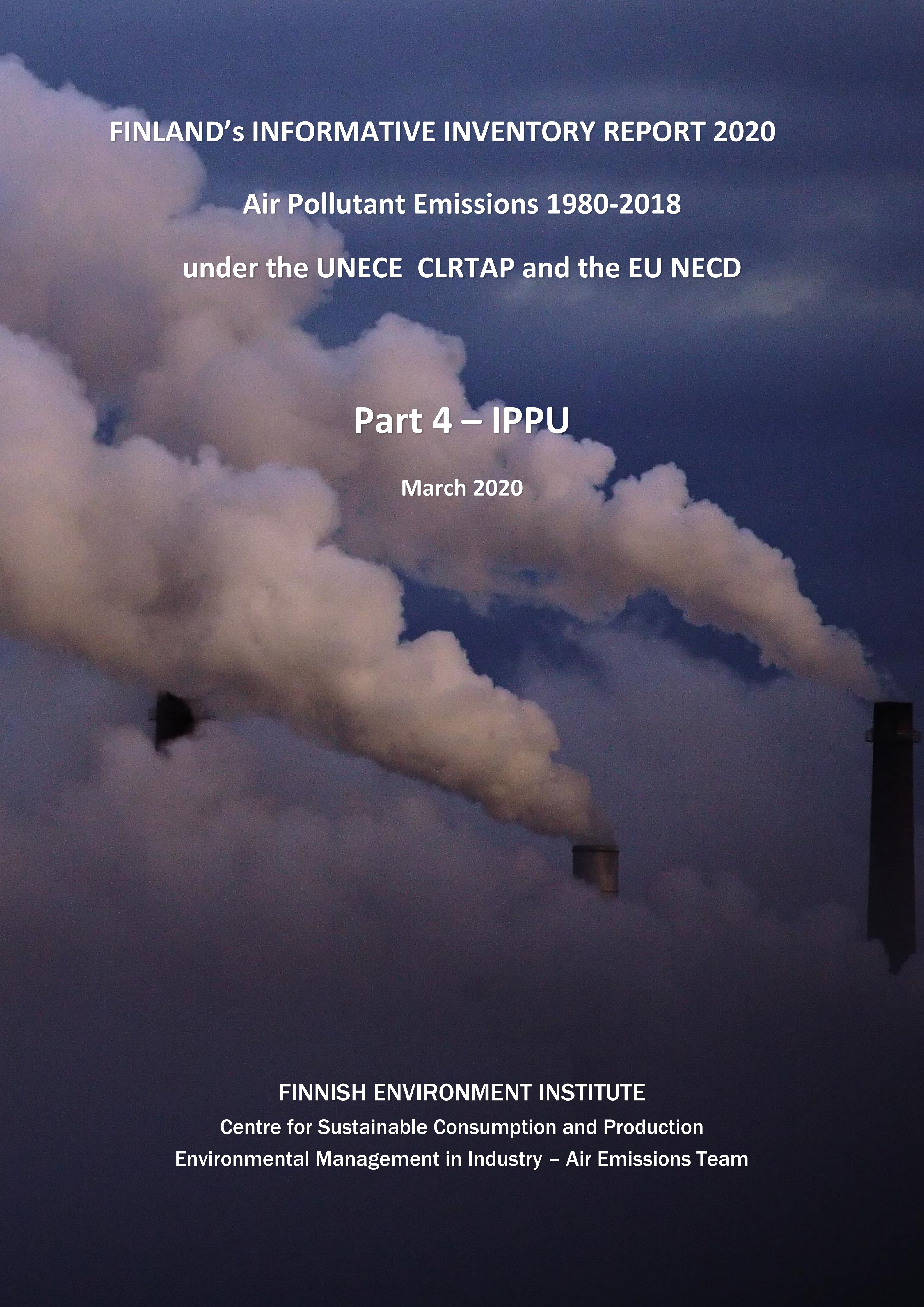


FINLAND's INFORMATIVE INVENTORY REPORT 2020

Air Pollutant Emissions 1980-2018

under the UNECE CLRTAP and the EU NECD

Part 4 – IPPU

March 2020

FINNISH ENVIRONMENT INSTITUTE
Centre for Sustainable Consumption and Production
Environmental Management in Industry – Air Emissions Team

Photo on the cover page: Ari Andersin (2008), Valkeakoski, ympäristöhallinnon kuvapankki

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

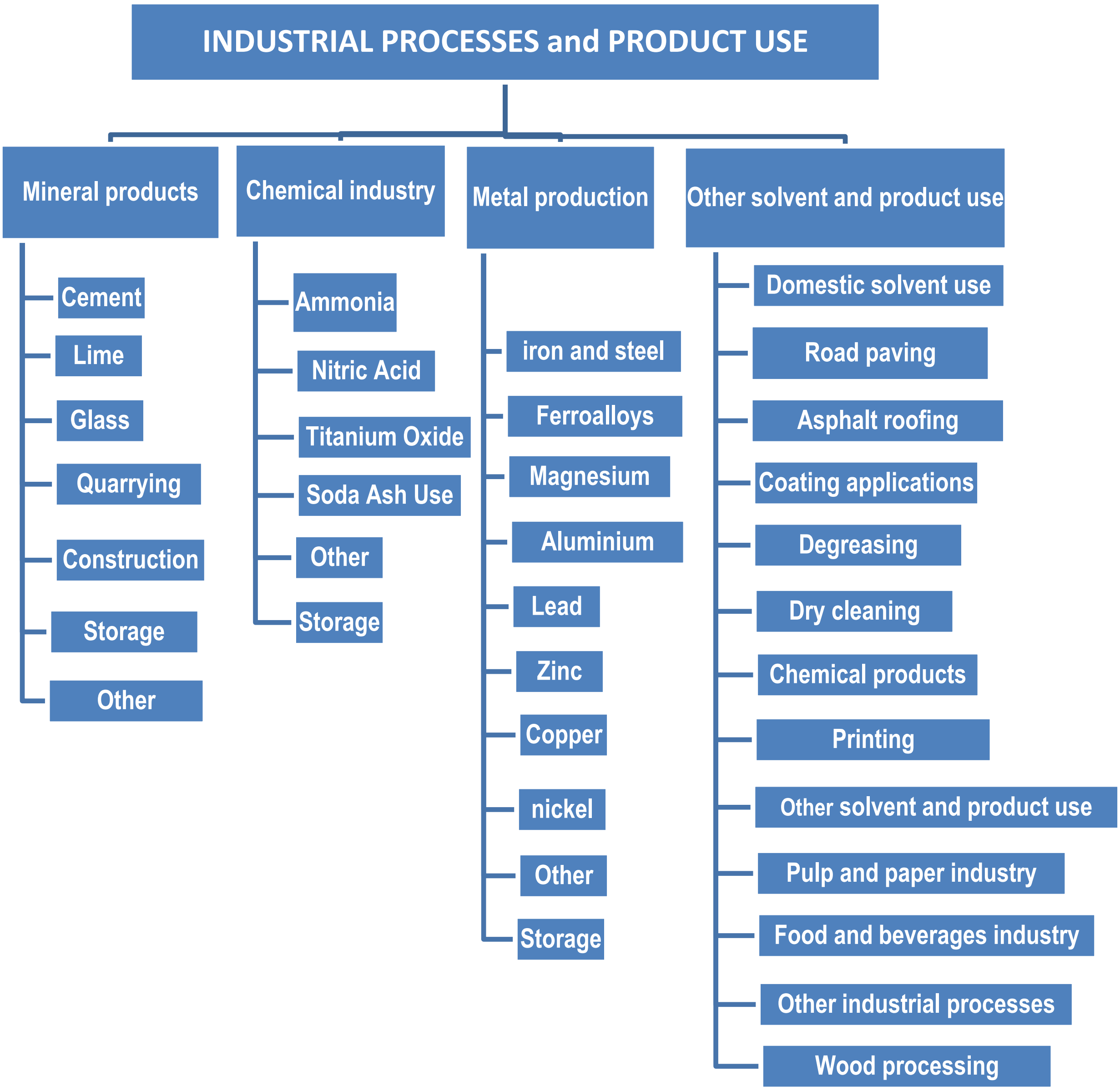


Figure 4.1 Industrial process included in the Finnish air pollutant inventory.

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 many 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 cases where it has not been possible to make a split between energy and process related emissions, or when the emissions are clearly fuel based, all emissions are reported under the relevant NFR 1A2 subcategory.

For those plants that have a reporting obligation to report all emissions from all activities as total emissions from the site (e.g. under the E-PRTR), 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.

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 PM10 or PM2.5 fractions that are calculated from these TSP emissions.

When Guidebook 2016 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, as this is considered to be 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. This is due to the fact that 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 clearly seen that the production volumes decreased in the 1990s' when a number of plants shut down their operations due to the recession and increased again since 1996 until mid-2000's, when a decreasing trend has returned with the economic turndown (Figure 4.2).

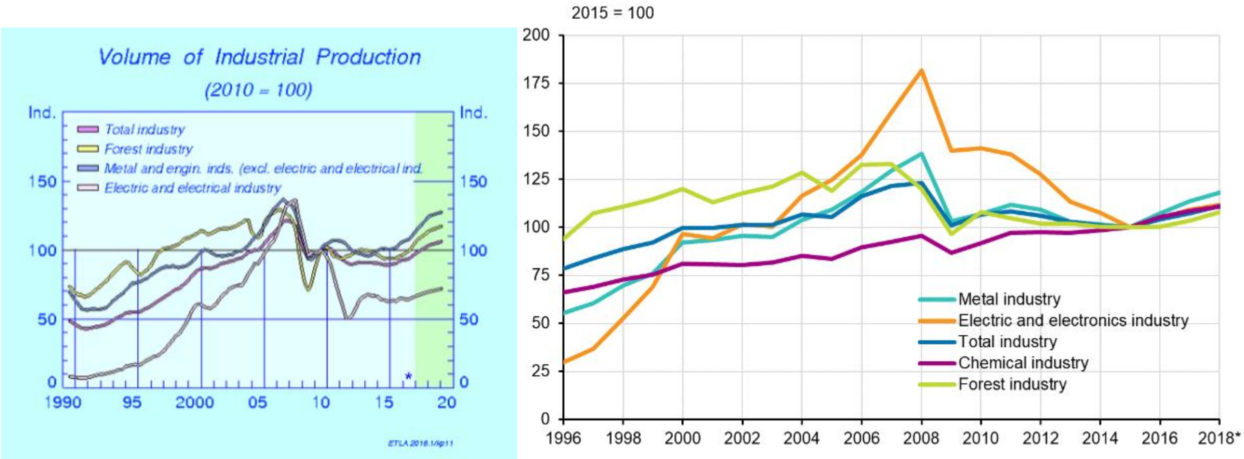


Figure 4.2 Industrial production 1990-2018 (Statistics Finland, ETLA, 2018)

4.2 Mineral Products (NFR 2.A)

Changes in chapter	
March 2020	KS, JMP

Overview of the category

Industrial activities falling under NFR 2A Mineral products are listed in Table 4.1. Corrections in the allocations will be made when the recalculations are finalized.

Table 4.1 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
2A2	Lime production	TSP, PM_{10}, $PM_{2.5}$, BC, PCDD/F, PCB
2A3	Glass production	PM2.5, PM10, TSP, BC, NMVOC, , PCDD/F
2A5a	Quarrying and mining of minerals other than coal	TSP, PM_{10}, $PM_{2.5}$,
2A5b	Construction and demolition	TSP, PM_{10}, $PM_{2.5}$, heavy metals Pb, Cd, Hg, As, Cr, Cu, Ni are energy related and allocated under 1A2f.
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	
January 2020	JMP, KS

Source category description

SNAP 040612	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. REF (recovered fuels prepared out of waste material) is used as fuel in these plants, in addition to rubber waste (since 1996). 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	**Source of emissions**
SOx, NOx, CO, NH3	These are emissions from fuel combustion, They are reported by the plants according to the monitoring and reporting requirements in the environmental permits and allocated under NFR 1A2gviii.
NMVOC	Cement production prosess emissions (partly reported by the plants and partly calculated), allocated under 2A1
TSP, PM10, PM2.5	Fuel combustion, reported by the plants according to the monitoring and reporting requirements in the environmental permits and allocated under NFR 1A2f.
Hg	Waste fuel combustion, reported by the plants according to the monitoring and reporting requirements in the environmental permits and allocated under NFR 1A2f.
PCDD/F	waste fuel combustion (rubber, REF) allocated under 2A1
PCB	waste fuel combustion (rubber, REF) allocated under 2A1

Emission trend

Cement industry is a minor source of air pollutant emissions in Finland. Part of emissions are reported by the plants. For those plants that do not report emissions, these are calculated. The shares of emissions reported by the plants out of total emissions for each air pollutant are presented in Table 4.2.

Cement production volumes affect emissions over the years

Table 4.2 Contribution of cement production to total emissions and the shares reported by plants in 2018.

Pollutant	Emissions from cement production	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.022	85.317	Gg	<0.1	18.3
PCDD/ F	0.05	14.356	g I-Teq	0.3	100
PAHs	<0.001	9.991	Mg	<0.1	0
PCBs	2.932	26.346	kg	11.1	0

Methodological issues

Activity data

Cement production volumes used as activity data presented in Table 4.3 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 and thus confidential because there are less than 3 plants.

Table 4.3 Cement production volumes (t/a), Kemia-Kemi Journal (1990-1999) and from YLVA (since 2000)

Year	t/a	Year	t/a	Year	t/a	Year	t/a
1980	1 815 128	1990	1 649 220	2000	C	2010	C
1981	1 862 913	1991	1 343 000	2001	C	2011	C
1982	1 906 639	1992	1 133 000	2002	C	2012	C

1983	1 978 925	1993	836 000	2003	C	2013	C
1984	1 691 511	1994	864 000	2004	C	2014	C
1985	1 695 367	1995	906 970	2005	C	2015	C
1986	1 495 411	1996	975 425	2006	C	2016	C
1987	1 579 284	1997	1 151 990	2007	C	2017	C
1988	1 618 509	1998	1 232 235	2008	C	2018	C
1989	1 693 304	1999	1 309 935	2009	C		

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 IEFof 0.033 kg/t for that period, which is derived from emission data reported by the plants (SYKE, 2007). The calculated emissions from cement production are presented in Table 4.4.
- 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.

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

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

PCB emissions are calculated using the EF of 2000 ug/t (BiPRO, 2006) because there is no method in the Guidebook. The relevance of the emissions will be studied for future submissions.

Table 4.4 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	2006	46	0.013	3.08
1991	44	0.035	2.69	2007	35	0.014	3.54
1992	37	0.029	2.27	2008	25	0.014	3.27
1993	28	0.022	1.67	2009	16	0.008	2.05
1994	29	0.022	1.73	2010	17	0.010	2.39
1995	30	0.023	1.81	2011	22	0.014	2.80
1996	14	0.025	1.95	2012	16	0.011	2.55
1997	12	0.030	2.30	2013	19	0.011	2.55
1998	14	0.032	2.46	2014	27	0.010	2.52
1999	14	0.034	2.62	2015	25	0.010	2.35
2000	35	0.037	2.85	2016	124	0.014	2.68
2001	75	0.012	2.65	2017	29	0.015	3.07
2002	63	0.011	2.39	2018	22	0.050	2.90
2003	21	0.011	2.37				
2004	38	0.010	2.59				
2005	27	0.011	2.69				

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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 current NFR codes
- The time series was calculated using harmonized methods

2020

- PCDD/F emission figures between categories 2A1, 2A2 and 2A3 were the wrong way around in the NFR tables for 1990 in the 2019 submission. These were corrected for submission 2020.

