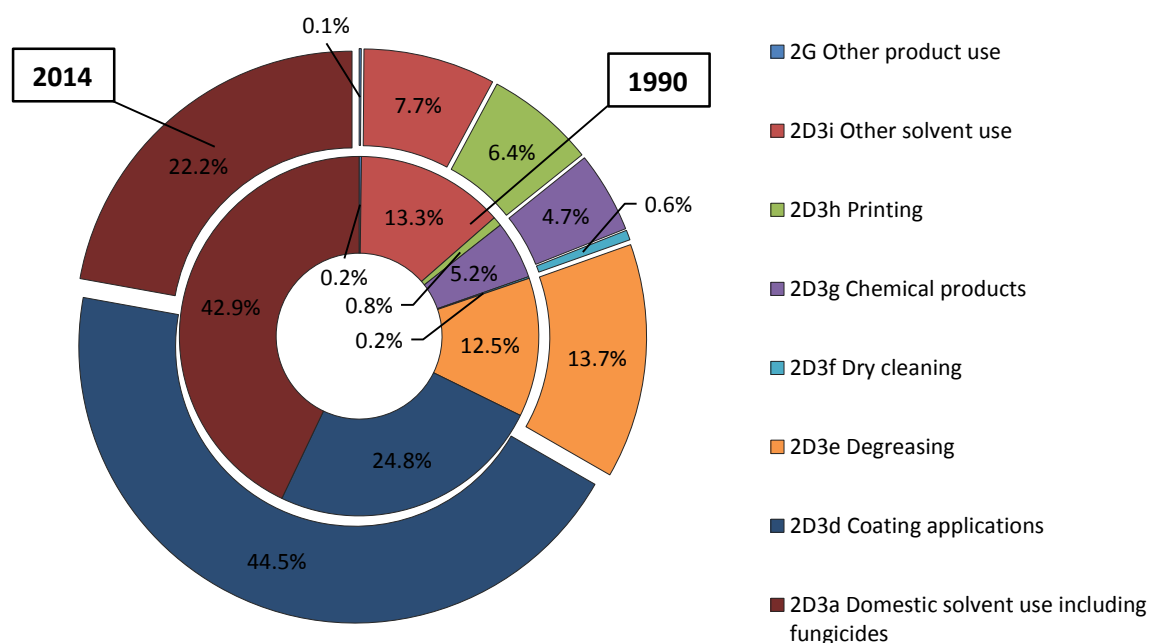


Figure 4.11 The share of NMVOC emissions in 1990 and 2014 by NFR solvent subcategory codes

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 from Statistics Estonia and Eurostat using international emission factors and expert opinions. Information sources for the NMVOC inventory by different subcategories are presented in the Table 4.22 together with emission sources not included in the inventory.

Table 4.22 Information sources for the NMVOC inventory in solvent sector

PS – point sources

DS – diffuse sources

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC 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 (DS); reported by operators (PS, since 2000)	DS: 600 g/kg paint applied (1990-1999); 400 g/kg paint applied (2000-2014) PS: facility specific

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC emission factors
		060103	Construction and buildings	Statistics Estonia / Eurostat and expert estimate	DS: 217 g/kg of paint (1990-1999); 150 g/kg of paint applied (2000-2014)
		060104	Domestic use	Statistics Estonia / Eurostat and expert estimate	
		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
2D3e	Degreasing: Solvents in products	060200	Degreasing (vapour and cold cleaning)	Statistics Estonia / Eurostat	DS: 460 g/kg cleaning products (vapour); 0.7 kg/person/year (cold)
		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
2D3f	Dry cleaning: Chlorinated solvents in products	060202	Dry cleaning	Statistics Estonia / Eurostat; reported by operators (since 2002)	DS: 400 g/kg solvent use 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

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC emission factors
		060308	Inks manufacturing	Reported by operators (since 2007)	PS: facility specific
		060309	Glues manufacturing	Reported by operators (since 2006)	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 / Eurostat; reported by operators (since 2001)	DS: 500 g/kg ink; PS: facility specific
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); 1,2 kg/person/year (since 2005); EFs for the years 2001-2004 are interpolated
		060411	Domestic use of pharmaceutical products	Included under SNAP 060408	DS: 1.8% share of the previous emission factors
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	Reported by operators (since 2002)	PS: facility specific
		060405	Application of glues and adhesives	Statistics Estonia / Eurostat; reported by operators (since 1990)	DS: 780 g/kg adhesives (1990-2000); 522 g/kg adhesive (since 2005); EFs for the years 2001-2004 are interpolated; PS: facility specific
		060406	Preservation of wood	Reported by operators (since 2000)	PS: facility specific

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC emission factors
		060407	Underseal treatment and conservation of vehicles	Eurostat (1990-2004; since 2005 any occurring emissions are considered negligible)	DS: see Chapter 4.2.10.2 subparagraph 5
		060409	Vehicles dewaxing	Not included (emissions are negligible)	NA
		060412	Other (preservation of seeds,...)	Reported by operators (since 2000)	PS: facility specific
2G	Other product use	060602	Use of tobacco	Statistics Estonia / Eurostat	DS: 4.84 kg/Mg tobacco
		060603	Use of shoes	Not included	NA

Emissions, other than NMVOC, are taken from the OSIS database (reported by operators and are facility specific), except emissions from fireworks and tobacco use, where Tier 2 emission factors are taken from the EMEP/EEA Guidebook 2013.

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 0.1 tonnes or more.

The data collected in the annual air emissions report for the solvent use are:

- Class – solvent, varnish, adhesive, paint or other preparation 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 EMTAK (Estonian classification of economic activities – not required since 2012) and SNAP codes where the reported chemical has been used;
- The annual consumption of solvent or solvent containing preparation in tonnes per year;
- Emissions of pollutants by the used solvent or solvent containing preparation – CAS number, name of the substance, maximum emissions in grammes per second (not required since 2012), NMVOC emissions 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 2014 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 SO₂ 50%, for ammonia and particulates 50-100%; in the activity data in the range from 2% to 5%. Uncertainty estimates for stationary combustion are given in Table 4.23.

Table 4.23 Uncertainties in solvent and other products use sector

Pollutant	Emission, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	0.003	kt	0.01	0.72	0.18
NMVOC	7.126	kt	31.62	40.53	18.83
SO _x	0.002	kt	0.004	0.44	0.17
NH ₃	0.011	kt	0.08	2.27	1.15
PM _{2.5}	0.076	kt	0.97	7.00	3.98
PM ₁₀	0.101	kt	0.81	6.36	3.52
TSP	0.125	kt	0.75	6.61	1.35
CO	0.106	kt	0.08	2.05	0.93
Pb	0.406	t	1.11	7.47	3.15
Cd	0.011	t	1.18	7.68	2.63
Hg	0.012	t	1.81	7.63	3.49
PCDD/PCDF	0.0002	g I-TEQ	0.005	1.07	0.26
B(a)p	0.0002	t	0.01	1.41	1.14
B(b)f	0.0001	t	0.004	0.85	0.70
B(k)f	0.0001	t	0.007	1.18	0.78
I(1,2,3-cd)p	0.0001	t	0.005	1.04	0.82

4.2.5. Coating Applications (NFR 2D3d)

4.2.5.1. 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 borne 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 borne 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 2014, NMVOC emissions from this sector had increased by 35% 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.

4.2.5.2. Methodological issues

The Tier 1 default emission factors have been taken from the online version of the GAINS model (IIASA, 2008⁶). A (rounded) weighted average emission factor over all the countries in the model has been derived from dividing the total NMVOC emissions by the total paint use. Data for the year 2000 have been used in order to estimate an average emission factor to describe the situation; however, care should be taken when applying this emission factor. Due to the EU directive 2004/42/EC, which came into force on 1 January 2007, it is no longer permitted to bring decorative or vehicle refinishing paint products to the market with a VOC content that exceeds the maximum for those product categories in EU Member States. For non-EU countries, however, emissions may be significantly higher than the estimate provided here. This has been taken into account in the 95% confidence intervals. These are expert judgements based on former values and the more specific implied emission factors from GAINS.

Emissions from the industrial coating application sector have been significantly reduced by the introduction of the Solvent Emissions Directive (1999/13/EC).

In Estonia, the directive 2004/42/EC was implemented in 2005 and came into force in 2007 (I stage) and 2010 (II stage). The Solvent Emissions Directive (1999/13/EC) was implemented and came into force in 2004 (2007 for existing installations). In 2013 Estonia implemented the Industrial Emissions Directive 2010/75/EU.

Decorative coating application

For the years 2000-2009, the EMEP Guidebook 2013 Tier 1 emission factor 150 g/kg paint applied is used for calculations. The general equation 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.

For the years 1990-1999, Corinair (2000) emission factors are used for calculations. As this guidebook provides different emission factors for solvent borne and water borne paints, an

⁶ IIASA (2008). Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model, www.iiasa.ac.at/rains/gains-online.html.

averaged emission factor is calculated by taking into account the proportion of solvent borne and water borne paints used.

The NMVOC emission factor for decorative solvent borne paints (all) is 300-400 g/kg paint applied (average 350 g/kg paint applied is used) and for water borne paints is 33 g/kg paint applied.

Precise division by solvent borne and water borne paint production is not known. The ratio is estimated by production for the year 2000, when approximately 55% of paint produced was solvent borne and 45% was water borne. Furthermore, by taking import and export data into account, it was estimated that 58% of decorative paint used in 1995 was solvent borne and 42% of paint was water borne.

The weighted average emission factor for the years 1990-1999 can be calculated as follows:

$$(58\% \times 350 \text{ g/kg} + 42\% \times 33 \text{ g/kg}) / 100\% = 217 \text{ g/kg paint applied}$$

Industrial coating application

For the years 1990-2005, EMEP Guidebook 2009 Tier 1 emission factor 400 g/kg paint applied is used for calculations. The general equation 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.

Different emission factors are proposed for vehicle refinishing (in the 280-700 g/kg range of paint applied, no abatement included). The emission factor 600 g/kg paint applied is chosen for the year 1990-1999 as three different factors are similar to this value. Since the year 2000 emission factor 400 g/kg paint applied is used for vehicle refinishing.

Since 2006, detailed NMVOC emissions from point sources with activity data are reported by operators and collected into the OSIS database by SNAP codes.

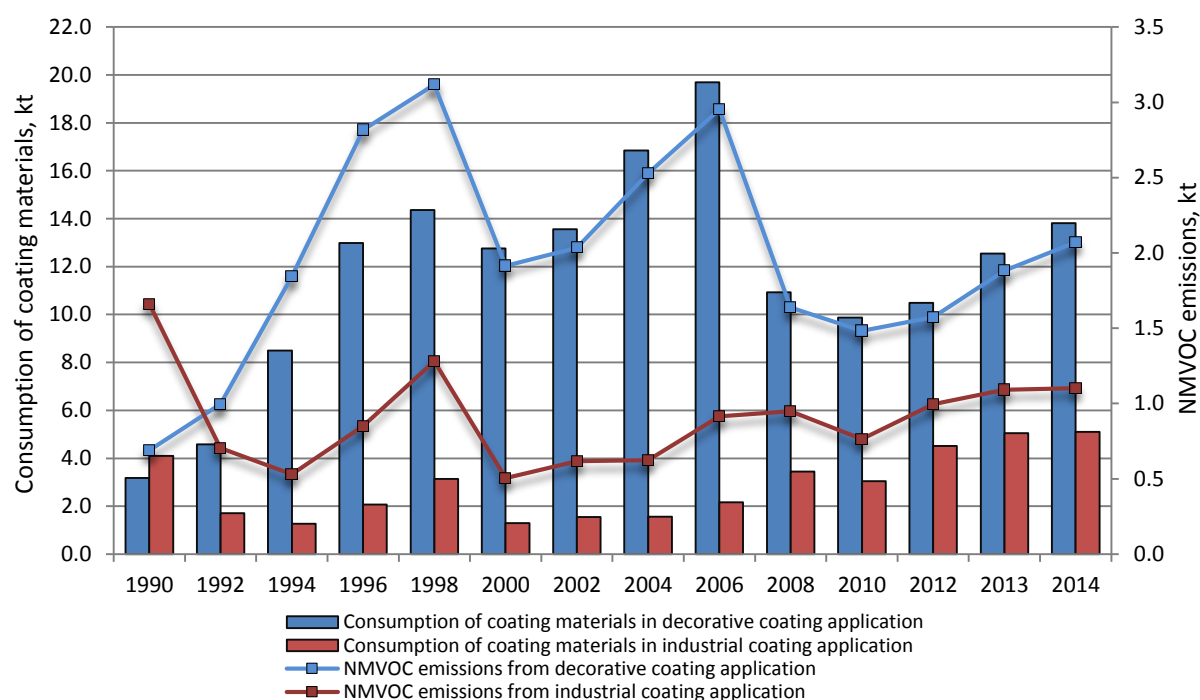


Figure 4.12 Consumption of coating materials and NMVOC emissions from decorative and industrial coating application in the period of 1990-2014

The huge drop in industrial paint consumption and NMVOC emissions in 1992 (Figure 4.12) was due to the renewed independence of the Estonian Republic and the cessation of large-scale production distinctive of the Soviet Union. A huge restructuring in industry took place, and many of the large enterprises went bankrupt and were shut down because of inefficient operation.

NMVOC emissions and activity data in Figure 4.12 are based on data presented in the Tables 4.24-25.

4.2.5.3. Activity data

The quantity of paints and lacquers used in total in Estonia is estimated according to the import and export data (CN codes 3208, 3209 and 3210) and production data (total amount of paints and lacquers) from Statistics Estonia (for the years 1995-2001) and Eurostat (for the years 2002 and onward).

Data related to import and export are not available for the years 1990-1994; therefore, these amounts were calculated using the change in the current prices at that time in the industrial production of chemicals and chemical products.

Some paint is used by point sources (permitted companies) and most of the remaining paint is used for decorative coating application. Also, some of the paint is used for car repairing.

There is no statistical information regarding the amount of paint used for car repairing. Therefore, expert opinion was sought from a representative of the Association of Estonian Automobile Sales and Maintenance Companies "repair unit".

The expert opinion was received from 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 repairing in Estonia is estimated to have risen from 100 tonnes in 1990 up to 207.4 tonnes in 2014. As this is a rough estimate, the annual growth is estimated to be equal.

The paint use for decorative coating application is estimated in the following way:

$$\text{Paint used for decorative coating application} = \text{total paint use} - \text{paint used by all point sources} - \text{paint used by car repairing (diffuse part)}$$

It is unknown how much paint has been used by permitted companies between 1990 and 2005. Therefore, a reverse calculation is carried out, taking into account the emission factor for industrial coating application (NMVOC: 400 g/kg paint applied). All reported emissions from point sources are estimated to be from industrial coating applications.

Data regarding paint use in point sources are available in the OSIS database for the years 2006-2014.

Decorative paint is used by construction enterprises, professional painters (SNAP 060103) and private consumers (SNAP 060104) (Table 4.24).

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 at large construction stores revealed that:

1. sales division by companies and private customers depends on the marketing policy of the store,
2. a change in the division between 1995 and 2014 also depends on the marketing policy, and
3. in the years 2004-2007, an increase in paint use was mainly caused by the rapid increase in developments and construction; the increased use of paint was mainly caused by professional painters and construction companies.

As a result of the discussions, it is estimated that up to 60% of paint can be assigned to professional painters and the remaining 40% to private customers.

In the period 2001-2007, Estonia experienced extensive development and construction, during which time it is estimated that the private use of paints was similar to the amount used in 2000.

Therefore, the following assumptions were made:

- For the years 1990-2003 and 2008-2014, it is estimated that up to 60% of paint went to professional painters and the remaining 40% to private customers.
- Consumption among private consumers in 2005-2007 is assumed to be equal to consumption in 2000, and the remaining part is deemed to have been used by professional painters and construction companies. The year 2004 is viewed as a transitional year between 2003 and 2005.

Table 4.24 NMVOC emissions and the consumption of coating materials from decorative paint application by SNAP codes in the period of 1990-2014 (kt)

SNAP code	060103		060104	
Year	NMVOC	Activity data	NMVOC	Activity data
1990	0.414	1.908	0.276	1.272
1991	0.450	2.076	0.300	1.384
1992	0.597	2.752	0.398	1.835
1993	0.611	2.813	0.407	1.876
1994	1.107	5.101	0.738	3.401
1995	1.328	6.122	0.886	4.081
1996	1.691	7.790	1.127	5.194
1997	1.918	8.838	1.279	5.892
1998	1.871	8.620	1.247	5.747
1999	1.890	8.710	1.260	5.807
2000	1.148	7.654	0.765	5.102
2001	1.090	7.266	0.727	4.844
2002	1.221	8.138	0.814	5.426
2003	1.332	8.880	0.888	5.920
2004	1.687	11.247	0.840	5.600
2005	2.125	14.166	0.765	5.100
2006	2.188	14.588	0.765	5.100
2007	1.982	13.213	0.765	5.100
2008	0.983	6.554	0.655	4.370
2009	0.834	5.560	0.556	3.706
2010	0.889	5.926	0.593	3.951
2011	0.998	6.651	0.665	4.434
2012	0.944	6.296	0.630	4.197
2013	1.129	7.529	0.753	5.019
2014	1.243	8.288	0.829	5.525

Table 4.25 NMVOC emissions and consumption of coating materials from industrial paint application by SNAP codes in the period of 1990-2014 (kt)

SNAP code	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	3.938	NA	NA	0.060	0.100	NA	NA	IE	IE	IE	IE	0.025	0.063
1991	1.955	4.887	NA	NA	0.063	0.104	NA	NA	IE	IE	IE	IE	IE	IE
1992	0.639	1.598	NA	NA	0.065	0.109	NA	NA	IE	IE	IE	IE	IE	IE
1993	0.428	1.071	NA	NA	0.068	0.113	NA	NA	IE	IE	0.054	0.135	IE	IE
1994	0.430	1.076	NA	NA	0.071	0.118	NA	NA	IE	IE	0.027	0.067	0.001	0.004

SNAP code	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
1995	0.795	1.989	NA	NA	0.073	0.122	NA	NA	IE	IE	0.047	0.119	0.094	0.236
1996	0.626	1.565	NA	NA	0.076	0.126	NA	NA	IE	IE	0.037	0.093	0.112	0.280
1997	0.610	1.526	NA	NA	0.078	0.131	NA	NA	IE	IE	0.097	0.243	0.112	0.280
1998	0.976	2.439	NA	NA	0.081	0.135	NA	NA	IE	IE	0.110	0.276	0.113	0.284
1999	0.689	1.721	NA	NA	0.084	0.140	NA	NA	IE	IE	0.088	0.220	0.113	0.284
2000	--	--	NA	NA	0.058	0.178	NA	NA	0.117	0.292	0.119	0.298	0.211	0.528
2001	--	--	NA	NA	0.059	0.175	NA	NA	0.116	0.290	0.218	0.544	0.054	0.136
2002	--	--	NA	NA	0.061	0.161	NA	NA	0.080	0.201	0.244	0.611	0.231	0.577
2003	--	--	NA	NA	0.063	0.164	NA	NA	0.082	0.206	0.184	0.461	0.229	0.572
2004	--	--	NA	NA	0.065	0.170	NA	NA	0.137	0.342	0.209	0.523	0.212	0.530
2005	--	--	0.002	0.004	0.066	0.169	NA	NA	0.131	0.329	0.184	0.459	0.350	0.874
2006	--	--	0.003	0.006	0.068	0.170	NA	NA	0.171	0.505	0.407	0.828	0.265	0.650
2007	--	--	0.002	0.002	0.072	0.178	NA	NA	0.357	1.126	0.439	1.191	0.147	0.659
2008	--	--	NA	NA	0.073	0.183	NA	NA	0.335	1.024	0.369	1.188	0.173	1.050
2009	--	--	NA	NA	0.075	0.187	NA	NA	0.160	0.477	0.302	1.362	0.085	0.343
2010	--	--	NA	NA	0.076	0.191	NA	NA	0.157	0.575	0.409	1.552	0.123	0.730
2011	--	--	NA	NA	0.077	0.196	NA	NA	0.135	0.470	0.463	2.056	0.188	0.938
2012	--	--	NA	NA	0.080	0.208	0.002	0.005	0.109	0.385	0.539	2.723	0.264	1.193
2013	--	--	NA	NA	0.084	0.221	0.011	0.021	0.117	0.385	0.575	3.158	0.304	1.257
2014	--	--	NA	NA	0.085	0.236	0.013	0.024	0.101	0.355	0.607	3.228	0.296	1.259

NMVOC emissions presented in the Table 4.25 are collected from point sources. Emissions for the period 1990-1999 are received from facilities on paper reports; emissions for the period of 2000-2005 were submitted into the CollectER database by an 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.

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 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.

4.2.5.5. Source-specific planned improvements

Some corrections and recalculations of the NMVOC emissions 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.

4.2.6. Degreasing (NFR 2D3e)

4.2.6.1. 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.

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 perfluoro-carbons (PFCs) (ETC/AEM-CITEPA-RISOE, 1997⁷).

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 2014, NMVOC emissions from this sector had decreased by 17.3% 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,

⁷ ETC/AEM-CITEPA-RIOSE (1997). Selected nomenclature for air pollution for Corinair94 inventory (SNAP 94), version 0.3 (draft).

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.

4.2.6.2. Methodological issues

The Tier 1 methodology for emissions from degreasing is based on solvent sales data, in combination with assumptions about the distribution over the different environmental compartments (emissions to air, water, soil and conversion to waste).

If total solvent sales are not known, the following two approaches are applied:

- 1) Vapour cleaning – consumption of most common organic solvents for vapour cleaning (according to the EMEP Guidebook 2013) is considered for emission calculations.
- 2) Cold cleaning – emission from the rest of vapour cleaning is estimated by different emission factors by the inhabitant.

Emission factor for vapour cleaning

Tier 1 emission factor 460 g/kg cleaning products are used for calculations. The general equation 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.

Emission factor for cold cleaning

The emission factor used for cold cleaning is 0.7 kg/person/year, which is derived from an expert estimate made by the VTT Technical Research Centre of Finland⁸.

⁸ SYKE (2011). Air Pollutant Emissions in Finland 1980-2009. Informative Inventory Report. p 252.

4.2.6.3. Activity data

Vapour cleaning operations

Consumption of the most common organic solvents for vapour cleaning methylene chloride (MC), tetrachloroethylene (PER), trichloroethylene (TRI) and xylenes (XYL) is used as a basis for emission calculations from vapour cleaning.

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 1995-2001 and from Eurostat for the years 2002 and onward. 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 for the years 1990-2005. The OSIS database provides some information regarding xylenes production between 2006 and 2014.

Cold cleaning operations

The basic activity statistics for using the Finnish emission factor are national population figures. Data regarding population by counties are available from Statistics Estonia.

4.2.6.4. Results

Part of the facilities report NMVOC emissions from degreasing operations as point sources. These are taken into account in the calculations of vapour cleaning operations.

Between 2006 and 2014, the OSIS database received activity data regarding solvent use for degreasing in point sources.

For the years 2006-2014, 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.

Table 4.26 NMVOC emissions and the consumption of solvents from degreasing by SNAP codes in the period of 1990-2014

SNAP code	060200		060200		060201		060203		060204	
Year	NMVOC (vapour cleaning), kt	Activity data, kt	NMVOC (cold cleaning), kt	Activity data, mln.inhab.	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt
1990	0.084	0.183	1.099	1.571	NA	NA	NA	NA	NA	NA
1991	0.071	0.155	1.097	1.568	NA	NA	NA	NA	NA	NA
1992	0.061	0.132	1.088	1.555	NA	NA	NA	NA	NA	NA
1993	0.067	0.145	1.058	1.511	NA	NA	NA	NA	NA	NA
1994	0.102	0.223	1.034	1.477	NA	NA	NA	NA	NA	NA
1995	0.143	0.312	1.014	1.448	NA	NA	NA	NA	NA	NA
1996	0.260	0.566	0.998	1.425	NA	NA	NA	NA	NA	NA
1997	0.239	0.519	0.984	1.406	NA	NA	NA	NA	NA	NA
1998	0.203	0.440	0.975	1.393	NA	NA	NA	NA	NA	NA
1999	0.207	0.451	0.965	1.379	NA	NA	NA	NA	NA	NA
2000	0.179	0.388	0.981	1.401	NA	NA	0.001	0.001	NA	NA
2001	0.140	0.305	0.975	1.393	0.001	0.002	0.002	0.004	0.001	0.001
2002	0.165	0.359	0.968	1.384	0.003	0.006	0.002	0.005	0.000	0.001
2003	0.147	0.320	0.963	1.375	0.002	0.005	0.002	0.005	0.001	0.001
2004	0.147	0.319	0.956	1.366	0.003	0.007	0.003	0.006	0.000	0.000
2005	0.150	0.326	0.951	1.359	0.000	0.001	0.003	0.006	0.001	0.001
2006	0.175	0.342	0.945	1.351	0.002	0.003	0.018	0.056	0.005	0.006
2007	0.149	0.277	0.940	1.343	0.005	0.006	0.009	0.021	0.013	0.014
2008	0.118	0.184	0.937	1.338	0.001	0.001	0.013	0.026	0.032	0.038
2009	0.063	0.096	0.935	1.336	0.006	0.007	0.005	0.008	0.012	0.018
2010	0.085	0.125	0.933	1.333	0.011	0.012	0.005	0.008	0.016	0.020
2011	0.085	0.121	0.931	1.330	0.007	0.008	0.005	0.008	0.027	0.028
2012	0.069	0.086	0.928	1.325	0.005	0.006	0.003	0.008	0.040	0.036
2013	0.066	0.071	0.924	1.320	0.005	0.007	0.002	0.006	0.036	0.048
2014	0.047	0.015	0.921	1.316	0.011	0.013	0.005	0.009	0.035	0.057

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 2001-2014.

4.2.6.5. 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.

4.2.6.6. Source-specific planned improvements

No major improvements are planned for the next submission.

4.2.7. Dry cleaning (NFR 2D3f)

4.2.7.1. 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 metal and POP emissions are unlikely to be significant.

4.2.7.2. 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, 1993⁹; UBA, 1989¹⁰). 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.

⁹ Passant N.R. (1993). Emissions of Volatile Organic Compounds from Stationary Sources in the United Kingdom: A Review of Emission Data by Process.

¹⁰ UBA (1989). Luftreinhaltung '89 – Tendenzen – Probleme – Lösungen. Edited by the German Federal Protection Agency (Umweltbundesamt), Erich Schmidt Verlag GmbH, Berlin 1989.

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, 2008¹¹) – 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 4.27.

Table 4.27 The results of the interviews with the dry cleaning operators

Question	Answers			
	<i>Virumaa Puhastus</i>	<i>Euroclean</i>	<i>Pernau Pesumaja</i>	<i>Rea Pesumaja</i>
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

4.2.7.3. 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.

¹¹ IIASA (2008). Greenhouse Gas and Air Pollution Integrations and Synergies (GAINS) model, www.iiasa.ac.at/rains/gains-online.html.

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.

According to OSIS, no production of tetrachloroethylene/perchloroethylene is reported for the years 2006-2014.

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.

4.2.7.4. 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 equals about 40%. The emission factor for dry cleaning is 400 g/kg solvent use.

Table 4.28 NMVOC emissions and the consumption of solvents from dry cleaning in the period of 1990-2014 (kt)

SNAP code	060202	
Year	NMVOC	Activity data
1990	0.015	0.036
1991	0.012	0.031
1992	0.011	0.026
1993	0.012	0.029
1994	0.018	0.044
1995	0.025	0.062
1996	0.030	0.076
1997	0.005	0.012
1998	0.024	0.060
1999	0.050	0.124
2000	0.050	0.126
2001	0.047	0.117
2002	0.056	0.131
2003	0.064	0.152
2004	0.064	0.152
2005	0.062	0.149
2006	0.065	0.158
2007	0.054	0.131

SNAP code	060202	
Year	NMVOC	Activity data
2008	0.051	0.124
2009	0.022	0.052
2010	0.012	0.027
2011	0.018	0.042
2012	0.008	0.017
2013	0.039	0.094
2014	0.041	0.098

For the dry cleaning sector for the years 1990 to 2001, only statistical data are used, whereas for the period 2002 to 2014, both statistical and reported data are used.

