FINLAND'S INFORMATIVE INVENTORY REPORT 2024

Air Pollutant Emissions 1980-2022

under the UNECE CLRTAP and the EU NECD

Part 4 – IPPU

March 2024

FINNISH ENVIRONMENT INSTITUTE

Climate solutions unit

Air pollution group

Finland’s IIR

Part 4

IPPU

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PART 4 IPPU

4 INDUSTRIAL PROCESSES and PRODUCT USE (NFR 2)

INDUSTRIAL PROCESSES AND PRODUCT USE (NFR 2)

4.1 Overview of the sector

Changes in chapter	
January 2020	KS

The main activities in the Industrial processes and product use sector in respect to air pollutant emissions in Finland are mineral, chemical, metal and forest industries, as presented in Figure 4.1

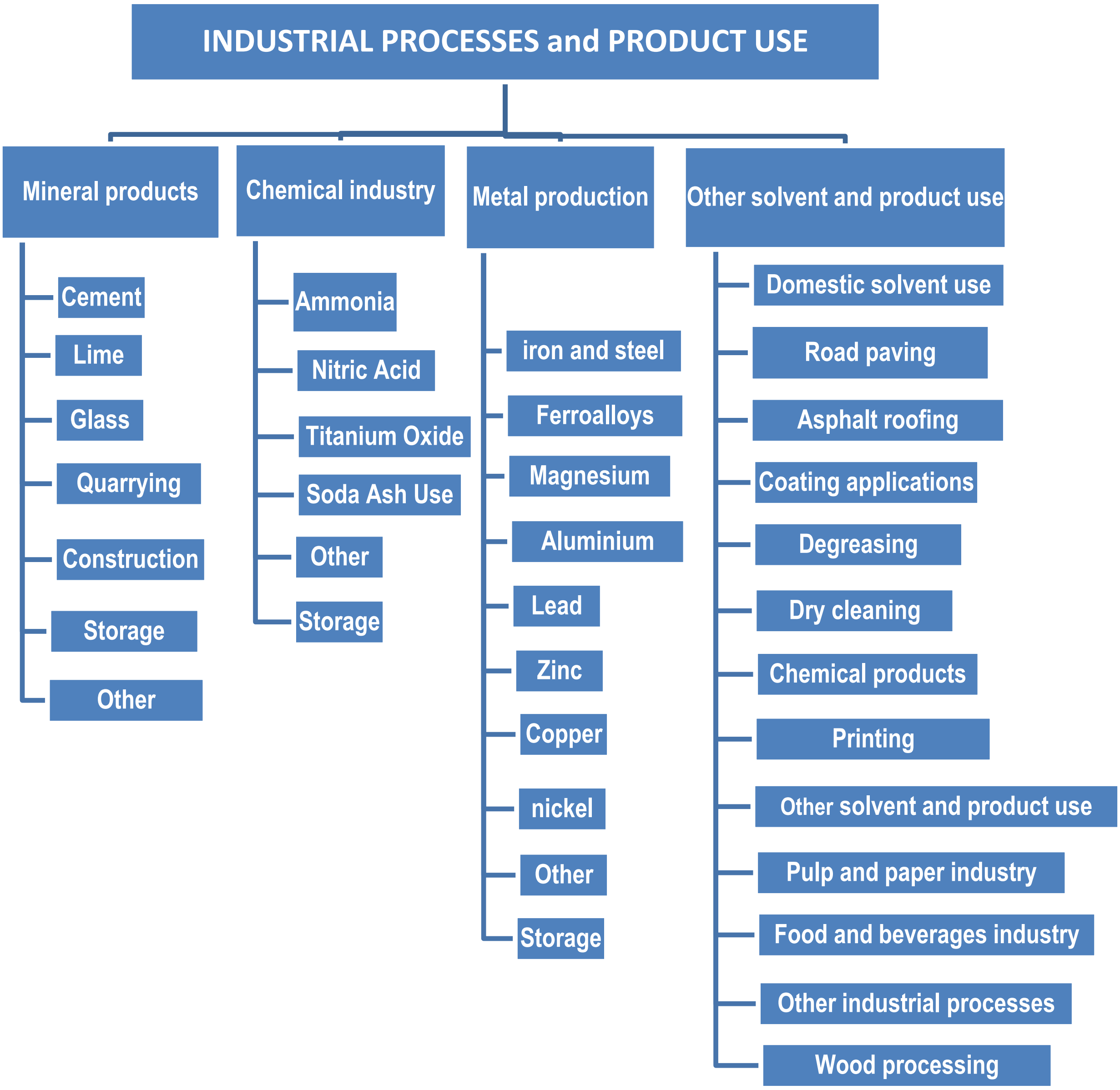


Figure 4.1 Industrial process included in the Finnish air pollutant inventory.

Allocation of emissions in the NFR Table

Emissions from industrial activities are allocated under the NFR categories as follows:

Energy	NFR 1	production of electricity consumed in the industry
		electricity and heat autoproducers in the industry
		use of off-road machinery and industrial transport
IPPU	NFR 2	production processes
Waste	NFR 5	industrial waste management

Data reported by the plants

Plant operators report their emissions to the supervising authorities[1] according to the monitoring requirements in their environmental permits. In some cases, the reporting obligations determined in the monitoring programmes are for the total emissions of the plants and not separately for fuel combustion or the individual process emissions. In the case of all the emissions reported in YLVA, the emissions have been classified either as combustion based or process related emissions in the calculation system of the air pollutant emission inventory. In cases where the emissions have been classified as energy related emissions (fuel based), all emissions are reported under the relevant NFR 1A2 or 1A1 subcategory.

In the cases where the reported emissions data in the YLVA system clearly are the total figure of energy and process related emission, the process related emissions are estimated as the difference between the total emissions reported by the plant and the default emissions calculated on basis of fuel consumption, the difference is reported under the industrial process categories. These cases relate mainly to paticulate matter (TSP) emissions reported by a relatively small number of plants.

Condensable part of particulate matter

TSP emission concentrations are measured in the stack according to the agreed the EN standards (EN 13284-1), which is a gravimetric particle measurement and thus does not cover condensable particles. Thus, TSP emissions reported by the operators and used in the preparation of the inventory, do not include the condensable part, neither PM_{10} or $PM_{2.5}$ fractions that are calculated from these TSP emissions.

When Guidebook 2019/2023 EFs for particles are used, we refer to the Guidebook in the knowledge of inclusion or exclusion of condensables.

Activity data

The Finnish air pollutant emissions inventory is largely based on data reported by the plants, where this data is available. This data is considered more accurate than calculation with emission factors and statistical data. In cases where the emissions are based on data reported by the plants, it has in many cases not been possible to present the related activity data. Finland is a small country and for many industrial processes there only exist one or two plants, thus the units of activities fall under three, which is the internationally used threshold for statistical confidentiality and means that the data cannot be publicly presented. This is the case especially for the IPPU sector.

[1] The emission data is available from the YLVA (formely VAHTI) database after it has been checked and approved by the authorities.

Emission trends

Emissions from industrial processes are affected by changes in production volumes, changes in the processes or in the use of raw materials and auxiliary chemicals. In the trends it can be seen that the production volumes decreased in the early 1990s when a number of plants shut down their operations due to the recession and increased again since the mid-1990s until the late-2000s, when a decreasing trend returned with the economic turndown. The production volumes haven't yet returned to the pre late-2000s recession levels (Figure 4.2).

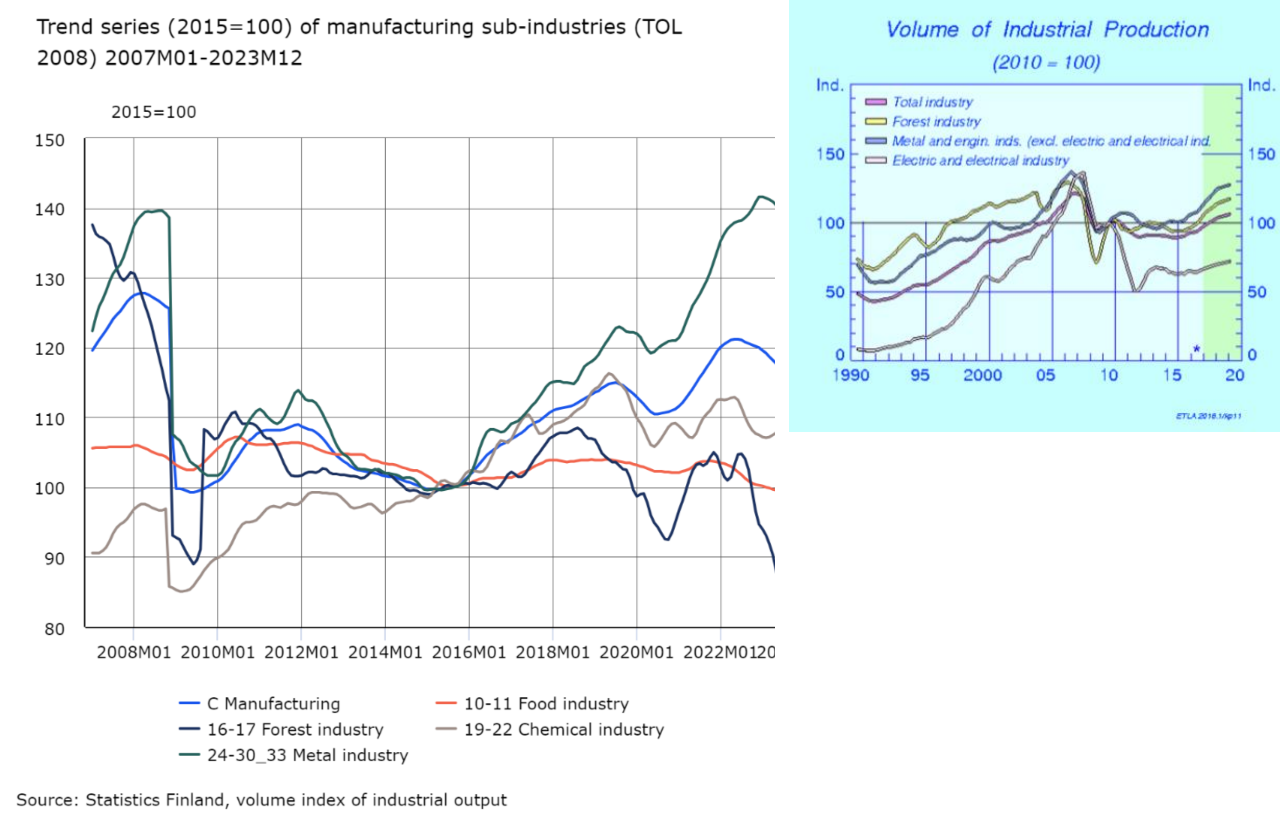


Figure 4.2. Industrial production volumes 1990-2022 (Sources: Statistics Finland, Volume index of industrial output https://stat.fi/en/statistics/ttvi, ETLA Economic Research, https://www.etla.fi/kultap/index.html 2021).

Key categories

Key categories in the Industrial processes and product use sector and the related Tier level of methods are presented in the Table 4.1.

Table 4.1. Key Categories in the IPPU sector.

NFR	Fuel	NO_x	Tier	NMVOC	Tier	SO_x	Tier	NH_3	Tier	CO	Tier
2B10a				L1	3	L1	3				
2C1						L1, T1	3				
2D3a				L1, T1	2						
2D3c				T1	3						
2D3d				L1, T1	2/3						
2D3g				L1	2/3						
2D3h				T1	2/3						
2D3i				L1	2/3						
2H1						L1, T1	3	T1	3		
2H2				L1	2/3						
NFR	Fuel	$PM_{2.5}$	Tier	PM_{10}	Tier	TSP	Tier	BC	Tier		
2C1		L1, T1	3	T1	3	T1	3				
2H1		T1	3	T1	3	T1	3				
2H2		L1, T1	2/3	L1	2/3						
NFR	Fuel	Pb	Tier	Cd	Tier	Hg	Tier	As	Tier	Cr	Tier
2B10a						L1, T1	3				
2C1		T1	3			L1, T1	3			L1, T1	3
2C2										L1, T1	3
2C6				T1	3						
2C7a								L1, T1	3		
2C7c		T1	3	L1, T1	3			L1, T1	3		
2G		L1, T1	2								
NFR	Fuel	Cu	Tier	Ni	Tier	Se	Tier	Zn	Tier		
2C1				L1, T1	3			T1	3		
2C6								L1	3		
2C7a						L1, T1	3				
2C7b				L1, T1	3						
2C7c		T1	3	L1, T1	3	T1	3	T1	3		
NFR	Fuel	PCDD/F	Tier	PAH-4	Tier	HCB	Tier	PCB	Tier		
2A1								L1, T1	2		
2B10a		L1, T1	3			L1, T1	3				
2C1		L1, T1	3	T1	3			L1	3		
2C7a						L1, T1	2				

4.2 Mineral Products (NFR 2.A)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

Industrial activities falling under NFR 2A Mineral products are listed in Table 4.2.

Table 4.2. Industrial activities and air pollutant emissions under NFR 2A Mineral products.

NFR	Source	Emissions reported under NFR 2A
2A1	Cement production	NMVOC, PCDD/F, PCB, PAHs
2A2	Lime production	TSP, PM_{10}, $PM_{2.5}$, BC, PCDD/F, PCB
2A3	Glass production	$PM_{2.5}$, PM_{10}, TSP, BC, NMVOC, PCDD/F, Pb, Cd, Cu, Se, Zn
2A5a	Quarrying and mining of minerals other than coal	TSP, PM_{10}, $PM_{2.5}$,
2A5b	Construction and demolition	TSP, PM_{10}, $PM_{2.5}$
2A5c	Storage, handling and transport of mineral products	TSP, PM_{10}, $PM_{2.5}$
2A6	Other mineral products	Not Occuring

Cement production (NFR 2A1)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

SNAP 040612 Key category for PCB emissions (level, Approach 1)		Cement has been produced in Finland since 1914. There are currently two operating plants in Finland. At a third plant procution ceased in 1993. The current plants fall under the IED and report their emissions according to the monitoring requirements in their environmental permits. In addition to REF (recovered fuels prepared out of waste material) , rubber waste (since 1996) and other waste fuels, also fossil fuels (mainly coal and coke) are used as fuels in these plants. The plants also have permission to use bio-based fuels (plant or grain-based fuels) for experimental use. Fuel combustion emissions are reported under the energy sector.
Emissions	Tier	Source of emissions
NMVOC	T3/T2	Cement production prosess emissions (partly reported by the plants and partly calculated), allocated under 2A1, emissions reported 1990 onwards.
PCDD/F	T3/T2	Emissions from waste fuel combustion (rubber, REF, carcass) are allocated under 2A1. emissions reported by plants 2001 onwards. Emissions 1990-2000 calculated.
PCB	T2	waste fuel combustion (rubber, REF) allocated under 2A1, emissions calculated 1990-2020.
PAHs	T3	waste fuel combustion (rubber, REF) allocated under 2A1, emissions reported by plants 2007 onwards. Emissions prior 2007 calculated.

Emission trend

Cement industry is a minor source of air pollutant emissions in Finland (Figure 4.3). Cement production volumes affect emissions over the years. The NMVOC peak in 2016 and PAH peak in 2017 are reported by the plants.

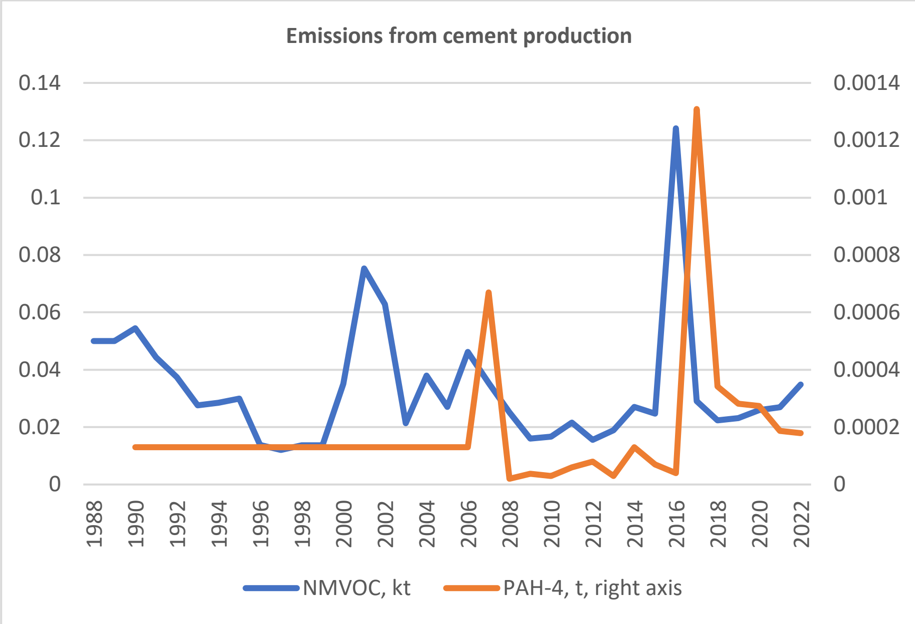


Figure 4.3. Emissions from cement production.

Part of emissions are reported by the plants. For those plants that do not report emissions, emissions are calculated. The shares of emissions reported by the plants out of total emissions for each air pollutant are presented in Table 4.3.

Table 4.3 Contribution of cement production to total emissions and the shares reported by plants in 2022.

Pollutant	Emissions from cement production in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.035	75.464	Gg	<0.1	40.3
PCDD/F	0.01	9.497	g I-Teq	0.1	100
PAH-4	<0.001	18.531	Mg	<0.1	0
PCB	3.06	19.922	kg	15.4	0

Methodological issues

Activity data
Cement production volumes used as activity data presented in Table 4.4 are based on yearly statistics in the Kemia-Kemi Journal before the year 2000, and after the year 2000 on data reported by the plants (available from YLVA system) and thus confidential because there are less than 3 plants. Table 4.4 Cement production volumes (t/a), Kemia-Kemi Journal (1990-1999) and from YLVA (since 2000).

Table 4.4 Cement production volumes.

Year	production (t/a)
1990	1 649 220
1991	1 343 000
1992	1 133 000
1993	836 000
1994	864 000
1995	906 970
1996	975 425
1997	1 151 990
1998	1 232 235
1999	1 309 935
confidential from year 2000 onwards	

Estimation of emissions

Emissions are mainly calculated at T2/T3 level based and partly reported by the plants. For those plants that do not report emissions, or for years of missing data in the companies' reporting, the emissions are calculated.

NMVOC emissions are either reported by the plants or calculated:

- For the years 1990-1995 and 1997-1999 no data has been reported by the plants, thus the emissions for are calculated using the IEF of 0.033 kg/t for that period, which is derived from emission data reported by the plants (SYKE, 2007). The emissions from cement production are presented in Table 4.5.
- For the year 1996 and since 2000 the emissions include both data reported by the plants according to the monitoring requirements in the environmental permits and calculated emissions using IEF 0.033 kg/t (SYKE 2007).

PCDD/F emissions include both data reported by the plants and calculated data:

- Emissions have been reported by one of the plants since 2001.
- For the years prior to 2001 the emissions of all plants are calculated using the national EF 25.8 ng I-Teq/t, which is derived from data reported by the plants (SYKE, 2007).
- Since 2001 the reported emission data contains both calculated emission data (using EF 25.8 I-Teq) and emission data reported by the plants.
- Since 2018 emissions are reported by plants

PCB emissions are calculated using the EF of 2000 ug/t (BiPRO, 2006).

PAH emissions have been reported by one plant between 2007-2017 and another plant has reported its emissions since 2018. For the years 1990-2006 the same emission estimate based on plant reported data in 1995 has been used. For the same plant emissions from 2018 onwards have been calculated based on the plant specific emission factor (1,98*10^{-7} kg/t, SYKE 2021). In 2021, the renewal of an injector of a kiln caused minor emissions.

Table 4.5. NMVOC, PCDD/F and PCB emissions from cement production.

Year	NMVOC (kg)	PCDD/F gI-Teq	PCB (kg)	Year	NMVOC (kg)	PCDD/F gI-Teq	PCB (kg)
1990	54	0.029	3.30	2007	35	0.014	3.54
1991	44	0.035	2.69	2008	25	0.014	3.27
1992	37	0.029	2.27	2009	16	0.008	2.05
1993	28	0.022	1.67	2010	17	0.010	2.39
1994	29	0.022	1.73	2011	22	0.014	2.80
1995	30	0.023	1.81	2012	16	0.011	2.55
1996	14	0.025	1.95	2013	19	0.011	2.55
1997	12	0.030	2.30	2014	27	0.010	2.52
1998	14	0.032	2.46	2015	25	0.010	2.35
1999	14	0.034	2.62	2016	124	0.014	2.68
2000	35	0.037	2.85	2017	29	0.015	3.07
2001	75	0.012	2.65	2018	22	0.050	2.90
2002	63	0.011	2.39	2019	23	0.040	2.85
2003	21	0.011	2.37	2020	26	0.020	2.89
2004	38	0.010	2.59	2021	27	0.010	3.04
2005	27	0.011	2.69	2022	35	0.010	3.06
2006	46	0.013	3.08				

In Guidebook 2023, emission factors are presented for particle emissions. In the Finnish inventory, TSP emissions reported by the plants according to the monitoring and reporting requirements in the environmental permits are used. These emissions are fuel based and therefore the emissions are allocated under NFR 1A2f.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to assessment of magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2018

- Recalculation of the energy sector time series enabled harmonization of the reporting under the 2019 NFR codes.
- The whole time series was calculated using same methods.

2020

- Activity data for years 2013-2018 were updated.

Source-specific planned improvements

There are no methods in the Guidebook for quantification of PCDD/F and PCB emissions, therefore we consider that there is need to remove these emissions in the future submissions and/or check if the allocation should be under the IPPU or of the Energy sector.

Lime production (NFR 2A2)

Changes in chapter	
February 2024	JMP KS TF

Overview of the sector

SNAP 040614 Not a key category for any pollutants		LIME DECARBONIZING Production volumes of lime were constant over the period 1990-2002. A new plant was started in 2003. There are currently four lime-producing plants in Finland, one plant was closed down at the end of 2014, and another one was closed down in 2019. All plants fall under the IED and report their emissions according to monitoring requirements in their environmental permits. The category also includes lime stone mines (quarrying of lime).
Emissions	Tier	Source of emissions
TSP	T3	Particle emissions are reported by plants since 1990. PM_{10} and $PM_{2.5}$ fractions have been calculated from the TSP emissions using fraction factors of 39% and 8% from TSP (GB23). Black carbon emissions are calcuted from $PM_{2.5}$ emissions.
PM10, PM2.5, BC	T3	
PCDD/F, PCB	T1	Emissions originate from lime kilns, emissions reported since 1990.

Emission trends

The emission trends are impacted by annual production volumes (Figure 4.4). The peak in particle emissions in 2007 is due to malfunction of abatement at one plan and the declining emissions are due to new abetement technologies. The strong decrease in particle emissions since 2013 is due to optimization of abatment technologies at one plant.

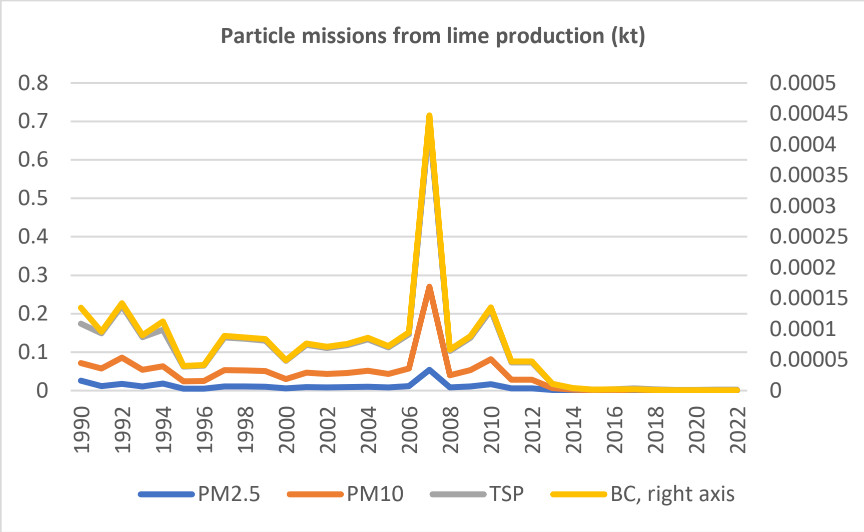


Figure 4.4. Emissions from Lime production.

The shares of emissions reported under the NFR category are presented in Table 4.6.

Table 4.6 Contribution of lime production to total emissions and shares reported by plants in 2022.

Pollutant	Emissions from lime in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	<0.001	13.384	Gg	<0.1	0
PM_{10}	<0.001	26.778	Gg	<0.1	0
TSP	0.002	42.014	Gg	<0.1	100
BC	<0.001	3.121	Gg	<0.1	0
PCDD/F	0.026	9.497	g I-Teq	0.3	0
PCB	<0.001	19.922	kg	<0.1	0

Methodological issues

Only total particle emissions are reported by the plants (Table 4.6) according to the monitoring requirements in the environmental permits. When no plant specific data is available, the emissions have been calculated from lime production (Table 4.7).

Particles

PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions reported by the plants using fraction factors of 38.8% and 7.8%, respectively (Guidebook 2023).

Black carbon emissions have been calculated using the factor of 0.46% of PM2.5 emissions (Guidebook 2023).

POPs

Emissions were previously calculated using lime production annual statistics available in the Kemia-Kemi Journal, but since 2012 this activity data has not been available. Since 2022 the data source was changed to data reported by the plants on the production of lime (Table 4.7), which is the same that is used in the calculation of ghg emissions. Activity data for the different plants for years 1990 to 1997 have been estimated by using the proportion of the production data of these. From 1998 to 2004, production data are partly received from the industry and partly available from industrial statistics and environmental permits or the YLVA system. From 2005 onwards production data reported to the EU ETS data has been used.

The following emission factors has been used: for PCDD/F 78 ng I-TEQ/t (UNEP, 1999) and for PCB 0.15 mg/t (BiPRO, 2006) as here are no methods in Guidebook 2023. The relevance of the methods will be studied for future submissions.

POP emissions are presented in Table 4.8.

Table 4.7. Activity data for lime production (Finland's NID 2024).

Year	Lime production (t)	Year	Lime production (t)	Year	Lime production (t)
1990	488 177	2001	543 409	2012	501 746
1991	484 625	2002	558 709	2013	501 440
1992	482 620	2003	640 923	2014	480 974
1993	487 808	2004	653 636	2015	445 001
1994	503 924	2005	631 709	2016	479 606
1995	478 877	2006	684 314	2017	495 274
1996	501 380	2007	651 797	2018	384 000
1997	456 899	2008	577 012	2019	327 000
1998	468 424	2009	477 176	2020	327 000
1999	512 186	2010	513 878	2021	393 000
2000	540 272	2011	543 670	2022	327 500

Table 4.8. Calculated PCDD/F emissions from lime production.

Year	PCDD/F (g I-TEQ)	PCB (kg)	Year	PCDD/F (g I-TEQ)	PCB (kg)
1990	0.038	0.00007	2007	0.051	0.00010
1991	0.038	0.00007	2008	0.045	0.00009
1992	0.038	0.00007	2009	0.037	0.00007
1993	0.038	0.00007	2010	0.040	0.00008
1994	0.039	0.00008	2011	0.042	0.00008
1995	0.037	0.00007	2012	0.039	0.00008
1996	0.039	0.00008	2013	0.039	0.00008
1997	0.036	0.00007	2014	0.038	0.00007
1998	0.037	0.00007	2015	0.035	0.00007
1999	0.040	0.00008	2016	0.037	0.00007
2000	0.042	0.00008	2017	0.039	0.00007
2001	0.042	0.00008	2018	0.030	0.00006
2002	0.044	0.00008	2019	0.026	0.00005
2003	0.050	0.00010	2020	0.026	0.00005
2004	0.051	0.00010	2021	0.031	0.00006
2005	0.049	0.00009	2022	0.026	0.00005
2006	0.053	0.00010			

Uncertainty analysis and source specific recalculations

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2019

- PM_{10} and $PM_{2.5}$ fractions have been recalculated from the TSP emissions using the fraction from Guidebook 2019.

2022

- Activity data has been replaced with AD reported under the GHG inventory.

Source-specific planned improvements

There are no methods in the Guidebook for estimating PCDD/F and PCB, therefore we consider that there may be need to remove these emissions in the future submissions or to allocate these rather under the Energy than the IPPU sector.

Glass production (NFR 2A3)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

SNAP 040613		GLASS MANUFACTURING
Not a key category for any pollutants		Activities under this sector include manufacturing of glass, glass fibre, glass wool and glasfelt manufacturing. The history of the industry is presented below: 1923-2012 Flat glass production 1987-2008 Flat glass production with float technique Until 2008 Container glass production Until 2009 Glass fibre at 2 plants 1996-2006 Glass wool Since 2010 Glassfelt at one of the former glass fibre plants Until 2010 Dinnerware 3 plants producing dinnerware deceased the operation strongly Since 2010 Only certain parts of the dinnerware were manufactured in Finland. Since 2015 Only one glass felt manufacturer and some minor glass ovens are left.
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$, BC	T3	Reported since 1990.
Pb, Cd, Cu, Se, Zn	T3	Reported 1990-2014. Heavy metal emissions from dinnerware production reported by plants.
SOx		Included to the Energy sector (IE). Emissions due to fuel combustion are reported under the Energy sector.
NH_3	T3	Reported 1988-2010. NH_3 emissions from manufacture of glassfibre are reported by the plants.
NMVOC	T3/T2	Reported since 1990. NMVOC emissions from glass wool are reported by plants. NMVOC emissions from glass manufacturing for those plants not reporting their emissions are calculated on basis of production volumes.
PCDD/F	T1/T2	PCDD/F emissions from glass manufacturing calculated on basis of production volumes. Reported since 1990.

The share of glass manufacture emissions to national total emissions and the share of emissions reported by the operators are presented in Table 4.9.

Table 4.9. Contribution of emissions from Glass products to total emissions in 2022.

Pollutant	Emissions from glass production in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.002	75.464	Gg	<0.1	99.3
$PM_{2.5}$	0.005	13.384	Gg	<0.1	0
PM_{10}	0.005	26.778	Gg	<0.1	0
TSP	0.006	42.014	Gg	<0.1	100
BC	<0.001	3.121	Gg	<0.1	0
PCDD/F	<0.001	9.497	g I-Teq	<0.1	0

Emission trends

Glass production volumes have decreased to only some percentages from their levels in the 1990s and from the high production volume period in 2005-2008 as presented in Figure 4.5 and in Table 4.10. The large variations in the reported emissions are due to the fluctuating production levels.

Cd emissions originated from raw material processing in dinnerware production. In 2014 this raw material processing was relocated abroad and the activity causing Cd emissions was closed down. Note, while the share of air pollutant emissions in national total emissions are generally low, cadmium emissions contributed to 10% of the national total of Cd emissions during 2008-2013.

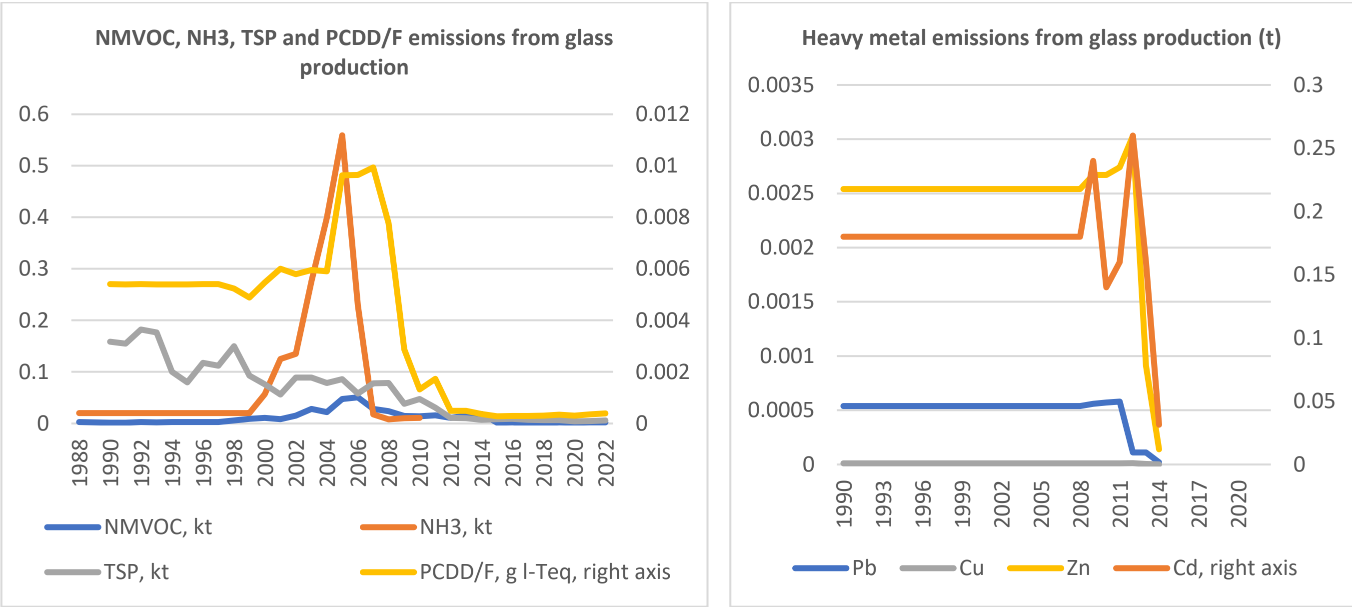


Figure 4.5. NMVOC, particle, ammonia, heavy metal and PCDD/F emissions from Glass production.

Table 4.10. Glass production volumes (tonnes/year) from YLVA.

Year	Plants that do not report emissions to supervising authorities, used in calculation of NMVOC emissions	All glass production plants, used in calculation of POP and NH3 emissions
1990	137 600*	169 153
1991	137 600*	168 678
1992	137 600*	169 096
1993	137 600*	168 490
1994	137 600*	168 491
1995	137 600*	168 530
1996	137 600	169 100
1997	138 332	169 167
1998	133 394	163 491
1999	118 625	152 725
2000	119 034	171 134
2001	141 592	187 718
2002	131 642	180 908
2003	146 343	186 023
2004	145 838	184 596
2005	257 764	301 203
2006	252 745	301 340
2007	260 019	310 513
2008	189 584	242 782
2009**	55 568	89 751
2010	6 072	41 359
2011	8 035	54 111
2012	7 968	15 149
2013	6 855	15 278
2014	3 218	11 437
20 15	1 535	8 717
2016	1 562	9 094
2017	1 819	9 286
2018	1 788	9 928
2019	1 573	10 661
2020	1 307	9 560
2021	1 815	11 200
2022	1 579	12 340

* information collected in the Finnish national BAT Group for glass industry ** emissions have been declining since 2009 due to closure of a large flat glass plant and a container glass plant in 2009.

Methodological issues

Heavy metals
The emissions originate in energy production and are mainly reported by the plants according to the monitoring requirements in the environmental permits. Heavy metal emissions (lead, copper, selenium, zinc and cadmium), cadmium as most significant, origante from raw material processing in dinnerware production in melting of glass and in mixing colours in glass melting. The process of mixing colours was relocated abroad in 2014 and therefore heavy metal emissions ceased from this category and therefore heavy metal emission occurred only in 1990-2004. No fuel based heavy metal emissions occur from these plants due to use of natural gas for the heating of their process ovens.

Particles
TSP emissions are generated in the glass smelting process. TSP emissions are reported by the plants according to their emissions monitoring requirements.

PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions using fraction factors of 90% and 80% from TSP (Guidebook 2023).

Black carbon emissions have been calcuted using the emission factor 0.062 % of PM2.5 (Guidebook 2023).

NMVOC

Glass production
For glass manufacture plants that do not report their emissions, the emissions are calculated using the emission factor of 0.01 kg/t of glass produced (BREF Manufacture of Glass, Table 4.40, 2013), together with the production rates of the companies. NMVOC emissions are presented in Table 4.11.

Dinnerware production
There is no method presented in the Guidebook for dinnerware production. Due to the varying quality of data reported by the plants it has not been possible to develop a national emission factor.

Glass wool
NMVOC emissions from glass wool are reported by the plants according to the monitoring requirements in the environmental permits.

Glass fibre
There are no emission factors for glass fibre production in the Guidebook.

NH_3

Glass fibre and glass felt (i.e. glass fibre)
Ammonia emissions presented in Table 4.11 are related to the glass fibre production. There has been one glassfibre producer operating under the period of 1988-2010. In 2011, the production process of glass fibre was converted to a production process of glass felt. Glass felt production does not generate ammonia emissions, therefore no ammonia emissions occur after the year 2010.

For the period of 1988-2010 data reported by the plants have been available only for 2007-2010 and therefore the emission value of 2007 has been used over the whole period of 1988-2006. No production data is available after 2007. The emissions are based on emission data reported by the plants according to the monitoring requirements in their environmental permits.

PCDD/F
Glass fibre, glas wool and dinner ware
The emissions have been calculated using the emission factor of 32 ng I-TEQ/t from UNEP (UNEP, 1999), because no method is presented in the Guidebook. The emissions are presented in Table 4.11. The relevance of emissions will be studied for future submissions.

Table 4.11 NH_3, NMVOC and PCDD/F emissions from production of glass, glass fibre, glass wool and dinner ware manufacturing.

Year	NMVOC (kg)	PCDD/F (g I-TEQ)	NH_3 (kt)	Year	NMVOC (kg)	PCDD/F (g I-TEQ)	NH3 (kt)
1990	1.376	0.0054	0.020	2007	28.349	0.0099	0.018
1991	1.376	0.0054	0.020	2008	24.198	0.0078	0.008
1992	2.576	0.0054	0.020	2009	14.596	0.0029	0.010
1993	2.396	0.0054	0.020	2010	13.938	0.0013	0.011
1994	2.576	0.0054	0.020	2011	15.689	0.0017	NA
1995	2.576	0.0054	0.020	2012	10.986	0.0005	NA
1996	2.876	0.0054	0.020	2013	15.069	0.0005	NA
1997	2.883	0.0054	0.020	2014	18.229	0.0004	NA
1998	5.634	0.0052	0.020	2015	1.815	0.0003	NA
1999	9.286	0.0049	0.020	2016	1.910	0.0003	NA
2000	10.890	0.0055	0.057	2017	0.478	0.0003	NA
2001	8.616	0.0060	0.125	2018	0.578	0.0003	NA
2002	15.416	0.0058	0.135	2019	0.212	0.0003	NA
2003	27.963	0.0060	0.276	2020	0.182	0.0003	NA
2004	22.158	0.0059	0.399	2021	0.233	0.0004	NA
2005	47.478	0.0096	0.559	2022	0.234	0.0004	NA
2006	50.714	0.0096	0.229				

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to assessment of magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2013

- NMVOC: Change of method to the EF from BREF for Manufacture of Glass (previously,1990-2011, calculated with the EF of 0.005 kg/t from USEPA AP-42 (USEPA, 1990) and AD based on information collected in the Finnish national BAT Group for glass industry (Conclusions of Finnish BAT group for Glass Industry, 2001). The same value was used for all the years.

2014

- The emission factor for NMVOC emissions and activity data were revised for the whole time series. Previosly, the same activity data was used for whole time series, since 2014 submission production rates of the companies are used.

2015

- NH_3 emissions from glass wool production were included.

2018

- Notation key corrections 2010-2016 for CO (IE to NA)
- Allocation correction for Pb and Zn (1990 to 1A2fI)
- Se 1990-2007 and 2012-2014 completion of the time series for the missing emissions
- Se 2015-2016 notation key IE to NA

2019

- All heavy metal (Cd, Pb, Cu, Se, Zn) emissions reported in 1990-2014 under NFR 2A3 are based on plant reported data and according to information in the plant's environmental permit, also lead, copper, selenium and zinc emissions originate from smelting of glass, not only cadmium. The process of mixing colours was relocated abroad in 2014 and therefore heavy metal emissions ceased from this category. No fuel based heavy metal emissions occur from these plants due to use of natural gas for the heating of their process ovens. The description provided in the IIR submitted in 2020 has already been updated to the draft of the 2021 IIR to reflect this response to the TERT.

Source-specific planned improvements

None.

Quarrying and mining of minerals other than coal (NFR 2A5a)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

SNAP 040616 and 040623 Not a key category for any pollutants		EXTRACTION OF MINERAL ORES and QUARRYING includes copper and zinc, talc manufacturing, limestone and quartzite quarrying
Emissions	Tier	Source of emissions
NOx, SOx, CO and heavy metals (Pb, Cd, As, Cr, Cu, Ni, Zn)		These emissions are related to combustion and reported under the Energy sector.
Particles (TSP, PM_{10}, $PM_{2.5}$)	T3	TSP reported by the plants, fraction factors used for PM_{10} and $PM_{2.5}$

Mining of metallic minerals in Finland includes iron, chromium, copper, nickel, zinc, gold, vanadium, titanium, lead, cobalt, silver, tungsten, and molybdenum, along with ores containing rare-earth elements. In 2022, there were 9 metallic mineral mines (Tables 4.13 and 4.14) operating in Finland. Four of these were gold mines, and the other mines produced chromium, copper, nickel, zinc, sulphur, cobalt, silver, lead and platinum group metals (PGE). (Vasara et al. 2023)

Industrial minerals are excavated e.g. for the production of building materials, fertilisers, dishes, paper, plastics, electronics, cosmetics, medicines, foodstuffs, and clean drinking water. Industrial stones are crushed and ground, then used as raw material for stone wool, cement, and similar products. The major industrial minerals mined in Finland are carbonates, apatite and talc (Finnish Safety and Chemicals Agency (Tukes), 2024).
Significant processing and refining of copper and nickel concentrates in Harjavalta, zinc in Kokkola, chromium in Kemi, and of iron in Raahe.

The shares of emissions of national total emissions and shares emissions reported by the operators are presented in Table 4.12 and the structure of the Finnish mining industry is presented in Figure 4.6 and the mining sites in Figure 4.7.

Table 4.12. Contribution of Quarrying and mining of minerals other than coal (NFR 2A5a) in 2022.

Pollutant	Emissions from Quarrying and mining of minerals other than coal in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	<0.001	13.384	Gg	<0.1	0
PM_{10}	0.002	26.778	Gg	<0.1	0
TSP	0.004	42.014	Gg	<0.1	97

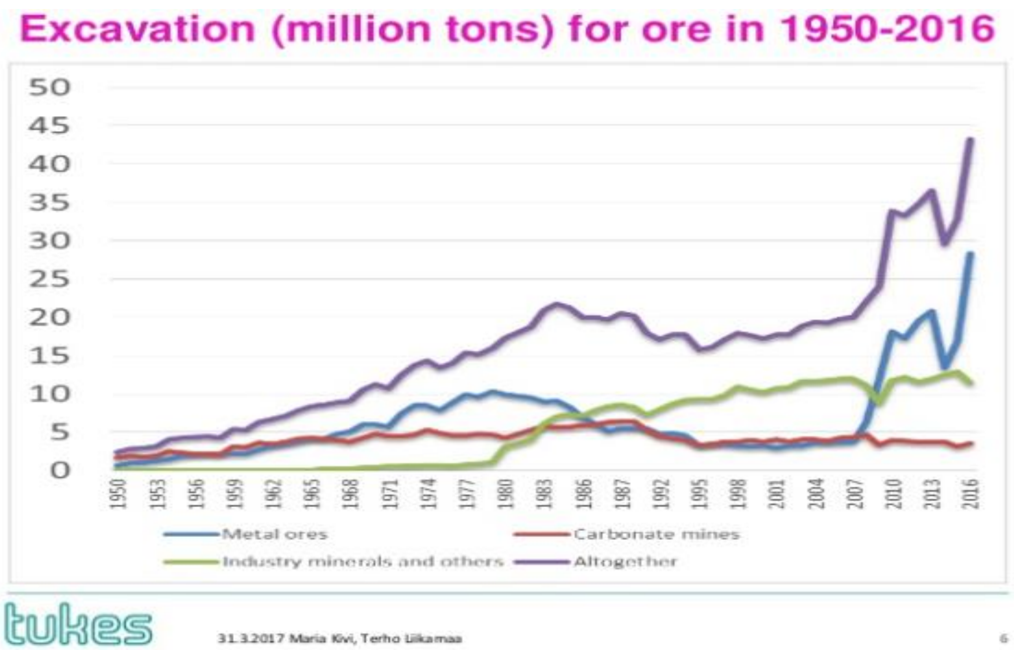
Table 4.13. Mining in Finland 2022 (Finnish Safety and Chemicals Agency (Tukes), 2024).

Group	Mines/Quarries	Total output (t)	Total ore output (t)	Leftover rock (t)
Metallic ores	9	86 590 868	33 242 035	53 348 833
Carbonate rocks	12	4 479 299	3 372 760	1 206 539
Other industrial minerals	14	27 939 721	12 753 145	15 186 576
Industrial rocks and other	8	435 830	219 449	216 381
In total	43	119 445 718	49 587 389	69 958 329

Table 4.14. Mining of metallic ores in Finland 2022 (Finnish Safety and Chemicals Agency (Tukes), 2024).