Source-specific planned improvements

Not scheduled: Check of EFs in the time-series

Lime production (NFR 2A2)

Changes in chapter	
January 2020	JMP KS

Overview of the sector

<table>
<tr><td>SNAP 040614</td><td>LIME DECARBONIZING
Production volumes of lime were constent over the period 1990-2002. A new plant was started in 2003. There are currently five lime-producing plants in Finland, one plant was closed down at the end of 2014. 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).</td></tr>
<tr><td>Emissions</td><td>Source of emissions</td></tr>
<tr><td>SO2, NOx, CO</td><td>Fuel combustion, reported by the plants according to the monitoring and reporting requirements in the environmental permits and allocated under NFR 1A2gviii/1A2f.</td></tr>
<tr><td>TSP, PM10, PM2.5, BC</td><td rowspan="2">Fuel combustion, reported by the plants according to the monitoring and reporting requirements in the environmental permits and should be allocated under NFR 1A2gviii/1Af. NFR PM_{10} and $PM_{2.5}$ fractions have been calculated from the TSP emissions using fraction factors of 39% and 8% from TSP (GB16).</td></tr>
<tr><td>Cd, Hg, Cr</td></tr>
<tr><td>PCDD/F</td><td>waste incineration (recycled and waste oils) reported under NFR 2A2</td></tr>
<tr><td>PCB</td><td>waste incineration (waste oil) reported under 2A2</td></tr>
</table>

Emission trends

The emission trends are impacted by annual production volumes. The shares of emissions reported under the NFR category are presented in Table 4.5.

Table 4.5 Contribution of lime production to total emissions and shares reported by plants in 2018

Pollutant	Emissions from lime production	Total emissions	Unit	Share of total emissions %	% reported by the plants
PM2.5	<0.001	17.798	Gg	<0.1	0
PM10	0.001	31.116	Gg	<0.1	0
TSP	0.003	45.069	Gg	<0.1	100
BC	<0.001	4.014	Gg	<0.1	0
PCDD/ PCDF	0.129	14.356	g I-Teq	0.9	0
PCBs	0.248	26.346	kg	0.9	0

Methodological issues

Emissions are mainly 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. Calculated emissions from lime production are presented in 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 7.78%, respectively (Guidebook2019).

Black carbon emissions have been calculated using the factor of 0.46 % of PM2.5 emissions (GGuidebook 2019, EEA 2019).

POPs

Emissions are calculated using lime production annual statistics available in the Kemia-Kemi Journal (Table 4.7) and the following emission factors: for PCDD/F 78 ng I-TEQ/t (UNEP, 1999) and for PCB 0.15 mg/t (BiPRO, 2006). There are no methods in Guidebook 2019. The relevance of the methods will be studied for future submissions.

Table 4.6 Activity data for lime production (Kemia-Kemi Journal)

Year	Lime production (t)	Year	Lime production (t)	Year	Lime production (t)
1990	1 950 000	2000	1 860 800	2010	1 758 216
1991	1 535 400	2001	2 042 200	2011	1 652 233
1992	1 315 800	2002	2 259 900	2012	1 652 233*
1993	1 718 100	2003	1 919 000	2013	1 652 233*
1994	1 755 400	2004	1 900 300	2014	1 652 233*
1995	1 645 200	2005	1 852 400	2015	1 652 233*
1996	1 716 500	2006	2 212 000	2016	1 652 233*
1997	1 894 400	2007	2 067 197	2017	1 652 233*
1998	1 961 800	2008	1 950 433	2018	1 652 233*
1999	2 017 800	2009	1 681 000		

*due lack of activity data in the YLVA database, the production rate of 2011 is used for the years 2011-2018

Table 4.7 Calculated PCDD/F emissions from lime production

Year	PCDD/F (g I-TEQ)	PCB (kg)	Year	PCDD/F (g I-TEQ)	PCB (kg)
1990	0.15	0.29	2006	0.17	0.33
1991	0.12	0.23	2007	0.16	0.31
1992	0.10	0.20	2008	0.15	0.29
1993	0.13	0.26	2009	0.13	0.25
1994	0.14	0.26	2010	0.14	0.26
1995	0.13	0.25	2011	0.13	0.25
1996	0.13	0.26	2012	0.13	0.25
1997	0.15	0.28	2013	0.13	0.25

1998	0.15	0.29	2014	0.13	0.25
1999	0.16	0.30	2015	0.13	0.25
2000	0.15	0.28	2016	0.13	0.25
2001	0.16	0.31	2017	0.13	0.25
2002	0.18	0.34	2018	0.13	0.25
2003	0.15	0.29			
2004	0.15	0.29			
2005	0.14	0.28			

Uncertainty analysis and source specific recalculations

The results of the uncertainty analysis are presented in Annex 7 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 fraction from GB16.

2020

- PCDD/F emission figures between categories 2A1, 2A2 and 2A3 were the wrong way around in the NFR tables for 1990 in the 2019 submission. These were corrected for submission 2020.

Source-specific planned improvements

Planned for 2020

- Check of production rates for the years 2011-2018 (YLVA database) and the relevance of emissions while there is no method in Guidebook 2019

Glass production (NFR 2A3)

Changes in chapter	
January 2020	KS & JMP

Source category description

SNAP 040613	GLASS MANUFACTURING
	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	**Source of emissions**
TSP, PM10, PM2.5, BC, Pb, Cd, Cu, Se, Zn	Emissions due to fuel combustion should be reported under the Energy sector.
SOx	Emissions due to fuel combustion are reported under the Energy sector
NH_3, NMVOC, PCDD/F	NH_3 emissions from manufacture of glassfibre are reported by the plants. NMVOC emissions for glass wool are calculated according to GB2019. PCDD/F emissions (as well as NMVOC emissions for those plants not reporting their emissions) from glass manufacturing are calculated as the difference of total emissions from the site reported by the plants and default emissions calculated on basis of production volumes.

The share of glass manufacture emissions to national total emissions and the share of emissions reported by the operators are presented in Table 4.8.

Table 4.8 Contribution of emissions from Glass products to total emissions in 2018

Pollutant	Emissions 2A3	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	<0.001	85.317	Gg	<0.1	97.3
PM2.5	0.005	17.798	Gg	<0.1	0
PM10	0.006	31.116	Gg	<0.1	0
TSP	0.007	45.069	Gg	<0.1	100
BC	<0.001	4.014	Gg	<0.1	0
PCDD/F	<0.001	14.356	g I-Teq	<0.1	0

Emission trends

Glass production volumes and thus also emissions have decreased to only some percentages from their levels in the 1990's and from the high production volume period in 2005-2008 as presented in Table 4.9. The large variations in the reported emissions are due to the fluctuating production levels.

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. Cd emissions originated from raw material processing in dinnerware production. In 2014 raw material processing was relocated and the activity causing Cd emissions was closed down.

Table 4.9 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	1 535	9 674

* 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

SOx, NOx, and heavy metals

The emissions originate in energy production and are mainly reported by the plants according to the monitoring requirements in the environmental permits. All other heavy metals, except for cadmium are reported under energy sector. Cadmium emissions origante from raw material processing in dinnerware production and are reported under 2A3.

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 (expert estimate SYKE, 2005).

Black carbon emissions have been calcuted using the emission factor 0.062 % of PM2.5 (Guidebook 2019, EEA 2019).

NMVOC

Due to the varying quality of data reported by the plants it has not been possible to develop a national emission factor. For glass manufacture plants 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.

NH3

Ammonia emissions presented in Table 4.10 are related to the glass fibre production. There has been one glassfibre producer operating under the period of 1988-2010. In 2011 there was a change in the production processes as the production process of glass fibre was convert to a production process of glass felt. Glass felt production does not generate ammonia emissions, therefore no ammonia emission 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 to Emissions after 2007 are based on emission data reported by the plants according to the monitoring requirements in their environmental permits.

PCDD/F

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 4.10. The relevance of emissions will be studied for future submissions.

Table 4.10 NH3, NMVOC and PCDD/F emissions from glass 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	2005	47.478	0.0096	0.559
1991	1.376	0.0054	0.020	2006	50.714	0.0096	0.229
1992	2.576	0.0054	0.020	2007	28.349	0.0099	0.018
1993	2.396	0.0054	0.020	2008	24.198	0.0078	0.008
1994	2.576	0.0054	0.020	2009	14.596	0.0029	0.010
1995	2.576	0.0054	0.020	2010	13.938	0.0013	0.011
1996	2.876	0.0054	0.020	2011	15.689	0.0017	NA
1997	2.883	0.0054	0.020	2012	10.986	0.0005	NA
1998	5.634	0.0052	0.020	2013	15.069	0.0005	NA
1999	9.286	0.0049	0.020	2014	18.229	0.0004	NA
2000	10.890	0.0055	0.057	2015	1.815	0.0003	NA
2001	8.616	0.0060	0.125	2016	1.910	0.0003	NA
2002	15.416	0.0058	0.135	2017	0.478	0.0003	NA
2003	27.963	0.0060	0.276	2018	0.575	0.0003	NA
2004	22.158	0.0059	0.399				

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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 (previosly,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

2020
- PCDD/F emission figures between categories 2A1, 2A2 and 2A3 were the wrong way around in the NFR tables for 1990 in the 2019 submission. These were corrected for submission 2020.
- BC emissions for 1990 were recalculated due to addition of emissions from one plant previously missing from the inventory (emissions calculated at SYKE)

Source-specific planned improvements

None.

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

Changes in chapter	
January 2020	JMP KS

Source category description

SNAP 040616 and 040623	EXTRACTION OF MINERAL ORES and QUARRYING includes copper and zinc, talc manufacturing, limestone and quartzite quarrying
Emissions	**Source of emissions**
NOx, SOx, CO and heavy metals (Pb, Cd, As, Cr, Cu, Ni, Zn)	Emissions are related to combustion and reported under the Energy sector.
Particles (TSP, PM10, PM2.5)	TSP reported by the plants, fraction factors used for PM10 and PM2.5

Metal and mineral ore mining activities and developing metallurgical technology and mining equipment have a long history in Finland. Metals and minerals present in the bedrock are mined on basis of their composition, extent, and geographical location of the deposit, operating expenditures, and global market prices. To open a mine, an environmental permit is needed.

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 2014, there were 11 metallic mineral mines (Tables 4.11 and 4.13) operating in Finland. Eight of these were gold mines, and the other mines produced chromium, copper, nickel, zinc, sulphur, cobalt, silver and platinum group metals (PGM). In addition, three mines are commencing operation (GTK, Geolocigal Survey of Finland, 2016).

Industrial minerals are excavated for the production of, for example, 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[2]. 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 4.11.

Table 4.11 Contribution of Quarrying and mining of minerals other than coal (NFR 2A5a) in 2018

Pollutant	Emissions from Quarrying and mining of minerals other than coal	Total emissions	Unit	Share of total emissions %	% reported by the plants
PM2.5	<0.001	17.798	Gg	<0.1	0
PM10	0.004	31.116	Gg	<0.1	0
TSP	0.007	45.069	Gg	<0.1	76.4

The structure of the Finnish mining industry is presented in Figure 4.4 below and the mining sites some pages further in Figure 4.5

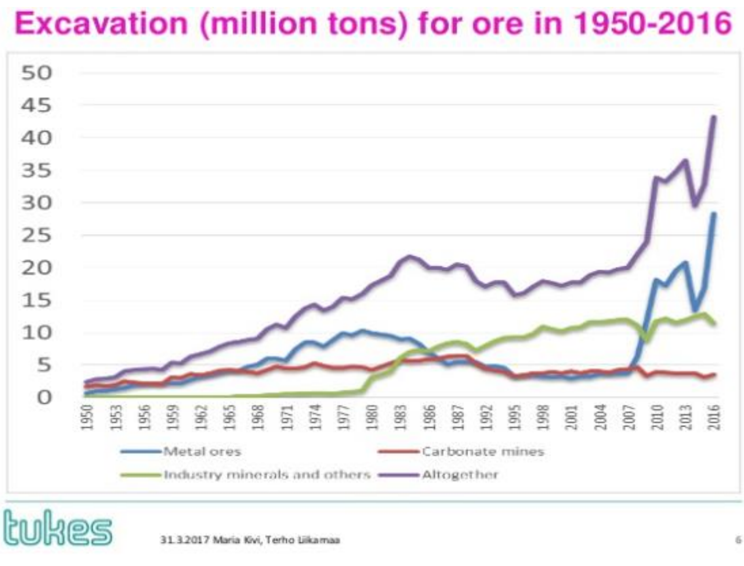


Figure 4.4 Number of enterprises 2007-2016 in mining industry

[2] http://en.gtk.fi/informationservices/mineralproduction/index.html

Table 4.12 Mining in Finland 2018 (Geological Survey of Finland 22.11.2019) www.en.gtk.fi

Mining in Finland 2018

Group	Mines/ Quarries	Total output (tonnes)	Total ore output (tonnes)	Ore %	Leftover rock (tonnes)
Metallic ores	11	95 177 969	32 468 824	34 %	62 709 145
Carbonate rocks	14	5 230 471	3 726 313	71 %	1 504 158
Other industrial minerals*	13	29 135 674	12 369 776	42 %	16 765 898
Industrial rocks	4	266 577	258 499	97 %	8 078
Natural stones**	5	296 306	192 294	65 %	104 012
In total	**46**	**130 106 997**	**49 015 706**	**38 %**	**81 091 291**

* Includes also gemstones
** Dimension stones included in the Finnish Mining Law

Table 4.13 Mining in Finland 2018 (Geological Survey of Finland, www.en.gtk.fi)

Mine/Quarry	Locality	Commodity	Operator	Total output (t)	Total ore output (t)
Kittilä	Kittilä	Au	Agnico Eagle Finland Oy	2 656 715	1 563 612
Jokisivu	Huittinen	Au	Dragon Mining Oy	392 738	244 383
Orivesi	Orivesi	Au	Dragon Mining Oy	101 885	69 291
Pampalo	Ilomantsi	Au	Endomines Oy	180 389	170 389
Laiva	Raahe	Au	Nordic Gold Oy	2 124 866	319 261
Taivalhopea	Sotkamo	Ag, Au, Pb, Zn	Sotkamo Silver Oy	203 509	0
Kevitsa	Sodankylä	Ni, Cu, Co, PGM, Au	FQM Kevitsa Mining Oy	41 428 452	7 932 917
Kylylahti	Polvijärvi	Cu, Co, Ni, Zn	Kylylahti Copper Oy	792 619	791 424
Kemi	Keminmaa	Cr	Outokumpu Chrome Oy	3 318 138	2 211 284
Pyhäsalmi	Pyhäjärvi	Zn, Cu, S	Pyhäsalmi Mine Oy	1 247 536	1 247 536
Sotkamo	Sotkamo, Kajaani	Zn, Cu, Ni	Terrafame Oy	42 277 065	17 910 496
Total: 11				**95 177 969**	**32 468 824**

PGM = platinum group metals, Kv=quartz

Emission trends

The emission trends follow closely the quarrying and mining volumes.