4.2.7.5. 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.

4.2.7.6. Source-specific planned improvements

No major improvements are planned for the next submission.

4.2.8. Chemical Products (NFR 2D3h)

4.2.8.1. 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 1.5% to the total national NMVOC emissions in 2014 and only 4.7% to the whole solvent sector.

By 2014, NMVOC emissions from the chemical products sector had decreased by 31.9% compared to the year 1990.

4.2.8.2. 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 2006-2014 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 2006-2014.

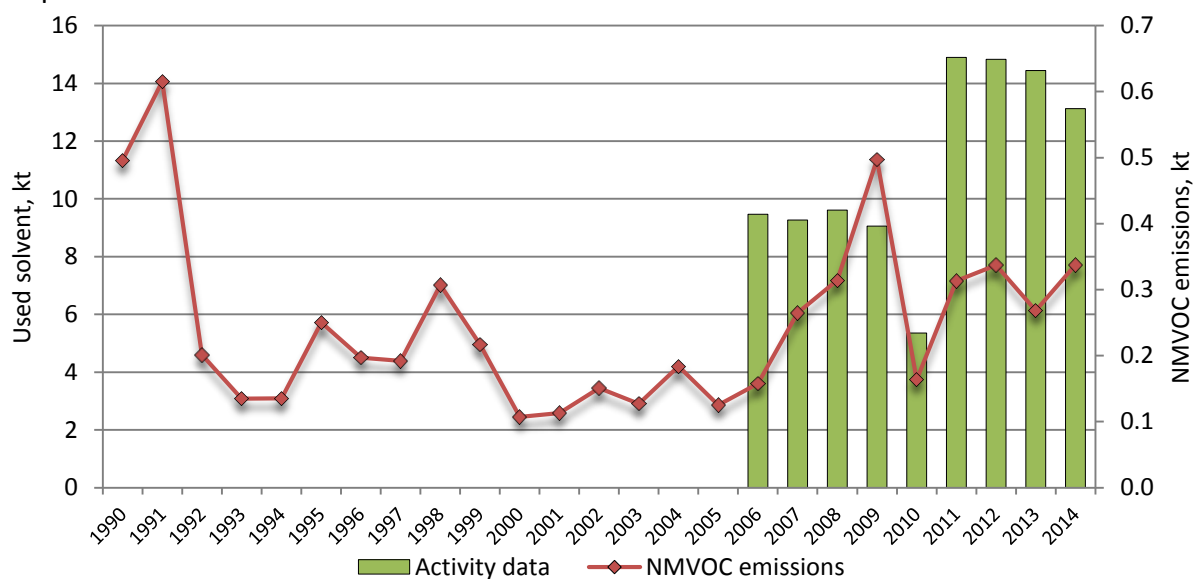


Figure 4.13 Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period of 1990-2014

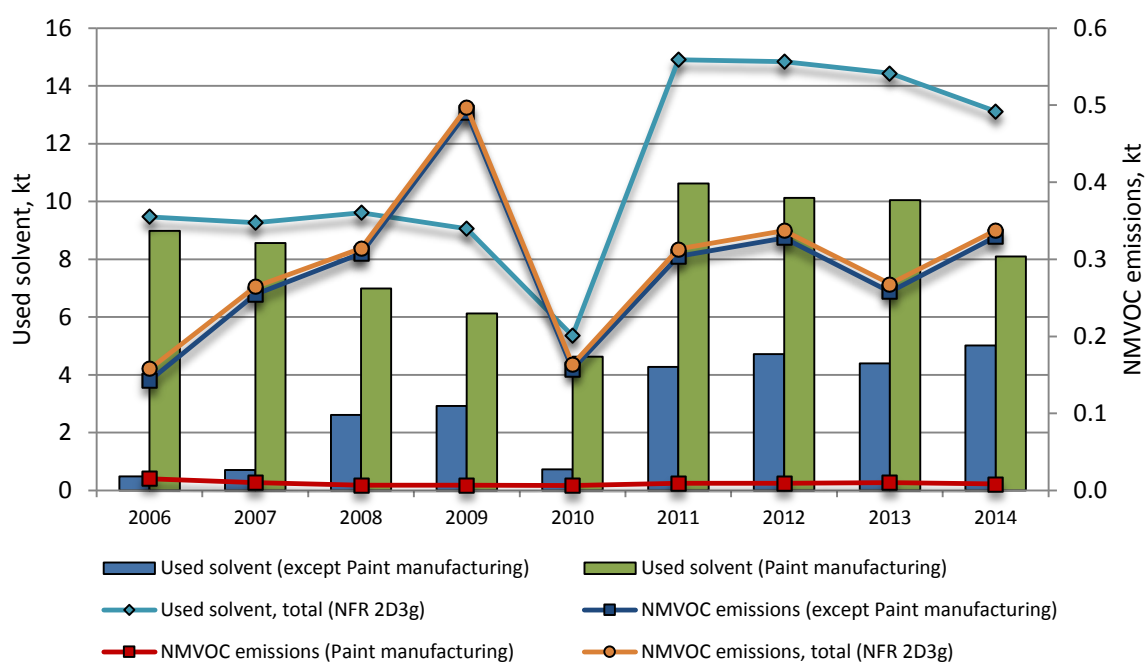


Figure 4.14 Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period of 2006-2014

Figure 4.14 explains quite well why Figure 4.13 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 1990 to 2005 came only from point sources, but without the availability of the activity data for that period.

Table 4.29 NMVOC emissions and the consumption of solvents from chemical products manufacturing or processing by SNAP codes in the period of 1990-2014 (kt)

SNAP code	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
1991	0.615	NA	NA	NA	NA	NA	NA	NA	NA	NA
1992	0.201	NA	NA	NA	NA	NA	NA	NA	NA	NA
1993	0.135	NA	NA	NA	NA	NA	NA	NA	NA	NA
1994	0.135	NA	NA	NA	NA	NA	NA	NA	NA	NA
1995	0.250	NA	NA	NA	NA	NA	NA	NA	NA	NA
1996	0.197	NA	NA	NA	NA	NA	NA	NA	NA	NA
1997	0.192	NA	NA	NA	NA	NA	NA	NA	NA	NA
1998	0.307	NA	NA	NA	NA	NA	NA	NA	NA	NA
1999	0.217	NA	NA	NA	NA	NA	NA	NA	NA	NA
2000	0.107	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	0.113	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002	0.151	NA	NA	NA	NA	NA	NA	NA	NA	NA
2003	0.127	NA	NA	NA	NA	NA	NA	NA	NA	NA
2004	0.184	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

Table 4.29 continues

SNAP code	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
1991	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1992	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1993	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1994	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1995	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1996	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1998	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

SNAP code	060308		060309		060312		060313		060314	
Year	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data
1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2004	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	0.0880	0.001727	NA	0.000040	0.001	0.026	0.236
2007	0.0005	0.0405	0.00154	NA	0.000154	NA	0.000043	0.001	0.111	0.248
2008	0.0007	0.0532	0.00064	NA	0.000005	NA	0.000064	0.003	0.186	0.383
2009	0.0003	0.0262	0.00045	0.0006	0.000002	NA	0.000245	0.008	0.434	1.187
2010	0.0003	0.0262	0.00043	0.0006	0.000001	NA	0.000297	0.014	0.082	0.601
2011	NA	NA	0.00004	NA	0.000356	0.0003	0.000182	0.013	0.210	0.714
2012	NA	NA	0.00001	NA	0.000350	0.0002	0.000170	0.018	0.238	0.703
2013	NA	NA	0.00007	NA	0.000330	0.0001	0.000008	0.018	0.170	0.688
2014	NA	NA	0.00003	NA	0.000373	0.0001	0.000116	0.010	0.238	1.090

4.2.8.3. 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.

4.2.8.4. 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.

4.2.9. Printing (NFR 2D3h)

4.2.9.1. 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, 2005¹²).

- Publication 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, 2005⁸).

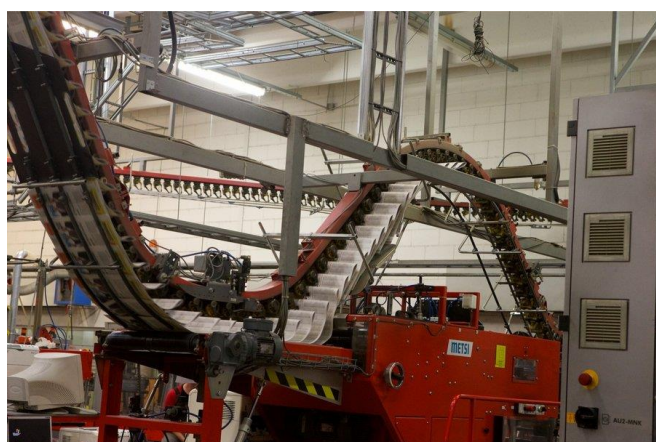
- Rotogravure & Flexography

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, 2005⁸).

The emissions of NMVOCs from printing have been significantly reduced following the introduction of the Solvent Emissions Directive 1999/13/EC in March 1999. 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.

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.

(Photo by Mari Luud; The printing machine of Kroonpress AS)

¹² EGTEI (2005), Heatset Offset: synopsis sheet.

4.2.9.2. Methodological issues

The 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 Corinair¹³, 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.

4.2.9.3. Activity Data

The quantity of ink (CN code 3215) used in Estonia can be estimated by the import and export data from Statistics Estonia (1995-2001) and Eurostat (2002 and onward). 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.

¹³ Atmospheric Emission Inventory Guidebook. Second Edition. EEA 2000

4.2.9.4. Results

A number of printing facilities is permitted.

Between 2006 and 2014, activity data regarding ink use in point sources were collected in the OSIS database. For the years 2006 to 2014, activity data for calculations were calculated as follows:

$$\text{Ink use in diffuse sources} = \text{total ink use} - \text{ink use in point sources}$$

In 2005, according to CollectER, five companies reported as point sources. No activity data were available. Emissions from point sources were subtracted from the total calculated NMVOC emissions.

Table 4.30 NMVOC emissions and the consumption of solvents from the printing industry by SNAP code in the period of 1990-2014 (kt)

SNAP code	060403	
Year	NMVOC	Activity data
1990	0.080	0.160
1991	0.066	0.133
1992	0.054	0.109
1993	0.058	0.116
1994	0.090	0.180
1995	0.126	0.252
1996	0.134	0.269
1997	0.172	0.345
1998	0.214	0.427
1999	0.223	0.445
2000	0.248	0.497
2001	0.273	0.545
2002	0.323	0.645
2003	0.392	0.783
2004	0.474	0.949
2005	0.744	1.488
2006	0.655	1.740
2007	0.452	2.012
2008	0.765	2.314
2009	0.204	1.660
2010	0.354	2.150
2011	0.344	2.063
2012	0.456	2.385
2013	0.461	2.305
2014	0.457	2.487

4.2.9.5. 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.

4.2.9.6. Source-specific planned improvements

No major improvements are planned for the next submission.

4.2.10. Domestic solvent use including fungicides (NFR 2D3a)

4.2.10.1. 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:

Table 4.31 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 section and will be omitted.
Car care products	Products used for improving the appearance of vehicles to maintain vehicles or winter products such as antifreeze.

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 Hg, are also included in this category.

For most products, all of the NMVOC will be emitted to the atmosphere. However, in some products, the NMVOC will be mainly lost to waste water.

In 2014, NMVOC emissions from the NFR 2D3a sector decreased by 61.2% compared to the year 1990.

4.2.10.2. 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 by population.

Tier 1 emission factors are 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 domestic solvent use;

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

Table 4.32 presents the EMEP/EEA Guidebook 2013 default emission factors for NFR source category 2D3a for NMVOC and Hg, for EU-15 including Iceland, Norway and Switzerland. This table also presents additional information on Tier 1 emission factors for the four main subcategories: household products, car care products, cosmetics and toiletries, DIY/buildings in addition to pharmaceutical products and other various products.

Table 4.32 Tier 1 emission factors for NFR source category 2D3a domestic solvent use including fungicides

Source category	Pollutant	Share, %	Value	Unit
Domestic solvent use including fungicides, total	Σ NMVOC	100.0	2,700	g/person
Household (cleaning) products	NMVOC	18.7	507	g/person
Car care products	NMVOC	17.2	464	g/person
Cosmetics and toiletries	NMVOC	40.2	1,088	g/person
DIY/building	NMVOC	19.3	522	g/person
Pharmaceutical products (SNAP 060411)	NMVOC	1.8	48	g/person
Various	NMVOC	2.8	76	g/person
Domestic solvent use including fungicides (fluorescent tubes)	Hg	--	5.6	g/person

An IIASA Tier 1 NMVOC emission factor for western European Union Member States (EU-15 including Iceland, Norway and Switzerland) is $1,519 \pm 559$ g/person. An IIASA Tier 1 NMVOC emission factor for eastern EU countries (EU-12 and 12 EECCA countries) is 703 ± 273 g/person. This suggests that an emission factor for EU-12 can be derived from Table 4.29 by multiplying with a factor $703 / 1,519 = 0.46$. Total 2D3a for EU-12 and 12 EECCA countries is thus: $0.46 * (2,700 (-1,700; +3,700)) = 1,200 (-780; +1,700)$ g/person. The derived emission factor is used to calculate NMVOC emissions from the NFR sector 2D3a for the years 2005 and onward.

NMVOC emissions for years 1990-2000 are calculated using EMEP/Corinair Emission Inventory Guidebook 2007 Tier 1 default emission factor for domestic solvent use 2,590 g/person. The emission factors for years 2001-2004 are interpolated.

4.2.10.3. Activity Data and results

The basic activity statistics for using the Tier 1 emission factor are national population figures obtained from the Statistics Estonia.

Table 4.33 NMVOC and Hg emissions from domestic solvent use (other than paint application) and the population of Estonia in the period of 1990-2014

Year	Population, mln.inhab.	NMVOC emissions by domestic solvent use categories, kt							Hg emissions, kg
		Household products	Car care products	Cosmetics and toiletries	DIY/building	Pharmaceutical products (SNAP 060411)	Various	Total (SNAP 060408)	
1990	1.571	0.762	0.698	1.636	0.785	0.072	0.114	4.068	8.795
1991	1.568	0.761	0.697	1.633	0.784	0.072	0.114	4.060	8.779
1992	1.555	0.755	0.691	1.620	0.777	0.071	0.113	4.027	8.707
1993	1.511	0.734	0.671	1.574	0.755	0.069	0.110	3.914	8.463
1994	1.477	0.717	0.656	1.539	0.738	0.068	0.107	3.825	8.271
1995	1.448	0.703	0.643	1.509	0.724	0.067	0.105	3.751	8.109
1996	1.425	0.692	0.633	1.485	0.712	0.066	0.104	3.691	7.981
1997	1.406	0.683	0.625	1.465	0.703	0.065	0.102	3.642	7.874
1998	1.393	0.676	0.619	1.451	0.696	0.064	0.101	3.608	7.801
1999	1.379	0.670	0.613	1.437	0.689	0.063	0.100	3.572	7.724
2000	1.401	0.680	0.623	1.460	0.700	0.064	0.102	3.629	7.847
2001	1.393	0.603	0.552	1.294	0.621	0.057	0.090	3.217	7.799
2002	1.384	0.526	0.482	1.130	0.542	0.050	0.079	2.809	7.748
2003	1.375	0.454	0.415	0.974	0.467	0.043	0.068	2.420	7.701
2004	1.366	0.379	0.347	0.813	0.390	0.036	0.057	2.022	7.651
2005	1.359	0.306	0.280	0.656	0.315	0.029	0.046	1.631	7.610
2006	1.351	0.304	0.278	0.652	0.313	0.029	0.046	1.621	7.564
2007	1.343	0.302	0.276	0.648	0.311	0.029	0.045	1.612	7.520
2008	1.338	0.301	0.276	0.646	0.310	0.029	0.045	1.606	7.495
2009	1.336	0.300	0.275	0.645	0.309	0.028	0.045	1.603	7.480
2010	1.333	0.300	0.274	0.644	0.309	0.028	0.045	1.600	7.466
2011	1.330	0.299	0.274	0.642	0.308	0.028	0.045	1.596	7.446
2012	1.325	0.298	0.273	0.640	0.307	0.028	0.045	1.590	7.421
2013	1.320	0.297	0.272	0.637	0.306	0.028	0.045	1.584	7.393
2014	1.316	0.296	0.271	0.635	0.305	0.028	0.044	1.579	7.369

4.2.10.4. 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.

4.2.10.5. 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, 2003¹⁴).

In 2014, NMVOC emissions from the NFR 2D3i sector had decreased by 56.5% compared to the year 1990.

4.2.11.2. Methodological issues

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.

¹⁴ 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.

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.

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 adhesive¹⁵ for the period of 1990-2000, 522 g/kg adhesive¹⁶ 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 2006-2014. At present, there is no information available regarding adhesive production between 1990 and 1999.

¹⁵ EMEP/EEA Emission Inventory Guidebook 2009.

¹⁶ EMEP/EEA Emission Inventory Guidebook 2013.

Results

A number of facilities using adhesives are permitted.

In the period from 2006 to 2014, activity data regarding adhesives use in point sources are collected in the OSIS database (SNAP 060405).

For the years 2006-2014, activity data for calculations are calculated as follows:

Adhesives use in diffuse sources = total adhesive use – adhesive use 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 (Festmeter¹⁷). The largest wood impregnation companies were the following (only waterborne preservatives were used):

- Hansacom Ltd. – 33,000 m³;
- Kestvuspuit plc – 30,000 m³;
- Imprest plc – 15,000 m³;
- Kehra Wood Industries Ltd. – 8,000 m³;
- Natural plc – 5,000 m³.

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.

¹⁷ 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.

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 4.34 Motorisation rate - cars per 1,000 inhabitants¹⁸

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%
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.

¹⁸ EUROSTAT -

<http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsdpc340&plugin=0>

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 2000-2014 are gathered from OSIS and CollectER databases, and are reported by operators.

4.2.11.3. Results

Table 4.35 NMVOC emissions from other solvent use and the activity data by SNAP codes in the period of 1990-2014

SNAP code	060400		060404		060405	
Year	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt
1990	0.817	NA	NA	NA	0.324	0.415
1991	1.014	NA	NA	NA	0.215	0.275
1992	0.332	NA	NA	NA	0.155	0.198
1993	0.224	NA	NA	NA	0.127	0.163
1994	0.223	NA	NA	NA	0.155	0.199
1995	0.412	NA	NA	NA	0.218	0.279
1996	0.325	NA	NA	NA	0.438	0.562
1997	0.316	NA	NA	NA	0.296	0.379
1998	0.506	NA	NA	NA	0.448	0.574
1999	0.357	NA	NA	NA	0.556	0.712

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SNAP code	060400		060404		060405	
Year	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt
2000	--	--	NA	NA	0.906	1.162
2001	--	--	NA	NA	0.866	1.189
2002	--	--	0.0013	NA	1.202	1.776
2003	--	--	0.0017	NA	1.282	2.051
2004	--	--	0.0016	NA	1.183	2.063
2005	--	--	0.0018	NA	1.379	2.642
2006	--	--	0.0018	NA	1.555	3.364
2007	--	--	0.0017	NA	1.194	3.967
2008	--	--	0.0017	NA	1.068	2.516
2009	--	--	0.0016	NA	0.736	1.794
2010	--	--	0.0015	NA	0.399	1.260
2011	--	--	0.0009	NA	0.483	1.476
2012	--	--	0.0003	NA	0.584	1.721
2013	--	--	0.0012	NA	0.513	1.817
2014	--	--	0.0032	NA	0.498	1.825

Table 4.35 continues

SNAP code	060406		060407		060412	
Year	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, mln.inhab.	NMVOC, kt	Activity data, kt
1990	NA	NA	0.124	1.571	NA	NA
1991	NA	NA	0.136	1.568	NA	NA
1992	NA	NA	0.141	1.555	NA	NA
1993	NA	NA	0.154	1.511	NA	NA
1994	NA	NA	0.161	1.477	NA	NA
1995	NA	NA	0.180	1.448	NA	NA
1996	NA	NA	0.187	1.425	NA	NA
1997	NA	NA	0.195	1.406	NA	NA
1998	NA	NA	0.201	1.393	NA	NA
1999	NA	NA	0.199	1.379	NA	NA
2000	0.001	NA	0.200	1.401	0.008	NA
2001	0.002	NA	0.180	1.393	0.008	NA
2002	0.0001	NA	0.159	1.384	0.030	NA
2003	NA	NA	0.138	1.375	0.025	NA
2004	NA	NA	0.118	1.366	0.001	NA
2005	0.00001	NA	NO	--	0.003	NA
2006	0.003	0.069	NO	--	0.028	0.238
2007	0.015	0.029	NO	--	0.005	0.289
2008	0.007	0.017	NO	--	0.020	0.353
2009	0.014	0.026	NO	--	0.013	0.052
2010	0.011	0.018	NO	--	0.012	0.069
2011	0.011	0.022	NO	--	0.022	0.081
2012	0.011	0.022	NO	--	0.034	0.137
2013	0.011	0.029	NO	--	0.037	0.108
2014	0.013	0.036	NO	--	0.036	0.432

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 IIR.

4.2.12.2. Methodological issues

1) Use of fireworks (SNAP 060601)

The Tier 2 emission factors are used for pollutant emissions calculations.

Table 4.36 Emission factors from the EMEP/EEA Guidebook 2013 for calculating pollutant emissions from the use of fireworks

Pollutant	Emission Factor	Unit
SO ₂	3020	g/t product
NO _x	260	g/t product
CO	7150	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

Pollutant	Emission Factor	Unit
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.

Table 4.37 Emission factors from the EMEP/EEA Guidebook 2013 for calculating pollutant emissions from tobacco combustion

Pollutant	Emission Factor	Unit
NMVOC	4.84	kg/Mg tobacco
NO _x	1.8	kg/Mg tobacco
CO	55.1	kg/Mg tobacco
NH ₃	4.15	kg/Mg tobacco
TSP	27	kg/Mg tobacco
PM ₁₀	27	kg/Mg tobacco
PM _{2.5}	27	kg/Mg tobacco
BC	0.45	% of PM _{1.8}
PCDD/PCDF	0.1	µg I-TEQ/Mg tobacco
B(a)p	0.111	g/Mg tobacco
B(b)f	0.045	g/Mg tobacco
B(k)f	0.045	g/Mg tobacco
I(1,2,3-cd)p	0.045	g/Mg tobacco
Cd	5.4	g/Mg tobacco
Ni	2.7	g/Mg tobacco
Zn	2.7	g/Mg tobacco
Cu	5.4	g/Mg 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 are 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.

Table 4.38 The use of fireworks and pollutant emissions in the period of 1990-2014

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
1991	3.906	0.012	0.028	0.001	0.429	0.390	0.203
1992	6.009	0.018	0.043	0.002	0.660	0.600	0.312
1993	9.244	0.028	0.066	0.002	1.015	0.924	0.480
1994	14.222	0.043	0.102	0.004	1.562	1.421	0.739
1995	21.880	0.066	0.156	0.006	2.403	2.186	1.136
1996	29.528	0.089	0.211	0.008	3.243	2.950	1.534
1997	67.817	0.205	0.485	0.018	7.448	6.776	3.522
1998	90.045	0.272	0.644	0.023	9.890	8.997	4.677
1999	110.417	0.333	0.789	0.029	12.127	11.033	5.735
2000	68.993	0.208	0.493	0.018	7.578	6.894	3.584
2001	83.688	0.253	0.598	0.022	9.191	8.362	4.347
2002	98.639	0.298	0.705	0.026	10.834	9.856	5.123
2003	127.588	0.385	0.912	0.033	14.013	12.749	6.627
2004	191.336	0.578	1.368	0.050	21.014	19.118	9.938
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

Table 4.38 continues

Year	Product, t	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
		kg							
1990	2.539	0.003	0.004	0.040	1.127	0.0001	0.076	1.990	0.660
1991	3.906	0.005	0.006	0.061	1.734	0.0002	0.117	3.062	1.015
1992	6.009	0.008	0.009	0.094	2.668	0.0003	0.180	4.711	1.562
1993	9.244	0.012	0.014	0.144	4.104	0.0005	0.277	7.247	2.403
1994	14.222	0.019	0.021	0.222	6.314	0.0008	0.427	11.150	3.698
1995	21.880	0.029	0.032	0.341	9.714	0.0012	0.656	17.154	5.689
1996	29.528	0.039	0.044	0.461	13.110	0.0017	0.886	23.150	7.677
1997	67.817	0.090	0.100	1.058	30.111	0.0039	2.035	53.169	17.632
1998	90.045	0.120	0.133	1.405	39.980	0.0051	2.701	70.596	23.412
1999	110.417	0.147	0.163	1.723	49.025	0.0063	3.313	86.567	28.708
2000	68.993	0.092	0.102	1.076	30.633	0.0039	2.070	54.091	17.938
2001	83.688	0.111	0.124	1.306	37.157	0.0048	2.511	65.611	21.759
2002	98.639	0.131	0.146	1.539	43.796	0.0056	2.959	77.333	25.646
2003	127.588	0.170	0.189	1.990	56.649	0.0073	3.828	100.029	33.173
2004	191.336	0.254	0.283	2.985	84.953	0.0109	5.740	150.007	49.747
2005	332.275	0.442	0.492	5.183	147.530	0.0189	9.968	260.504	86.392
2006	388.849	0.517	0.575	6.066	172.649	0.0222	11.665	304.858	101.101
2007	492.507	0.655	0.729	7.683	218.673	0.0281	14.775	386.125	128.052
2008	313.097	0.416	0.463	4.884	139.015	0.0178	9.393	245.468	81.405

Year	Product, t	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
		kg							
2009	127.661	0.170	0.189	1.992	56.681	0.0073	3.830	100.086	33.192
2010	276.950	0.368	0.410	4.320	122.966	0.0158	8.309	217.129	72.007
2011	293.392	0.390	0.434	4.577	130.266	0.0167	8.802	230.019	76.282
2012	393.956	0.524	0.583	6.146	174.916	0.0225	11.819	308.862	102.429
2013	439.705	0.585	0.651	6.859	195.229	0.0251	13.191	344.729	114.323
2014	517.402	0.688	0.766	8.071	229.726	0.0295	15.522	405.643	134.525

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 (Table 4.39).