Mine/Quarry	Locality	Commodity	Operator	Total output (t)	Total ore output (t)
Kittilä	Kittilä	Au	Agnico Eagle Finland	2 460 535	1 799 036
Jokisivu	Huittinen	Au	Dragon Mining Oy	330 801	319 535
Pampalo	Ilomantsi	Au	Endomines Oy	318 272	138 717
Hopeakaivos	Sotkamo	Ag, Au, Pb, Zn	Sotkamo Silver Oy	1 012 330	644 068
Kevitsa	Sodankylä	Ni, Cu, PGE	Boliden Kevitsa Mining	36 412 795	9 948 930
Kemi	Keminmaa	Cr	Outokumpu Chrome	2 094 635	1 997 701
Pyhäsalmi	Pyhäjärvi	Zn, Cu, S	Pyhäsalmi Mine Oy	475 285	475 285
Sotkamo	Sotkamo, Kajaani	Zn, Cu, Ni	Terrafame Oy	42 893 215	17 918 763
Syväjärvi	Kaustinen, Kokkola	Li	Keliber Technology Oy	593 000	
Total: 9				86 590 868	33 242 035

PGM = platinum group metals, Kv=quartz



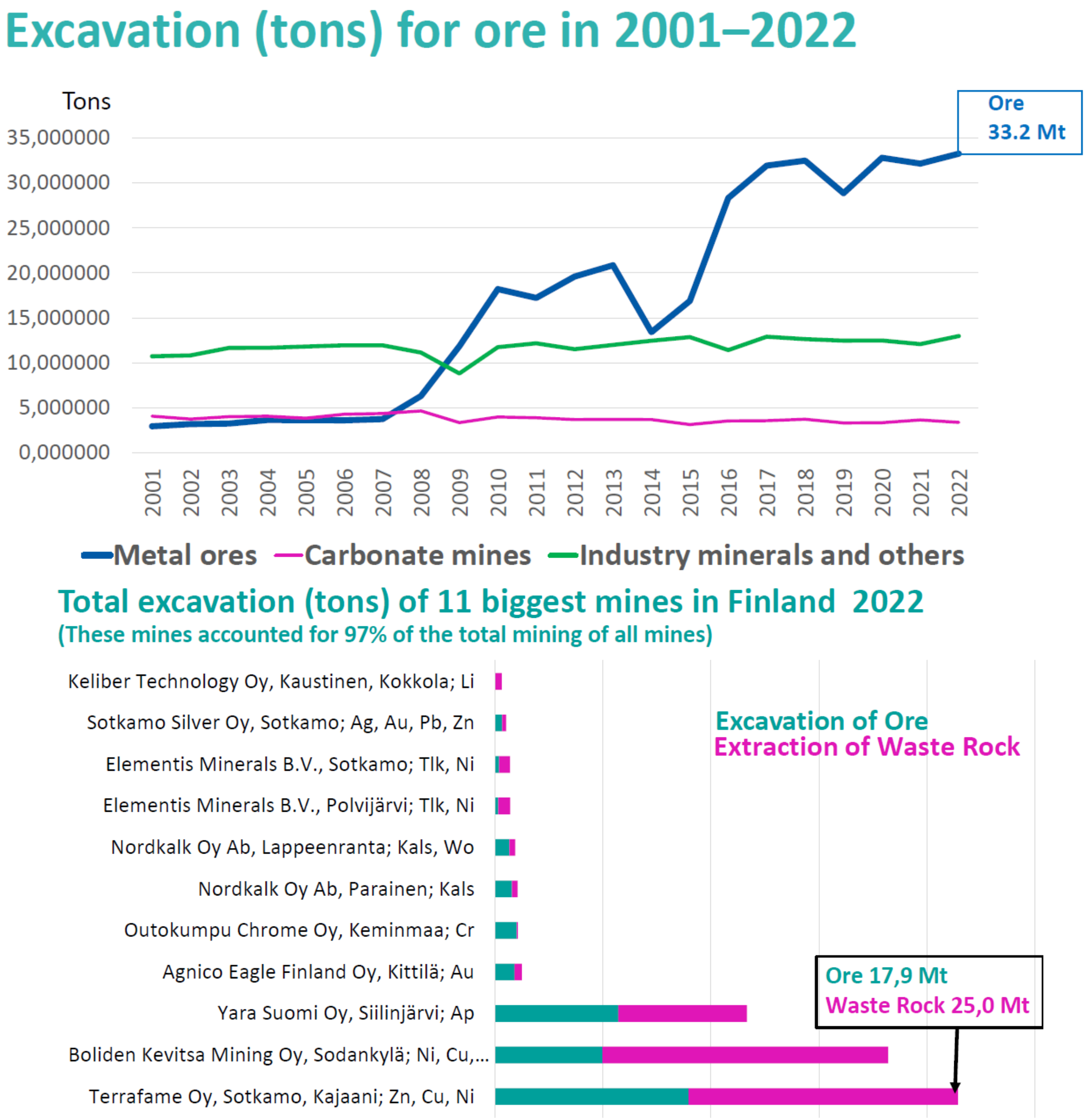


Figure 4.6. Excavation for ore in Finland (Tukes, 2024).
https://tukes.fi/documents/5470659/6373016/Review+of+mining+authority+Tukes+on+exploration+and+mining+industry+in+Finland+in+2022.pdf/a9722b35-2da8-6edc-b4d5-43f278b6e02e?t=1679637888445

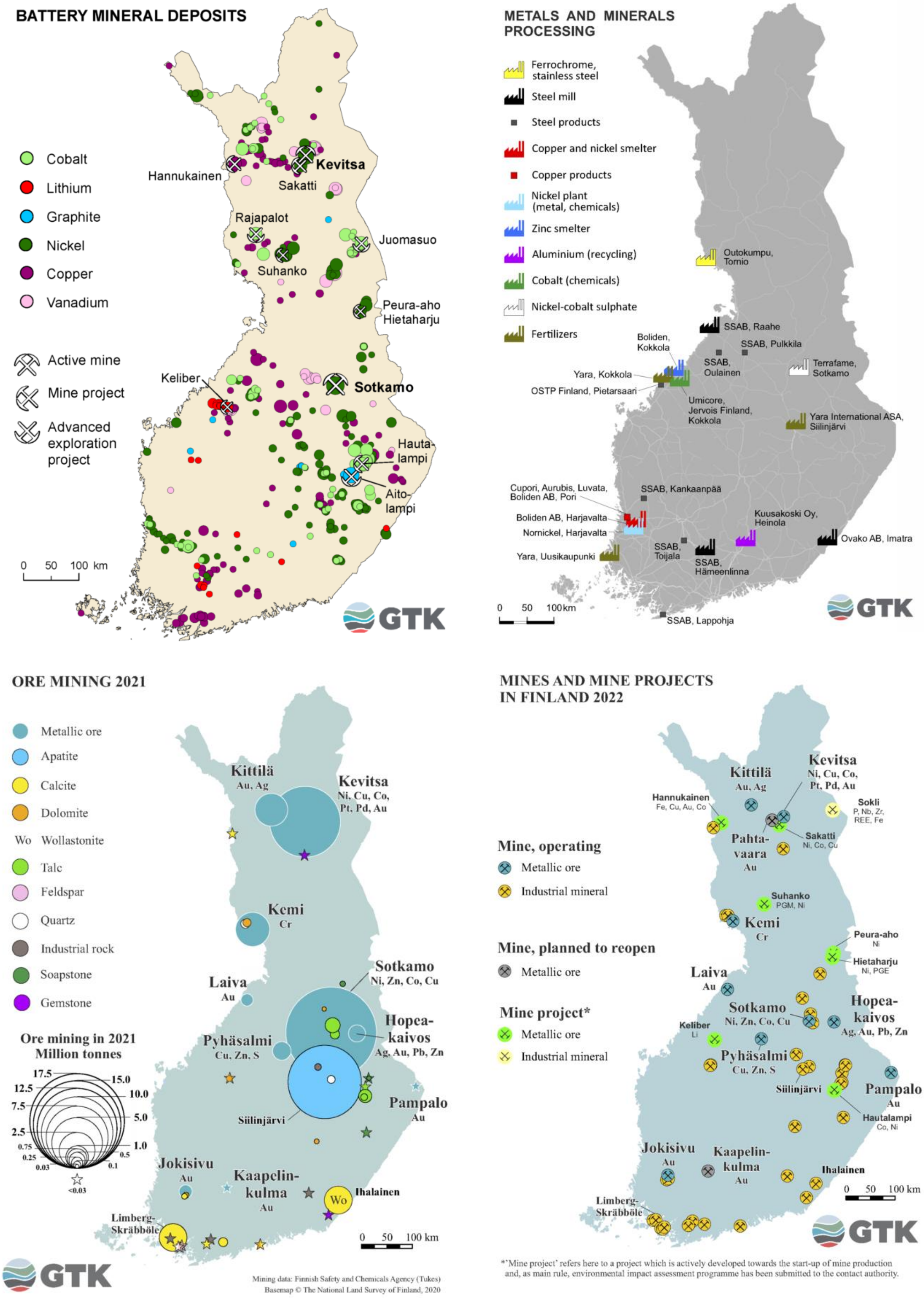


Figure 4.7 Battery mineral deposits, Metals and minerals processing, Mines, Mine projects
Geological Survey of Finland (2024) https://www.gtk.fi/en/services/data-sets-and-online-services-geo-fi/mining-maps/

Emission trends

The emission trends follow closely the quarrying and mining volumes (Figure 4.8).

The peak in particle emissions in 2013 is due to a fault situation in one mine that has had problems with environmental emissions from time to time. The mine has been in operation since 2011 but was temporary closed down in 2018. The operation in the mine has been declining since 2013 and thereforethe emissions are a hundredth part of the earlier emission level. Zinc has been mined only at one mine in central Finland and the production ceased at the end of 2020. Mining of copper at the same mine will be ceased during 2022-2023.

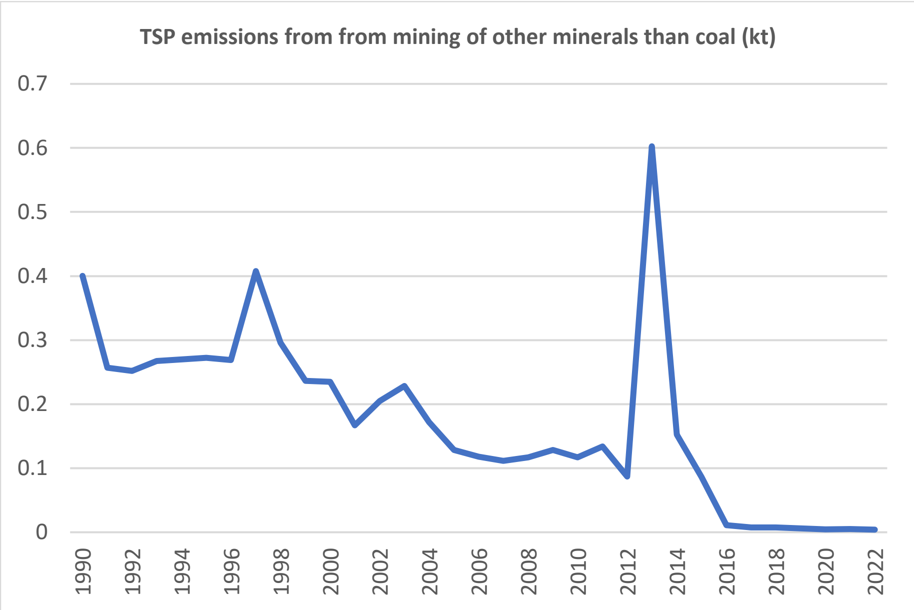


Figure 4.8. Particle emissions from mining of other minerals than coal.

Methodological issues

Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available, emissions have been calculated as presented below.

Activity data is presented in Table 4.15. Note that there is no activity data available at the level of detail (e.g. average area/height of the hole etc.) for the use of the new calculation method presented in Guidebook 2023 (Tier 2). However, the category is not a key category for particles in Finland.

Particles
Most of the TSP emissions are generated in zinc and copper ore quarrying and preparation and are mainly reported by the plants according to their monitoring requirements in their environmental permits. Particle fractions are calculated with Guidebook 2023 fraction factors. The emissions are presented in Table 4.16. For plants that do not report emissions, the emissions are calculated using emission factors from the Guidebook 2023.

Table 4.15. Mining of copper and zinc ores: activity data (First Quantum Minerals Ltd).

Year	Amount of mined copper ore (1000 t)	Amount of mined zinc ore (1000 t)	Year	Amount of mined copper ore (1000 t)	Amount of mined zinc ore (1000 t)
1990	1439	357	2010	1307	191
1991	1575	389	2011	1245	205
1992	1350	213	2012	1120	163
1993	1402	156	2013	1321	138
1994	1311	149	2014	1321*	138*
1995	1087	119	2015	1321*	138*
1996	1076	190	2016	148	10.8
1997	1013	221	2017	135	17.4
1998	988	216	2018	119	22.7
1999	1020	143	2019	80	12
2000	1211	118	2020	45	2.5
2001	1031	128	2021	33	0**
2002	996	167	2022	24	0**

2003	1325	246			
2004	1378	236			
2005	1378	257			
2006	1372	227			
2007	1209	247			
2008	1182	177			
2009	1298	172			
*for the years 2014 and 2015 the amounts of mined ores are not available, therefore 2013 data has been used ** mining of zinc ceased in 2020.					

Table 4.16 Particle emissions from quarrying and mining of minerals other than coal (covers both reported and calculated emissions)

Year	$PM_{2,5}$ (t)	PM_{10} (t)	TSP (t)	Year	$PM_{2,5}$ (t)	PM_{10} (t)	TSP (t)
1990	6.74	44.91	91.37	2010	5.62	37.45	76.19
1991	7.37	49.11	99.90	2011	5.44	36.24	73.73
1992	5.86	39.07	79.48	2012	4.81	32.07	65.24
1993	5.84	38.94	79.22	2013	5.47	36.45	74.16
1994	5.48	36.50	74.26	2014	5.47	36.45	74.16
1995	4.52	30.16	61.36	2015	5.47	36.45	74.16
1996	4.75	31.65	64.39	2016	0.13	0.89	1.81
1997	4.63	30.85	62.76	2017	0.12	0.77	1.57
1998	4.51	30.10	61.23	2018	0.13	0.87	1.76
1999	4.36	29.09	59.18	2019	0.08	0.50	1.02
2000	4.98	33.22	67.58	2020	0.02	0.23	0.48
2001	4.35	28.97	58.94	2021	0.02	0.24	0.49
2002	4.36	29.07	59.13	2022	0.02	0.20	0.40
2003	5.89	39.27	79.90				
2004	6.05	40.35	82.10				
2005	6.13	40.88	83.16				
2006	6.00	39.97	81.31				
2007	5.46	36.40	74.05				
2008	5.10	33.97	69.11				
2009	5.51	36.75	74.77				

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Part 3 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2018
- Fuel combustion related emissions were reallocated in the 2018 submission under NFR1A2gviii.

2019
- Particle fractions are calculated with Guidebook 2016 fraction factors.

2021
- Particle fractions are calculated with Guidebook 2019 fraction factors.

Source-specific planned improvements

None

Construction and demolition (NFR 2A5b)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

SNAP 040624 Not a key category for any pollutants		PUBLIC WORKS AND BUILDING SITES Activities include manufacturing of light expanded clay aggregate (LECA), granulates and asphalt mixing plants. Emissions from rock-crushing plants are included in the emissions of asphalt stations in cases where the activity is required to have an environmental permit. Small rock-crushing plants are not included in the inventory.
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$	T2	calculated using GB23

Process emissions from asphalt mixing plants are reported under NFR 2A5b and fuel combustion related emissions under NFR 1A2gviii.

Construction and demolition is a minor source of particle emissions.

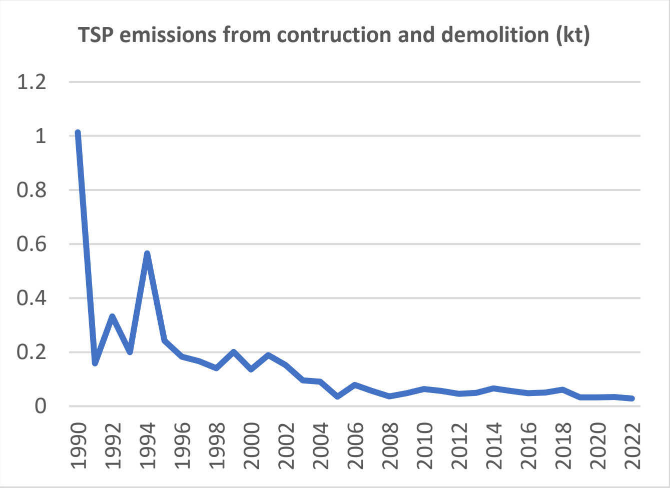
The shares of total emissions and of emissons reported by the plants are presented in Table 4.17.

Table 4.17. Contribution of Construction and demolition (NFR 2A5b) to total emissions in 2022.

Pollutant	Emissions from construction and demolition in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	0.001	13.384	Gg	<0.1	0
PM_{10}	0.009	26.778	Gg	<0.1	0
TSP	0.028	42.014	Gg	<0.1	1.7

Emission trends

Particle emission trend is presented in Figure 4.9. The emissions have decreased since the early 2000s due to increased abatement.



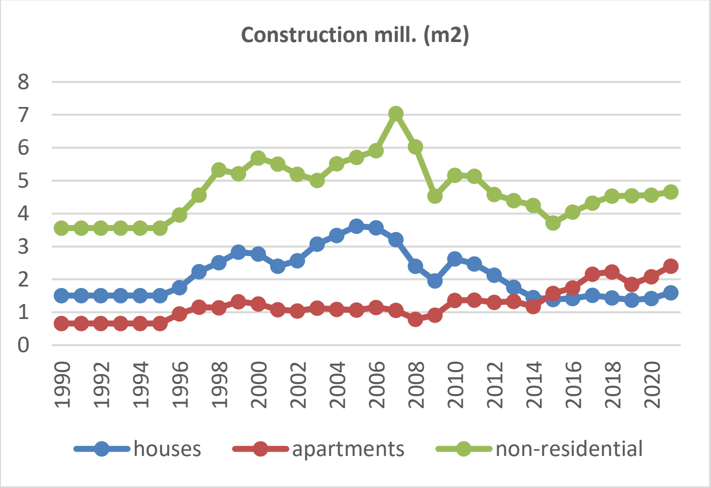


Figure 4.9. Particle emissions from construction and demolition.

Methodological issues

Particle emissions

Emissions are calculated as described in Guidebook 2023. The same assumptions for duration of construction and for control efficiency of applied emission reduction measures (CE) as presented in the Guidebook 2023 have been used also for Finland. For PE index value of 128 (wet) is used. The same silt content (20%) is used in the calculation as is assumed for Germany in Guidebook 2023. In Finland only total constructed area (see Table 4.17a) is available. So as described in the Guidebook 2019 affected area is estimated using 0,8 m^2 footprint are per m^2 utility floor area. In Finland information of constructed area (provided by Statistic Finland) is available from 1995 onwards, for years 1990-1994 has been used same value as for year 1995.

Emissions from road construction are calculated as described in the Guidebook 2023. Activity data presented in Table 4.19 is from yearly statistics of The Finnish Transport Infrastructure Agency.

Volumes of constructed houses, apartment buildings and non-residential buildings used as activity data are presented in Table 4.18.

Table 4.18. Volumes of constructed houses, apartment buildings and non-residential buildings (Statistics Finland).

Year	constructed houses (m^2)	constructed apartment buildings(m^2)	non-residentail construction (m^2)
1990*	1508775	658752	3560360
1991*	1508775	658752	3560360
1992*	1508775	658752	3560360
1993*	1508775	658752	3560360
1994*	1508775	658752	3560360
1995	1508775	658752	3560360
1996	1745638	950882	3953983
1997	2239295	1156117	4564231
1998	2512920	1141342	5326516
1999	2827773	1319407	5209074
2000	2772252	1253966	5688264
2001	2401019	1074854	5505425
2002	2562980	1040785	5192928
2003	3074723	1125068	5007556
2004	3336142	1091668	5512145
2005	3618269	1072646	5711187
2006	3571248	1151543	5912508
2007	3205658	1059417	7041046
2008	2404061	787076	6028113
2009	1956191	918298	4529770
2010	2629159	1361794	5166918
2011	2465305	1373480	5131192
2012	2126059	1299118	4579609
2013	1760010	1328529	4399736
2014	1453438	1174278	4246316
2015	1391401	1579064	3711899
2016	1419991	1736980	4044515
2017	1514086	2157886	4322511
2018	1441103	2231769	4532115
2019	1375233	1849109	4540234
2020	1418484	2077659	4566141
2021	1596431	2405403	4660856
2022	1369984	1855284	4101593

** Statistics have been available only from 1995 onwards, for years 1990-1994 values from year 1995 have been used*

Table 4.19. Length of new roads (only new mains roads i.e highways) in Finland (Road statistics, The Finnish Transport Infrastructure Agency)

Years	New roads (km)	Years	New roads (km)	Years	New roads (km)	Years	New roads (km)
1990	208	2000	33	2010	45	2020	0
1991	67	2001	161	2011	37	2021	0
1992	305	2002	88	2012	0	2022	0
1993	166	2003	110	2013	0		
1994	811	2004	98	2014	39		
1995	215	2005	0	2015	21		
1996	122	2006	74	2016	0		
1997	92	2007	27	2017	31		
1998	41	2008	2	2018	50		
1999	136	2009	34	2019	0		

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2019
- The whole time series was recalculated using Guidebook 2016 method.
- Heavy metal emissions reported currently under this NFR were removed under energy.

2020
- Guidebook 2019 method equals to that of Guidebook 2016.

2024
- Guidebook 2023 method equals to that of Guidebook 2019.

Source-specific planned improvements

None.

Storage, handling and transport of mineral products (NFR 2A5c)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

SNAP 040900 Not a key category for any pollutants		STORAGE, HANDLING AND TRANSPORT OF MINERAL PRODUCTS Activities included here are storage and handling of aluminoxide, bentonite, clay, cement, coal, coke, fly ash and kaolin
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$	T2	Calculated

The category is a minor source of particle emissions. The shares of emissions are presented in Table 4.20.

Table 4.20. Contribution of Storage, handling and transport of mineral products (NFR 2A5c) to total emissions and the shares of emissions reported by the plants in 2022.

Pollutant	Emissions from Storage, handling and transport of mineral products in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	0.027	13.384	Gg	0.2	0
PM_{10}	0.265	26.778	Gg	1.0	0
TSP	0.678	42.014	Gg	1.6	0

Emission trend

The emission trend is presented in Figure 4.10.

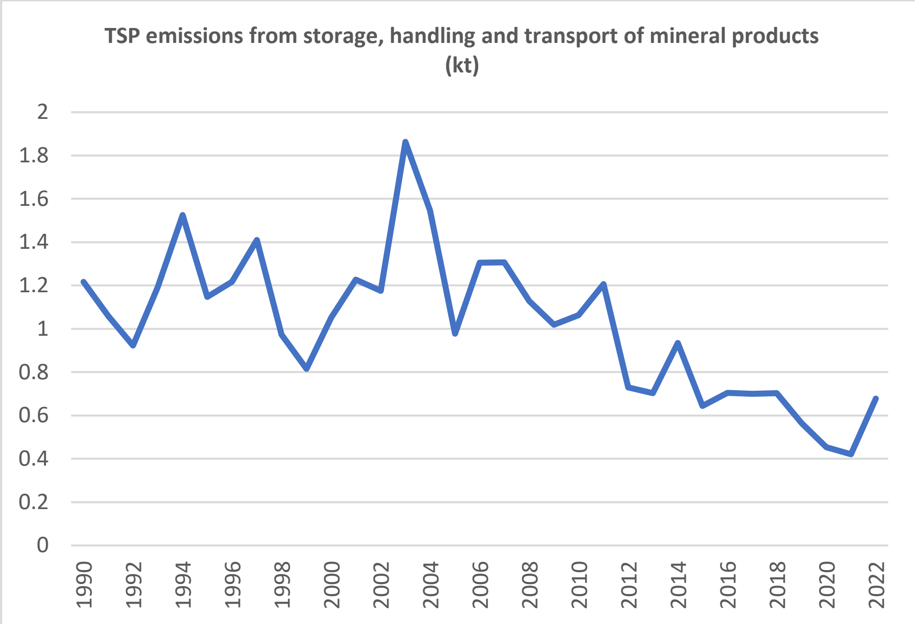


Figure 4.10. Particle emissions from Storage, handling and transport of mineral products.

Methodological issues

Particle emissions are calculated using emission factors (TNO, 2002) presented in Table 4.21. There are no methods in the Guidebook for the different species presented below, therefore we prefer to use the specific fraction factors of TNO.

Table 4.21 TSP. PM_{10}. $PM_{2.5}$ emission factors for NFR 2A5c storage and handling.

Source	EFs t/t (TNO, 2002)		
	TSP	PM_{10}	$PM_{2.5}$
Storage and handling, aluminoxide	0.0002	0.00008	0.000008
Storage and handling, bentonite	0.00004	0.0000128	0.0000016
Storage and handling, clay	0.000025	0.000008	0.000001
Storage and handling, cement	0.00001	0.00005	0.0000005
Storage and handling, coal	0.00015	0.00006	0.000006
Storage and handling, coke	0.00011	0.000044	0.0000044
Storage and handling, fly ash	0.0001	0.000032	0.000004
Storage and handling, kaolin	0.00004	0.0000128	0.0000016

Activity data collected from Finland Custom Statistics (ULJAS), the Confederation of Finnish Construction Industries and the Finnish Energy Industries Federation is presented in Table 4.22.

TSP, PM_{10} and $PM_{2.5}$ emissions from storage, handling and transport of mineral products are presented in Table 4.23.

Table 4.22. Activity data for storage and handling of minerals

AD (t/m2)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Amount of imported alumina	3317	1134	1524	5781	3537	1669	3366	2353	2006	2564
Amount of imported bentonite	7841	7583	6273	8808	12583	18688	22722	48491	56864	53935
Amount of handled clay as tiles and light gravel	339000	270000	198000	183000	171000	156000	120000	219270	200145	194430
Amount of used cement as production and import	1917740	1513330	1254919	1023578	1058023	1106527	1217959	1433304	1627917	1767248
Amount of imported coal	6101614	5174521	4264324	5953057	8104916	5887526	6252607	7474226	4727631	3596331
Amount of produced and imported coke	1273047	1175507	1184466	1291656	1326901	1083946	1067868	1106694	1119537	1267754
Amount of produced fly ash	939702	939702	939702	939702	939702	739563	959487	893000	619000	605000
Amount of imported	967917	937236	1017452	1175689	1328205	1378081	1198212	1402209	1359976	1249452

kaolin										
AD (t/m2)	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Amount of imported alumina	2179	2204	2042	1904	2220	2659	2327	3297	2350	1733
Amount of imported bentonite	30609	50898	27758	26569	27321	26395	32520	37739	31445	19334
Amount of handled clay as tiles and light gravel	188715	183000	171000	174000	177000	162000	156000	143700	129000	91500
Amount of used cement as production and import	1939579	1762180	1493126	1613900	1756330	904064	2027988	2443914	2167516	1358273
Amount of imported coal	5072701	6174440	5788973	10145016	8283891	4724395	6684023	6676418	5677080	5941051
Amount of produced and imported coke	1327170	1306480	1365237	1390807	1417438	1398969	1390541	1438165	1395458	245805
Amount of produced fly ash	590000	811000	877800	1142200	713909	541376	740483	706218	503602	541056
Amount of imported kaolin	1493786	1301200	1207343	1305240	1301806	1144335	1261699	1155040	1147686	739685
AD (t/m2)	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Amount of imported alumina	2421	2423	2478	2198	2573	2834	3078	3700	3624	2929
Amount of imported bentonite	16084	21318	25469	21227	26449	43347	35630	24140	31970	34100
Amount of handled clay as tiles and light gravel *	116000	108900	100944	97700	71000	41200	238000	142000	148200	252300
Amount of used cement as production and import	1807747	1985441	1792816	1651613	1703571	1595705	1844920	2106350	555258	453092
Amount of imported coal	5902004	6954191	3892598	4022356	5421559	3500330	3896830	3855300	3982297	3077538
Amount of produced and imported coke	440170	443407	319132	359	437	480	343	271	337	320
Amount of produced fly ash	692256	537737	537737	537737	5377737	5377737	715000	715000	715000	715000
Amount of imported kaolin	944809	936544	860243	628512	745438	696962	660800	639780	604098	526023
AD (t/m2)	**2020**	**2021**	**2022**							
Amount of imported alumina	2899	3346	11914							
Amount of imported bentonite	41560	38909	43258							
Amount of handled clay as tiles and light gravel *	255200	252259	79829							
Amount of used cement as production and import	495600	500847	447959							
Amount of imported coal	2365854	2153587	3898352							
Amount of produced and imported coke	300	249	334							
Amount of produced fly ash	715000	715000	715000							
Amount of imported kaolin	384570	384321	286122							

Amounts of imported alumina, bentonite, coal and kaolin are taken from ULJAS database, Amount of used cement as production and import is taken from YLVA and ULJAS databases. Amount of handled clay as tiles and light gravel is taken from statistics of the Confederation of Finnish Construction Industries and YLVA database (production amounts of light gravel). Amount of produced and imported coke is taken from statistic of the Federation of Finnish Technology Industries and YLVA database. Amount of produced fly ash in taken from statistics of Finenergy.

- updated from 2013 onwards in the 2022 submission

Table 4.23. Particle emissions from storage, handling and transport of mineral products.

Year	$PM_{2,5}$ (t)	PM_{10} (t)	TSP (t)	Year	$PM_{2,5}$ (t)	PM_{10} (t)	TSP (t)
1990	48.9	477.8	1218.4	2010	43.0	420.6	1070.5
1991	42.7	415.9	1064.9	2011	48.8	479.9	1215.3
1992	37.3	361.1	928.9	2012	29.6	288.4	736.4

1993	48.0	468.3	1198.6	2013	28.5	278.1	708.9
1994	61.3	600.7	1530.8	2014	37.1	363.9	924.3
1995	46.2	451.3	1153.4	2015	25.5	247.8	633.8
1996	49.0	477.7	1222.0	2016	28.7	277.9	711.8
1997	56.8	555.0	1415.3	2017	28.5	276.5	707.3
1998	39.3	382.5	978.0	2018	28.4	275.9	709.4
1999	33.0	320.2	820.8	2019	22.8	220.0	570.0
2000	42.6	415.0	1059.3	2020	15.7	154.5	391.0
2001	49.6	484.3	1235.9	2021	17.0	162.0	423.0
2002	47.5	462.9	1183.4	2022	27.0	265.0	678.0
2003	75.0	735.8	1871.6				
2004	62.3	612.2	1553.4				
2005	39.5	385.9	985.1				
2006	52.8	516.7	1314.2				
2007	52.9	518.1	1315.3				
2008	45.7	447.8	1136.0				
2009	41.1	403.6	1024.0				

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2009

- Emissions from storage, handling and transport of mineral products were included in the inventory.

2022

- Acitity data for clay handled as tiles and light gravel upadated 2013 onwards.

Source-specific planned improvements

We are using the material specific TNO EFs which we consider more precise than the T1 EFs in Guidebook 2023. However, we plan to compare the results of the two methods in the near future.

Other Mineral products (NFR 2A6)

Changes in chapter	
January 2020	JMP KS

Source category description

SNAP 040613z 040615 040618 040628 040629	OTHER (MINERAL PRODUCTS), BATTERIES MANUFACTURING, LIMESTONE AND DOLOMITE USE, BRICKS AND TILES (DECARBONIZING), FINE CERAMIC MATERIALS (DECARBONIZING)

No activities falling under NFR 2A6 occur currently in Finland.

4.3 Chemical Industry (NFR 2.B)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

NFR	Chemical Industy	Description		Emissions
2B1	Ammonia production	There has been no ammonia production in Finland since 1993.		Not Occuring after 1992
2B2	Nitric acid production	Three nitric acid plants, a fourth was closed down in 1992. In 2004 a new plant replaced an older plant, which was closed down in 2005.		NO_x
2B10a	Other chemical industry			NOx, NMVOC, SOx, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, Pb, Hg, Cr, Cu, Ni, Zn, PCDD/F, HCB
	040401	Sulfuric acid		
	040406	Ammonium phosphate		
	040407	NPK fertilisers		
	040410	Titanium dioxide		
	040413	Chlorine production		
	040414	Phosphate fertilizers		
	040416	Other	Calcium Carbonate manufacturing	
	040416	Other	Silicon wafer manufacturing	
	040416	Other	Production of oxygen, nitrogen and hydrogen	
	040416	Other	Al- and Fe-chemicals manufacturing	
	040416	Other	Manufacturing of ion exchange and chromatographic resins and special polymers	
	040416	Other	Pigments manufacturing	
	040416	Other	Manufacturing of explosives	
	040416	Other	Fertilizer manufacturing	
	040416	Other	Manufacturing of cobolt based special chemicals	
	040416	Other	Hydrogenperoxide plant	
	040416	Other	Manufacturing of natrium silicate	
	040416	Other	Potassium sulphate manufacturing	
	040416	Other	Formic acid and hydrogen peroxide manufacturing	
	040416	Other	Manufacturing of viscose staple fibres and by-products	
	040501	Ethylene		
	040506	Polyethylene Low Density		
	040507	Polyethylene High Density		
	040509	Polypropylene		
	040511	Polystyrene		
	040512	Styrene butadiene		
	040513	Styrene-butadiene latex		
	040527	Other (phytosanitary,...)	Entzyme production	
	040527	Other (phytosanitary,...)	Manufacturing of techno-chemical products	
	040527	Other (phytosanitary,...)	Manufacturing of benzene, cumene and phenols	

NFR	Chemical Industy	Description		Emissions
	040527	Other (phytosanitary,...)	Drag reducing additive production	
	040527	Other (phytosanitary,...)	Manufacturing of organic base chemicals	
	040527	Other (phytosanitary,...)	Manufacturing of tall oil	
	040527	Other (phytosanitary,...)	Manufacturing of organic fine chemicals	
	040527	Other (phytosanitary,...)	Manufacturing of pharmaceuticals	
	040527	Other (phytosanitary,...)	Manufacturing of titanium dioxide pigments	
	040527	Other (phytosanitary,...)	Manufacturing of lignosulphonate products	
	040527	Other (phytosanitary,...)	Cleaning of solvents and manufacturing of solvent mixtures	
	040527	Other (phytosanitary,...)	Manufacturing of biocides and other agricultural chemicals	
	040527	Other (phytosanitary,...)	Manufacturing of carboxymethylcellulose	
2B10b	Storage, handling and transport of chemical products	Chemical and fuel storages, storage and handling of phosphates.		NMVOC, TSP, PM_{10}, $PM_{2.5}$

Methodological issues

Emissions of those plants that report their emissions to the supervising authorities[2] according to the monitoring requirements in the environmental permits are in some cases reported as aggregated for the whole plant and not by individual processes. In the case of all the emissions reported in YLVA, the emissions have been classified either as combustion based or process related emissions in the calculation system of the air pollutant emission inventory. In the cases of clear process emissions, these are reported separately under NFR 2B categories. In the cases where the reported emissions data in the YLVA system clearly are the total figure of energy and process related emission, the process related emissions are estimated to be the difference between the total emissions reported by the plant and the default emissions calculated on basis of fuel consumption, the difference is reported under the industrial processes. These cases relate mainly to paticulate matter (TSP) emissions reported by a relatively small number of plants. In case it has not been possible to make a split between energy and process related emissions, all emissions are reported under NFR 1A2c.

Ammonia production (NFR 2B1)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

SNAP 040403 Not a key category for any pollutants	Tier T1	AMMONIA PRODUCTION Ammonia was produced between the years 1951-1992 in Finland. The annually produced amounts of ammonia were between 12-30 kt. Ammonia was mainly used as raw material of fertilizers and in the production of nitric acid.

Emission trends

The magnitude of NMVOC emissions between 1990-1992 was around 0.01-0.03 kilotons.
NH_3, NO_x and CO emissions have been included in the inventory since the 2020 submission.

Methodological issues

Activity data

Ammonia was produced during the years 1990-1992 as presented in Table 4.24. Ammonia was mainly produced using peat and heavy oil as feedstock for the needed hydrogen. There was an experimentation to use sod peat to produce synthesis gas for ammonia, hydrogen peroxide and formic acid production in

[2] The emissions are available from the YLVA database.

1988 to 1991. The experimentation ended uneconomic and instead, peat gasification of oil products was continued (Finland's NID 2024).

Table 4.24. Estimated Ammonia production in 1990-1992 (Expert estimate, Regional Environmental Centre 2010).

Years	produced ammonia (t)
1990	30 000
1991	30 000
1992	12 000

NH_3, NO_x, CO, NMVOC

Emissions are calculated using emission factors presented in Guidebook 2023 (Table 3-7).

Table 4.25. NH_3, NO_x, CO and NMVOC emissions from ammonia production.

Year	NH_3 (tonnes)	NOx (tonnes)	NMVOC (tonnes)	CO (tonnes)
1990	1.5	30	30	0.18
1991	1.5	30	30	0.18
1992	0.6	12	12	0.072

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2019

- Information of ammonia production volumes 1990-1992 added to the IIR.
- NH3 emissions in 1990-1992 were included in the inventory and documented in the IIR.

2020

- NOx, NMVOC and CO emissions in 1990-1992 were included in the inventory.

Source specific planned improvements

- None

Nitric acid production (NFR 2B2)

Changes in chapter	
February 2024	KS&JMP TF

Source category description

SNAP 040402 Not a key category for any pollutants		NITRIC ACID PRODUCTION Nitric acid is currently produced at three plants. Two of these plants are situated at the same site. In 1990–1992 there were four plants producing nitric acid. In 2004 a new plant replaced an older plant, which was closed down in 2005. The operating plants are single-stage medium pressure plants (3.8, 6.5 and 7.5 bar). The produced nitric acid is mainly used for the integrated fertiliser production. Total annual total production volume has varied from 430 to 620 Gg of nitric acid per year.
Emissions	Tier	Source of emissions
NO_x	T3	Emissions are reported by the plants according to their reporting obligations in the environmental permits and available in YLVA database. NOx emissions include NO_2, NO, N_2O_3, N_2O_4, HNO_3 compounds.

Air pollutant emissions from nitric acid production vary according to the production volumes over the years. The allocation of activities has been changed over the years and is not currently consistent in the time series.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.26.

Table 4.26. Contribution of nitric acid production to total emissions in 2022.

Pollutant	Emissions from other mineral products in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NO_x (as NO_2)	0.35	99.292	Gg	0.4	100

Emission trend

The emission trend is presented in Figure 4.11.

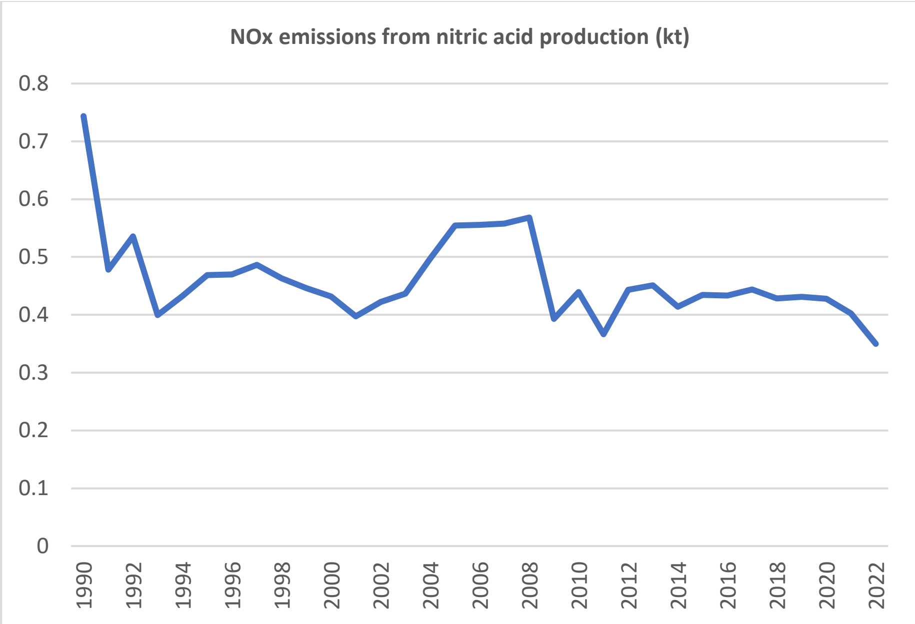


Figure 4.11. NO_x emissions from nitric acid production 1990-2022.

Methodological issues

Nitric acid plants report their emissions to the supervising authorities[3] according to the monitoring requirements in the environmental permits. The reporting covers all NOx emissions from nitric acid production processes.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

[3] The emission data is available from the YLVA database after it has been checked and approved by the authorities.

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

None.

Source-specific planned improvements

None.

Adipic acid production (NFR 2B3)

SNAP 040521	ADIPIC ACID PRODUCTION Adipic acid production has not occurred in Finland in 1980-2022.

Carbide production (NFR 2B5)

SNAP 040412	CARBIDE PRODUCTION Carbide production has not occurred in Finland in 1980-2022.

Titanium dioxide production (NFR 2B6)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

SNAP 040410 Not a key category for any pollutants		TITANIUM DIOXIDE PRODUCTION One plant has produced titanium dioxide pigments since 1957. These pigments have been used in paint and cosmetics industry and also in manufacture of printing inks. The annual production rate of TiO2 is currently 130 000 tonnes.
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$, BC	T3/T2	Particle emissions are reported by the plant according to its environmental monitoring programme from dry kiln.

Emission trend

The particle emission trend is presented in Figure 4.12. The emissions since 2017 are one tenth to the emissions in the 2000s due to emissions reported by one plant, that made major changes in production in 1997, so particle emissions declined.

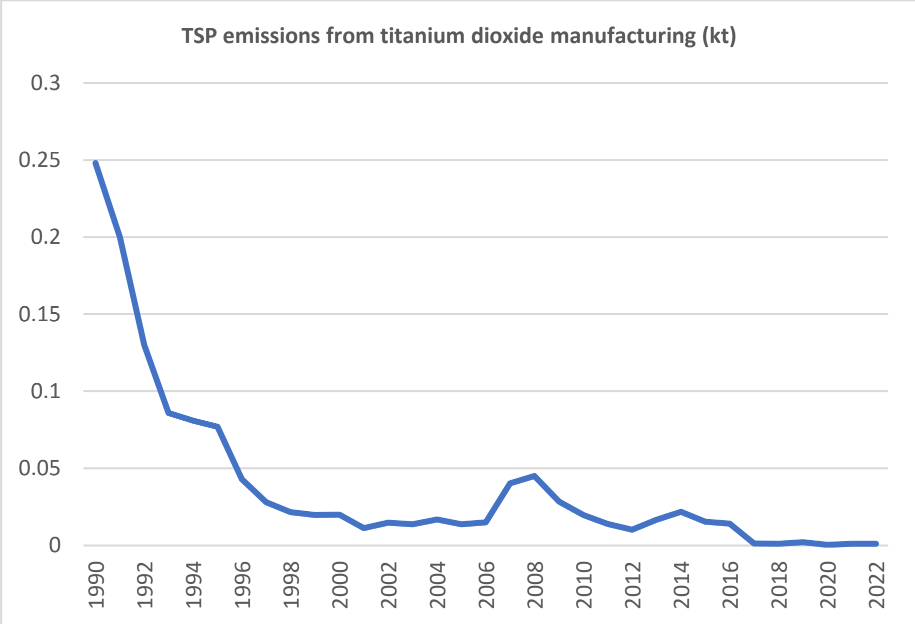


Figure 4.12. TSP emission trend 1990-2022.

The shares of emissions of total emissions and the shares reported by the plants are presented in table 4.27.

Table 4.27 Contribution of Titanium dioxide production (NFR 2B6) to total emissions in 2022.

Pollutant	Emissions from titanium dioxide production in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
PM2.5	<0.001	13.384	Gg	<0.1	0
PM10	<0.001	26.778	Gg	<0.1	0
TSP	0.001	42.014	Gg	<0.1	0
BC	<0.001	3.121	Gg	<0.1	0

Methodological issues

Particles

TSP emissions are reported by the TiO2 manufacturer. PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions using the default fractions for 2B chemical production in the 2023 Guidebook, 0.8 × TSP for PM_{10} and 0.6 × TSP for $PM_{2.5}$. There are no sector specific methods or fraction factors available for titanium dioxide production in the Guidebook, hence the use of default fractions for 2B chemical production.

For black carbon, the Guidebook 2023 emission factor of 1.8 % of $PM_{2.5}$, has been used. This Tier 1 emission factor is an average emission factor for chemical industry.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2023

- Following the recommendation in the 2022 NECD inventory review, PM_{10} and $PM_{2.5}$ emissions were recalculated for the whole time series 1990 to 2020 due to correction of small particle fractions from TSP:PM_{10}:$PM_{2.5}$ – 1:1:1 to the 2019 Guidebook defaults for 2B chemical production.

Source-specific planned improvements

None.

Soda ash production (NFR 2B7)

Changes in chapter	
February 2023	JMP, KS, TF

SNAP 040619	SODA ASH PRODUCTION AND USE NFR 2B7 SODA ASH PRODUCTION Soda ash is not produced in Finland. Soda ash is used in Finland in the production of tile, steel, calcium chloride, phosphates, mineral wool and in the energy industry. Emissions from soda ash use in these sectors are reported by the plants according to the monitoring programmes in their environmental permits (available in YLVA). The emissions are allocated under the NFR category of the main activity of these plants using soda ash and it is not possible to report the emissions separately under NFR 2B7.

Other chemical industry (NFR 2B10a)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

SNAP 040401		SULPHURIC ACID Number of plants (<5) Production capacity: 1 000 000 t sulphuric acid
Emissions		Source of emissions
NOx, SOx, TSP, PM10, PM2.5, BC,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040406		AMMONIUM PHOSPHATE Number of plants (<5) Phosphoric acid is produced from phosphorus containing minerals, the most important mineral is phosphorite (=apatite $3Ca_3(PO_4)_2*CaF_2$). There are two different methods to produce phosphoric acid; thermal and wet process; in Finland the wet process has been used. In the wet process the raw phosphate is dissolved into sulphur acid and the released phosphoric acid is separated from calcium sulphate. Production capacity: 300 000 t phosphoric acid and polyphosphoric acids
Emissions		Source of emissions
SOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NOx		reported by one plant in year 1990, should be allocated under the energy sector

SNAP 040407		NPK FERTILISERS Number of plants (<5) Production capacity: 1.5 million t mineral or chemical fertilisers (including N,P,K)

Emissions		Source of emissions
NH_3, NMVOC, SOx, TSP, PM_{10}, $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040413		CHLORINE PRODUCTION Number of plants (<5) Production capacity: 200 000 t chlorine
Emissions		Source of emissions
Hg	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
SOx	T3	reported by plants 1990-1993, should be allocated under Energy sector

SNAP 040414		PHOSPHATE FERTILIZERS Number of plants (< 5)
Emissions		Source of emissions
		Only NH_3 emissions from 1990. The allocation of emissions will be checked for the next submissions. No emission since 1991.

SNAP 040416		OTHER Production of oxygen, nitrogen and hydrogen Number of plants <5 Production capacity: oxygen (liquid) 45 000t/a, nitrogen (liquid) 40 000t/a and argon (liquid) 8000t/a
Emissions		Source of emissions
NMVOC, NOx, SOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Al- and Fe-chemicals manufacturing Number of plants <5 Production capacity: ~30 000t/a Al-salts
Emissions		Source of emissions
TSP, PM_{10}. $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of ion exchange and chromatographic resins and special polymers Number of plants <5 Production capacity ~1000 m3/a ion exhange resins
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Pigments manufacturing Number of plants <5 Production capacity: ~50 000t/a Al-silicate and silicone dioxide pigments
Emissions		Source of emissions
TSP, PM10, PM2.5, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of explosives Number of plants <5

		Production capacity: not availble
Emissions		Source of emissions
NMVOC, NOx, SOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Fertilizer manufacturing Number of plants <5 Production capacity: not available
Emissions		Source of emissions
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of cobolt based special chemicals Number of plants <5 Production capacity: not available
Emissions		Source of emissions
Cu, Ni, NMVOC, SOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Hydrogen peroxide plant Number of plants <5 Production capacity: ~130 000 t/a hydrogen peroxide
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of natrium silicate Number of plants <5 Production capacity: ~45 000t/a silicate
Emissions		Source of emissions
TSP, PM_{10}, $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of synthetic fibre Number of plants – none in 2010 century Production capacity: not availble

SNAP 040416		OTHER Potassium sulphate manufacturing Number of plants <5 Production capacity: ~200 000 t/a potassium sulphate
Emissions		Source of emissions
HCB, PCDD/F	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of fine chemicals Number of plants <5 Production capacity: not available
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of PCC (Precipitated calcium carbonate) Number of plants<5 Production capacity: not availble
Emissions		Source of emissions
NOx, SOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040501		ETHYLENE Number of plants <5 Production capacity: ~400 000 t/a
Emissions		Source of emissions
NMVOC, SO_x, TSP, PM_{10}, $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040506		POLYETHYLENE LOW DENSITY Number of plants <5 Production capacity: not available
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040507		POLYETHYLENE HIGH DENSITY Number of plants <5 Production capacity ~350 000 t/a
Emissions		Source of emissions
NMVOC, SO_x	T3	reported by the plants according 39ot he monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5	T3	emissions 1996-1998 reported by the plants according 39ot he monitoring and reporting obligations in their environmental permits

SNAP 040508		PVC Polyvinylchloride has been manufactured in Finland in 1969-2006 Number of plants Production capacity
Emissions		Source of emissions
NMVOC, TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040509		POLYPROPYLENE Number of plants <5 Production capacity: ~200 000 t/a

Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NOx	T3	emissions from 2002 reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040510		STYRENE Number of plants <5
Emissions		Source of emissions
NMVOC	T3	reported by the plants 1994-2000.