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 4.14. Note that there is no activity data available for the use of the new calculation method presented in Guidebook 2019 (tier 2).

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 2016 fraction factors. The emissions are presented in Table 4.15.

For plants that do not report emissions, the emissions are calculated using emission factors from the Guidebook 2016.

Table 4.14 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			
2000	1211	118			
2001	1031	128			
2002	996	167			
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					

Table 4.15 Particle emissions from quarrying and mining of minerals other than coal

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				
2000	4.98	33.22	67.58				
2001	4.35	28.97	58.94				
2002	4.36	29.07	59.13				
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

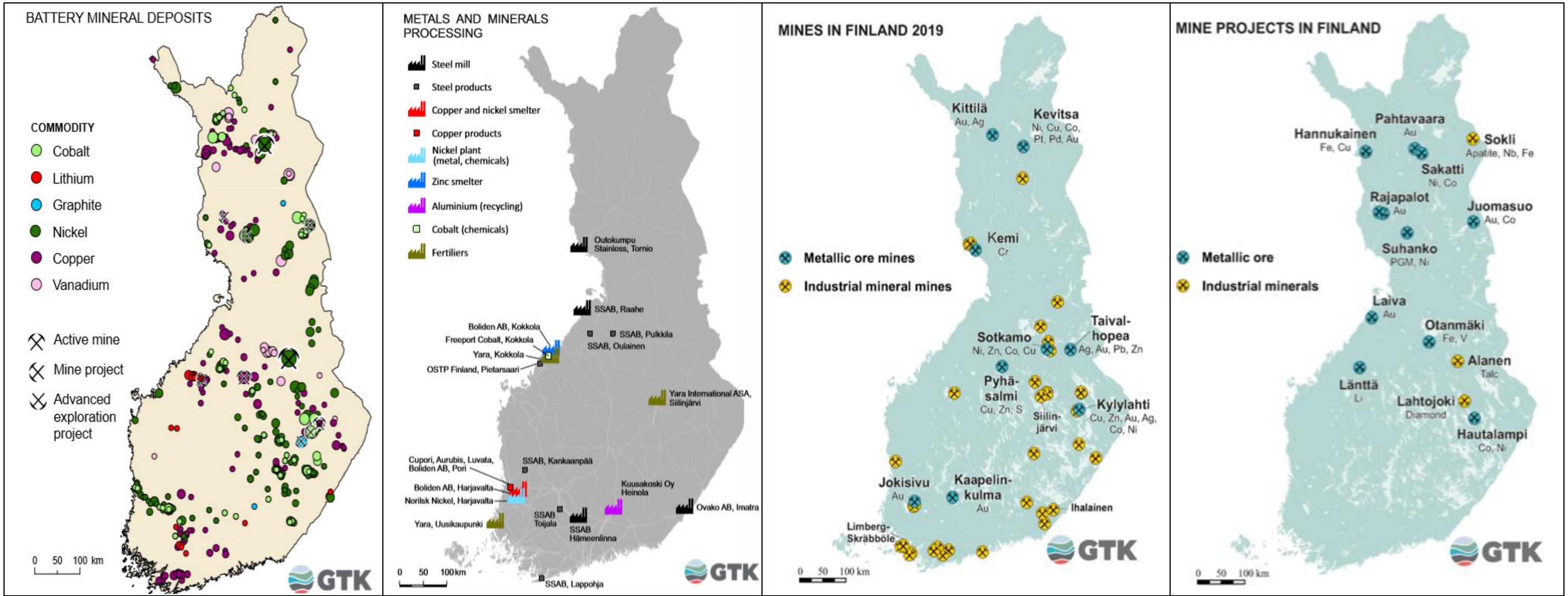
- Fuel combustion related emissions were reallocated in the 2018 submission under NFR1A2gviii

2019

- Particle fractions are calculated with Guidebook 2016 fraction factors.

Source-specific planned improvements

None



Geological Survey of Finland (2020) https://www.gtk.fi/en/services/data-sets-and-online-services-geo-fi/mining-maps/

Figure 4.5 Battery mineral deposits, Metals and minerals processing, Mines, Mine projects

Construction and demolition (NFR 2A5b)

Changes in chapter	
March 2020	JMP KS

Source category description

SNAP 040624	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	**Source of emissions**
TSP, PM10, PM2.5	calculated using GB19

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 4.16

Table 4.16 Contribution of Construction and demolition (NFR 2A5b) to total emissions in 2018

Pollutant	Emissions from Construction and demolition	Total emissions	Unit	Share of total emissions %	% reported by the plants
PM2.5	0.003	17.798	Gg	<0.1	0
PM10	0.019	31.116	Gg	<0.1	0
TSP	0.061	45.069	Gg	0.1	1.7

Methodological issues

Particle emissions

Emissions are calculated as described in Guidebook 2019. The same assumptions for duration of construction and for control efficiency of applied emission reduction measures (CE) as presented in the Guidebook 2019 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 2019. 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 2019. Activity data presented in Table 4.17b 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 4.17a.

Table 4.17a 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

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

Table 4.17b Value of new roads (only new mains roads i.e highways) in Finland 1990-2018 (Road statistics, The Finnish Transport Infrastructure Agency)

Years	New roads (km)	Years	New roads (km)	Years	New roads (km)
1990	208	2000	33	2010	45
1991	67	2001	161	2011	37
1992	305	2002	88	2012	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	0
1999	136	2009	34		

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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

Source-specific planned improvements

None

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

Changes in chapter	
January 2020	JMP KS

Source category description

SNAP 040900	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	**Source of emissions**
TSP, PM_{10}, $PM_{2.5}$	Calculated

The category is a minor source of particle emissions. The shares of emissions are presented in Table 4.18

Table 4.18 Contribution of Storage, handling and transport of mineral products (NFR2A5c) to total emissions and the shares of emissions reported by the plants in 2018.

Pollutant	Emissions from Storage, handling and transport of mineral products	Total emissions	Unit	Share of total emissions %	% reported by the plants
PM2.5	0.028	17.798	Gg	0.2	0
PM10	0.277	31.116	Gg	0.9	0
TSP	0.709	45.069	Gg	1.6	0

Methodological issues

Particle emissions are calculated using emission factors (TNO, 2002) presented in Table 4.19. 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 4.19 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 4.20.

TSP, PM_{10} and $PM_{2.5}$ emissions from storage, handling and transport of mineral products are presented in Table 4.21.

Table 4.20. Activity data for storage and handling of minerals

AD (t/m2)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Reference
Amount of imported alumina	3317	1134	1524	5781	3537	1669	3366	2353	2006	2564	ULJAS
Amount of imported bentonite	7841	7583	6273	8808	12583	18688	22722	48491	56864	53935	ULJAS
Amount of handled clay as tiles and light gravel	413000	490000	446000	431000	407000	392000	360000	413090	416715	444477	The Confederation of Finnish Construction Industries + Production amount of light gravel (VAHTI)
Amount of used cement as production and import	1917740	1513330	1254919	1023578	1058023	1106527	1217959	1433304	1627917	1767248	VAHTI + ULJAS
Amount of imported coal	6101614	5174521	4264324	5953057	8104916	5887526	6252607	7474226	4727631	3596331	ULJAS
Amount of produced and imported coke	1273047	1175507	1184466	1291656	1326901	1083946	1067868	1106694	1119537	1267754	The Federation of Finnish Technology Industries + ULJAS
Amount of produced fly ash	939702	939702	939702	939702	939702	739563	959487	893000	619000	605000	Finergy
Amount of imported kaolin	967917	937236	1017452	1175689	1328205	1378081	1198212	1402209	1359976	1249452	ULJAS

AD (t/m2)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Reference
Amount of imported alumina	2179	2204	2042	1904	2220	2659	2327	3297	2350	1733	ULJAS
Amount of imported bentonite	30609	50898	27758	26569	27321	26395	32520	37739	31445	19334	ULJAS
Amount of handled clay as tiles and light gravel	502238	510000	492841	512000	492000	479986	482598	487106	448689	298194	The Confederation of Finnish Construction Industries + Production amount of light gravel according to VAHTI
Amount of used cement as production and import	1939579	1762180	1493126	1613900	1756330	904064	2027988	2443914	2167516	1358273	VAHTI + ULJAS
Amount of imported coal	5072701	6174440	5788973	10145016	8283891	4724395	6684023	6676418	5677080	5941051	ULJAS
Amount of produced and imported coke	1327170	1306480	1365237	1390807	1417438	1398969	1390541	1438165	1395458	245805	The Federation of Finnish Technology Industries + ULJAS
Amount of produced fly ash	590000	811000	877800	1142200	713909	541376	740483	706218	503602	541056	Finergy
Amount of imported kaolin	1493786	1301200	1207343	1305240	1301806	1144335	1261699	1155040	1147686	739685	ULJAS

AD (t/m2)	2010	2011	2012	2013	2014	2015	2016	2017	2018		
Amount of imported alumina	2421	2423	2478	2198	2573	2834	3078	3700	3624		ULJAS
Amount of imported bentonite	16084	21318	25469	21227	26449	43347	35630	24140	31970		ULJAS
Amount of handled clay as tiles and light gravel	423563	438594	389280	352800	352800	352800	352800	352800	352800		The Confederation of Finnish Construction Industries + Production amount of light gravel according to VAHTI
Amount of used cement as production and import	1807747	1985441	1792816	1651613	1703571	1595705	1844920	2106350	555258		VAHTI + ULJAS
Amount of imported coal	5902004	6954191	3892598	4022356	5421559	3500330	3896830	3855300	3982297		ULJAS
Amount of produced and imported coke	440170	443407	319132	359	437	480	343	271	337		The Federation of Finnish Technology Industries + ULJAS
Amount of produced fly ash	692256	537737	537737	537737	5377737	5377737	715000	715000	715000		Finergy
Amount of imported kaolin	944809	936544	860243	628512	745438	696962	660800	639780	604098		ULJAS

Table 4.21 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				
2000	42.6	415.0	1059.3				
2001	49.6	484.3	1235.9				
2002	47.5	462.9	1183.4				
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 5 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 since

2020

- Guidebook 2019 EFs implemented

Source-specific planned improvements

None

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	
January 2020	KS&JMP

Overview of the category

NFR	Chemical Industy	Description		Emissions reported
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.		NOx
2B10a	Other chemical industry			NOx, NMVOC, SOx, NH3, TSP, PM10, PM2.5, 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	
	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		
	040507	Polyethylene High		
	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	
	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	
	040527	Other (phytosanitary,...)	Manufacturing of biocides and other agricultural	
	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[3] according to the monitoring requirements in the environmental permits are in most cases reported as aggregated for the whole plant and not by individual processes. It has not been possible to make a complete split between emissions from fuel based and non-fuel-based sources in the air emissions inventory system. In cases where it has been possible to separate fuel combustion emissions from process emissions, these are reported separately under NFR 2B categories. For those plants that report only total emissions, the split is based on the default emissions calculated on basis of fuel consumption which is subtracted from the emissions reported by the plants and then reported under the NFR 1A2c. 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	
January 2020	KS&JMP

Source category description

SNAP 040403	**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 , NOx and CO emissions have been included in the inventory in the 2020 submission.

Methodological issues

Activity data

Ammonia was produced during the years 1990-1992 as presented in Table 4.22a.

Table 4.22a. Estimates of Ammonia production in 1990-1992 (Expert estimate from Regional Environmental Centre, 2010)

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

NH_3, NOx ,CO, NMVOC

Emissions are calculated using emission factors presented in Guidebook 2019 (Table 4.23b).

Table 4.22b. NH3, NOx, CO and NMVOC emissions from ammonia production

	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

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

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 5 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	
January 2020	KS&JMP

Source category description

SNAP 040402	NITRIC ACID PRODUCTION Nitric acid is currently produced at three sites. 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). Two of the plants are situated at the same site and 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	**Source of emissions**
NOx	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 4.23.

Table 4.23 Contribution of nitric acid production to total emissions in 2018.

Pollutant	Emissions from other mineral products in	Total emissions in	Unit	Share of total emissions %	% reported by the plants
NOx (as NO2)	0.428	126.6	Gg	0.3	100

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 most cases reported as aggregated for the whole plant and not by individual processes. It has not been possible to make a complete split between emissions from fuel based and non-fuel-based sources in the air emissions inventory system.

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

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 5 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.

Adipic acid production (NFR 2B3)

SNAP 040521	**ADIPIC ACID PRODUCTION** Adipic acid production has not occurred in Finland in 1980-2018.

Carbide production (NFR 2B5)

SNAP 040412	**CARBIDE PRODUCTION** Carbide production has not occurred in Finland in 1980-2018.

Titanium dioxide production (NFR 2B6)

Changes in chapter	
January 2020	KS&JMP

Source category description

SNAP 040410	**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 TiO_2 is currently 130 000 tonnes.
Emissions	**Source of emissions**
TSP, PM_{10}, $PM_{2.5}$, BC	Particle emissions are reported by the plant according to its environmental monitoring programme from dry kiln.

Emission trends

The shares of emissions of total emissions and the shares reported by the plants are presented in table 4.24.

Table 4.24 Contribution of Titanium dioxide production (NFR 2B6) to total emissions in 2018

Pollutant	Emissions from Titanium dioxide production in 2018	Total emissions in 2018	Unit	Share of total emissions %	% reported by the plants
PM2.5	<0.001	17.798	Gg	<0.1	0
PM10	<0.001	31.116	Gg	<0.1	0
TSP	<0.001	45.069	Gg	<0.1	100
BC	<0.001	4.014	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 national fraction factors of 100% from TSP (Karvosenoja, 2002). There are no methods or fraction factors in the Guidebook, so the shares of small particles are assumed TSP:PM_{10}:$PM_{2.5}$=1:1:1.

For black carbon the Guidebook 2019 emission factor of 1.8 % from $PM_{2.5}$ emissions 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 7 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.

Soda ash production (NFR 2B7)

Changes in chapter	
January 2020	JMP, KS

SNAP 040619	**SODA ASH PRODUCTION AND USE** **NFR 2B7 SODA ASH PRODUCTION** Soda ash has not been produced in Finland in 1990-2018. 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 YLVAI). 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	
January 2020	JMP KS

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,	reported by the plants according to the monitoring and reporting obligations in their environmental permits
heavy metals (Pb, Cd, Hg, As, Cu, Ni, Se, Zn)	reported by one plant in 2001, should be allocated under the energy sector

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 in to 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	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NOx	reported by one plant in 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 fertlisers (including N,P,K)
Emissions	**Source of emissions**
NH_3, NMVOC, SOx, TSP,PM_{10}, $PM_{2.5}$, BC	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	reported by the plants according to the monitoring and reporting obligations in their environmental permits
SOx	reported by plants 1990-1993, should be allocated under Energy sector

SNAP 040414	**PHOSPHATE FERTILIZERS** Number of plants (< 5)
Emissions	**Source of emissions**
	Only NH3 emissions from 1990, in 2019 submission should be studied the allocation oft he emission 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	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	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	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	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	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	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	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	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, PM10. PM2.5, BC	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
Emissions	**Source of emissions**
	reported by the plants according to the monitoring and reporting obligations in their environmental permits

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	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	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	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, TSP, PM10, PM2.5, BC	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	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	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5	emissions 1996-1998 reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040508	PVC Polyvinylchloridehas been manufactured in Finland in 1969-2006 Number of plants Production capacity
Emissions	**Source of emissions**
NMVOC, TSP, PM10, PM2.5	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	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NOx	emissions from 2002 reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040511	POLYSTYRENE Number of plants <5 Production capacity ~50 000 t/a
Emissions	**Source of emissions**
NMVOC	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	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	reported by the plants according to the monitoring and reporting obligations in their environmental permits
SOx	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**
NMVOC	emissions from 1990 reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040527	**OTHER (PHYTOSANITARY,...)** Entzyme production Number of plants <5 Production capacity: not available
Emissions	**Source of emissions**
TSP,PM10, PM2.5	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, PAH4, Cr, Ni, NH3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Emission trends

Other chemical industry is a major source of HCB emissions which are generated in the manufacturing of potassium sulphate.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.25

Table 4.25 Contribution of Chemical Industry: other (NFR 2B10a) to total emissions in 2018.