Table 4.39 The use of tobacco and pollutant emissions from tobacco combustion in the period of 1990-2014

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	0.112	0.112	0.051	0.0004
1991	3.577	0.017	0.006	0.197	0.015	0.097	0.097	0.097	0.043	0.0004
1992	1.780	0.009	0.003	0.098	0.007	0.048	0.048	0.048	0.022	0.0002
1993	2.630	0.013	0.005	0.145	0.011	0.071	0.071	0.071	0.032	0.0003
1994	2.287	0.011	0.004	0.126	0.009	0.062	0.062	0.062	0.028	0.0002
1995	2.218	0.011	0.004	0.122	0.009	0.060	0.060	0.060	0.027	0.0002
1996	2.097	0.010	0.004	0.116	0.009	0.057	0.057	0.057	0.025	0.0002
1997	3.199	0.015	0.006	0.176	0.013	0.086	0.086	0.086	0.039	0.0003
1998	2.035	0.010	0.004	0.112	0.008	0.055	0.055	0.055	0.025	0.0002
1999	2.148	0.010	0.004	0.118	0.009	0.058	0.058	0.058	0.026	0.0002
2000	1.949	0.009	0.004	0.107	0.008	0.053	0.053	0.053	0.024	0.0002
2001	1.948	0.009	0.004	0.107	0.008	0.053	0.053	0.053	0.024	0.0002
2002	2.308	0.011	0.004	0.127	0.010	0.062	0.062	0.062	0.028	0.0002
2003	2.345	0.011	0.004	0.129	0.010	0.063	0.063	0.063	0.028	0.0002
2004	2.339	0.011	0.004	0.129	0.010	0.063	0.063	0.063	0.028	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	1.795	0.009	0.003	0.099	0.007	0.048	0.048	0.048	0.022	0.0002
2013	1.835	0.009	0.003	0.101	0.008	0.050	0.050	0.050	0.022	0.0002
2014	1.812	0.009	0.003	0.100	0.008	0.049	0.049	0.049	0.022	0.0002

Table 4.39 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
1991	3.577	0.397	0.161	0.161	0.161	19.315	9.658	9.658	19.315
1992	1.780	0.198	0.080	0.080	0.080	9.612	4.806	4.806	9.612
1993	2.630	0.292	0.118	0.118	0.118	14.201	7.101	7.101	14.201
1994	2.287	0.254	0.103	0.103	0.103	12.349	6.175	6.175	12.349
1995	2.218	0.246	0.100	0.100	0.100	11.980	5.990	5.990	11.980
1996	2.097	0.233	0.094	0.094	0.094	11.324	5.662	5.662	11.324
1997	3.199	0.355	0.144	0.144	0.144	17.272	8.636	8.636	17.272
1998	2.035	0.226	0.092	0.092	0.092	10.988	5.494	5.494	10.988
1999	2.148	0.238	0.097	0.097	0.097	11.600	5.800	5.800	11.600
2000	1.949	0.216	0.088	0.088	0.088	10.524	5.262	5.262	10.524
2001	1.948	0.216	0.088	0.088	0.088	10.522	5.261	5.261	10.522
2002	2.308	0.256	0.104	0.104	0.104	12.463	6.231	6.231	12.463
2003	2.345	0.260	0.106	0.106	0.106	12.663	6.331	6.331	12.663
2004	2.339	0.260	0.105	0.105	0.105	12.632	6.316	6.316	12.632
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	19.181	9.591	9.591	19.181
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	1.795	0.199	0.081	0.081	0.081	9.694	4.847	4.847	9.694
2013	1.835	0.204	0.083	0.083	0.083	9.908	4.954	4.954	9.908
2014	1.812	0.201	0.082	0.082	0.082	9.786	4.893	4.893	9.786

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

No major improvements are planned for the next submission.



Source: www.public.delfi.ee

5. AGRICULTURE (NFR 3)

Agriculture (NFR 3)

5.1. Overview of the sector

5.1.1. Sources category description

The Estonian inventory of air pollutants from agriculture presently includes emissions from animal husbandry and the application of fertilizers as listed in Table 5.1.

Table 5.1 Reporting activities for the agriculture sector

NFR	Source	Description	Method	Emissions reported
3B1a	Cattle dairy	Includes emissions from dairy cows	Tier 2 / Tier 1	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}
3B1b	Cattle non-dairy	Includes emissions from young cattle, beef cattle and suckling cows	Tier 2 / Tier 1	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}
3B2	Sheep	Includes emissions from sheep and goats	Tier 1	NO _x , NMVOC, NH ₃
3B3	Swine	Includes emissions from fattening pigs and sows	Tier 1	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}
3B4d	Goats	Emissions from this sector are allocated to NFR 3B2	Tier 1	IE
3B4e	Horses	Includes emissions from horses	Tier 1	NO _x , NMVOC, NH ₃ , PM ₁₀ , PM _{2.5}
3B4gi	Laying hens	Includes emissions from laying hens	Tier 1	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}
3B4gii	Broilers	Includes emissions from broilers	Tier 1	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}
3B4giii	Turkeys	Emissions from this sector are allocated to NFR 3B4giv	Tier 1	IE
3B4giv	Other poultry	Includes emission from cocks, ducks, geese and turkeys	Tier 1	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}
3B4h	Manure management - Other animals	Includes emission from foxes, minks, racoons and chinchillas	Tier 1	NO _x , NMVOC, NH ₃ , TSP, PM ₁₀ , PM _{2.5}
3Da1	Synthetic N-fertilizers	Includes emissions from application of nitrogen fertilizers and field	Tier 1	NO _x , NMVOC, NH ₃ , PM ₁₀ , PM _{2.5}
3Da2a	Animal manure applied to soils	NH ₃ emissions from this sector are allocated to NFR 3B1a, 3B1b and 3B2	Tier 2	NH ₃

The share of agriculture sources in total emissions in 2014 was: NO_x – 2.9%, NH₃ – 93.3%, NMVOC – 22.3%, PM₁₀ and TSP – 10.0%. The share of other pollutants was not as significant.

The emissions of NO_x, NH₃ and NMVOC decreased by 50%, 54% and 60% 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 in the 1990s.

In 2014, the emissions of NMVOC, NH₃ and particles increased compared to 2013 by 5%, 3%, and 6% respectively, mainly due to the increase in cattle non-dairy livestock and the use of fertilisers during the same period.

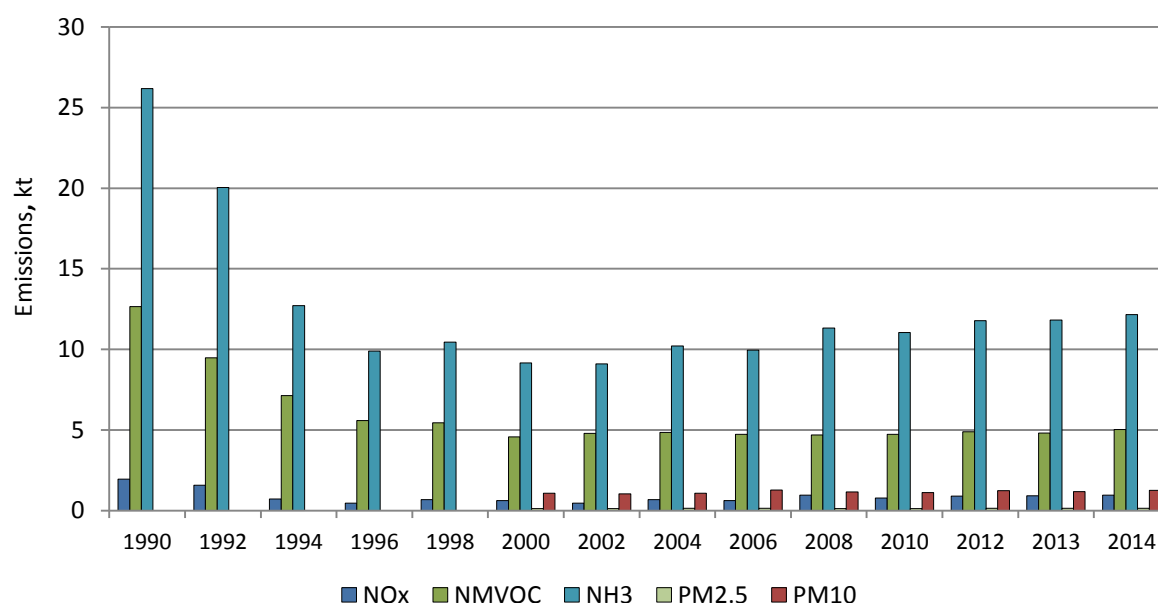


Figure 5.1 NO_x, NH₃, NMVOC, PM_{2.5} and PM₁₀ emissions from the agriculture sector in the period of 1990-2014 (kt)

Table 5.2 Total emissions from the agriculture sector in the period of 1990-2014 (kt)

Year	NO _x	NMVOC	NH ₃	PM _{2.5}	PM ₁₀
1990	1.948	12.653	26.172	NR	NR
1991	1.594	11.696	23.527	NR	NR
1992	1.581	9.478	20.038	NR	NR
1993	0.828	7.518	17.860	NR	NR
1994	0.721	7.134	12.709	NR	NR
1995	0.530	6.451	11.108	NR	NR
1996	0.468	5.581	9.895	NR	NR
1997	0.569	5.524	10.156	NR	NR
1998	0.684	5.453	10.453	NR	NR
1999	0.549	4.652	9.059	NR	NR
2000	0.613	4.577	9.163	0.126	1.077
2001	0.544	4.907	9.336	0.133	1.004
2002	0.468	4.785	9.102	0.130	1.039
2003	0.639	4.903	10.036	0.132	1.042

Year	NO _x	NM VOC	NH ₃	PM _{2.5}	PM ₁₀
2004	0.679	4.852	10.219	0.133	1.076
2005	0.554	4.769	9.645	0.137	1.251
2006	0.619	4.728	9.955	0.135	1.276
2007	0.680	4.675	10.071	0.140	1.383
2008	0.954	4.694	11.331	0.129	1.156
2009	0.741	4.653	10.690	0.128	1.096
2010	0.775	4.728	11.042	0.129	1.111
2011	0.807	4.815	11.275	0.133	1.175
2012	0.890	4.887	11.771	0.138	1.229
2013	0.908	4.800	11.824	0.136	1.177
2014	0.965	5.029	12.165	0.143	1.262
Trend 1990-2014, %	-50.3	-60.3	-53.5	14.0	17.2

The largest part of NH₃ emissions comes from manure management – 72%, and 28% is from the use of synthetic fertilizers (Figure 5.2). The main source of pollution of PM₁₀ is agricultural crop operations – 63% (Figure 5.3).

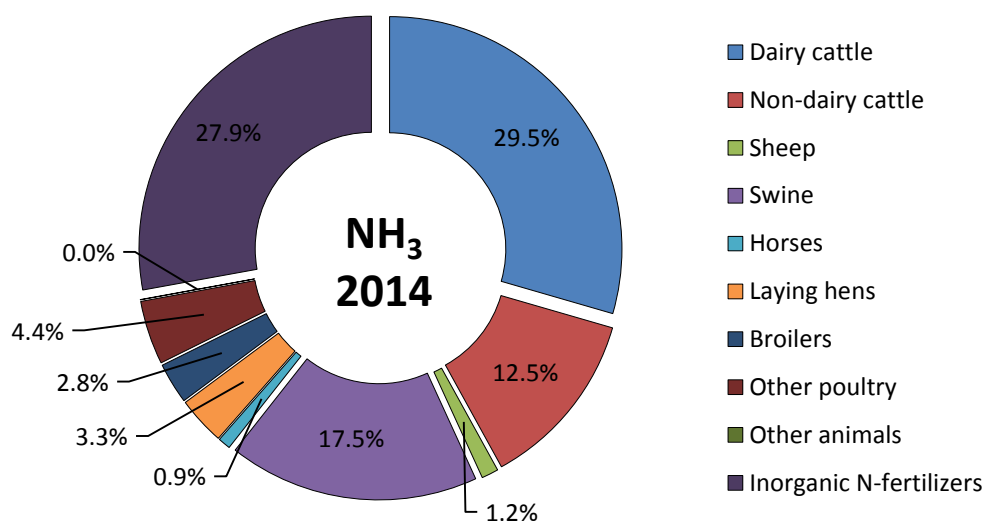


Figure 5.2 NH₃ emission distributions by the agriculture sector activities in 2014

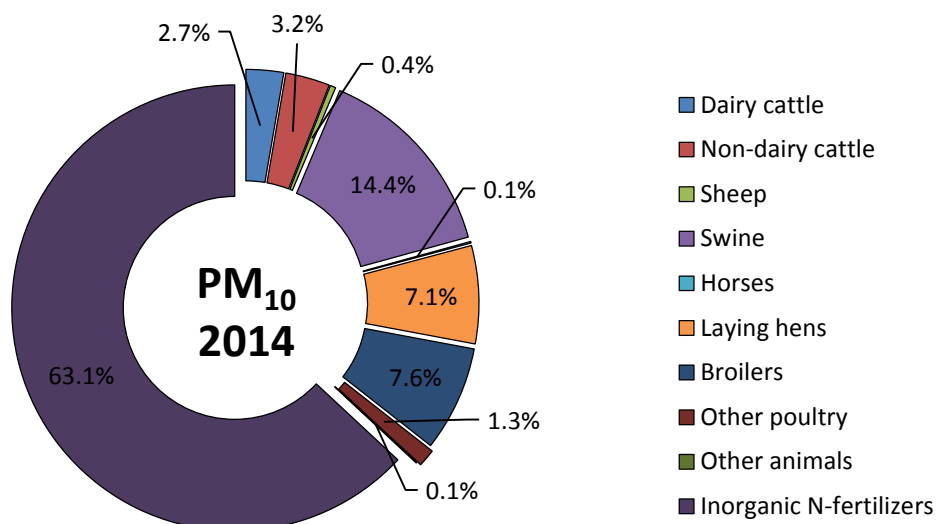


Figure 5.3 PM₁₀ emissions from livestock and agricultural soils in 2014

5.2. Manure Management (NFR 3B)

5.2.1. Source category description

Manure management is the main source of NH₃ emissions in Estonia. The share of manure management in total emissions in 2014 was 60%. 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.



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 Tables 5.3-5.7.

(Manure storage in Ekseko swine farm; source: www.arhliit.ee)

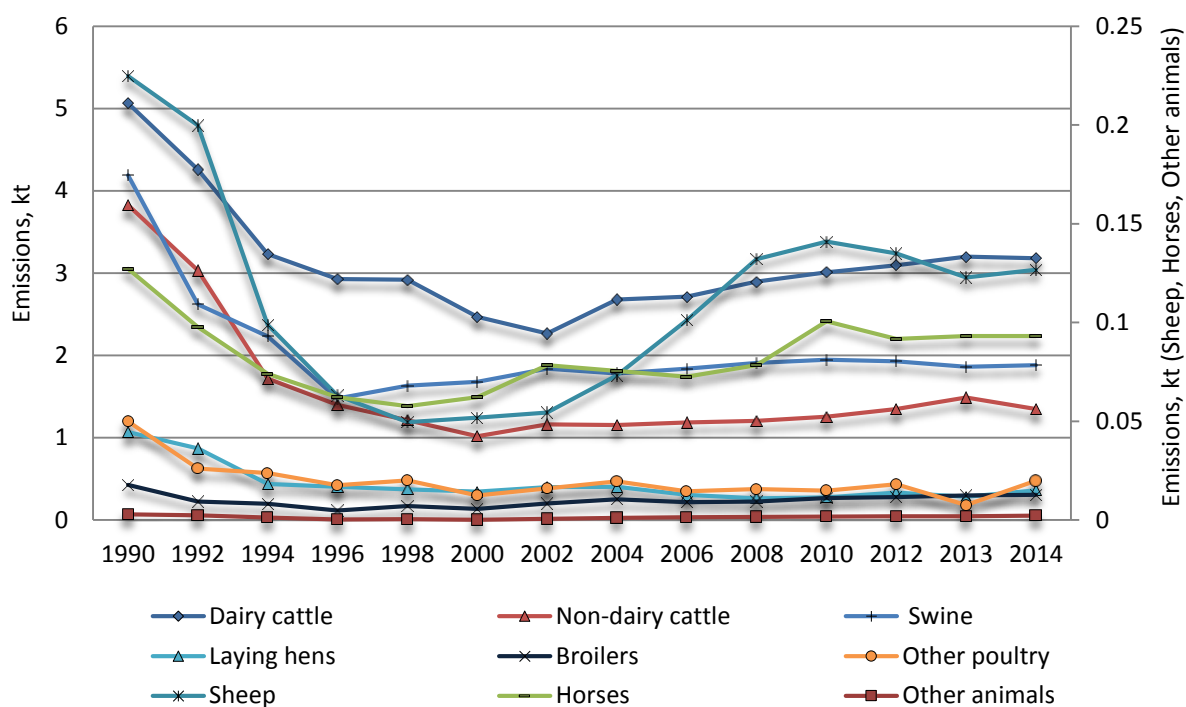


Figure 5.4 NH₃ emissions from manure management in the period of 1990-2014

During the period of 1990-2014, the emission of NH₃ decreased 51.7% (Figure 5.4). The reduction in air pollution was mainly due to the rapid economic changes in agriculture in the 1990s.

In 2014, ammonia emissions have increased compared to 2013 by 3.2%, due to decrease in sheep and poultry livestock during the same period.

Table 5.3 Total emissions of NO_x from manure management in the period of 1990-2014 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry	Other animals
1990	0.030	0.030	0.001	0.008	0.001	0.007	0.002	0.005	0.00003
1991	0.027	0.029	0.001	0.007	0.001	0.005	0.002	0.004	0.00003
1992	0.025	0.024	0.001	0.005	0.001	0.005	0.001	0.003	0.00002
1993	0.022	0.016	0.000	0.004	0.001	0.004	0.001	0.002	0.00002
1994	0.018	0.014	0.000	0.004	0.001	0.003	0.001	0.002	0.00001
1995	0.016	0.012	0.000	0.004	0.001	0.002	0.001	0.002	0.00001
1996	0.017	0.011	0.000	0.003	0.001	0.003	0.001	0.002	0.00000
1997	0.018	0.010	0.000	0.003	0.001	0.002	0.001	0.002	0.00000
1998	0.017	0.010	0.000	0.003	0.001	0.002	0.001	0.002	0.00000
1999	0.015	0.009	0.000	0.003	0.001	0.002	0.001	0.001	0.00000
2000	0.015	0.008	0.000	0.004	0.001	0.002	0.001	0.001	0.00000
2001	0.015	0.009	0.000	0.004	0.001	0.003	0.001	0.001	0.00000
2002	0.015	0.009	0.000	0.004	0.001	0.003	0.001	0.002	0.00001
2003	0.014	0.011	0.000	0.004	0.001	0.002	0.001	0.002	0.00001
2004	0.014	0.009	0.000	0.004	0.001	0.003	0.001	0.002	0.00001
2005	0.013	0.009	0.000	0.004	0.001	0.002	0.001	0.001	0.00002
2006	0.013	0.009	0.000	0.005	0.001	0.002	0.001	0.001	0.00001
2007	0.011	0.009	0.000	0.006	0.001	0.002	0.001	0.001	0.00002

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry	Other animals
2008	0.013	0.009	0.000	0.005	0.001	0.002	0.001	0.002	0.00002
2009	0.012	0.009	0.000	0.004	0.001	0.002	0.001	0.001	0.00002
2010	0.011	0.010	0.001	0.005	0.001	0.002	0.001	0.002	0.00002
2011	0.011	0.010	0.000	0.005	0.001	0.002	0.001	0.002	0.00002
2012	0.012	0.010	0.000	0.004	0.001	0.002	0.001	0.002	0.00002
2013	0.012	0.011	0.000	0.004	0.001	0.002	0.001	0.001	0.00002
2014	0.012	0.010	0.000	0.004	0.001	0.002	0.001	0.002	0.00002
Trend 1990-2014, %	-59.5	-65.5	-43.7	-45.8	-26.8	-66.2	-28.4	-59.9	-33.3

Table 5.4 Total emissions of NMVOC from manure management in the period of 1990-2014 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Laying hens	Broilers	Other poultry	Other animals
1990	3.818	3.531	0.032	3.796	0.367	0.211	0.616	0.283
1991	3.594	3.286	0.033	3.505	0.295	0.179	0.522	0.283
1992	3.446	2.673	0.029	2.371	0.300	0.110	0.322	0.228
1993	3.083	1.750	0.011	1.893	0.199	0.104	0.304	0.173
1994	2.875	1.540	0.014	2.043	0.151	0.098	0.295	0.118
1995	2.521	1.369	0.011	1.970	0.137	0.093	0.274	0.075
1996	2.334	1.268	0.009	1.527	0.139	0.057	0.219	0.028
1997	2.281	1.168	0.008	1.619	0.119	0.056	0.245	0.027
1998	2.157	1.102	0.007	1.688	0.129	0.084	0.248	0.039
1999	1.882	0.954	0.007	1.417	0.131	0.070	0.171	0.021
2000	1.782	0.901	0.007	1.534	0.119	0.067	0.153	0.013
2001	1.749	0.976	0.007	1.722	0.164	0.078	0.176	0.034
2002	1.572	1.023	0.008	1.684	0.138	0.100	0.198	0.063
2003	1.588	1.039	0.008	1.688	0.133	0.119	0.220	0.107
2004	1.584	0.986	0.010	1.653	0.139	0.123	0.242	0.113
2005	1.534	1.012	0.012	1.674	0.120	0.112	0.137	0.169
2006	1.474	1.009	0.014	1.700	0.105	0.106	0.180	0.138
2007	1.401	1.018	0.017	1.814	0.106	0.103	0.062	0.155
2008	1.365	1.018	0.019	1.744	0.091	0.111	0.193	0.152
2009	1.315	1.021	0.019	1.744	0.106	0.117	0.154	0.176
2010	1.312	1.035	0.020	1.780	0.095	0.131	0.184	0.170
2011	1.308	1.052	0.020	1.761	0.094	0.140	0.251	0.189
2012	1.317	1.104	0.019	1.785	0.114	0.137	0.223	0.187
2013	1.331	1.210	0.018	1.712	0.097	0.147	0.094	0.191
2014	1.300	1.251	0.018	1.721	0.124	0.151	0.247	0.216
Trend 1990-2014, %	-65.9	-64.6	-43.6	-54.7	-66.2	-28.4	-59.9	-23.7

Table 5.5 Total emissions of NH₃ from manure management in the period of 1990-2014 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry	Other animals
1990	5.066	3.829	0.225	4.188	0.127	1.068	0.429	1.197	0.003
1991	4.617	3.722	0.230	3.871	0.115	0.859	0.364	1.014	0.003

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry	Other animals
1992	4.258	3.033	0.200	2.620	0.098	0.872	0.225	0.626	0.002
1993	3.782	1.992	0.080	3.782	0.077	0.580	0.212	0.591	0.002
1994	3.232	1.719	0.099	2.234	0.074	0.438	0.199	0.573	0.001
1995	2.868	1.499	0.080	2.168	0.068	0.398	0.190	0.533	0.001
1996	2.930	1.398	0.063	1.480	0.062	0.405	0.116	0.426	0.000
1997	2.996	1.307	0.057	1.532	0.062	0.345	0.114	0.476	0.000
1998	2.920	1.213	0.050	1.633	0.058	0.375	0.171	0.482	0.000
1999	2.510	1.084	0.050	1.557	0.058	0.380	0.142	0.332	0.000
2000	2.471	1.018	0.052	1.682	0.062	0.347	0.136	0.298	0.000
2001	2.267	1.161	0.052	1.841	0.081	0.478	0.159	0.341	0.000
2002	2.267	1.161	0.054	1.841	0.078	0.400	0.203	0.384	0.001
2003	2.560	1.311	0.055	1.839	0.086	0.388	0.243	0.428	0.001
2004	2.679	1.155	0.073	1.781	0.075	0.403	0.251	0.471	0.001
2005	2.686	1.188	0.082	1.827	0.071	0.348	0.227	0.266	0.002
2006	2.716	1.185	0.101	1.839	0.073	0.306	0.216	0.351	0.001
2007	2.619	1.217	0.120	2.037	0.078	0.309	0.210	0.120	0.002
2008	2.896	1.205	0.132	1.911	0.078	0.264	0.227	0.376	0.002
2009	2.936	1.238	0.134	1.894	0.080	0.310	0.238	0.299	0.002
2010	3.009	1.258	0.141	1.950	0.101	0.278	0.267	0.358	0.002
2011	2.985	1.286	0.138	1.929	0.096	0.273	0.286	0.488	0.002
2012	3.097	1.351	0.135	1.931	0.092	0.333	0.279	0.434	0.002
2013	3.203	1.488	0.123	1.864	0.093	0.284	0.300	0.182	0.002
2014	3.183	1.350	0.127	1.884	0.093	0.361	0.308	0.480	0.002
Trend 1990-2014, %	-37.2	-64.7	-43.7	-55.0	-26.7	-66.2	-28.4	-59.9	-23.7

Table 5.6 Total emissions of PM_{2.5} from manure management in the period of 2000-2014 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry
2000	0.030	0.019	0.001	0.024	0.001	0.017	0.006	0.001
2001	0.030	0.021	0.001	0.028	0.001	0.023	0.007	0.001
2002	0.027	0.022	0.001	0.028	0.001	0.019	0.008	0.002
2003	0.027	0.022	0.001	0.028	0.001	0.019	0.010	0.002
2004	0.027	0.021	0.001	0.028	0.001	0.019	0.010	0.002
2005	0.026	0.022	0.001	0.028	0.001	0.017	0.009	0.001
2006	0.025	0.022	0.001	0.028	0.001	0.015	0.009	0.001
2007	0.024	0.022	0.001	0.031	0.001	0.015	0.009	0.001
2008	0.023	0.022	0.002	0.030	0.001	0.013	0.009	0.002
2009	0.022	0.022	0.002	0.030	0.001	0.015	0.010	0.001
2010	0.022	0.022	0.002	0.030	0.001	0.013	0.011	0.002
2011	0.022	0.023	0.002	0.030	0.001	0.013	0.012	0.002
2012	0.022	0.024	0.002	0.030	0.001	0.016	0.011	0.002
2013	0.023	0.026	0.001	0.029	0.001	0.014	0.012	0.001
2014	0.022	0.027	0.002	0.029	0.001	0.017	0.013	0.002
Trend 1990-2014, %	-27.0	38.9	144.5	18.8	75.0	4.0	126.7	61.1

Table 5.7 Total emissions of PM₁₀ from manure management in the period of 2000-2014 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry
2000	0.047	0.029	0.002	0.153	0.001	0.086	0.043	0.010
2001	0.046	0.032	0.002	0.176	0.001	0.118	0.050	0.011
2002	0.042	0.033	0.002	0.173	0.001	0.099	0.064	0.013
2003	0.042	0.034	0.002	0.175	0.001	0.096	0.076	0.014
2004	0.042	0.032	0.003	0.173	0.001	0.100	0.079	0.016
2005	0.041	0.033	0.003	0.176	0.001	0.086	0.071	0.009
2006	0.039	0.033	0.004	0.176	0.001	0.076	0.068	0.012
2007	0.037	0.033	0.005	0.192	0.001	0.077	0.066	0.004
2008	0.036	0.033	0.005	0.185	0.001	0.065	0.071	0.013
2009	0.035	0.033	0.005	0.185	0.001	0.077	0.075	0.010
2010	0.035	0.034	0.006	0.189	0.001	0.069	0.084	0.012
2011	0.035	0.034	0.005	0.186	0.001	0.068	0.090	0.016
2012	0.035	0.036	0.005	0.190	0.001	0.083	0.087	0.015
2013	0.035	0.039	0.005	0.182	0.001	0.070	0.094	0.006
2014	0.034	0.041	0.005	0.182	0.001	0.090	0.096	0.016
Trend 1990-2014, %	-27.0	38.9	144.3	18.6	83.3	4.0	126.7	61.1

5.2.2. Methodological issues

Emission calculations from manure management are based on the Tier 1 and Tier 2 methods from the renewed EMEP/EEA Guidebook 2013 and stem from country-specific values whenever possible. For particles and NMVOC the Tier 1 methods from the EMEP/EEA Guidebook 2013 were used to calculate emissions from manure management of dairy cattle, non-dairy cattle and swine. Tier 1 were also used to calculate emissions from manure management of sheep, horses, 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 general equation:

$$E = AAP_{animal} \times EF_{pollutant\_animal}$$

where

AAP_{animal} - number of animals of a particular category present on average within the year

$EF_{pollutant\_animal}$ - 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 (Table 5.13). According to the EMEP/EEA Guidebook 2013, there are different emission factors for solid and slurry manure types (Table 5.8).

For swine and cattle, old emissions factors from the previous guidebook were used. For other livestock, new EMEP/EEA Guidebook 2013 emissions factors were used when appropriate.