SNAP 040511		POLYSTYRENE Number of plants <5 Production capacity ~50 000 t/a
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040512		STYRENE-BUTADIENE Number of plants <5 Production capacity ~300 000 t/a
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040513		STYRENE-BUTADIENE LATEX Number of plants <5 Production capacity; 180 000 t synthetic rubberlatex
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
SOx	T3	emissions from 1997 reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040525		PESTICIDE PRODUCTION Earlier energy related emissions were erroneously reported under this category. No activities in Finland.
Emissions		Source of emissions

SNAP 040527		OTHER (PHYTOSANITARY,...) Entzyme production Number of plants <5 Production capacity: not available
Emissions		Source of emissions
TSP, PM_{10}, $PM_{2.5}$	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040527		OTHER (PHYTOSANITARY,...) Manufacturing of techno-chemical products Number of plants 12 Production capacity: not available
Emissions		Source of emissions
SO_x, TSP, PM_{10}, $PM_{2.5}$, NMVOC, BC, PCB, diox,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

PAH4, Cr, Ni, NH3		

NFR 2B10a is a key category for SO_x, NMVOC, Hg, PCDD/F and HCB, see Table 4.28.

Table 4.28. Key categories and tier level of methods for the Other chemical industry.

Process	SOx	Tier	NMVOC	Tier	Hg	Tier	PCDD/F	Tier	HCB	Tier
Manufacturing of potassioum sulphate							L1, T1	3	L1, T1	T3
Production of oxygen, nitrogen and hydrogen Manufacturing of ion exchange and chromatographic resins and special polymers Manufacturing of explosives Manufacturing of cobolt based special chemicals Hydrogen peroxide plant Manufacturing of fine chemicals Production of polyethylene low density, high density polypropylene, polystyrene Production of styrene butadiene and styrene-butadiene latex Pesticide production Manufacturing of techno-chemical products			L1	T3						
Production of sulphuric acid Production of fertilizers Prodcution of cobolt based chemicals Production of pigments used in paper making Production of techno-chemical products	L1	T3								
Production of sulphuric acid Production of fertilizers Production of phosphates Production of PVC Production of inorganic chemicals, ethylene, polyethylene, other organic chemicals and										
Chlorine production using the mercury process					L1, T1	T3				

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.29.

Table 4.29. Contribution of Chemical Industry: other (NFR 2B10a) to total emissions in 2022.

Pollutant	Emissions from other chemical industry in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NO_x (as NO2)	0.150	99.292	Gg	0.2	20.3
NMVOC	2.230	75.464	Gg	3.0	100
SO_x (as SO2)	1.201	22.692	Gg	5.3	99.2
NH_3	0.212	31.583	Gg	0.7	100
$PM_{2.5}$	0.148	13.384	Gg	1.1	0
PM_{10}	0.371	26.778	Gg	1.4	0
TSP	0.429	42.014	Gg	1.0	100
BC	0.003	3.121	Gg	<0.1	0
Pb	0.001	12.516	Mg	<0.1	0
Hg	0.035	0.505	Mg	6.9	0.3
Cu	0.008	38.391	Mg	<0.1	100
Ni	0.013	9.917	Mg	0.1	100
Zn	0.250	131.533	Mg	0.2	0
PCDD/PCDF	0.790	9.497	g I-Teq	8.3	100
HCB	21.900	29.245	kg	74.9	100

Emission trends

NH_3 emissions are generated in production of fertilizers (Figure 4.13)

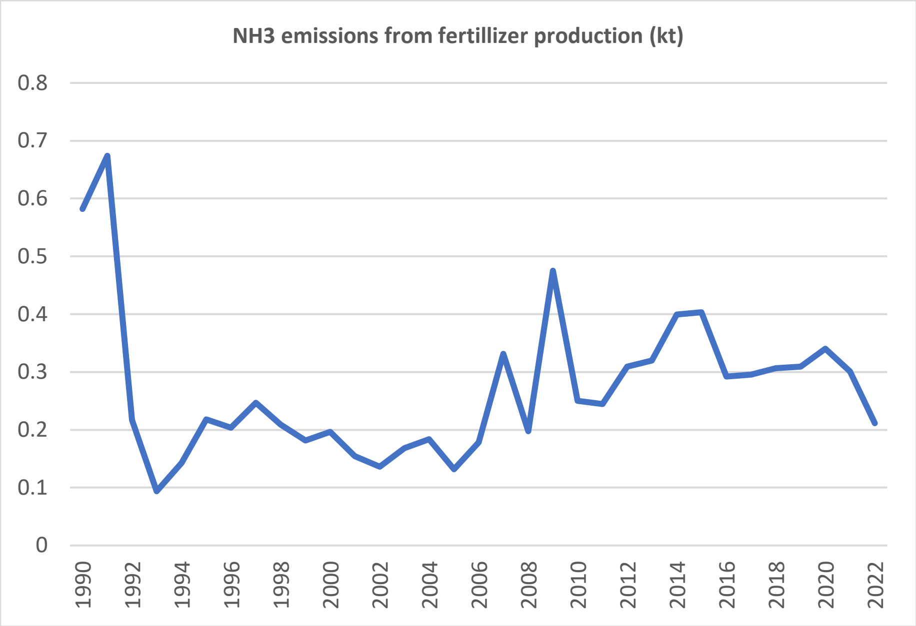


Figure 4.13. Ammonia emissions from the production of fertilizers 1990-2022.

Particle emissions originate in production of sulphuric acid, fertilizers, phosphates, and PVC as well as from the production of inorganic chemicals, ethylene, polyethylene, other organic chemicals and chemicals products.

BC emissions originate from Al- and Fe-chemicals and pigments manufacturing, manufacturing of natrium silicate and techno-chemical products. (Figure 4.14)

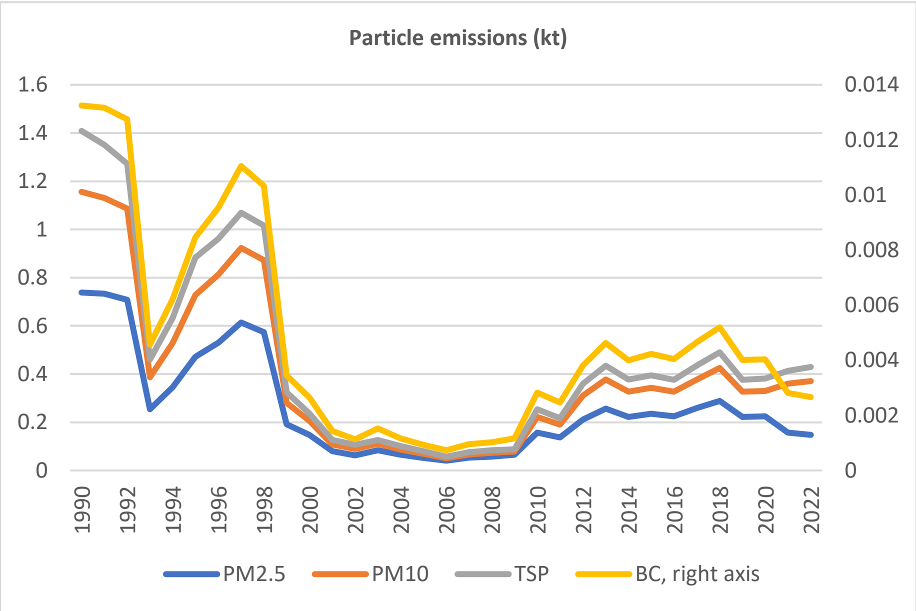


Figure 4.14. Particle emissions from production of H_2SO_4, fertilizers, phosphates and PVC 1990-2022.

Heavy metals
Chromium emissions are related to lignin manufacturing which occurred only in 1993-2008. The emissions are reported by the plants.

POP emissions
PCDD/F emissions originate in the manufacturing of potassium sulphate but due the improvements the refining methods, the emissions decreased in 2017, were under the ELV in 2018 and in 2019. From 2020 onwards the plant again reported PCDD/F emissions. Due to the fluctuations of the production

process it is not possible to make a calculation model to estimate these emissions and therefore only reported data is included in the inventory.

HCB emissions originate in the manufacturing of potassium sulphate, which is a major source of HCB emissions in the Finnish HCB inventory (Figure 4.15).

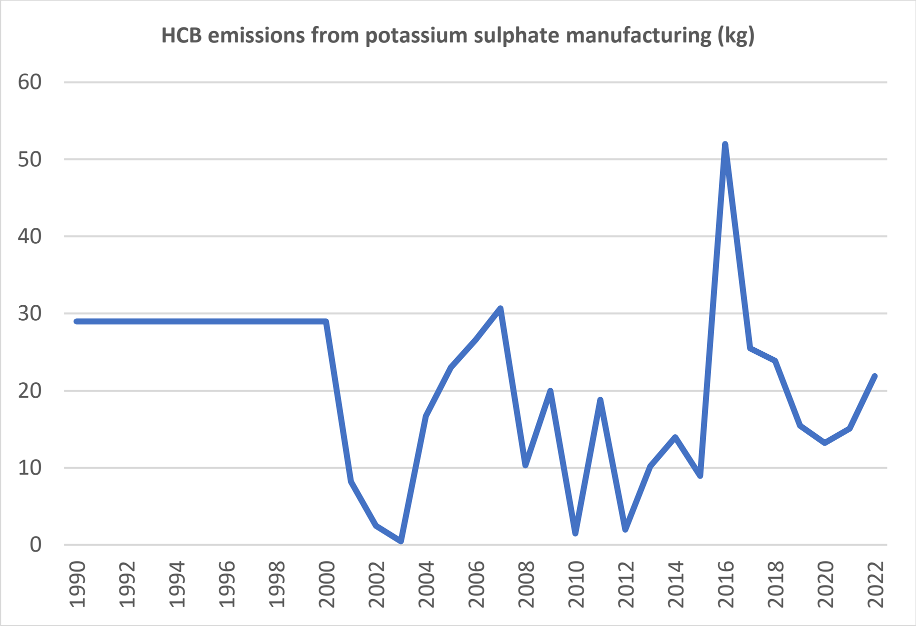


Figure 4.15. HCB emissions from potassium sulphate manufacturing 1990-2022.

Methodological issues

The emissions falling under this category are reported by the plants according to the monitoring and reporting obligations in their environmental permits (T3). When no plant specific data is available emissions have been calculated as presented below.

Particles
Particle emissions from this sector in the inventory are based on TSP emission data reported by the plants (YLVA). PM_{10} and $PM_{2.5}$ emissions are calculated from TSP emissions using size fraction factors as follows:
- Production of sulphuric acid: 100 % for both $PM_{2.5}$ and PM_{10} (TNO, 2002).
- Production of fertilizers 98% for PM_{10} and 66 %, $PM_{2.5}$ (IIASA, 2001/AEAT, 2000)
- Production of phosphates: 80% for PM_{10} and 60 %, $PM_{2.5}$ (Guidebook 2023)
- Production of PVC: 38% for PM_{10} and 1.9 %, $PM_{2.5}$ (Guidebook 2023)
- Production of inorganic chemicals, ethylene, polyethylene, other organic chemicals and chemicals products: 80 % for PM_{10} and 50 % for $PM_{2.5}$ (national expert estimate, Karvosenoja, 2002).

Black carbon
Black carbon emissions have been calculated using the fraction factor of 1.8 % of $PM_{2.5}$ (T1) (Guidebook 2023) for the following sources: Al- and Fe-chemicals and pigments manufacturing, manufacturing of natrium silicate and techno-chemical products.

NOx
Nitrogen dioxide emissions from this sector in the inventory are based on emission data reported by the plants (YLVA) from the following sectors:
- Production of sulfuric acid
- Manufacturing of ammunition
- Production of pigments used in paper making.

SO_x (Key category for SO_x, T3)
Sulphur dioxide emissions (reported mostly as TRS, total reduced sulphur, and converted into SO_2) from this sector in the inventory are based on emission data reported by the plants (YLVA) from the following sectors:

- Production of sulphuric acid
- Production of fertilizers
- Prodcution of cobolt based chemicals
- Production of pigments used in paper making
- Production of techno-chemical products

NH_3
Ammonia emissions are generated in production of fertilizers and are based on emission data reported by the plants.

NMVOC (Key category for NMVOC, T3)
Chemical industry processes emitting NMVOCs include
- Production of oxygen, nitrogen and hydrogen
- Manufacturing of ion exchange and chromatographic resins and special polymers
- Manufacturing of explosives
- Manufacturing of cobolt based special chemicals
- Hydrogen peroxide plant
- Manufacturing of fine chemicals
- Production of polyethylene low density, high density polypropylene, polystyrene
- Production of styrene butadiene and styrene-butadiene latex
- Pesticide production
- Manufacturing of techno-chemical products
- NMVOC emissions from this sector in the inventory are either based on data reported by the plants according to their environmental permits

Heavy metals (Key category for Hg, T3)
- Nickel and copper emissions are generated in manufacturing of cobolt based special chemicals and reported by the operators according to their environmental permits.
- Chromium emissions are related to lignin manufacturing which occurred only in 1993-2008.
- Mercury is emitted from chlorine production using the mercury process. There is also chlorine-alkali production, which uses the membrane method, however, no mercury emissions are generated from this process.

POPs
Emissions of HCB, PCDD/Fs and PAHs from the manufacturing of potassium sulphate, as well as PCDD/F emissions from the manufacturing of organic fine chemicals are reported by the plants and available in YLVA for the use in the inventory.

HCB (Key category for HCB, T3)
- Manufacturing of potassium sulphate is a key category for HCB emissions (L1, T1). The NFR 2B10a is thus a key category for HCB emissions (L1, T1). The emissions are reported by the plant based on site-specific measurements.
- HCB emissions vary strongly due to the fluctuating quality and volume of auxiliary chemicals used in the process. The raw material quality and emissions in the potassium production process, from which the emissions originate, are monitored closely. Annual HCB emissions are reported by plant operators to the environmental authorities. However, for the years 1990-2000, i.e. before the emissions were discovered in connection with other research, no data on the emission levels is available. The plant has estimated the emissions during these years to be at the level of 29 kg annully, and thus these figures are used in the inventory as there are no other methods to estimate these historical emissions. Work to find and install a suitable flue gas abatement technology is underway.

PCDD/F emissions have been reported by one plant and for the first time in 2000. Emissions between 1990-1999 are expert estimates based on the reported emission value in 2000. In 2001 a new activated carbon filter was taken in use at the plant resulting in 97% reduction of dioxine emissions. The emissions decreased in 2017 due to improvements in the refining methods. In 2018 and in 2019 PCDD/F emissions were under the ELV. Since 2020 PCDD/F emissions have been reported. Due to the fluctuation of the process, it is not possible to calculate the emissions and therefore only reported emissions are included in the inventory.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2018-2019

- The emissions were reallocated between the Energy sector and the IPPU sector as far as possible and in a consistent manner over the time series. The reallocation did not introduce changes into total emission levels.
- Between the 2018 and 2019 submissions SO2 emissions for 2B10a were recalculated since emissions from one plant for 2001 were incorrectly reported in the YLVA system (YLVA is the national data system for data reported by operators to environmental authorities). The error was discovered when preparing the 2019 submission. The SO2 emissions reported for 2001 belong under category 1A2b and the emissions were reallocated there. Unfortunately, the explanation for this was missing from the IIR 2019.

Source-specific planned improvements

None

Storage, handling and transport of chemical products (NFR 2B10b)

Changes in chapter	
Ferbuary 2024	JMP, KS, TF

Source category description

SNAP 040415 and 040522 No key category for any pollutants		STORAGE AND HANDLING OF INORGANIC CHEMICAL PRODUCTS, STORAGE AND HANDLING OF ORGANIC CHEMICAL PRODUCTS Chemical and fuel storages, storage and handling of phosphates.
Emissions	Tier	Emission source
TSP, PM_{10}, $PM_{2.5}$	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits, calculated
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Emission trends

Particle emissions from Storage and handling of phosphates are included in this category (Figure 4.16).

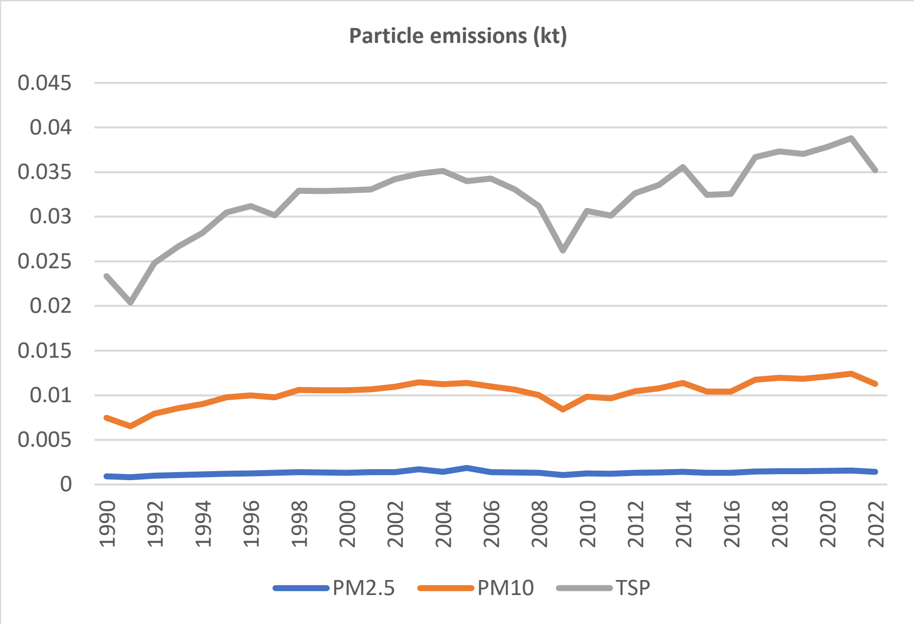


Figure 4.16. Particles from storage and handling of phosphates 1990-2022.

The emissions include both data reported by the plants and data calculated, and the shares of these fluctuate annually. The shares in the 2020 submission are presented in Table. 4.30.

Table 4.30. Contribution of Storage, handling and transport of chemical products (NFR 2B10b) to total emissions in 2022.

Pollutant	Emissions in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.053	75.464	Gg	<0.1	100
$PM_{2.5}$	0.001	13.384	Gg	<0.1	0
PM_{10}	0.011	26.778	Gg	<0.1	0
TSP	0.035	42.014	Gg	<0.1	0

Methodological issues

Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available emissions have been calculated. Production of phosphates is presented in Table 4.31 and the emissions in Table 4.32.

Particles

Particulate emissions from storage and handling of phosphates are calculated with emission factors: $PM_{2.5}$ 0.0000016 t/t, PM_{10} 0.0000128 t/t and TSP 0.00004 t/t (TNO, 2002). There are no methods in the Guidebook. Activity data presented in Table 4.27 is provided by the Customs statistics (ULJAS).

Table 4.31. Activity data for storage and handling of phosphates (Customs Statistics ULJAS).

Year	Production (t)	Year	Production (t)	Year	Production (t)	Year	Production (t)
1990	584 000	2000	824 000	2010	765 000	2020	944 533
1991	510 000	2001	823 000	2011	752 000	2021	970 079
1992	621 000	2002	856 000	2012	814 400	2022	880 050
1993	668 000	2003	853 000	2013	838 300		
1994	704 000	2004	879 000	2014	888 940		
1995	762 000	2005	823 000	2015	810 309		
1996	780 000	2006	857 000	2016	813 889		
1997	748 000	2007	824 000	2017	917 418		
1998	820 000	2008	777 000	2018	933 197		
1999	820 000	2009	655 000	2019	925 934		

Table 4.32. Calculated particle emissions from storage, handling and transport of chemicals products.

Year	$PM_{2,5}$ (t)	PM_{10} (t)	TSP (t)	Year	$PM_{2,5}$ (t)	PM_{10} (t)	TSP (t)
1990	0.93	7.47	23.35	2010	1.22	9.80	30.61

1991	0.82	6.52	20.39	2011	1.20	9.63	30.10
1992	0.99	7.94	24.82	2012	1.30	10.42	32.58
1993	1.07	8.54	26.70	2013	1.34	10.73	33.53
1994	1.13	9.01	28.17	2014	1.42	11.38	35.56
1995	1.22	9.76	30.50	2015	1.30	10.37	32.41
1996	1.25	9.98	31.19	2016	1.30	10.42	32.56
1997	1.20	9.58	29.93	2017	1.47	11.74	36.70
1998	1.31	10.50	32.81	2018	1.49	11.94	37.33
1999	1.31	10.49	32.78	2019	1.48	11.85	37.04
2000	1.32	10.55	32.97	2020	1.51	12.09	37.78
2001	1.32	10.53	32.91	2021	1.55	12.40	38.80
2002	1.37	10.95	34.22	2022	1.41	11.26	35.20
2003	1.37	10.92	34.13				
2004	1.41	11.25	35.15				
2005	1.32	10.53	32.90				
2006	1.37	10.97	34.28				
2007	1.32	10.55	32.97				
2008	1.24	9.94	31.07				
2009	1.05	8.38	26.18				

NMVOC

Emissions are data reported by the plants according to their environmental permits.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2021

- Facility reported TSP emissions were corrected for one plant for 2010. As result, emissions of $PM_{2.5}$ and PM_{10} were also recalculated for this plant.

Source-specific planned improvements

None.

4.4 Metal Production (NFR 2C)

Changes in chapter	
February 2023	JMP, KS, TF

Source category description

Metal Production activities in Finland include iron and steel production, copper products, refined steel, zinc, nickel and alloys.

NFR	Processes	Description	Emissions reported
2C1	Iron and steel production	Iron and steel plants (< 5 plants), both emissions reported by the plant and calculated at the inventory agency	NMVOC, SO_X, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/F, PAH-4, HCB, PCB
2C2	Ferroalloys production	Ferrochromium production plants (< 5 plants) are part of integrated stainless steel plants, emission reported by the plants	NMVOC, SOx, TSP, PM_{10}, $PM_{2.5}$, BC, Pb, Cd, Hg, Cr, Cu, Ni, Zn, As, PAH-4

2C3	Aluminium production	There is no primary aluminium production in Finland. Secondary aluminium production and aluminium casting (<5 plants)	NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC, Pb, Cd, As, Zn, PCDD/F, HCB, PCB
2C4	Magnesium production	No magnesium production ocuurs	Not Occuring
2C5	Lead production	No lead production occurs	Not Occuring
2C6	Zinc production	< 5 zinc production plants, emissions both reported by the plants and calculated at the inventory agency	TSP, PM_{10}, $PM_{2.5}$ Pb, Cd, Hg, As, Cu, Ni, Zn, PCDD/F
2C7a	Copper production	Copper production plants (< 5 plants) and production of upgraded copper products. Emissions both calculated or reported by the plants	NMVOC, SO_X, TSP, PM_{10}, $PM_{2.5}$, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCB, PCB, PCDD/F
2C7b	Nickel production	< 5 plants	NMVOC, SOx, NH_3, Ni
2C7c	Other metal production		NMVOC, SO_X, NH_3, TSP, PM_{10}, $PM_{2.5}$, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCB
	040307 Galvanizing		
	040309 Other	Recycling of waste and scrap	
	040309 Other	Aluminium foundry	
	040309 Other	Handling of FeCr slag	
	040309 Other	Surface treatment of metals	
	040309 Other	Secondary aluminium production	
	040309 Other	Manufacturing of furniture (zinc electroplating)	
	040309 Other	Manufacturing of metallic construction mountings	
	040309 Other	Cable manufacturing	
	040309 Other	Manufacturing of nails	
	040309 Other	Lock manufacturing	
2C7d	Storage, handling and transport of metal products	Storage and handling of iron ore.	TSP, PM_{10}, $PM_{2.5}$

Emission trends

Air pollutant emissions from metal production depend on the annual production volumes, which depend e.g. on markets, as well as on chemicals' use volumes over the years. There have also been changes in the production and emission abatement technologies over time. Detailed trend explanations are provided separately for each of the NFR sub-categories.

Methodological issues

Emissions of those plants that report their emissions to the supervising authorities[4] according to the monitoring requirements in the environmental permits are in some cases reported as aggregated for the whole plant and not by individual processes. In the case of all the emissions reported in YLVA, the emissions have been classified either as combustion based or process related emissions in the calculation system of the air pollutant emission inventory. In the cases of clear process emissions, these are reported separately under NFR 2C categories. In the cases where the reported emissions data in the YLVA system clearly are the total figure of energy and process related emission, the process related emissions are estimated to be the difference between the total emissions reported by the plant and the default emissions calculated on basis of fuel consumption, the difference is reported under the industrial processes. These cases relate mainly to paticulate matter (TSP) emissions reported by a relatively small numbber of plants. In case it has not been possible to make a split between energy and process related emissions, all emissions are reported under NFR 1A2a (iron and steel) or 1A2b (non-ferrous metal processes).

For those plants that do not report their emissions to supervising authorities, emissions have been calculated based on production data available in YLVA or on statistical information from industrial associations, and emission factors.

The share of especially heavy metal, POP and NMVOC emissions reported to the environmental authorities available in YLVA has increased during the recent years due to the implementation of the E-PRTR regulation. Part of the emissions in the inventory, which were previously calculated with international emission factors, are now reported by individual companies based on measurements or plant specific other information.

[4] The emission data is available from the YLVA database after it has been checked and approved by the authorities.

When the plants do not have plant specific information for the basis of estimation of emissions, they use national emission factors, which are the same that are also used in the inventories and are available for the use of the plants at a website maintained by the Finnish Environment Institute for this purpose[5].

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2019 submission

- Check of national emission factors and calculation of new emission factors based on site specific information.
- Presentation of emission trends.

Source specific planned improvements

None

[5] https://www.ymparisto.fi/fi/saasteettomuus-ja-ymparistoriskit/ilmansuojelu/ilman-epapuhtauksien-paastot-suomessa/paastotiedon-tuottaminen-ja-ilmoittaminen-paastorekistereihin/kansallista-aineistoa-paastojen-maarittamiseen

Iron and steel production (NFR 2C1)

Changes in chapter	
February 2024	KS, JMP TF

Source category description

<table>
<tr>
<td>SNAP 040202, 040203, 040205, 040206, 040207, 040208, 040209, 040210

Key category for
SOx (L1, T1)
PM$_{2.5}$ (L1, T1)
TSP, PM$_{10}$ (T1)
Hg, Cr, Ni (L1, T1)
As (L1)
Pb, Zn (T1)
PCDD/F (L1, T1)
PAH-4 (T1)
PCB (L1, T1)

Method for all T3</td>
<td>IRON AND STEEL PRODUCTION

The first blast furnace in Finland was built in 1616 in Mustio. In 1916 the first smelter plant was established.

Currently steel is produced at three plants in Finland with an annual total capacity of about 5 million tonnes. Both ore and recycled steel (about 2 million tonnes annually) are used.

Sintering unit – 1994 - December 2011, expanded in 1971
Sintering unit - 2013-
Blast furnace – 1961-2012
Blast furnace - 1964, renovated in 1995
Blast furnace – 1975, renovated in 1996 and 2011

The plants included in this sector are in 2022 inventory:
• One iron and steel plant including coke oven, blast furnace, lime production plant and steel converter
• One iron and steel plant including blast furnace and steel converter (closed down in 2012)
• One integrated ferrochromium and stainless steel plant
• One steel plant with electronic arc furnace, using scrap iron only

The Finnish plants use both iron ore and scrap metal and produce iron ore, iron pellets, steel, hot and cold rolled coils/sheets, steel bars, strips, plates, billets, wire rod products.

Emissions from iron and steel plants are both reported by the plants according to their monitoring and reporting requirements in the environmental permits, and also calculated at the inventory agency. Tier 3 / 2

Emissions related to fuel combustion are mainly reported under NFR 1A2a.</td>
</tr>
</table>

Units	Emissions	Emission data reported by the plants	Calculated for
Steel production, < 5 plants (the other of the remaining blast furnaces was closed down in 2012)	NMVOC	75% (< 5 plants)	25% (< 5 plants)
	PAH-4	50% (< 5 plants)	50% (< 5 plants)
	PCDD/F	75% (< 5 plants)	25% (< 5 plants)
	PCB	25% (< 5 plants)	75% (< 5 plants)
	As, Cd, Pb, Zn	100% (< 5 plants)	-
	Cr, Cu, Hg, Ni	100% (< 5 plants)	-
	CO	100% (< 5 plants)	-
	NOx, SOx	100% (< 5 plants)	-
	TSP	100% (< 5 plants)	PM10, PM2.5, BC
Pig iron tapping	PAH-4	-	100% (< 5 plants)
Sinter processes,< 5 plants (last unit was closed down in December 2011 and a new one started operation in 2013)	NMVOC	100% (< 5 plants)	-
	PAH-4	100% (< 5 plants)	-
	PCDD/F	100% (< 5 plants)	-
	PCB	-	100% (< 5 plants)
	HCB	-	100% (< 5 plants)
	TSP	100% (< 5 plants)	PM10, PM2.5
	Cd, Cr	100% (< 5 plants)	-
	Pb	100% (< 5 plants)	-
	SOx, NOx	100% (< 5 plants)	-
Rolling mills, < 5 plants	As, Cr, Cu, Pb, Ni	100% (< 5 plants)	-
	Hg, Cd	100% (< 5 plants)	-

	Zn	100% (< 5 plants)	-
	TSP	100% (< 5 plants)	PM10, PM2.5, PM
	NMVOC	100% (< 5 plants)	-
	SOx	100% (< 5 plants)	-
	NOx	100% (< 5 plants)	-
Other, 26 plants	NH3	100% (< 5 plants)	-
	As	100% (5 plants)	-
	Hg	<5 plants	-
	CO	<5 plants	-
	TSP	10-20 plants	PM10, PM2.5, PM
	Cd	5-10 plants	-
	Cr, Cu, Zn	10-20 plants	-
	Pb	10-20 plants	-
	Ni	10-20 plants	-
	NMVOC	10-20 plants	-
	SOx, NOx	<5 plants	-

Steel producers in Finland

Producers of steel and non-ferrous metals in Finland in 2014 are presented in Figures 4.17 and 4.18.

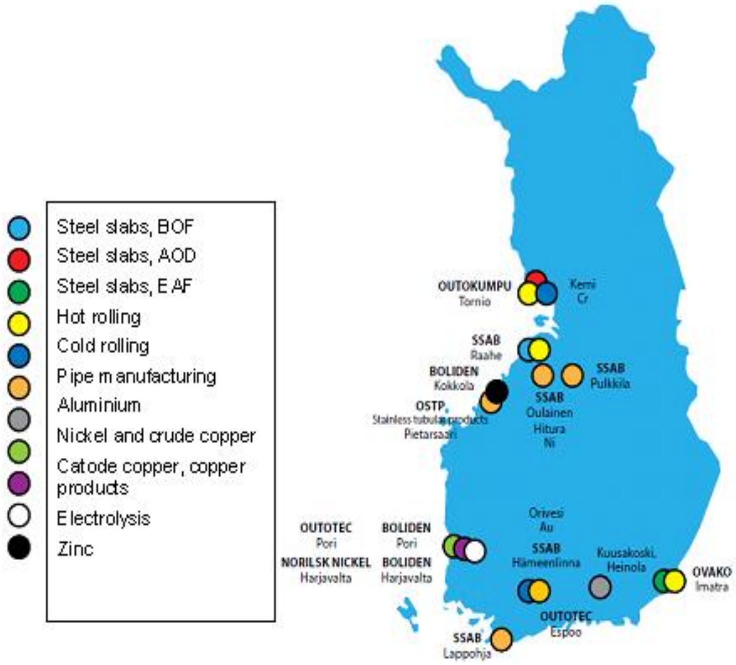


Figure 4.17. Technologies in steel and non-ferrous metals in Finland in 2014.

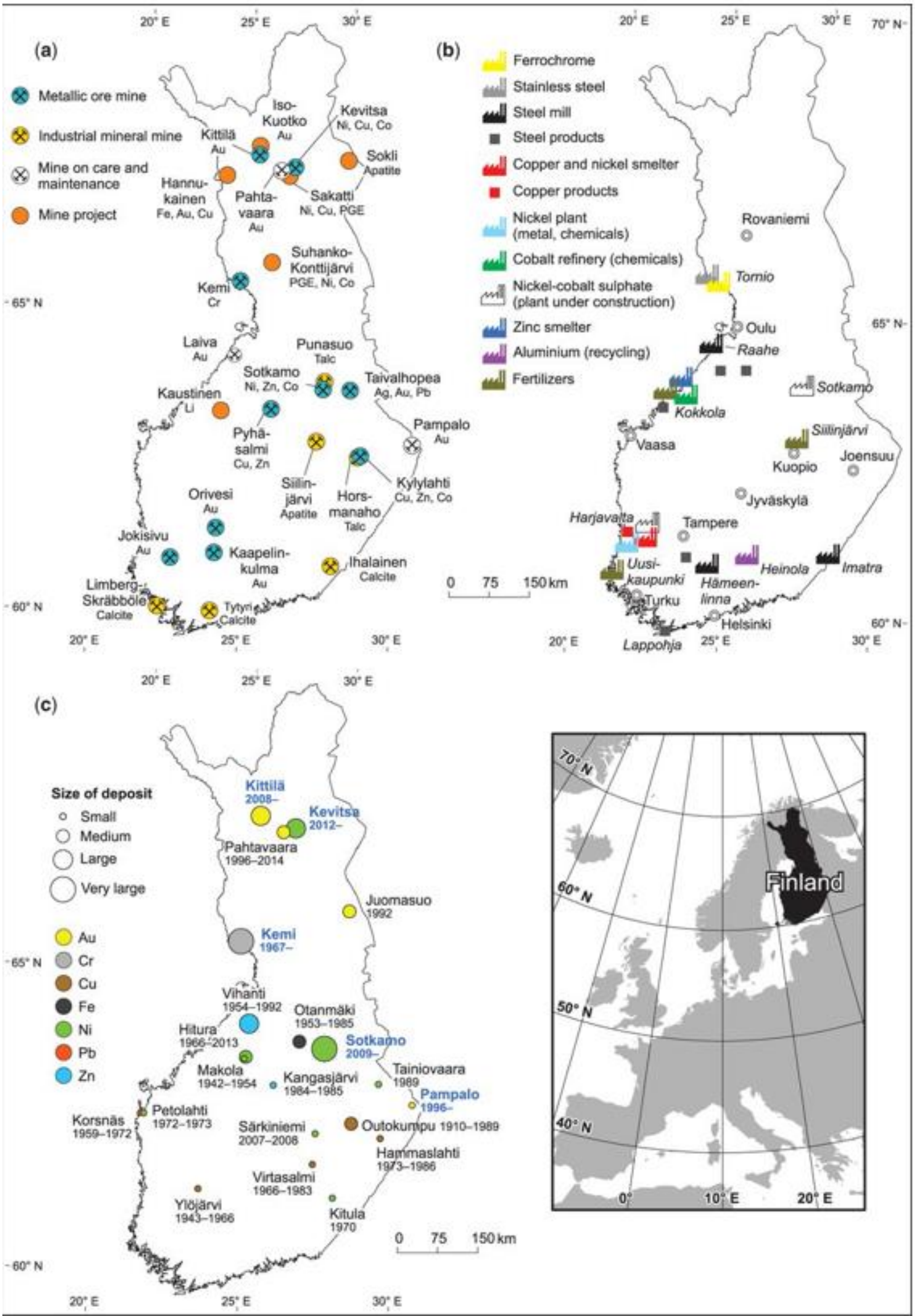


Figure 4.18. Producers of steel and non-ferrous metals in Finland in 2020
https://sp.lyellcollection.org/content/early/2020/02/04/SP499-2019-83

Production of steel[6]

Processes used in the production of steel from iron ore and scrap metal in Finland are described below (Figure 4.19).

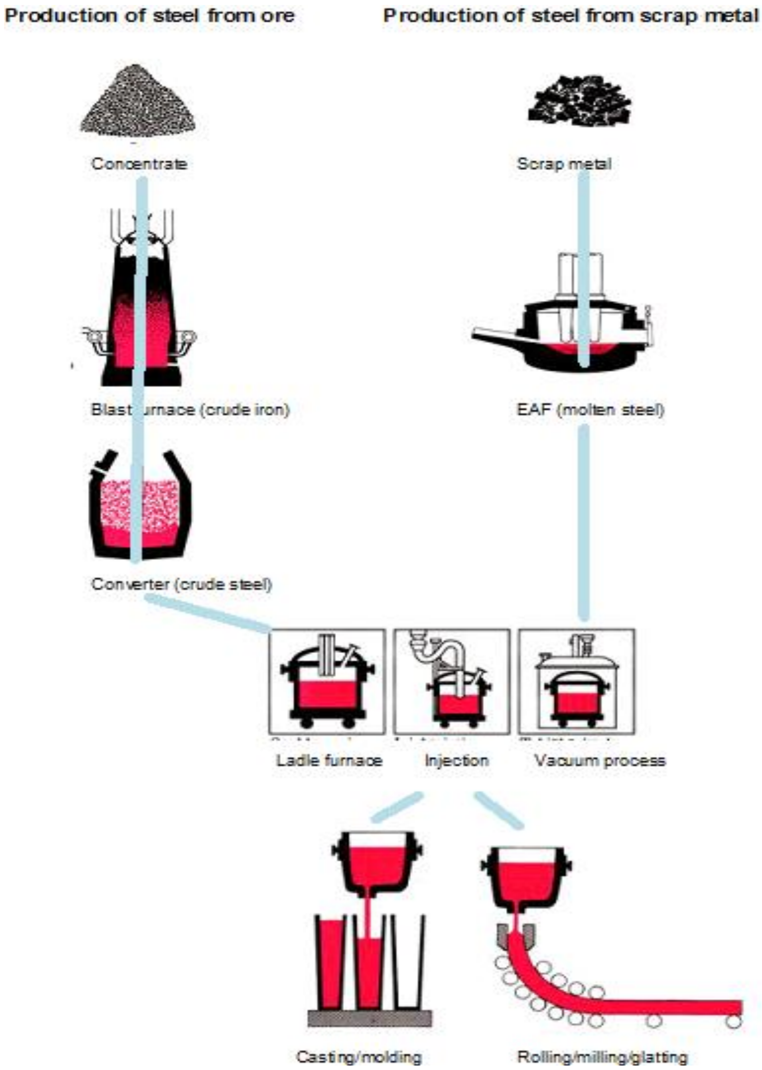


Figure 4.19. Production of steel from iron ore and scrap metal in Finland according to Teräskirja (Book of Steel in Hiilitieto, 2017).

Production from ore

Steel production processes in Finland include oxygen injection, EAF and AOD methods. In 2015 two blast furnaces were in operation. The blast furnaces are small but belong to the most efficient ones in Europe regarding production volumes and fuel use as well as the use of coal per steel tonne produced.

Process units for iron and ferrochrome production use coal and coke and utilise carbon monoxide and hydrogen containing process gases as energy sources. Processes include coking plant, blast furnace, sinter plant, sulphur removal, ladle furnace, BOF converters, LD converter, casting, hot and cold rolling.

[6] http://www.outokumpu.com/en/products-properties/more-stainless/producing-stainless-steel/Pages/default.aspx
http://www.ovako.com/en/Products/Standard-steel-grades/
http://usa.amegroup.com/Website/Content/GuestInformation/SiteDetail/Steel/8766/FNsteel_-_Koverhar
https://hiilitieto.fi/hiilitietoa/perustietoa-hiilesta/hiili-terasteollisuudesta/

In the production of carbon steel iron ore is reduced in blast furnaces using coke and oil into crude iron. Coke and oil are added to reduce the oxygen present in the iron ore. Crude iron contains 4.5% coal and the iron turns into steel in the converter (steel is iron where the coal content is below 2%). Combustion gases from coking are used as energy sources in the processes of the steel mill and contribute to 60% of the energy demand.

In the production of ferrochrome which is rawmaterial for stainless steel, coal is used to reduce chrome concentrate and combustion gases from this are used as fuel.

Processing of steel from scrap and alloys

Electric arc furnace (EAF) is used for steel production from scrap metal in Finland. Molten ferro chromium smelting is used in addition to EAF. The steps in processing metal scrap include

1) Melting of raw materials in an electric arc furnace (EAF)
   During the melting process, the arc reaches temperatures of up to 3,500 °C, and the molten steel can reach up to 1,800 °C. The additional injection of chemical energy, in the form of carbon, ferrosilicon, oxygen, or fuel gas mixtures, speeds up the melting process.

2) Removal of carbon, sulfur, and possibly nitrogen, in a steel converter
   After melting, the steel is further processed in an AOD (http://www.outokumpu.com/en/products-properties/more-stainless/producing-stainless-steel/Pages/default.aspx) converter or through a VOD (Vacuum Oxygen Decarburization).
   In the AOD the carbon content is reduced to a target amount and to supply additional alloying elements. When liquid ferrochrome is used, an iron-rich scrap mix with low alloy content is melted in the arc furnace. Nickel and molybdenum, together with the liquid ferrochrome, are then added to the AOD converter.
   The VOD (Vacuum Oxygen Decarburization) is used to produce very low carbon or nitrogen content for high chromium ferritic stainless steels.

3) Tuning of the steel composition and temperature
   Secondary metallurgical treatment is done in a ladle station, ladle furnace, or as a vacuum treatment of the liquid steel to adjust and to homogenize both the temperature and chemistry of the molten material.

4) Casting of slabs or ingots
   The liquid steel ladle is transported to casting.

Hot rolling

In hot rolling the cast microstructure of semi-finished casting products is broken down maintaining but maintaining a structure to prevent the steel from hardening. The finished product's surface is covered with an iron- and chromium-rich oxide that forms at high temperatures. It is usually removed in the annealing and pickling line, which restores the smooth metallic surface.

Cold rolling, annealing, and pickling

a) Small-diameter working rolls work out the strip profile and flatness. Restoring the material properties after cold rolling is carried out in a heat treatment and all oxide scale is removed in acid pickling baths, and then finishing off with high pressure water rinsing. Alternatively, a bright annealing line (BA-line) is used to restore the material properties hydrogen or a mixture of hydrogen and nitrogen. As no oxygen is available inside the furnace, no additional oxide scale is formed and whatever oxide remains on the strip is reduced to metal.
b) Skin pass rolling (temper rolling) is a light cold-rolling treatment with low reduction (0.5–1%) to improve the strip shape, finish, and mechanical properties.

Final processing

To tailor coils and plates to customer requirements the following processes are used:
- Roller or stretch leveler
- Edge trimming to the desired width
- Slitting into narrow coils

- Cutting into desired length sheets/plates
- Shearing/cutting into an order-sized shapes.
- Coating and preparing edges for special welding requirements

Emission trends

In surface preparation such as grinding, brushing, pattern rolling, or embossing the emissions are impacted by annual production rates (Figure 4.20), which depend on the markets. Technological changes in production and abatement techniques have occurred over the time.

- Dip in HCB emissions in 2011 is due to closing of one sintering unit (high HCB emission level), while a new sintering unit was started in 2012 (low HCB emission level). Please refer to sinter production volumes.
- PAH emissions originate from sintering, however, an explanation has not yet been found for the lower emission level since 2006, however, PAH emissions are only based on few measurements made at the plant.
- PCB emissions originate in sintering and production of crude steel. The fluctuation of emissions in 2008-2011 is related to the fluctuation of the production volumes of iron in the same years.

Contribution of iron and steel production to total emissions is presented in Table 4.33.

Table 4.33. Contribution of Iron and Steel production (NFR 2C1) to total emissions in 2022.

Pollutant	Emissions iron and steel industry in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.208	75.464	Gg	0.3	86.6
SOx (as SO_2)	0.848	22.692	Gg	3.7	100
NH_3	0.036	31.583	Gg	0.1	100
$PM_{2.5}$	0.197	13.384	Gg	1.5	0
PM_{10}	0.214	26.778	Gg	0.8	0
TSP	0.260	42.014	Gg	0.6	85.7
BC	<0.001	3.121	Gg	<0.1	0
CO	0.134	310.209	Gg	<0.1	100
Pb	0.425	12.516	Mg	3.4	100
Cd	0.006	0.779	Mg	0.8	100
Hg	0.085	0.505	Mg	16.7	100
As	0.058	1.920	Mg	3.0	100
Cr	2.069	14.905	Mg	13.9	100
Cu	0.365	38.391	Mg	0.9	100
Ni	0.637	9.917	Mg	6.4	100
Zn	2.522	131.533	Mg	1.9	100
PCDD/F	0.509	9.497	g I-Teq	5.4	100
PAH-4	0.008	18.531	Mg	<0.1	0
HCB	0.014	29.245	kg	<0.1	0
PCB	9.460	19.922	kg	47.0	46.7

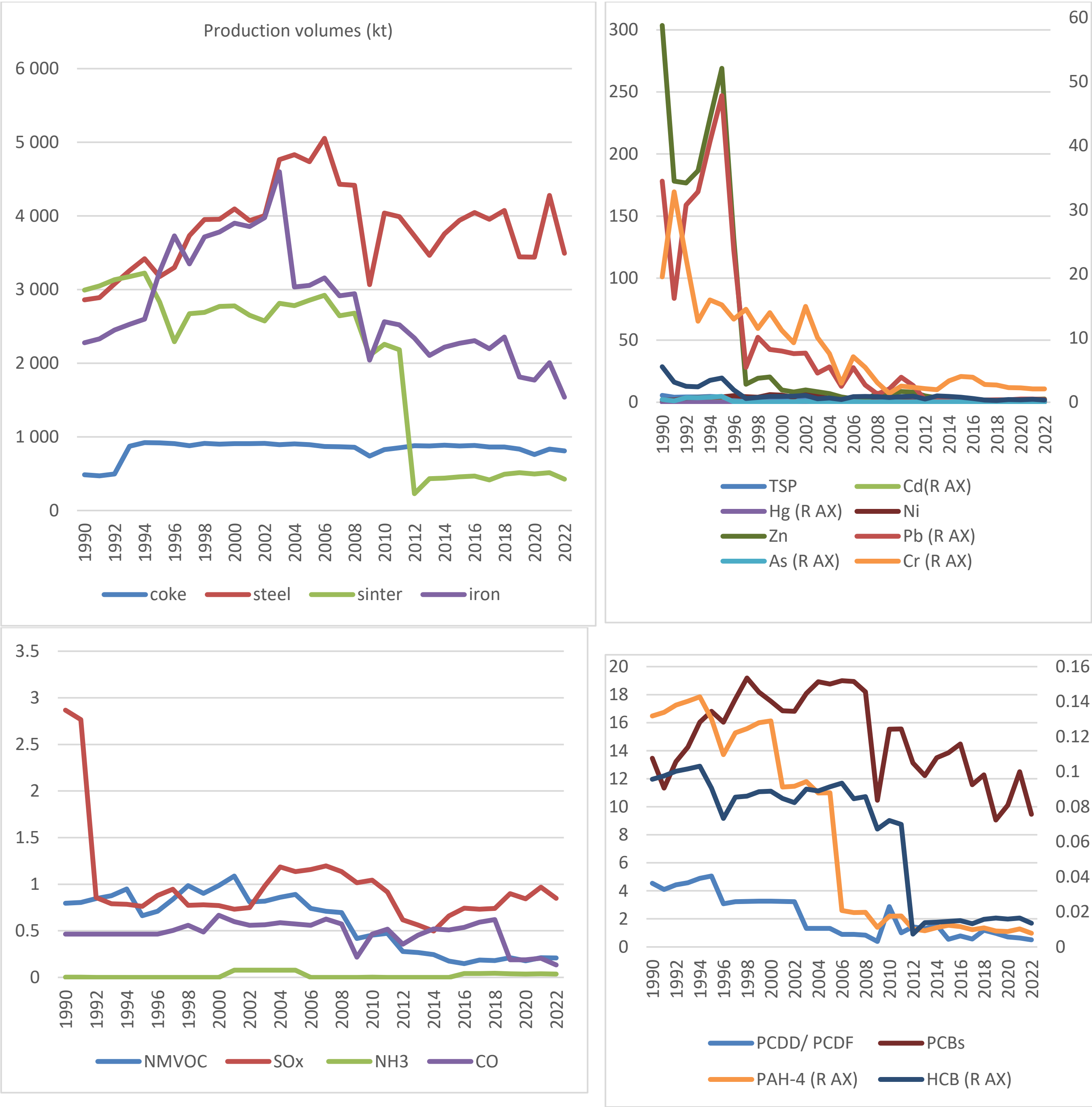


Figure 4.20. Iron and Steel production and emissions 1990-2022.