Pollutant	Emissions from other chemical industry	Total emissions	Unit	Share of total emissions %	% reported by the plants
NOx (as	0.123	126.595	Gg	<0.1	100
NMVOC	2.403	85.317	Gg	2.8	100
SOx (as	1.538	33.127	Gg	4.6	100
NH3	0.306	32.189	Gg	1	100
PM2.5	0.289	17.798	Gg	1.6	0
PM10	0.425	31.116	Gg	1.4	0
TSP	0.491	45.069	Gg	1.1	100
BC	0.005	4.014	Gg	0.1	0
Pb	0.001	15.410	Mg	<0.1	0
Hg	0.035	0.677	Mg	5.2	100
Cu	0.003	40.173	Mg	<0.1	100
Ni	0.162	14.139	Mg	1.1	100
Zn	0.25	118.644	Mg	0.2	0
PCDD/	0.031	14.356	g I-Teq	0.2	100
HCB	23.9	32.024	kg	74.6	100

Methodological issues

The emissions falling under this source are reported by the plants according to the monitoring and reporting obligations in their environmental permits. 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 2019)

- Production of PVC: 38% for PM_{10} and 1.9 %, $PM_{2.5}$ (Guidebook 2019)
- 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 $PM_{2.5}$ (Guidebook 2019, EEA 2019) 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.

SOx

Sulphur dioxide emissions (reported mostly in TRS) 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

NH3

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

NMVOC

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, or if emissions would not be reported in the inventory year, the emissions from the previous year have been included in the inventory, instead.

Heavy metals

Nickel and copper emissions are generated in manufacturing of cobolt based special chemicals and reported by the operators according to their environmental permits.

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 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 emission have been reported by one plant the first time in 2000. Emissions between 1990-1999 are expert estimates based on the reported emission figure in 2000. In 2001 a new active carbon filter was taken in use at the plant resulting in 97% reduction of dioxine emissions.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 5 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.

2020

- NOx emissions for 2016-2017 were recalculated due to addition of facility reported emissions from the YLVA system previously missing from the inventory for one plant
- NMVOC emissions for 2005-2006 were recalculated due to addition of facility reported emissions from the YLVA system previously missing from the inventory for one plant
- SOx emissions for 2016-2017 were recalculated due to addition of facility reported emissions from the YLVA system previously missing from the inventory for one plant
- BC emissions for 1990-2005 and 2010-2017 were recalculated due to addition of emissions from two plants previously missing from the inventory (emissions calculated at SYKE)

Source-specific planned improvements

- Change of methods to Guidebook 2019 will be studied

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

Changes in chapter	
January 2020	JMP KS

Source category description

SNAP 040415 and 040522	STORAGE AND HANDLING OF INORGANIC CHEMICAL PRODUCTS, STORAGE AND HANDLING OF ORGANIC CHEMICAL PRODUCTS Chemical and fuel storages, storage and handling of phosphates.
Emissions	**Emission source**
TSP, PM_{10}, $PM_{2.5}$	reported by the plants according to the monitoring and reporting obligations in their environmental permits, calculated
NMVOC	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Emission trends

Storage and handling of phosphates is included in this category.

The shares of emissions of total emissions and the shares reported by the plants are presented in Table 4.26

Table 4.26 Contribution of Storage, handling and transport of chemical products (NFR 2B10b) to total emissions in 2018.

Pollutant	Emissions NFR 2B10b	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.158	85.317	Gg	0.2	100
PM2.5	0.001	17.798	Gg	<0.1	0
PM10	0.012	31.116	Gg	<0.1	0
TSP	0.037	45.069	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 4.27 and the emissions in Table 4.28.

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 fertilizer producers (available in YLVA datasystem) and in the Customs statistics (ULJAS).

Table 4.27 Activity data for storage and handling of phosphates (Customs Statistics ULJAS).

Year	Production of phosphates (t)	Year	Production of phosphates (t)	Year	Production of phosphates (t)
1990	584 000	2000	824 000	2010	765 000
1991	510 000	2001	823 000	2011	752 000
1992	621 000	2002	856 000	2012	814 400
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		

NMVOC

Emissions are reported by the plants.

Table 4.28 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				
2000	1.32	10.55	32.97				
2001	1.32	10.53	32.91				
2002	1.37	10.95	34.22				
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				

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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

2020

- NMVOC emissions for 2016-2017 were recalculated due to addition of facility reported emissions from the YLVA system previously missing from the inventory for one plant

Source-specific planned improvements

None.

4.4 Metal Production (NFR 2C)

Changes in chapter	
January 2020	JMP KS

Overview of the category

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, NH3, 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	NMVOC, 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
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, PCDD/F , HCB, 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}, $PM_{2.5}$

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.

Emissions of those plants that report their emissions to the supervising authorities[5] according to the monitoring requirements in the environmental permits are reported as "IE" and allocated under NFR 1A2a or NFR 1A2b. This is because the reporting obligations determined in the monitoring programmes are for the total emissions of the plants and not separated between fuel combustion and other processes. In most cases it has not been possible to split emissions in the NFR categories. In cases where it has been possible to separate fuel combustion emissions from process emissions, these are reported separately under the NFR 2C categories. For those plants that report only total emissions, the split is based on the default emissions calculated on basis of fuel consumption which is reduced from the emissions reported by the plants, and reported under the NFR 1A2a for iron and steel or under 1A2b for non-ferrous metals processes. In case it has not been possible to make a split between energy and process related emissions, all emissions are reported under NFR 1A2a or NFR 1A2b.

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

For those plants that do not report their emissions to supervising authorities, emissions have been calculated based on production data available in VAHTI 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 VAHTI 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.

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[6].

Iron and steel production (NFR 2C1)

Changes in chapter	
January 2020	KS, JMP

Source category description

SNAP 040202, 040203, 040205, 040206, 040207, 040208, 040209, 040210	**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 four 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 2018 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. Emissions related to fuel combustion are mainly reported under NFR 1A2a, however, the allocation of part of emissions reported by the plants may differ between the years, and part of energy related emissions can be reported under NFR 2C in some years when it has not been possible to calculate the shares for the correct allocation.

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 4.6a and 4.6b.

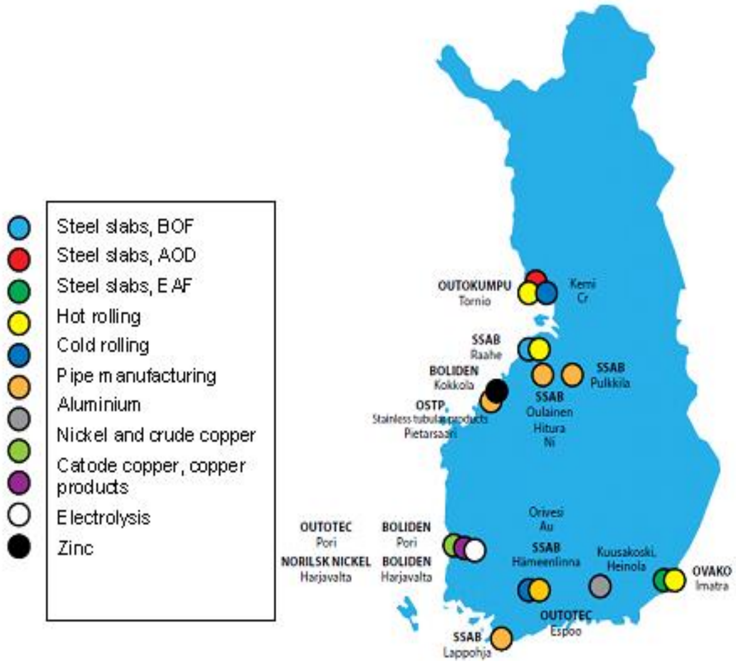


Figure 4.6a. Technologies in steel and non-ferrous metals in Finland in 2014

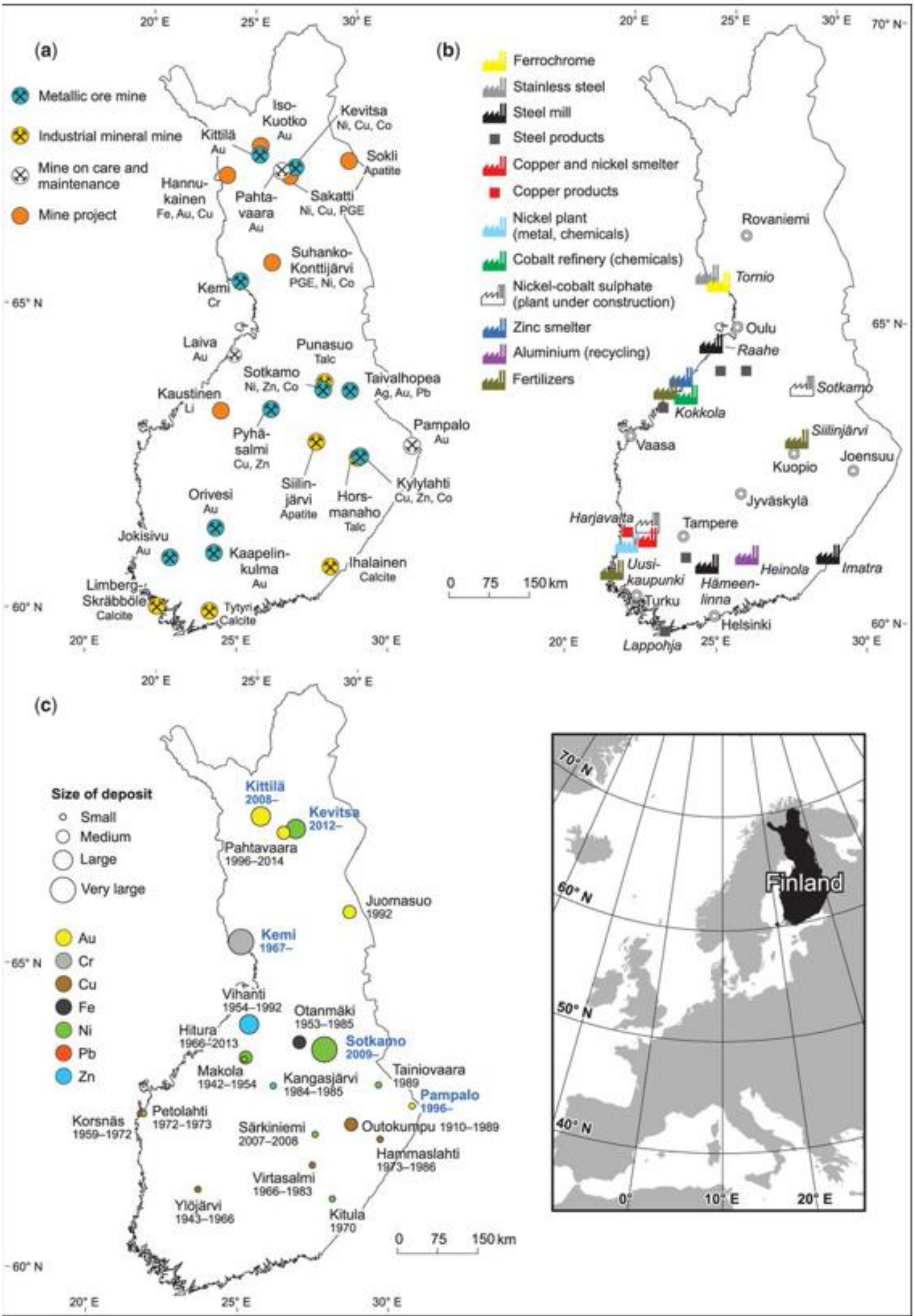


Figure 4.6b. Producers of steel and non-ferrous metals in Finland in 2020
https://sp.lyellcollection.org/content/early/2020/02/04/SP499-2019-83

Production of steel[7]

Processes used in the production of steel from iron ore and scrap metal in Finland are described below (Figure 4.7).

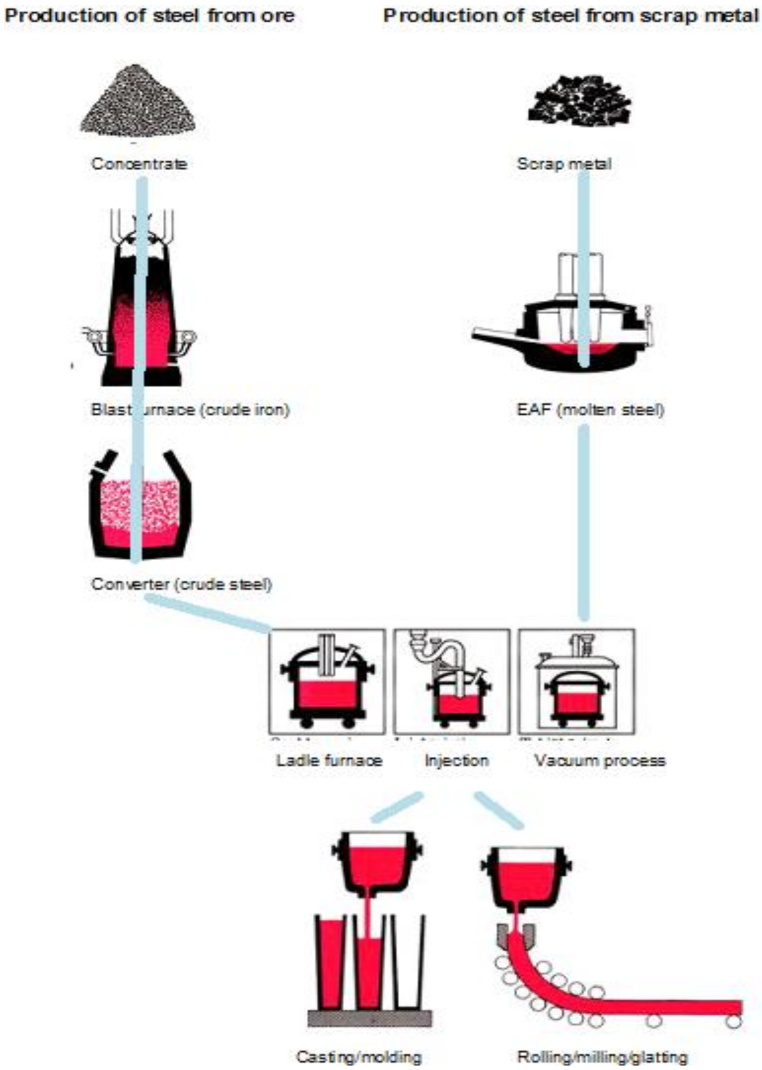


Figure 4.7 Production of steel from iron ore and scrap metal in Finland according to Teräskirja (Book of Steel in Hiilitieto, 2017)

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.