Table 5.8 NO_x, NH₃, 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	0.007	0.154	13.600	39.300	28.700	0.230	0.360	0.799
Cattle non-dairy	0.002	0.094	7.400	13.400	9.200	0.160	0.240	0.533
Sheep and goats		0.005	0.200		1.400	0.017	0.056	0.139
Horses		0.131			14.800	0.140	0.220	0.480
Fattening pigs	0.001		3.900	6.700		0.080	0.500	1.111
Sows	0.004		13.300	15.800		0.090	0.580	1.287
Laying hens		0.003	0.165		0.480	0.023	0.119	0.119
Broilers		0.001	0.108		0.220	0.009	0.069	0.069
Other poultry		0.004	0.489		0.950	0.004	0.032	0.068
Fur animals		0.0002	1.941		0.020	0.004	0.008	0.018

The Tier 2 methods from the renewed EMEP/EEA Guidebook 2013 were used to calculate for NO and NH₃ emission from manure management and from animal manure applied to soils (ammonia emissions under NFR 3D2a) of dairy cattle, non-dairy cattle and swine. For non-dairy cattle and swine category emissions were calculated separately for sub-categories as presented in Tables 5.10 and 5.11. The Tier 2 method uses a mass flow approach based on the concept of a flow of Total Ammoniacal Nitrogen (TAN) through the manure management system. For the calculation method of total annual nitrogen, excretion by the dairy cattle and non-dairy cattle described in Estonian GHG National Inventory Report 2015¹⁹, were used. Result of nitrogen excretion estimation are presented in Tables 5.9 and 5.10. For nitrogen excretion rates from swine (Regulation no 8 of the Minister of Environment, 25.03.2014) were used. For cattle and swine slurry based and solid-manure-based housing types are distinguished. For each stage of manure management the Tier 2 default NH₃-N EFs and default data on proportions of TAN excreta were used. According to the EMEP/EEA Guidebook 2013, there are different emission factors for housing, manure storage and grazing (Table 5.12).

Table 5.9 Nitrogen excretion by Dairy cattle livestock in 1990-2014²⁰

Year	Nitrogen excretion rate, kg N/head/yr
1990	85.0
1991	83.1
1992	80.9
1993	80.5
1994	75.9
1995	76.5
1996	81.8
1997	84.4
1998	86.2
1999	85.3

¹⁹ Estonian GHG National Inventory Report 2015, Ch. 5 Agriculture (CFR 3)

²⁰ https://www.riigiteataja.ee/aktiis/1280/3201/4033/KKM_m8_lisa.pdf

Year	Nitrogen excretion rate, kg N/head/yr
2000	87.7
2001	91.7
2002	91.6
2003	91.6
2004	93.5
2005	94.7
2006	97.1
2007	96.9
2008	107.7
2009	109.4
2010	110.2
2011	110.0
2012	113.1
2013	115.4
2014	117.18

Table 5.10 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 5.11 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

For assessing proportions of different manure management type for different livestock category separately, country specific manure management system (liquid/slurry, solid storage and pasture/range) was used. Detail description of manure management system (MMS) was described in Estonian GHG National Inventory Report 2015. The share of proportion of pasture

was used to calculate the housed period (in days). To calculate the mass of bedding EMEP/EEA Guidebook standards were used.

For further insight regarding the activity data and methodology applied for manure management system and N excretions estimations, see Estonian IIR 1990-2014 submitted under the UNFCCC.

Table 5.12 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	0.190	0.200	0.270	0.000	0.008	0.550	0.790	0.100
Other cattle	0.200	0.190	0.200	0.270	0.000	0.008	0.550	0.790	0.600
Fattening pigs	0.280	0.270	0.140	0.450	0.000	0.008	0.400	0.810	0.000
Sows	0.220	0.025	0.140	0.450	0.000	0.008	0.290	0.810	0.000

Activity data

Information regarding the numbers of livestock in agriculture is available from Statistics Estonia (www.stat.ee) for the years 1990-2014. 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 5.13 Number of livestock (1,000 head)

Year	Cattle dairy	Cattle non-dairy	Sheep	Horses	Fattening pigs	Sows	Laying hens	Broilers	Other poultry	Fur animals
1990	280.7	477.1	160.6	8.6	812.8	47.1	2 224.0	1 951.8	1 259.5	145.6
1991	264.3	444.0	164.0	7.8	757.1	41.5	1 788.9	1 653.7	1 067.2	145.6
1992	253.4	361.2	142.8	6.6	513.4	27.7	1 816.1	1 020.6	658.6	117.4
1993	226.7	236.5	57.2	5.2	399.0	25.3	1 207.8	963.3	621.6	89.1
1994	211.4	208.1	70.7	5.0	433.2	26.6	912.5	904.7	603.1	60.9
1995	185.4	185.0	57.3	4.6	425.4	23.4	828.3	862.2	561.0	38.5
1996	171.6	171.4	45.0	4.2	259.8	38.6	843.4	528.2	448.0	14.3
1997	167.7	157.9	40.9	4.2	261.1	45.2	719.2	517.5	501.4	14.0
1998	158.6	148.9	35.4	3.9	282.3	44.1	780.9	779.1	507.9	19.9
1999	138.4	128.9	35.5	3.9	253.5	32.2	791.7	645.4	349.3	10.6
2000	131.0	121.8	37.0	4.2	261.6	38.6	723.5	616.7	313.5	6.8
2001	128.6	131.9	37.3	5.5	304.9	40.1	995.6	724.9	359.0	17.5
2002	115.6	138.3	38.9	5.3	303.1	37.7	834.3	924.6	404.6	32.3
2003	116.8	140.4	39.4	5.8	308.0	36.6	807.9	1 103.6	450.1	55.2
2004	116.5	133.3	52.3	5.1	305.4	34.7	839.6	1 142.2	495.7	58.4
2005	112.8	136.7	58.6	4.8	312.2	34.3	725.7	1 033.8	279.8	87.2
2006	108.4	136.4	72.2	4.9	308.4	37.4	637.6	980.9	369.0	71.0
2007	103.0	137.5	85.6	5.3	343.3	35.7	643.3	956.0	125.9	80.1
2008	100.4	137.5	94.3	5.3	330.8	34.1	550.1	1 031.0	395.6	78.6
2009	96.7	138.0	95.8	5.4	331.0	34.1	644.8	1 083.2	314.4	90.6

Year	Cattle dairy	Cattle non-dairy	Sheep	Horses	Fattening pigs	Sows	Laying hens	Broilers	Other poultry	Fur animals
2010	96.5	139.8	100.8	6.8	336.6	35.1	578.2	1 212.2	377.2	87.7
2011	96.2	142.1	98.8	6.5	330.1	35.6	568.9	1 298.3	513.7	97.6
2012	96.8	149.2	96.4	6.2	340.8	34.3	693.9	1 267.9	456.5	96.6
2013	97.9	163.5	87.7	6.3	325.4	33.3	590.8	1 361.5	191.5	98.4
2014	95.6	169.1	90.5	6.3	323.3	34.6	752.8	1 398.0	505.1	111.2

5.2.3. Uncertainty

An uncertainty analysis was carried out for the year 2014 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 5.14.

Table 5.14 Uncertainties in agriculture sector

Pollutants	Emissions, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	0.965	kt	2.90	0.17	0.04
NM VOC	5.029	kt	22.34	0.47	0.11
NH ₃	12.165	kt	93.28	0.97	0.30
PM _{2.5}	0.143	kt	1.84	0.14	0.07
PM ₁₀	1.262	kt	10.10	0.32	0.16
TSP	1.605	kt	9.64	0.31	0.07

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 or Tier 3 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 fertilizers and particle emissions from grain fields are reported under NFR 3D1a. NH₃ emissions from animal manure applied to soils are reported under NFR 3D2a.

The share of agricultural soils in total NH₃ emissions in 2014 was 33.5%.

In addition to NH₃, NO_x, NMVOC, PM₁₀ and PM_{2.5} are generated from this sector.

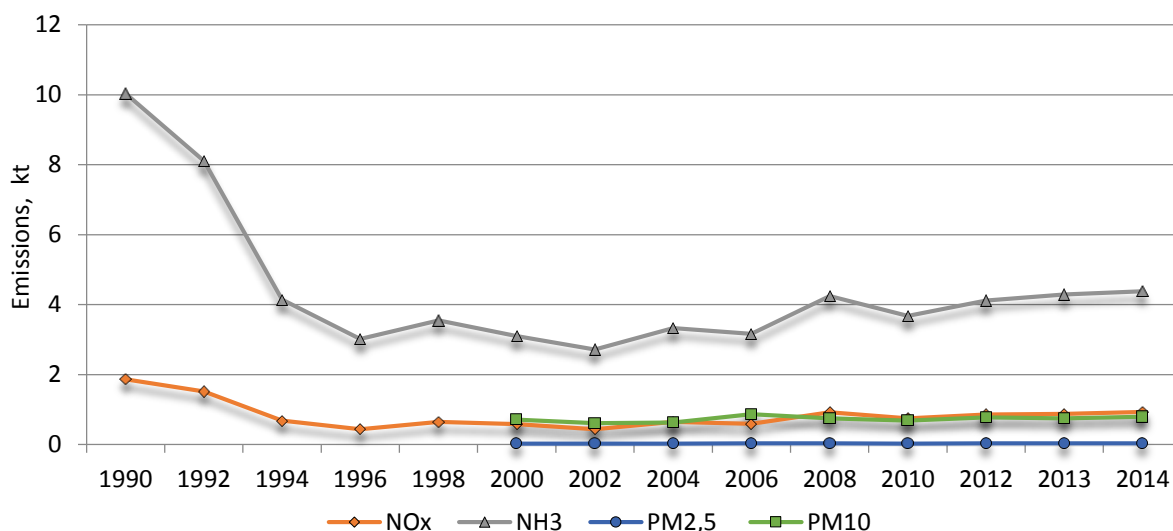


Figure 5.5 NO_x, NH₃, PM₁₀ and PM_{2.5} emissions from agricultural soils in the period of 1990-2014

During the period of 1990-2014, the emission of NH₃ decreased to 56.4% (Figure 5.5), mainly due to changes in Estonian agriculture. All the emission time series are presented in Table 5.15.

In 2014 NO_x and NH₃ emissions increased 2% compared to 2013, mainly due to an increase in the use of fertilisers. The particles emissions have increased by 6%, mainly due to an increase in the use of agricultural soils.

Table 5.15 Total emissions from agricultural soils in the period of 1990-2014 (kt)

Year	NO _x	NH ₃	PM _{2.5}	PM ₁₀
1990	1.864	10.041	NR	NR
1991	1.517	8.733	NR	NR
1992	1.517	8.105	NR	NR
1993	0.779	4.771	NR	NR
1994	0.678	4.141	NR	NR
1995	0.492	3.304	NR	NR
1996	0.431	3.015	NR	NR
1997	0.532	3.266	NR	NR
1998	0.648	3.550	NR	NR
1999	0.517	2.946	NR	NR
2000	0.582	3.098	0.027	0.706
2001	0.510	2.954	0.022	0.567
2002	0.434	2.710	0.024	0.612
2003	0.605	3.126	0.023	0.601
2004	0.646	3.329	0.024	0.631
2005	0.522	2.949	0.032	0.830

Year	NO _x	NH ₃	PM _{2.5}	PM ₁₀
2006	0.588	3.167	0.033	0.867
2007	0.650	3.359	0.037	0.968
2008	0.922	4.241	0.029	0.745
2009	0.711	3.559	0.026	0.674
2010	0.744	3.679	0.026	0.682
2011	0.775	3.792	0.028	0.740
2012	0.857	4.118	0.030	0.776
2013	0.875	4.285	0.029	0.744
2014	0.931	4.377	0.031	0.796
Trend 1990-2014, %	-50.1	-56.4	12.8	12.8

5.3.2. Methodological issues

Emission calculations from agricultural soils are based on the Tier 1 method and emissions from animal manure applied to soils (detail description Ch. 5.2.2.2) are based on the Tier 2 method from the renewed EMEP/EEA Guidebook 2013. There are no default emission factors for TSP in the Guidebook, so the PM₁₀ emission factors were used. The Tier 1 method uses readily available statistical data (Table 5.17) and default emission factors (Table 5.16). Emissions that stem from animal manure applied to soils were previously reported under 3B. Under the NFR 2016 reporting template, these have been split out and included under animal manure applied to soils (3Da2a). This subcategory covers emissions from the application of slurry (as TAN) to land.

Table 5.16 NO_x, NH₃, NMVOC and PM emission factors for agricultural soils

Pollutant	Unit	Value
NO _x	kg kg ⁻¹ fertilizer-N applied	0.026
NMVOC	kg kg ⁻¹ fertilizer-N applied	5.96E-09
NH ₃	kg kg ⁻¹ fertilizer-N applied	0.084
PM _{2.5}	g/ha	0.06
PM ₁₀	g/ha	1.56
TSP	g/ha	1.56

Activity Data

Information regarding synthetic N-fertilizer use and the area covered by these crops is available from Statistics Estonia (www.stat.ee) for the years 1990-2014.

Table 5.17 Synthetic N-fertilizer use and the area covered by these crops in the period of 1990-2014

Year	Synthetic N-fertilizers, tonnes	Area covered by crop, ha
1990	58,360	952,103

Year	Synthetic N-fertilizers, tonnes	Area covered by crop, ha
1991	58,360	754,579
1992	58,360	952,103
1993	29,949	545,833
1994	26,068	517,607
1995	18,905	415,952
1996	16,560	355,638
1997	20,471	422,690
1998	24,932	478,345
1999	19,895	421,067
2000	22,396	452,538
2001	19,603	363,504
2002	16,700	392,196
2003	23,255	384,951
2004	24,833	404,309
2005	20,083	532,319
2006	22,610	556,083
2007	24,982	620,449
2008	35,455	477,786
2009	27,328	432,051
2010	28,628	437,302
2011	29,803	474,102
2012	32,978	497,269
2013	33,659	476,623
2014	35,803	510,317

5.3.3. Uncertainty

An uncertainty analysis was carried for to the year 2014 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 5.14.

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. Sources-specific planned improvements

- Improve data quality to introduce other Tier 2 or Tier 3 methods for emissions estimating which is based on detailed activities data and emission factors.



Source: www.bioneer.ee

6. WASTE (NFR 5)

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.

Table 6.1 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	NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO
5B1	Compost production	Includes point and diffuse sources emissions from the biological treatment of waste – composting	Tier 2 / Tier 3	NMVOC, NH ₃ , CO
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 sources emissions from municipal solid waste (MSW) incineration process with heat recovery (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, 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
5C1biii	Clinical waste incineration	Includes point sources emissions from the incineration of hospital wastes	Tier 2	NO _x , SO _x , NMVOC, NH ₃ , TSP, CO, HM, PAHs Total, HCB, PCBs (all IE under NFR 5C1bi), PCDD/PCDF (expert estimation)
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/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs total, HCB, PCBs
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/PCDF, 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 3	NO _x , NMVOC, SO _x , NH ₃

NFR	Source	Description	Method	Emissions reported
5D2	Industrial wastewater handling	Includes point sources emissions from industrial wastewater handling	Tier 1 / Tier 3	NO _x , NMVOC, SO _x , NH ₃ , TSP, CO
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/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, PAHs total

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 system in EstEA. The emission factors given in EMEP/EEA Guidebook 2013 and expert opinions are used in the additional calculations.

The waste sector in the emissions inventory is mostly an insignificant sector, except dioxin emissions, which in 2014 comprised about 31% of the total dioxin emissions. Over the years that share has been decreasing, reaching the peak of 44.4% in 2002. The main reason for that decrease is over 3 times less unintentional car and building fires in 2014 compared to the year 2002, which is the main source for dioxin emissions in the waste sector.

6.2. Uncertainty

An uncertainty analysis was carried out to the year 2014 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 stationary combustion are given in Table 6.2.

Table 6.2 Uncertainty estimation of the waste sector

Pollutant	Emission, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
NO _x	0.033	kt	0.10	3.16	0.57
NMVOC	0.174	kt	0.77	8.13	6.33
SO _x	0.021	kt	0.05	1.61	0.27
NH ₃	0.088	kt	0.67	5.80	3.93
PM _{2.5}	0.105	kt	1.35	11.64	5.75
PM ₁₀	0.120	kt	0.96	9.81	2.68
TSP	0.136	kt	0.82	9.05	1.38
CO	0.107	kt	0.08	2.06	1.34
Pb	0.336	t	0.92	9.61	3.12
Cd	0.011	t	1.27	11.31	3.65
Hg	0.021	t	3.04	14.93	8.10
PCDD/PCDF	1.214	g I-TEQ	30.88	88.40	23.32
B(a)p	0.00001	t	0.001	0.37	0.30
B(b)f	0.00001	t	0.0004	0.30	0.26
B(k)f	0.00001	t	0.001	0.41	0.29
I(1,2,3-cd)p	0.0000001	t	0.000003	0.03	0

Pollutant	Emission, 2014	Unit	Share in total emission, %	Uncertainty, %	Trend uncertainty 1990-2014, %
HCB	0.008	kg	2.73	25.02	44.98
PCB	0.020	kg	0.48	8.47	2.45

6.3. Solid waste disposal on land (NFR 5A)

6.3.1. Sources category description

This chapter includes emissions from treatment and disposal of municipal, industrial and other solid waste disposal at landfills. This sector, however, is only a minor source of air pollutant emissions. Small quantities of NO_x, NMVOC, SO_x, NH₃ and CO had been emitted. Also, particulate emissions from waste handling are generated.

Table 6.3 Emissions from solid waste disposal on land in the period of 1990-2014

Year	NO _x	NMVOC	SO _x	CO	NH ₃	PM _{2.5}	PM ₁₀	TSP
	kt				t			
1990	NA	1.213	NA	NE	NE	NR	NR	0.360
1991	NA	1.201	NA	NE	NE	NR	NR	0.356
1992	NA	1.189	NA	NE	NE	NR	NR	0.353
1993	NA	1.214	NA	NE	NE	NR	NR	0.360
1994	NA	0.980	NA	NE	NE	NR	NR	0.291
1995	NA	1.107	NA	NE	NE	NR	NR	0.329
1996	NA	1.138	NA	NE	NE	NR	NR	0.338
1997	NA	1.285	NA	NE	NE	NR	NR	0.382
1998	NA	1.032	NA	NE	NE	NR	NR	0.306
1999	NA	1.004	NA	NE	NE	NR	NR	0.298
2000	NA	0.810	NA	NE	NE	0.017	0.114	0.240
2001	NA	0.913	NA	NE	NE	0.019	0.128	0.271
2002	NA	0.944	NA	NE	NE	0.020	0.133	0.280
2003	NA	1.104	NA	NE	NE	0.023	0.152	0.322
2004	NA	0.896	NA	NE	NE	0.019	0.126	0.266
2005	NA	0.789	NA	NE	NE	0.017	0.111	0.234
2006	NA	0.766	NA	NE	NE	0.016	0.108	0.227
2007	NA	0.817	NA	NE	NE	0.017	0.115	0.243
2008	NA	0.699	NA	NE	NE	0.085	0.237	0.485
2009	NA	0.569	NA	0.024	0.038	0.012	0.077	0.173
2010	NA	0.508	NA	NE	0.025	0.011	0.071	0.209
2011	NA	0.493	NA	NE	0.025	0.010	0.311	0.920
2012	NA	0.318	NA	NE	0.025	0.007	0.327	0.951
2013	0.004	0.175	0.005	0.012	0.025	0.004	0.267	0.825
2014	0.005	0.139	0.006	0.014	0.025	0.003	0.285	0.984

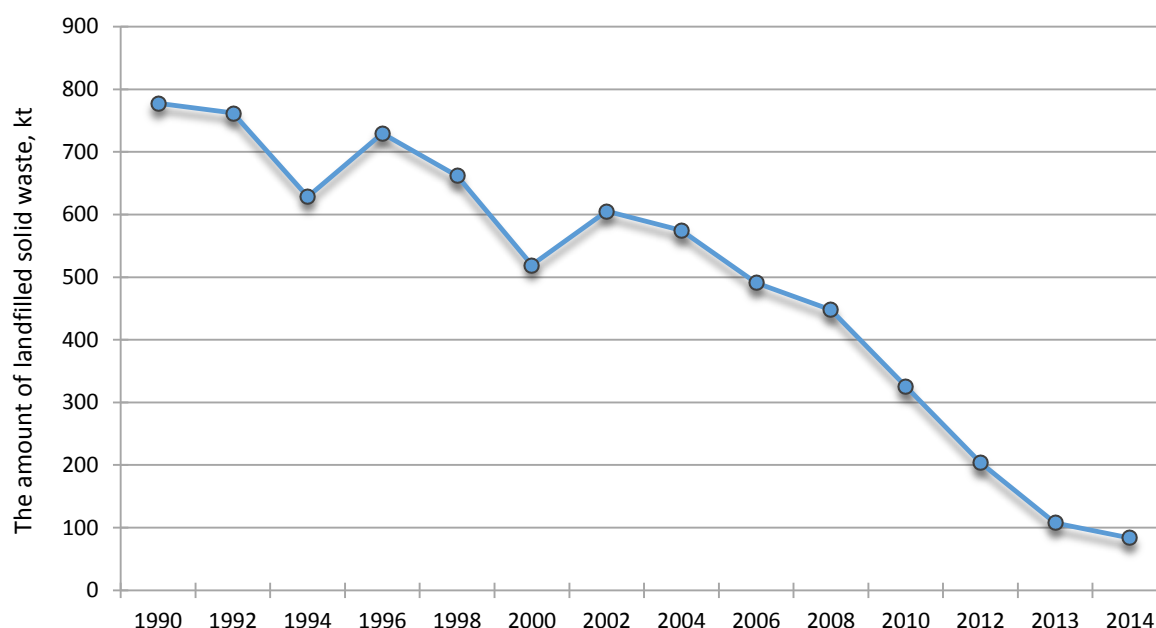


Figure 6.1 The amount of landfilled solid waste in the period of 1990-2014 (kt)

Recalculations

For the period of 1990-2013 NMVOC, TSP, PM_{2.5} and PM₁₀ emissions were additionally calculated or recalculated for some of the later years according to the landfilled solid waste data gathered from the waste management system in EstEA. Detailed overview of the updated data is given in Chapter 8.

6.3.2. Methodological issues

For diffuse sources EMEP/EEA Guidebook 2013 Tier 1 methodology is used for calculating NMVOC and particulate emissions. The annual amount of landfilled solid waste is gathered from the waste management system.

Also some point sources emissions from OSIS database, reported by operators, are used. In 2014 there were 7 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. Sources-specific planned improvements

Emission calculations from landfills by using data from the waste management system.

6.4. Biological treatment of waste (NFR 5B)

6.4.1. Sources category description

This chapter covers the emissions from the biological treatment of waste – compost production (NFR 5B1) and anaerobic digestion at biogas facilities (NFR 5B2). Small quantities of NMVOC, NH₃ and CO may be emitted.

Table 6.4 Emissions of NH₃ from compost production in the period of 1990-2014 (kt)

Year	NMVOC	NH ₃	CO
1990	NE	0.004	0.004
1991	NE	0.005	0.004
1992	NE	0.005	0.004
1993	NE	0.005	0.004
1994	NE	0.005	0.005
1995	NE	0.006	0.005
1996	NE	0.004	0.003
1997	NE	0.007	0.006
1998	NE	0.001	0.001
1999	NE	0.004	0.004
2000	NE	0.013	0.011
2001	NE	0.012	0.010
2002	NE	0.011	0.009
2003	NE	0.044	0.038
2004	NE	0.050	0.043
2005	0.001	0.069	0.059
2006	0.003	0.076	0.065
2007	0.004	0.123	0.104
2008	0.003	0.137	0.116
2009	0.004	0.153	0.129
2010	0.004	0.144	0.122
2011	0.004	0.104	0.088
2012	0.004	0.098	0.083
2013	0.004	0.119	0.101
2014	0.004	0.086	0.078

Table 6.5 Emissions from anaerobic digestion at biogas facilities in 2013 and 2014

Year	NO _x	NH ₃	CO	NMVOC	SO ₂	TSP
	kt			t		
2013	0.008	0.000	0.008	0.676	0.348	0.011
2014	0.007	0.000	0.008	0.590	0.290	0.012

Recalculations

NH₃ emissions in composting sector are recalculated for the periods 1990-1991, 2005-2009 and 2012-2013. Additionally are calculated NMVOC emissions for the period 2005-2013 and CO emissions for the period 1990-2013. An overview of the updated data is given in Chapter 8.

6.4.2. Methodological issues

Point sources emissions are based on operator reports. In 2014 there were 5 anaerobic digestion operators and 2 composting operators.

Additional data to calculate diffuse sources emissions of NH₃ and CO in compost production sector are obtained from the waste management system. For these calculations, the Tier 2 method is used. Default emission factor for NH₃ and CO are obtained from the EMEP/EEA Guidebook 2013 (Table 6.6).

Table 6.6 Emission factor for composting

Pollutant	Unit	Value
NH ₃	kg/Mg waste	0.66
CO	kg/Mg waste	0.56

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. Sources-specific planned improvements

Specify activity data and make recalculations, if necessary.

6.5. Waste incineration (NFR 5C)

6.5.1. Sources 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 will end in Estonia because for the first time the waste that previously

went into landfills can 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 emission that occur in the process are reported in the combustion sector (NFR 1A1a).

The next Table 6.7 will give overview of emissions from industrial waste incineration in the period of 1990-2014.