This sector contributed more than 10% of the total Cr and Hg emissions and approximately 5% of total As, Ni and PCB emissions. The shares of emissions of total emissions and the shares reported by the plants are presented in Table 4.30.

Methodological issues

Activity data

Activity data for production of coke, steel and iron, is presented in Table 4.34.

Table 4.34 Production of coke, steel and iron as reported by plants to the YLVA-database

Year	Production of coke (1000t)	Production of crude steel (1000t)	Production of sinter (t)	Production of iron (t)
1990	487	2 861	2 992 000	2 280 000
1991	471	2 890	3 049 000	2 330 000
1992	498	3 077	3 133 000	2 450 000
1993	874	3 256	3 178 000	2 530 000
1994	922	3 420	3 224 000	2 600 000
1995	920	3 176	2 832 000	3 242 000
1996	910	3 301	2 292 000	3 730 000
1997	879	3 734	2 673 000	3 350 000
1998	912	3 952	2 689 000	3 716 000
1999	900	3 956	2 770 000	3 783 000
2000	910	4 096	2 780 000	3 903 000
2001	909	3 938	2 650 000	3 857 000
2002	912	4 003	2 574 000	3 975 000
2003	895	4 766	2 815 000	4 600 000
2004	904	4 830	2 782 000	3 036 566
2005	894	4 738	2 857 000	3 056 165
2006	870	5 054	2 922 119	3 157 894
2007	865	4 431	2 644 780	2 915 130
2008	860	4 417	2 680 894	2 942 946
2009	740	3 066	2 104 435	2 042 112
2010	828	4 040	2 256 069	2 564 451
2011	852	3 989	2 184 169	2 522 316
2012	880	3 728	229 000	2 340 089
2013	877	3 465	434 000	2 107 032
2014	888	3 759	441 000	2 219 096
2015	876	3 939	457 000	2 270 261
2016	882	4 048	469 000	2 308 774
2017	864	3 953	416 000	2 196 276
2018	861	4 074	493 000	2 356 386
2019	836	3 444	515 000	1 813 106
2020	761	3 440	495 000	1 770 483
2021	835	4 279	515 000	2 007 573
2022	808	3 495	424 600	1 539 655

Emissions are either reported by the plants or calculated using activity data.

Sulphur dioxide, nitrogen dioxide and heavy metals (Key category for SOx, Pb, Hg, As, Cr, Ni. Zn, all T3)
Sulphur dioxide, nitrogen dioxide and heavy metal emissions from the iron and steel industry are based on data reported by the plants.

Particle emissions (Key category for TSP, PM_{10} and $PM_{2.5}$, all T3)
Particle emissions are generated in the foundries and sinter plants. TSP emissions are reported by the plants to the supervising authorities and are available in YLVA to be used in the inventory. PM_{10} and $PM_{2.5}$ emissions have been calculated with fraction factors as follows:
- Foundries: 80% for PM_{10} and 50 % for $PM_{2.5}$ (Guidebook 2023)
- Sinter plants: 50% for PM_{10} and 40% for $PM_{2.5}$ (Guidebook 2023)
- Steelworks (BOF): 91% for PM_{10} and 80% for $PM_{2.5}$ (Guidebook 2023)
- Steelworks (EF) and rolling of steel: 80% for PM_{10} and 70% for $PM_{2.5}$ (Guidebook 2023)

Black carbon
BC emissions are calculated using following emission factors:
- Basic oxygen furnace, electric furnace steel plant, rolling mills and foundries: 0.36 % of PM2.5 (Guidebook 2023)
- Sinter and pelletizing plant: 0.17 % of PM2.5 (Guidebook 2023)

NMVOC

Emission data from steel plants are reported by the plants to the supervising authorities. For those plants, which do not report their NMVOC emissions, the emissions are calculated with activity data and emission factors as follows:

Basic oxygen furnace steel plant

- Emission factor 0.08 kg/t (Guidebook 2002) is used for the years 1990-2013. Note: Guidebook 2002 is used as it provides a T2 EF while the later Guidebooks, including the 2023 version, provide only a T1 EF which we consider to over-estimate emissions.

Electric arc furnace steel plant

- In the 2023 submission the emission factor has been revised to a plant specific EF of 0.09271 kg/t, which was calculated for the years 1990-2007 based on emissions reported to the YLVA database from 2008 onwards. No changes have occurred in the steel plant process since 1990.

PAH

Iron and steel industry is a key category for PAH-4 emissions and a T3/T2 method is used to quantify emissions.
Most of the steel mills report their PAH emissions to the environmental authorities. For those plants which do not report their emissions, PAH-4 emissions presented in Table 4.35 are calculated with emission factors as follows:

Production of steel, EFs:

- PAH-4 0.07 mg/t (UBA, 1998)

Production of iron, EFs:

- PAH-4 4.3 mg/t PAH-4 (EPA, 1988)
  Note that the Guidebook 2023 state that the default EF of 2.5 g/t provided in the 2023 Guidebook is very high and only appropriate if tar-containing coating material is used. The Guidebook EF does not correspond to Finnish conditions. Therefore, the EF suitable for the Finnish conditions and corresponding to modern techniques' performance is used.

PAH emissions originate in sintering and iron and steel production processes:

(1) Sintering - there have been two sintering units operating in since 1990.

One of the units was in operation in 1990-2011, after that the unit was closed down and a new unit started operation in 2012.

Emissions in 1990-2000 have been calculated using production data and the country specific EF of 0.04 g/t which is based on measurements and is thus considered to better reflect the techniques used in the 1990s, while the Guidebook 2023 EFs would correspond better to the more recent years.

Emissions in 2001-2011 are reported by the plants and here the years 2001-2005 are based on measurements carried out in 1999, while the years 2006-2011 are based on measurements carried out in 2006. The sintering plant was shut down in 2011.

Emissions since 2012: The emissions from the new unit that started the operation in 2012 are reported by the plant and are low compared to the emissions from the earlier unit that was closed in 2011. The reason for the strong decreases is the actual changes in the activities.

(2) Iron and steel production units, which have been operating all the years.

From iron production the emissions are calculated using the country specific EF of 4.3 mg/t based on B(a)P-, benzo(b)-, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene measurements at the plant, and production data.

From steel production, emissions of 2 of the 3 plants are based on information from the plants for the whole time series. For the third plant, the emissions have been calculated using the EF 0.07 mg/t (UBA, 1998) because the processes at the third plant differed from the two other ones so that an IEF of the other plants could not be used. Emissions from the third plant occured in 1990-2003.

The split of PAH-4 emissions into the 4 PAH species has been carried out according to the results from a survey to the plants.

PCB and HCB (Table 4.35) (Key category for PCB, method T3/T2)
Most of the steel mills report their POP emissions to the environmental authorities.

PCB
For those plants which do not report their emissions, PCB emissions from the production of steel are calculated with the EF of 2.5 mg/Mg (Guidebook 2023). In the 2022 submission a new country-specific emission factor for one plant was taken in use for emissions from year 2017-2019. This EF (0.4 mg/Mg) is based on measurements done in 2017 at the plant, where abatement technology is based on activated carbon. Emissions from 2020 onwards are reported by the plant..

Emission factors used for production of sinter
- HCB 32 µg/t Guidebook 2023
- PCB 0.09 mg/t Guidebook 2023

PCDD/F (Key category for PCDD/F, method T2/T3)
The emissions from sintering in 1990-2001 have been calculated using production data and the country specific EF based on expert estimate 0.36 µg *I-TEQ*/t which is considered to better reflect the techniques used in the 1990s, while the Guidebook 2023 EFs correspond better to the more recent years. However, country-specific EFs are used for all years. The emissions were reported by plants in 2002-2011. These sintering units were shut down in 2011. Since 2013 PCDD/F emissions from sintering are reported by one plant which started operation in 2013.

PCDD/F emissions from steel production are reported by plants.

Contribution of POP emissions from iron and steel production to total emissions is presented in Table 4.35.

Table 4.35. POP emissions from iron and steel production.

Year	PCB (kg)	Benzo(a)pyrene (kg)	Benzo(b)fluoranthene (kg)	Benzo(k)fluoranthene (kg)	Indeno(1,2,3-cd) pyrene (kg)	PCDD/F (g I-TEQ)
1990	13.464	32.9	33.0	33.0	32.7	4.6
1991	11.327	33.4	33.5	33.4	33.2	4.1
1992	13.224	34.4	34.6	34.5	34.2	4.4
1993	14.250	35.0	35.2	35.1	34.8	4.6
1994	16.030	35.6	35.8	35.7	35.4	4.9
1995	16.821	32.5	32.6	32.6	32.2	5.1
1996	16.033	27.3	27.5	27.4	27.2	3.1
1997	17.680	30.4	30.6	30.5	30.4	3.2
1998	19.188	31.0	31.2	31.1	31.0	3.3
1999	18.174	31.9	32.0	32.0	31.9	3.3
2000	17.531	32.1	32.3	32.2	32.1	3.3
2001	16.849	22.7	22.8	22.8	22.7	3.2
2002	16.817	22.8	23.0	22.9	22.8	3.2
2003	18.084	23.5	23.6	23.6	23.5	1.3
2004	18.931	21.8	22.0	21.9	21.8	1.3
2005	18.752	21.9	22.0	21.9	21.8	1.3
2006	19.001	5.1	5.3	5.2	5.0	0.9
2007	18.932	4.9	4.9	4.9	4.8	0.9
2008	18.209	4.9	5.0	4.9	4.8	0.8
2009	10.458	2.8	2.8	2.8	2.8	0.4
2010	15.528	4.4	4.4	4.4	4.4	2.9
2011	15.561	4.4	4.4	4.4	4.4	1.0
2012	13.133	2.5	2.6	2.6	2.5	1.4
2013	12.231	2.3	2.3	2.3	2.3	1.3
2014	13.491	3.0	2.7	2.6	2.6	1.6
2015	13.853	3.7	2.9	2.9	2.9	0.5
2016	14.481	3.2	2.9	2.8	2.7	0.8
2017	11 566	2.4	2.5	2.4	2.4	0.6
2018	12 270	2.6	2.7	2.6	2.6	1.2

2019	9 054	2.3	2.4	2.2	2.1	1.0
2020	10 120	2.2	2.4	2.2	2.1	0.7
2021	12 492	2.7	2.7	2.5	2.4	0.6
2022	9 460	2.0	2.0	1.9	1.8	0.5

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2018
- The whole time series was recalculated.
- National emission factors were checked and new emission factors calculated based on site specific information on emissions and production volumes while recalculating the time series.
- PAH4 emissions were split into the PAH indicator species for whole time series based on information received from the plants.
- Use of Guidebook 2016 EFs was checked.

2020
- Update to Guidebook 2019 EFs

2020-2021
- PAH emissions from iron production were missing from the 2019 submission and were included in the 2020 submission while information on the issue was not included in the 2020 IIR (related to ERT finding)

PAH emissions were erroneous and duplicated for 2008-2016 for one plant and for 2014-2015 for another plant in submission 2020. These were corrected for submission 2021.

2022
- Change of EF for PCB emissions for one plant (country-spesific EF) from year 2017 onwards.

2023
- Update of the method to calculate NMVOC emissions: implementation of an IEF for one plant for years 1990-2007.

Source-specific planned improvements

None.

Ferroalloys production (2C2)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

SNAP 040302 Key category for Cr (L1, T1)		FERRO ALLOYS Ferrochromium production plants (< 5 plants) are part of integrated stainless steel plants, emission reported by the plants Production capacity: 600 000t
Emissions	Tier	Source of emissions
NMVOC, SOx, PAHs	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM_{10}, $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Pb, Cd, Hg, As, Cr, Cu, Ni, Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Ferrochromium production occurs in the integrated stainless steel plants.

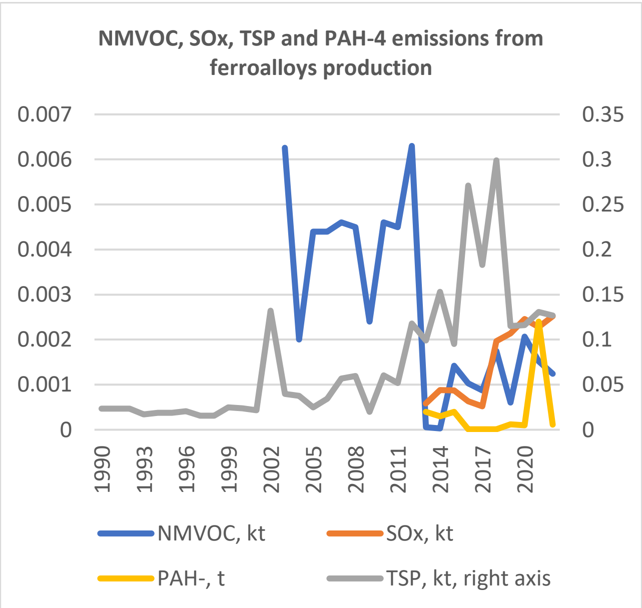
The emissions are either allocated under NFR 2C2 or NFR 2C1 according to information of the main activity of the plant as stated in their environmental permits.

Emission trends

Ferroalloys production is a major source of chromium emissions. In 2016, 2014 and also in 2002 several malfunction situations occurred at a production unit during the year, which could be seen as an increase in the level of zinc, nickel and chrome (also in 2007-2008) emissions.

PAH emissions are related to ferrochrome production, and a new unit duplicating the production rate was started in 2013. The possibility to calculate emissions related to ferrochrome production before 2012 will be studied for next submission.

Emission trends are presented in Figure 4.21.



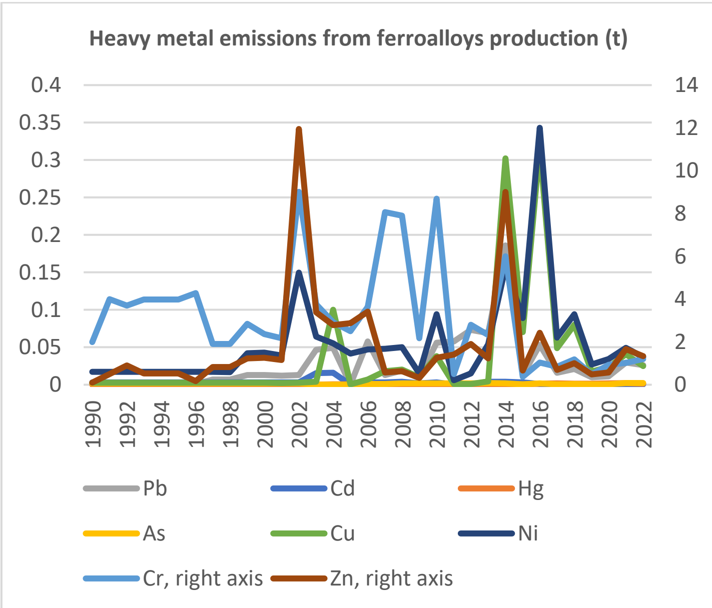


Figure 4.21. Emission trends from ferroalloys production.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.36.

Table 4.36. Contribution of Ferroalloys production (NFR 2C2) to total emissions in 2022.

Pollutant	Emissions ferroalloys production in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.001	75.464	Gg	<0.1	100
SOx (as	0.003	22.692	Gg	<0.1	100
PM2.5	0.076	31.583	Gg	0.6	0
PM10	0.108	13.384	Gg	0.4	0
TSP	0.127	26.778	Gg	0.3	100
BC	0.008	42.014	Gg	0.2	0
Pb	0.026	12.516	Mg	0.2	100
Cd	<0.001	0.779	Mg	<0.1	100
Hg	0.002	0.505	Mg	0.3	100
As	0.002	1.92	Mg	0.1	100
Cr	1.023	14.905	Mg	8.1	100
Cu	0.025	38.391	Mg	<0.1	100
Ni	0.037	9.917	Mg	0.4	100
Zn	1.334	131.533	Mg	1.0	100
PAHs	<0.001	18.531	Mg	<0.1	0

Methodological issues

As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, TSP, SOx, and NMVOC
Emissions are reported according to requirements for monitoring and reporting in the environmental permits of the plants. When no plant specific data is available emissions has been calculated.

PM_{10} and $PM_{2.5}$
Emissions are calculated using size fraction factors of 85% for PM_{10} and 60% for $PM_{2.5}$ (Guidebook 2023) from TSP emissions that are reported by the plants.

Black carbon
Emissions have been calculated using the fraction factor of 10 % of $PM_{2.5}$ (Guidebook 2023).

PAH
Emissions originate from ferrochrome production, where a new unit started operation in 2013. Emissions are reported according to requirements for monitoring and reporting in the environmental permits of the plants.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2019
- Change of particle fraction factors according to Guidebook 2019

2021
- PAH emissions were erroneous and duplicated for 2013 and 2015 for one plant in submission 2020. These were corrected for submission 2021.

Source-specific planned improvements

The possibility to calculate emissions related to ferrochrome production before 2012 will be studied for next submission.

Aluminium production (NFR 2C3)

Changes in chapter	
February 2023	JMP KS TF

Source category description

SNAP 040301 Not a key category for any pollutants		OTHER Secondary aluminium production and aluminium casting Number of plants < 5 Production capacity: ~50 000 t/a aluminium profiles
Emissions	Tier	Source of emissions
NMVOC, TSP, PM10, PM2.5, BC, Pb, Cd, As, Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
PCDD/F, HCB, PCB,	T3/T2	calculated (EF*AD)

There is no primary aluminium production in Finland.

Emissions from the production of secondary aluminium and from aluminium casting were earlier reported under NFR 2C7c due to the old definition of the category, and according to the Guidebook, as noted in the 2017 NECD review should have been allocated in the 2018 submission under NFR 2C3. The allocation was changed, however, not for all plants, and was re-checked for 2019 submission.

The contribution of aluminium production to national total emissions and the share of emissions reported by the operators is presented in Table 4.37.

Table 4.37 Contribution of Aluminium production (NFR 2C3) to total emissions in 2022.

Pollutant	Emissions ferroalloys production in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.001	75.464	Gg	<0.1	100
$PM_{2.5}$	<0.001	13.384	Gg	<0.1	0
PM_{10}	<0.001	26.778	Gg	<0.1	0
TSP	<0.001	42.014	Gg	<0.1	93.9
BC	<0.001	3.121	Gg	<0.1	0
Pb	<0.001	12.516	Mg	<0.1	100
Cd	<0.001	0.779	Mg	<0.1	100
As	<0.001	1.920	Mg	<0.1	100
Zn	0.004	131.533	Mg	<0.1	100
PCDD/F	0.045	9.497	g I-Teq	0.5	0
HCB	0.036	29.245	kg	0.1	0
PCB	0.096	19.922	kg	0.5	0

Emission trends

Emission trends are presented in Figure 4.22

The increase in Zn emissions in 2019 ia related to the aluminium quality that year.

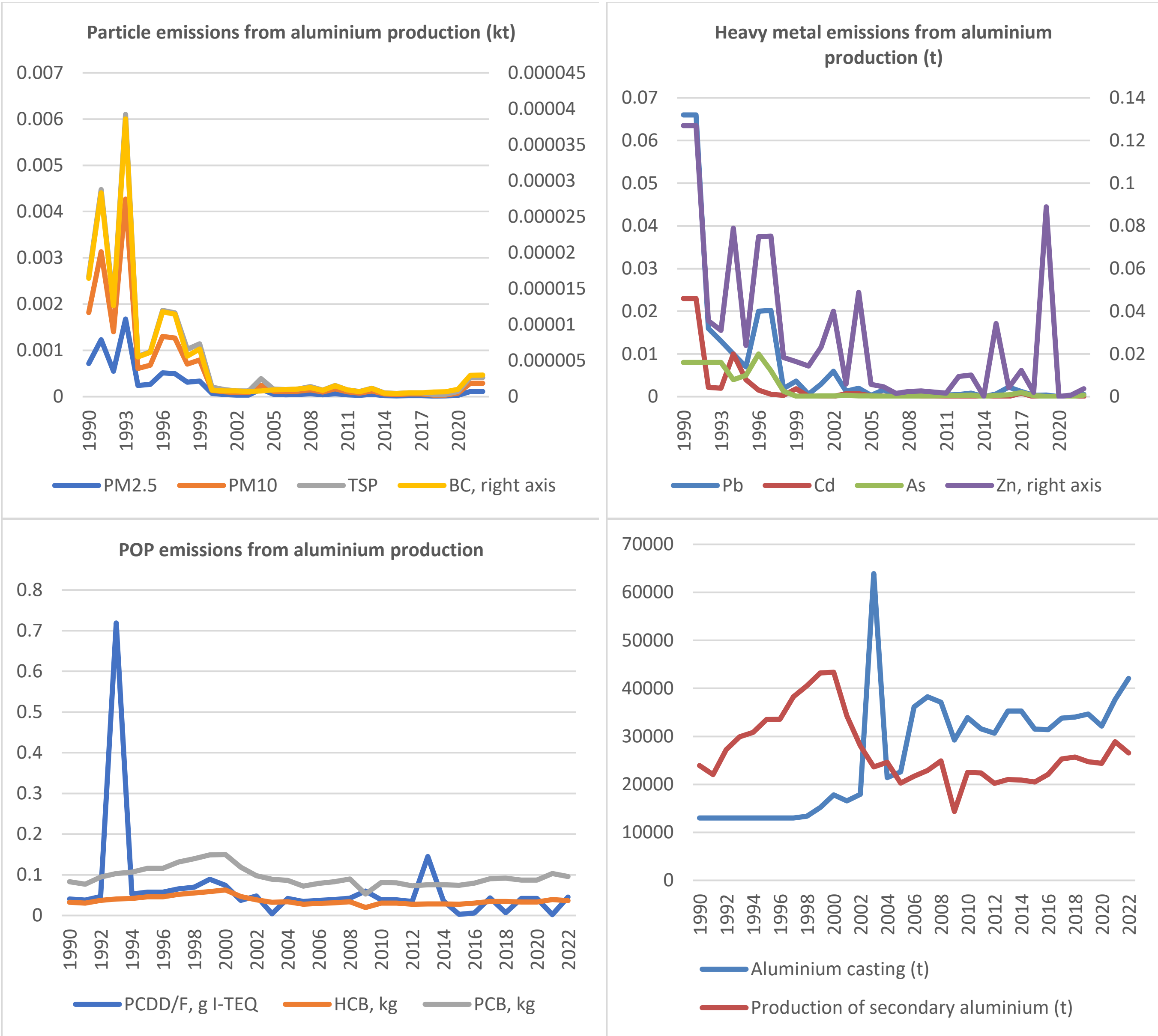


Figure 4.22. Production volumes and emissions from aluminium production 1990-2022.

Methodological issues

NMVOC

NMVOC emissions are reported by the plants according to their monitoring and reporting obligations.

Particles

TSP emissions are reported by the plants according to their monitoring and reporting obligations. PM_{10} and $PM_{2.5}$ emissions from the production of secondary aluminium are calculated using size fraction factors of 70 % for PM_{10} and of 27.5 % for $PM_{2.5}$ (Guidebook 2023).

Heavy metals

Arsenic, cadmium, lead and zinc emissions are reported by the plants according to their monitoring and reporting obligations. Heavy metal emissons are quite small but the quality of the used raw material in the process impacts to the emissions.

POP emissions

PCB, HCB and PCP emissions from production of secondary aluminium as well as PCB emissions from aluminium casting are calculated for plants using emission factors listed in Table 4.38 and activity data presented in Table 4.39.

PCDD/F emissions were calculated for the whole times series using the IEF of 1.707 ug I-TEQ/ calculated from data reported by the plant for years when measured data reported by the plant has not been available. The peak in emissions in 1993 is reported by the plant.

Table 4.38. Emission factors for POP emissions.

Pollutant	Process	EF	Reference
PCDD/F	secondary aluminium	1.71 ug I-TEQ/t	SYKE, 2022
HCB	secondary aluminium	1.365 mg/t	SYKE, 2007
PCB	secondary aluminium	3.4 mg/t	BiPRO, 2006 No method in the Guidebook
PCP	secondary aluminium	0.128 mg/t	SYKE, 2007
PCB	aluminium casting	0.135325 mg/t	Toda, 2005. No method in the Guidebook

Table 4.39. Secondary aluminium production and aluminium casting volumes.

Production of secondary aluminium (t) (The Federation of Finnish Technology Industries)		Aluminium casting (t) Expert estimate at SYKE 1990-1997, Statistics Finland from 1998 onwards	
1990	23 926	1990	13 000
1991	22 054	1991	13 000
1992	27 249	1992	13 000
1993	29 905	1993	13 000
1994	30 828	1994	13 000
1995	33 539	1995	13 000
1996	33 577	1996	13 000
1997	38 229	1997	13 000
1998	40 525	1998	13 378
1999	43 242	1999	15 193
2000	43 361	2000	17 799
2001	34 252	2001	16 548
2002	28 014	2002	17 910
2003	23 652	2003	63 907
2004	24 629	2004	21 421
2005	20 242	2005	22 602
2006	21 696	2006	36 146
2007	22 904	2007	38 240
2008	24 867	2008	37 132
2009	14 355	2009	29 258
2010	22 477	2010	33 896
2011	22 400	2011	31 573
2012	20 238	2012	30 649
2013	20 991	2013	35 268
2014	20 906	2014	35 268
2015	20 490	2015	31 521
2016	22 071	2016	31 385
2017	25 298	2017	33 810
2018	25 709	2018	34 013
2019	24 724	2019	34 638
2020	24 406	2020	32 128
2021	28 884	2021	37 664
2022	26 552	2022	42 073

Note: Values are total production amounts. If plant has reported emissions to the supervising authoritites (YLVA), emissions are not calculated for the one in question

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2018
- The allocation of secondary aluminium production was partly reallocated to NFR 2C3 from NFR 2C7c according to the recommendations from the NECD 2017 review.
- Small particle distribution factors were updated according to the recommendations from the NECD 2017 review.

2019
- The allocation of one plant is corrected and moved to NFR 2C3 in the 2019 submission.

2020
- The allocation of PCDD/PCDF were corrected for years 2009, 2013 and 2016 from category 2C7c to category 2C3.

2021
- PCDD/F emissions were calculated for years before before 2017 using an IEF derived from data reported by the plants.

2022
- Activity data for aluminium casting has been updated for 2014-2019.

2023
- PCDD/F emissions has been updated using IEF and measurement data provided by the plant. The whole timeseries has been updated.

Source-specific planned improvements

None.

Magnesium production (2C4)

No magnesium production has occurred in Finland.

Lead production (2C5)

No lead production has occurred in Finland.

Zinc production (NFR 2C6)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

SNAP 040309c Key category for Cd (T1) Zn (L1)		Zinc production plants (< 5 plants), emissions both reported by the plants and calculated at the inventory agency
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC	T2	NA
Pb, Cd, Hg, As, Cr, Cu, Ni, Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
PCDD/F	T2	calculated (EF*AD)

Special high-grade zinc is produced in Finland by an electrolytic process in a smelter. The electrolytic process includes four main stages: 1) Roasting of zinc concentrate in temperature of more than 900 ºC (ZnO as product), 2) Leaching stage, where the zinc oxide is separated from the other calcines 3) Impurities elimination 4) Electrolysis. According to 2006 IPCC Guidelines this process does not result in non-energy CO_2 emissions. (Finlands GHG-NIR, 2016)

Emission trends

Zinc production is a source of heavy metals, and PCDD/F. Process emissions fluctuate annually (e.g. zinc) depending on operation, raw material and products. Zn emissions from this sector contribute to nearly 10% of the total emissions.

There is slight increase in emission levels in 2019 due to disturbances in the electrolytics process.

Ni emissions occurred in 1992-1996, whereafter the process causing these emissions was closed down (emissions in 1990-1991 are included in the energy sector).

Cd emissions starting from 2002 are related to zinc production.

Particle emissions are most of the years allocated under the energy sector.

Emission trends and production are presented in Figure 4.23.

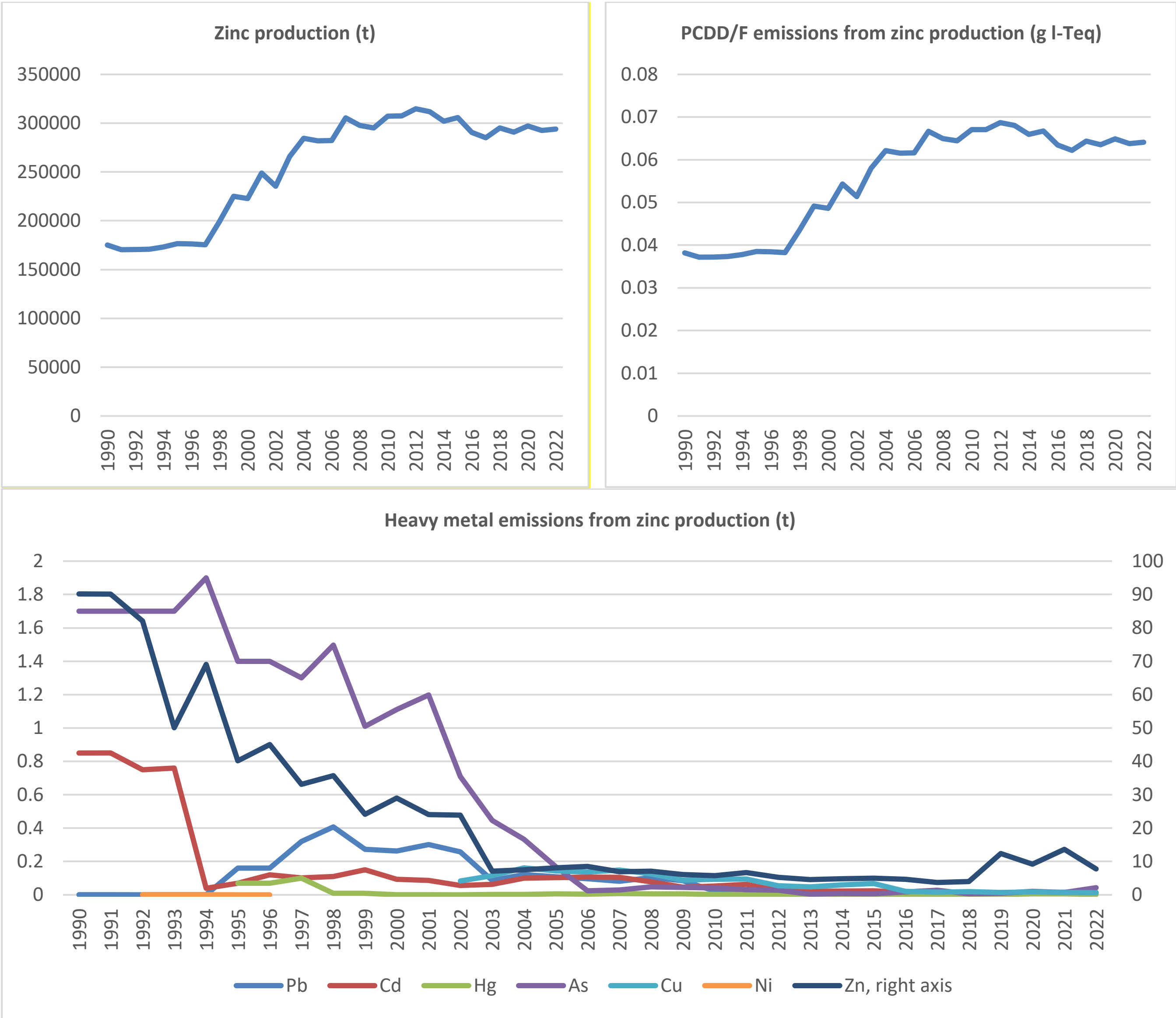


Figure 4.23. Emission trends and production of zinc 199-2022.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.40.

Table 4.40. Contribution of Zinc production (NFR 2C6) to total emissions in 2022.

Pollutant	Emissions from zinc production in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	<0.001	13.384	Gg	<0.1	0
PM_{10}	<0.001	26.778	Gg	<0.1	0
TSP	<0.001	42.014	Gg	<0.1	100
Pb	0.015	12.516	Mg	0.1	100
Cd	0.010	0.779	Mg	1.3	100
Hg	0.003	0.505	Mg	0.6	100
As	0.042	1.92	Mg	2.2	100
Cu	0.013	38.391	Mg	<0.1	100
Zn	7.787	131.533	Mg	5.9	100
PCDD/F	0.064	9.497	g I-Teq	0.7	0

Methodological issues

SO_x
Zinc production occurs alongside sulphur productios and SO_2 emissions from zinc production are utilised in the sulphur production. Therefore, SO_2 emissions are not emitted from zinc production except in exceptional situations such as malfunctioning or during start-up and shut-down periods.

Adding the above explanation for the non-occurring SO_2 emissions was recommended by the NECD 2017 review. In addition, the TERT recommended to replace the notation key “NA” with “NO”. However, the notation key has not been changed, because the use of “NO” means that the activity does not exist and the use of the notation key “NA” means that the emission is not relevant/occurring.

Heavy metals (As, Hg, Cd, Cu, Pb, Zn) (Key category for Cd and Zn, T3)
The plants report these emissions according to the monitoring programmes in the environmental permits to the environmental authorities and the data are available in YLVA for use in the inventories.

Cd emissions starting from 2002 are related to zinc production.
Ni emissions occurred in 1992-96 from zinc white production which occurred in these years. Ni emissions from 1990 to 1991 are included in the energy sector emissions.

When no plant specific data is available emissions have been calculated using plant specific activity data and IEFs.

Particles
TSP emissions are reported by the plants according to their monitoring and reporting obligations in their environmental permits. The reported figures are the total emissions including both the fuel based and process related emissions. The process related emissions are estimated as the difference between the total reported emissions and the default emissions calculated on basis of fuel consumption. Hence, the difference is reported under NFR 2C6. Under NFR 2C6, PM_{10} and $PM_{2.5}$ emissions are calculated using size fraction factors of 91% for PM_{10} and 81% or $PM_{2.5}$ from TSP emissions (Guidebook 2023). Particle emissions in 2016-2017 and 2019-2021 are included in NFR 1A2b.

NMVOC and PCDD/F

An implied emission factor of 0.218 t/t for PCDD/F (SYKE, 2021) has been used for the years 1990 onwards and production data presented in Table 4.41. The IEF for PCDD/F was updated to the 2022 submission based on new information received from the plant, because the old IEF of 0.098 t/t was based on an incorrect emission value in the YLVA database.

In the earlier submissions, NMVOC emissions were included. In consultation with the plant during 2022 it was discovered that NMVOC emisisons they reported for 2007 did not originate from the process itself but from maintenance work at the plant. Therefore, to the 2023 submission, NMVOC emissions were removed for the whole time-series and replaced by the notation key NA.

Production volumes are available either at plant level in YLVA or from the Federation of Finnish Technology Industries (Table 4.41). The reported emissions are presented Table 4.42.

Table 4.41. Production of zinc in 1990-2022 (reported by plants to the YLVA database).

Year	Zinc production (t)	Year	Zinc production (t)
1990	175 000	2007	305 543
1991	170 389	2008	297 772
1992	170 523	2009	295 049
1993	170 934	2010	307 144
1994	173 244	2011	307 352
1995	176 583	2012	314 742

1996	176 223	2013	311 682
1997	175 334	2014	302 024
1998	198 940	2015	305 717
1999	225 190	2016	290 599
2000	222 881	2017	284 992
2001	248 816	2018	295 029
2002	235 337	2019	290 843
2003	265 853	2020	297 257
2004	284 525	2021	292 648
2005	281 904	2022	294 122
2006	282 261		

Table 4.42. PCDD/F emissions from zinc production.

Year	PCDD/F (g I-TEQ)	Year	PCDD/F (g I-TEQ)
1990	0.038	2010	0.067
1991	0.037	2011	0.067
1992	0.037	2012	0.069
1993	0.037	2013	0.068
1994	0.038	2014	0.066
1995	0.039	2015	0.067
1996	0.038	2016	0.063
1997	0.038	2017	0.062
1998	0.043	2018	0.064
1999	0.049	2019	0.063
2000	0.049	2020	0.065
2001	0.054	2021	0.064
2002	0.051	2022	0.064
2003	0.058		
2004	0.062		
2005	0.062		
2006	0.062		
2007	0.067		
2008	0.065		
2009	0.064		

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2017
- NMVOC emissions for whole time series added to the inventory in 2017 submission.

2018
- For the not occurring SO2 emissions, the 2017 NECD review TERT recommended to replace the notation key “NA” with “NO”. However, the notation key has not been changed, because the use of “NO” means that the activity does not exist and the use of the notation key “NA” means that the emission is not relevant/occurring.

2019
- The allocation of emissions between the energy/processes sectors was checked.

2020
- Particle fractions updated according to Guidebook 2019.

2022

- The IEF for PCDD/F emissions has been corrected.

2023

- NMVOC emission for whole time series have been removed and replanced with the notation key NA.

Source-specific planned improvements

The emission factor for dioxins will be updated in the next submissions to a country-specific EF based on measurements.

Copper production (NFR 2C7a)

Changes in chapter	
February 2024	JMP KS TF

Source category description

SNAP 040309a Key category for As (L1, T1) HCB (L1, T1)		SNAP-NAME Secondary copper production plants (< 5 plants) and production of upgraded copper products. Emissions both calculated or reported by the plants Production capacity see table 4.39
Emissions	Tier	Source of emissions
SO_X, CO, NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM_{10}, $PM_{2.5}$,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Pb, Cd, Hg, As, Cu, Ni, Se, Zn,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
PCDD/F, HCB, PCB, BC	T2	calculated (EF*AD)

Emission trends

Primary copper production is a major source of HCB emissions. Also, heavy metal (arsenic and selene) and PCDD/F emissions occur form copper production (Figure 4.24). Other pollutants contribute less than 1% of the total emissions as presebted in table 4.38. Emission trends are mainly decreasing due to increased abatement.

PCDD/F emissions have increased since 2014 due to commence of secondary copper production, earlier only primary copper have been produced.

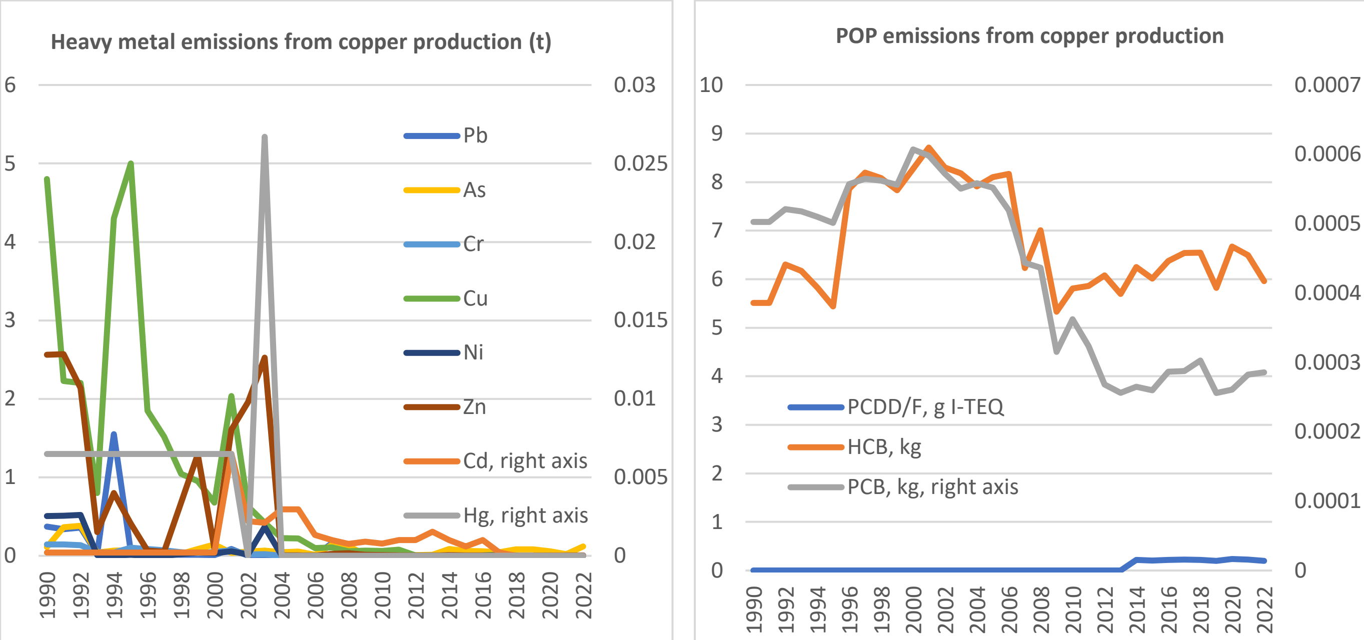


Figure 4.24. Emission trends in copper production.

Contribution of secondary copper production to total emissions is presented in Table 4.43.

Table 4.43. Contribution of Secondary copper production (NFR 2C7a) to total emissions in 2022.

Pollutant	Emissions from copper production in 2022	Total emissions in	Unit	Share of total emissions %	% reported by the plants
NMVOC	<0.001	75.464	Gg	<0.1	0
SOx (as SO2)	0.113	22.692	Gg	0.5	3.6
PM2.5	<0.001	13.384	Gg	<0.1	0
PM10	<0.001	26.778	Gg	<0.1	0
TSP	<0.001	42.014	Gg	<0.1	13
BC	<0.001	3.121	Gg	<0.1	0
CO	0.008	310.209	Gg	<0.1	100
Pb	0.003	12.516	Mg	<0.1	58.0
Cd	<0.001	0.779	Mg	<0.1	100
Hg	<0.001	0.505	Mg	<0.1	0
As	0.019	1.920	Mg	6.2	90.9
Cr	<0.001	14.905	Mg	<0.1	100
Cu	0.002	38.391	Mg	<0.1	100
Ni	<0.001	9.917	Mg	<0.1	0
Se	0.086	0.419	Mg	20.6	100
Zn	0.003	131.533	Mg	<0.1	100
PCDD/PCDF	0.201	9.497	g I-Teq	2.1	0.3
HCB	5.962	29.245	kg	20.4	0
PCBs	<0.001	19.922	kg	<0.1	0

Methodological issues

Total suspended particles, heavy metals (As, Cd, Cu, Pb, Zn, Ni, Hg) and sulphur dioxide (Key category for As, T3)
Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available emissions has been calculated.

Small particle emissions and black carbon
PM_{10} and $PM_{2.5}$ emissions are calculated using size fraction factors 78 % for PM_{10} and 59 % for $PM_{2.5}$ (Guidebook 2023) from TSP emissions. Black carbon emissions are calculated using the emission factor 0.1 % of PM2.5 (Guidebook 2023).

POPs (Key category for HCB, method T2)
PCDD/F, PCB and HCB emissions from production of copper as well as PCB and HCB emissions from wrought copper manufacturing are calculated separately for each plant using emission factors listed below

- PCDD/F: production of copper 0.01ug I-TEQ/t (Guidebook 2023)
- PCDD/F: production of secondary copper 50 ug I-TEQ/t (Guidebook 2023)
- HCB: production of copper 39 mg/t (Pacyna, 2003)
  wrought copper production 17.5235 mg/t (Toda 2005)
- PCB: production of copper 0.9 ug/t (Guidebook 2023)
  wrought copper production 3.7 ug/t (Guidebook 2023)

Activity data used in the calculation is presented in Table 4.44 and the emissions in Table 4.45.

Table 4.44. Copper production volumes 1990-2022 (reported by plants to the YLVA-database).

Year	Copper production (t)	Wrought copper production (t)	Year	Copper production (t)	Wrought copper production (t)
1990	90 200	113 941	2010	117 900	69 189
1991	90 100	113 941	2011	124 642	57 133
1992	110 500	113 941	2012	138 374	38 795
1993	107 000	113 941	2013	128 959	37 930
1994	98 200	113 941	2014	143 765*	36 648
1995	88 300	113 941	2015	137 682*	36 713
1996	150 300	113 941	2016	146 871*	36 947
1997	159 000	113 941	2017	149 605*	41 486
1998	156 000	113 941	2018	147 203*	45 984
1999	149 600	113 941	2019	132 668*	36 900
2000	155 400	126 287	2020	156 157*	32 463
2001	169 250	120 449	2021	148 531*	40 202
2002	160 900	115 477	2022	132 717*	44 884
2003	160 566	109 683			
2004	151 647	114 007			
2005	157 933	110 707			
2006	164 306	100 391			
2007	118 911	90 933			
2008	142 154	83 454			
2009	110 479	58 332			

*Production of secondary copper included since 2014.

Table 4.45. POP emissions from copper production.