[7] 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-terasteollisuudessa/

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 (Argon Oxygen Decarburization) 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
- Surface preparation such as grinding, brushing, pattern rolling, or embossing

Emission trends

The emissions are impacted by annual production rates (Figure 4.8), which depend on markets. Technological changes in production and abatement techniques have occurred over the time.

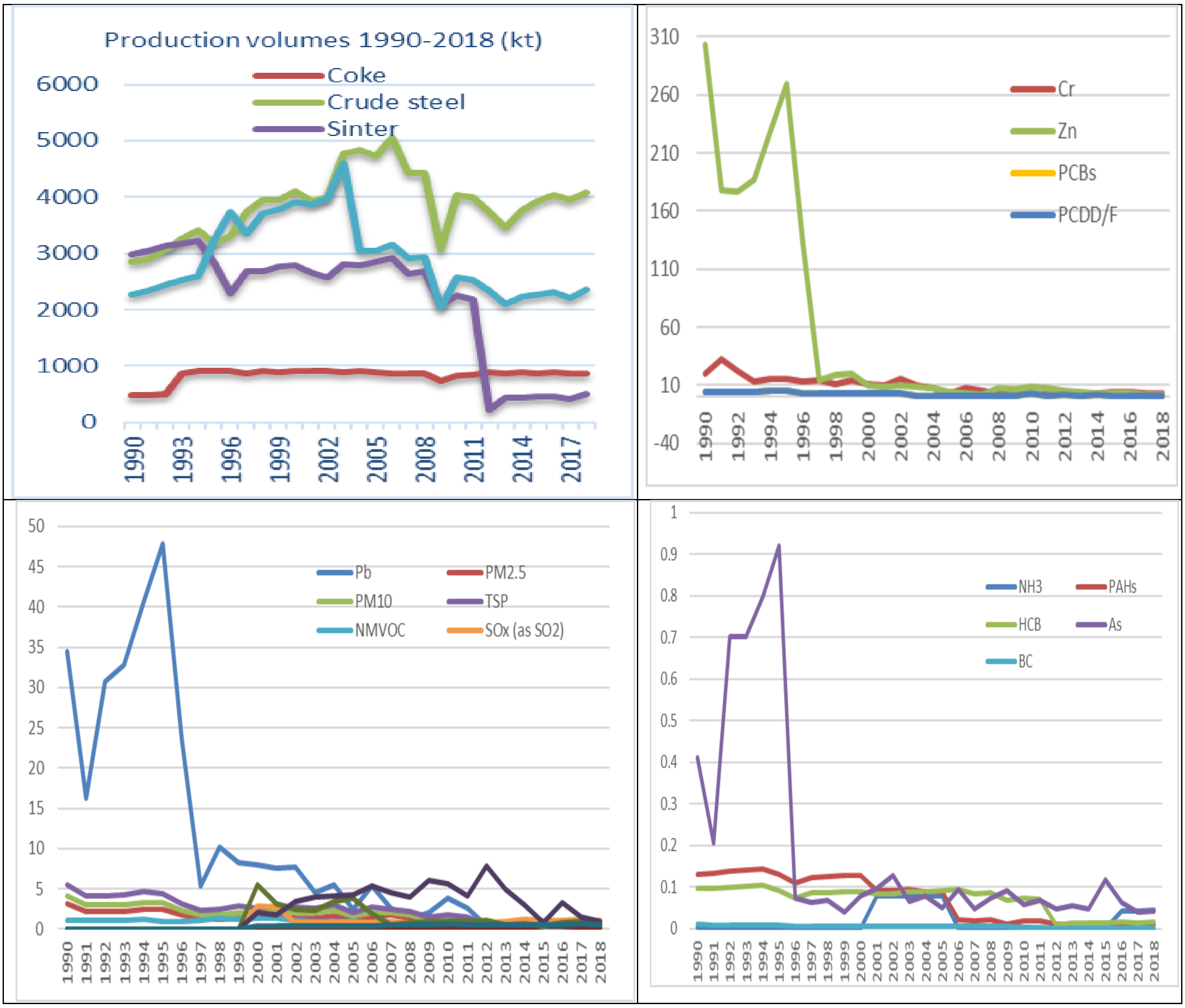


Figure 4.8 Iron and Steel production and emissions 1990-2018

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 4.29.

Table 4.29 *Contribution of Iron and Steel production (NFR 2C1) to total emissions in 2018.*

Pollutant	Emissions iron and steel industry	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.181	85.317	Gg	0.2	100
SOx (as SO2)	0.739	33.127	Gg	2.2	100
NH3	0.044	32.189	Gg	0.1	100
PM2.5	0.208	17.798	Gg	1.2	0
PM10	0.225	31.116	Gg	0.7	0
TSP	0.275	45.069	Gg	0.6	100
BC	<0.001	4.014	Gg	<0.1	0
CO	0.62	350.531	Gg	0.2	100
Pb	0.376	15.410	Mg	2.4	100
Cd	0.006	0.883	Mg	0.6	100
Hg	0.102	0.677	Mg	15.0	100
As	0.041	2.415	Mg	1.7	100
Cr	2.698	15.344	Mg	17.6	100
Cu	0.277	40.173	Mg	0.7	100
Ni	0.921	14.139	Mg	6.5	100
Zn	1.811	118.644	Mg	1.5	100
PCDD/F	1.196	14.356	g I-Teq	8.3	100
PAHs	0.011	9.991	Mg	0.1	4.4
HCB	0.016	32.024	kg	<0.1	0
PCBs	15.025	26.346	kg	57.0	35.3

Methodological issues

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

Activity data

Activity data for production of coke, steel and iron, is presented in Table 4.30.

Table 4.30 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

Sulphur dioxide, nitrogen dioxide and heavy metals

Sulphur dioxide, nitrogen dioxide and heavy metal emissions from the iron and steel industry are based on data reported by the plants.

Particle emissions

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 2019)
- Sinter plants: 50% for PM_{10} and 40% for PM2.5 (Guidebook 2019, (EEA, 2019))
- Steelworks (BOF): 91% for PM_{10} and 80% for $PM_{2.5}$ (Guidebook 2019 (EEA, 2019))
- Steelworks (EF) and rolling of steel: 80% for PM_{10} and 70% for $PM_{2.5}$ (Guidebook2019)

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 2019 (EEA, 2019))
- Sinter and pelletizing plant: 0.17 % of PM2.5 (Guidebook 2019 (EEA, 2019))

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) . Note: Guidebook 2002 is used as it provides a T2 EF while the later Guidebooks including 2019 provide only a T1 EF of “NE”, which we consider to overestimate emissions.
- Electric arc furnace steel plant, emission factor 0.46 kg/t (Guidebook 2019, (EEA,2019)

PAH (Table 4.31)

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 are calculated with emission factors as follows:

Production of steel, EFs:
- PAH-4 0.07 mg/t (UBA, 1998) (emissions occurred in 1990-2013)

Production of iron, EFs:
- PAH-4 4.3 mg/t PAH-4 (EPA, 1988)

  Note that the Guidebook EF of 2.5g/t likely is in an incorrect unit. Therefore the EF has not been used until the Guidebook value has been checked. This is related to the TERT recommendation from 2018.[8]

PAH emissions originate from the following processes:

(1) Sintering, which occurred in 1990-2011, after that the unit was closed down
A new unit started operation in 2013.
(2) Iron and steel production, which have been operating all the years.

The emissions from sintering in 1990-2000 have been calculated using production data and the country specific EF based on measurements 0.04 g/t, which is considered to better reflect the techniques used in

8 The TERT identified a number of observations on the trend and its use of EFs that were not country specific or consistent with the guidebook for 2C1 Iron and Steel production and PAH emission for 2006-2016. In response to a question raised during the review Finland provided additional information on the estimation method and the trends. The TERT recommends that Finland include this information in its IIR and considers using the 2016 EMEP/EEA Guidebook emission factors if no better country specific emission factors are available.

the 1990's, while the Guidebook 2019 EFs would correspond better to the more recent years. However, country-specific EFs are used for all years.

For the years 2001-2011 the emissions from sintering 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.

The emissions from the new unit that started the operation in 2013 are reported by the plant and are low compared to the emissions from the earlier unit that was closed down in 2011. The reason for the strong decreases are thus due to actual changes in the activities.

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 emission are calculated using the US EPA EF of 0.007 mg/t. These emissions have 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 recent survey to the plants.

PCB and HCB (Table 4.31)

Most of the steel mills report their POP emissions to the environmental authorities. For those plants which do not report their emissions, PCB emissions are calculated as follows:

Production of steel with the EF of 2.5 mg/Mg Guidebook 2019

Emission factors used for production of sinter
- HCB 32 ug/t Guidebook 2019, (EEA, 2019)
- PCB 0.09 mg/t Guidebook 2019, (EEA, 2019)

PCDD/F

The emissions from sintering in 1990-2001 have been calculated using production data and the country specific EF based on expert estimate 0.36 ug *I-TEQ*/t (unfortunately missing from IIR 2019), which is considered to better reflect the techniques used in the 1990's, while the Guidebook 2019 EFs correspond better to the more recent years. However, country-specific EFs are used for all years. These sintering plants 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.

Table 4.31 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	14.396	2.4	2.5	2.4	2.4	0.6
2018	15 025	2.6	2.7	2.6	2.6	1.2

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 5 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.
- Use of Guidebook 2016 EFs was checked

2020

- Update to Guidebook 2019 EFs
- TSP, PM2.5, PM10 and BC emissions were recalculated for 2017 due to addition of facility reported TSP emissions from the YLVA system previously missing from the inventory for seven plants. PM2.5, PM10 and BC emissions were calculated for these plants at SYKE (slight increase of emissions)
- BC emissions calculated for the plants for 1990-2011 and 2017 were recalculated due to addition of emissions from eight plants previously missing from the inventory (slight increase of emissions)

Source-specific planned improvements

None.

Ferroalloys production (2C2)

Changes in chapter	
January 2020	JMP KS

Source category description

SNAP 040302	**FERRO ALLOYS** Ferrochromium production plants (< 5 plants) are part of integrated stainless steel plants, emission reported by the plants Production capacity: 600 000t
Emissions	**Source of emissions**
NMVOC, SOx, PAHs	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5, BC	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Pb, Cd, Hg, As, Cr, Cu, Ni, Zn,	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 2014 several malfunction situations occurred at a production unit during the year, which could be seen as an increase in the level of zinc and chrome emissions. In 2015 and onwards all plants have operated normally, so all pollutants contributed less than 1% of the total emissions.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.32.

Table 4.32 Contribution of Ferroalloys production (NFR 2C2) to total emissions in 2018.

Pollutant	Emissions ferroalloys production	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.002	85.317	Gg	<0.1	100
SOx (as	0.002	33.127	Gg	<0.1	100
PM2.5	0.179	17.798	Gg	1.0	0
PM10	0.254	31.116	Gg	0.8	0
TSP	0.299	4.014	Gg	0.7	100
BC	0.018	15.410	Gg	0.4	0
Pb	0.021	0.883	Mg	0.1	100
Cd	<0.001	0.677	Mg	<0.1	100
Hg	0.002	2.415	Mg	0.2	100
As	<0.001	15.344	Mg	<0.1	100
Cr	1.181	40.173	Mg	7.7	100
Cu	0.08	14.139	Mg	0.2	100
Ni	0.094	118.644	Mg	0.7	100
Zn	1.013	9.991	Mg	0.9	100
PAHs	<0.001	85.317	Mg	<0.1	0

Methodological issues

As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, TSP, Sox, PAH4 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 PM10 and 60% for PM2.5 (Guidebook 2019, EEA 2019) from TSP emissions that are reported by the plants.

Black carbon

Emissions have been calculated using the fraction factor of 10 % of PM2.5 (Guidebook 2019, EEA 2019).

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 5 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

Source-specific planned improvements

None

Aluminium production (NFR 2C3)

Source category description

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 will be re-checked for 2019 submission.

SNAP 040301	**OTHER** Secondary aluminium production and aluminium casting Number of plants < 5 Production capacity: ~50 000 t/a aluminium profiles
Emissions	**Source of emissions**
NMVOC, TSP, PM10, PM2.5, BC, Pb, Cd, As, Zn	reported by the plants according to the monitoring and reporting obligations in their environmental permits
diox, HCB, PCB,	calculated (EF*AD)

The contribution of aluminium production to national total emissions and the share of emissions reported by the operators is presented in Table 4.33.

Table 4.33 Contribution of Aluminium production (NFR 2C3) to total emissions in 2018.

Pollutant	Emissions ferroalloys production	Total emissions	Unit	Share of total emissions %	% reported by the plants
PM2.5	<0.001	17.798	Gg	<0.1	0
PM10	<0.001	31.116	Gg	<0.1	0
TSP	<0.001	45.069	Gg	<0.1	58
BC	<0.001	4.014	Gg	<0.1	0
Pb	<0.001	15.410	Mg	<0.1	100
Cd	<0.001	0.883	Mg	<0.1	100
As	<0.001	2.415	Mg	<0.1	100
Zn	0.002	118.644	Mg	<0.1	100
PCDD/ PCDF	0.9	14.356	g I-Teq	6.3	0
HCB	0.035	32.024	kg	0.1	0
PCBs	0.092	26.346	kg	0.3	0

Methodological issues

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 2019).

POP emissions

PCDD/F, 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 4.34a and activity data presented in Table 4.34b.

Table 4.34a Emission factors for POP emissions

Pollutant	Process	EF	Reference
PCDD/F	secondary aluminium	35 ug I-TEQ/t	Guidebook2019
HCB	secondary aluminium	1.365 mg/t	SYKE, 2007
PCB	secondary aluminium	3.4 mg/t	(iPRO, 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 4.34b 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 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	32 929
2014	20 906	2014	32 929*
2015	20 490	2015	32 929*
2016	22 071	2016	32929*
2017	25 298	2017	32 929*
2018	25 709	2018	32 929*

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

- due the lack of activity data, year's 2013 data is used

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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 (slight increase of emissions).

Source-specific planned improvements

- None

Magnesium production (2C4)

No magnesium production occurs in Finland.

Lead production (2C5)

No lead production occurs in Finland.

Zinc production (NFR 2C6)

Changes in chapter	
January 2020	KS JMP

Source category description

SNAP 040309c	Zinc production plants (< 5 plants), emissions both reported by the plants and calculated at the inventory agency
Emissions	**Source of emissions**
TSP, PM_{10}, $PM_{2.5}$	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Pb, Cd, Hg, As, Cr, Cu, Ni, Zn,	reported by the plants according to the monitoring and reporting obligations in their environmental permits
PCDD/F	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, NMVOC, particles and PCDD/F. Zn emissions from this sector contribute to nearly 4% of the total emissions. The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.35.

Table 4.35 Contribution of Zinc production (NFR 2C6) to total emissions in 2018.