Table 6.7 Emissions from industrial waste incineration in the period of 1990-2014

Year	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
	kt			t					kt
2000	NA	NA	NA	NA	NA	NA	NA	NR	NA
2001	IE	IE	IE	IE	IE	IE	IE	NR	IE
2002	IE	IE	IE	IE	IE	IE	IE	NR	IE
2003	NA	NA	0.010	NA	NE	NE	4.000	NE	0.020
2004	NA	0.010	0.050	NA	NA	NA	NA	NA	NA
2005	NA	0.010	0.020	NA	NA	NA	NA	NA	NA
2006	NA	NA	NA	NE	NA	NA	NA	NA	NA
2007	NA	NA	0.010	NA	NA	NA	NA	NA	NA
2008	0.006	0.0004	0.005	NA	0.022	0.039	0.055	0.001	0.003
2009	0.016	0.001	0.017	0.118	0.042	0.074	0.106	0.001	0.013
2010	0.016	0.005	0.010	0.229	0.065	0.113	0.162	0.002	0.015
2011	0.014	0.028	0.010	0.108	0.324	0.402	0.583	0.011	0.015
2012	0.011	0.0006	0.050	0.300	0.076	0.133	0.190	0.003	0.005
2013	0.006	0.0006	0.039	0.137	0.031	0.053	0.076	0.001	0.002
2014	0.007	0.0005	0.006	0.246	0.052	0.092	0.131	0.002	0.003

Table 6.7 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn	PCDD/ PCDF	PAHs total	PCBs
	kg								g I-Teq	kg	
2000	NA	NA	NA	NE	NE	NE	NE	NE	0.120	NA	NE
2001	IE	IE	IE	IE	IE	IE	IE	IE	0.140	NA	NE
2002	IE	IE	IE	IE	IE	IE	IE	IE	0.080	NA	NA
2003	NE	NE	NE	NE	NE	NE	NE	NE	NA	NA	NA
2004	240.000	NA	NA	NA	NA	NA	NA	NA	0.160	NA	NE
2005	270.000	NA	NA	NA	NA	NA	NA	NE	0.120	NA	NE
2006	210.000	NA	NA	NA	NA	NA	NA	NA	0.010	NA	NE
2007	NA	NA	NA	NA	NA	NA	NA	NA	0.260	NA	NA
2008	NA	NA	NA	NA	NA	3.000	NA	NA	0.430	NA	NA
2009	NA	NA	NA	NA	NA	24.000	NA	NA	0.508	NA	NA
2010	NA	NA	NA	NA	NA	9.400	NA	NA	0.255	NA	NA
2011	0.048	0.000	0.000	0.029	0.010	8.923	0.019	0.029	0.295	0.085	NA
2012	NA	NA	NA	NA	NA	7.200	NA	NA	0.140	NA	NA
2013	NA	NA	NA	NA	NA	9.500	NA	NA	0.220	NA	NA
2014	NA	NA	NA	NA	NA	6.000	NA	NA	0.250	NA	NA

Table 6.8 Emissions from clinical waste incineration in the period of 1990-2014

Year	PCDD/PCDF	PCBs
	g I-TEQ	kg
1990	0.470	NE
1991	0.470	NE
1992	0.460	NA
1993	0.450	NA
1994	0.440	NA
1995	0.430	NA
1996	0.430	NA
1997	0.620	NA
1998	0.560	NA
1999	0.290	NA
2000	0.280	NE
2001	0.220	NE
2002	0.540	NE
2003	0.483	0.001
2004	0.500	NE
2005	0.520	NE
2006	0.040	NE
2007	0.040	NA
2008	0.026	NA
2009	0.074	NA
2010	0.066	NA
2011	0.066	IE
2012	0.068	IE
2013	0.017	IE
2014	0.073	IE

Table 6.9 Pollutants emissions from cremation in the period of 1993-2014

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
1994	0.436	0.007	0.060	NA	NR	NR	0.020	NR	0.074
1995	0.723	0.011	0.099	NA	NR	NR	0.034	NR	0.123
1996	1.039	0.016	0.142	NA	NR	NR	0.049	NR	0.176
1997	1.534	0.024	0.210	NA	NR	NR	0.072	NR	0.260
1998	1.974	0.031	0.270	NA	NR	NR	0.092	NR	0.335
1999	2.383	0.038	0.326	NA	NR	NR	0.111	NR	0.404
2000	2.527	0.040	0.346	NA	0.106	0.106	0.118	NE	0.429
2001	2.937	0.046	0.402	NA	0.124	0.124	0.137	NE	0.498
2002	3.305	0.052	0.453	NA	0.139	0.139	0.154	NE	0.561
2003	3.647	0.057	0.500	NA	0.153	0.153	0.170	NE	0.619
2004	3.968	0.063	0.544	NA	0.167	0.167	0.185	NE	0.673
2005	3.920	0.062	0.537	NA	0.165	0.165	0.183	NE	0.665
2006	4.325	0.068	0.592	NA	0.182	0.182	0.202	NE	0.734
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	5.777	0.091	0.791	1.678	0.243	0.243	0.270	NE	0.980
2012	6.046	0.095	0.828	0.004	0.254	0.254	0.283	NE	1.026

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2013	6.071	0.096	0.832	0.007	0.255	0.255	0.284	NE	1.030
2014	6.202	0.098	0.850	0.007	0.261	0.261	0.290	NE	1.053

Table 6.9 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	kg								
1993	0.001	0.0002	0.058	0.001	0.001	0.0005	0.001	0.001	0.006
1994	0.016	0.003	0.787	0.007	0.007	0.007	0.009	0.010	0.085
1995	0.026	0.004	1.305	0.012	0.012	0.011	0.015	0.017	0.140
1996	0.038	0.006	1.876	0.017	0.017	0.016	0.022	0.025	0.202
1997	0.056	0.009	2.770	0.025	0.025	0.023	0.032	0.037	0.298
1998	0.072	0.012	3.566	0.033	0.032	0.030	0.041	0.047	0.383
1999	0.087	0.015	4.303	0.039	0.039	0.036	0.050	0.057	0.462
2000	0.092	0.015	4.564	0.042	0.042	0.038	0.053	0.061	0.490
2001	0.107	0.018	5.304	0.048	0.048	0.044	0.062	0.070	0.570
2002	0.120	0.020	5.969	0.055	0.054	0.050	0.069	0.079	0.641
2003	0.133	0.022	6.587	0.060	0.060	0.055	0.077	0.087	0.708
2004	0.144	0.024	7.167	0.065	0.065	0.060	0.083	0.095	0.770
2005	0.143	0.024	7.079	0.065	0.064	0.059	0.082	0.094	0.761
2006	0.157	0.026	7.811	0.071	0.071	0.065	0.091	0.104	0.839
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	0.210	0.035	10.434	0.095	0.095	0.087	0.121	0.139	1.121
2012	0.220	0.037	10.919	0.100	0.099	0.091	0.127	0.145	1.173
2013	0.221	0.037	10.965	0.100	0.100	0.091	0.128	0.146	1.178
2014	0.226	0.038	11.202	0.102	0.102	0.093	0.130	0.149	1.204

Table 6.9 continues

Year	PCDD/ PCDF	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	0.0005	0.0003	0.0003	0.0003	0.006	0.016
1994	0.014	0.0070	0.0038	0.0034	0.0037	0.079	0.216
1995	0.024	0.0116	0.0063	0.0056	0.0061	0.131	0.359
1996	0.034	0.0166	0.0091	0.0081	0.0088	0.189	0.516
1997	0.050	0.0245	0.0134	0.0120	0.0130	0.279	0.762
1998	0.065	0.0316	0.0173	0.0154	0.0167	0.359	0.981
1999	0.078	0.0381	0.0208	0.0186	0.0202	0.433	1.184
2000	0.083	0.0404	0.0221	0.0197	0.0214	0.459	1.256
2001	0.096	0.0470	0.0257	0.0229	0.0249	0.534	1.460
2002	0.108	0.0529	0.0289	0.0258	0.0280	0.601	1.642
2003	0.119	0.0584	0.0319	0.0285	0.0309	0.663	1.813
2004	0.130	0.0635	0.0347	0.0310	0.0336	0.722	1.972
2005	0.128	0.0627	0.0343	0.0306	0.0332	0.713	1.948
2006	0.142	0.0692	0.0378	0.0338	0.0366	0.786	2.149
2007	0.151	0.0740	0.0404	0.0361	0.0392	0.840	2.297
2008	0.151	0.0739	0.0404	0.0361	0.0392	0.840	2.297
2009	0.155	0.0757	0.0413	0.0369	0.0401	0.860	2.351
2010	0.168	0.0820	0.0448	0.0400	0.0434	0.932	2.547
2011	0.189	0.0924	0.0505	0.0451	0.0490	1.050	2.871
2012	0.198	0.0967	0.0528	0.0472	0.0512	1.099	3.004

Year	PCDD/ PCDF	PAHs				HCB	PCBs
		B(a)p	B(b)f	B(k)f	I(1,2,3- cd)p		
	mg I-TEQ	g					
2013	0.199	0.0971	0.0531	0.0474	0.0514	1.104	3.017
2014	0.203	0.0992	0.0542	0.0484	0.0526	1.128	3.082

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 Tables 6.10-11. 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 (tonnes)

Year	Total MSW	MSW burned
1990	382,150.6	7,643.0
1991	382,150.6	7,643.0
1992	432,580.0	8,651.6
1993	371,770.0	7,435.4
1994	472,639.3	9,452.8
1995	522,097.2	10,441.9
1996	564,703.6	11,294.1
1997	593,258.1	11,865.2
1998	557,157.1	11,143.1
1999	564,264.7	11,285.3
2000	570,582.4	11,411.6
2001	398,710.1	7,974.2
2002	431,674.7	8,633.5
2003	451,115.8	9,022.3
2004	470,851.1	4,708.5
2005	465,437.9	4,654.4
2006	470,257.1	4,702.6
2007	395,304.7	3,953.0
2008	365,630.1	3,656.3
2009	310,382.1	3,103.8
2010	289,423.3	2,894.2
2011	292,716.2	2,927.2
2012	277,826.1	2,778.3
2013	294,720.2	2,947.2
2014	322,484.8	3,224.8

Table 6.11 Pollutants emissions from domestic waste burning in the period of 1990-2014

Year	NO _x	NMVOC	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
1991	13.757	0.153	12.993	NR	NR	139.867	NR	5.350
1992	15.573	0.173	14.708	NR	NR	158.324	NR	6.056
1993	13.384	0.149	12.640	NR	NR	136.068	NR	5.205
1994	17.015	0.189	16.070	NR	NR	172.986	NR	6.617
1995	18.795	0.209	17.751	NR	NR	191.088	NR	7.309
1996	20.329	0.226	19.200	NR	NR	206.682	NR	7.906
1997	21.357	0.237	20.171	NR	NR	217.132	NR	8.306
1998	20.058	0.223	18.943	NR	NR	203.920	NR	7.800
1999	20.314	0.226	19.185	NR	NR	206.521	NR	7.900
2000	20.541	0.228	19.400	104.987	156.340	208.833	3.675	7.988
2001	14.354	0.159	13.556	73.363	109.247	145.928	2.568	5.582
2002	15.540	0.173	14.677	79.428	118.279	157.993	2.780	6.043
2003	16.240	0.180	15.338	83.005	123.606	165.108	2.905	6.316
2004	8.475	0.094	8.004	43.318	64.507	86.166	1.516	3.296
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	5.805	0.064	5.482	29.669	44.180	59.015	1.038	2.257

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
1991	794.873	25.986	21.400	16.356	1.414	0.711	0.917	6.879
1992	899.766	29.415	24.224	18.514	1.601	0.805	1.038	7.786
1993	773.282	25.280	20.819	15.912	1.376	0.691	0.892	6.692
1994	983.090	32.139	26.468	20.229	1.749	0.879	1.134	8.508
1995	1,085.962	35.503	29.237	22.346	1.932	0.971	1.253	9.398
1996	1,174.584	38.400	31.623	24.169	2.089	1.050	1.355	10.165
1997	1,233.977	40.342	33.222	25.391	2.195	1.103	1.424	10.679
1998	1,158.887	37.887	31.201	23.846	2.061	1.036	1.337	10.029
1999	1,173.670	38.370	31.599	24.151	2.088	1.050	1.354	10.157
2000	1,186.811	38.800	31.953	24.421	2.111	1.061	1.369	10.270
2001	829.317	27.112	22.328	17.065	1.475	0.742	0.957	7.177

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
kg								
2002	897.883	29.354	24.174	18.476	1.597	0.803	1.036	7.770
2003	938.321	30.676	25.262	19.308	1.669	0.839	1.083	8.120
2004	489.685	16.009	13.184	10.076	0.871	0.438	0.565	4.238
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	335.384	10.964	9.030	6.901	0.597	0.300	0.387	2.902

Table 6.11 continues

Year	PCDD/ PCDF	B(a)p	B(b)f	B(k)f	HCB	PCB
g I-TEQ		kg				
1990	0.306	0.032	0.024	0.024	0.015	0.041
1991	0.306	0.032	0.024	0.024	0.015	0.041
1992	0.346	0.036	0.028	0.027	0.017	0.046
1993	0.297	0.031	0.024	0.023	0.015	0.039
1994	0.378	0.040	0.030	0.029	0.019	0.050
1995	0.418	0.044	0.033	0.032	0.021	0.055
1996	0.452	0.047	0.036	0.035	0.023	0.060
1997	0.475	0.050	0.038	0.037	0.024	0.063
1998	0.446	0.047	0.036	0.035	0.022	0.059
1999	0.451	0.047	0.036	0.035	0.023	0.060
2000	0.456	0.048	0.037	0.035	0.023	0.060
2001	0.319	0.033	0.026	0.025	0.016	0.042
2002	0.345	0.036	0.028	0.027	0.017	0.046
2003	0.361	0.038	0.029	0.028	0.018	0.048
2004	0.188	0.020	0.015	0.015	0.009	0.025
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	0.129	0.014	0.010	0.010	0.006	0.017

6.5.2. Methodological issues

Emissions from cremation, 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/PCDF emissions from clinical and industrial waste incineration are calculated. In these calculations, data from the waste data management system were used.

UNEP Standardized Toolkit emission factors were used in the calculation of dioxin 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 total amount of municipal waste and from 2004 – 1% of MSW) and EMEP/EEA Guidebook 2013 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 (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
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/PCDF	µg/Mg waste	40
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. Sources-specific planned improvements

Specify activity data and make recalculations, if necessary.

6.6. Waste water handling (NFR 5D)

6.6.1. Sources category description

This chapter covers emissions from domestic and industrial wastewater handling. 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 2013 and 2014

Year	NO _x	NMVOC	SO _x	NH ₃
2013	0.128	0.051	0.068	0.173
2014	0.128	0.033	0.068	0.032

Table 6.14. Emissions from industrial wastewater handling in the period of 1994-2014 (t)

Year	NO _x	NMVOC	SO _x	NH ₃	CO
1994	NA	29.427	NA	NA	NA
1995	NA	27.735	NA	NA	NA
1996	NA	25.373	NA	NA	NA
1997	NA	25.296	NA	NA	NA
1998	NA	25.059	NA	NA	NA
1999	NA	22.984	NA	NA	NA
2000	NA	22.428	NA	NA	NA
2001	NA	22.628	NA	NA	NA
2002	NA	21.408	NA	NA	NA
2003	NA	24.411	NA	NA	NA
2004	NA	27.123	NA	NA	NA
2005	NA	24.296	NA	NA	NA
2006	NA	24.225	NA	0.000	NA
2007	NA	28.204	NA	NA	NA
2008	1.234	24.886	0.124	0.979	0.790
2009	0.444	22.173	0.124	1.074	6.335
2010	0.441	28.490	0.126	0.426	NA
2011	0.444	28.995	0.124	0.229	NA

Year	NO _x	NMVOC	SO _x	NH ₃	CO
2012	0.441	25.478	0.125	0.318	NA
2013	1.236	26.936	1.763	0.149	NA
2014	1.486	26.432	2.183	0.134	0.547

6.6.2. Methodological issues

Emissions from waste water handling are based on data from facilities. In 2014 there were 7 operators.

In addition to the facility data, NMVOC emissions are based on the 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 1994.

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. Sources-specific planned improvements

Emission calculations from waste water treatment by using data from the waste management system. Also, specify data for latrines.

6.7. Other waste (NFR 5E)

6.7.1. Sources category description

This chapter covers emissions from other waste, which includes data from facilities (3 operators in 2014) and from car fires, detached and undetached house fires, apartment and industrial building fires. Detailed data about fires is obtained from Estonian Rescue Board and is available since 1998.

Recalculations

There are minor recalculations for the years 2004, 2012 and 2013. An overview of the updated data is given in Chapter 8.

Table 6.15. Emissions from other waste in the period of 1998-2014

Year	NO _x	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	CO
	t				kt			t
1998	NA	NA	NA	NA	NR	NR	0.209	NA
1999	NA	NA	NA	NA	NR	NR	0.208	NA
2000	NA	NA	NA	NA	0.200	0.200	0.200	NA

Year	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	CO
	t				kt			t
2001	NA	NA	NA	NA	0.202	0.202	0.202	NA
2002	NA	NA	NA	NA	0.208	0.208	0.208	NA
2003	NA	NA	NA	NA	0.182	0.182	0.182	NA
2004	NA	NA	NA	NA	0.161	0.161	0.161	NA
2005	NA	NA	NA	NA	0.170	0.170	0.170	NA
2006	NA	NA	NA	NA	0.172	0.172	0.172	NA
2007	NA	NA	NA	NA	0.153	0.153	0.153	NA
2008	NA	5.409	NA	NA	0.138	0.138	0.138	NA
2009	NA	3.692	NA	NA	0.129	0.129	0.129	NA
2010	0.475	5.035	NA	NA	0.099	0.099	0.099	0.475
2011	1.329	6.022	0.068	NA	0.091	0.091	0.091	1.444
2012	3.534	6.786	0.276	1.280	0.091	0.091	0.091	3.727
2013	1.797	4.878	0.018	1.137	0.075	0.075	0.075	0.247
2014	0.317	3.523	NA	1.780	0.075	0.075	0.075	NA

Table 6.15 continues

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
	kg							
1998	0.611	1.230	1.230	1.942	1.853	4.318	NA	NA
1999	0.609	1.227	1.227	1.939	1.850	4.310	NA	NA
2000	0.583	1.175	1.175	1.856	1.770	4.126	NA	NA
2001	0.589	1.186	1.186	1.873	1.787	4.164	NA	NA
2002	0.607	1.222	1.222	1.931	1.842	4.292	NA	NA
2003	0.533	1.074	1.074	1.697	1.619	3.773	NA	NA
2004	0.470	0.948	0.948	1.497	1.428	3.327	NA	NA
2005	0.496	0.998	0.998	1.576	1.504	3.505	NA	NA
2006	0.503	1.013	1.013	1.600	1.527	3.559	NA	NA
2007	0.449	0.904	0.904	1.431	1.365	3.175	NA	NA
2008	0.403	0.811	0.811	1.281	1.222	2.849	NA	NA
2009	0.376	0.756	0.756	1.194	1.139	2.656	NA	NA
2010	0.288	0.580	0.580	0.916	0.874	2.038	NA	NA
2011	0.264	0.532	0.532	0.839	0.800	1.867	NA	NA
2012	0.865	0.531	0.690	0.839	0.799	1.867	0.0007	0.0010
2013	0.906	0.497	0.581	0.688	0.656	1.530	0.0004	0.0006
2014	0.217	0.439	0.439	0.694	0.664	1.548	NA	NA

Table 6.15 continues

Year	PCDD/PCDF	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p
	g I-TEQ	g			
1998	2.101	NA	NA	NA	NA
1999	2.103	NA	NA	NA	NA
2000	2.012	NA	NA	NA	NA
2001	2.034	NA	NA	NA	NA
2002	2.094	NA	NA	NA	NA
2003	1.841	NA	NA	NA	NA
2004	1.628	NA	NA	NA	NA
2005	1.711	NA	NA	NA	NA
2006	1.740	NA	NA	NA	NA
2007	1.545	NA	NA	NA	NA
2008	1.396	NA	NA	NA	NA
2009	1.301	NA	NA	NA	NA
2010	0.999	NA	NA	NA	NA
2011	0.920	NA	NA	NA	NA
2012	0.919	1.100	1.400	0.900	5.000
2013	0.757	0.600	0.700	0.400	0.200
2014	0.762	NA	NA	NA	NA

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 Tier 2 method giving default emission factors. In this calculation, data from the Estonian Rescue Board were used.

Table 6.16 Emission factors for other waste sector

Category	PM _{2.5}	PM ₁₀	TSP	Pb	Cd	Hg	As	Cr	Cu	PCDD/PCDF
	kg/fire			mg/fire						µg/fire
Car fire	2.3	2.3	2.3							48
Detached house fire	143.82	143.82	143.82	420	850	850	1350	1290	2990	1440
Undetached house fire	61.62	61.62	61.62	180	360	360	580	550	1280	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

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. Sources-specific planned improvements

Specify activity data and make recalculations if necessary.



Golden Spring Morning (*Photo by Sven Začek*)

Nature Year Photo 2011

7. OTHER AND NATURAL EMISSIONS (NFR 6 & 11)

Other and natural emissions (NFR 6 & 11)

7.1. Overview of the sector

The emissions are not included in the present inventory.



Source: www.driverlayer.com

8. RECALCULATIONS AND IMPROVEMENTS

Recalculations and improvements

The latest recalculations in the emission inventory were done for the time period from 1990 to 2013. 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 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 2015 and 2016 are made by using exact calculation numbers.

1A2gviii Stationary combustion in manufacturing industries and construction: Other

1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals

In comparison with the previous submission, the emissions of main pollutants and heavy metals were recalculated for period 2000-2012, namely, the emissions from mineral products activities were extracted from NFR 1A2giii and allocated to the sector NFR 1A2f.

The differences in emissions between 2015 and 2016 submissions are presented in Tables 8.1 and 8.2.

Table 8.1 The differences in Stationary combustion in manufacturing industries and construction (NFR 1A2giii) emissions (kt) for the year 2000-2012 between 2015 and 2016 submissions (%)

Year	NO _x			NMVOC			SO ₂		
	2015	2016	%	2015	2016	%	2015	2016	%
2000	2.470	0.844	-65.8	0.130	0.112	-13.6	10.090	9.150	-9.3
2001	2.570	1.303	-49.3	0.420	0.387	-7.9	11.640	11.376	-2.3
2002	2.160	1.168	-45.9	0.930	0.891	-4.2	11.860	9.521	-19.7
2003	2.370	1.299	-45.2	0.950	0.925	-2.7	11.450	8.185	-28.5
2004	2.190	1.235	-43.6	0.960	0.883	-8.0	11.880	9.385	-21.0
2005	2.140	1.309	-38.9	0.930	0.860	-7.5	12.170	10.197	-16.2

Year	NO _x			NMVOC			SO ₂		
	2015	2016	%	2015	2016	%	2015	2016	%
2006	2.030	0.914	-55.0	0.710	0.610	-14.0	6.020	4.050	-32.7
2007	2.060	0.903	-56.2	0.620	0.547	-11.8	4.390	3.329	-24.2
2008	2.320	1.038	-55.2	0.941	0.877	-6.8	6.007	4.923	-18.0
2009	1.333	0.834	-37.5	0.605	0.411	-32.0	4.817	4.528	-6.0
2010	1.617	0.844	-47.8	0.656	0.632	-3.8	4.117	3.111	-24.4
2011	1.820	0.646	-64.5	0.541	0.524	-3.2	4.317	3.301	-23.5
2012	1.612	0.573	-64.4	0.403	0.378	-6.0	4.874	3.826	-21.5

Table 8.1 continues

Year	NH ₃			PM _{2.5}			PM ₁₀			TSP		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
2000	NE	NE		1.650	1.055	-36.0	2.657	1.256	-52.7	4.464	1.583	-64.55
2001	NE	NE		2.674	2.536	-5.2	3.108	2.843	-8.5	3.940	3.408	-13.51
2002	NE	NE		3.360	3.256	-3.1	3.874	3.625	-6.4	4.740	4.341	-8.409
2003	NE	NE		4.044	3.909	-3.3	4.399	4.096	-6.9	4.790	4.453	-7.032
2004	NE	NE		4.350	4.085	-6.1	4.870	4.274	-12.2	5.160	4.498	-12.83
2005	NE	NE		4.300	4.042	-6.0	4.880	4.511	-7.6	5.830	5.234	-10.21
2006	NE	NE		1.580	1.437	-9.1	2.080	1.852	-11.0	2.920	2.514	-13.92
2007	NE	NE		1.410	1.292	-8.4	1.880	1.693	-10.0	3.110	2.706	-12.98
2008	8.7E-05	8.7E-05	0.3	3.201	3.064	-4.3	3.764	3.542	-5.9	4.931	4.570	-7.314
2009	7.0E-04	7.0E-04	0.0	1.584	1.543	-2.6	2.173	2.103	-3.2	3.070	2.921	-4.866
2010	1.6E-04	1.6E-04	0.0	2.134	2.102	-1.5	2.500	2.450	-2.0	3.147	2.929	-6.928
2011	NE	NE		1.772	1.740	-1.8	2.029	1.982	-2.3	2.352	2.142	-8.928
2012	NE	NE		1.061	1.025	-3.4	1.144	1.098	-4.0	1.517	1.363	-10.16

Table 8.1 continues

Year	CO			Pb			Cd			Hg		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
2000	3.740	2.771	-25.9	3.740	0.255	-93.18	0.030	0.003	-89.6	0.010	0.006	-35.9
2001	7.260	5.787	-20.3	7.260	0.681	-90.63	0.040	0.013	-68.0	0.010	0.006	-36.7
2002	7.870	6.529	-17.0	7.870	0.764	-90.3	0.050	0.025	-51.0	0.010	0.006	-36.0
2003	8.750	7.767	-11.2	8.750	0.925	-89.42	0.030	0.021	-31.1	0.010	0.002	-84.0
2004	9.760	8.721	-10.6	9.760	0.809	-91.71	0.010	0.009	-10.0	0.000	0.000	0.0
2005	10.630	9.623	-9.5	10.630	0.905	-91.48	0.020	0.020	-2.0	0.000	0.000	0.0
2006	5.840	4.676	-19.9	5.840	0.485	-91.69	0.010	0.007	-28.1	0.000	0.000	0.0
2007	6.100	4.464	-26.8	6.100	0.583	-90.45	0.030	0.028	-6.4	0.020	0.014	-27.7
2008	9.371	7.620	-18.7	9.371	1.027	-89.04	0.057	0.047	-16.9	0.033	0.029	-13.0
2009	5.172	4.263	-17.6	5.172	0.726	-85.97	0.021	0.021	-3.4	0.006	0.006	-0.4
2010	6.497	5.529	-14.9	6.497	0.722	-88.88	0.020	0.019	-5.0	0.004	0.004	-0.2
2011	5.708	4.730	-17.1	5.708	0.481	-91.57	0.013	0.011	-12.9	0.003	0.003	-14.9
2012	4.920	3.706	-24.7	4.920	0.323	-93.43	0.014	0.011	-19.6	0.003	0.003	-0.9

Table 8.1 continues

Year	As			Cr			Cu			Ni		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
2000	0.020	0.015	-23.2	0.069	0.053	-23.4	0.040	0.021	-46.6	0.289	0.252	-12.7
2001	0.040	0.035	-13.8	0.139	0.124	-10.8	0.055	0.036	-34.6	0.569	0.536	-5.8
2002	0.050	0.044	-11.5	0.189	0.175	-7.3	0.057	0.039	-31.2	0.378	0.347	-8.1

Year	As			Cr			Cu			Ni		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
2003	0.200	0.067	-66.7	0.319	0.190	-40.5	0.088	0.058	-33.8	0.389	0.283	-27.3
2004	0.030	0.029	-3.3	0.139	0.121	-12.9	0.047	0.030	-36.2	0.308	0.289	-6.2
2005	0.030	0.029	-3.3	0.179	0.168	-6.0	0.062	0.048	-22.3	0.359	0.339	-5.7
2006	0.030	0.023	-23.4	0.149	0.130	-13.0	0.070	0.038	-45.0	0.189	0.169	-10.4
2007	0.060	0.053	-11.5	0.230	0.219	-4.9	0.120	0.062	-48.2	0.219	0.207	-5.6
2008	0.102	0.089	-13.0	0.330	0.302	-8.4	0.126	0.074	-41.4	0.375	0.353	-5.6
2009	0.083	0.077	-7.5	0.248	0.235	-5.4	0.099	0.080	-19.1	0.284	0.276	-2.8
2010	0.071	0.061	-13.1	0.202	0.183	-9.3	0.090	0.079	-12.0	0.219	0.193	-11.9
2011	0.044	0.033	-25.1	0.105	0.086	-18.6	0.054	0.031	-42.7	0.114	0.091	-20.0
2012	0.048	0.038	-20.7	0.091	0.080	-12.6	0.043	0.029	-32.8	0.104	0.088	-15.9

Table 8.1 continues

Year	Zn		
	2015	2016	%
2000	0.578	0.466	-19.3
2001	1.499	1.498	0.0
2002	1.575	1.468	-6.8
2003	2.587	2.004	-22.5
2004	1.965	1.962	-0.2
2005	2.000	1.947	-2.7
2006	1.040	1.018	-2.2
2007	0.768	0.742	-3.4
2008	1.716	1.678	-2.2
2009	0.837	0.773	-7.6
2010	1.102	1.058	-4.0
2011	0.752	0.696	-7.5
2012	0.334	0.281	-15.7

Table 8.2 The differences in Stationary combustion in manufacturing industries and construction: Non-metallic minerals (NFR 1A2f) emissions for the year 2000-2012 between 2015 and 2016 submissions (kt)

Year	NO _x		NMVOC		SO ₂		PM _{2.5}		PM ₁₀	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
2000	IE	1.626	IE	0.018	IE	0.940	IE	0.595	IE	1.401
2001	IE	1.267	IE	0.033	IE	0.264	IE	0.138	IE	0.265
2002	IE	0.992	IE	0.039	IE	2.339	IE	0.104	IE	0.249
2003	IE	1.071	IE	0.025	IE	3.265	IE	0.135	IE	0.303
2004	IE	0.955	IE	0.077	IE	2.495	IE	0.265	IE	0.596
2005	IE	0.831	IE	0.070	IE	1.973	IE	0.258	IE	0.369
2006	IE	1.116	IE	0.100	IE	1.970	IE	0.143	IE	0.228
2007	IE	1.157	IE	0.073	IE	1.061	IE	0.118	IE	0.187
2008	IE	1.282	IE	0.064	IE	1.084	IE	0.137	IE	0.222
2009	IE	0.500	IE	0.023	IE	0.289	IE	0.041	IE	0.070
2010	IE	0.773	IE	0.025	IE	1.006	IE	0.033	IE	0.050
2011	IE	1.174	IE	0.017	IE	1.017	IE	0.032	IE	0.047
2012	IE	1.038	IE	0.024	IE	1.048	IE	0.036	IE	0.046

Table 8.2 continues

Year	TSP		CO		Pb		Cd		Hg	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
2000	IE	2.881	IE	0.969	IE	0.525	IE	0.027	IE	0.004
2001	IE	0.532	IE	1.473	IE	0.529	IE	0.027	IE	0.004
2002	IE	0.399	IE	1.341	IE	0.496	IE	0.025	IE	0.004
2003	IE	0.337	IE	0.983	IE	0.465	IE	0.009	IE	0.008
2004	IE	0.662	IE	1.039	IE	0.041	IE	0.001	IE	0.000
2005	IE	0.596	IE	1.007	IE	0.045	IE	0.000	IE	0.000
2006	IE	0.406	IE	1.164	IE	0.065	IE	0.003	IE	0.003
2007	IE	0.404	IE	1.636	IE	0.107	IE	0.002	IE	0.006
2008	IE	0.361	IE	1.751	IE	0.095	IE	0.010	IE	0.004
2009	IE	0.149	IE	0.909	IE	0.024	IE	0.001	IE	0.000
2010	IE	0.218	IE	0.968	IE	0.023	IE	0.001	IE	0.000
2011	IE	0.210	IE	0.979	IE	0.042	IE	0.002	IE	0.000
2012	IE	0.154	IE	1.214	IE	0.032	IE	0.003	IE	0.000

Table 8.2 continues

Year	As		Cr		Cu		Ni		Zn	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
2000	IE	0.005	IE	0.016	IE	0.019	IE	0.037	IE	0.112
2001	IE	0.006	IE	0.015	IE	0.019	IE	0.033	IE	0.114
2002	IE	0.006	IE	0.014	IE	0.018	IE	0.031	IE	0.107
2003	IE	0.009	IE	0.129	IE	0.030	IE	0.106	IE	0.116
2004	IE	0.001	IE	0.018	IE	0.017	IE	0.019	IE	0.003
2005	IE	0.001	IE	0.011	IE	0.014	IE	0.021	IE	0.053
2006	IE	0.007	IE	0.019	IE	0.032	IE	0.020	IE	0.022
2007	IE	0.007	IE	0.011	IE	0.058	IE	0.012	IE	0.026
2008	IE	0.013	IE	0.028	IE	0.052	IE	0.021	IE	0.038
2009	IE	0.006	IE	0.013	IE	0.019	IE	0.008	IE	0.063
2010	IE	0.009	IE	0.019	IE	0.011	IE	0.026	IE	0.044
2011	IE	0.011	IE	0.020	IE	0.023	IE	0.023	IE	0.056
2012	IE	0.010	IE	0.011	IE	0.014	IE	0.017	IE	0.052

1A4bi Residential: Stationary

Main pollutants and POPs emissions have been recalculated for the 1990-2013. Recalculation concern using new national emission factors for wood and waste combustion in domestic sector (on the base of real measurements for different types of technologies) and using new EMEP/EEA Guidebook 2013 for other fuels in domestic sector.