Year	HCB (kg)	PCDD/F (g I-TEQ)	PCB (kg)	Year	HCB (kg)	PCDD/F (g I-TEQ)	PCB (kg)
1990	5.51	0.90	0.50	2010	5.81	1.18	0.36
1991	5.51	0.90	0.50	2011	5.86	1.25	0.32
1992	6.31	1.11	0.52	2012	6.08	1.38	0.27
1993	6.17	1.07	0.52	2013	5.69	1.29	0.26
1994	5.83	0.98	0.51	2014	6.25	217.0	0.26
1995	5.44	0.88	0.50	2015	6.01	207.9	0.26
1996	7.86	1.50	0.56	2016	6.38	221.7	0.29
1997	8.20	1.59	0.56	2017	6.54	225.9	0.29
1998	8.08	1.56	0.56	2018	6.54	222.2	0.30
1999	7.83	1.50	0.56	2019	5.82	200.3	0.26
2000	8.27	1.55	0.61	2020	6.67	237.4	0.27
2001	8.71	1.69	0.60	2021	6.50	224.5	0.28
2002	8.30	1.61	0.57	2022	5.96	201.1	0.29
2003	8.18	1.61	0.55				
2004	7.91	1.52	0.56				
2005	8.10	1.58	0.55				
2006	8.17	1.64	0.52				
2007	6.23	1.19	0.44				
2008	7.01	1.42	0.44				
2009	5.33	1.10	0.32				

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2014
- Activity data for copper production was corrected.

2018
- Emissions from this NFR category were checked to include all plants according to the recommendation of the NECD 2017 review.
- PCB and PCDD/F – the emission factosr was updated to correspond to the revised EF in Guidebook 2016. The change increased the PCDD/F emissions to be 10-fold.

2019
- Sox and PM2.5 emissions for 2015 and 2014 are now corrected (the emission values had accidentally been transposed in the 2017 submission.)
- Re-check of Guidebook 2016 EFs

2020
- In the 2019 submission PCDD/F emissions from copper production were allocated to an incorrect NFR by a mistake. The allocation was corrected to the 2020 submission.
- Guidebook 2019 EFs adopted.

2021

Activity data updated for years 2016 and 2017.

Source-specific planned improvements

None

Nickel production (NFR 2C7b)

Changes in chapter	
February 2024	JMP KS TF

Source category description

SNAP 040305 Key category for Ni (L1, T1)		NICKEL PRODUCTION < 5 plants Production capacity 60 000- 90 000 tonnes nickel and nickel chemicals per year
Emissions	Tier	Source of emissions
SO2, NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NH3, Ni	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Emission trend

Emission trends are presented in Figure 4.25

Nickel production is a major source of Ni emissions, while other pollutants contribute less than 1% of the total emissions. Nickel emissions fluctuate in the time series and there has been exceptional emissions e.g. in 2018 due to malfunctioning of abatement techniques. The peak in NMVOC emissions in 2016 and the peak in SO_x emission in 2017 were due to malfunctioning of abatement techniques.

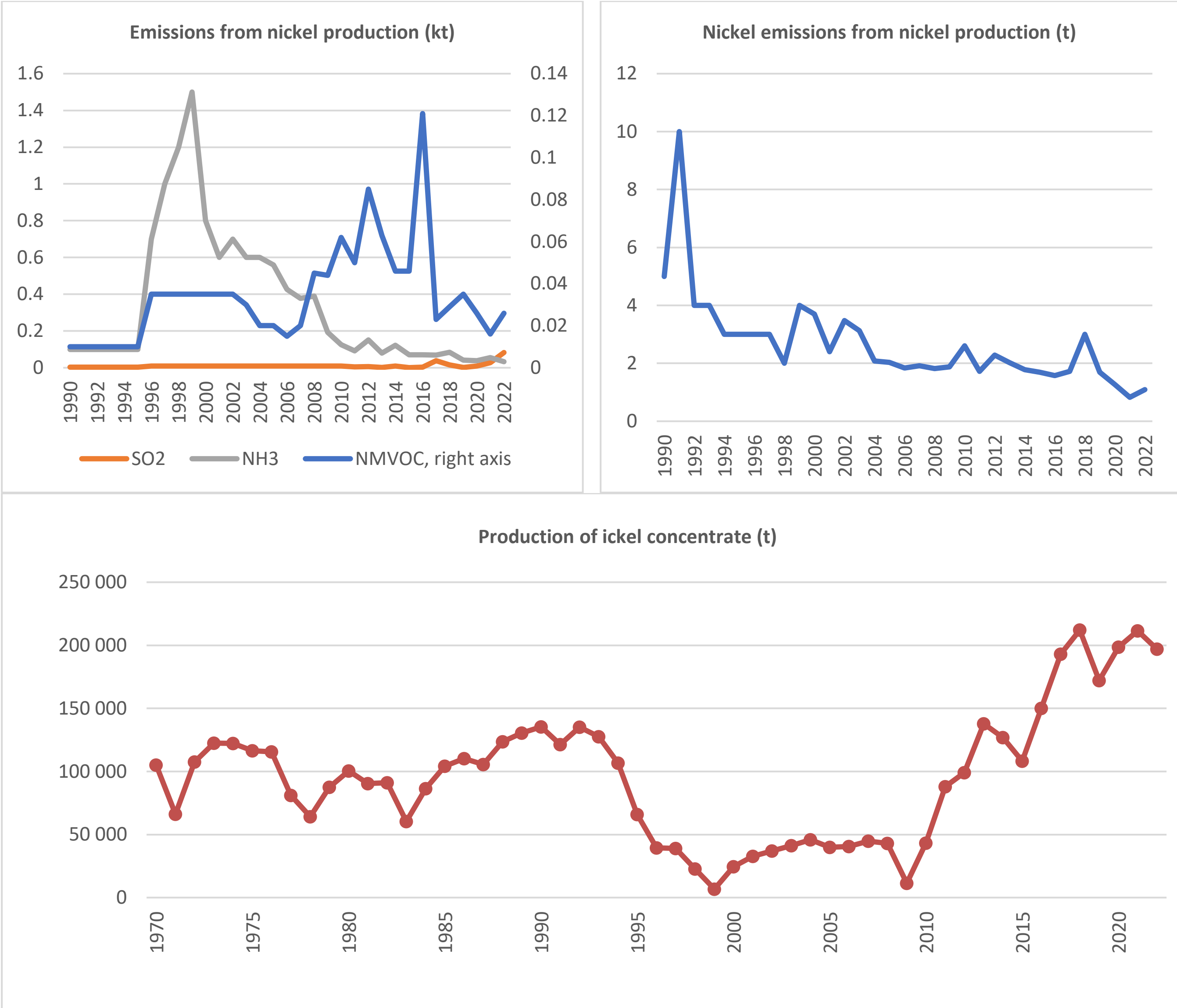


Figure 4.25. Emission trends in nickel production and production of nickel concentrate (Ministry of Economic Affairs and Employment of Finland, 2024)

The shares of emissions of total emissions and shares reported by the plants are presented Table 4.46.

Table 4.46. Contribution of Nickel production (NFR 2C7b) to total emissions in 2022.

Pollutant	Emissions from nickel production in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.026	75.464	Gg	<0.1	100
SOx (as SO2)	0.083	22.692	Gg	0.4	100
NH3	0.033	31.583	Gg	0.1	100
Ni	1.088	9.917	Mg	11.0	100

Methodological issues

(Key category for Ni emissions, T3)
NMVOC, NH_3, SO_x and nickel emissions are reported by the plants according to the monitoring requirements in the environmental permits.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

None.

Source-specific planned improvements

None.

Other metal production (NFR 2C7c)

Changes in chapter
February 2022 KS JMP TF

Source category description

SNAP 040306		ALLIED METAL MANUFACTURING Number of plants <5 Production capacity:~1000 t casting products
Emissions	Tier	Source of emissions
Cu, Pb, Zn, Ni	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
SNAP 040307		GALVANIZING Number of plants 7 Production capacity: varies, in smaller plants ~10 000 t steel structures is hot galvanized in a year, in bigger plant ~1 000 000 tonnes of steel in coils is reprocessed in a year
Emissions		Source of emissions
Zn, Cr	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Recycling of waste and scrap Number of plants <5 Production capacity: waste metals and waste containing metals 200 000 t/a, decomissioned vechicles 80 000 t/a .
Emissions	Tier	Source of emissions
As, Cd, Pb, Zn,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
PCB, PCP	T1	calculated (EF*AD)
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Surface treatment of metals Number of plants<5 Production capacity: not available, plenty of small plants, supply and demand varies yearly
Emissions	Tier	Source of emissions
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Pb, Zn, Cr, Ni,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC, NH3,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Cable manufacturing Number of plants <5 Production capacity: ~500 000 t/a cables

Emissions	Tier	Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Zinc wire manufacturing Number of plants <5 Production capacity: ~10 000 t/a wire
Emissions	Tier	Source of emissions
Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Lock Manufacturing Number of plants <5 Production capacity: not available
Emissions	Tier	Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Zn, Cr	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Chromite mine and concentration plant Number of plants <5 Production capacity: not available
Emissions	Tier	Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Handling of FeCr slag Number of plants <5 Production capacity: not availble
Emissions	Tier	Source of emissions
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Manufacturing of small caliber cartridges Number of plants <5 Production capacity: ~80 000 000 catridges, ~60 000 000 bullets
Emissions	Tier	Source of emissions
Pb	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Handling of noble metals Number of plants <5 Production capacity: not available
Emissions	Tier	Source of emissions
PCB	T1	calculated (EF*AD)

SNAP 040309z		OTHER Handling of copper and nickel concentrates Number of plants <5 Production capacity ~70 000 t/a raw nickel matte
Emissions	Tier	Source of emissions
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
As, Cu, Pb	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Manufacturing of nails Number of plants <5 Production capacity: ~5000 t/a nails
Emissions	Tier	Source of emissions
Pb, Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Around thirty industrial installations that report their emissions to the authorities and for which data is available in YLVA database are included under NFR 2C7c. The installations work in recycling of waste and scrap metals, surface treatment, galvanizing, metallic construction mountings, cable manufacturing, and manufacturing of nails and locks. Due to the competitive position of the installations it is difficult to publish production capacities in the list presented above and in many cases there is only one installation working in a specific field. The category Other metal production is key category for Cd and As according to the level and trend (Approach 1) and according to the trend (Approach 1) for the following pollutants: Cu, Ni, Pb, Se and Zn.

Emission trends

Emissions in NFR 2C7c originate from several activities. The peak in NH_3 emissions in 1999 is related to a malfunction in NO_x abatement (Figure 4.26).

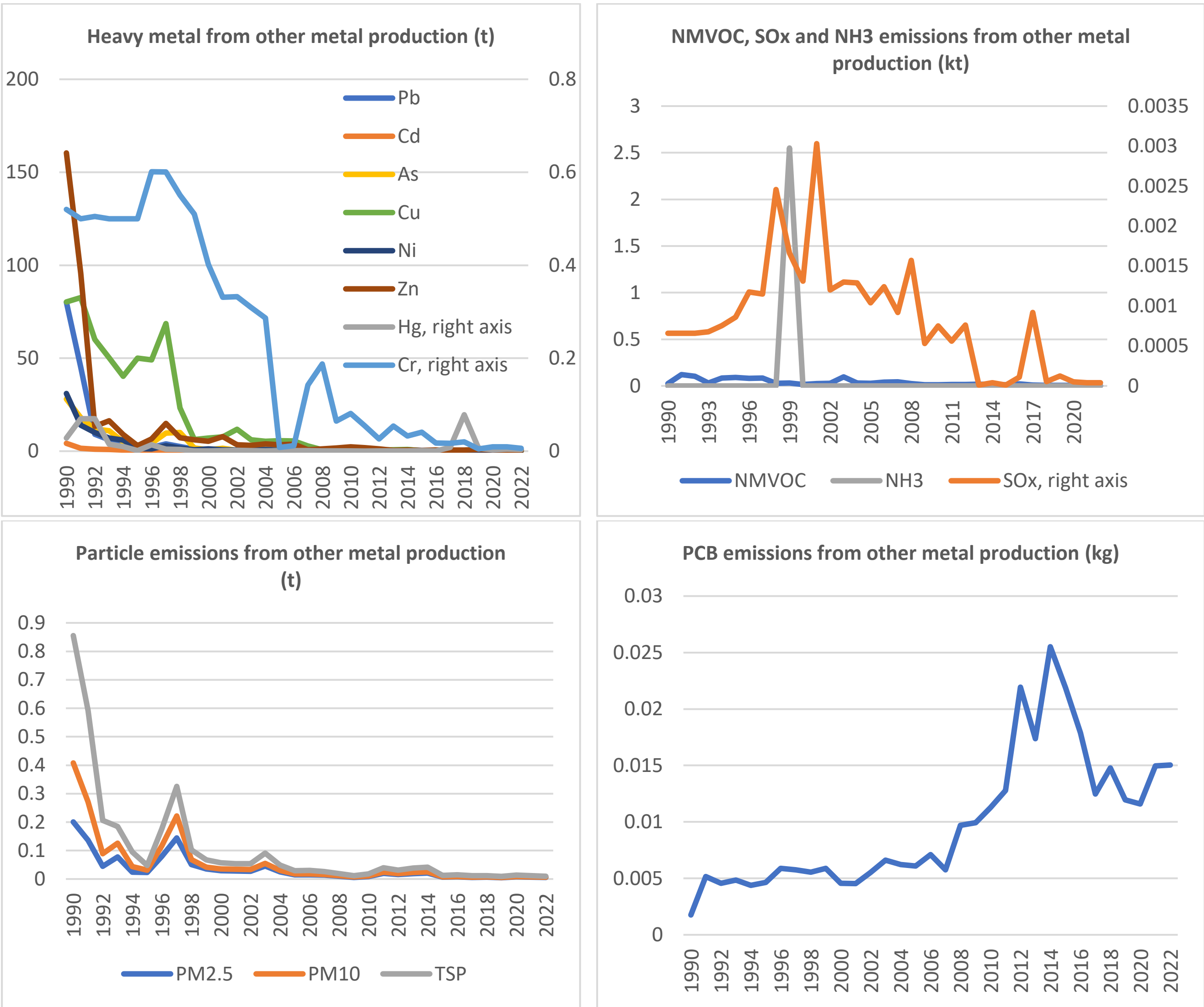


Figure 4.26. Emission trends in Other metal production.

The shares of emissions of total emissions and shares reported by the plants are presented Table 4.47.

Table 4.47. Contribution of Other metal production (NFR 2C7c) to total emissions 2022.

Pollutant	Emissions from other metal production in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.002	75.464	Gg	<0.1	100
SOx (as SO2)	<0.001	22.692	Gg	<0.1	100
NH3	<0.001	31.583	Gg	<0.1	100
PM2.5	0.005	13.384	Gg	<0.1	0
PM10	0.006	26.778	Gg	<0.1	0
TSP	0.010	42.014	Gg	<0.1	100
Pb	0.288	12.516	Mg	2.3	100
Cd	0.038	0.779	Mg	4.9	100
Hg	0.004	0.505	Mg	0.7	100
As	0.143	1.920	Mg	7.5	100
Cr	0.006	14.905	Mg	<0.1	100
Cu	0.349	38.391	Mg	0.9	100
Ni	0.218	9.917	Mg	2.2	100
Se	0.002	0.419	Mg	0.4	0
Zn	0.550	131.533	Mg	0.4	100
PCBs	0.015	19.922	kg	<0.1	0

The process emissions fluctuate annually according to operation, e.g. copper emissions originate from smelting.

Methodological issues

Heavy metals (Key category for Pb, Cd, As, Cu, Ni, Se and Zn emissions, method T3)
As, Cd, Cr, Cu, Pb, Ni, Hg and Zn emissions are reported by the plants according to the monitoring requirements in the environmental permits.

Ammonia
Use of ammonium chloride in hot galvanizing causes ammonia emissions. Only one plant uses ammonium chloride, the other plants are using electrolytic resurfing. The emissions are reported by the plants

The peak NFR2 (Industry) in 1999 is due to an accidental emission reported by the plant to the environmental authorities.

Particles
TSP emissions are reported by the plants according to their monitoring and reporting obligations.

PM_{10} and $PM_{2.5}$ emissions are calculated using size fraction factors of 60 % for PM_{10} and of 50 % for $PM_{2.5}$ (AEAT, 2000). There is no method in the Guidebook.

For galvanizing (SNAP 040307) size fraction factors of 92 % for PM_{10} and of 82 % for $PM_{2.5}$ (AEAT, 2000).

HCB
In discussion with the plant in 2020 it was confirmed that HCB emissions do not occur from the processes. The notation key has now been changed into NA for the whole time series. There is no method in the Guidebook.

Precious metals
From production of gold and silver metals also PCB emissions are calculated with the emission factor of 159.795 mg/t (Toda, 2005) and using activity data presented in Table 4.48. The activity data for 2017-2019 was updated to the 2022 submission.

Table 4.48. Precious metals; production of gold and silver (t) (Statistics Finland).

Year	Production of gold and silver (t) (Statistics Finland)	Year	Production of gold and silver (t) (Statistics Finland)
1990	31.8	2007	36.0
1991	32.2	2008	61.6
1992	28.6	2009	62.1
1993	30.4	2010	70.6
1994	27.4	2011	80.0
1995	29.1	2012	137
1996	36.9	2013	109
1997	36.1	2014	160
1998	34.7	2015	137
1999	36.8	2016	112
2000	28.6	2017	78
2001	28.4	2018	93
2002	34.6	2019	75
2003	41.4	2020	73
2004	38.9	2021	94
2005	38.2	2022	94
2006	44.4		

POP emissions from other metal production are presented in Table 4.49.

Table 4.49. POP emissions from other metal production.

Year	PCB (kg)	Year	PCB (kg)
1990	0.005	2010	0.011
1991	0.005	2011	0.013
1992	0.005	2012	0.022
1993	0.004	2013	0.017
1994	0.005	2014	0.026
1995	0.006	2015	0.022
1996	0.006	2016	0.012
1997	0.006	2017	0.015
1998	0.006	2018	0.012
1999	0.005	2019	0.012
2000	0.005	2020	0.012
2001	0.006	2021	0.015
2002	0.007	2022	0.015
2003	0.006		
2004	0.006		
2005	0.007		
2006	0.006		
2007	0.010		
2008	0.010		
2009	0.005		

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2018

- Check of Guidebook 2016 EFs

2020

- In the 2019 submission PCDD/F emissions from copper production were allocated to NFR 2C7c by mistake, the allocation was corrected.

2021

- In 2020 it was confirmed with the plant that HCB emissions donot occur from the processes. The notation key has now been changed into NA for the whole time series.
- Erroneous facility reported As, Cd, Cr, Cu, Ni, Pb and Zn emisssions were corrected for one plant for 2017-2018. In addition, erroneous facility reported Zn emissions were corrected for another plant for 2018.
- Ammonia emissions from one plant were incorrectly allocated under category 1A2b in submission 2020. The allocation of these emissions under category 2C7c was corrected in submission 2021.

2022

- Activity data for 2017-2019 updated for production of silver and gold.

Source-specific planned improvements

None.

Storage, handling and transport of metal products (NFR 2C7d)

Update of text	
February 2024	JMP, KS, TF

Source category description

SNAP 040211 Not a key category for any pollutants		Storage, handling and transport of metal products storage and handling of iron ore.
Emissions	Tier	Emission source
TSP, PM_{10}, $PM_{2.5}$	T2	calculated (EF*AD)

Emission trend

The particle emission trend (kilotonnes) is presented in Figure 4.27.

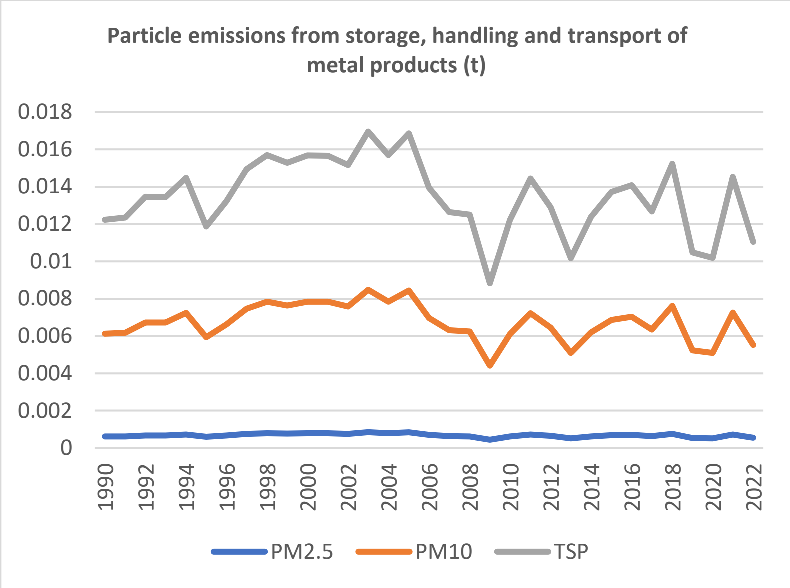


Figure 4.27. Particle emissions from storage, handling and transport of metal products 1990-2022.

The shares of emissions of total emissions and shares reported by the plants are presented in Table 4.50.

Table 4.50 Contribution of Storage, handling and transport of metal products (NFR 2C7d) to total emissions 2022.

Pollutant	Emissions from Storage. handling and transport of metal products in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
PM2.5	<0.001	13.384	Gg	<0.1	0
PM10	0.006	26.778	Gg	<0.1	0
TSP	0.011	42.014	Gg	<0.1	0

Methodological issues

Particle emissions from storage, handling and transport of iron ore are calculated with emissions factors presented in Guidebook 2019 for whole timeseries.0,002 t/t, (TSP); 0.000094 t/t (PM_{10}) and 0.000008 t/t ($PM_{2.5}$). Production of iron ore is presented in Table 4.51 and particle emissions in Table 4.52.

Table 4.51. Activity data for iron ore (Customs Statistics ULJAS).

Year	Iron ore (t))	YEAR	Iron ore (t)	YEAR	Iron ore (t)	YEAR	Iron ore (t)
1990	3 058 362	2000	3 917 135	2010	3 055 661	2020	2 546 974
1991	3 085 141	2001	3 916 263	2011	3 611 830	2021	3 630 977
1992	3 363 742	2002	3 791 709	2012	3 224 219	2022	2 759 738
1993	3 360 634	2003	4 238 321	2013	2 542 827		
1994	3 617 472	2004	3 921 570	2014	3 094 723		
1995	2 964 994	2005	4 215 633	2015	3 428 486		
1996	3 305 776	2006	3 484 500	2016	3 519 551		
1997	3 732 484	2007	3 159 252	2017	3 169 204		
1998	3 922 551	2008	3 124 424	2018	3 806 107		
1999	3 818 566	2009	2 206 222	2019	2 617 816		

Table 4.52. Calculated particulate emissions from storage, handling and transport of metal products.

Year	$PM_{2,5}$ (t)	PM_{10} (t)	TSP (t)	Year	$PM_{2,5}$ (t)	PM_{10} (t)	TSP (t)
1990	0.61	6.12	12.23	2010	0.61	6.11	12.22
1991	0.62	6.17	12.34	2011	0.72	7.22	14.45
1992	0.67	6.73	13.45	2012	0.64	6.45	12.90
1993	0.67	6.72	13.44	2013	0.51	5.09	10.17
1994	0.72	7.23	14.47	2014	0.62	6.19	12.38
1995	0.59	5.93	11.86	2015	0.69	6.86	13.71

1996	0.66	6.61	13.22	2016	0.70	7.04	14.08
1997	0.75	7.46	14.93	2017	0.63	6.34	12.68
1998	0.78	7.85	15.69	2018	0.76	7.61	15.22
1999	0.76	7.64	15.27	2019	0.52	5.24	10.47
2000	0.78	7.83	15.67	2020	0.51	5.10	10.19
2001	0.78	7.83	15.67	2021	0.72	7.26	14.5
2002	0.76	7.58	15.17	2022	0.55	5.52	11.0
2003	0.85	8.48	16.95				
2004	0.78	7.84	15.69				
2005	0.84	8.43	16.86				
2006	0.70	6.97	13.94				
2007	0.63	6.32	12.64				
2008	0.62	6.25	12.50				
2009	0.44	4.41	8.82				

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

None.

Source-specific planned improvements

None.

4.5 Solvent and other product use (NFR 2D-2G)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

NFR	Processes	Description	Emissions reported
2D3a	Domestic solvent use including fungicides	Personal care and cosmetics, household cleaning, car dare and other products	NMVOC
2D3b	Road paving with asphalt		NMVOC, BC, TSP, PM_{10}, $PM_{2.5}$, PCDD/PCDF
2D3c	Ashalt roofing	Aspahlt mixing plants	NMVOC
2D3d	Coating applications	Decorative, industrial and other coating	NMVOC, TSP, PM_{10}, $PM_{2.5}$
2D3e	Degreasing	Chlorinated organic solvents are not produced in Finland, all the used solvents are imported.	NMVOC, NH_3
2D3f	Dry cleaning	Included in degreasing (2D3e)	NMVOCs included in degreasing, all other emissions NA
2D3g	Chemical Products	- pharmaceutical industry - textile and leather industry - plastics manufacturing and handling - rubber conversion - manufacture of paints, inks and glues - manufacturing adhevise, tapes and films	NMVOC, TSP, PM_{10}, $PM_{2.5}$, NH_3, SOx, Cd, As, Cr, Ni
2D3h	Printing	printing	NMVOC, SOx

2D3i	Other solvent use	- glass and mineral wool enduction - fat, edible oil extraction - preservation of wood - industrial application of glues and adhesives	NMVOC, SOx, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, PAHs, HCB
2G	Other product use	Use of fireworks and tobacco	As, Cd, Cr, Cu, Hg, Pb, CO, NH_3, NOx, SOx, NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC, PCDD/PCDF, PAHs

The Other solvent and product use category covers domestic solvent use, road paving with aspahalt, asphalt roofing, coating applications, degreasing, dry cleaning, chemical producst, printing and other solvent and product use. NMVOC and particle emissions are typical emissions for these categories.

Under the Other product use category, use of tobacco and fireworks are sources of heavy metals and POP emissions.

Emissions of those plants that report their emissions to the supervising authorities[7] according to the monitoring requirements in the environmental permits are in some cases reported as aggregated for the whole plant and not by individual processes. In the case of all the emissions reported in YLVA, the emissions have been determined either as combustion based or process related emissions in the calculation system of the air pollutant emission inventory. In the cases of clear process emissions, these are reported separately under NFR 2D categories. In the cases where the reported emissions data in the YLVA system clearly are the total figure of energy and process related emission, the process related emissions are estimated to be the difference between the total emissions reported by the plant and the default emissions calculated on basis of fuel consumption, the difference is reported under the industrial processes. These cases relate mainly to paticulate matter (TSP) emissions reported by a relatively small amount of plants. In case it has not been possible to make a split between energy and process related emissions, all emissions are reported under NFR 1A1 or 1A2.

[8] The emission data is available from the YLVA database after it has been checked and approved by the authorities.

Domestic solvent use including fungicides (NFR 2D3a)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

SNAP 060408 SNAP 060411 Key category for NMVOC (L1, T1)		Domestic solvent use (other than paint application) Domestic use of pharmaceutical products Use of personal care and cosmetics, household cleaning products, car care prodcuts and other products
Emissions	Tier	
NMVOC	T2	NMVOC (calculated)
Hg		Hg emissions from fluorescent tubes are reported under 1A1a by the hazardous waste incineration plant (with energy recovery)

Emission trend

Domestic solvent use is a key category for NMVOCs (level and trend, Approach 1). The emission trend presented in Figure 4.28 has been stable until 2020 when the global pandemic caused emissions to peak, i.e. in Finland the use and emissions of desinfectants increased to 6.8 kt in 2020 from the earlier level of 0.5-1 kt in 1990-2019. In 2021, the use of desinfectants was still at a considerably higher level compared to the situation prior to the pandemic, but in 2022 the use of desinfectants decreased to the level of 2019.

The contribution of all subcategories is illustrated in Figure 4.28a.

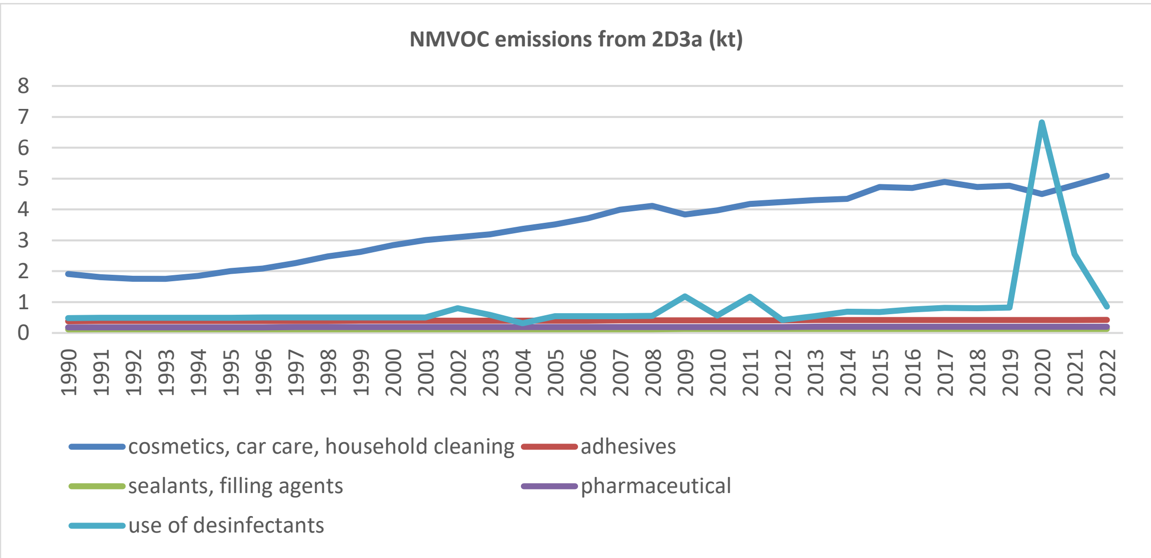


Figure 4.28a. NMVOC emissions from 2D3a 1990-2022.

The shares of emissions of national totals and shares reported by the operators are presented in Table 4.53.

Table 4.53. Contribution of domestic solvent use (NFR 2D3a) to total NMVOC emissions in 2022.

Pollutant	Emissions from domestic solvent use in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	6.692	75.464	Gg	8.9	0

Methodological issues

NMVOC emissions are calculated with a methodology that corresponds with a Tier 2 level methodology.

Emissions have been calculated using different calcution models:

1. Calculation of emissions from household product use
2. Calculation of emissions from pharmaseutic, adhesives and filling agents
3. Calculation of emissions from the use of desinfectants

Calculation of emissions from household product use

The emissions are calculated using a calculation model for NMVOC emissions from household products which covers the years from 1990 to 2022. The first version of the model was created in 2015 and emissions from 1990 to 2014 were included. The model was updated in 2022. The summary of the results is presented in Table 4.54. In the new version of the model, NMVOC emissions are calculated for certain base years based on sales data of different product categories. The base years are 2014, 2015 or 2020 depending on the product category. The other years are estimated with the surrogate method using GDP as the surrogate data, and in the case of car care products, vehicles in traffic use. In addition, in the case of cosmetics and toiletries, also the year 2018 to 2022 are calculated based on actual sales data. The purpose is to update the model every 5 years with a new base year. The next update is scheduled to be reported in the 2028 submission.

Table 4.54. NMVOC emissions from Household Products Use in 1990, 2000, 2010, 2014, 2020 and 2022.

NMVOC emissions [kt/a]	1990	2000	2010	2014	2020	2022
Cosmetics and toiletries	1.24	1.79	2.38	2.57	2.46	2.61
Household cleaning products	0.11	0.15	0.20	0.22	0.24	0.28
Car care products	0.50	0.80	1.27	1.43	1.72	2.12
Other products	0.06	0.09	0.12	0.13	0.07	0.08
TOTAL	1.91	2.84	3.97	4.35	4.50	5.1

NMVOC emission from Household Products Use 1988-2022 are presented in Figure 28b.

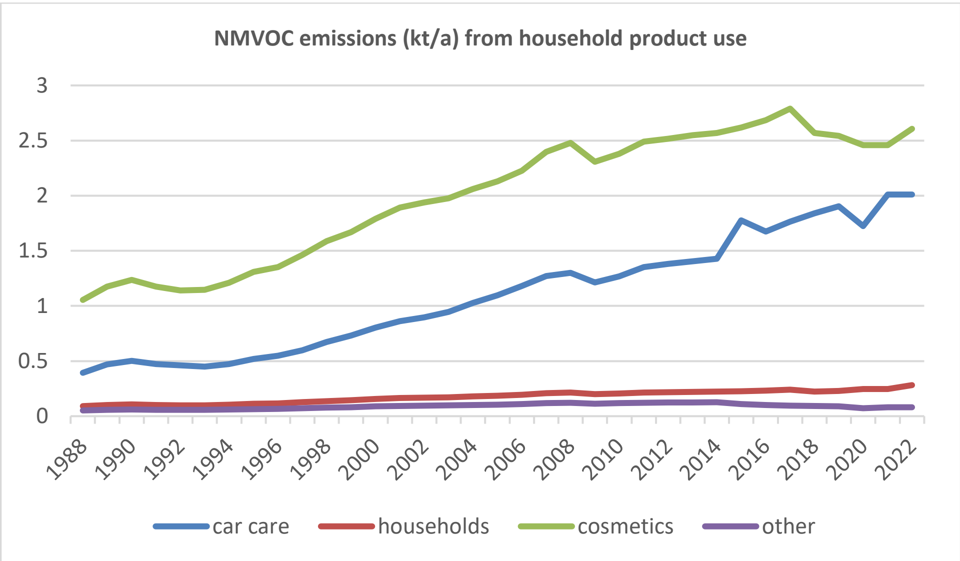


Figure 28b. NMVOC emissions from household products (car care, households, cosmetics and other products) 1988-2022.

Calculation principles in the model

The model follows the actual domestic sales of different products for the base years. Only products identified as sources of NMVOC emissions are included in the model as presented in Table 4.55a. The following groups are currently not covered by the model due to lack of sales data: Do It Yourself (DIY) products, adhesives and sealants.

Table 4.55a. NMVOC containing products froups and data collection basis in the domestic sources' NMVOC emissions model.

Product category	NMVOC containing products	Data collection basis
Cosmetics and toiletries	deodorants, parfymes, oral care, sun care, shaving, nail care, hygiene ad hair care products.	sales volumes
Househould cleaning products	glass surface cleaning agents (3 subgroups), airrefresheners, general cleansing agents (2 subgroups)	sales volumes
Car care products	car wax, whindscreen washing agents, de-icing, degreasing and engine detergents	sales volumes
Other products	lighter fluids for grilling and repellents.	sales volumes

In the original version of the calculation model (Rantanen el al., 2015), NMVOC emissions of cosmetics and toiletries and househould cleaning products were based on money spend. In the revised version of the model (2022), NMVOC emissions from all product categories are based on sales volumes.

Sales volumes of different products from different product categories (in litres) were derived from information received from selected large retail companies and then scaled to the whole country according to the sales shares of the retailers taking into account the specific sales profiles of the different retailers. NMVOC emissions were estimated based on sales volumes and the contents and volatilization rates of NMVOC compounds typically present in the products (see Appendix I and II of the IPPU IIR). The product mix of different product categories may vary a little from year to year in the data received from the retail companies. The product categories and their product mixes included in the NMVOC emissions calculations for the year 2020 are presented in Table 4.55b.

Table 4.55b. Product categories in 2020 emission calculations.

Product category	Products
Cosmetics and toiletries	deodorants (spray), deodorants (roll-on) parfymes mounthwash, toothpaste sun care products self-tan products aftersaves hair removal products nail polish nail polish removals bubble paths soaps skin care products shampoons hair car products hair aerosols hair foams hair dyes
Househould clening	all-purpose cleaners washing-up liquids kitchen and bathroom cleaners window cleaners surface cleaners special cleaners (abrasives, antiliming agents) laundry detergents fabric conditioners stain removers aerosols toilet fresheners

Car care	windsshiled washer fluids (concentrate) windshield washer fluids (for summers) windshield washer fluids (ready to use) boat waxes car waxes wax shampoons car shampoos de-icers degreasants
Other products	water-proof preservers of protective co impregnation sprays lighter fluids insect repalleants

The emissions for the years between, before or after the base years of the model, were estimated with the surrogate method using GDP as the surrogate data (cosmetics, househould and other products). In the case of car care products, in addition to GDP (Statistics Finland, 2023), also information about the vehicles in traffic use (Statistics Finland, Motor vehicle stock, 2023) were used. NMVOC emissions were calculated based on sales data for the years 2014 and for 2018-2022 in the case of cosmetics and toiletries. In the case of household clening products and car care products, emissions were calculated based on sales data for the years 2014, 2015 and 2020. In the case of other products, emissions were calculated based on sales data for the years 2014 and 2020.

Typical concentrations of NMVOCs in selected products are presented in Appendix II of the IPPU IIR. The concentrations are mainly based on information from the material safety data sheets (MSDS) available for different products. In the MSDSs, the concentrations are generally expressed as percentage intervals, for example “contains 10-20 per cent ethanol”. Mainly the average concentration values were used in the calculations.

The product-specific emission factors used in calculation are based on literature and expert estimations. The emission factors take into account that not all NMVOCs contained in the product are emitted to ambient air because they may (1) remain in the product, (2) rather end up in the sewage than emit into the air, or (3) are partly destroyed while the product remains in a waste container (Tebert, et al., 2009). Product-specific emission factors used in the calculations [kg/tonn (product)] are listed in the Appendix I of the IPPU IIR.

The emission estimates, including the sales data, are planned to be updated every 5 years.

Calculation of emissions from pharmaseutic, adhesives and filling agents

Guidebook 2023 Tier 2 method (Table 3.5 on page 17) has been used for pharmaceuticals (EF 48 g/person), adhesives (EF 76 g/person) and filling agents (EF 23 g/person), which are not included in the calculation model for household products. Population is used as activity data (Table 4.56).

Table 4.56. Population 1990-2022 (Statistics Finland, 2023).

Year	Population	Year	Population	Year	Population
1990	4998478	2005	5255580	2020	5533793
1991	5029002	2006	5276955	2021	5548241
1992	5054982	2007	5300484	2022	5563970
1993	5077912	2008	5326314		
1994	5098754	2009	5351427		
1995	5116826	2010	5375276		
1996	5132320	2011	5401267		
1997	5147349	2012	5426674		
1998	5159646	2013	5451270		
1999	5171302	2014	5471753		
2000	5181115	2015	5487308		
2001	5194901	2016	5503297		
2002	5206295	2017	5513130		

2003	5219732	2018	5517919		
2004	5236611	2019	5525292		

Calculation of emissions from the use of desinfectants

A new data collection was established at the Finnish Chemicals Agency TUKES to resolve the use of desinfectants during the Covid-19 pandemic since 2020 (Figure 4.29). TUKES receives from the companies data on the volumes of hazardous chemicals in products. This information was used to sort out products used as desinfectants for professional, domestic and industrial purposes or their combinations. Out of the ingredients of the products, only NMVOC species were included in the calculation of the total volume of volatile organic substances in desinfectants. Volume data on chemicals in products is available only since 2001. The earlier years were estimated as a specific average of years 2003-2007 in proportion to population. The evaporation rate of 100% was used in the calculation.

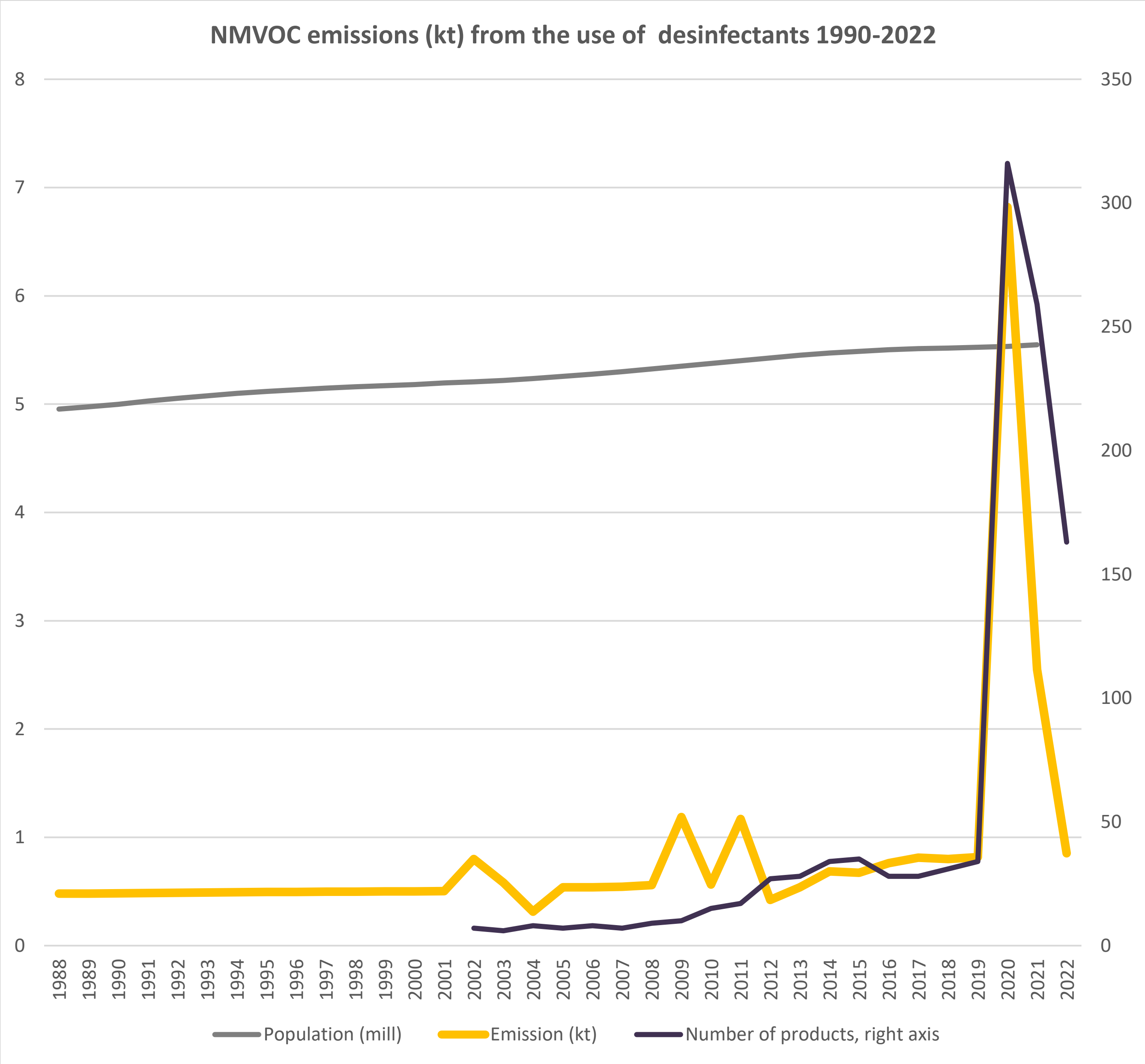


Figure 4.29. Number of products used as desinfectants, amount of NMVOCs in the products and population.

Mercury emissions from fluorescent tubes

Mercury emissions from disposal of fluorescent tubes are included under 1A1a and cannot be reported separately. The disposed tubes are collected and treated at a hazardous waste incineration plant with energy recover, thus the plant falling under 1A1a. The emissions are reported by the plant according to the monitoring requirements of the plant's environmental permit.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2016

- The calculation of NMVOC emissions from domestic solvent use was revised for the whole time series. The earlier estimates for the use of personal care, adhesive and sealant, household cleaning and car care products were prepared by the Finnish Cosmetic, Toiletry and Detergent Association at the beginning of the 2000's. The aggregate estimate of 4.66 kt/a covering all these sources was based on a questionnaire sent to members of the Association and covered the different NMVOC compounds and their volatilation rates from the different product types. The estimate was used as a constant value for all years and thus this estimate did not include product development or changes in the use of products or in the legislation. (Finnish Cosmetics, 2002). During summer 2015 a project was carried out at SYKE to get more accurate information of the level and trend of NMVOC emisisons from domestic sourses.

2019

- Inclusion of mercury emissions from fluorescen tubes using a Tier 1 methodology. The emissions from disposal are included as explained above.

2020

- Inclusion of NMVOC emissions from pharmaceuticals, adhesives and filling agents using a Tier 1 methodology (Guidebook 2019) due the 2019 NECD Review.

2021

- For 1988-1989 the emissions in categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i were split from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.

2022

- The calculation of emissions from the use of desinfectants were revised and a new data collection established.

2024

- The calculation of NMVOC emission from from household product use was revised for the whole time series based on new activity data.

Source-specific planned improvements

None.

Road paving with asphalt (2D3b)

Changes in chapter	
February 2024	KS & JMP TF

Source Category description

SNAP 040611 Not a key		Asphalt roofing Asphalt mixing plants

category for any pollutants		
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$, BC, NMVOC, PCDD/F	T3/T2	calculated
PCB		PCB emissions are not estimated into air, only through solubility to water and soil
PAH-4		Coal tar is not used in road work in Finland (impact the reuse of asphalt material) and therefore PAH emissions are estimated not to occur in the mainlad of Finland. However, in the Aland Islands (as in Sweden) coal tar has been used since 1973. The emissions from Aland are not currently included in the inventory.

Approximately twenty asphalt mixing plants have an environmental permit and report their emissions according to their monitoring requirements. The majority of asphalt mixing plants do not fall under IED but are regulated by the local environmental authorities and are part of the notification procedure, i.e. new plants are required to report to a register. The register covers technical information (e.g. construction of the plant, stack height, process techniques, storage of liquids).

Emission trend

Road paving with asphalt is a minor source of NMVOC, particle and PCDD/F. The emissions from road paving with asphalt vary according to the production volumes over the years.

Emissions from bitumen oils, bitumen emulsions and industry bitumens are allocated under NFR 2D3c Asphalt roofing, while road bitumens and road bitumen solutions are allocated under NFR 2D3b Road paving with asphalt.

Process emissions from asphalt mixing plants are reported under NFR 2D3b and fuel combustion related emissions under NFR 1A2gviii.

The emission trends are presented in Figure 4.30.

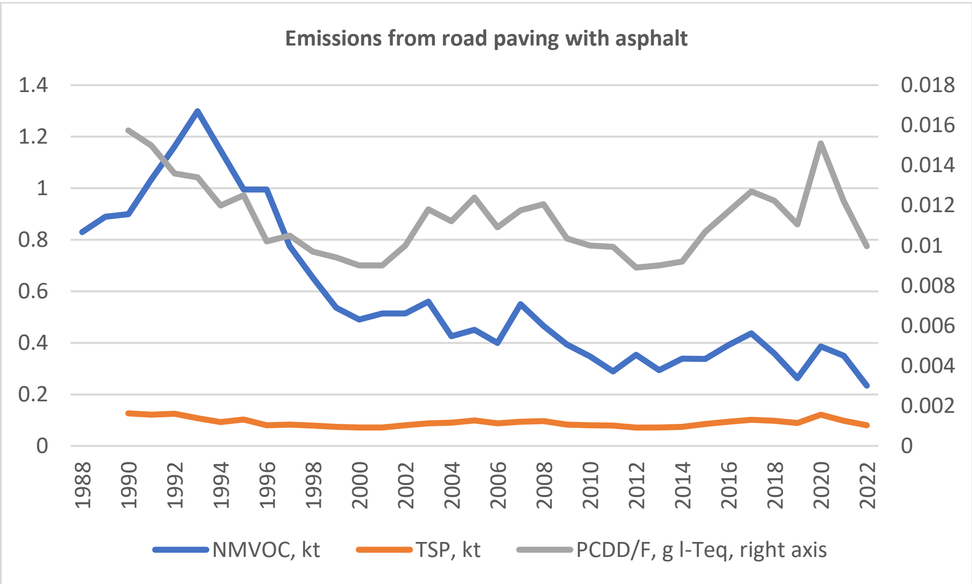


Figure 4.30. Emission trends in road paving with asphalt.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.57.