Pollutant	Emissions from zinc production	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.001	85.317	Gg	<0.1	0
PM2.5	<0.001	17.798	Gg	<0.1	0
PM10	<0.001	31.116	Gg	<0.1	0
TSP	<0.001	45.069	Gg	<0.1	100
Pb	0.008	15.410	Mg	<0.1	100
Cd	0.012	0.883	Mg	1.4	100
Hg	0.001	2.415	Mg	0.2	100
As	0.006	40.173	Mg	0.2	100
Cu	0.019	118.644	Mg	<0.1	100
Zn	3.982	14.356	Mg	3.4	100
PCDD/ PCDF	0.029	85.317	g I-Teq	0.2	0

Methodological issues

SOx

Zinc production occurs alongside sulphur productios and SO2 emissions from zinc production are utilised in the sulphur production. Therefore, SO2 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 SO2 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.

TSPs and heavy metals (As, Hg, Cd, Cu, Pb, Zn)

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. These emissions are included in the inventory as the difference between data reported by the plants and the default emissions calculated on basis of energy consumption. It will be further studied in the coming years, if the energy emission factor should be revised to be higher or if these really are process emissions.

When no plant specific data is available emissions has been calculated.

Small particles

PM_{10} and $PM_{2.5}$ emissions are calculated using size fraction factors of 91% for PM10 and 81% or PM2.5 from TSP emissions, which are reported by the plants (Guidebook 2019).

NMVOC and PCDD/F

NMVOC and PCDD/F emissions from primary zinc smelting in hot dip galvanizing processes were reported to the supervising authorities for the year 2007 only. As these emissions were not reported for the years 2008-2018, emissions are calculated for the years after 2007 based on production data (seeTable 4.37) of the plant and a plant specific emission factor (calculated as IEF from 2007 data). An implied emission factor 0.005 t/t for NMVOC and 0.098 t/t for PCDD/F (SYKE, 2009) have been used for 1990-2018. Production volumes are available either at plant level in YLVA or from the Federation of Finnish Technology Industries (Table 4.36). The reported emissions are presented Table 4.37.

Table 4.36 Production of zinc in 1990-2018. (reported by plants to the YLVA-database)

Year	Zinc production (t)	Year	Zinc production (t)
1990	175 000	2006	282 261
1991	170 389	2007	305 543
1992	170 523	2008	297 772
1993	170 934	2009	295 049
1994	173 244	2010	307 144
1995	176 583	2011	307 352
1996	176 223	2012	314 742
1997	175 334	2013	311 682
1998	198 940	2014	302 024
1999	225 190	2015	305 717
2000	222 881	2016	290 599
2001	248 816	2017	284 992
2002	235 337	2018	295 029
2003	265 853		
2004	284 525		
2005	281 904		

Table 4.37 NMVOC and PCDD/F emissions from zinc production.

Year	NMVOC(kg)	PCDD/F (g I-TEQ)	Year	NMVOC(kg)	PCDD/F (g I-TEQ)
1990	0.818	0.017	2010	1.435	0.030
1991	0.796	0.017	2011	1.436	0.030
1992	0.797	0.017	2012	1.471	0.031
1993	0.799	0.017	2013	1.457	0.031
1994	0.810	0.017	2014	1.412	0.030
1995	0.825	0.017	2015	1.429	0.030
1996	0.824	0.017	2016	1.358	0.029
1997	0.819	0.017	2017	1.331	0.028
1998	0.930	0.020	2018	1.379	0.029
1999	1.052	0.022			
2000	1.042	0.022			
2001	1.163	0.024			
2002	1.100	0.023			
2003	1.243	0.026			
2004	1.330	0.028			
2005	1.318	0.028			

2006	1.319	0.028			
2007	1.428	0.030			
2008	1.391	0.029			
2009	1.379	0.029			

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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

Source-specific planned improvements
- None

Copper production (NFR 2C7a)

Changes in chapter	
January 2020	JMP KS

Source category description

SNAP 040309a	**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	**Source of emissions**
SO_X, CO, NMVOC	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM_{10}, $PM_{2.5}$,	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Pb, Cd, Hg, As,, Cu, Ni, Se, Zn,	reported by the plants according to the monitoring and reporting obligations in their environmental permits
PCDD/F, HCB, PCB, BC	calculated (EF*AD)

Emission trends

Secondary copper production is a major source of HCB and PCDD/F emissions. Other pollutants contribute less than 1% of the total emissions 4.38.

Table 4.38 Contribution of Secondary copper production (NFR 2C7a) to total emissions in 2018.

Pollutant	Emissions from copper production	Total emissions in	Unit	Share of total emissions %	% reported by the plants
NMVOC	<0.001	85.317	Gg	<0.1	100
SOx (as SO2)	0.111	33.127	Gg	0.3	1.7
PM2.5	<0.001	17.798	Gg	<0.1	0
PM10	<0.001	31.116	Gg	<0.1	0
TSP	<0.001	45.069	Gg	<0.1	4.4
BC	<0.001	4.014	Gg	<0.1	0
CO	0.006	350.531	Gg	<0.1	100
Pb	0.002	15.410	Mg	<0.1	9.1
Cd	<0.001	0.883	Mg	<0.1	100
Hg	<0.001	0.677	Mg	<0.1	0
As	0.082	2.415	Mg	3.4	86.9
Cr	<0.001	15.344	Mg	<0.1	100
Cu	0.004	40.173	Mg	<0.1	100
Ni	<0.001	14.139	Mg	<0.1	0
Se	0.101	0.472	Mg	21.4	100
Zn	0.002	118.644	Mg	<0.1	100
PCDD/PCDF	0.221	14.356	g I-Teq	1.5	0
HCB	6.541	32.024	kg	20.4	0
PCBs	<0.001	26.346	kg	<0.1	0

Methodological issues

Total suspended particles, heavy metals (As, Cd, Cu, Pb, Zn, Ni, Hg) and sulphur dioxide

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 2019) from TSP emissions. Black carbon emissions are calculated using the emission factor 0.1 % of PM2.5 (Guidebook B2019, EEA 2019).

POPs

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 2019),
- PCDD/F: production of secondary copper 50 ug I-TEQ/t (Guidebook 2019
- 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 2019)
  wrought copper production 3.7 ug/t (Guidebook 2019).

Activity data used in the calculation is presented in Table 4.39 and the emissions in Table 4.40.

Table 4.39 Copper production volumes 1990-2018 (reported by plants to the VAHTI-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			
2000	155 400	126 287			
2001	169 250	120 449			
2002	160 900	115 477			
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 4.40 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	6.46	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				
2000	8.27	1.55	0.61				
2001	8.71	1.69	0.60				
2002	8.30	1.61	0.57				
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 7of 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.)
- 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
- Cr emissions calculated for the plants for 1990 to 2017 were recalculated due to inclusion of emissions from one plant previously missing from the inventory

Source-specific planned improvements

None

Nickel production (NFR 2C7b)

Changes in chapter	
January 2020	JMP KS

Source category description

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

Emission trend

Nickel production is a major source of Ni emissions, while other pollutants contribute less than 1% of the total emissions.

The shares of emissions of total emissions and shares reported by the plants are presented Table 4.41.

Table 4.41 Contribution of Nickel production (NFR 2C7b) to total emissions in 2018.

Pollutant	Emissions from nickel production	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.029	85.317	Gg	<0.1	100
SOx (as SO2)	0.015	33.127	Gg	<0.1	100
NH3	0.084	32.189	Gg	0.3	100
Ni	2.998	14.139	Mg	21.2	100

Methodological issues

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 7 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	
January 2020	KS JMP

Source category description

SNAP 040306	**ALLIED METAL MANUFACTURING** Number of plants <5 Production capacity:~1000 t casting products
Emissions	**Source of emissions**
Cu, Pb, Zn, Ni	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	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$	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	**Source of emissions**
As, Cd, Pb, Zn,	reported by the plants according to the monitoring and reporting obligations in their environmental permits
HCB, PCB, PCP	calculated (EF*AD)
TSP, PM10, PM2.5	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	**Source of emissions**
TSP, PM10, PM2.5	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Pb, Zn, Cr, Ni,	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC, NH3,	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	**Source of emissions**
NMVOC	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	**Source of emissions**
Zn	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	**Source of emissions**
NMVOC	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Zn,Cr	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5	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	**Source of emissions**
NMVOC	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	**Source of emissions**
TSP, PM10, PM2.5	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	**Source of emissions**
Pb	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	**Source of emissions**
PCB	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	**Source of emissions**
TSP, PM10, PM2.5	reported by the plants according to the monitoring and reporting obligations in their environmental permits
As, Cu, Pb	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC	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	**Source of emissions**
Pb, Zn	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5	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 VAHTI 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.

Emission trends

The shares of emissions of total emissions and shares reported by the plants are presented Table 4.42.

Table 4.42 Contribution of Other metal production (NFR 2C7c) to total emissions 2018

Pollutant	Emissions from other metal production	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.006	85.317	Gg	<0.1	100
SOx (as SO2)	<0.001	33.127	Gg	<0.1	100
NH3	<0.001	32.189	Gg	<0.1	100
PM2.5	0.006	17.798	Gg	<0.1	0
PM10	0.007	31.116	Gg	<0.1	0
TSP	0.012	45.069	Gg	<0.1	100
Pb	0.298	350.531	Mg	1.9	100
Cd	0.007	15.410	Mg	0.7	100
Hg	0.078	0.883	Mg	11.6	100
As	0.23	0.677	Mg	9.5	100
Cr	0.02	2.415	Mg	0.1	100
Cu	0.274	15.344	Mg	0.7	100
Ni	0.034	40.173	Mg	0.2	100
Zn	0.002	14.139	Mg	0.4	0
PCDD/ PCDF	0.504	118.644	g I-Teq	0.4	100
HCB	0.067	14.356	kg	0.2	0
PCBs	0.015	32.024	kg	<0.1	0

Methodological issues

Heavy metals

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

HCB emissions from primary zinc smelting in the hot dip galvanizing process are calculated with the emission factor of 1.45644 mg/t (Toda, 2005) and activity received from the industry. There is no method in the Guidebook.

Precious metals

From production of gold and silver metals also PCB emissions are calculated with emission factor 159.795 mg/t (Toda, 2005) and using activity data presented in Table 4.44

Table 4.43 Precious metals; production of gold and silver (t) 1990-2018 (Statistics Finland)

Year	Production of gold and silver (t) (Statistics Finland)	Year	Production of gold and silver (t) (Statistics Finland)
1990	31.8	2006	44.4
1991	32.2	2007	36.0
1992	28.6	2008	61.6
1993	30.4	2009	62.1
1994	27.4	2010	70.6
1995	29.1	2011	80.0
1996	36.9	2012	137
1997	36.1	2013	109
1998	34.7	2014	160
1999	36.8	2015	137
2000	28.6	2016	112
2001	28.4	2017	96
2002	34.6	2018	96
2003	41.4		
2004	38.9		
2005	38.2		

Table 4.44 Primary zinc smelting in hot dip galvanizing process in 1990-2018 (reported by plants to the YLVA-database)

Year	Primary zinc smelting (t)	Year	Primary zinc smelting (t)
1990	23 094	2006	49 121
1991	21 092	2007	38 000
1992	24 270	2008	37 625
1993	26 527	2009	28 927
1994	18 331	2010	36 250
1995	31 428	2011	34 078
1996	31 999	2012	37 392
1997	33 526	2013	28 918
1998	32 339	2014	30 636
1999	31 931	2015	32 516
2000	43 125	2016	50 042
2001	47 716	2017	48 069
2002	51 684	2018	46 182
2003	49 890		
2004	49 403		
2005	43 459		

POP emissions from other metal production are presented in Table 4.45.

Table 4.45 POP emissions from other metal production.

Year	HCB (kg)	PCB (kg)	Year	HCB (kg)	PCB (kg)
1990	0.029	0.005	2010	0.051	0.011
1991	0.034	0.005	2011	0.050	0.013
1992	0.037	0.005	2012	0.055	0.022
1993	0.040	0.004	2013	0.051	0.017
1994	0.044	0.005	2014	0.054	0.026
1995	0.045	0.006	2015	0.057	0.022
1996	0.047	0.006	2016	0.073	0.018
1997	0.045	0.006	2017	0.070	0.012
1998	0.045	0.006	2018	0.067	0.015
1999	0.060	0.005			
2000	0.067	0.005			
2001	0.072	0.006			
2002	0.070	0.007			
2003	0.069	0.006			
2004	0.061	0.006			
2005	0.069	0.007			
2006	0.053	0.006			
2007	0.053	0.010			
2008	0.040	0.010			
2009	0.029	0.005			

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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.
- TSP, Pb, Cd, As, Cr, Cu, Ni, Zn emissions calculated for the plants for 2017 were recalculated due to inclusion of facility reported emissions from the YLVA system previously missing from the inventory for one plant, in addition to PM2.5 and PM10 emissions.

Source-specific planned improvements

None.

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

Update of text	
January 2020	JMP KS

Source category description

SNAP 040211	**Storage, handling and transport of metal products** storage and handling of iron ore.
Emissions	**Emission source**
TSP, PM_{10}, $PM_{2.5}$	calculated (EF*AD)

Emission trend

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

Table 4.46 Contribution of Storage, handling and transport of metal products (NFR 2C7d) to total emissions 2018

Pollutant	Emissions from Storage, handling and transport of metal products i	Total emissions	Unit	Share of total emissions %	% reported by the plants
PM2.5	<0.001	17.798	Gg	<0.1	0
PM10	0.008	31.116	Gg	<0.1	0
TSP	0.015	45.069	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.

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 (PM10) and 0,000008 t/t (PM2.5), (TNO, 2002). Production of iron ore is presented in Table 4.47 and particle emissions in Table 4.48.

Table 4.47 Activity data for iron ore in 1990-2018 (Customs Statistics ULJAS)

YEAR	Iron ore (t))	YEAR	Iron ore (t)	YEAR	Iron ore (t)
1990	3 058 362	2000	3 917 135	2010	3 055 661
1991	3 085 141	2001	3 916 263	2011	3 611 830
1992	3 363 742	2002	3 791 709	2012	3 224 219
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		

Table 4.48 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				
2000	0.78	7.83	15.67				
2001	0.78	7.83	15.67				
2002	0.76	7.58	15.17				
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 5 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

2020

- Particle emissions for 1990-2017 were recalculated due to adoption of Guidebook 2019 EFs leading to significant decrease of emissions

Source-specific planned improvements

None.

Other solvent and product use (NFR 2D-2L)

Changes in chapter	
January 2020	JMP KS

Source category description

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. Acitivites and emissions reported under the Other solvent and product use categories are presented in Table 4.49.

Table 4.49 Activities and emissions reported under the Other solvent and product use categories

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, PM10, PM2.5, PCDD/PCDF
2D3c	Ashalt roofing	Aspahlt mixing plants	NMVOC
2D3d	Coating applications	Decorative, industrial and other coating	NMVOC, TSP, PM10, PM2,5
2D3e	Degreasing	Chlorinated organic solvents are not produced in Finland, all the used solvents are imported.	NMVOC, NH3, TSP, PM10, PM2,5
2D3f	Dry cleaning	Included in degreasing (2D3e)	NMVOC's 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, PM10, PM2,5, NH3, 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, NH3, TSP, PM10, PM2,5, BC, PAHs, HCB
2G	Other product use	Use of fireworks and tobacco	As, Cd, Cr, Cu, Hg, Pb, CO, NH3, NOx, SOx, NMVOC, TSP, PM10, PM2,5, BC, PCDD/PCDF, PAHs

Emissions of those plants that report their emissions to the supervising authorities[9] according to the monitoring requirements in the environmental permits are in most cases reported as IE. This is because the reporting obligations determined in the monitoring programmes are for the total emissions of the plants and not separated between fuel combustion and other processes. Thus it has not been possible to make a complete split between emissions from fuel based and non-fuel based sources. In cases where it has been possible to separate fuel combustion emissions from process emissions, these are reported separately under the NFR 2D categories. For those plants that report only total emissions, the split is done where it has been possible based on the default emissions calculated on basis of fuel consumption which is reduced from the emissions reported by the plants, and reported under NFR 1A2gviii.