The differences in emissions between 2015 and 2016 submissions are presented in Table 8.3.

Table 8.3 The differences in Residential: Stationary emissions (main pollutants in kt, PAHs in t, PCDD/F in g, HCB and PCB in kg) for the year 1990-2013 between 2015 and 2016 submissions (%))

Year	NO _x			NMVOC			SO ₂			NH ₃		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
1990	1.510	4.142	174.3	10.450	4.328	-58.6	4.240	3.010	-29.0	0.040	0.296	641.1
1991	1.460	3.916	168.2	9.920	4.264	-57.0	4.270	3.064	-28.2	0.030	0.276	819.5
1992	0.780	3.382	333.5	7.780	2.873	-63.1	1.700	1.019	-40.1	0.030	0.259	764.1
1993	0.840	3.469	312.9	7.000	2.737	-60.9	1.000	0.634	-36.6	0.030	0.270	799.4
1994	0.920	5.286	474.5	9.000	3.803	-57.7	0.440	0.237	-46.1	0.040	0.428	969.8
1995	1.560	9.715	522.8	16.850	7.242	-57.0	1.080	0.691	-36.0	0.070	0.804	1048.4
1996	1.820	11.068	508.1	19.570	8.416	-57.0	1.570	1.117	-28.8	0.080	0.911	1039.0
1997	1.810	11.242	521.1	19.510	8.544	-56.2	1.440	1.147	-20.4	0.080	0.921	1051.8
1998	1.430	8.570	499.3	14.870	6.452	-56.6	1.040	0.864	-17.0	0.060	0.694	1056.0
1999	1.430	8.128	468.4	14.450	6.371	-55.9	1.210	1.361	12.5	0.060	0.646	976.9
2000	1.430	7.970	457.3	14.340	6.128	-57.3	1.020	1.142	11.9	0.060	0.632	952.9
2001	1.360	7.479	449.9	13.920	5.656	-59.4	0.880	0.883	0.4	0.060	0.591	884.6
2002	1.350	7.228	435.4	14.110	5.497	-61.0	0.990	1.014	2.4	0.060	0.563	838.6
2003	1.360	7.187	428.4	14.520	5.344	-63.2	0.710	0.773	8.9	0.060	0.557	828.6
2004	1.390	6.886	395.4	14.630	5.221	-64.3	1.040	0.962	-7.5	0.060	0.526	775.9
2005	1.230	5.692	362.8	12.600	4.295	-65.9	0.890	0.845	-5.1	0.050	0.425	749.8
2006	1.180	5.422	359.5	12.180	4.030	-66.9	0.750	0.703	-6.2	0.050	0.401	703.0
2007	1.440	6.809	372.8	15.680	4.900	-68.8	0.470	0.525	11.7	0.060	0.509	748.5
2008	1.496	6.785	353.4	16.316	4.886	-70.1	0.463	0.557	20.3	0.066	0.502	659.7
2009	1.554	6.927	345.7	17.116	4.939	-71.1	0.402	0.444	10.5	0.069	0.509	633.2
2010	1.605	6.882	328.7	17.623	4.926	-72.0	0.419	0.470	12.4	0.071	0.497	596.2
2011	1.416	5.715	303.6	15.296	4.125	-73.0	0.475	0.511	7.6	0.062	0.401	549.3
2012	1.499	5.861	290.9	16.278	4.144	-74.5	0.438	0.476	8.8	0.066	0.410	523.1
2013	1.445	5.405	274.2	15.740	3.800	-75.9	0.429	0.462	7.6	0.064	0.372	484.0

Table 8.3 continues

Year	PM _{2.5}			PM ₁₀			TSP			CO		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
1990	NR	NR	NA	NR	NR	NA	8.680	3.264	-62.4	72.850	61.034	-16.2
1991	NR	NR	NA	NR	NR	NA	8.280	3.274	-60.5	70.250	59.206	-15.7
1992	NR	NR	NA	NR	NR	NA	6.400	2.247	-64.9	51.090	44.575	-12.8
1993	NR	NR	NA	NR	NR	NA	5.750	2.125	-63.0	45.040	43.739	-2.9
1994	NR	NR	NA	NR	NR	NA	10.190	2.756	-73.0	56.260	64.233	14.2
1995	NR	NR	NA	NR	NR	NA	13.780	4.911	-64.4	106.320	121.645	14.4
1996	NR	NR	NA	NR	NR	NA	16.020	5.660	-64.7	124.280	140.648	13.2
1997	NR	NR	NA	NR	NR	NA	15.980	5.741	-64.1	124.030	143.428	15.6
1998	NR	NR	NA	NR	NR	NA	12.180	4.449	-63.5	94.480	108.941	15.3
1999	NR	NR	NA	NR	NR	NA	11.890	4.453	-62.5	92.180	105.676	14.6
2000	10.260	3.828	-62.7	10.260	3.971	-61.3	11.880	4.296	-63.8	90.970	103.086	13.3
2001	9.960	3.528	-64.6	9.960	3.660	-63.3	11.560	3.960	-65.7	88.150	96.689	9.7
2002	10.160	3.426	-66.3	10.160	3.555	-65.0	11.590	3.846	-66.8	89.610	94.226	5.2
2003	10.386	3.283	-68.4	10.386	3.407	-67.2	11.867	3.685	-69.0	91.480	93.617	2.3
2004	10.490	3.215	-69.4	10.490	3.336	-68.2	11.980	3.610	-69.9	93.040	91.136	-2.0
2005	9.030	2.684	-70.3	9.030	2.787	-69.1	10.310	3.017	-70.7	80.110	75.639	-5.6
2006	8.720	2.531	-71.0	8.720	2.628	-69.9	9.960	2.845	-71.4	77.150	71.923	-6.8

Year	PM _{2.5}			PM ₁₀			TSP			CO		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
2007	11.200	2.965	-73.5	11.200	3.076	-72.5	12.800	3.328	-74.0	98.140	89.813	-8.5
2008	11.652	2.948	-74.7	11.652	3.059	-73.7	13.316	3.310	-75.1	102.008	90.059	-11.7
2009	12.221	2.940	-75.9	12.221	3.050	-75.0	13.966	3.300	-76.4	106.904	92.330	-13.6
2010	12.583	2.897	-77.0	12.583	3.006	-76.1	14.379	3.253	-77.4	110.084	92.644	-15.8
2011	10.926	2.476	-77.3	10.926	2.570	-76.5	12.485	2.784	-77.7	95.773	77.960	-18.6
2012	11.624	2.516	-78.4	11.624	2.612	-77.5	13.283	2.829	-78.7	101.778	79.681	-21.7
2013	11.241	2.342	-79.2	11.241	2.431	-78.4	12.845	2.634	-79.5	98.436	74.095	-24.7

Table 8.3 continues

Year	PCDD/F			B(a)p			B(b)f			B(k)f		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
1990	3.786	3.128	-17.4	1.813	1.616	-10.9	2.004	1.701	-15.1	1.147	1.082	-5.7
1991	3.923	3.229	-17.7	1.756	1.548	-11.8	2.006	1.686	-16.0	1.090	1.021	-6.3
1992	1.661	1.446	-13.0	0.978	0.914	-6.6	1.006	0.905	-10.0	0.629	0.608	-3.3
1993	1.227	1.114	-9.2	0.866	0.832	-3.9	0.835	0.782	-6.4	0.567	0.556	-1.9
1994	0.826	0.814	-1.4	0.806	1.111	37.9	0.708	0.966	36.4	0.545	0.754	38.5
1995	2.381	2.282	-4.1	2.180	2.150	-1.4	1.957	1.909	-2.5	1.465	1.456	-0.7
1996	3.037	2.858	-5.9	2.592	2.537	-2.1	2.368	2.282	-3.6	1.734	1.716	-1.0
1997	3.089	2.910	-5.8	2.620	2.564	-2.1	2.398	2.310	-3.6	1.751	1.733	-1.0
1998	2.291	2.172	-5.2	1.971	1.934	-1.9	1.793	1.733	-3.3	1.321	1.309	-0.9
1999	2.717	2.500	-8.0	2.030	1.962	-3.3	1.919	1.812	-5.5	1.343	1.320	-1.6
2000	2.436	2.273	-6.7	1.915	1.863	-2.7	1.781	1.699	-4.6	1.274	1.257	-1.3
2001	2.099	1.988	-5.3	1.715	1.677	-2.2	1.579	1.520	-3.7	1.142	1.130	-1.0
2002	2.135	2.013	-5.7	1.696	1.655	-2.4	1.569	1.504	-4.2	1.130	1.116	-1.2
2003	1.851	1.783	-3.7	1.592	1.566	-1.6	1.440	1.398	-2.9	1.068	1.060	-0.8
2004	2.007	1.908	-4.9	1.568	1.532	-2.3	1.456	1.399	-4.0	1.039	1.027	-1.1
2005	1.679	1.599	-4.8	1.285	1.255	-2.3	1.198	1.150	-4.0	0.850	0.840	-1.1
2006	1.471	1.418	-3.6	1.180	1.158	-1.9	1.084	1.048	-3.3	0.785	0.778	-0.9
2007	1.476	1.469	-0.4	1.367	1.357	-0.8	1.211	1.193	-1.5	0.921	0.918	-0.3
2008	1.477	1.472	-0.4	1.358	1.347	-0.8	1.204	1.184	-1.6	0.915	0.912	-0.4
2009	1.372	1.388	1.2	1.328	1.323	-0.4	1.163	1.153	-0.9	0.898	0.897	-0.2
2010	1.375	1.389	1.0	1.303	1.296	-0.5	1.146	1.134	-1.1	0.878	0.876	-0.2
2011	1.222	1.226	0.3	1.088	1.080	-0.8	0.969	0.954	-1.6	0.731	0.728	-0.3
2012	1.197	1.215	1.5	1.093	1.086	-0.6	0.967	0.955	-1.2	0.735	0.733	-0.2
2013	1.103	1.125	2.0	0.992	0.986	-0.6	0.880	0.869	-1.2	0.666	0.664	-0.2

Table 8.3 continues

Year	I(1,2,3-cd)p			PAHs total			HCB			PCB		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
1990	1.577	1.526	-3.3	6.541	5.924	-9.4	0.084	0.093	10.8	0.601	0.601	0.0
1991	1.427	1.372	-3.8	6.278	5.627	-10.4	0.077	0.089	16.0	0.638	0.638	0.0
1992	0.905	0.889	-1.8	3.518	3.316	-5.7	0.074	0.085	14.8	0.206	0.206	0.0
1993	0.855	0.847	-0.9	3.123	3.017	-3.4	0.076	0.088	15.1	0.119	0.119	0.0
1994	0.877	1.220	39.2	2.936	4.052	38.0	0.086	0.132	53.3	0.024	0.024	0.5
1995	2.327	2.320	-0.3	7.929	7.835	-1.2	0.221	0.236	6.8	0.106	0.106	0.0
1996	2.724	2.710	-0.5	9.417	9.245	-1.8	0.251	0.269	7.2	0.190	0.190	0.0
1997	2.745	2.731	-0.5	9.513	9.339	-1.8	0.255	0.276	8.1	0.199	0.199	0.0
1998	2.082	2.073	-0.4	7.167	7.049	-1.7	0.194	0.215	10.8	0.144	0.144	0.0
1999	2.059	2.042	-0.8	7.350	7.137	-2.9	0.182	0.204	12.4	0.258	0.258	0.0

Year	I(1,2,3-cd)p			PAHs total			HCB			PCB		
	2015	2016	%	2015	2016	%	2015	2016	%	2015	2016	%
2000	1.975	1.963	-0.6	6.945	6.782	-2.3	0.179	0.204	13.9	0.209	0.209	0.0
2001	1.777	1.769	-0.5	6.213	6.096	-1.9	0.168	0.195	15.7	0.161	0.161	0.0
2002	1.756	1.746	-0.6	6.151	6.021	-2.1	0.162	0.190	17.5	0.186	0.186	0.0
2003	1.686	1.680	-0.3	5.785	5.703	-1.4	0.162	0.192	18.9	0.130	0.130	0.0
2004	1.599	1.590	-0.5	5.661	5.547	-2.0	0.154	0.186	21.3	0.186	0.186	0.0
2005	1.303	1.296	-0.5	4.636	4.540	-2.1	0.126	0.157	24.5	0.166	0.166	0.0
2006	1.218	1.213	-0.4	4.266	4.197	-1.6	0.121	0.152	26.2	0.131	0.131	0.0
2007	1.471	1.469	-0.1	4.970	4.936	-0.7	0.153	0.193	26.1	0.076	0.076	0.0
2008	1.461	1.459	-0.1	4.937	4.902	-0.7	0.152	0.194	27.2	0.082	0.082	0.0
2009	1.446	1.445	0.0	4.836	4.818	-0.4	0.157	0.201	28.0	0.054	0.054	0.0
2010	1.407	1.406	-0.1	4.734	4.713	-0.5	0.156	0.201	28.5	0.062	0.062	0.0
2011	1.159	1.157	-0.1	3.947	3.919	-0.7	0.130	0.171	31.9	0.079	0.079	0.0
2012	1.170	1.169	-0.1	3.965	3.944	-0.5	0.131	0.180	37.5	0.070	0.070	0.0
2013	1.057	1.057	0.0	3.595	3.577	-0.5	0.120	0.170	42.5	0.069	0.069	0

1B1b Fugitive emission from solid fuels: Solid fuel transformation

Emissions of PM₁₀ and PM_{2.5} have been recalculated for the years 2010-2013. Recalculations were made based on a new emission factors in EMEP/EEA Guidebook 2013.

The differences in emissions between 2015 and 2016 submissions are presented in Table 8.4.

Table 8.4 The differences in Fugitive emission from solid fuels: Solid fuel transformation sector emissions (kt) for the years 1990-2013 between 2015 and 2016 submissions (%)

Year	PM _{2.5}			PM ₁₀		
	2015	2016	%	2015	2016	%
2010	0,00051	0,00019	-62,45	0,00066	0,00046	-29,8
2011	0,00070	0,00026	-62,37	0,00090	0,00063	-29,8
2012	0,00013	0,00005	-62,2	0,00016	0,00012	-29,9
2013	0,00076	0,00029	-62,42	0,00098	0,00069	-29,9

8.1.2. Transport sector

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2015 and 2016 are made by using exact calculation numbers.

1A2gvii Mobile Combustion in manufacturing industries and construction

Emissions are recalculated for the years 2008, 2011, and 2013. All changes shown in Table 8.5 for the years 2008 and 2011 are due to a correction of statistical fuel consumption. Improvements were also made in the BC emissions. BC emissions for 2013 have been recalculated due to a correction of f-BC emission factors. Because old BC emissions data were available only from 2013, emissions are calculated for the period 1990–2012.

Table 8.5 The differences in 1A2gvii sector emissions between the 2015 and 2016 submissions (%)

Pollutant	2008	2011	2013
NO _x	0.00	-2.33	
NMVOC	0.01	-2.33	
SO _x	0.47	-1.07	
NH ₃	0.43	-1.79	
PM _{2.5}		-2.33	
PM ₁₀		-2.33	
TSP		-2.33	
BC			0.01
CO	0.07	-2.24	
Cd		-2.38	
Cr		-2.29	
Cu		-2.33	
Ni		-2.31	
Se		-2.38	
Zn		-2.33	
Total PAHs		-2.32	

1A3ai-ii (i-ii) Domestic and international aviation

There were not any recalculations in the aviation sector. During the compilation of the IIR, minor errors were detected in emissions data represented in previous NFR table.

Emissions data have been corrected under NFR codes 1A3ai(i) and 1A3aii(i) in 2011. In addition, emissions data for 1993 and 1994 were mistakenly represented under wrong NFR code (1A3ai(ii) emissions under 1A3aii(ii) and vice versa). Same with NFR codes 1A3ai(i) and 1A3aii(i) in 1991.

1A3b Road transport

All the emissions are recalculated for the period 1990–2013. Recalculations concerned use a new COPERT 4 version 11.3 which includes updated emission factors and a small correction in average annual mileage driven (2009–2013).

In addition, new COPERT version includes HCB and PCBs emissions factors. Therefore HCB and PCBs emissions were calculated from transport sector for all years and included in the inventory.

The differences in road transport emissions between the submissions for 2015 and 2016 are presented in Table 8.6.

Table 8.6 The differences in road transport emissions between the 2015 and 2016 submissions (%)

Year	NO _x	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1990	0.00	-1.37							0.00
1991	0.00	-0.78							0.00

Year	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
1992	0.00	12.06							0.00
1993	0.00	10.44							0.00
1994		5.49							
1995		9.80							
1996		8.17							
1997		7.62							
1998		6.52							
1999		5.33							
2000		4.62							0.00
2001	0.00	-3.33							
2002		-1.69							0.00
2003	0.00	-0.96							0.00
2004	0.00	0.27							0.00
2005		0.13							0.00
2006	0.00	0.50							
2007		2.25							0.00
2008		3.28							0.00
2009	0.02	5.08		0.04	0.03	0.04	0.02		-0.01
2010	0.10	7.47	-0.02	-0.32	0.12	0.11	0.08		-0.03
2011	0.39	7.86	-0.01	-0.89	0.27	0.24	0.19		-0.14
2012	1.05	15.43	-0.01	-1.39	0.44	0.39	0.28		-0.31
2013	1.73	17.32	-0.02	-2.27	0.60	0.49	0.37	0.74	-0.39

Table 8.6 continues

Year	Pb	Cd	Cr	Cu	Ni	Se	Zn	PCDD/F	PAHs
1990	0.00							63.36	0.00
1991	0.00							56.54	0.00
1992	0.00							77.38	0.00
1993	0.00							82.73	-0.01
1994								72.21	-0.01
1995								79.06	0.01
1996								63.06	0.00
1997								63.98	0.00
1998								84.54	0.01
1999								67.96	0.00
2000								64.66	0.01
2001								70.76	0.00
2002								87.11	0.00
2003								91.67	0.00
2004								103.17	0.00
2005								107.18	0.00
2006								114.96	0.00
2007								118.31	0.00
2008								105.45	0.00

Year	Pb	Cd	Cr	Cu	Ni	Se	Zn	PCDD/F	PAHs
2009	0.00	-0.01	0.00	0.00			0.00	109.07	0.00
2010	0.01		0.01	0.02	0.01		0.00	121.20	0.02
2011	0.03	0.01	0.06	0.06	0.04	0.05	0.02	126.69	0.05
2012	0.00	0.00	0.08	0.09	0.07	0.10	0.03	142.70	0.08
2013	0.07	0.04	0.11	0.13	0.09	0.10	0.05	144.42	0.10

1A3c Railways

All the emissions are recalculated for the year 2012. Recalculations concerned use corrected statistical fuel consumption. All changes in emissions are shown in Table 8.7 for the year 2012.

Table 8.7 The differences in railways emissions between the 2015 and 2016 submissions (%)

Pollutant	2012
NO _x	0.5
NM VOC	0.5
SO _x	0.5
NH ₃	0.5
PM _{2.5}	0.5
PM ₁₀	0.5
TSP	0.5
CO	0.5
Cd	0.7
Cr	0.5
Cu	0.5
Ni	0.5
Se	0.7
Zn	0.5
Total PAHs	0.5

1A3dii National navigation

All the emissions are recalculated for the years 1999, 2000 and 2012. Recalculations concerned use corrected statistical fuel consumption. All changes in emissions are shown in Table 8.8.

Improvements were also made in the BC emissions. BC emissions for 2013 have been recalculated due to a correction of f-BC emission factors. Since old BC emissions data were available only from 2013, emissions are calculated for the period 1990–2012.

Table 8.8 The differences in national navigation emissions between the 2015 and 2016 submissions (%)

Pollutant	1999	2000	2012	2013
NO _x	5.1	40.0	9.9	
NMVOC	5.1	40.0	9.9	
SO _x	5.1	40.0	9.9	
NH ₃	5.7	40.0	10.7	
PM _{2.5}		40.0	9.9	
PM ₁₀		40.0	9.9	
TSP	5.1	40.0	9.9	
BC				1000.0
CO	5.1	40.0	9.9	
Cd	6.0	40.0	10.0	
Cr	5.2	40.0	10.0	
Cu	5.1	40.0	9.9	
Ni	5.1	40.0	10.0	
Se	6.0	40.0	10.0	
Zn	5.1	40.0	9.9	
Total PAHs	5.3	40.0	10.0	

1A4aii Commercial/institutional: Mobile

SO_x emissions from commercial sector have been recalculated for the period 2012–2013. Recalculations concerned use corrected sulphur content in fuels.

During the compilation of the IIR, minor errors were detected in emissions data represented in previous NFR table. Therefore, there have been made some corrections of NMVOC and NH₃ emissions in 2012 represented in NFR table.

Table 8.9 The differences in 1A4aii sector emissions between the 2015 and 2016 submissions (%)

Year	NMVOC	SO _x	NH ₃
2012	0.0	14.6	2.0
2013		-1.3	

1A4bii Residential: Household and gardening (mobile)

All the emissions have been recalculated for the period 2002–2013. Recalculations in the household and gardening sector were made based on the correction of statistical fuel consumption (2002–2009), sulphur content in fuels (2012–2013), correction of f-BC emission factors (2013), and data represented in NFR table (2012).

Table 8.10 The differences in household and gardening sector emissions between the 2015 and 2016 submissions (%)

Year	NO _x	NM VOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
2002	13.2	0.1	3.6	4.8	3.8	3.8	3.8		0.1
2003	7.8	0.1	4.4	4.5	2.5	2.5	2.5		0.0
2004	17.0	0.2	9.7	10.0	5.4	5.4	5.4		0.1
2005	25.0	0.2	7.7	15.8	8.1	8.1	8.1		0.1
2006	23.0	0.2	18.9	9.5	7.6	7.6	7.6		0.1
2007	28.5	0.3	25.0	13.6	9.3	9.3	9.3		0.2
2008	21.6	0.2	19.7	13.6	7.1	7.1	7.1		0.1
2009	22.9	0.0	7.3	14.3	7.3	7.3	7.3		0.1
2010									0.2
2012		0.0	21.1						
2013			6.7					452.2	

Table 8.10 continues

Year	Cd	Cr	Cu	Ni	Se	Zn	PAHs
2002	4.0	3.6	3.6	3.7	4.0	3.6	3.5
2003	2.0	2.3	2.3	2.5	2.0	2.3	2.2
2004	6.5	5.2	5.2	5.2	6.5	5.2	5.1
2005	9.1	7.7	7.7	7.8	9.1	7.7	7.6
2006	8.5	7.2	7.2	7.3	8.5	7.2	7.1
2007	8.0	8.9	8.9	8.9	8.0	8.9	8.8
2008	5.9	6.7	6.7	6.8	5.9	6.7	6.7
2009			0.0				
2010			0.0				
2011							
2012							
2013							

1A4cii-iii Agricultural sector and national fishing

BC emissions for 2013 have been recalculated due to a correction of f-BC emission factors. Because old BC emissions data were available only from 2013, emissions are calculated for the period 1990–2012. The differences in 1A4cii and 1A4ciii sector emissions between the 2015 and 2016 submissions are presented in Table 8.11.

Table 8.11 The differences in 1A4cii and 1A4ciii BC emissions between the 2015 and 2016 submissions (%)

Year	1A4cii	1A4ciii
2013	0.004	17,636.842

1A3di (i) International maritime navigation

All the NO_x, NMVOC, NH₃, PM_{2.5}, PM₁₀, and TSP emissions have been recalculated for the period 2005–2013. Recalculations in the international maritime sector were made based on the correction of the average gross tonnage of vessels by Statistics Estonia.

BC emissions for 2013 have been recalculated due to a correction of f-BC emission factors. Because old BC emissions data were available only from 2013, emissions are calculated for the period 1990–2012.

The differences in international maritime navigation sector emissions between the 2015 and 2016 submissions are presented in Table 8.12.

Table 8.12 The differences in international maritime emissions between the 2015 and 2016 submissions (%)

Year	NO _x	NMVOC	PM _{2.5}	PM ₁₀	TSP	BC
2005	63.7	-3.7	9.0	30.6	30.6	
2006	21.1	-1.9	3.3	10.0	10.0	
2007	17.7	-1.6	2.7	7.9	7.9	
2008	14.7	-1.3	2.3	6.5	6.5	
2009	11.7	-1.0	1.9	5.2	5.2	
2010	15.5	-1.2	2.2	6.2	6.2	
2011	19.2	-1.5	2.7	7.7	7.7	
2012	-0.3	0.0	-0.1	-0.1	-0.1	
2013	8.0	-0.7	1.2	3.4	3.4	53.8

8.2. Industrial processes and product use (NFR 2)

8.2.1. Industrial processes

2A5b Construction and demolition

Particulates emission have been recalculated for the period 2000–2013 and additionally calculated for 1990-1999. Recalculations for this sector were made based on the correction of data of granted permits for new construction (dwellings and non-residential). Comparing with 2015 submission additionally have been calculated emissions from demolition activity.