Table 4.57. Contribution of road paving with asphalt (NFR 2D3b) to total emissions in 2022.

Pollutant	Emissions from road paving with asphalt in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.334	75.464	Gg	0.3	0
$PM_{2.5}$	0.055	13.384	Gg	0.4	0
PM_{10}	0.060	26.778	Gg	0.2	0
TSP	0.080	42.014	Gg	0.2	0
BC	0.003	3.121	Gg	0.1	0
PCDD/ F	0.010	9.497	g I-Teq	0.1	0

Methodological issues

Emissions are mainly reported by the plants according to the monitoring requirements in their environmental permits. When no plant specific data is available, the emissions have been calculated on the basis of plant specific asphalt production.

Particles and black carbon

Particle emissions are calculated using the following emission factors; 0.000016 t/t (TSP), 0.000012 t/t (PM_{10}) and 0.000011t/t ($PM_{2.5}$). These emission factors by TNO (2002) are considered to reflect better national circumstances than the default EFs in the EMEP/EEA Emission Inventory Guidebook 2023. The unit of the method presented in the Guidebook is likely incorrect (0.014 t/t).

Black carbon emissions are calcuted using the emission factor 5.7 % of $PM_{2.5}$ (Guidebook 2023).

Activity data used in the calculation is presented in Table 4.58. The activity data has been updated for from year 2015 onwards in 2024 submission.

Table 4.58. Amount of used asphalt (1990-2022), Confederation of Finnish Construction Industries RT Infra Division (Infra ry, 2023).

Year	Amount of used asphalt (1000 t)	Year	Amount of used asphalt (1000 t)
1990	7900	2010	5 000
1991	7600	2011	4 965
1992	7800	2012	4 450
1993	6700	2013	4 500
1994	5800	2014	4 600
1995	6400	2015	5 300
1996	5000	2016	5 900
1997	5200	2017	6 400
1998	4900	2018	6 200
1999	4600	2019	5 500
2000	4500	2020	7 500
2001	4500	2021	6 100
2002	5000	2022	5 000
2003	5 500		
2004	5 600		
2005	6 200		
2006	5 500		
2007	5 880		
2008	6 050		
2009	5 176		

POP emissions

The emission factor used for PCDD/F is 2 ng I-TEQ/t (UNEP 1999). There is no method in the Guidebook 2023. The emissions are presented in Table 4.60 and the activity data in Table 4.58.

NMVOC

NMVOC emissions from road paving with aphalt (NFR 2D3b) and asphalt roofing (NFR 2D3c) are calculated from bitumen use, which is confidential data. Data on bitumen use is received from the domestic bitumen producer (Nynas Oy, previously Fortum Oil and Gas Ltd., Ref. Blomberg, 2006, Remes. H., 2023). This bitumen use data is divided into five groups: road bitumens, road bitumen solutions, bitumen oils, bitumen emulsions and industry bitumens. For these VOC fractions for the different years are provided by

Nynäs Oy (Table 4.59). To this, the imported amount of bitumen from customs statistics database ULJAS is added and divided in corresponding five groups as an expert estimation at SYKE.

VOC fractions from bitumen are measured annually by the producer. Bitumen emulsions are applied cold, they are water-based and do not contain solvents. For bitumen solutions and oils, the NMVOC emission rate corresponds to the actual solvent content. The NMVOC rate of road bitumen and industrial bitumens is determined using the heating weight loss in the thin layer test (5 hours, 163 ºC). Development of NMVOC fractions is presented in Table 4.59.

Table 4.59. NMVOC fractions of bitumens (Nynäs Oy).

Year	Production group	VOC fraction %	Year	Production group	VOC fraction %
1988-1990	Road bitumen	0-0.1	2004-2010	Road bitumen	0-0.1
	Road bitumen solutions	10-50		Road bitumen solutions	10-50
	Bitumen oils	~10		Bitumen oils	~10
	Bitumen emulsions	0*		Bitumen emulsions*	0
	Industry bitumen solutions	40-60		Industry bitumens	0.1
1991-2003	Road bitumen	0-0.1	2012 onwards	Road bitumen	0-0.1
	Road bitumen solutions	10-50		Road bitumen solutions	10-50
	Bitumen oils	~10		Bitumen oils	~5**
	Bitumen emulsions*	0		Bitumen emulsions*	0
	Industry bitumen	0.1		Industry bitumens	0.1
	Industry bitumen solutions	30-65			

*bitumen emulsions are applied cold, they are water-based and do not contain solvents
**new biobased degrable solvent

Activity data

Activity data used in the inventory for 2006-2022 is based on the sum of production and import data, which are confidential, and cannot be published. Activity data for the years 1990-2005 is based on confidential production data, because for these years the import has been estimated negligible (Blomberg, 2006). The production of bitumen ended in March 2021. In 2020 the production volume was higher than in the previous years.

The emissions are presented in Table 4.60.

Table 4.60. Emissions from road paving with asphalt.

Year	TSP (t)	PM10 (t)	PM2,5 (t)	BC (t)	NMVOC (t)	PCDD/Fs (g-ITeq)
1990	126.4	94.8	86.9	5.0	900	0.016
1991	121.6	91.2	83.6	4.8	1035	0.015
1992	124.8	93.6	85.8	4.9	1162	0.014
1993	107.2	80.4	73.7	4.2	1299	0.013
1994	92.8	69.6	63.8	3.6	1147	0.012
1995	102.4	76.8	70.4	4.0	995	0.013
1996	80.0	60.0	55.0	3.1	995	0.010
1997	83.2	62.4	57.2	3.3	775	0.011
1998	78.4	58.8	53.9	3.1	653	0.010
1999	73.6	55.2	50.6	2.9	536	0.009
2000	72.0	54.0	49.5	2.8	491	0.009
2001	72.0	54.0	49.5	2.8	514	0.009
2002	80.0	60.0	55.0	3.1	537	0.010
2003	88.0	66.0	60.5	3.4	560	0.012
2004	89.7	67.3	61.7	3.5	426	0.011
2005	99.2	74.4	68.2	3.9	451	0.012
2006	87.3	65.5	60.0	3.4	399	0.011
2007	94.1	70.6	64.7	3.7	550	0.012
2008	96.4	72.3	66.3	3.8	466	0.012
2009	82.8	62.1	56.9	3.2	393	0.010
2010	80.0	60.0	55.0	3.1	347	0.010
2011	79.4	59.6	54.6	3.1	289	0.010

2012	71.2	53.4	49.0	2.8	353	0.009
2013	72.0	54.0	49.5	2.8	294	0.009
2014	73.6	55.2	50.6	2.9	339	0.009
2015	85.5	64.1	58.8	3.4	337	0.011
2016	93.6	70.2	64.3	3.7	391	0.012
2017	101.7	76.2	69.9	4.0	437	0.013
2018	97.9	73.4	67.3	3.8	359	0.012
2019	88.5	66.4	60.8	3.5	263	0.011
2020	120.7	90.6	83.0	4.7	386	0.015
2021	97.7	73.2	67.1	3.8	350	0.012
2022	79.7	59.8	54.8	3.2	234	0.010

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2018
- The allocation of activities has been harmonized due to the recalculation of point source data.

2020
- Use of Guidebook 2019 methods for particles
- NMVOC emissions from 2017 were updated.

2021
- For 1998-1989 the emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.
- Activity data for particle calculation have been updated for years 2016-2018.

2022
- Activity data for particles and PCDD/F was corrected for the year 2019.

2024
Activity data for particles and PCDD/F has been updated from year 2015 onwards.

Source-specific planned improvements

None.

Asphalt roofing (NFR 2D3c)

Changes in chapter	
February 2024	KS JMP TF

Source category description

SNAP 040610 Key category for NMVOC (T1)		Roof covering with asphalt materials Emissions from the use of bitumen oils, bitumen emulsions and industry bitumens are reported under this category.
Emissions	Tier	Source of emissions
NMVOC	T3	Calculated

Emission trend

Asphalt roofing is a minor source of NMVOC emissions and the emissions vary according to the production volumes over the years. The emission trend is presented in Figure 4.31.

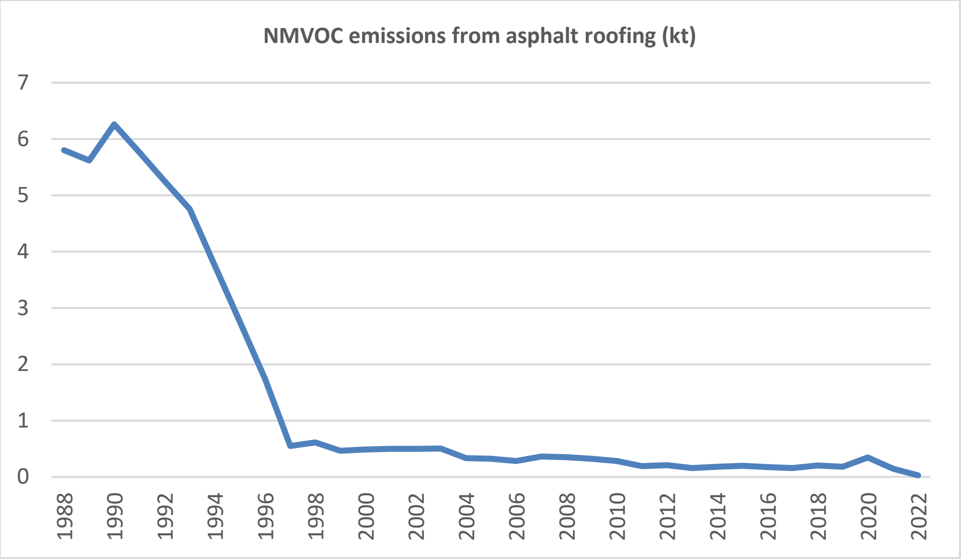


Figure 4.31. NMVOC emissions from asphalt roofing.

The shares of emissions reported under the NFR category are presented in Table 4

Table 4.61. Contribution of asphalt roofing (NFR 2D3c) to total emissions in 2022.

Pollutant	Emissions from asphalt roofing in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.027	75.464	Gg	0.3	0

Methodological issues

NMVOC (Key category for NMVOC according to the trend in Approach 1)
The same calculation method is used for road paving with aphalt (NFR 2D3b) and asphalt roofing (NFR 2D3c). NMVOC emissions asphalt roofing are calculated based on data from the domestic bitumen producer (Nynas Oy, previously Fortum Oil and Gas Ltd., Ref. Blomberg, 2006, Remes., H. 2023 and the imported amount of bitumen (information from customs statistics database ULJAS).

The data presented in Table 4.59 of the previous chapter represent NMVOC emission rates from the use of bitumen products, not from manufacture of products. The emitted NMVOCs are based on annual meaurements by the producer.

The domestic production data is divided between the different product groups and for each group the specific NMVOC content is determined. The product groups are road bitumes, road bitumen solution, bitumen oils, bitumen emulsions and industry bitumens. Emissions from bitumen oils, bitumen emulsions and industry bitumens are allocated under NFR 2D3c Asphalt roofing, while road bitumens and road bitumen solutions are allocated under NFR 2D3b Road paving with asphalt. The division of the activity data between the product groups is based on information from Customs statistics and on expert estimation at SYKE as also for the imported amount of bitumen.

Activity data used in the inventory for the years 2006-2020 is based on the sum of production and import data, which is confidential, and cannot be published. Activity data for 1990-2005 is based on only confidential production data, because for these years import has been estimated (Blomberg, 2006) negligible.

In Finland bitumen has been produced only in one plant, in which the production of bitumen ended in March 2021. In 2022 all NMVOC emissions originated from use of imported bitumen.

NMVOC emissions from asphalt roofing are presented in Table 4.62.

Table 4.62. NMVOC emissions from other asphalt roofing.

Year	NMVOC (t)	Year	NMVOC (t)
1990	6260	2010	283
1991	5758	2011	191
1992	5257	2012	209
1993	4755	2013	158
1994	3757	2014	181
1995	2748	2015	197
1996	1742	2016	174
1997	549	2017	157
1998	614	2018	202
1999	461	2019	181
2000	489	2020	343
2001	494	2021	144
2002	498	2022	27
2003	503		
2004	332		
2005	324		
2006	283		
2007	362		
2008	349		
2009	321		

Particles and CO
Particle emissions are reported by the plants according to the monitoring requirements of the monitoring programme included in their environmental permits. Process emissions do not occur because the dust emitted is removed and treated through a specifically designed equipment (dust filters with continuous operation control) and are monitored through continuous mesurements. All particle and carbon monoxide emissions from asphalt roofing result from the use of LFO and terefore they are reported NA and allocated under NFR 1A2f.

The 2021 TERT (NECD review) noted that the notation key 'NA' (not applicable) is used for particles and CO whilst a Tier 1 method is available in the Guidebook and asked to provide an estimate. To the question, Finland referred to the existing information in the IIR (see the chapter above) that process emissions do not occur. This was explained also to the 2018 the TERT (NECD review), which agreed that the correct notation key is NA.

It should be noted that the EF tables in the GB are not always accurately separating process and fuel based emissions. The Reporting Guidelines[8] determine the use of NA as follows: *"NA" (not applicable), for activities under a given source category that do occur within the Party but do not result in emissions of a specific pollutant."*

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

[8] https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2022/emissions_reporting_guidelines_2023_final.pdf

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

2018
- Particle emissions, which are very low, around 0.0001 kt/a, and earlier reported as NA were included in the inventory due to the recommendation of the NECD 2017 Review.

2019
- To notation keys for all particles for all years were changed back to NA from the accidentially inserted IE during the recalculation of the time series (NECD Review 2018).

2020
- NMVOC emissions from 2017 were updated.

Source-specific planned improvements

None.

Coating applications (NFR 2D3d)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

Source	Description	Emissions reported
Decorative coating application	Non-industrial paint application in construction and buildings (SNAP 060103) and domestic use (SNAP 060104)	NMVOC
Industial coating application	Paint application in car repairing (SNAP 060102), manufacturing of automobiles (SNAP 060101), coil coating (SNAP 060105), boat building (SNAP 060106), painting of wood (SNAP 060107) and other industrial coating (SNAP 060108).	NMVOC, TSP, PM_{10}, $PM_{2.5}$
Other coating applications	Road marking paints, non-decorative floor paints. (SNAP 060109) Usually other coating applications are reported under industrial coating applications because the allcoation between sectors is difficult.	NMVOC

According EMEP/EEA Guidebook 2023 NFR 2D3d coating applications consists of decorative, industrial and other coating applications. Industrial activities in Finland falling under NFR 2D3d Coating applications are presented above.

The allocation of emissions between decorative and industrial coating apllications in the Finnish inventory is consistent over the years.

NMVOC emissions for other coating applications are included under decorative and industrial coating as it is not possible to calculate these separately based on the current activity data detail level. Attempts are made to improve activity data collection in the next inventory rounds in order to receive more detailed information for other coating applications.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.64.

Table 4.64. Contribution of coating applications (NFR 2D3d) to total emissions in 2022.

Pollutant	Emissions from coating applications in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	5.871	75.464	Gg	7.8	15.6
$PM_{2.5}$	<0.001	13.384	Gg	<0.1	0
PM_{10}	0.001	26.778	Gg	<0.1	0
TSP	0.001	42.014	Gg	<0.1	100

Coating applications is a key category in NMVOC emissions (level and trend, Approach 1).

Emission trends

NMVOC emissions from paint application are presented in Figure 4.32 and in Table 4.65. In Table 4.65 the same value of voc content in products has been used since 2014 due the lack of information. The allocation of emissions from years 1988 and 1989 is not consistent. NMVOC emission values are reported under NFR 2D3d but these reported values contain emissions from whole solvent use sector.

The decrease in emissions in the beginning of the 1990's is due to the recession and fall in the consumption of paints. The consumption of paints started to grow again in 1994. Despite of the growth, NMVOC emissions have been decreasing due to lower content of volatile organic compounds in the various paints and coatings. In 2022 the sales of solvent based paints decreased by 20 % compared to the sales in 2021.

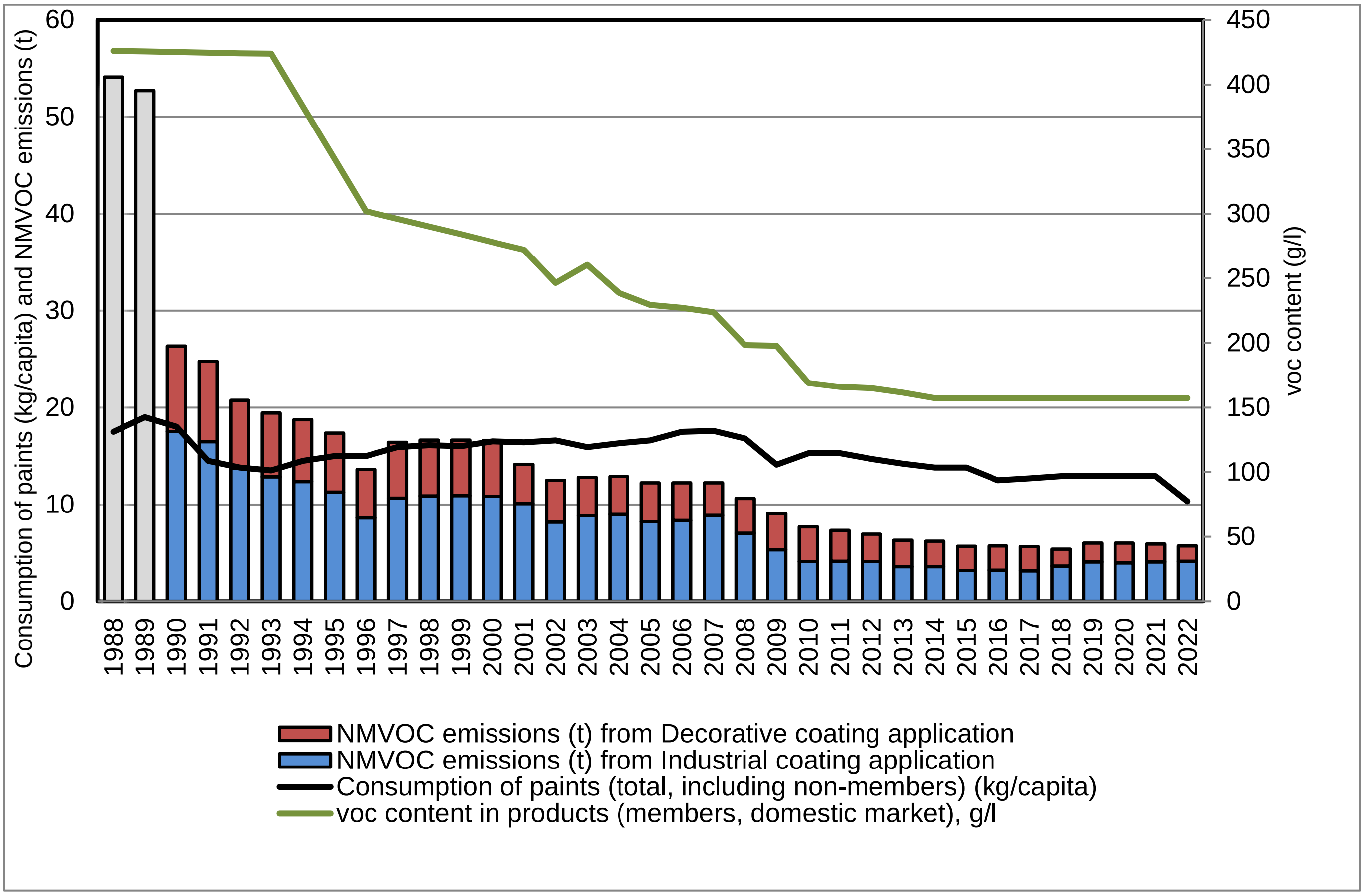


Figure 4.32 NMVOC emissions from paint application, VOC content and consumption of paints.

Table 4.65. NMVOC emissions reported under NFR 2D3d coating applications (Gg).

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
decorative	IE[1]	IE[1]	8.8	8.3	7.0	6.6	6.4	6.1	5.0	5.8	5.8
industrial	54.1	52.7	17.5	16.5	13.7	12.9	12.3	11.3	8.6	10.6	10.9
other coating	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
decorative	5.7	5.7	4.0	4.3	4.0	3.9	4.0	3.9	3.3	3.6	3.5
industrial	10.9	10.9	10.0	8.2	8.8	9.0	8.2	8.3	8.9	7.0	5.3
other coating	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	0.01
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
decorative	3.3	2.9	2.7	2.7	2.6	2.5	2.5	2.5	1.7	2.0	2.1
industrial	4.1	4.1	4.1	3.6	3.6	3.2	3.2	3.2	3.6	3.8	3.9

other coating	0.03	0.02	0.01	NA	NA	NA	NA	NA	NA	NA	NA
	2021	**2022**									
decorative	1.9	1.6									
industrial	4.1	4.1									
other coating	NA	NA									

[1]Included in industrial coating applications

Methodological issues

The paint sales and product statistics are divided into decorative (DIY/architectural) and industrial sectors.

Under decorative coating application SNAP categories 060103 and 060104 are reported.

It is not possible to separate emissions falling under industrial coating applications (SNAP 060101, 060102, 060105, 060106, 060107 and 060108) and other coating application (SNAP 060109) due to lack of detailed information. Part of the emissions falling under these sources is interconnected with emission data reported by the plants, which have reporting obligations only for their total emissions and not at activity level. Information sources for industrial and other coating applications are presented in Table 4.66. Paint application on *Wood* and *Other coating application* included in the table are included in industrial paint coating SNAP 060100 and cannot be reported separately.

Table 4.66 Information sources for the industrial and other coating applications

Sector	Paint application in	Reference
Industrial coating application	Manufacture of automobiles	Reported by operators, questionnaire to operators and Association of Finnish Paint Industry
	Coil coating	Reported by operators, questionnaire to operators and Association of Finnish Paint Industry
	Car repair	Reported by operators, questionnaire to operators and Association of Finnish Paint Industry
	Wood	Questionnaire to operators and Association of Finnish Paint Industry
	Other industrial paint application	Reported by operators, questionnaire to operators and Association of Finnish Paint Industry
Other coating application	Questionnaire to operators and the Association of Finnish Paint Industry (road marking paints)	

As presented in Table 4.66 NMVOC emissions from industrial and other coating applications are reported by operators or are obtained from responses to questionnaire to operators or estimated by Association of Finnish Paint Industry (VTY). Emissions from decorative coating application are from questionnaires and from VTY’s estimates. The diviation between decorative and industrial coating application has been made since 2001 emissions reported in 2003 submission.

Emissions from application of paints of VTY members

Emissions from the application of paints produced by companies that are members of the Association of Finnish Paint Industry (VTY), are estimated by VTY, which compiles national statistics on the annual sales of paint products of its members. It covers about 90% of the paints produced in Finland. In the calculation of 2022 emissions, 97% of emissions are based on estimates by VTY.

Basis of calculation by VTY for the members

NMVOC emissions from decorative and industrial coating applications are calculated on the basis of the use volumes and solvent content of paints that develop over the years. The calculation is based on the actual formulations and the VOC content of raw materials used in the different formulations annually and on daily sales volumes of each product collected in each company's data system.

According to information from 2003 (Riala, 2003) 75% of paints used for construction and 90% of paints used for indoor painting were waterborne already then. According to the statistics collected by the members of the Association of Finnish Paint Industry the share of waterborne paints has been increased especially in the sector of industrial coatings since 2001.

For the baseline year 1988 for NMVOC emissions, the statistics of water and solvent based paints were further divided into subgroups of several types of products and various types of surfaces to be painted, such as “waterborne decorative indoor paints“ or “solvent borne decorative indoor paints“. For each of these subgroups the average NMVOC content and the average density have been estimated by the expert group set by the Member Companies of the Association of Finnish Paint Industry (VTY).

Emissions from application of paints of non-VTY members

VTY members produce about 90% of paints in Finland. In the calculation of 2022 emissions 97% of emissions are based on estimates by VTY. Emissions from the application of paints of those paint manufacturers that are not members of VTY were in 2022 3% of total emissions. The calculation is based on data acquired from annual questionnaires sent out by Finnish Environment Institute SYKE (since the 2003 submission). Information on paint production and sales of the companies as well as the likely use of paints (decorative/industrial) are collected from the companies. The questionnaire was earlier based on a mailed questionnaire and from 2011 an e-mail inquiry has been used, in addition. The response rate to the questionnaire varies from year to year. The collection of emission data for 2022 was carried out sending out questionnaires (excel-sheet) by e-mail to 5 companies, out of which 4 responded. All of the responses were provided in the excel sheet. In 2005 the questionnaires were sent by mail to 14 companies, out of which 12 responded. The number of companies has decreased over the years, in 2008 questionnaries were send to 10 companies while in 2011 only for 6 companies.

Basis of calculation by SYKE for non-VTY members

Information on the volume of paints/solvents used and their content of volatile organic compounds by CAS number and concentration are used in the calculation. The default volatility rate of 100% is used for the VOC compounds unless the operators provide a more accurate rate in their response. The questionnaire includes guidance for the operators if they choose to calculate the VOC emissions themselves. In any case, they report the details needed for the national inventory.

NMVOC emissions from coating applications are presented in Table 4.67.

Table 4.67. NMVOC emissions from coating applications.

Year	NMVOC (kt)	Year	NMVOC (kt)
1990	27.500	2010	9.170
1991	26.000	2011	8.719
1992	22.000	2012	8.181
1993	20.500	2013	7.512
1994	20.000	2014	7.270
1995	19.000	2015	6.772
1996	15.630	2016	6.803

1997	18.000	2017	6.803
1998	18.000	2018	6.538
1999	17.900	2019	7.348
2000	17.900	2020	7.083
2001	15.586	2021	6.988
2002	14.130	2022	5.871
2003	14.581		
2004	14.495		
2005	14.007		
2006	14.517		
2007	14.633		
2008	12.559		
2009	10.576		

Particle emissions
Particulate matter emissions (TSP, PM_{10} and $PM_{2.5}$) from industrial coating application are based on TSP data reported by the plants which are available in YLVA. Particle emissions are mainly generated during spray painting for example in a shipyard. PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions based on national fraction factors 80% for PM10 and 50% for PM2.5 (Karvosenoja, 2002). In 2023 particle emission from paint applications were less than 0.1 % of total emissions.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process
2018-2019
- The differences in NMVOC and particle emissions between the submissions in 2017 and 2018 was due the reallocation of emissions, which were corrected.

2020
- During the preparation of the 2019 submission, incorrect record of data reported by the plants in the YLVA system was identified and is corrected to the 2020 submission.

2021
- For 1988-1989 the emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.

Source-specific planned improvements

In the next 5 years
- Separation of emissions between other coating applications and decorative and industrial coating

Degreasing (NFR 2D3e)

Changes in chapter	
February 2024	KS, JMP. TF

Source category description

Product group	Activity where used	Reference
Chlorinated solvents in products	Metal degreasing SNAP 060201	Customs statistics and expert estimate
	Other industrial cleaning SNAP 060204	Customs statistics and expert estimate
	Electronic components manufacturing SNAP 060203	Customs statistics and expert estimate

There is no production of chlorinated organic solvents in Finland, all the used solvents are imported.

Degreasing and dry cleaning is a source of NMVOC emissions. Chlorinated organic solvents are used in the metal and electronic industries to clean surfaces of different components and in dry cleaners.

Degreasing in the Finnish inventory includes part of the emissions from Dry cleaning (NFR 2D3f) which can not currently be reported separately. Degreasing is not a key category for any pollutants.

Emission trend

Ammonia

NH_3 emissions from electronic components manufacturing were subject to many changes in the production activities which are reflected in the emission trend and also originate from different activities in the 1990's and in the 2000's. Between 1990-2002 there were less than five companies manufacturing electronic components, in 2003 none, and in 2004 a new company started manufacturing.

Emission trends are presented in Figure 4.33.

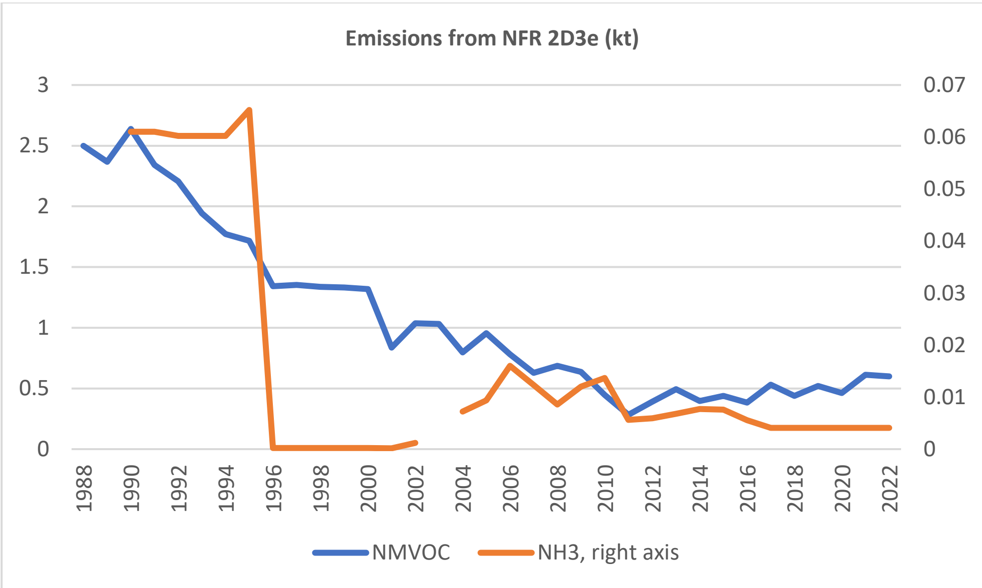


Figure 4.33. Emission trends in 2D3e.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.68.

Table 4.68. Contribution of Degreasing (NFR 2D3e) to total emissions in 2022.

Pollutant	Emissions from degreasing in 2022	Total emissions	Unit	Share of total emissions %	% reported by plants
NMVOC	0.598	75.464	Gg	0.8	3.5
NH_3	0.004	31.583	Gg	<0.1	0

Methodological issues

NMVOC
Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits.

When no plant specific data is available emissions has been calculated based on import statistics of pure chlorinated solvents and products containing chlorinated organic solvents and the volume of solvent waste processed in the hazardous waste treatment plants.

There is no production of chlorinated organic solvents in Finland. All the solvents used are imported and the amounts are obtainable from the Customs Statistics (ULJAS), but the split of their use between metal degreasing and dry cleaning is not available resulting in aggregated reporting.

Estimation of emissions from degreasing is based on the assumption that all purchased chemicals are used during the year of import. Activity data used in the calculation is presented in Table 4.69. The emission factor 0.7 kg/kg used in the calculation is an expert estimate by VTT Technical Research Centre of Finland since 2001 (YM, 1992). For the years 1990-2000 it is not possible to split the solvent volumes between solvents imported or solvents in imported products, so the solvent use is presented as a sum and it is based on an expert estimate. (SYKE, 2002)

Calculated NMVOC emissions from degreasing are presented in Table 4.70.

Table 4.69. Activity data for NMVOC emissions under NFR 2D3e (sum, based on expert estimate)*

Year	Chlorinated organic solvents import (t) from ULJAS	Chlorinated organic solvents import in products (t) Expert estimate	Chlorinated organic solvents processed in the waste treatment plants (expert estimate) (t)
1990	2600*		
1991	2300*		
1992	2100*		
1993	1800*		
1994	1700*		
1995	1500*		
1996	1300*		
1997	1300*		
1998	1300*		
1999	1200*		
2000	1200*		
2001	1094	100	160
2002	1421	150	160
2003	1407	150	140
2004	1110	150	140
2005	1317	150	140
2006	1070	150	140
2007	855	150	140
2008	936	150	140
2009	863	150	140
2010	595	150	140
2011	371	150	140
2012	529	150	140
2013	680	150	140
2014	545	150	140
2015	603	150	140
2016	524	150	140

2017	702	150	140
2018	576	150	140
2019	725	150	140
2020	613	150	140
2021	832	150	140
2022	815	150	140

Table 4.70. NMVOC emissions from degreasing (use of chlorinated organic solvents)

Year	NMVOC (kt)	Year	NMVOC (kt)	Year	NMVOC (kt)	Year	NMVOC (kt)
1990	2.638	2000	1.360	2010	0.446	2020	0.464
1991	2.340	2001	0.874	2011	0.283	2021	0.613
1992	2.207	2002	1.063	2012	0.392	2022	0.598
1993	1.944	2003	1.031	2013	0.494		
1994	1.771	2004	0.797	2014	0.397		
1995	1.717	2005	0.954	2015	0.438		
1996	1.343	2006	0.782	2016	0.382		
1997	1.353	2007	0.629	2017	0.531		
1998	1.336	2008	0.685	2018	0.439		
1999	1.378	2009	0.636	2019	0.521		

NH_3

Ammonia emissions (SNAP 060203, electronic components manufacturing) originate from production of silicon wafers, circuit boards and other electronic components where NH_3 is used as a process chemical. The emissions are based on data reported by the plants according to their monitoring and reporting requirements in the environmental permits.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2021

- For 1988-1989 the emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.

2022

- Particle emissions reported under this category (emissions reported by the plants) were previously incorrectly allocated under this category. The allocation of emissions was corrected under category 2D3i or 1A2gviii (depending on the plant). In addition, the allocation of NMVOC emissions from one plant previously reported under 2D3e were corrected under 2D3i.

2023

- Information on the source of ammonia emissions in electronic components manufacturing has been included.

Source-specific planned improvements

None.

Dry cleaning (NFR 2D3f)

Changes in chapter	
January 2020	KS & JMP

NMVOC emissions from dry cleaning are included in the emissions calculated from the use of chlorinated organic solvents as presented in the previous chapter. In the inventory they are allocated under Degreasing (NFR 2D3e). The emissions cannot be reported separately due to missing tools to estimate the share of solvents used for dry cleaning.

Chemical products (NFR 2D3g)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

Activities allocated under NFR 2D3g	Emissions
Pharmaceutical industry SNAP 060306 Textile and leather industry SNAP 060312 and 060313 Plastics manufacturing and handling of polymer plastics (e.g. polyester, polyvinylchloride, polystyrene foam processing) SNAP 060301, 060302, 060303 and 060304 Rubber conversion SNAP 060305 Manufacture of paints, inks and glues SNAP 060307, 060308 and 060309 Adhesive, magnetic tapes, films and photographs manufacturing SNAP 060311 1988-2004 Asphalt blowing	NMVOC, TSP, PM_{10}, $PM_{2.5}$, NH_3, SOx, Cd, As, Cr, Ni

Chemical products is a key category in NMVOC emissions according to the level of emissions (Approach 1). NMVOC emissions are calculated with Tier 2 methods.

Emission trends

NFR category Chemical products is a minor source of NMVOC emissions, the share of total emissions in NH_3 and particles is less than 0.1 %. Since the 2011 inventory, CO emissions are allocated under NFR 1A2d and 1A2c.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.71.

Table 4.71. Contribution of chemical products (NFR 2D3g) to total emissions in 2022.

Pollutant	Emissions from chemical products in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.465	75.464	Gg	1.9	81.3
SOx	<0.001	22.692	Gg	<0.1	100
NH_3	0.002	31.583	Gg	<0.1	39.6
$PM_{2.5}$	<0.001	13.384	Gg	<0.1	0
PM_{10}	0.002	26.778	Gg	<0.1	0
TSP	0.003	42.014	Gg	<0.1	100

Heavy metals reported in 1988-2004 originated from asphalt blowing, which has not occurred thereafter. Emission trends are presented in Figure 4.34

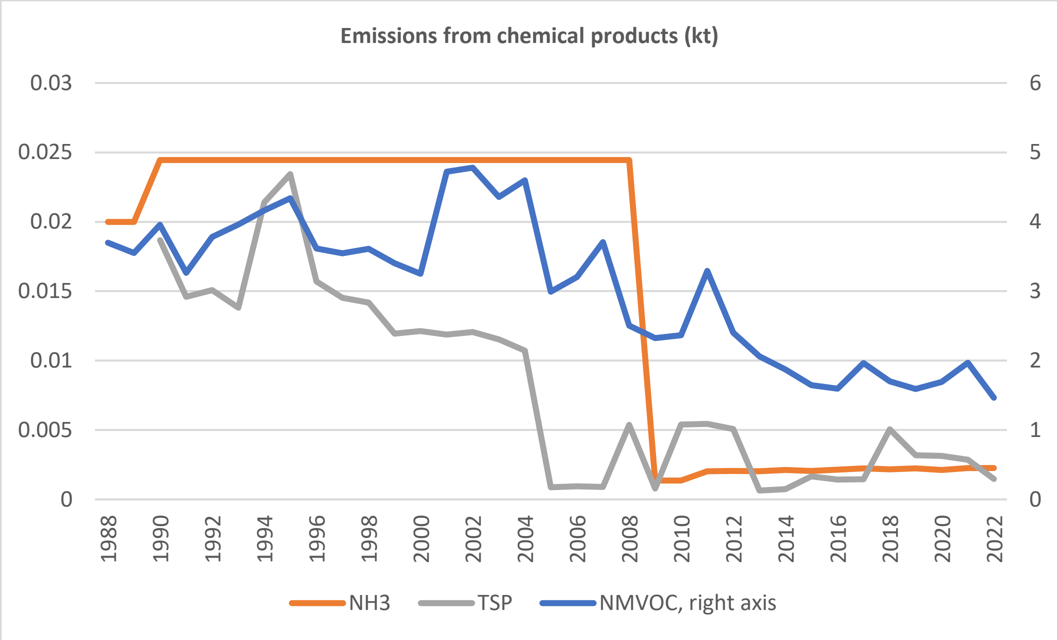


Figure 4.34 Emission trends in Chemical products

Methodological issues

Emissions reported in this category are heavy metals and NMVOCs which are calculated using the methodologies available in the Guidebook.

Air pollutant emissions from chemical products depend on the use volumes of solvents. The allocation of activities has been changed over the years but is consistent in the current time series.

Methodologies used in the calculation of solvent use in the different chemical products manufacture and processing are presented in Table 4.72. Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available, emissions have been calculated.

Table 4.72. Information sources for the NMVOC inventory under NFR 2D3g.

Activity	Methodology
Polyester processing	Reported by operators + questionnaire to operators
Polyvinylchloride processing	Reported by operators
Polyurethane foam processing	Reported by operators
Polystyrene foam processing	Reported by operators
Rubber processing	Reported by operators
Pharmaceutical products manufacturing	Reported by operators + questionnaire to operators
Paints manufacturing	Reported by operators + questionnaire to operators
Inks manufacturing	Reported by operators
Glues manufacturing	Reported by operators
Adhesive, magnetic tapes, films &	Reported by operators
Textile finishing	Reported by operators + questionnaire to operators
Leather tanning	Reported by operators + questionnaire to operators
Other	Reported by operators + questionnaire to operators
Asphalt blowing	Calculated

NMVOC

NMVOC emissions reported under Chemical Products include emission data reported by the plants and calculated emissions based on information from questionnaires to small and medium sized companies in the paint manufacturing, plastic and leather industries, which are not obligated to report their emissions to the environmental authorities.

NMVOC emissions, their sources and the number of companies allocated to this sector are presented in Table 4.73 to illustrate the contribution of the questionnaire to the total emissions of this sector.

Table 4.73. The contribution of responses received to the questionnaire sent to companies in summer 2023 for the inventory of 2022 emissions, to the total emissions of the sector 2D3g.

Sector	Year	NMVOC emissions (t)	Source of information	Number of companies
Pharmaceutical industry	2022	91	YLVA 100%	5-10
Plastic industry (incl. polyester, polyvinylchloride, polystyrene foam processing and other)	2022	1 270	YLVA 65% Questionnaire 35%	10 - 20 50 -100
Textile and leather industry	2022	0.0005	Questionnaire 100%	less than 10
Rubber conversion	2022	Incl. in plastic industry due to confidentiality	YLVA 100%	less than 10
Manufacture of paints, inks and glues	2022	105	YLVA 99.5% Questionnaire 1%	10 - 20 less than 10
Total NMVOC emissions from NFR 2D3g	2022	1 465		

Plastic industries

Emissions are calculated on the basis of data from replies to the questionnaires[9]. Information on the volume of solvent containing substances used and their content of volatile organic compounds by CAS number and concentration are used in the calculation. The default volatility rate of 100% is used for the VOC compounds unless the operators provide a more accurate rate in their response.

For the year 2022 inventory, a questionnaire was sent to 37 companies, out of which 18 responded. In order to estimate emissions from those activities not covered by the replies, it was assumed that in 40% of those activities not covered by the responses, had emissions.

Paint production

Majority of paint producers report emissions to the supervising authority and this emission data is thus available from YLVA. Questionnaires are sent to those companies that are not obligated to report emissions from their production processes. These emissions are calculated with the help of responses to the questionnaire mentioned above using the emission data and/or data on solvent use from the replies.

For the year 2022 inventory, a questionnaire was sent out to 7 companies, from which 6 responded. To estimate emissions from those companies that did not respond, it was assumed that only 40 % of those activities not included in the responses, generated emissions.

Particle emissions

Emissions are mainly generated during the manufacturing of pharmaceutical products and inks. TSP emissions are reported by the plants. PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions based on fraction factors of 80 % for PM_{10} and of 50% for $PM_{2.5}$ (Karvosenoja, 2002).

Leather tanning

NH3 emissions

NH3 emissions are calculated according to EMEP/EEA Guidebook 2023 using the emission factor of 0.68 g/kg raw hid. As activity data, 2000 t raw hid/year for 1990-2022 is used and it is based on an estimate of production volumes provided in the companies' environmental permits. The same emission estimate is used for years 1990-2021 due to lack of better data. The whole calculation will be updated for future submissions.

[9] Also an Internet based questionnaire is used, see information under "Coating application".

Asphalt blowing
Asphalt blowing occurred in 1988-2004. The existence of the source was only recognized after the NECD Review in 2018 and preliminary estimates were prepared for the related PAH emissions. However, in autumn 2018 the TERT Secretary informed that the Tier 2 EFs in the Guidebook 2016 (Tables 3-9 and 3-10 of 2.D.3.g Chemical products) were incorrect. NMVOC, TSP, PM_{10}, $PM_{2.5}$ and heavy metal (Cd, As, Cr, Ni, Se) emissions has been calculated for 1988-2004 according to the Guidebook 2023 in 2024 submission.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2015
- In the submission in 2015 NH_3 emissions from leather tanning were included for the first time.

2019
- NMVOC emissions were recalculated for the years 1990-2004 (the years when the activity existed) to the 2019 submission using the method in the 2019 Guidebook.

2021
- For 1988-1989 the NMVOC emissions were split into 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.
- Facility reported NH_3 emissions for 1990 from one plant were erroneously missing from 2020 submission. These were included in submission 2021.

2022
- An error in calcuation formula was corrected in calculation of NH_3 emissions from leather tanning.

2023
- NMVOC, TSP, PM10, PM2.5 and heavy metal (Cd, As, Cr, Ni, Se) emissions from asphalt blowing from 1988-2004 were included in.

2024
- An error in calculation formula was corrected in calcution of NMVOC emission from plastic industry from 2008 onwards.

Source-specific planned improvements

- Calculation of NH_3 emissions from leather tanning will be revised to the future submissions.
- PAH emissions from leather tanning to be estimated in the next submissions.

Printing (NFR 2D3h)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

Printing inks used in Finland vary widely in the composition, but they consist of three major components: pigments, binders and solvents. The type of ink which is used is usually the most important factor in estimating emissions from printing operations. Table 4.74 shows typical compositions of traditional printing inks in 2008.

Table 4.74 Typical compositions of traditional printing inks (Antson, 2008).

Composition of printing inks	Offset			Other pinting inks		
	newspaper %	sheet %	heatset %	Flexographic inks %	gravure printing %	screen printing %
pigments	10—20	15-25	10-20	5-30	5-15	5-8
binders	10-35	20-40	20-40	15-30	20-35	30-40
solvent	25-75	30-50	30-50	40-70	50-70	54-60
additives	0-5	0-5	0-6	0-8	0-5	1-2

NMVOC emission trend from printing activities is decreasing due to increased recovery of solvents and VOC compounds and cleaning of process emissions through e.g. incineration. The larger plants carry out NMVOC measurements from flue gases.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.75.

Table 4.75. Contribution of Printing (NFR 2D3h) to total emissions in 2022.

Pollutant	Emissions from printing in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.367	75.464	Gg	0.5	68.7

Printing is a key category in NMVOC emissions according to the trend of emissions (Approach 1). Emissions are calculated with T2/T3 methods.

Emission trends

NMVOC emission trend is presented in Figure 4.35

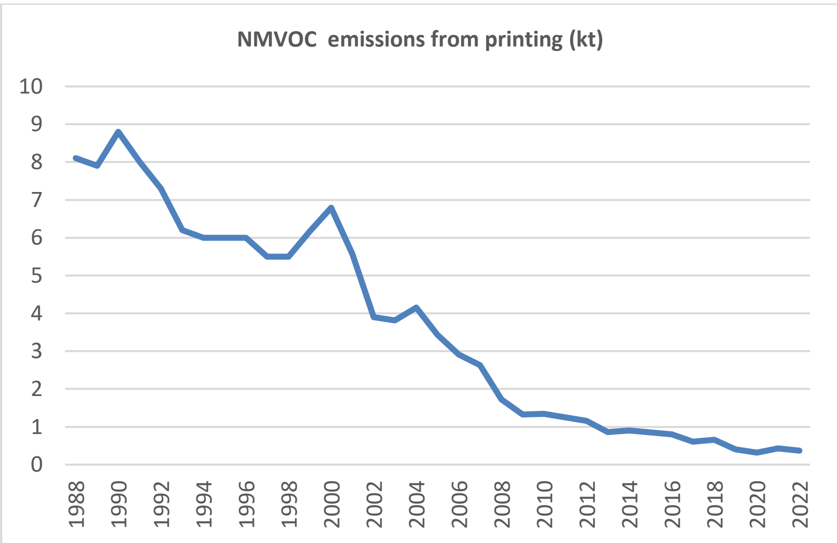


Figure 4.35. NMVOC emission trend in Printing.

Methodological issues

NMVOC

Emissions from printing industry are based on emission reported by the plants as well as on information received as response to the questionnaire sent out by SYKE to printing houses that are not obligated to report their emissions to the supervising authority according to their environmental permits.