Domestic solvent use including fungicides (NFR 2D3a)

Changes in chapter	
January 2020	KS & JMP

Source category description

SNAP 060408 SNAP 060411	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	NMVOC (calculated)
	Hg from fluorescent tubes are reported under 1A1a by the hazardous waste incineration plant (with energy recovery)

Emission trend

The shares of emissions of national totals and shares reported by the operators are presented in Table 4.50.

Table 4.50 Contribution of domestic solvent use (NFR 2D3a) to total NMVOC emissions

Pollutant	Emissions from domestic solvent use	Total emissions in	Unit	Share of total emissions %	% reported by the plants
NMVOC	5.031	85.317	Gg	5.9	0

NMVOC emissions are calculated using emission factors presented in Guidebook 2019 for pharmaceuticals, adhesives and filling agents which are not included to the calculation model for household products.

The calculation model includes estimates for the years 1990, 1995, 2000, 2005, 2010 and 2014. The summary of the results is presented in Table 4.51. The purpose is to update the model every 5 years.

Table 4.51 NMVOC emissions from Household Products Use in 1990, 1995, 2000, 2005, 2010 and 2014 (Rantanen et al., 2015)

NMVOC emissions [kt/a]	1990	1995	2000	2005	2010	2014
Cosmetics and toiletries	1.80	1.84	2.10	2.23	2.69	2.69
Household cleaning products	0.61	0.58	0.61	0.68	0.64	0.68
Car care products	0.42	0.84	0.90	1.02	0.90	0.74
Other products	0.02	0.03	0.04	0.06	0.08	0.11
TOTAL	**2.85**	**3.30**	**3.66**	**3.98**	**4.31**	**4.21**

Calculation principles in the model

The model follows the actual domestic sales of different products. Only products identified as sources of NMVOC emissions are included in the model as presented in Table 4.52. The following groups are currently not covered by the model due to lack of sales data: pharmaceuticals, office products, Do It Yourself (DIY) products, adhesives and sealants.

Table 4.52 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	hygiene, hair care (4 subgroups), soap (1) and parfume products (2 subgroups).	money spent
Househould cleaning products	glass surface cleaning agents (3 subgroups), airrefresheners, general cleansing agents (2 subgroups)	money spent
Car care products	car wax, windscreen washing agents (2 subgroups), de-icing, degreasing and engine detergents	sales volumes
Other products	lighter fluids for grilling and repellents.	sales volumes

Information on money spent on products was received from the Finnish Cosmetic, Toiletry and Detergent Association and this was divided between each of the subgroups based on expert estimates. NMVOC emissions were estimated based on sales volumes in litres derived from average product specific prices (€/l) and the density of the product, as well as from the contents and volatilization rates of NMVOC compounds typically contained in the products.

Sales volumes in litres was derived from information received from some selected large retail companies and then scaled according to the sales shares to the whole country taking into account the specific sales profiles of the different types of retailers. NMVOC emissions were estimated based on sales volumes and the contents and volatilization rates of NMVOC compounds typically present in the products.

The emissions reported in the NFR tables for the intermediate years of those provided by the model, project are extrapolated. A method to calculate the emissions using GDP or population data will be developed for these years. The emission estimates are planned to be updated every 5 years. In the 2018 submission the same emission estimate was used for the year 2015 as for 2014.

A detailed documentation of the model with information on data sources, assumptions made and detailed calculations is presented in Rantanen et al., 2015.

EMEP/EEA Guidebook 2019 Tier 1 method has been used for pharmaceuticals, adhesives and filling agents, which are not included in the calculation model for household products. Population is used as activity data (Table 4.53).

Table 4.53. Population 1990-2018 (Statistics Finland, 2020)

Year	Population
1990	4998478
1991	5029002
1992	5054982
1993	5077912
1994	5098754
1995	5116826
1996	5132320
1997	5147349
1998	5159646
1999	5171302
2000	5181115
2001	5194901
2002	5206295
2003	5219732
2004	5236611

Year	Population
2005	5255580
2006	5276955
2007	5300484
2008	5326314
2009	5351427
2010	5375276
2011	5401267
2012	5426674
2013	5451270
2014	5471753
2015	5487308
2016	5503297
2017	5513130
2018	5517919

In Finland the use of paint/varnish removers is included in the NMVOC emissions from paint application. The inventory of paint application is carried out by the Association of Finnish Paint Industry and Printing Ink Companies and includes both manufactured and imported removers and thinners. There has been a change in the person carrying out this inventory and a new description of the inventory will be included in the 2020 IIR. It is worth to note that due to the great depression in the beginning of the 1990's (see IIR

General partA) the large mass of small workshops producing doors, windows etc. carpenter products and engineering products were closed down and never reopened and these products are now imported.

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 the monitoring requirements of the plant's environmental permit.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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 took into account 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 did not take into account 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).

Source-specific planned improvements

In the next years when resources will be approved for the work

- New data collection on NMVOC containing products' sales.
- Fine-tuning of the NMVOC model to reflect changes in legislation and product development and to calculate the emissions using GDP or population for years which are not covered by data collection.

Road paving with asphalt (2D3b)

Changes in chapter	
January 2020	KS & JMP

Source Category description

SNAP 040611	**Asphalt roofing** Asphalt mixing plants
Emissions	**Source of emissions**
TSP, PM_{10}, $PM_{2.5}$, BC, NMVOC, PCDD/F	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 does 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 shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.54.

Table 4.54 Contribution of road paving with asphalt (NFR 2D3b) to total emissions in 2018

Pollutant	Emissions from road paving with asphalt	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.359	85.317	Gg	0.4	0
PM2.5	0.058	17.798	Gg	0.3	0
PM10	0.064	31.116	Gg	0.2	0
TSP	0.085	45.069	Gg	0.2	0
BC	0.003	4.014	Gg	<0.1	0
PCDD/ F	0.011	14.356	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 basis of plant specificasphalt 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 EF in the EMEP/EEA Emission Inventory Guidebook 2019. 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 $PM_{2.5}$ (Guidebook2019, EEA, 2019). Activity data used in the calculation is presented in Table 4.55.

Table 4.55 Amount of produced asphalt (1990-2018), Confederation of Finnish Construction Industries RT Infra Division (Infra ry, 2019)

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	5 300
1997	5200	2017	5 300
1998	4900	2018	5 300
1999	4600		
2000	4500		
2001	4500		
2002	5000		
2003	5 500		
2004	5 600		
2005	6 200		
2006	5 500		
2007	5 880		
2008	6 050		
2009	5 176		

POP emissions

PCDD/F emissions are based on asphalt production, which is publicly available in industrial statistics (Statistics Finland). The emission factor for asphalt production is 2 ng I-TEQ/t (UNEP 1999). There is no method provided in the Guidebook 2016. The emissions are presented in Table 4.56.

NMVOCs

For NMVOC emissions from road paving with aphalt (NFR 2D3b) and asphalt roofing (NFR 2D3c) are calculated using the same method based on bitumen use, which is confidential. Data on bitumen use is received from the domestic bitumen producer (Nynas Oy, previously Fortum Oil and Gas Ltd., Ref. Blomberg, 2006, Remes. H., 2019). 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 4.55). 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 4.55.

Table 4.55 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--2018 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).

Table 4.56 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	84.8	63.6	58.3	3.3	337	0.011
2016	84.8	63.6	58.3	3.3	391	0.011
2017	84.8	63.6	58.3	3.3	437	0.011
2018	84.8	63.6	58.3	3.3	359	0.011

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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

- Adoption of Guidebook 2019 methods for particles
- NMVOC emissions from 2017 were recalculated due to update of activity data, slight increase in emissions

Source-specific planned improvements

None

Asphalt roofing (NFR 2D3c)

Changes in chapter	
January 2020	KS JMP

Source category description

SNAP 040610	**Roof covering with asphalt materials** Emissions from the use of bitumen oils, bitumen emulsions and industry bitumens are reported under this category,
Emissions	**Source of emissions**
NMVOC	Calculated
Particles	Reported by the plants according to requirements in their monitoring programmes.

Emission trend

Asphalt roofing is a minor source of NMVOC and the emissions vary according to the production volumes over the years.

The time series of emissions has not been recalculated and thus the variations in the emissions do not fully represent actual variations in emissions.

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

Table 4.57 Contribution of asphalt roofing (NFR 2D3c) to total emissions in 2018.

Pollutant	Emissions from asphalt roofing	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.202	85.317	Gg	0.2	0

Methodological issues

NMVOC

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. 2019) and the imported amount of bitumen (information from customs statistics database ULJAS).

The data presented in Table 4.56 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 2006-2018 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.

NMVOC emissions from asphalt roofing are presented in Table 4.58.

Table 4.58 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		
2000	489		
2001	494		
2002	498		
2003	503		
2004	332		
2005	324		
2006	283		
2007	362		
2008	349		
2009	321		

Particles

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 emissions from asphalt roofing result from the use of LFO and terefore they are reported NA and allocated under NFR 1A2f.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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.

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 recalculated due to update of activity data, slight decrease in emissions.

Source-specific planned improvements

None.

4.5 Solvent and Other Product Use

Coating applications (NFR 2D3d)

Changes in chapter	
January 2020	KS JMP

Source category description

According EMEP/EEA Guidebook 2019 NFR 2D3d coating applications consists of decorative, industrial and other coating applications. Industrial activities in Finland falling under NFR 2D3d Coating applications are presented in Table 4.59.

Table 4.59 Activities and emissions reported from coating applications.

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

The allocation of emissions between decorative and industrial coating apllications in the Finnish inventory is not consistent over the years. The division between decorative and industrial coating has been possible only since 2001. Emissions from years 1990-2000 are presented on a more aggregated level.

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 4.60.

Table 4.60 Contribution of coating applications (NFR 2D3d) to total emissions in 2018.

Pollutant	Emissions from coating applications	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	6.538	85.317	Gg	7.7	17
PM2.5	<0.001	17.798	Gg	<0.1	0
PM10	0.001	31.116	Gg	<0.1	0
TSP	0.002	45,069	Gg	<0.1	100

Emission trends

NMVOC emissions from paint application are presented in Figure 4.10 and in Table 4.61. In Table 4.61 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.

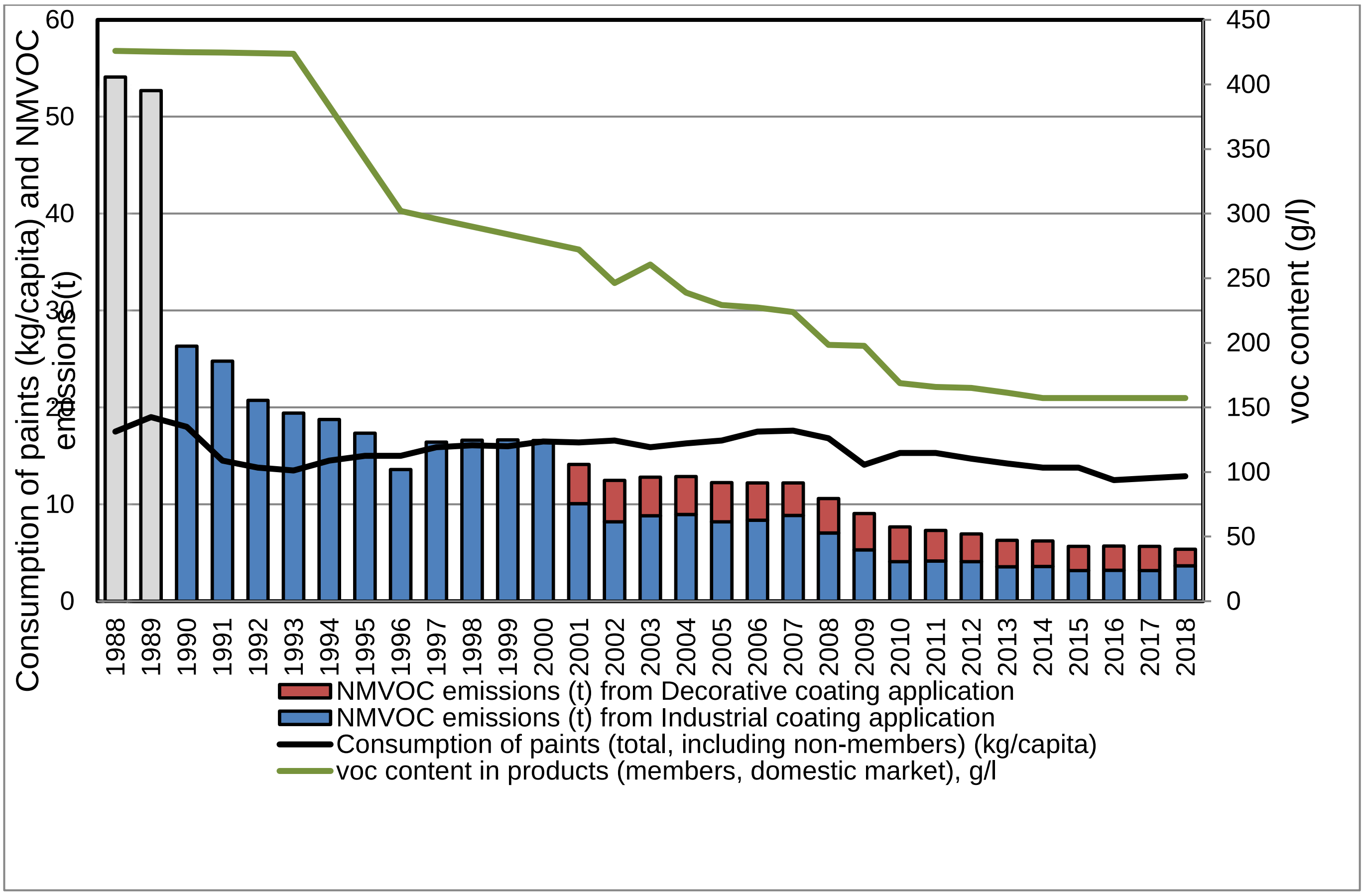


Figure 4.10 NMVOC emissions from paint application, VOC content and consumption of paints.