The differences in emissions between 2015 and 2016 submissions are presented in Table 8.13.

Table 8.13 The differences in Construction and demolition sector emissions (kt) for the years 1990-2013 between 2015 and 2016 submissions (%)

Year	PM _{2.5}			PM ₁₀			TSP		
	2015	2016	%	2015	2016	%	2015	2016	%
1990	NE	0.018		NE	0.176		NE	0.350	
1991	NE	0.012		NE	0.123		NE	0.246	
1992	NE	0.009		NE	0.090		NE	0.180	

Year	PM _{2.5}			PM ₁₀			TSP		
	2015	2016	%	2015	2016	%	2015	2016	%
1993	NE	0.007		NE	0.068		NE	0.136	
1994	NE	0.003		NE	0.031		NE	0.061	
1995	NE	0.004		NE	0.038		NE	0.076	
1996	NE	0.004		NE	0.042		NE	0.083	
1997	NE	0.005		NE	0.049		NE	0.098	
1998	NE	0.006		NE	0.056		NE	0.113	
1999	NE	0.004		NE	0.044		NE	0.089	
2000	0.003	0.005	65.1	0.033	0.054	65.1	0.065	0.108	65.1
2001	0.003	0.006	110.7	0.031	0.065	110.7	0.062	0.130	110.7
2002	0.004	0.011	169.2	0.042	0.112	169.2	0.083	0.224	169.2
2003	0.007	0.010	39.7	0.070	0.097	39.7	0.139	0.194	39.7
2004	0.010	0.018	78.5	0.100	0.178	78.5	0.199	0.356	78.5
2005	0.009	0.020	129.9	0.087	0.200	129.9	0.173	0.398	129.9
2006	0.010	0.025	137.9	0.105	0.249	137.9	0.209	0.497	137.9
2007	0.012	0.023	87.4	0.121	0.226	87.4	0.241	0.452	87.4
2008	0.012	0.021	73.2	0.119	0.206	73.2	0.237	0.411	73.2
2009	0.009	0.011	26.4	0.090	0.113	26.4	0.179	0.226	26.4
2010	0.005	0.010	81.1	0.054	0.098	81.8	0.107	0.195	81.6
2011	0.004	0.012	174.1	0.043	0.118	174.1	0.086	0.236	174.1
2012	0.006	0.013	126.8	0.057	0.130	126.8	0.115	0.260	126.8
2013	0.007	0.014	99.3	0.070	0.139	99.3	0.139	0.277	99.3

8.2.2. Solvent and Other Product Use

There has been made some recalculations of NMVOC emissions for the period of 1999-2013 due to the statistical data corrections. Major changes occurred for the year 2013, where due to the activity data corrections NMVOC emissions rose by 0.644 kt, i.e. 10.3% (Table 8.14).

Table 8.14 The differences in solvent sector NMVOC emissions between the 2015 and 2016 submissions (%)

Year	2D3d	2D3e	2D3f	2D3h	2D3i	2G	Total
	Coating applications	Degreasing	Dry cleaning	Printing	Other solvent use	Other product use	
1999				0.00			0.00
2000		-0.00		-0.20	-0.03	0.00	-0.01
2001		0.00		0.04	0.00	0.00	0.00
2002			-0.06				-0.00
2003			-0.03				-0.00
2004	0.02		-0.07				0.01
2005	0.01		0.05				0.01
2006	0.03		0.00				0.01
2007	0.01		0.01	-0.02			0.00
2008	0.02						0.01
2009	0.07		-0.08				0.02
2010	-0.01		1.20				-0.00
2011	-0.00		-0.22				-0.00
2012	0.19		1.60				0.07
2013	15.98	0.00	629.02	9.51	39.90	0.00	10.30

Additional BC emissions were calculated for the period of 2000-2012 for activities where emission factor is provided by the EMEP/EEA Guidebook 2013. Also some minor corrections for some years were made to particulates, NH₃, CO and PAHs total emissions, but as they are insignificant changes in the scope of IIR, they are not separately presented in the IIR.

8.3. Agriculture sector (NFR 4)

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2015 and 2016 are made by using exact calculation numbers.

8.3.1. Manure management

NO_x and NH₃, NMVOC, TSP, PM_{2.5} and PM₁₀ emissions from swine and boiler manure management have been recalculated for the 1990-2013. Recalculations concern using corrected activity data (average animal number). For swine manure management the Tier 2 methodology was used instead of Tier 1 for the first time.

NO_x and NH₃ emissions from dairy and non-dairy cattle manure management have been recalculated for the 1990-2014. Recalculations concern using the Tier 2 methodology instead of Tier 1. NH₃ emissions from animal manure applied to soils were calculated separately from manure management for the first time. This is the main reason why NO_x and NH₃ emissions from cattle and swine manure management decreased but the summary emissions from agriculture increased.

Table 8.15 The differences in dairy cattle manure management NO_x and NH₃ emissions (kt) for the years 1990-2013 between 2015 and 2016 submissions (%)

Year	NO _x			NH ₃		
	Old	Recalc.	%	Old	Recalc.	%
1990	0.043	0.030	-31.4	8.056	5.066	-37.1
1991	0.041	0.027	-34.1	7.585	4.617	-39.1
1992	0.039	0.025	-37.2	7.273	4.258	-41.5
1993	0.035	0.022	-37.8	6.506	3.782	-41.9
1994	0.033	0.018	-44.3	6.067	3.232	-46.7
1995	0.029	0.016	-43.4	5.321	2.868	-46.1
1996	0.026	0.017	-35.9	4.925	2.930	-40.5
1997	0.025	0.018	-28.8	4.902	2.996	-38.9
1998	0.022	0.017	-22.2	4.720	2.920	-38.1
1999	0.018	0.015	-19.4	4.192	2.510	-40.1
2000	0.016	0.015	-10.4	4.037	2.471	-38.8
2001	0.015	0.015	-1.6	4.032	2.267	-43.8
2002	0.013	0.015	16.7	3.685	2.267	-38.5
2003	0.012	0.014	16.3	3.785	2.560	-32.4

Year	NO _x			NH ₃		
	Old	Recalc.	%	Old	Recalc.	%
2004	0.011	0.014	24.7	3.838	2.679	-30.2
2005	0.010	0.013	32.7	3.775	2.686	-28.9
2006	0.009	0.013	44.4	3.686	2.716	-26.3
2007	0.008	0.011	37.5	3.502	2.619	-25.2
2008	0.008	0.013	59.7	3.414	2.896	-15.2
2009	0.008	0.012	50.4	3.288	2.936	-10.7
2010	0.008	0.011	42.5	3.281	3.009	-8.3
2011	0.008	0.011	42.4	3.271	2.985	-8.7
2012	0.008	0.012	48.3	3.291	3.097	-5.9
2013	0.008	0.012	52.9	3.329	3.203	-3.8

Table 8.16 The differences in non-dairy cattle manure management NO_x and NH₃ emissions (kt) for the years 1990-2013 between 2015 and 2016 submissions (%)

Year	NO _x			NH ₃		
	Old	Recalc.	%	Old	Recalc.	%
1990	0.045	0.030	-32.4	4.389	3.829	-12.8
1991	0.042	0.029	-30.1	4.085	3.722	-8.9
1992	0.034	0.024	-30.0	3.323	3.033	-8.7
1993	0.022	0.016	-29.7	2.176	1.992	-8.5
1994	0.020	0.014	-30.7	1.915	1.719	-10.2
1995	0.017	0.012	-31.7	1.702	1.499	-11.9
1996	0.016	0.011	-31.4	1.577	1.398	-11.3
1997	0.015	0.010	-30.6	1.453	1.307	-10.0
1998	0.014	0.010	-31.5	1.370	1.213	-11.5
1999	0.012	0.009	-29.7	1.186	1.084	-8.6
2000	0.011	0.008	-30.0	1.121	1.018	-9.2
2001	0.010	0.009	-8.3	1.324	1.161	-12.3
2002	0.009	0.009	-0.5	1.261	1.161	-7.9
2003	0.008	0.011	32.1	1.528	1.311	-14.2
2004	0.006	0.009	40.0	1.506	1.155	-23.3
2005	0.005	0.009	72.3	1.602	1.188	-25.9
2006	0.004	0.009	121.9	1.656	1.185	-28.4
2007	0.004	0.009	122.4	1.669	1.217	-27.1
2008	0.004	0.009	117.0	1.669	1.205	-27.8
2009	0.004	0.009	118.6	1.675	1.238	-26.1
2010	0.004	0.010	132.2	1.697	1.258	-25.9
2011	0.004	0.010	133.0	1.725	1.286	-25.5
2012	0.004	0.010	134.1	1.811	1.351	-25.4

Year	NO _x			NH ₃		
	Old	Recalc.	%	Old	Recalc.	%
2013	0.005	0.011	134.3	1.985	1.488	-25.0

Table 8.17 The differences in swine manure management emissions (kt) for the years 1990-2013 between 2015 and 2016 submissions (%)

Year	NO _x			NMVOC			NH ₃			PM _{2.5}			PM ₁₀			TSP		
	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%
1990	0.001	0.008	1385	1.937	3.796	96	2.995	4.188	40	NR	NR	NR	NR	NR	NR	0.072	0.964	1241
1991	0.000	0.007	1508	1.642	3.505	113	2.528	3.871	53	NR	NR	NR	NR	NR	NR	0.073	0.895	1125
1992	0.000	0.005	1517	1.107	2.371	114	1.707	2.620	54	NR	NR	NR	NR	NR	NR	0.079	0.606	668
1993	0.000	0.004	1456	0.916	1.893	107	1.395	3.782	171	NR	NR	NR	NR	NR	NR	0.077	0.476	521
1994	0.000	0.004	1458	0.981	2.043	108	1.498	2.234	49	NR	NR	NR	NR	NR	NR	0.073	0.516	602
1995	0.000	0.004	1394	0.924	1.970	113	1.422	2.168	52	NR	NR	NR	NR	NR	NR	0.075	0.503	570
1996	0.000	0.003	1186	0.921	1.527	66	1.309	1.480	13	NR	NR	NR	NR	NR	NR	0.078	0.338	336
1997	0.000	0.003	959	1.019	1.619	59	1.432	1.532	7	NR	NR	NR	NR	NR	NR	0.089	0.348	290
1998	0.000	0.003	1034	1.032	1.688	64	1.462	1.633	12	NR	NR	NR	NR	NR	NR	0.078	0.370	374
1999	0.000	0.003	1369	0.814	1.417	74	1.171	1.557	33	NR	NR	NR	NR	NR	NR	0.077	0.323	318
2000	0.000	0.004	1335	0.899	1.534	71	1.273	1.682	32	0.011	0.024	114	0.072	0.153	113	0.080	0.340	324
2001	0.000	0.004	1423	0.921	1.722	87	1.300	1.841	42	0.012	0.028	142	0.073	0.176	141	0.079	0.390	393
2002	0.000	0.004	1394	0.946	1.684	78	1.360	1.841	35	0.013	0.028	121	0.079	0.173	120	0.080	0.385	382
2003	0.000	0.004	1429	0.919	1.688	84	1.320	1.839	39	0.012	0.028	130	0.077	0.175	129	0.079	0.389	392
2004	0.000	0.004	1496	0.877	1.653	88	1.262	1.781	41	0.012	0.028	137	0.073	0.173	135	0.163	0.384	135
2005	0.000	0.004	1662	0.887	1.674	89	1.282	1.827	43	0.012	0.028	135	0.075	0.176	134	0.167	0.391	134
2006	0.000	0.005	1632	0.933	1.700	82	1.339	1.839	37	0.012	0.028	128	0.078	0.176	127	0.172	0.391	127
2007	0.000	0.006	1929	1.011	1.814	79	1.485	2.037	37	0.014	0.031	116	0.089	0.192	115	0.199	0.427	115
2008	0.000	0.005	1734	0.909	1.744	92	1.322	1.911	45	0.012	0.030	138	0.078	0.185	137	0.174	0.411	137
2009	0.000	0.004	1646	0.903	1.744	93	1.311	1.894	45	0.012	0.030	141	0.077	0.185	139	0.172	0.412	139
2010	0.000	0.005	1654	0.934	1.780	91	1.357	1.950	44	0.013	0.030	136	0.080	0.189	135	0.178	0.419	135
2011	0.000	0.005	1662	0.931	1.761	89	1.348	1.929	43	0.013	0.030	135	0.079	0.186	134	0.176	0.413	134
2012	0.000	0.004	1293	0.925	1.785	93	1.347	1.931	43	0.013	0.030	139	0.080	0.190	138	0.178	0.423	138
2013	0.000	0.004	1548	0.9093	1.712	88	1.327	1.864	40	0.013	0.029	131	0.079	0.182	130	0.176	0.404	130

Table 8.18 The differences in boiler manure management emissions (kt) for the years 2000-2013 between 2015 and 2016 submissions (%)

Year	NO _x			NMVOC			NH ₃			PM _{2.5}			PM ₁₀			TSP		
	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%
1990	0.004	0.002	-53	0.451	0.211	-53	0.919	0.429	-53	NR	NR	NR	NR	NR	NR	0.288	0.135	-53
1991	0.003	0.002	-52	0.372	0.179	-52	0.757	0.364	-52	NR	NR	NR	NR	NR	NR	0.238	0.114	-52
1992	0.003	0.001	-64	0.306	0.110	-64	0.624	0.225	-64	NR	NR	NR	NR	NR	NR	0.196	0.070	-64
1993	0.002	0.001	-56	0.234	0.104	-56	0.478	0.212	-56	NR	NR	NR	NR	NR	NR	0.150	0.066	-56

Year	NO _x			NMVOC			NH ₃			PM _{2.5}			PM ₁₀			TSP		
	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%
1994	0.002	0.001	-50	0.196	0.098	-50	0.400	0.199	-50	NR	NR	NR	NR	NR	NR	0.125	0.062	-50
1995	0.002	0.001	-49	0.183	0.093	-49	0.372	0.190	-49	NR	NR	NR	NR	NR	NR	0.117	0.059	-49
1996	0.001	0.001	-62	0.148	0.057	-61	0.302	0.116	-61	NR	NR	NR	NR	NR	NR	0.095	0.036	-61
1997	0.001	0.001	-58	0.134	0.056	-58	0.272	0.114	-58	NR	NR	NR	NR	NR	NR	0.085	0.036	-58
1998	0.002	0.001	-50	0.168	0.084	-50	0.343	0.171	-50	NR	NR	NR	NR	NR	NR	0.108	0.054	-50
1999	0.001	0.001	-55	0.155	0.070	-55	0.316	0.142	-55	NR	NR	NR	NR	NR	NR	0.099	0.045	-55
2000	0.001	0.001	-54	0.145	0.067	-54	0.295	0.136	-54	0.012	0.006	-54	0.092	0.043	-54	0.092	0.043	-54
2001	0.002	0.001	-58	0.186	0.078	-58	0.379	0.159	-58	0.015	0.007	-58	0.119	0.050	-58	0.119	0.050	-58
2002	0.002	0.001	-47	0.190	0.100	-47	0.387	0.203	-47	0.016	0.008	-47	0.121	0.064	-47	0.121	0.064	-47
2003	0.002	0.001	-42	0.206	0.119	-42	0.421	0.243	-42	0.017	0.010	-42	0.132	0.076	-42	0.132	0.076	-42
2004	0.002	0.001	-42	0.214	0.123	-42	0.436	0.251	-42	0.018	0.010	-42	0.137	0.079	-42	0.137	0.079	-42
2005	0.002	0.001	-41	0.190	0.112	-41	0.387	0.227	-41	0.016	0.009	-41	0.121	0.071	-41	0.121	0.071	-41
2006	0.002	0.001	-39	0.175	0.106	-39	0.356	0.216	-39	0.015	0.009	-39	0.112	0.068	-39	0.112	0.068	-39
2007	0.002	0.001	-40	0.173	0.103	-40	0.352	0.210	-40	0.014	0.009	-40	0.110	0.066	-40	0.110	0.066	-40
2008	0.002	0.001	-35	0.171	0.111	-35	0.348	0.227	-35	0.014	0.009	-35	0.109	0.071	-35	0.109	0.071	-35
2009	0.002	0.001	-37	0.187	0.117	-37	0.380	0.238	-37	0.016	0.010	-37	0.119	0.075	-37	0.119	0.075	-37
2010	0.002	0.001	-32	0.193	0.131	-32	0.394	0.267	-32	0.016	0.011	-32	0.124	0.084	-32	0.124	0.084	-32
2011	0.002	0.001	-30	0.202	0.140	-30	0.411	0.286	-30	0.017	0.012	-30	0.129	0.090	-30	0.129	0.090	-30
2012	0.002	0.001	-35	0.212	0.137	-35	0.432	0.279	-35	0.018	0.011	-35	0.135	0.087	-35	0.135	0.087	-35
2013	0.002	0.001	-30	0.211	0.147	-30	0.430	0.300	-30	0.018	0.012	-30	0.135	0.094	-30	0.135	0.094	-30

8.4. Waste sector (NFR 5)

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2015 and 2016 are given in the percentage difference.

5A Solid waste disposal on land

Solid waste disposal on land was totally recalculated according to the activity data gathered from the waste management system in EstEA. The difference in emissions between the 2015 and 2016 submissions are presented in Table 8.19.

Table 8.19 The differences in solid waste disposal on land emissions between the 2015 and 2016 submissions (%)

Year	NMVOC	PM _{2.5}	PM ₁₀	TSP
1990	100.00	NR	NR	100.00
1991	100.00	NR	NR	100.00
1992	100.00	NR	NR	100.00
1993	100.00	NR	NR	100.00
1994	100.00	NR	NR	100.00
1995	100.00	NR	NR	100.00
1996	100.00	NR	NR	100.00

Year	NMVOC	PM _{2.5}	PM ₁₀	TSP
1997	100.00	NR	NR	100.00
1998	100.00	NR	NR	100.00
1999	100.00	NR	NR	100.00
2000	100.00	100.00	100.00	100.00
2001	100.00	100.00	100.00	100.00
2002	100.00	100.00	100.00	100.00
2003	5421.59	100.00	100.00	100.00
2004	100.00	100.00	100.00	100.00
2005	100.00	100.00	100.00	100.00
2006	100.00	100.00	100.00	100.00
2007	100.00	100.00	100.00	100.00
2008	100.00	21.43	70.50	74.46
2009	2281.61	100.00	100.00	1472.73
2010	100.00	100.00	100.00	260.34
2011	100.00	-95.87	28.51	18.86
2012	100.00	-97.52	15.63	11.09
2013	2255.92	100.00	9.83	6.45

5B1 Composting of waste

NMVOC emissions for the years 2005-2012 were added to the inventory according to data submitted by facilities into the OSIS point sources database. Ammonia emissions were slightly corrected throughout the time series and the year 1990-1991 recalculated due to the calculation error done in the previous submission. CO emissions were calculated first time using emission factor presented in the EMEP/EEA Guidebook 2013.

The difference in emissions between the 2015 and 2016 submissions are presented in Table 8.20.

Table 8.20 The differences in composting of waste emissions between the 2015 and 2016 submissions (%)

Year	NMVOC	NH ₃	CO
1990	NE	175.03	100.00
1991	NE	175.00	100.00
1992	NE	0.00	100.00
1993	NE	0.01	100.00
1994	NE	0.00	100.00
1995	NE	0.01	100.00
1996	NE	0.01	100.00
1997	NE	-0.00	100.00
1998	NE	-0.01	100.00
1999	NE	-0.01	100.00
2000	NE	0.00	100.00
2001	NE	-0.00	100.00
2002	NE	-0.00	100.00
2003	NE	0.00	100.00
2004	NE	0.00	100.00
2005	100.00	0.06	100.00
2006	100.00	0.23	100.00
2007	100.00	0.27	100.00
2008	100.00	0.04	100.00

Year	NM VOC	NH ₃	CO
2009	100.00	0.10	100.00
2010	100.00	0.00	100.00
2011	100.00	0.00	100.00
2012	100.00	-1.29	100.00
2013	21.65	-0.95	100.00

5C1bi Industrial waste incineration

PM_{2.5}, PM₁₀ and BC emissions were calculated according to the emission factor presented in the EMEP/EEA Guidebook 2013. Cu emissions for the years 2008, 2012 and 2013 were corrected due to decimal place mistake done in the previous submission.

The difference in emissions between the 2015 and 2016 submissions are presented in Table 8.21.

Table 8.21 The differences in industrial waste incineration emissions between the 2015 and 2016 submissions (%)

Year	PM _{2.5}	PM ₁₀	BC	Cu
2008	100.00	100.00	100.00	99900.00
2009	100.00	100.00	100.00	
2010	100.00	100.00	100.00	
2011			100.00	
2012	100.00	100.00	100.00	102757.14
2013	100.00	100.00	100.00	99900.00

5C1bv Cremation

All the pollutant emissions (including heavy metals and POPs) in the cremation subsector were recalculated according to the activity data gathered from all the cremation facilities in Estonia using emission factors given in the EMEP/EEA Guidebook 2013.

The difference in emissions between the 2015 and 2016 submissions are presented in Table 8.22 (heavy metals and POPs emissions not included).

Table 8.22 The differences in cremation emissions between the 2015 and 2016 submissions (%)

Year	NO _x	NM VOC	SO _x	PM _{2.5}	PM ₁₀	TSP	CO
1993	100.00	100.00	100.00	NR	NR	100.00	100.00
1994	100.00	100.00	100.00	NR	NR	100.00	100.00
1995	100.00	100.00	100.00	NR	NR	100.00	100.00
1996	100.00	100.00	100.00	NR	NR	100.00	100.00
1997	100.00	100.00	100.00	NR	NR	100.00	100.00
1998	100.00	100.00	100.00	NR	NR	100.00	100.00
1999	100.00	100.00	100.00	NR	NR	100.00	100.00
2000	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2001	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2002	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2003	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2004	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Year	NO _x	NM VOC	SO _x	PM _{2.5}	PM ₁₀	TSP	CO
2005	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2006	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2007	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2008	7354.84	1725.00	1443.90	100.00	100.00	402.33	1164.52
2009	7292.19	-99.21	1480.49	100.00	100.00	413.95	1154.69
2010	1281.13	-99.19	521.24	100.00	100.00	378.00	3525.00
2011	1337.06	-99.12	543.09	100.00	100.00	400.00	3669.23
2012	1325.94	-85.23	541.86	100.00	100.00	396.49	3700.00
2013	1331.84	-75.01	542.97	100.00	100.00	401.77	3700.74

5C2 Open burning of waste

Additional BC emissions were calculated from open burning of waste for the period of 2000-2012 using emission factor presented in the EMEP/EEA Guidebook 2013.

5D2 Industrial wastewater handling

Some improvements in data allocation between SNAP activity codes were made in the OSIS point sources database. The difference in emissions between the 2015 and 2016 submissions are presented in Table 8.23.

Table 8.23 The differences in industrial wastewater handling emissions between the 2015 and 2016 submissions (%)

Year	NO _x	NM VOC	SO _x
2013	291.14	-8.17	3048.21

5E Other waste

All recalculations in other waste sector were based on corrections of estimation error. The difference in emissions between the 2015 and 2016 submissions are presented in Table 8.24.

Table 8.24 The differences in other waste sector emissions between the 2015 and 2016 submissions (%)

Year	NO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	PCDD/F
2004	NA	NA	0.03	0.03	0.03	0.03
2012	1.39	100.00				
2013	366.25	100.00				



Source: www.cakover.hr

9. PROJECTIONS

Projections

Emission projections have been calculated based on national strategic documents, also action plans of biggest stakeholders have been taken into account where possible. In some cases projections exceed the national emission ceilings agreed for Estonia during amendments made to LRTAP Gothenburg Protocol in 2012 and the emission ceilings currently under negotiation for 2030. In these cases further work identifying applicable further measures and/or development of projection methodologies is planned in the future.

For practical reasons the emissions from sectors 1A1, 1A2 and Industrial Processes should be viewed together, since in some cases for exceptional activities emissions from one activity might be reflected under different sectors in reporting and projections.

Regarding specific substances, biggest changes in projections were made for agriculture (methodological change from Tier 1 to Tier 2 methodology) and for emissions from domestic sector, where emission factors from measurements carried out in Estonia were used for the first time.