The largest printing houses that report their emissions account more than 80% of total NMVOC emissions from the printing industry. The remaining 20% of emissions are estimated on basis of data collected through the questionnaire (see for details under “Coating appliations”). For calculation of the year 2021 emissions, the questionnaire was sent to 42 companies, from which 18 responded. In order to estimate emissions from those companies that did not reply, it was assumed that only 40% of the emissions from those activities not included in the responses of the questionnaire, do not have emissions.

The volume of VOC containing substances, their VOC content by CAS numbers and a default volatility rate of 100% were used in the calculation, in case a more accurate volatility rate was not available.

Calculated NMVOC emissions from printing are presented in Table 4.75.

Table 4.75. NMVOC emissions from printing

Year	NMVOC (kt)	Year	NMVOC (t)
1990	8.800	2010	1.340
1991	8.000	2011	1.250
1992	7.300	2012	1.155
1993	6.200	2013	0.865
1994	6.000	2014	0.902
1995	6.000	2015	0.853
1996	6.000	2016	0.806
1997	5.500	2017	0.604
1998	5.500	2018	0.661
1999	6.166	2019	0.546
2000	6.792	2020	0.318
2001	5.574	2021	0.428
2002	3.902	2022	0.367
2003	3.815		
2004	4.155		
2005	3.434		
2006	2.911		
2007	2.631		
2008	1.722		
2009	1.325		

Uncertainty and time series’ consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2021

- For 1988-1989 NMVOC emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogate.

2022

- Activity data for printing for the year 2019 was corrected.

Source-specific planned improvements

In the next years

- In the 2018 submission SO_x emissions were reported under NFR 2D3h for 1990-1994. The possibly to reallocate the emissions to the energy sector is studied.

Other solvent use (NFR 2D3i)

Changes in chapter	
February 2024	KS & JMP TF

Source category description

NFR	Activity	Description	Emissions
2D3i	Other product use Key category for NMVOC (L1)	Glass and mineral wool enduction (SNAP 060401-02), fat, edible oil extraction (SNAP 060404), preservation of wood (SNAP 060406), industrial application of glues and adhesives (SNAP 060405) *Not estimated*: domestic application of glues and adhesives	NMVOC, SO_X, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, PAHs, HCB

Other solvent and product use is a key category in NMVOC emissions according to the level of emissions (Approach 1). Emissions are calculated with T3/T2 methods.

Emission trends

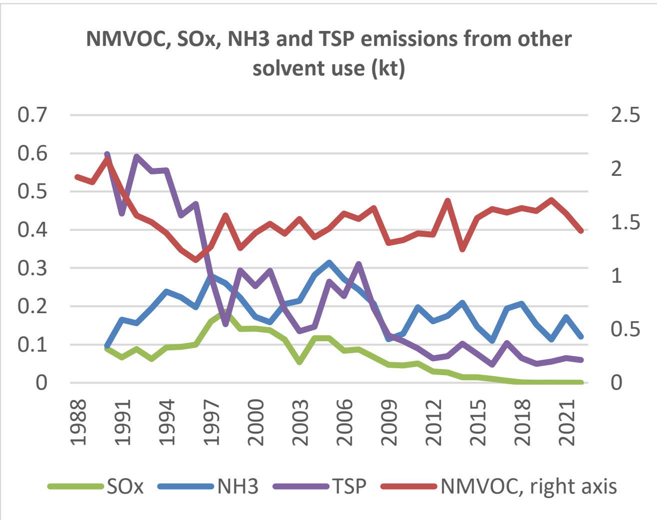
The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.76.

Table 4.76. Contribution of Other solvent and product use (NFR 2D3i) to total emissions 2022.

Pollutant	Emissions from other solvent and product use in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.419	75.464	Gg	1.9	4.0
SOx (as SO2)	<0.001	22.692	Gg	<0.1	100
NH_3	0.121	31.583	Gg	0.4	100
$PM_{2.5}$	0.051	13.384	Gg	0.4	0
PM_{10}	0.055	26.778	Gg	0.2	0
TSP	0.059	42.014	Gg	0.1	95.3
BC	<0.001	3.121	Gg	<0.1	0
PAHs	0.009	18.531	Mg	<0.1	0
HCB	0.002	29.245	kg	<0.1	0

Other solvent and products use is a minor source of NMVOC, SO_x, particles, NH_3, HCB and PAHs. HCB emissions are generated from the use of chlorinated solvents, which varies from year to year. SOx emissions are generated from manufacturing of rock and mineral wool.

Emission trends are presented in Figure 4.36.



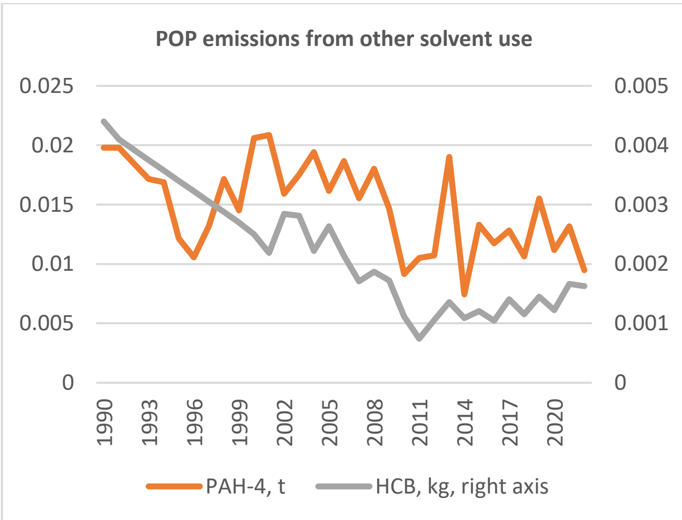


Figure 4.36. NMVOC, ammonia, particle, SOx, PAH-4 and HCB trends in Other solvent use.

Methdological issues

A compilation of activites and estimation methods regarding NMVOC emissions reported under NFR Other solvent use as presented in Table 4.77.

Table 4.77. Methods to estimate emissions by sub-category under NFR 2D3i.

Activity	Method
Glass wool enduction	Reported by operators
Mineral wool enduction	Reported by operators
Fat, edible and not edible oil exraction	Reported emissions by operators
Application of glues and adhesives	Domestic application: Finnish Cosmetics, Toiletry and Detergents Association (inclusion in the current emisions from Domestic solvent use needs to be checked) Industrial application: YLVA database (emissions allocated to different sectors, for example 2I)
Preservation of wood	Calculation
Underseal treatment and conservation of vehicles	Finnish Cosmetics, Toiletry and Detergents Association (included in Domestic solvent use)
Vehicles dewaxing	Finnish Cosmetics, Toiletry and Detergents Association (inclusion in Domestic solvent use needs to be checked)
Other (preservation of seeds,...): use of pesticides in cultivations and in construction	Calculation

<u>Glass and Mineral Wool Enduction</u>

NMVOC
Emissions from glass and mineral wool enduction activities are reported by the plants.

SO_x and NH_3
Emissions are generated during manufacturing of rock and mineral wool and are based on data reported by the plants.

Particles
TSP emissions are reported by the plants and PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions based on fraction factors 95 % for PM10 and 91% for PM2.5 (AEAT, 2000).

Black carbon emissions are calculated using the emission factor 0.06 % of PM2.5 (Aasestad, 2013). There is no method for BC in the Guidebook.

<u>Solvent Extraction of edible oils</u>

NMVOC
Emissions from solvent extraction of edible oils from oilseeds are based on emission data reported by the plants. In past years also a questionnaire was sent to companies that do not report their emissions. In 2012 it was discovered that these companies produce cold-drown vegetable oils and no NMVOCs are emitted during the production process.

<u>Industrial and domestic application of glues and adhesives</u>

NMVOC
Emissions from industrial application of glues and adhesives are included in the total NMVOC emissions reported by the plants, and aggregated under the main activity of the plant, for instance under NFR 2I.

Domestic use of adhesive and sealants fall under NFR 2D3a.

<u>Impregnation of wood</u>

NMVOC
Part of emissions from wood impregnation activities is reported by the plants and available in YLVA database. Emissions from the remaining impregnation activities are calculated with and the NMVOC emission factor for impregnation of wood 100 kg/t. (SYKE, 2001). Activity data for impregnation of wood is received from Finnish Safety and Chemicals Agency as the amount of sold creosote oil.

PAH-4
Part of emissions from wood impregnation activities is reported by the plants and available in YLVA database. Emissions from impregnation of wood and the use of impregnated wood have been calculated using the emission factors presented in Guidebook 2019. Annual volumes of impregnation of wood are presented in Table 4.78. Data on the use of impregnated wood, which is the activity data for both impregnation of wood and for the use of impregnated wood (all PAHs are assumed to be released during one year).

<u>Use of pesticides</u>

Use of pesticides covers all use purposes from agriculture to domestic use. The data is confidential in most recent years and can therefore not be presented in the IIR.

PAH-4
Emissions from the use of pesticides are calculated using the sales data of pesticides presented in Table 4.78 and the emission factor of 80 kg/t (SYKE, 2001). The amount of pesticides sold is received from the Finnish Food Safety Authority (TUKES).

Table 4.78. Acitivty data: Use of pesticides and impregnation of wood 1988-2022.

Year	Use of pesticides	Impregnation of wood
1988	NE	7 800 t creosote sold***
1989	NE	NE
1990	4 789 t pesticides sold**	7 500 t creosote sold***
1991	4 253 t pesticides sold**	7 500 t creosote sold***
1992	3 348 t pesticides sold**	7 000 t creosote sold***
1993	3 106 t pesticides sold**	6 500 t creosote sold***
1994	3 119 t pesticides sold**	6 400 t creosote sold***
1995	2 767 t pesticides sold**	4 600 t creosote sold***
1996	2 630 t pesticides sold**	4 000 t creosote sold***
1997	2 755 t pesticides sold**	5 000 t creosote sold***
1998	3 059 t pesticides sold**	6 500 t creosote sold***
1999	3 000 t pesticides sold**	5 500 t creosote sold***
2000	3 161 t pesticides sold**	7 800 t creosote sold***
2001	3 680 t pesticides sold**	7 900 t creosote sold***
2002	4 230 t pesticides sold**	6 030 t creosote sold***
2003	4 355 t pesticides sold**	6 640 t creosote sold***
2004	4 146 t pesticides sold**	7 357 t creosote sold***
2005	4 726 t pesticides sold**	6 120 t creosote sold***
2006	5 510 t pesticides sold**	7 072 t creosote sold***
2007	6 192 t pesticides sold**	5 886 t creosote sold***
2008	6 866 t pesticides sold**	C***
2009	6 503 t pesticides sold**	C****
2010	7 412 t pesticides sold**	C****
2011	8 691 t pesticides sold**	C****
2012	8 882 t pesticides sold**	C****
2013	9 518 t pesticides sold**	C****
2014	10 250 t pesticides sold**	C****
2015	11 547 t pesticides sold**	C****
2016	13 223 t pesticides sold**	C****
2017	12 600 t pesticides sold**	C****
2018	14 375 t pesticides sold	C****
2019	11 800 t pesticides sold	C****
2020	1 4 600 t pesticides sold	C****
2021	12 200 t pesticides sold	C****
2022	12 400 t pesticides sold	C****

*reference Statistics Finland
**reference Finnish Food Safety Authority Evira
***reference Finnish Environment Institute
****reference Finnish Safety and Chemicals Agency
***** reference National Institute for Health and Welfare

<u>Use of chlorinated solvents</u>

HCB
Emissions from the use of chlorinated solvents have been calculated with the emission factor 2 mg/ t from an earlier version of the EMEP/EEA Guidebook (EEA, 2005) (no method in Guidebook

2023) and information from customs statistics (ULJAS) on the imports of chlorinated chemicals as presented in Table 4.79. Chlorinated solvents are not produced in Finland.

Table 4.79. Use of chlorinated solvents (Custom Statistics)

Use of chlorinated solvents per year (t) (Custom Statistics, ULJAS)							
1990	2 200 t	2000	1 250 t	2010	557 t	2020	613 t
1991	2 050 t	2001	1 094 t	2011	371 t	2021	832 t
1992	1 963 t	2002	1 421 t	2012	529 t	2022	814 t
1993	1 875 t	2003	1 407 t	2013	680 t		
1994	1 788 t	2004	1 110 t	2014	545 t		
1995	1 700 t	2005	1 317 t	2015	603 t		
1996	1 613 t	2006	1 070 t	2016	524 t		
1997	1 525 t	2007	855 t	2017	702 t		
1998	1 438 t	2008	936 t	2018	576 t		
1999	1 350 t	2009	863 t	2019	726 t		

A summary of calculated is presented in Table 4.80.

Table 4.80. NMVOC and POP emissions from other solvent use.

Year	NMVOC (kt)	HCB (kg)	Benzo(a)pyrene (kg)	Benzo(b)fluoranthene (kg)	Benzo(k)fluoranthene (kg)	Indeno(1,2,3-cd) pyrene (kg)
1990	2.085	0.004	7.9	4.0	4.0	4.0
1991	1.793	0.004	7.9	4.0	4.0	4.0
1992	1.562	0.004	7.4	3.7	3.7	3.7
1993	1.501	0.004	6.8	3.4	3.4	3.4
1994	1.399	0.004	6.7	3.4	3.4	3.4
1995	1.240	0.003	4.8	2.4	2.4	2.4
1996	1.146	0.003	4.2	2.1	2.1	2.1
1997	1.271	0.003	5.3	2.7	2.7	2.7
1998	1.561	0.003	6.8	3.4	3.4	3.4
1999	1.214	0.003	5.8	2.9	2.9	2.9
2000	1.357	0.003	8.2	4.1	4.1	4.1
2001	1.449	0.002	8.3	4.2	4.2	4.2
2002	1.364	0.003	6.3	3.2	3.2	3.2
2003	1.530	0.003	7.0	3.5	3.5	3.5
2004	1.456	0.002	7.7	3.9	3.9	3.9
2005	1.440	0.003	6.4	3.2	3.2	3.2
2006	1.579	0.002	7.4	3.7	3.7	3.7
2007	1.528	0.002	6.2	3.1	3.1	3.1
2008	1.630	0.002	7.2	3.6	3.6	3.6
2009	1.306	0.002	5.8	2.9	2.9	2.9
2010	1.331	0.001	3.6	1.8	1.8	1.8
2011	1.395	0.001	4.2	2.1	2.1	2.1
2012	1.383	0.001	4.3	2.2	2.2	2.2
2013	1.700	0.001	7.6	3.8	3.8	3.8
2014	1.247	0.001	3.0	1.5	1.5	1.5
2015	1.539	0.001	5.3	2.7	2.7	2.7
2016	1.621	0.001	4.7	2.4	2.4	2.4
2017	1.590	0.001	5.1	2.6	2.6	2.6
2018	1.493	0.001	4.2	2.1	2.1	2.1
2019	1.811	0.001	6.2	3.1	3.1	3.1
2020	1.705	0.001	4.4	2.2	2.2	2.2
2021	1 581	0.001	5.2	2.7	2.7	2.7
2022	1 419	0.002	3.8	1.9	1.9	1.9

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2018

- Guidebook 2016 emission factors have been taken in use for calculation PAHs from preservation of wood.

2020

- The time-series have been double-checked due the false data for the use of pesticides from year 2002 in 2019 submission. The value has for an unknown reason changed for 2002 to equal the value for 2001. The correct value for the year 2002 is 1.364 (the incorrect 1.320).
- The sales data of creosote oil (not pesticides as stated in 2020 submission) as activity data for 2017 were updated.

2021

- For 1988-1989 NMVOC emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.

2022

- The sales data of pestisides for 2019 were updated.
- Allocation of particle emissions from some facilities were corrected from 2D3e to 2D3i. In addition, NMVOC emissions from one facility were corrected from 2D3e to 2D3i.
- One mineral wool plant ceased operation during 2017. Ammonia emissions for 2018-2019 and NMVOC emissions for 2018 from this plant were previously incorrectly included in the inventory. These emissions were removed from the inventory.
- Activity data for the calculation of NMVOC emissions from solvent extraction of edible oils in 2004 was corrected.

Source-specific planned improvements

- There is need to check and possibly recalculate NMVOC emissions from solvent extraction of edible oils as the emissions may be double counted in the 1990s.

Other product use (NFR 2G)

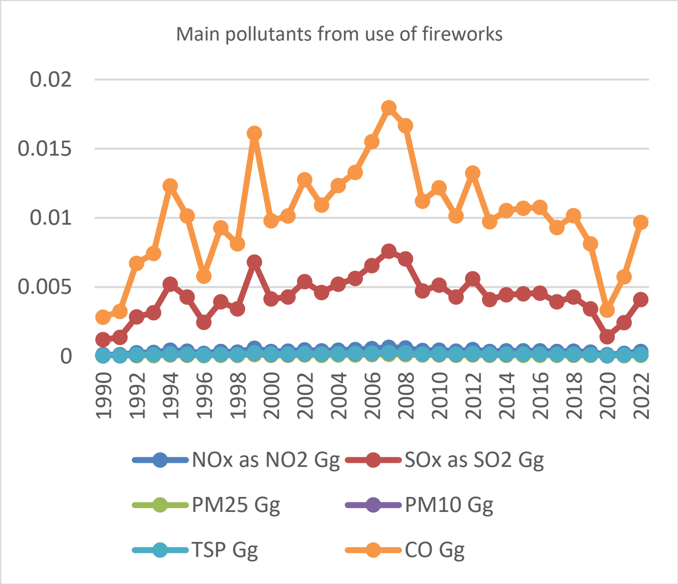
Changes in chapter	
February 2024	KS & JMP TF

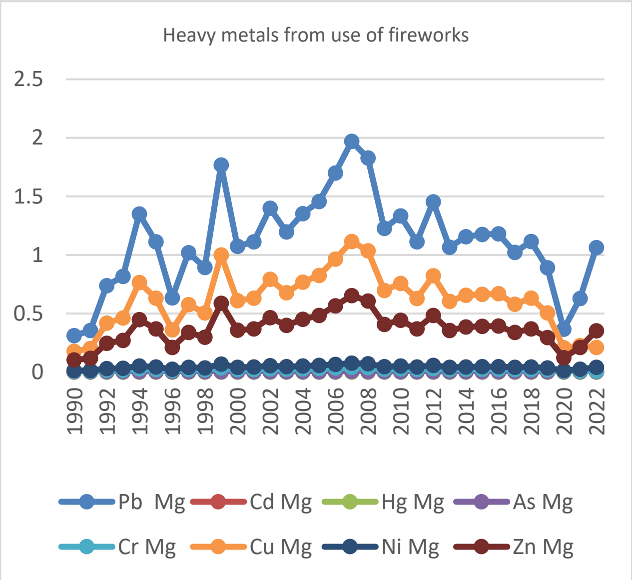
Source category description

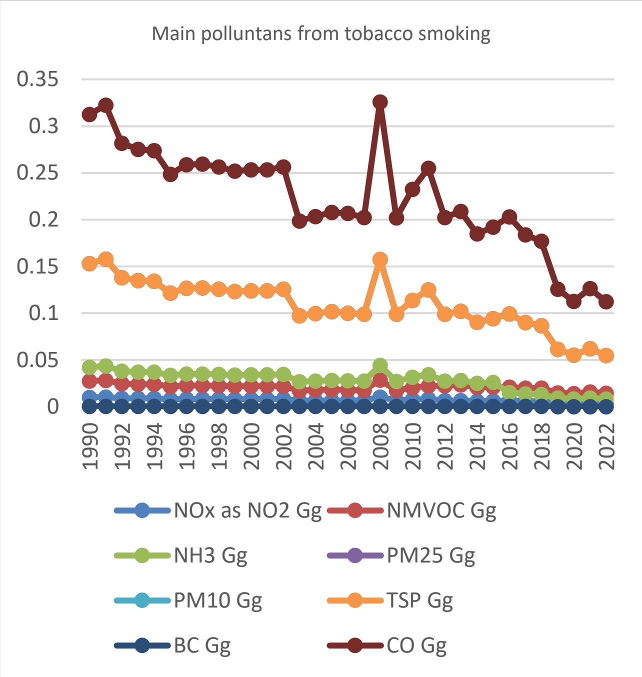
NFR	Activity	Description	Emissions
2G	Other product use	Use of fireworks and tobacco Key categpry for Pb (L1)	NO_X, NMVOC, SO_X, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, CO, Pb, Cd, Hg, As, Cr, Cu, PCDD/F, PAH-4, HCB

Emission trends

Emission trends are presented in Figure 4.37. The peak in tobacco smoking emissions is related to the peak in tobacco sales as presented in Table 4.83, where the sale figures in 2008 are exceptional. This is due the changes in taxation that took place on1 January 2009.







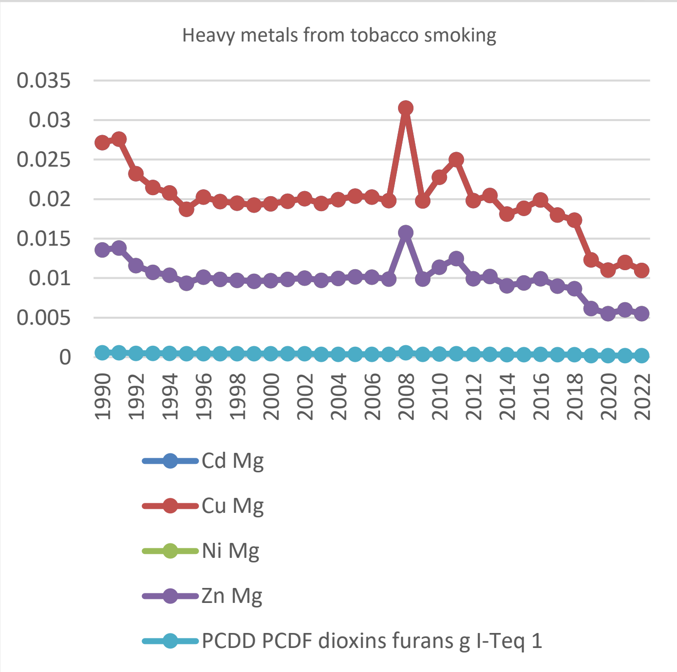


Figure 4.37. Heavy metal and main pollutants emissions from the use of firework and from tobacco smoking.

The shares of emissions reported under the NFR category are presented in Table 4.81.

4.81. Contribution of Other product use (NFR 2G) to total emissions 2022.

Pollutant	Emissions from other product use in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NOx (as NO2)	0.004	99.292	Gg	<0.1	0
NMVOC	0.015	75.464	Gg	<0.1	0
SOx (as SO2)	0.004	22.692	Gg	<0.1	0
NH3	0.008	31.583	Gg	<0.1	0
PM2.5	0.055	13.384	Gg	0.4	0
PM10	0.055	26.778	Gg	0.2	0
TSP	0.055	42.014	Gg	0.1	0
BC	<0.001	3.121	Gg	<0.1	0

CO	0.122	310.209	Gg	<0.1	0
Pb	1.061	12.516	Mg	8.5	0
Cd	0.012	0.779	Mg	1.5	0
Hg	<0.001	0.505	Mg	<0.1	0
As	<0.001	1.92	Mg	<0.1	0
Cr	0.007	14.905	Mg	<0.1	0
Cu	0.221	38.391	Mg	0.6	0
Ni	0.046	9.917	Mg	0.3	0
Zn	0.357	131.533	Mg	0.2	0
PCDD/ PCDF	<0.001	9.497	g I-Teq	<0.1	0
PAHs	<0.001	18.531	Mg	<0.1	0

Methdological issues

Tobacco smoking

The annual sales statistics of cigars and cigarettes that are used as activity data (Table 4.84) are from Statistics Finland for the years 1990-2010. Since 2011 the statistics has been provided by National Institute for Healt and Welfare (THL). As it can be seen in Table 4.82 the sale figures in 2008 are exceptional. This is due the changes in taxation that took place on 1 January 2009.

Table 4.82. Activity data for tobacco smoking (Statiscs Finland, since 2011 National Institute for Healt and Welfare).

Sales of cigars and cigarettes (1990-2010 Statistics Finland, since 2011 National Institute for Health and Welfare THL)			
1990	5 674 t	2007	3 672 t
1991	5 854 t	2008	5 917 t
1992	5 111 t	2009	3 665 t
1993	4 994 t	2010	4 219 t
1994	4 970 t	2011	4 629 t
1995	4 509 t	2012	3 674 t
1996	4 694 t	2013	3 789 t
1997	4 709 t	2014	4 317 t
1998	4 657 t	2015	4 391 t
1999	4 575 t	2016	4 787 t
2000	4 600 t	2017	4 113 t
2001	4 598 t	2018	4 133 t
2002	4 653 t	2019	3 107 t
2003	3 606 t	2020	2 957 t
2004	3 691 t	2021	3 392 t
2005	3 775 t	2022	2 998 t
2006	3 751 t		

Emissions from tobacco smoking are calculated with emission factors presented in Guidebook 2023 (Table 4.83).

Table 4.83 NOx, CO, NH3, SOx, NMVOC, particle and heavy metal emissions from tobacco smoking.

Year	NOx as NO2 Gg	NMVOC Gg	NH3 Gg	PM2.5 Gg	PM10 Gg	TSP Gg	BC Gg	CO Gg
1990	0.010	0.027	0.042	0.153	0.153	0.153	0.0007	0.313
1991	0.011	0.028	0.044	0.158	0.158	0.158	0.0007	0.323
1992	0.009	0.025	0.038	0.138	0.138	0.138	0.0006	0.282
1993	0.009	0.024	0.037	0.135	0.135	0.135	0.0006	0.275
1994	0.009	0.024	0.037	0.134	0.134	0.134	0.0006	0.274
1995	0.008	0.022	0.034	0.122	0.122	0.122	0.0005	0.248
1996	0.008	0.023	0.035	0.127	0.127	0.127	0.0006	0.259

1997	0.008	0.023	0.035	0.127	0.127	0.127	0.0006	0.259
1998	0.008	0.023	0.035	0.126	0.126	0.126	0.0006	0.257
1999	0.008	0.022	0.034	0.124	0.124	0.124	0.0006	0.252
2000	0.008	0.022	0.034	0.124	0.124	0.124	0.0006	0.253
2001	0.008	0.022	0.034	0.124	0.124	0.124	0.0006	0.253
2002	0.008	0.022	0.035	0.126	0.126	0.126	0.0006	0.256
2003	0.006	0.017	0.027	0.097	0.097	0.097	0.0004	0.199
2004	0.007	0.018	0.028	0.100	0.100	0.100	0.0004	0.203
2005	0.007	0.018	0.028	0.102	0.102	0.102	0.0005	0.208
2006	0.007	0.018	0.028	0.100	0.100	0.100	0.0005	0.207
2007	0.007	0.018	0.027	0.099	0.099	0.099	0.0004	0.202
2008	0.011	0.029	0.044	0.158	0.158	0.158	0.0007	0.326
2009	0.007	0.018	0.027	0.099	0.099	0.099	0.0004	0.202
2010	0.008	0.020	0.032	0.114	0.114	0.114	0.0005	0.232
2011	0.008	0.022	0.035	0.125	0.125	0.125	0.0006	0.255
2012	0.007	0.023	0.027	0.099	0.099	0.099	0.0004	0.202
2013	0.007	0.024	0.028	0.102	0.102	0.102	0.0005	0.209
2014	0.006	0.021	0.025	0.091	0.091	0.091	0.0004	0.185
2015	0.006	0.021	0.026	0.094	0.094	0.094	0.0004	0.192
2016	0.007	0.021	0.015	0.100	0.100	0.100	0.0004	0.203
2017	0.006	0.020	0.014	0.090	0.090	0.090	0.0004	0.184
2018	0.006	0.020	0.013	0.087	0.087	0.087	0.0004	0.177
2019	0.004	0.015	0.009	0.062	0.062	0.062	0.0003	0.126
2020	0.004	0.014	0.008	0.055	0.055	0.055	0.003	0.113
2021	0.004	0.016	0.010	0.062	0.062	0.062	0.003	0.126
2022	0.004	0.015	0.009	0.055	0.055	0.055	0.003	0.112
Year	**Cd Mg**	**Cu Mg**	**Ni Mg**	**Zn Mg**	**PCDD/F g I-Teq**			
1990	0.027	0.027	0.014	0.014	0.0006			
1991	0.028	0.028	0.014	0.014	0.0006			
1992	0.023	0.023	0.012	0.012	0.0005			
1993	0.021	0.021	0.011	0.011	0.0005			
1994	0.021	0.021	0.010	0.010	0.0005			
1995	0.019	0.019	0.009	0.009	0.0005			
1996	0.020	0.020	0.010	0.010	0.0005			
1997	0.020	0.020	0.010	0.010	0.0005			
1998	0.020	0.020	0.010	0.010	0.0005			
1999	0.019	0.019	0.010	0.010	0.0005			
2000	0.019	0.019	0.010	0.010	0.0005			
2001	0.020	0.020	0.010	0.010	0.0005			
2002	0.020	0.020	0.010	0.010	0.0005			
2003	0.019	0.019	0.010	0.010	0.0004			
2004	0.020	0.020	0.010	0.010	0.0004			
2005	0.020	0.020	0.010	0.010	0.0004			
2006	0.020	0.020	0.010	0.010	0.0004			
2007	0.020	0.020	0.010	0.010	0.0004			
2008	0.032	0.032	0.016	0.016	0.0006			
2009	0.020	0.020	0.010	0.010	0.0004			
2010	0.023	0.023	0.011	0.011	0.0004			
2011	0.025	0.025	0.012	0.012	0.0005			
2012	0.020	0.020	0.010	0.010	0.0004			
2013	0.020	0.020	0.010	0.010	0.0004			
2014	0.018	0.018	0.009	0.009	0.0003			
2015	0.019	0.019	0.009	0.009	0.0003			
2016	0.020	0.020	0.010	0.010	0.0004			
2017	0.018	0.018	0.010	0.010	0.0003			
2018	0.017	0.017	0.009	0.009	0.0003			
2019	0.012	0.012	0.006	0.006	0.0002			
2020	0.011	0.011	0.006	0.006	0.0002			
2021	0.012	0.012	0.006	0.006	0.0002			

2022	0.011	0.011	0.006	0.006	0.0002			

Use of fireworks

The amount of imported fireworks is used as activity data for the whole time series since 1990. The emission factors are from Guidebook 2023. The amount of imported fireworks is presented in Table 4.84 and the emissions in Tables 4.85 and 4.86.

Table 4.84. Amount of imported fireworks (tonnes) (Custom Statiscis)

Year	Imported fireworks (t)	Year	Imported fireworks (t)	Year	Imported fireworks (t)
1990	396	2001	1418	2012	1853
1991	454	2002	1785	2013	1360
1992	939	2003	1528	2014	1474
1993	1040	2004	1727	2015	1497
1994	1721	2005	1859	2016	1506
1995	1418	2006	2169	2017	1303
1996	809	2007	2512	2018	1420
1997	1299	2008	2332	2019	1136
1998	1138	2009	1566	2020	466
1999	2253	2010	1702	2021	803
2000	1370	2011	1417	2022	1354

Table 4.85 NOx, CO, Sox andand particle emissions from use of fireworks.

Year	NOx Gg	SOx Gg	$PM_{2.5}$ g	PM_{10} g	TSP g	CO Gg
1990	0.00010	0.0012	0.02	0.04	0.04	0.0028
1991	0.00012	0.0014	0.02	0.05	0.05	0.0032
1992	0.00024	0.0028	0.05	0.09	0.10	0.0067
1993	0.00027	0.0031	0.05	0.10	0.11	0.0074
1994	0.00045	0.0052	0.09	0.17	0.19	0.0123
1995	0.00037	0.0043	0.07	0.14	0.16	0.0101
1996	0.00021	0.0024	0.04	0.08	0.09	0.0058
1997	0.00034	0.0039	0.07	0.13	0.14	0.0093
1998	0.00030	0.0034	0.06	0.11	0.12	0.0081
1999	0.00059	0.0068	0.12	0.23	0.25	0.0161
2000	0.00036	0.0041	0.07	0.14	0.15	0.0098
2001	0.00037	0.0043	0.07	0.14	0.16	0.0101
2002	0.00046	0.0054	0.09	0.18	0.20	0.0128
2003	0.00040	0.0046	0.08	0.15	0.17	0.0109
2004	0.00045	0.0052	0.09	0.17	0.19	0.0123
2005	0.00048	0.0056	0.10	0.19	0.20	0.0133
2006	0.00056	0.0066	0.11	0.22	0.24	0.0155
2007	0.00065	0.0076	0.13	0.25	0.28	0.0180
2008	0.00061	0.0070	0.12	0.23	0.26	0.0167
2009	0.00041	0.0047	0.08	0.16	0.17	0.0112
2010	0.00044	0.0051	0.09	0.17	0.19	0.0122
2011	0.00037	0.0043	0.07	0.14	0.16	0.0101
2012	0.00048	0.0056	0.10	0.19	0.20	0.0133
2013	0.00035	0.0041	0.07	0.14	0.15	0.0097
2014	0.00038	0.0045	0.08	0.15	0.16	0.0105
2015	0.00039	0.0045	0.08	0.15	0.16	0.0107
2016	0.00039	0.0045	0.08	0.15	0.17	0.0108
2017	0.00034	0.0039	0.07	0.13	0.14	0.0093
2018	0.00037	0.0043	0.07	0.14	0.16	0.0102
2019	0.00030	0.0034	0.06	0.11	0.12	0.0081
2020	0.00012	0.0014	0.02	0.05	0.05	0.003
2021	0.00020	0.0024	0.04	0.08	0.09	0.006
2022	0.00352	0.0041	0.07	0.14	0.15	0.010

Table 4.86. Heavy metal emissions from use of fireworks.

Year	Pb Mg	Cd Mg	Hg kg	As Mg	Cr Mg	Cu Mg	Ni Mg	Zn Mg
1990	0.3103	0.0006	0.00023	0.0005	0.0062	0.176	0.012	0.103
1991	0.3556	0.0007	0.0026	0.0006	0.0071	0.201	0.014	0.118
1992	0.7364	0.0014	0.00054	0.0012	0.0147	0.417	0.028	0.244
1993	0.8154	0.0015	0.00059	0.0014	0.0162	0.462	0.031	0.270
1994	1.3493	0.0025	0.00098	0.0023	0.0268	0.764	0.052	0.447
1995	1.1114	0.0021	0.00081	0.0019	0.0221	0.629	0.043	0.369
1996	0.6342	0.0012	0.00046	0.0011	0.0126	0.359	0.024	0.210
1997	1.0185	0.0019	0.00074	0.0017	0.0203	0.577	0.039	0.338
1998	0.8920	0.0017	0.00065	0.0015	0.0177	0.505	0.034	0.296
1999	1.7667	0.0033	0.00128	0.0030	0.0352	1.001	0.068	0.586
2000	1.0740	0.0020	0.00078	0.0018	0.0214	0.608	0.041	0.356
2001	1.1118	0.0021	0.00081	0.0019	0.0221	0.630	0.043	0.369
2002	1.3991	0.0026	0.00102	0.0024	0.0278	0.792	0.054	0.464
2003	1.1978	0.0023	0.00087	0.0020	0.0238	0.678	0.046	0.397
2004	1.3537	0.0026	0.00098	0.0023	0.0269	0.767	0.052	0.449
2005	1.4575	0.0028	0.00106	0.0025	0.0290	0.825	0.056	0.483
2006	1.7005	0.0032	0.00124	0.0029	0.0338	0.963	0.065	0.564
2007	1.9697	0.0037	0.00143	0.0033	0.0392	1.115	0.075	0.653
2008	1.8279	0.0035	0.00133	0.0031	0.0364	1.035	0.070	0.606
2009	1.2278	0.0023	0.00089	0.0021	0.0244	0.695	0.047	0.407
2010	1.3341	0.0025	0.00097	0.0023	0.0265	0.756	0.051	0.442
2011	1.1109	0.0021	0.00081	0.0019	0.0221	0.629	0.043	0.368
2012	1.4529	0.0027	0.00106	0.0025	0.0289	0.823	0.056	0.482
2013	1.0660	0.0020	0.00078	0.0018	0.0212	0.604	0.041	0.354
2014	1.1557	0.0022	0.00084	0.0020	0.0230	0.655	0.044	0.383
2015	1.1733	0.0022	0.00085	0.0020	0.0233	0.664	0.045	0.389
2016	1.1811	0.0022	0.00086	0.0020	0.0235	0.669	0.045	0.392
2017	1.0213	0.0019	0.00074	0.0017	0.0203	0.578	0.039	0.339
2018	1.1133	0.0021	0.00081	0.0019	0.0222	0.630	0.043	0.369
2019	0.8906	0.0017	0.00065	0.0015	0.0177	0.504	0.034	0.295
2020	0.365	0.0007	0.00027	0.0006	0.0072	0.207	0.014	0.121
2021	0.629	0.0012	0.00046	0.0011	0.0123	0.357	0.024	0.209
2022	1.061	0.0020	0.00077	0.0018	0.0212	0.601	0.040	0.352

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2004
- Particle emissions from the use of fireworks were included to the 2004 inventory for the first time.

2008
- NMVOC emissions from tobacco smoking were included

2015
- NH3 emissions were included.

2017

- The calculation of the use of fireworks was revised for the whole time series. In the previous calculations the number of inhabitants was used as acitivty data. In the new calculation the amount of imported fireworks (tonnes) is used as activity data for whole time series since 1990.

2018

- The calcution of tobacco smoking was revised for the whole time series using emission factors from Guidebook 2016.

2019

- NH_3 emissions from tobacco smoking were corrected for the whole time series.

2022

Activity data for tobacco combustion in 2019 were updated.

Source-specific planned improvements

- The possibility to include emissions from tobacco use since 1980 will be investigated.

4.6 Other industrial production (NFR 2H)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

NFR	Processes	Description	Emissions reported
2H1	Pulp and paper industry	Pulp and paper mills	NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, SOx, HCB, PCB
2H2	Food and beverages industry	Food and drink industry	NMVOC, TSP, PM_{10}, $PM_{2.5}$, SOx
2H3	Other industrial processes	Not Occuring	

Other industrial production includes pulp and paper industry and food and beverages industry. NMVOC and particle emissions are typical emissions for these categories. Also sulphur dioxide, ammonia, dioxins and furans and zinc emissions are generated.

Methodological issues

Emissions of those plants that report their emissions to the supervising authorities according to the monitoring requirements in the environmental permits are in some cases reported as aggregated for the whole plant and not by individual processes. In the case of all the emissions reported in YLVA, the emissions have been classified either as combustion based or process related emissions in the calculation system of the air pollutant emission inventory. In the cases of clear process emissions, these are reported separately under NFR 2H categories. In the cases where the reported emissions data in the YLVA system clearly are the total figure of energy and process related emission, the process related emissions are estimated to be the difference between the total emissions reported by the plant and the default emissions calculated on basis of fuel consumption, the difference is reported under the industrial processes. These cases relate mainly to paticulate matter (TSP) emissions reported by a relatively small number of plants. In case it has not been possible to make a split between energy and process related emissions, all emissions are reported under NFR 1A2d or 1A2e.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

None

Source-specific planned improvements

None

Pulp and paper (NFR 2H1)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

A typical feature for the Finnish pulp and paper industry is the integrated pulp and paper mills, where the use of energy can be optimized between the energy intensive paper production and the energy sources produced in the pulp processes.

All Finnish chemical pulp mills use sulphate process. The last sulphite-based processes were closed in 1991.

The industry has been subject to large changes and efficiency improvements during the last decades. The number of mills has continuously been decreasing since the 1980s while the production volumes significantly increased until 2006-2007 as presented in Figures 4.38 and 4.39 and in Table 4.87.

Between the years 2006-2009 approximately ten paper machines and pulp mills were closed down. In 2015 there were 19 pulp mills altogether, out of which 17 chemical pulp mills and in 2021 there were 19 pulp mills, 17 paper mills and 14 paperboad mills.

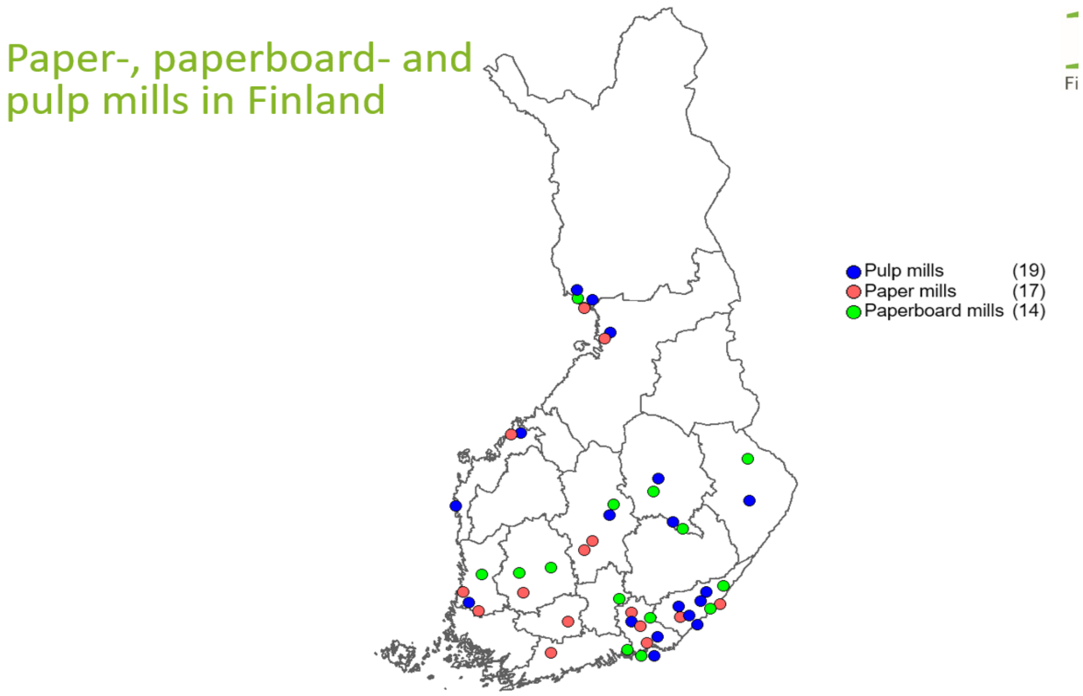


Figure 4.38. Forest industry production plants in 2020.

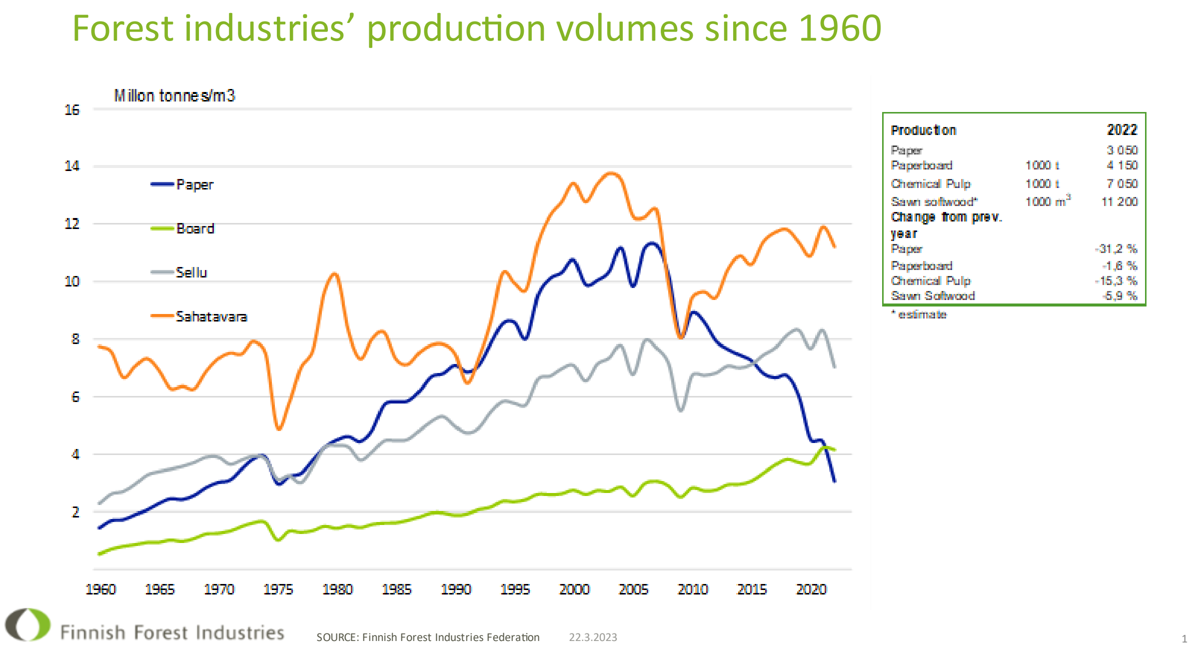


Figure 4.39. Production volumes (below) in Finland since 1960.
Source Finnish Forest Industries Federation (2024)

Table 4.87. Pulp and paper production since 1988 (Finnish Forest Industries Federation).

Year	Produced pulp (mill t)	Produced mechanical pulp (mill t)	Produced paper (mill t)
1988	5.3	3.2	8.8
1989	5.0	3.8	9.0
1990	4.7	4.1	9.0
1991	4.9	3.6	8.8
1992	4.9	3.6	9.2
1993	5.5	3.9	10.0
1994	5.8	4.1	10.9
1995	5.8	4.4	10.9
1996	5.7	4.0	10.4
1997	6.6	4.5	12.1
1998	6.7	4.6	12.7
1999	7.0	4.6	12.9
2000	7.1	4.8	13.5
2001	6.5	4.6	12.5
2002	7.1	4.6	12.8
2003	7.4	4.6	13.1
2004	7.7	4.8	14.0
2005	6.7	4.4	12.4
2006	13.4	incl. in produced pulp	14.1
2007	13.2	incl. in produced pulp	14.3
2008	11.6	incl. in produced pulp	13.1
2009	8.9	incl. in produced pulp	10.6
2010	10.7	incl. in produced pulp	11.9
2011	10.3	incl. in produced pulp	11.4
2012	10.4	incl. in produced pulp	10.7
2013	10.8	incl. in produced pulp	10.6
2014	10.7	incl. in produced pulp	10.4
2015	10.8	incl. in produced pulp	11.5
2016	10.5	incl. in produced pulp	9.9
2017	11.6	incl. in produced pulp	10.3
2018	12.1	incl. in produced pulp	10.5
2019	11.9	incl. in produced pulp	9.5

2020	10.5	incl. in produced pulp	8.2
2021	8.3	incl. in produced pulp	8.7
2022	7.1	incl. in produced pulp	7.2

Emission trends

Emissions reported under NFR category 2H1 include process-based SO_x emissions calculated from reduced sulphur compounds (TRS), ammonia, particle and NMVOC emissions. Also, from the early 1990s HCB and PCB emissions have been reported due the use of chlorinated solvents.

Emissions trends are presented in Figure 4.40.

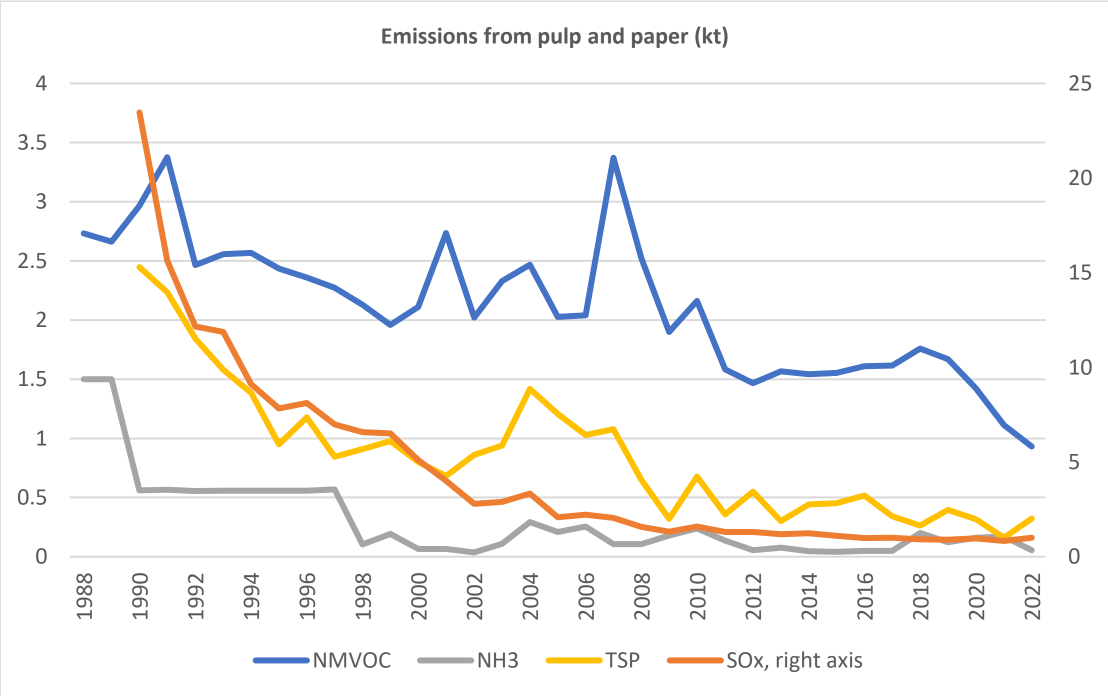


Figure 4.40. Emission trends from Pulp and paper.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.88.

Table 4.88. Contribution of Pulp and paper industry (2H1) to total emissions in 2022 (Note: NOx emissions are allocated in 1A2d).

Pollutant	Emissions from 2H1 in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.932	75.464	Gg	1.2	9.1
SOx (as	1.001	22.692	Gg	4.4	98.1
NH_3	0.056	31.583	Gg	0.2	96.6
$PM_{2.5}$	0.176	13.384	Gg	1.3	0
PM_{10}	0.31	26.778	Gg	1.2	0
TSP	0.323	42.014	Gg	0.8	100
BC	0.005	3.121	Gg	0.1	0

Pulp and paper industry is a key category in Approach 1 uncertainty analysis for SOx (L1, T1), NH_3 (T1), $PM_{2,5}$ (T1), PM_{10} (T1) and TSP (T1) emissions. All these emissions are reported by the plants (T3).

Methodological issues

Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available emissions has been calculated.

Activity data
Emissions not reported by the plants are calculated from total production volumes (Table 4.88). Until 2005 the data was available by pulp types.

Nitrogen dioxide
Nitrogen dioxide emissions from the pulp and paper industry are based on data reported by the plants to the supervising authorities according to the monitoring requirements in their environmental permits. NO_2 emissions from the pulp and paper industry are fuel-based emissions and result from the combustion of black liquor and other residue fuels. Thus, the emissions are reported under the energy sector in NFR 1A2d. In category 2H1, the notation key NA in used in the NFR tables.

Sulphur emissions reported as SO_2
Sulphur dioxide emissions are based on data reported by the plants to the supervising authorities according to the monitoring requirements in their environmental permits. SO_2 emissions are allocated in the inventory as fuel-based emissions under NFR 1A2d and as process-based emissions under 2H1. The fuel-based emissions originate from the combustion of black liquor and other residue fuels.

The process-based emissions include different sulphur compounds such as TRS (total reduced sulphur) and these are calculated into SO_2 equivalents. Most of the smelly gases are nowadays collected and incinerated due to the requirements for odour abatement in the environmental permits.

Particles
The plants report total suspended particle emissions to the supervising authorities and this data is used in the calculation of PM_{10} and $PM_{2.5}$ particle size fractions with factors 99.3% (PM_{10}) and 86.3 % ($PM_{2.5}$) for recovery boiler and with factors 98 % (PM10) and 96% ($PM_{2.5}$) for lime kiln. Size factors for recovery boiler are based on expert estimate, Karvosenja (2001) and factors for lime kiln are taken from USEPA AirChief (1988). Black carbon emissions are calculated using the emission factor 2.6 % of $PM_{2.5}$ (Guidebook 2023).

Heavy metals
As, Cr, Ni, V, Pb, Cd and Hg emissions from process boilers are included and reported under NFR 1A2d.

NMVOC
NMVOC emissions from the pulp and paper industry are partly included in the compliance reporting of the plants and thus available in YLVA. For plants, which are not obligated to report their NMVOC emissions, these are calculated by using plant specific activity data and emission factor based on information from the Finnish Forest Industries Federation FIFF. The emission factors presented in Table 4.89 are based on the actual levels observed at the plants (Reino Lammi, 2000). NMVOC emissions from pulp and paper sector are presented in Table 4.91.

Table 4.89. NMVOC emission factors kg/t of pulp (Finnish Forest Industries Federation).

Year	chemical pulp	mechanical pulp	paper	Year	chemical pulp	mechanical pulp	paper
1988	0.7	0.2	0.01	2000-2005	0.1	0.2	0.01
1989	0.65						
1990	0.4						

1991	0.37			from 2006	0.14	0.01
1992	0.34			<u>Pulping</u>: chemical: between 1988-1999 is based on written information by Reino Lammi, FFIF Since 2006 chemical and mechanical pulp production statistics have not been available separately. Therefore, a combined EF has been used		
1993	0.31					
1994	0.28					
1995	0.25					
1996	0.22					
1997	0.19					
1998	0.16					
1999	0.13					

Table 4.90. NMVOC emissions from pulp and paper sector

Year	NMVOC (t)	Year	NMVOC (t)	Year	NMVOC (t)	Year	NMVOC (t)
1990	2966	2000	2110	2010	2162	2020	1424
1991	3376	2001	2737	2011	1583	2021	1113
1992	2464	2002	2021	2012	1467	2022	932
1993	2558	2003	2329	2013	1568		
1994	2567	2004	2468	2014	1542		
1995	2435	2005	2027	2015	1555		
1996	2358	2006	2039	2016	1611		
1997	2273	2007	3371	2017	1616		
1998	2130	2008	2526	2018	1759		
1999	1958	2009	1901	2019	1670		

POP emissions
PCDD/F emissions originate from combustion of bark in grate ovens and are reported by the plants to the supervising authorities and allocated under NFR 1A2d.

PCB and HCB emissions in the timeseries are due to the use of elemental chlorine in the bleaching process, which ended by 1994. Thereafter no PCB or HCB compounds are used or generated in pulp and paper processes. Emissions in between 1980-1989 are not estimated but are reported for 1990-1994 by the plants according to their monitoring requirements in their permits as in Table 4.91.

Table 4.91. PCB and HCB emissions from pulp bleaching 1990-1994.

Year	1990	1991	1992	1993	1994
PCB (kg)	1.431	1.106	0.52	0.26	0.169
HCB (kg)	0.020	0.016	0.007	0.004	0.002

NH_3
Ammonia emissions may occur related to fumes from solvents, extinguishers, causticizing and smelly gases in cases when there are exceptional situations in the normal collection of these gases. NH_3 emissions are reported by the plants to the supervising authorities. NH_3 emissions total annually to 0.01-0.05 kt and are allocated under NFR 2H1. Ammonia emissions in the early 1990s are expert estimates at that time and cannot be recalculated.

Since 2018 NH_3 emissions have increased due the use of ammonium sulphite liquid in manufacturing of packing board.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2024

- During 2023, research was conducted regarding the missing emissions reporting data of pulp and paper plants especially from 1990s and 2000s in the YLVA system. The missing data were collected directly from the plants and included in the 2024 submission. As a result of the data collection, the following emissions were recalculated in category 2H1:
  - SO_X for 1990-2021
  - NH_3 for 1990-2015 and 2018-2021
  - Particle emissions for 1990-2000, 2002-2003, 2005-2006, 2008-2009, 2012 and 2021

Source-specific planned improvements

Not scheduled

- For the future inventories, it will be studied, if ammonia is released in all processes and if it is necessary to establish an inventory for ammonia emissions covering all pulp and paper plants.

Food and beverages industry (NFR 2H2)

Changes in chapter	
February 2024	JMP, KS, TF

Source category description

Product	Number of plants in YLVA allocated to this sector	Emissions reported by plants	Emissions calculated
Bread, bisquits	-		NMVOC
Wine	-		NMVOC
Beer	-		NMVOC
Spirits	< 5	NMVOC	NMVOC
Sugar production	-		TSP, PM_{10}, $PM_{2.5}$, NMVOC
Meat, fish etc. frying/curing	-		TSP, PM_{10}, $PM_{2.5}$
Coffee	-		NMVOC
Yeast	-		NMVOC
Dairies	< 5	TSP	PM_{10}, $PM_{2.5}$
Animal feed and raw material for animal feed	< 5	TSP, NMVOC	PM_{10}, $PM_{2.5}$, NMVOC
Food production	< 5	TSP	PM_{10}, $PM_{2.5}$

Food and drink industries in Finland include production of coffee, sugar, yeast, dairies, production of wine and beer as well as production of animal feed.

Air pollutant emissions from food and drink depend on the production and use volumes over the years.

Food and beverages industry is a key category in Approach 1 uncertainty analysis for $PM_{2.5}$ (L1, T1) and PM_{10} (L1) emissions. Emission estimation is based on T2/T3 methods.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.92.

Table 4.92. Contribution of Food and beverages industry (NFR 2H2) to total emissions in 2022.

Pollutant	Emissions from food and drink industry in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.885	75.464	Gg	2.5	8.7
PM2.5	0.399	13.384	Gg	3.0	0
PM10	0.414	26.778	Gg	1.5	0
TSP	0.431	42.014	Gg	1.0	11.9

Emission trends

Food and beverages industry is a minor source of NMVOC and particle emissions, the share of total emissions is only 1-3 %. Emissions depend on production rates, that have been quite constant over the timeseries. Emission trends are presented in Figure 4.41.

NMVOC emissions in 1988-1989 are based on expert estimates at the time of original reporting.

Particle emissions' level is increasing slightly due to the increase of companies, that report their emissions. The peaks in 2004-2011 are due to problems in abatement technlogy at one plant.

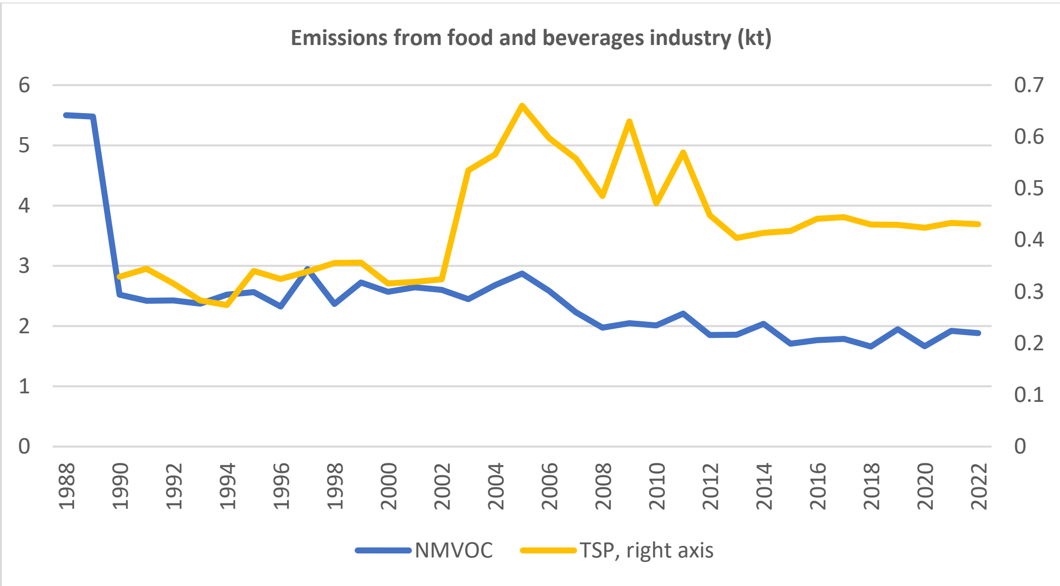


Figure 4.41. NMVOC and TSP emissions in from food and beverages industry.

Methodological issues

NMVOC

NMVOC emissions are reported by some plants from the production of spirits and food production to the supervising authorities and available for the inventory from the YLVA database. NMVOC emissions from animal rendering are reported by plants and are included under NFR 2L.

NMVOC emissions from those plants that do not report the emissions are calculated from production data using national or EMEP/EEA Guidebook emission factors as presented in Table 4.93.

Table 4.93. NMVOC emission factors for Food and beverage production.

Product	EF	Reference
Wholemeal bread products	3 kg/t	Guidebook 2023
animal feeds	0.1 kg/t	Guidebook 2023
other breads	4.5 kg/t	Guidebook 2023
cakes and bisquits	1 kg/t	Guidebook 2023
roasting of coffee	0.6 kg/t	National EF based on expert knowledge (SYKE 2005)
sugar production	10 kg/t	Guidebook 2023
yeast production, no method in the GB	18 kg/t	National EF based on expert knowledge (SYKE 2007)
wine production	0.8 kg/m3	Guidebook 2023
beer production factor	0.35 kg/m3	Guidebook 2023

All emission factors except roasting of coffee and yeast production are from the Guidebook 2023. The emission factor for roasting of coffee is an expert estimated based on environmental permits (Paulig, 2005).

Fish meal production is included under NFR 2H2 and the data is reported by the plants.

Production volumes used in the calculation of NMVOC emissions are presented in Table 4.94.

Table 4.94. Bread, cakes, bisquits production volumes, roasting of coffee and sugar, yeast, wine and beer production (Finnish Food and Drink Indusriries' Federation, Finnish Coffee Roasters' Association, Suomen Hiiva and National Supervisory Authority for Welfare and Health, Finnish Food Authority).

Year	Bread (wholemeal) products (million kg)	Bread (other) products (million kg)	Cakes, bisquits etc (million kg)	Roasting of coffee (t)	Sugar beet production (t)
1990	52.1*	108.7*	19.9*	50678	1125
1991	52.1*	108.7*	19.9*	49979	1043
1992	52.1*	108.7*	19.9*	50868	1049
1993	52.1*	108.7*	19.9*	50792	996
1994	52.1	108.7	19.9	46747	1097
1995	52.1*	108.7*	19.9*	40715	1110
1996	52.1*	108.7*	19.9*	47396	897
1997	57.4	118.9	21.5	44617	1360
1998	57.4*	118.9*	21.5*	47819	892
1999	57.4*	118.9*	21.5*	47091	1172
2000	57.4*	118.9*	21.5*	44991	1046
2001	57.4*	118.9*	21.5*	47280	1105
2002	57.4*	118.9*	21.5*	46300	1066
2003	95.2	120.9	29.7	47057	892
2004	95.2*	120.9*	29.7*	47751	1064
2005	95.2*	120.9*	29.7*	46871	1181
2006	95.2*	120.9*	29.7*	48749	952

2007	95.2*	120.9*	29.7*	48745	673
2008	95.2*	120.9*	29.7*	49266	468
2009	95.2*	120.9*	29.7*	48336	559
2010	94	94	31.7	46442	542
2011	94*	94*	31.7*	44165	676
2012	94*	94*	31.7*	43879	399
2013	91.9	91.9	32	45929	480
2014	91.9*	91.9*	32*	45030	626
2015	93.2	93.2	31.2	46000	407
2016	93.2	93.2	31.2	46000	434
2017	92.5	99.6	30.9	43000	430
2018	92.5	99.6	30.9	43400	356
2019	85.0	104	32.7	43300	501
2020	85.0	104	32.7	40500	242
2021	80.5	107	30.6	39700	403
2022	80.5	107	30.6	31000	380

Year	Yeast production (t)	Wine production (m3)	Beer production (m3)	Animal feeding (t)	
1990	7540	18111	413130	1112992	
1991	7440	16028	432563	1035233	
1992	7620	19938	454064	984019	
1993	8130	24043	458237	940240	
1994	9140	26606	433660	1037112	
1995	9610	40383	454468	1121858	
1996	10360	42583	464307	1106974	
1997	9680	43675	469614	1114315	
1998	8810	58964	454751	1183136	
1999	7940	67441	464932	1242558	
2000	7640	67500	465000	1342224	
2001	7642	68000	465000	1374621	
2002	8354	18520	400868	1397559	
2003	7700	18500	381451	1454419	
2004	7700	17380	444500	1430510	
2005	7750	66159	456544	1469987	
2006	7934	66886	449956	1424713	
2007	7942	67271	442342	1413527	
2008	8224	68736	433484	1377870	
2009	7395	58223	409427	1328773	
2010	7897	59008	395072	1349811	
2011	10029	51905	397800	1349320	
2012	9835	43559	378418	1396559	
2013	9416	43559	378418	1391469	
2014	8628	53427	388468	1392033	
2015	5832	55818	407119	1433117	
2016	7465	55392	410443	1405647	
2017	7800	51710	403630	1417957	
2018	6400	47592	392401	1411486	
2019	6850	47305	381416	1426000	
2020	8970	44628	376528	1450341	
2021	8372	41460	369568	1447182	

2022	9522	41011	355203	1447182	

* for 1990-1993 and 1995, 1996 years 1994 value was used, for 1998-2002 years 1997 value was used, for 2004-2009 years 2003 value, for 2011 and 2012 years 2010 value and for 2014 years 2013 value.

Particles

The plants report total suspended particle emissions according to monitoring requirements in their environmental permits and this data is available in YLVA. PM_{10} and $PM_{2.5}$ particle size fraction emissions are calculated from TSP emissions with factors 75 % (PM_{10}) and 60 % ($PM_{2.5}$) from USEPA Air Chief, 1998.

Particle emissions are also calculated from the commercial and residential meat frying and barbeque reported since year 2001. Emission factors are from TNO database (2002) and from McDonald., J etc (2012) and activity data from Finnish Food and Drink Industries' Federation, ETL (2021). For meat frying emission factor 0.0013 t/t meat consumed is used for TSP, PM_{10} and $PM_{2.5}$ as well as for barbeques factor 8.9 kg/ton meat is used for TSP, PM_{10} and $PM_{2.5}$.

For the 2017 submission, the emission factors for food heating in barbeques were revised for whole time series. The new emission factors for TSP, PM_{10} and $PM_{2.5}$ are more accurate than the old ones as they are based on actual measurements (McDonald, J., etc (2012) (Emissions fron Charbroiling and Grilling of Chicken and Beef, Macdonald., J., Zielinska B., Fujita E., Sagebiel J., Chow J. and Watson J (2012 in Journal of the Air&Waste Management Association).

Activity data

Activity data are presented in Table 4.95. The first figures in brackets in the columns are the amount of meat, while the following persentages with which the amount of meat is multiplied, are representing the following assumptions: It is estimated that from the total meat consumption (beef, pork and poultry) 40% is consumed as pure meat and 60% as processed food. 90% of pure meat is fried and 15% of that in barbeques (Anttonen, ETL, 2000).

Emissions from food and beverages industry are presented in Table 4.96.

Table 4.95. Activity data and for commercial and residential meat frying and barbeque.

Meat volume in the first bracket following the persentages of the different treatments		
Commercial and residential meat frying [1 000 t]		Commercial and residential barbecue's, from food heating [1 000 t]
1990	(306.5) x 40% x 90% x 85%	(306.5) x 40% x 90% * 15%
1991	(306.7) x 40% x 90% x 85%	(306.7) x 40% x 90% * 15%
1992	(299.3) x 40% x 90% x 85%	(299.3) x 40% x 90% * 15%
1993	(287.3) x 40% x 90% x 85%	(287.3) x 40% x 90% * 15%
1994	(287.6) x 40% x 90% x 85%	(287.6) x 40% x 90% * 15%
1995	(313.5) x 40% x 90% x 85%	(313.5) x 40% x 90% * 15%
1996	(317.3) x 40% x 90% x 85%	(317.3) x 40% x 90% * 15%
1997	(319.8) x 40% x 90% x 85%	(319.8) x 40% x 90% * 15%
1998	(336.5) x 40% x 90% x 85%	(336.5) x 40% x 90% * 15%
1999	(337.7) x 40% x 90% x 85%	(337.7) x 40% x 90% * 15%
2000	(168.8 + 99.0 + 68.9) x 40% x 90% x 85%	(168.8 + 99.0 + 68.9) x 40% x 90% * 15%

2001	(167.8 + 92.4 + 75.4) x 40% x 90% x 85%	(167.8 + 92.4 + 75.4) x 40% x 90% * 15%
2002	(165.6 + 92.9 + 80.2) x 40% x 90% x 85%	(165.6 + 92.9 + 80.2) x 40% x 90% * 15%
2003	(171.9 + 95.9 + 82.5) x 40% x 90% x 85%	(171.9 + 95.9 + 82.5) x 40% x 90% * 15%
2004	(176.9 + 99.3 + 83.3) x 40% x 90% x 85%	(176.9 + 99.3 + 83.3) x 40% x 90% * 15%
2005	(175.7 + 97.5 + 84.3) x 40% x 90% x 85%	(175.7 + 97.5 + 84.3) x 40% x 90% * 15%
2006	(180.6 + 97.3 + 82.9) x 40% x 90% x 85%	(180.6 + 97.3 + 82.9) x 40% x 90% * 15%
2007	(184.8 + 99.0 + 93.2) x 40% x 90% x 85%	(184.8 + 99.0 + 93.2) x 40% x 90% * 15%
2008	(187.4 + 96.6 + 98.1) x 40% x 90% x 85%	(187.4 + 96.6 + 98.1) x 40% x 90% * 15%
2009	(183.7 + 95.1 + 93.0) x 40% x 90% x 85%	(183.7 + 95.1 + 93.0) x 40% x 90% * 15%
2010	(187.0 + 99.8 + 97.4) x 40% x 90% x 85%	(187.0 + 99.8 + 97.4) x 40% x 90% * 15%
2011	(187.0 + 99.8 + 97.4) x 40% x 90% x 85%	(187.0 + 99.8 + 97.4) x 40% x 90% * 15%
2012	(193.0 + 81 + 107) x 40% x 90% x 85%	(193.0 + 81 + 107) x 40% x 90% x 15%
2013	(195.0 + 81 + 111) x 40% x 90% x 85%	(195.0 + 81 + 111) x 40% x 90% x 15%
2014	(186.0 + 83 + 113) x 40% x 90% x 85%	(186.0 + 83+ 113) x 40% x 90% x 15%
2015	(192.0 + 86 + 117) x 40% x 90% x 85%	(192.0 + 86+ 117) x 40% x 90% x 15%
2016	(190.0 + 87 + 125) x 40% x 90% x 85%	(190.0 + 87+ 125) x 40% x 90% x 15%
2017	(181.2 + 85 +130) x 40% x 90% x 85%	(181.2 + 85 +130) x 40% x 90% x 15%
2018	(169 + 87 + 137) x 40% x 90% x 85%	(169 + 87 + 137) x 40% x 90% x 15%
2019	(171+88+140) x 40% x 90% x 85%	(171+88+140) x 40% x 90% x 15%
2020	(176+87+145) x 40% x 90% x 85%	(176+87+145) x 40% x 90% x 15%
2021	(176+86+147) x 40% x 90% x 85%	(176+86+147) x 40% x 90% x 15%
2022	(176+86+147) x 40% x 90% x 85%	(176+86+147) x 40% x 90% x 15%

Table 4.96. NMVOC and particle emissions from food and beverages industry

Year	NMVOC (t)	TSP	PM_{10}	$PM_{2.5}$
1990	2523	0.303	0.320	0.329
1991	2420	0.315	0.336	0.344
1992	2428	0.301	0.314	0.316
1993	2373	0.266	0.270	0.283
1994	2519	0.268	0.273	0.274
1995	2565	0.314	0.326	0.340
1996	2326	0.312	0.323	0.325
1997	2948	0.323	0.337	0.339
1998	2368	0.340	0.354	0.356
1999	2723	0.340	0.354	0.356
2000	2569	0.310	0.315	0.316
2001	2646	0.312	0.318	0.319
2002	2541	0.317	0.323	0.324
2003	2446	0.449	0.506	0.535
2004	2680	0.468	0.529	0.566
2005	2872	0.527	0.615	0.660
2006	2584	0.487	0.559	0.598
2007	2228	0.446	0.494	0.558
2008	1972	0.422	0.458	0.485
2009	2048	0.498	0.583	0.629
2010	2010	0.414	0.444	0.471
2011	2210	0.470	0.530	0.570
2012	1852	0.401	0.425	0.448
2013	1857	0.376	0.394	0.404
2014	2036	0.380	0.402	0.414
2015	1707	0.387	0.406	0.418
2016	1768	0.406	0.421	0.441
2017	1788	0.406	0.425	0.444
2018	1 661	0.396	0.411	0.430
2019	1 947	0.376	0.412	0.429
2020	1 672	0.398	0.410	0.424
2021	1 921	0.433	0.417	0.403
2022	1 883	0.431	0.413	0.399

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2017

- NMVOC emissions from bread manufacturing and particles from barbeque were recalculated for the whole time series.
- 2018
- Improvement of the time series consistency depends on the allocation of emissions under the NFRs and can be corrected when the time series recalculation is finalized. (Recommendation of the NECD 2017 Review for particles in 2015).
- Annual sugar production volumes are no more available from the industry due to the integration of the domestic plant into an international corporation. The production volumes have been updated for the whole time series using different data sources: (1) LUKE's beet production

statistics) and (2) assumptions on raw material/production rates. It is assumed that for the production on one kilogramme of sugar 8 kilogrammes of sugar beet are needed (Dansukker website 25.10.2017). The updated method enables to follow the annual production rates in stead fo the constant figure used for the earlier years.

- 2019
- Between the 2018 and the 2019 submissions NMVOC emissions from alcoholic beverages were recalculated due to new information from Valvira (National Supervisory Authority for Welfare and Health
- 2021
- SO_x emissions in 2001-2 were reallocated under the Energy sector and the notation key was changed into NA for all years.
- 2023
- Activity data for wine and beer consumption updated for years 2019 and 2020.

Source-specific planned improvements

None.

Other industrial processes (NFR 2H3)

No sources are included under NFR 2H3. Other industrial activities not falling under the NFR2 categories are reported under NFR 2L “Other production, consumption, storage, transportation or handling of bulk products”.

Wood processing (NFR 2I)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

Activities reported under NFR 2I include mechanical wood processing, such as sawmills and production of plywood, chipboard and fibreboard.

Emission trends

Emission trends are presented in Figure 4.42.

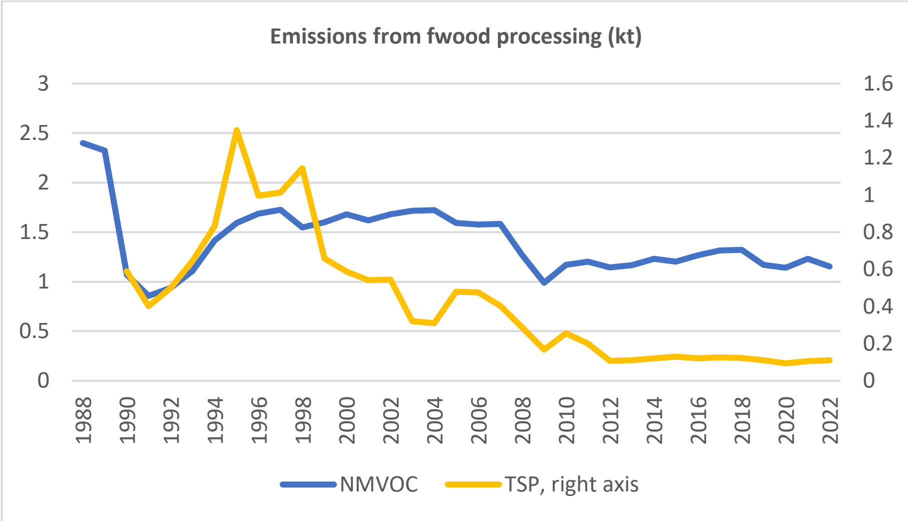


Figure 4.42. NMVOC and TSP emissions from wood processing.

Mechanical wood processing is a minor source of several air pollutants as presented in Table 4.97. Mechanical wood processing is not a key category for any pollutants.

Table 4.97. Contribution of Mechanical wood processing (NFR 2I) to total emissions in 2022.

Pollutant	Emissions from mechanical wood processing in 2022	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.153	75.464	Gg	1.5	39.6
$PM_{2.5}$	<0.001	13.384	Gg	<0.1	0
PM_{10}	0.021	26.778	Gg	<0.1	0
TSP	0.111	42.014	Gg	0.3	98.3

Methodological issues

Particle emissions

The plants report total suspended particle according to monitoring requirements in their environmental permits and this data is available in YLVA. PM_{10} and $PM_{2.5}$ emissions are calculated from TSP emissions with a fraction factor for PM_{10} of 18% and for $PM_{2.5}$ 0% (zero) according to information from US EPA Air Chief database. Some of the plants report only the total TSP emissions including both the fuel based and process related emissions. The process related emissions (TSP and small particles) are estimated as the difference between the total reported emissions and the default emissions calculated on basis of fuel consumption. The difference is reported under NFR 2I.

NMVOC emissions

NMVOC emissions from mechanical wood industry are calculated with activity data from Finnish Forest Federation (FFIF) and emission factors from NPI and FFIF presented in Tables 4.98 and 4.99. In addition, NMVOCs are reported by several plants according to their monitoring requirements to supervising authorities and available in YLVA database.

Table 4.98. NMVOC emission factors and activity data for wood processing industries.

*NOTE: * since 2013 chipboard and fibreboard manufacture volumes are in included in the plywood manufacture volumes*

Year	Production of chipboard (FFIF yearbook)	
	EF 0.2 kg/m³ (NPI; 2002)	Emissions (t)
1988	650 000 m³	130

Year	Production of sawn timber (from FFIF yearbook)	
	Emission factor 235 g (dry matter)/t of sawn timber (FFIF, 2005)	Emissions (t)
1988	3 239 000 t	761

1989	650 000 m³	130
1990	600 000 m³	120
1991	385 000 m³	77
1992	354 000 m³	71
1993	439 000 m³	88
1994	477 000 m³	95
1995	485 000 m³	97
1996	498 000 m³	100
1997	475 000 m³	95
1998	455 000 m³	91
1999	439 000 m³	88
2000	462 000 m³	92
2001	430 000 m³	86
2002	410 000 m³	82
2003	400 000 m³	80
2004	448 000 m³	90
2005	452 000 m³	90
2006	400 000 m³	88
2007	400 000 m³	80
2008	250 000 m³	50
2009	170 000 m³	34
2010	220 000 m³	44
2011	170 000 m³	34
2012	100 000 m3	20
2013	*	*
2014	*	*
2015	*	*
2016	*	*
2017	*	*
2018	*	*
2019	*	*
2020	*	*
2021	*	*
2022	*	*

1989	3 239 000 t	761
1990	3 075 000 t	723
1991	2 634 250 t	619
1992	2 984 800 t	701
1993	3 485 000 t	819
1994	4 190 200 t	985
1995	4 042 600 t	950
1996	3 981 100 t	936
1997	4 655 550 t	1094
1998	5 017 170 t	1179
1999	5 210 280 t	1224
2000	5 461 200 t	1283
2001	5 194 700 t	1221
2002	5 453 000 t	1281
2003	5 576 000 t	1310
2004	5 518 600 t	1297
2005	4 997 900 t	1175
2006	4 961 000 t	1170
2007	5 084 000 t	1195
2008	4 018 000 t	944
2009	3 280 000 t	771
2010	3 854 000 t	906
2011	3 977 000 t	935
2012	3 813 000 t	896
2013	4 264 000 t	1 002
2014	4 469 000 t	1 050
2015	4 346 000 t	1 021
2016	4 653 500t	1 094
2017	4 797 000t	1 127
2018	4 842 100t	1 138
2019	4 653 500t	1 094
2020	4 469 000t	1 050
2021	4 879 000t	1 147
2022	4 592 000t	1 079

Table 4.99 NMVOC emission factors and activity data for wood processing industries

*NOTE: * since 2013 chipboard and fibreboard manufacture volumes are in included in the plywood manufacture volumes*

Production of plywood (FIFF yearbook)		
Emission factor 0.15 kg/m³ (NPI 1999)		**Emissions (t)**
1988	600 000 m³	90
1989	600 000 m³	90
1990	650 000 m³	98
1991	477 000 m³	72
1992	462 000 m³	69
1993	621 000 m³	93
1994	700 000 m³	105
1995	778 000 m³	117
1996	869 000 m³	130
1997	987 000 m³	148
1998	992 000 m³	149
1999	1 076 000 m³	161

Production of fibreboard (FiFF Yearbook)		
Emission factor 1.3 kg/m³ (NPI 1999)		**Emissions (t)**
1988	90 000 m³	117
1989	80 000 m³	104
1990	100 000 m³	130
1991	69 000 m³	90
1992	73 000 m³	95
1993	85 000 m³	111
1994	86 000 m³	112
1995	79 000 m³	103
1996	77 000 m³	100
1997	88 000 m³	114
1998	100 000 m³	130
1999	96 000 m³	125

2000	1 167 000 m^3	175
2001	1 140 000 m^3	171
2002	1 240 000 m^3	186
2003	1 300 000 m^3	195
2004	1 350 000 m^3	203
2005	1 305 000 m^3	196
2006	1 400 000 m^3	212
2007	1 410 000 m^3	212
2008	1 265 000 m^3	190
2009	780 000 m^3	117
2010	980 000 m^3	147
2011	1 040 000 m^3	156
2012	1 000 000 m^3	150
2013	1 090 000 m^3	164
2014	1 160 000 m^3	174
2015	1 150 000 m^3	173
2016	1 150 000 m^3	173
2017	1 250 000 m^3	188
2018	1 230 000 m^3	185
2019	1 100 000 m^3	165
2020	1 090 000 m^3	164
2021	1 150 000 m^3	173
2022	1 100 000 m^3	165

2000	100 000 m^3	130
2001	109 000 m^3	142
2002	101 000 m^3	131
2003	100 000 m^3	130
2004	102 000 m^3	133
2005	101 000 m^3	131
2006	100 000 m^3	108
2007	75 000 m^3	98
2008	66 000 m^3	86
2009	46 000 m^3	60
2010	57 000 m^3	74
2011	60 000 m^3	78
2012	60 000 m^3	78
2013	*	*
2014	*	*
2015	*	*
2016	*	*
2017	*	*
2018	*	*
2019	*	*
2020	*	*
2021	*	*
2022	*	*

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

None.

Source-specific planned improvements

None.

Production of POPs (NFR 2J)

There is no production of POPs in Finland.

Consumption of POPs and heavy metals (NFR 2K)

Changes in chapter	
February 2021	KS, JMP

We consider the methods presented in the Guidebook for PCB and Hg emissions from consumption of POPs and heavy metals to highly overestimate the emission levels in Finland and thus to not be applicable for Finnish conditions.

In Finland, use of PCBs in open systems was banned already in the 1970s and PCB containing products have been banned since the 1990s.

Mercury releases from products is mostly a waste management issue and mercury containing products have been regarded as hazardous waste and treated as such already in the 1990s. Mercury in products has been restricted since the 2000s due to national legislation concerning Hg in products (batteries, electrical, measurement/control devices, lighting, paint, amalgam) and waste management of such products. Finland is party to international mercury agreements such as the EU regulations on restricting/banning Hg use in products and the recent Minamata Convention.

Emissions from consumption of F-gases are available from the Finnish greenhouse gas inventory available at https://stat.fi/en/statistics/khki

Other industrial production including production, consumption, storage, transportation or handling of bulk products (NFR 2L)

Changes in chapter	
February 2024	KS, JMP, TF

Source category description

SNAP code	SNAP	Detailed description	Emissions reported
040617	Other	Light gravel manufacturing	NMVOC, SO_x, NH_3, TSP, PM_{10}, $PM_{2.5}$, PCDD/F
040617	Other	Talc manufacturing	
040617	Other	Ceramic household and decorative products manufacturing	
040617	Other	Tile (brick) manufacturing	
040617	Other	Gypsum product manufacturing	
040617	Other	Quarrying and crushing	
040617	Other	Manufacturing of electricity distribution and monitoring devices	
040617	Other	Starch modification	
		Animal feed production	

NFR 2L "Other sector" includes emissions from tile, light gravel, talc, gypsum products and ceramic household and decorative products manufacturing, quarrying and crushing, manufacturing of electricity distribution and monitoring devices and starch modification. No emissions are reported under NFR 2H3.

The annual variations in the emissions are caused by fluctuation of production or the activity volume over the years. The shares of emissions of total emissions and shares of data reported by the plants are presented in Table 4.100. Category 2L is not a key category for any pollutants.

Table 4.100. Contribution of Other production, consumption, storage, transportation or handling of bulk products (NFR 2L) to total emissions in 2022.

Pollutant	Emissions from other processes	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.002	75.464	Gg	<0.1	100
SO_x (as SO_2)	<0.001	22.692	Gg	<0.1	100
NH_3	0.007	31.583	Gg	<0.1	2.9
$PM_{2.5}$	0.008	13.384	Gg	<0.1	0
PM_{10}	0.013	26.778	Gg	<0.1	0
TSP	0.017	42.014	Gg	<0.1	100
PCDD/F	0.015	9.497	g I-Teq	0.2	0

Methodological issues

Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available emissions has been calculated.

NMVOC, SOx, and particles
Emissions are based on emission data reported by the plants and available in YLVA database.

PCDD/F
Emissions from the production of bricks are calculated using the emission factor 87 ng I-TEQ/ t (UNEP, 1999) and activity data presented in Table 4.101. It is assumed that one brick weights 3 kg.

Table 4.101. Activity data for brick production (Confederation of Finnish Construction Industries, YLVA database (from 2013 onward))

Year	Brick production (t)	Year	Brick production (t)	Year	Brick production (t)	Year	Brick production (t)
1990	339 000	2000	188 715	2010	111 600	2020	169 400
1991	270 000	2001	183 000	2011	108 900	2021	153 060
1992	198 000	2002	171 000	2012	100 994	2022	169 390
1993	183 000	2003	174 000	2013	97 700		
1994	171 000	2004	177 000	2014	71 000		
1995	156 000	2005	162 000	2015	41 200		
1996	120 000	2006	156 000	2016	72 900		
1997	219 270	2007	143 700	2017	70 980		
1998	200 145	2008	129 000	2018	74 060		
1999	194 430	2009	91 500	2019	166 240		

Calculated emissions dioxin and furines (PCDD/PCDF) from other industrial production sector are presented in Table 4.102.

Table 4.102. PCDD/F emissions from other industrial production.

Year	PCDD/F (q I-TEQ)	Year	PCDD/F (q I-TEQ)	Year	PCDD/F (q I-TEQ)	Year	PCDD/F (q I-TEQ)
1990	0.0295	2000	0.0164	2010	0.0097	2020	0.0147
1991	0.0235	2001	0.0159	2011	0.0095	2021	0.0133
1992	0.0172	2002	0.0149	2012	0.0088	2022	0.0147

1993	0.0159	2003	0.0151	2013	0.0085		
1994	0.0149	2004	0.0154	2014	0.0062		
1995	0.0136	2005	0.0141	2015	0.0036		
1996	0.0104	2006	0.0136	2016	0.0063		
1997	0.0191	2007	0.0125	2017	0.0062		
1998	0.0174	2008	0.0112	2018	0.0064		
1999	0.0169	2009	0.0080	2019	0.01446		

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

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

2022

- Brick production activity data for 2013-2019 was revised.

2024

- Brick production activity data for 2016 onwards was revised.

Source-specific planned improvements

None.

APPENDIX I. NFR 2D3a, Emission factors for household products.

THE MAIN PRODUCT GROUPS AND THEIR PRODUCTS	EMISSION FACTOR [%]	LITERATURE REFERENCE
CAR CARE PRODUCTS		
Car wax	100	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Windscreen washing agents (concentrate)	70	(Expert estimate by industry, 2015)
Windscreen washing agents (ready-to-use)	90	(Expert estimate by industry, 2015)
De-icing	100	(Pearson & Brossier, 2015)
Radiator fluid	0	(Expert estimate by industry, 2015)
Brake fluid	0	(Expert estimate by industry, 2015)
Transmission oil	0	(Expert estimate by industry, 2015)
Motor oil	0	(Expert estimate by industry, 2015)
Vehicle and boat shampoo	0	(Expert estimate by industry, 2015)
Wax shampoo	3	(Expert estimate by industry, 2015)
Degreasing agents (3 types)	85	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Engine detergent	85	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
OTHER PRODUCTS		
Lighter fluid for grill	100	(Expert estimate by industry, 2015)
Repellent (for example on tarpaulin)	85	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
COSMETICS AND TOILETRIES		
Hair spray (aerosol)	95	95 (Terbert *et al.*, 2009), 1 (Staats *et al.*, 2005)
Hair spray (pump)	95	95 (Terbert *et al.*, 2009), 1 (Staats *et al.*, 2005)
Deodorant / Antiperspirant (Aerosol)	95	95 (Terbert *et al.*, 2009), 1 (Staats *et al.*, 2005)
Deodorant / Antiperspirant (Roll-on alcohol type)	95	95 (Terbert *et al.*, 2009), 85 (Staats *et al.*, 2005)
Perfume	85	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Shampoo	5	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Soaps (shower gel, liquid soap, bath foam)	5	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Styling mousse	100	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
HOUSEHOLD CLEANING PRODUCTS		
Glass and window cleaner	100	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Air freshener (aerosol)	100	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Universal cleaning product	10	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Surface cleaners	10	(Expert estimate by Noora Rantanen, 2015)
Special cleaning agents	5	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)

APPENDIX II. NFR 2D3a, Typical concentrations of NMVOC compounds in household products.

MAIN PRODUCT GROUP AND PRODUCTS	NMVOC COMPOUNDS	CAS-NUMBER OF THE COMPOUND	CONCENTRATION [%]	USED CONCENTRATION IN CALCULATIONS [%]
CAR CARE PRODUCTS				
Windscreen washing agent (Dilute)	Ethanol	64-17-5	1-5	5
Windscreen washing agent (Concentrate)	Ethanol	64-17-6	> 80	80
	Butanol	71-36-3	< 2	2
	Ethylene glycol	107-21-1	0-5	3
Car wax	Distillates (petroleum), hydrotreated light	647-47-8	10-20	15
Shine wax	Distillates (petroleum), hydrotreated light	647-47-8	5-10	5
	Dipentene	138-86-3	< 0,1	0,1
De-icing	Ethylene glycol	107-21-1	1-5	3
	2-Propanol	67-63-0	5-10	8
	2-Butanone	78-93-3	< 0,5	0,5
	Ethanol	64-17-6	30-60	50
	4-Methyl-2-pentanone	108-10-1	1-5	3
Radiator fluid	Ethylene glycol	107-21-1	30-50	40
Brake fluid	Diethylene glycol	111-46-6	10-20	15
	2-(2-butoksietoksi)Ethanol	112-34-5	0,5-1	1
	2-(2-metoksietoksi)Ethanol	111-77-3	1-3	2
Transmission oil	1,2,4-Trimethylbenzene	95-63-6	< 0,1	0,1
Motor oil (mineral oil)	Ethylenediamine	107-15-3	0,0001-0,1	0,01
Vax shampoo	Dietyleeniglykoli	111-46-6	0,0001-0,1	0,01
Caravan shampoo	Dipropyleneglycolmethylether	34590-94-8	1-3	2
Degreasing agent	Dipropyleneglycolmethylether	34590-94-8	1-5	3

	2-Butoxyethanol	111-76-2	1-5	3
Engine detergent	Dipropyleneglycolmethylether	34590-94-8	1-5	3
	Butane	106-97-8	10-30	20
	Propane	74-98-6	10-30	20
	Pentane	109-66-0	< 1	1
	Naphtha (petroleum), hydrotreated heavy	64742-48-9	60-100	80
OTHER PRODUCTS				
Lighter fluid for grill	Naphtha (petroleum), hydrotreated heavy	64742-48-9	100	100
Repellent (for example on tarpaulin)	Naphtha (petroleum), hydrotreated light	64742-49-0	10-25	12
	2-Propanol	67-63-0	10-25	12
	Acetic acid, 1-methylethyl ester	108-21-4	1-5	3
	Pentane	109-66-0	< 1	1
	Propane	74-98-6	10-25	12
	Acetic acid, butyl ester	123-86-4	10-25	12
	Butane	106-97-8	10-25	12
Boat wax	Diethanolamine	111-42-2	≤ 1	1
	Diethylene glycol	111-46-6	≤ 1	1
	Naphtha (petroleum), hydrodesulfurized light, dearomatized	92045-53-9	5-10	7
	Naphtha (petroleum), hydrotreated heavy	64742-48-9	10-30	20
Boat shampoo	Dipropyleneglycolmethylether	34590-94-8	1-3	2
COSMETICS AND TOILETRIES				
Hair spray (Aerosol)	Dimethylether	115-10-6	55	55
	2-Propanol	67-63-0	40	40
Hair spray (Pump)	Isopropyl alcohol	67-63-1	95	95
Deodorant (Aerosol)	Butane	106-97-8	95	95
Deodorant (Roll-on, alcohol type)	Ethanol	64-17-6	40 / 20 / 10	40 / 20 / 10

Perfume	Ethanol	64-17-7	80	80
Shampoo	Perfumes	N/A	0,1-1	1
Soaps (Shower gel, Liquid soap, Bath foam)	Perfumes	N/A	1	1
Styling mousse	Propane	74-98-6	30 / 5	30 / 5
	Ethanol	64-17-7	30 / 5	30 / 5
HOUSEHOLD CLEANING PRODUCTS				
Glass and window cleaner (Ready for use)	Ethanol	200-578-6	< 5	5
Glass and window cleaner (Concentrate)	Ethanol	200-578-6	15-30	25
Air freshener (Aerosol)	Propane	200-827-9	10-25	20
	Ethanol	200-578-6	10-25	20
	Butane	200-857-2	> 50	50
Universal cleaning product	2-Propanol	67-63-0	5-10	7
Surface cleaners	Ethanol	64-17-5	< 10	7
Special cleaning agents (Stain remover from surface)	Naphtha (petroleum), hydrotreated heavy	64742-48-9	65-75	70
	Butane	106-97-8	10-15	12
	Propane	74-98-6	10-15	12
Special cleaning agents (Antiliming agent)	Ethanol	64-17-5	1-3	2