Table 9.1 National emission projections for 2020, 2025 and 2030

	Emission projections for 2020 (kt)	Emission projections for 2025 (kt)	Emission projections for 2030 (kt)
NO _x	33.65	30.86	26.99
NM VOC	26.09	25.57	22.31
SO _x (as SO ₂)	39.23	29.73	24.57
NH ₃	13.13	13.14	13.14

ANNEX I

Key sources categories level assessment

Table 1 Key source categories for NO_x emissions for 2014, level assessment

NFR code	Longname	2014 (kt)	Cumulative Total
1A1a	Public electricity and heat production	10.1672	30.5%
1A4bi	Residential: Stationary	4.9937	45.5%
1A3biii	Road transport: Heavy duty vehicles and buses	4.5555	59.1%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	3.3036	69.1%
1A3bi	Road transport: Passenger cars	3.0444	78.2%
1A3c	Railways	1.0505	81.3%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	1.0310	84.4%
1A2gvii	Mobile Combustion in manufacturing industries and construction	1.0051	87.5%
3Da1	Inorganic N-fertilizers (includes also urea application)	0.9309	90.2%
1A3bii	Road transport: Light duty vehicles	0.7011	92.3%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.4760	93.8%
1A3dii	National navigation (shipping)	0.3608	94.9%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.3482	95.9%
1A4ai	Commercial/institutional: Stationary	0.3162	96.9%
1A1c	Manufacture of solid fuels and other energy industries	0.2790	97.7%
1A4aii	Commercial/institutional: Mobile	0.2630	98.5%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1052	98.8%
1A3ai(i)	International aviation LTO (civil)	0.0740	99.0%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0658	99.2%
1A4bii	Residential: Household and gardening (mobile)	0.0638	99.4%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0428	99.5%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.0234	99.6%
2C7c	Other metal production	0.0203	99.7%
3B1a	Manure management - Dairy cattle	0.0120	99.7%
3B1b	Manure management - Non-dairy cattle	0.0105	99.7%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0082	99.8%
1A3biv	Road transport: Mopeds & motorcycles	0.0078	99.8%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	0.0072	99.8%
5C1bi	Industrial waste incineration	0.0071	99.8%
1A1b	Petroleum refining	0.0067	99.8%
2A5a	Quarrying and mining of minerals other than coal	0.0065	99.9%
5C1bv	Cremation	0.0062	99.9%
5C2	Open burning of waste	0.0058	99.9%
5A	Biological treatment of waste - Solid waste disposal on land	0.0051	99.9%
3B3	Manure management - Swine	0.0042	99.9%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0035	99.9%
2G	Other product use	0.0034	99.9%
2H1	Pulp and paper industry	0.0028	100.0%
3B4gi	Manure management - Laying hens	0.0023	100.0%
3B4giv	Manure management - Other poultry	0.0020	100.0%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0017	100.0%
1A3aii(i)	Domestic aviation LTO (civil)	0.0016	100.0%
5D2	Industrial wastewater handling	0.0015	100.0%
3B4gii	Manure management - Broilers	0.0014	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0013	100.0%

NFR code	Longname	2014 (kt)	Cumulative Total
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0012	100.0%
3B4e	Manure management - Horses	0.0008	100.0%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0005	100.0%
3B2	Manure management - Sheep	0.0005	100.0%
5E	Other waste	0.0003	100.0%
2H2	Food and beverages industry	0.0003	100.0%
5D1	Domestic wastewater handling	0.0001	100.0%
2C1	Iron and steel production	0.0001	100.0%
3B4h	Manure management - Other animals	0.0000	100.0%
2I	Wood processing	0.0000	100.0%

Table 2 Key source categories for NMVOC emissions for 2014, level assessment

NFR code	Longname	2014 (kt)	Cumulative Total
1A4bi	Residential: Stationary	3.4881	15.5%
2D3d	Coating applications	3.1740	29.6%
3B3	Manure management - Swine	1.7211	37.2%
2D3a	Domestic solvent use including fungicides	1.5790	44.3%
3B1a	Manure management - Dairy cattle	1.3002	50.0%
3B1b	Manure management - Non-dairy cattle	1.2513	55.6%
1B2av	Distribution of oil products	1.1642	60.8%
1A3bi	Road transport: Passenger cars	1.1340	65.8%
2D3e	Degreasing	0.9786	70.1%
2H2	Food and beverages industry	0.6958	73.2%
2D3i	Other solvent use	0.5502	75.7%
1A1a	Public electricity and heat production	0.4910	77.9%
1A4bii	Residential: Household and gardening (mobile)	0.4702	80.0%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.4699	82.0%
2D3h	Printing	0.4567	84.1%
1A3bv	Road transport: Gasoline evaporation	0.4036	85.9%
2D3g	Chemical products	0.3377	87.4%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.3173	88.8%
3B4giv	Manure management - Other poultry	0.2470	89.9%
3B4h	Manure management - Other animals	0.2158	90.8%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1916	91.7%
1B2aiv	Fugitive emissions oil: Refining / storage	0.1850	92.5%
1A4aii	Commercial/institutional: Mobile	0.1762	93.3%
1A3biii	Road transport: Heavy duty vehicles and buses	0.1632	94.0%
3B4gii	Manure management - Broilers	0.1510	94.7%
1A1c	Manufacture of solid fuels and other energy industries	0.1444	95.3%
5A	Biological treatment of waste - Solid waste disposal on land	0.1392	95.9%
3B4gi	Manure management - Laying hens	0.1242	96.5%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.1038	96.9%
1A3c	Railways	0.0932	97.4%
1A3dii	National navigation (shipping)	0.0700	97.7%
1A3bii	Road transport: Light duty vehicles	0.0669	98.0%
2H1	Pulp and paper industry	0.0653	98.3%
2B10b	Storage, handling and transport of chemical products	0.0637	98.5%
1A4ai	Commercial/institutional: Stationary	0.0516	98.8%
2D3f	Dry cleaning	0.0412	99.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0410	99.1%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0409	99.3%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0212	99.4%

NFR code	Longname	2014 (kt)	Cumulative Total
2D3b	Road paving with asphalt	0.0206	99.5%
3B2	Manure management - Sheep	0.0181	99.6%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0164	99.7%
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	0.0152	99.7%
1A3ai(i)	International aviation LTO (civil)	0.0115	99.8%
2B10a	Chemical industry: Other	0.0093	99.8%
2G	Other product use	0.0088	99.9%
2C7c	Other metal production	0.0070	99.9%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0049	99.9%
5B1	Biological treatment of waste - Composting	0.0037	99.9%
5E	Other waste	0.0035	99.9%
1A3aii(i)	Domestic aviation LTO (civil)	0.0034	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0019	100.0%
1A1b	Petroleum refining	0.0017	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0016	100.0%
5D2	Industrial wastewater handling	0.0011	100.0%
2I	Wood processing	0.0011	100.0%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0007	100.0%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	0.0006	100.0%
5C1bi	Industrial waste incineration	0.0005	100.0%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0002	100.0%
5C1bv	Cremation	0.0001	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0001	100.0%
5C2	Open burning of waste	0.0001	100.0%
5D1	Domestic wastewater handling	0.0000	100.0%
2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	0.0000	100.0%
2C3	Aluminium production	0.0000	100.0%
3Da1	Inorganic N-fertilizers (includes also urea application)	0.0000	100.0%

Table 3 Key source categories for SO_x emissions for 2014, level assessment

NFR code	Longname	2014 (kt)	Cumulative Total
1A1a	Public electricity and heat production	34.3371	84.1%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	3.8871	93.6%
1A1c	Manufacture of solid fuels and other energy industries	1.1537	96.4%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.5290	97.7%
1A4bi	Residential: Stationary	0.4280	98.8%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1539	99.1%
1A4ai	Commercial/institutional: Stationary	0.1431	99.5%
1A3c	Railways	0.0401	99.6%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.0282	99.7%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0260	99.7%
1A3dii	National navigation (shipping)	0.0188	99.8%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0173	99.8%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0172	99.9%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0069	99.9%
1A3ai(i)	International aviation LTO (civil)	0.0066	99.9%
5C1bi	Industrial waste incineration	0.0061	99.9%

NFR code	Longname	2014 (kt)	Cumulative Total
5A	Biological treatment of waste - Solid waste disposal on land	0.0059	99.9%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0058	99.9%
5C2	Open burning of waste	0.0055	99.9%
1A3bi	Road transport: Passenger cars	0.0052	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0028	100.0%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0024	100.0%
5D2	Industrial wastewater handling	0.0022	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0021	100.0%
2G	Other product use	0.0016	100.0%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0012	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0011	100.0%
5C1bv	Cremation	0.0009	100.0%
1A3bii	Road transport: Light duty vehicles	0.0008	100.0%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0006	100.0%
2H1	Pulp and paper industry	0.0004	100.0%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	0.0003	100.0%
1A3aii(i)	Domestic aviation LTO (civil)	0.0003	100.0%
1A4aii	Commercial/institutional: Mobile	0.0001	100.0%
2C7c	Other metal production	0.0001	100.0%
5D1	Domestic wastewater handling	0.0001	100.0%
1A4bii	Residential: Household and gardening (mobile)	0.0001	100.0%
2A5a	Quarrying and mining of minerals other than coal	0.0000	100.0%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.0000	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0000	100.0%
2B10a	Chemical industry: Other	0.0000	100.0%
2C5	Lead production	0.0000	100.0%
2H2	Food and beverages industry	0.0000	100.0%
2I	Wood processing	0.0000	100.0%

Table 4 Key source categories for NH₃ emissions for 2014, level assessment

NFR code	Longname	2014 (kt)	Cumulative Total
3B1a	Manure management - Dairy cattle	3.1830	24.4%
3Da1	Inorganic N-fertilizers (includes also urea application)	3.0075	47.5%
3B3	Manure management - Swine	1.8842	61.9%
3Da3	Urine and dung deposited by grazing animals	1.3699	72.4%
3B1b	Manure management - Non-dairy cattle	1.3498	82.8%
3B4giv	Manure management - Other poultry	0.4799	86.4%
3B4gi	Manure management - Laying hens	0.3613	89.2%
1A4bi	Residential: Stationary	0.3334	91.8%
3B4gii	Manure management - Broilers	0.3076	94.1%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.1912	95.6%
1A3bi	Road transport: Passenger cars	0.1508	96.8%
3B2	Manure management - Sheep	0.1267	97.7%
3B4e	Manure management - Horses	0.0932	98.4%
5B1	Biological treatment of waste - Composting	0.0855	99.1%
2C7c	Other metal production	0.0428	99.4%
1A1c	Manufacture of solid fuels and other energy industries	0.0394	99.7%
2B10b	Storage, handling and transport of chemical products	0.0080	99.8%
2G	Other product use	0.0075	99.8%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0040	99.9%
1A3bii	Road transport: Light duty vehicles	0.0037	99.9%
2D3g	Chemical products	0.0029	99.9%
3B4h	Manure management - Other animals	0.0022	99.9%

NFR code	Longname	2014 (kt)	Cumulative Total
1A1a	Public electricity and heat production	0.0022	100.0%
5E	Other waste	0.0018	100.0%
2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	0.0011	100.0%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0008	100.0%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0002	100.0%
5C1bi	Industrial waste incineration	0.0002	100.0%
2B10a	Chemical industry: Other	0.0002	100.0%
1A3c	Railways	0.0001	100.0%
5D2	Industrial wastewater handling	0.0001	100.0%
1A3dii	National navigation (shipping)	0.0001	100.0%
1A4aii	Commercial/institutional: Mobile	0.0001	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0001	100.0%
5D1	Domestic wastewater handling	0.0000	100.0%
5A	Biological treatment of waste - Solid waste disposal on land	0.0000	100.0%
1A4bii	Residential: Household and gardening (mobile)	0.0000	100.0%
5C1bv	Cremation	0.0000	100.0%
2D3i	Other solvent use	0.0000	100.0%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0000	100.0%

Table 5 Key source categories for PM_{2.5} emissions for 2014, level assessment

NFR code	Longname	2014 (kt)	Cumulative Total
1A1a	Public electricity and heat production	2.7004	34.7%
1A4bi	Residential: Stationary	2.2706	63.9%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.8570	74.9%
1A4ai	Commercial/institutional: Stationary	0.1975	77.5%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1935	80.0%
1A1c	Manufacture of solid fuels and other energy industries	0.1887	82.4%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1638	84.5%
1A3bi	Road transport: Passenger cars	0.1479	86.4%
1A3bvi	Road transport: Automobile tyre and brake wear	0.0943	87.6%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0817	88.7%
2G	Other product use	0.0758	89.6%
5E	Other waste	0.0753	90.6%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0639	91.4%
2H1	Pulp and paper industry	0.0542	92.1%
1A3bvii	Road transport: Automobile road abrasion	0.0516	92.8%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0478	93.4%
1A3dii	National navigation (shipping)	0.0432	94.0%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0420	94.5%
1A3bii	Road transport: Light duty vehicles	0.0378	95.0%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0355	95.4%
3Da1	Inorganic N-fertilizers (includes also urea application)	0.0306	95.8%
5C2	Open burning of waste	0.0297	96.2%
3B3	Manure management - Swine	0.0290	96.6%
1A3c	Railways	0.0275	96.9%
3B1b	Manure management - Non-dairy cattle	0.0271	97.3%
2I	Wood processing	0.0233	97.6%
3B1a	Manure management - Dairy cattle	0.0220	97.9%
2C7c	Other metal production	0.0215	98.2%
1A4aii	Commercial/institutional: Mobile	0.0189	98.4%
3B4gi	Manure management - Laying hens	0.0173	98.6%

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NFR code	Longname	2014 (kt)	Cumulative Total
2A5b	Construction and demolition	0.0138	98.8%
3B4gii	Manure management - Broilers	0.0126	99.0%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0117	99.1%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0115	99.3%
1A4bii	Residential: Household and gardening (mobile)	0.0100	99.4%
2A5a	Quarrying and mining of minerals other than coal	0.0097	99.5%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.0071	99.6%
2H2	Food and beverages industry	0.0056	99.7%
2A1	Cement production	0.0043	99.7%
2B10a	Chemical industry: Other	0.0037	99.8%
2A6	Other mineral products	0.0022	99.8%
3B4giv	Manure management - Other poultry	0.0020	99.8%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0017	99.9%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0016	99.9%
3B2	Manure management - Sheep	0.0015	99.9%
2C3	Aluminium production	0.0014	99.9%
2D3b	Road paving with asphalt	0.0013	99.9%
3B4e	Manure management - Horses	0.0009	99.9%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0008	99.9%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0008	100.0%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0006	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0006	100.0%
3B4h	Manure management - Other animals	0.0005	100.0%
1A3ai(i)	International aviation LTO (civil)	0.0005	100.0%
2B10b	Storage, handling and transport of chemical products	0.0004	100.0%
5C1bv	Cremation	0.0003	100.0%
2C1	Iron and steel production	0.0001	100.0%
2C5	Lead production	0.0001	100.0%
5C1bi	Industrial waste incineration	0.0001	100.0%
2A2	Lime production	0.0000	100.0%
2C6	Zinc production	0.0000	100.0%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.0000	100.0%
1A3aii(i)	Domestic aviation LTO (civil)	0.0000	100.0%
2C7a	Copper production	0.0000	100.0%
5A	Biological treatment of waste - Solid waste disposal on land	0.0000	100.0%

Table 6 Key source categories for PM₁₀ emissions for 2014, level assessment

NFR code	Longname	2014 (kt)	Cumulative Total
1A1a	Public electricity and heat production	5.2101	41.7%
1A4bi	Residential: Stationary	2.3590	60.6%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.9773	68.4%
3Da1	Inorganic N-fertilizers (includes also urea application)	0.7961	74.8%
1A1c	Manufacture of solid fuels and other energy industries	0.4010	78.0%
1A4ai	Commercial/institutional: Stationary	0.2326	79.8%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.2022	81.5%
3B3	Manure management - Swine	0.1817	82.9%
1A3bvi	Road transport: Automobile tyre and brake wear	0.1757	84.3%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1638	85.6%
1A3bi	Road transport: Passenger cars	0.1479	86.8%
2A5b	Construction and demolition	0.1381	87.9%
2G	Other product use	0.1006	88.7%
3B4gii	Manure management - Broilers	0.0965	89.5%

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NFR code	Longname	2014 (kt)	Cumulative Total
1A3bvii	Road transport: Automobile road abrasion	0.0949	90.2%
2A5a	Quarrying and mining of minerals other than coal	0.0904	91.0%
3B4gi	Manure management - Laying hens	0.0896	91.7%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0817	92.3%
2I	Wood processing	0.0758	93.0%
5E	Other waste	0.0753	93.6%
2H1	Pulp and paper industry	0.0722	94.1%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.0697	94.7%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0639	95.2%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0535	95.6%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0501	96.0%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0460	96.4%
5C2	Open burning of waste	0.0442	96.8%
1A3dii	National navigation (shipping)	0.0432	97.1%
3B1b	Manure management - Non-dairy cattle	0.0406	97.4%
1A3bii	Road transport: Light duty vehicles	0.0378	97.7%
3B1a	Manure management - Dairy cattle	0.0344	98.0%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0334	98.3%
2C7c	Other metal production	0.0294	98.5%
1A3c	Railways	0.0289	98.7%
2D3b	Road paving with asphalt	0.0258	98.9%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0252	99.1%
1A4aii	Commercial/institutional: Mobile	0.0189	99.3%
2H2	Food and beverages industry	0.0168	99.4%
3B4giv	Manure management - Other poultry	0.0162	99.6%
2B10a	Chemical industry: Other	0.0111	99.6%
1A4bii	Residential: Household and gardening (mobile)	0.0100	99.7%
2A1	Cement production	0.0078	99.8%
2A6	Other mineral products	0.0066	99.8%
3B2	Manure management - Sheep	0.0050	99.9%
2C3	Aluminium production	0.0028	99.9%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0020	99.9%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0017	99.9%
3B4e	Manure management - Horses	0.0014	99.9%
2B10b	Storage, handling and transport of chemical products	0.0012	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0010	100.0%
3B4h	Manure management - Other animals	0.0009	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0008	100.0%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0008	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0006	100.0%
1A3ai(i)	International aviation LTO (civil)	0.0005	100.0%
5A	Biological treatment of waste - Solid waste disposal on land	0.0003	100.0%
5C1bv	Cremation	0.0003	100.0%
2A2	Lime production	0.0002	100.0%
2C1	Iron and steel production	0.0001	100.0%
2C5	Lead production	0.0001	100.0%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.0001	100.0%
5C1bi	Industrial waste incineration	0.0001	100.0%
2C6	Zinc production	0.0001	100.0%
1A3aii(i)	Domestic aviation LTO (civil)	0.0000	100.0%
2C7a	Copper production	0.0000	100.0%

Table 7 Key source categories for TSP emissions for 2014, level assessment

NFR code	Longname	2014 (kt)	Cumulative Total
1A1a	Public electricity and heat production	6.9357	41.7%
1A4bi	Residential: Stationary	2.5586	57.0%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	1.4064	65.5%
3Da1	Inorganic N-fertilizers (includes also urea application)	0.7961	70.3%
1A1c	Manufacture of solid fuels and other energy industries	0.5369	73.5%
3B3	Manure management - Swine	0.4038	75.9%
1A4ai	Commercial/institutional: Stationary	0.3371	77.9%
2A5b	Construction and demolition	0.2755	79.6%
1A3bvi	Road transport: Automobile tyre and brake wear	0.2260	80.9%
2I	Wood processing	0.2120	82.2%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.2109	83.5%
2A5a	Quarrying and mining of minerals other than coal	0.1975	84.7%
2D3b	Road paving with asphalt	0.1934	85.8%
1A3bvii	Road transport: Automobile road abrasion	0.1898	87.0%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.1809	88.1%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1638	89.0%
1A3bi	Road transport: Passenger cars	0.1479	89.9%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.1423	90.8%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.1059	91.4%
2G	Other product use	0.1058	92.1%
3B4gii	Manure management - Broilers	0.0965	92.6%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0924	93.2%
2H1	Pulp and paper industry	0.0903	93.7%
3B1b	Manure management - Non-dairy cattle	0.0901	94.3%
3B4gi	Manure management - Laying hens	0.0896	94.8%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0817	95.3%
3B1a	Manure management - Dairy cattle	0.0764	95.8%
5E	Other waste	0.0753	96.2%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0671	96.6%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0639	97.0%
5C2	Open burning of waste	0.0590	97.4%
2C7c	Other metal production	0.0511	97.7%
2H2	Food and beverages industry	0.0508	98.0%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0437	98.2%
1A3dii	National navigation (shipping)	0.0432	98.5%
1A3bii	Road transport: Light duty vehicles	0.0378	98.7%
3B4giv	Manure management - Other poultry	0.0346	98.9%
2B10a	Chemical industry: Other	0.0335	99.1%
1A3c	Railways	0.0305	99.3%
2A6	Other mineral products	0.0199	99.4%
1A4aii	Commercial/institutional: Mobile	0.0189	99.5%
2D3i	Other solvent use	0.0149	99.6%
3B2	Manure management - Sheep	0.0126	99.7%
1A4bii	Residential: Household and gardening (mobile)	0.0100	99.8%
2A1	Cement production	0.0086	99.8%
2C3	Aluminium production	0.0041	99.8%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0040	99.9%
2B10b	Storage, handling and transport of chemical products	0.0038	99.9%
3B4e	Manure management - Horses	0.0030	99.9%
2D3g	Chemical products	0.0028	99.9%

NFR code	Longname	2014 (kt)	Cumulative Total
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0026	99.9%
3B4h	Manure management - Other animals	0.0020	99.9%
2D3d	Coating applications	0.0018	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0012	100.0%
5A	Biological treatment of waste - Solid waste disposal on land	0.0010	100.0%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0009	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0008	100.0%
2A2	Lime production	0.0006	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0006	100.0%
1A3ai(i)	International aviation LTO (civil)	0.0005	100.0%
5C1bv	Cremation	0.0003	100.0%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.0002	100.0%
2C1	Iron and steel production	0.0002	100.0%
2C5	Lead production	0.0001	100.0%
5C1bi	Industrial waste incineration	0.0001	100.0%
2D3h	Printing	0.0001	100.0%
2C6	Zinc production	0.0001	100.0%
1A3aii(i)	Domestic aviation LTO (civil)	0.0000	100.0%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	0.0000	100.0%
2C7a	Copper production	0.0000	100.0%
5D2	Industrial wastewater handling	0.0000	100.0%

Table 8 Key source categories for CO emissions for 2014, level assessment

NFR code	Longname	2014 (kt)	Cumulative Total
1A4bi	Residential: Stationary	69.2621	54.7%
1A1c	Manufacture of solid fuels and other energy industries	25.8853	75.2%
1A3bi	Road transport: Passenger cars	10.8177	83.8%
1A1a	Public electricity and heat production	6.5076	88.9%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	3.1540	91.4%
1A4bii	Residential: Household and gardening (mobile)	2.5330	93.4%
1A3biii	Road transport: Heavy duty vehicles and buses	1.1181	94.3%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	1.0314	95.1%
1B2aiv	Fugitive emissions oil: Refining / storage	0.8588	95.8%
1A4ai	Commercial/institutional: Stationary	0.6503	96.3%
1A3bii	Road transport: Light duty vehicles	0.6260	96.8%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.6181	97.3%
1A3biv	Road transport: Mopeds & motorcycles	0.5028	97.7%
1A4aii	Commercial/institutional: Mobile	0.4678	98.0%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.3672	98.3%
2B10a	Chemical industry: Other	0.3665	98.6%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.3294	98.9%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.2163	99.0%
1A3c	Railways	0.2145	99.2%
1A3dii	National navigation (shipping)	0.1860	99.4%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.1681	99.5%
1A3ai(i)	International aviation LTO (civil)	0.1231	99.6%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.1227	99.7%
2G	Other product use	0.1036	99.8%
5B1	Biological treatment of waste - Composting	0.0784	99.8%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0564	99.9%

NFR code	Longname	2014 (kt)	Cumulative Total
1A3aii(i)	Domestic aviation LTO (civil)	0.0461	99.9%
2C7c	Other metal production	0.0211	99.9%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0165	99.9%
5A	Biological treatment of waste - Solid waste disposal on land	0.0139	100.0%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0115	100.0%
1A1b	Petroleum refining	0.0086	100.0%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	0.0076	100.0%
2A5a	Quarrying and mining of minerals other than coal	0.0062	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0052	100.0%
5C1bi	Industrial waste incineration	0.0034	100.0%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0034	100.0%
2H1	Pulp and paper industry	0.0023	100.0%
2D3g	Chemical products	0.0023	100.0%
5C2	Open burning of waste	0.0023	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0012	100.0%
5C1bv	Cremation	0.0011	100.0%
5D2	Industrial wastewater handling	0.0005	100.0%
2H2	Food and beverages industry	0.0004	100.0%
2C1	Iron and steel production	0.0001	100.0%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.0000	100.0%

Table 9 Key source categories for Pb emissions for 2014, level assessment

NFR code	Longname	2014 (t)	Cumulative Total
1A1a	Public electricity and heat production	34.3305	93.9%
1A4bi	Residential: Stationary	0.4648	95.2%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.4069	96.3%
2G	Other product use	0.4056	97.4%
5C2	Open burning of waste	0.3354	98.3%
1A3bvi	Road transport: Automobile tyre and brake wear	0.2392	99.0%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0830	99.2%
1A4ai	Commercial/institutional: Stationary	0.0774	99.4%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0501	99.6%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0331	99.7%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0287	99.7%
1A3bi	Road transport: Passenger cars	0.0183	99.8%
1A4bii	Residential: Household and gardening (mobile)	0.0182	99.8%
2C5	Lead production	0.0165	99.9%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0113	99.9%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0101	100.0%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0050	100.0%
1A3bii	Road transport: Light duty vehicles	0.0033	100.0%
1A4aii	Commercial/institutional: Mobile	0.0031	100.0%
1A1c	Manufacture of solid fuels and other energy industries	0.0030	100.0%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0008	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0006	100.0%
2C7c	Other metal production	0.0005	100.0%
5C1bv	Cremation	0.0002	100.0%
5E	Other waste	0.0002	100.0%
2D3i	Other solvent use	0.0002	100.0%

NFR code	Longname	2014 (t)	Cumulative Total
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0002	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0001	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0001	100.0%
2D3e	Degreasing	0.0001	100.0%
2D3d	Coating applications	0.0001	100.0%

Table 10 Key source categories for Cd emissions for 2014, level assessment

NFR code	Longname	2014 (t)	Cumulative Total
1A1a	Public electricity and heat production	0.6315	70.3%
1A4bi	Residential: Stationary	0.2027	92.9%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.0120	94.2%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0119	95.6%
5C2	Open burning of waste	0.0110	96.8%
2G	Other product use	0.0106	98.0%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0046	98.5%
1A3bi	Road transport: Passenger cars	0.0043	98.9%
1A4ai	Commercial/institutional: Stationary	0.0025	99.2%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0017	99.4%
1A3bvi	Road transport: Automobile tyre and brake wear	0.0011	99.5%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0009	99.6%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0008	99.7%
1A3bii	Road transport: Light duty vehicles	0.0006	99.8%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0005	99.9%
5E	Other waste	0.0004	99.9%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0003	99.9%
1A3c	Railways	0.0002	100.0%
1A3dii	National navigation (shipping)	0.0001	100.0%
1A4aii	Commercial/institutional: Mobile	0.0001	100.0%

Table 11 Key source categories for Hg emissions for 2014, level assessment

NFR code	Longname	2014 (t)	Cumulative Total
1A1a	Public electricity and heat production	0.6288	92.5%
5C1bv	Cremation	0.0112	94.2%
1A4bi	Residential: Stationary	0.0101	95.7%
5C2	Open burning of waste	0.0090	97.0%
2D3a	Domestic solvent use including fungicides	0.0074	98.1%
2G	Other product use	0.0049	98.8%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.0034	99.3%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0025	99.7%
1A4ai	Commercial/institutional: Stationary	0.0013	99.9%
5E	Other waste	0.0004	99.9%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0002	100.0%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0001	100.0%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0000	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0000	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0000	100.0%

NFR code	Longname	2014 (t)	Cumulative Total
1A1c	Manufacture of solid fuels and other energy industries	0.0000	100.0%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0000	100.0%

Table 12 Key source categories for PCB emissions for 2014, level assessment

NFR code	Longname	2014 (kg)	Cumulative Total
1A1a	Public electricity and heat production	3.1196	73.9%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.7788	92.3%
1A4ai	Commercial/institutional: Stationary	0.2175	97.5%
1A4bi	Residential: Stationary	0.0625	98.9%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0191	99.4%
5C2	Open burning of waste	0.0171	99.8%
1A1c	Manufacture of solid fuels and other energy industries	0.0051	99.9%
5C1bv	Cremation	0.0031	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0002	100.0%
1A3bi	Road transport: Passenger cars	0.0001	100.0%

Table 13 Key source categories for PCDD/PCDF emissions for 2014, level assessment

NFR code	Longname	2014 (kg)	Cumulative Total
1A1a	Public electricity and heat production	1.1184	28.4%
1A4bi	Residential: Stationary	1.0118	54.2%
5E	Other waste	0.7618	73.6%
5C1bi	Industrial waste incineration	0.2498	79.9%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.2221	85.6%
1A3bi	Road transport: Passenger cars	0.2175	91.1%
5C2	Open burning of waste	0.1290	94.4%
5C1biii	Clinical waste incineration	0.0734	96.2%
1A4ai	Commercial/institutional: Stationary	0.0514	97.5%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0498	98.8%
1A3bii	Road transport: Light duty vehicles	0.0332	99.7%
1A1c	Manufacture of solid fuels and other energy industries	0.0088	99.9%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0034	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0009	100.0%
5C1bv	Cremation	0.0002	100.0%
2G	Other product use	0.0002	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0001	100.0%
1A1b	Petroleum refining	0.0001	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0000	100.0%

Table 14 Key source categories for PAHs emissions for 2014, level assessment

NFR code	Longname	2014 (kg)	Cumulative Total
1A4bi	Residential: Stationary	3.1896	45.5%
1A1a	Public electricity and heat production	2.7560	84.8%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.7802	95.9%
1A4ai	Commercial/institutional: Stationary	0.2107	98.9%
1A3bi	Road transport: Passenger cars	0.0284	99.3%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0149	99.5%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0129	99.7%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0075	99.8%
1A3bii	Road transport: Light duty vehicles	0.0055	99.9%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0025	99.9%

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NFR code	Longname	2014 (kg)	Cumulative Total
1A3c	Railways	0.0025	99.9%
1A1c	Manufacture of solid fuels and other energy industries	0.0012	100.0%
1A3dii	National navigation (shipping)	0.0008	100.0%
1A4aii	Commercial/institutional: Mobile	0.0007	100.0%
2G	Other product use	0.0004	100.0%
1A4bii	Residential: Household and gardening (mobile)	0.0003	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0002	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0001	100.0%
5C2	Open burning of waste	0.0000	100.0%
5C1bv	Cremation	0.0000	100.0%

Table 15 Key source categories for HCB emissions for 2014, level assessment

NFR code	Longname	2014 (kg)	Cumulative Total
1A4bi	Residential: Stationary	0.1620	58.3%
1A1a	Public electricity and heat production	0.0787	86.6%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.0227	94.8%
5C2	Open burning of waste	0.0065	97.1%
1A4ai	Commercial/institutional: Stationary	0.0061	99.3%
5C1bv	Cremation	0.0011	99.7%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0004	99.9%
1A3bi	Road transport: Passenger cars	0.0003	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0000	100.0%
1A1c	Manufacture of solid fuels and other energy industries	0.0000	100.0%
1A1b	Petroleum refining	0.0000	100.0%

ANNEX II

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