Table 4.61 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]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]
industrial	54.1	52.7	27.5	26.0	22.0	20.5	20.0	19.00	15.6	18.0	18.0
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	IE	IE[1]	4.0	4.3	4.0	3.9	4.0	3.9	3.3	3.6	3.5
industrial	17.9	17.9	11.4	9.9	10.2	10.0	9.5	10.3	10.7	8.7	6.6
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**		
decorative	3.3	2.9	2.7	2.7	2.6	2.5	2.5	2.5	1.7		
industrial	5.4	5.3	5.2	4.6	4.5	4.2	4.2	3.2	3.6		
other coating	0.03	0.02	0.01	NA	NA	NA	NA	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 4.62. 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 4.62 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 4.62 NMVOC emissions from industrial and other coating applications are reported by operators, from 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 2017 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 2018 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 2018 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 2018 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 4.63

Table 4.63 NMVOC emissions from coating applications

Year	NMVOC (kt)	Year	NMVOC (kt)	Year	NMVOC (kt)
1990	27.500	2004	14.495	2018	6.538
1991	26.000	2005	14.007		
1992	22.000	2006	14.517		
1993	20.500	2007	14.633		
1994	20.000	2008	12.559		
1995	19.000	2009	10.576		
1996	15.630	2010	9.170		
1997	18.000	2011	8.719		
1998	18.000	2012	8.181		
1999	17.900	2013	7.512		
2000	17.900	2014	7.270		
2001	15.586	2015	6.772		
2002	14.130	2016	6.803		
2003	14.581	2017	6.803		

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 2018 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 7 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.
- NMVOC emissions for 1990-2017 were recalculated due to correction of errors

Source-specific planned improvements

In the next 5 years
- Improving the consistency of the allocation of emissions between decorative and industrial coating applications for the years 1990-2000 is planned to be carried out according to the division of earlier shares
- Separation of emissions between other coating applications and decorative and industrial coating

Degreasing (NFR 2D3e)

Changes in chapter	
January 2020	KS & JMP

Source category description

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. Activities listed in Table 4.64 are included in the inventory.

Table 4.64 Information sources for the NMVOC inventory under NFR 2D3e.

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

Degreasing in the Finnish inventory includes part of the emissions from Dry cleaning (NFR 2D3f) which can not currently be reported separately.

Emission trend

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.65.

Table 4.65 Contribution of Degreasing (NFR 2D3e) to total emissions in 2018.

Pollutant	Emissions from degreasing	Total emissions	Unit	Share of total emissions %	% reported by plants
NMVOC	0.439	85.317	Gg	0.5	6.7
NH_3	0.004	32.189	Gg	<0.1	100
PM2.5*	<0.001	17.798	Gg	<0.1	0
PM10*	<0.001	31.116	Gg	<0.1	0
TSP*	<0.001	45.069	Gg	<0.1	100

*there may be incorrect allocation of particle emissions, will be checked for the next submission

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 4.66. 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 4.67.

Table 4.66 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

Table 4.67 NMVOC emissions from degreasing (use of chlorinated organic solvents)

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

NH_3

Ammonia emissions are repoted by plants according to the monitoring requirements of the monitoring programme included in their environmental permits. These emissions originate from electronic components manufacturing.

Particles

Particle emissions are reported by the plants according to the monitoring requirements of the monitoring programme included in their environmental permits. 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).

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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

2020

- NMVOC emissions reported by a facility were included, slight increase in 2017 emissions

Source-specific planned improvements

- Allocation of particle emissions will be studied further.

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	
January 2020	KS & JMP

Source category description

Information on industrial activities falling under NFR 2D3g Chemical Products is presented in Table 4.68

Table 4.68 Activities and emissions reported under NFR 2D3g.

Activities included	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 Asphalt blowing – not estimated (Guidebook EF erroneous)	NMVOC, TSP, PM_{10}, $PM_{2.5}$, NH_3, SOx, Cd, As, Cr, Ni

Emission trends

NFR category Chemical products is a minor source of NMOC emissions, the share of total emissions in NH3 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 4.69

Table 4.69 Contribution of chemical products (NFR 2D3g) to total emissions in 2018.

Pollutant	Emissions from chemical products 8	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.856	85.317	Gg	2.2	75.5
SOx	<0.001	33.127	Gg	<0.1	100
NH3	0.004	32.189	Gg	<0.1	21.6
PM2.5	0.003	17.798	Gg	<0.1	0
PM10	0.004	31.116	Gg	<0.1	0
TSP	0.005	45.069	Gg	<0.1	100

Methodological issues

Asphalt blowing

Asphalt blowing has occurred in Finland in the years 1988-2004. Finland only recognized the existence of the source after the NECD Review 2018 and then made preliminary estimates for the related PAH emissions. However, in autumn 2018 the TERT Secretary informed that the Tier 2 EFs in the Guidebook (Tables 3-9 and 3-10 of 2.D.3.g Chemical products) are incorrect. We therefore report the emissions as NE and include the emissions only when a correct EF is provided in the Guidebook.

Other sources under 2D3g

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.

Air pollutant emissions from chemical products depend on the use volumes of solvents. The allocation of activities has also been changed over the years and is consistent in the time series. Methodologies used in the calculation of solvent use in the different chemical products manufacture and processing are presented in Table 4.70. For many of the activities allocated under this category, the emissions include only data reported by the plants.

Table 4.70 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	Not estimated (see above)

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 4.71 to illustrate the contribution of the questionnaire to the total emissions of this sector.

Table 4.71 The contribution of responses received to the questionnaire sent to companies in summer 2018 for the inventory of 2017 emissions, to the total emissions of the sector 2D3g.

Sector	Year	NMVOC emissions (t)	Source of information	Number of companies
Pharmaceutical industry	2018	167	VAHTI 100%	10 - 20
Plastic industry (incl. polyester, polyvinylchloride, polystyrene foam processing and other)	2018	1 491	VAHTI 57% Questionnaire 43%	10 - 20 50 -100
Textile and leather industry	2018	0.00	Questionnaire 100%	less than 10
Rubber conversion	2018	Incl. in plastic industry due to confidentiality	VAHTI 100%	less than 10
Manufacture of paints, inks and glues	2018	195	VAHTI 99.5% Questionnaire 1%	10 - 20 less than 10
Total NMVOC emissions from NFR 2D3g	2018	1 856		

Plastic industries

Emissions are calculated on the basis of data from replies to the questionnaires[10]. 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 2018 inventory, a questionnaire was sent to 59 companies, out of which 29 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 VAHTI. 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 2018 inventory, a questionnaire was sent out to7 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

In the submission in 2015 NH_3 emissions from leather tanning were included for the first time. NH3 emissions are calculated according to EMEP/EEA Guidebook 2019 using the emission factor of 0.68 g/kg raw hid. As activity data, 2000 t raw hid/year for 1990-2018 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 1990-2018 due to lack of better data.

Calculated emissions from chemical products are presented in Table 4.72.

Table 4.72 Calculated NH3 emissions from chemical products

Year	NH3 (t) from leather tanning	Year	NH3 (t) from leather tanning
1990	2.9	2010	2.9
1991	2.9	2011	2.9
1992	2.9	2012	2.9
1993	2.9	2013	2.9
1994	2.9	2014	2.9
1995	2.9	2015	2.9
1996	2.9	2016	2.9
1997	2.9	2017	2.9
1998	2.9	2018	2.9
1999	2.9		
2000	2.9		
2001	2.9		
2002	2.9		
2003	2.9		
2004	2.9		

[10] also an Internet based questionnaire is used, see information under "Coating application"

2005	2.9		
2006	2.9		
2007	2.9		
2008	2.9		
2009	2.9		

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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

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.

2020

- NMVOC emissions for 2010 and 2016-2017 were recalculated due to inclusion of facility reported emissions in the YLVA system previously missing from the inventory for one plant, minor increase in emissions
- TSP emissions for 2016 were recalculated due to inclusion of facility reported emissions in the YLVA system previously missing from the inventory for one plant. In addition, corresponding small particle emissions were calculated and included, resulting in minor increase in emissions.

Source-specific planned improvements

None.

Printing (NFR 2D3h)

Changes in chapter	
January 2020	KS & JMP

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 4.73 shows typical compositions of traditional printing inks in 2008.

Table 4.73 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 4.74.

Table 4.74 Contribution of Printing (NFR 2D3h) to total emissions in 2018.

Pollutant	Emissions from printing	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.661		Gg	0.8	83

Emission trends

To be completed

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 2018 emissions, the questionnaire was sent to 81 companies, from which 27 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		
2000	6.792		
2001	5.574		
2002	3.902		
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 7 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

None.

Source-specific planned improvements

In the next years

- In the 2018 submission SOx emissions were reported under NFR 2D3h for1990-1994. The possibly to reallocate the emissions to the energy sector is studied.

Non-scheduled

- Calculation of NMVOCs as carbon.

Other solvent use (NFR 2D3i)

Changes in chapter	
January 2020	KS & JMP

Source category description

Activities falling under NFR 2D3i Other solvent use in the Finnish inventory with emissions generated in the processes is presented in Table 4.76.

Table 4.76 Activities and emissions reported from the other solvent use sector.

NFR	Activity	Description	Emissions
2D3i	Other product use	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

Emission trends

Other solvent and products use is minor source of NMVOC, SOx, particles, NH3, HCB and PAHs. The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.77.

Table 4.77 Contribution of Other solvent and product use (NFR 2D3i) to total emissions 2018.

Pollutant	Emissions from other solvent and product use	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.493.	85.317	Gg	1.8	7.5
SOx (as	<0.001.	33.127	Gg	<0.1	100
NH3	0.213.	32.189	Gg	0,7	97.3
PM2.5	0.056.	17.798	Gg	0,3	0
PM10	0.06.	31.116	Gg	0,2	0
TSP	0.065.	45.069	Gg	0,1	100
BC	<0.001	4.014	Gg	<0.1	0
PAHs	0.011.	9.991	Mg	0,1	0
HCB	0.001.	32.024	kg	<0.1	0

Methdological issues

A compilation of activites and estimation methods regarding NMVOC emissions reported under NFR Other solvent use as presented in Table 4.78.

Table 4.78 Activities and emission estimation methods for NMVOC emissions 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: VAHTI 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.

NO_x, SO_x, NH_3 and CO

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.

Impregnation of wood

NMVOC

Part of emissions from wood impregnation activities is reported by the plants and available in VAHTI 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 4.79. 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).

Use of pesticides

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 4.79 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 4.79 Acitivty data: Use of pesticides and impregnation of wood 1988-2018

	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	12 600 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

Use of chlorinated solvents

HCB

Emissions from the use of chlorinated solvents have been calculated with the emission factor 2 mg/ t from the EMEP/EEA Guidebook (EEA, 2005) (no method in GB 2016) and information from customs statistics (ULJAS) on the imports of chlorinated chemicals as presented in Table 4.80. Chlorinated solvents are not produced in Finland.

Table 4.80 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
1991	2 050 t	2001	1 094 t	2011	371 t
1992	1 963 t	2002	1 421 t	2012	529 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		

A summary of calculated is presented in Table 4.81.

Table 4.81 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

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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
- Correction of activity data in the use of pesticides for 2002 in the 2019 submission. The correct value for the year 2002 is 1.364 (the incorrect 1.320).
- PAH emissions decreased significantly due to update of sales data of pesticides for 2017
- NMVOC emissions for 2016 were recalculated due to inclusion of facility reported emissions in the YLVA system previously missing from the inventory for one plant (minor increase in emissions).

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 1990's
- Re-check of the use of Guidebook 2918 methods for particles

4.33 Other product use (NFR 2G)

Changes in chapter	
January 2020	KS & JMP

Source category description

Activities falling under NFR 2G Other product use in the Finnish inventory with emissions generated in the processes is presented in Table 4.82

Table 4.82 Activities and emissions reported from the other product use sector.

NFR	Activity	Description	Emissions
2G	Other product use	Use of fireworks and tobacco	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

All emissions from tobacco smoking are included from year 1990 onwards.,. The time series is consistent. The possibility to include emissions since 1980 will be investigated.

The shares of emissions reported under the NFR category are presented in Table 4.83

Table 4.83 Contribution of Other product use (NFR 2G) to total emissions 2018.

Pollutant	Emissions from other product use	Total emissions	Unit	Share of total emissions %	% reported by the plants
NOx (as NO2)	0.006	126.595	Gg	<0.1	0
NMVOC	0.02	85.317	Gg	<0.1	0
SOx (as SO2)	0.004	33.127	Gg	<0.1	0
NH3	0.013	32.189	Gg	<0.1	0
PM2.5	0.087	17.798	Gg	0.5	0
PM10	0.087	31.116	Gg	0.3	0
TSP	0.087	45.069	Gg	0.2	0
BC	<0.001	4.014	Gg	<0.1	0
CO	0.187	350.531	Gg	<0.1	0
Pb	1.113	15.410	Mg	7.2	0
Cd	0.019	0.883	Mg	2.2	0
Hg	<0.001	0.677	Mg	<0.1	0
As	0.002	2.415	Mg	<0.1	0
Cr	0.022	15.344	Mg	0.1	0
Cu	0.648	40.173	Mg	1.6	0
Ni	0.051	14.139	Mg	0.4	0
Zn	0.378	118.644	Mg	0.3	0
PCDD/ PCDF	<0.001	14.356	g I-Teq	<0.1	0
PAHs	<0.001	9.991	Mg	<0.1	0

Methdological issues

Tobacco smoking

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

Table 4.84 Activity data for tobacco smoking (Statiscs Finland, since 2011 National Institute for Healt and Welfare).

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

Emissions from tobacco smoking are calculated with emission factors presented in Guidebook 2019 (Table 4.85).

Table 4.85 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	0.193
2018	0.006	0.020	0.013	0.087	0.087	0.087	0.0004	0.187

Year	Cd Mg	Cu Mg	Ni Mg	Zn Mg	PCDD PCDF dioxins furans g I-Teq 1
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

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 2019. The amount of imported fireworks is presented in Table 4.86 and the emissions in Tables 4.87a and b.

Table 4.86 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		
1998	1138	2009	1566		
1999	2253	2010	1702		
2000	1370	2011	1417		

Table 4.87a NOx, CO, Sox andand particle emissions from use of fireworks.

Year	NOx Gg	SOx Gg	PM2.5 g	PM10 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	0.0093	0.07	0.13	0.14	0.0093
2018	0.00037	0.0102	0.07	0.14	0.16	0.0102

Table 4.87b 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

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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
- NH3 emissions from tobacco smoking were corrected for the whole time series.

2020
- PCDD/F emissions for 2017 were recalculated due to correction of activity data for tobacco smoking.

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	
January 2020	JMP KS

Source category description

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 zinc emissions are generated.

NFR	Processes	Description	Emissions reported
2H1	Pulp and paper industry	Pulp and paper mills	NMVOC, NH3, TSP, PM10, PM2.5, BC, , SOx, HCB, PCB
2H2	Food and beverages industry	Food and drink industry	NMVOC, TSP, PM10, PM2,5, SOx
2H3	Other industrial processes	Not Occuring	

Emission trend

To be completed

Methodological issues

Emissions of those plants that report their emissions to the supervising authorities[11] according to the monitoring requirements in the environmental permits are in most cases reported as IE. This is because in most cases the reporting obligations determined in the monitoring programmes are for the total emissions of the plants and not separated between fuel combustion and other processes. Thus it has not been possible to make a complete split between emissions from fuel based and non-fuel based sources. In cases where it has been possible to separate fuel combustion emissions from process emissions, these are reported separately under NFR 2H categories. For those plants that report only total emissions, the split is based on the default emissions calculated on basis of fuel consumption which is reduced from the emissions reported by the plants, and reported under the NFR 1A2gviii.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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	
January 2020	JMP KS

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 1980’s while the production volumes significantly increased until 2006-2007 as presented in Figures 4.11-4.13 and in Table 4.89.

Between the years 2006-2009 approximately ten paper machines and pulp mills were closed down. In 2018 there were 33 pulp and paper mills, out of which 19 produced only pulp while the rest were integrated pulp and paper mills. Out of the 19 pulp mills 17 produced chemical pulp. 17 paper mills were in operation in 2018 as well as 14 paperboad mills.

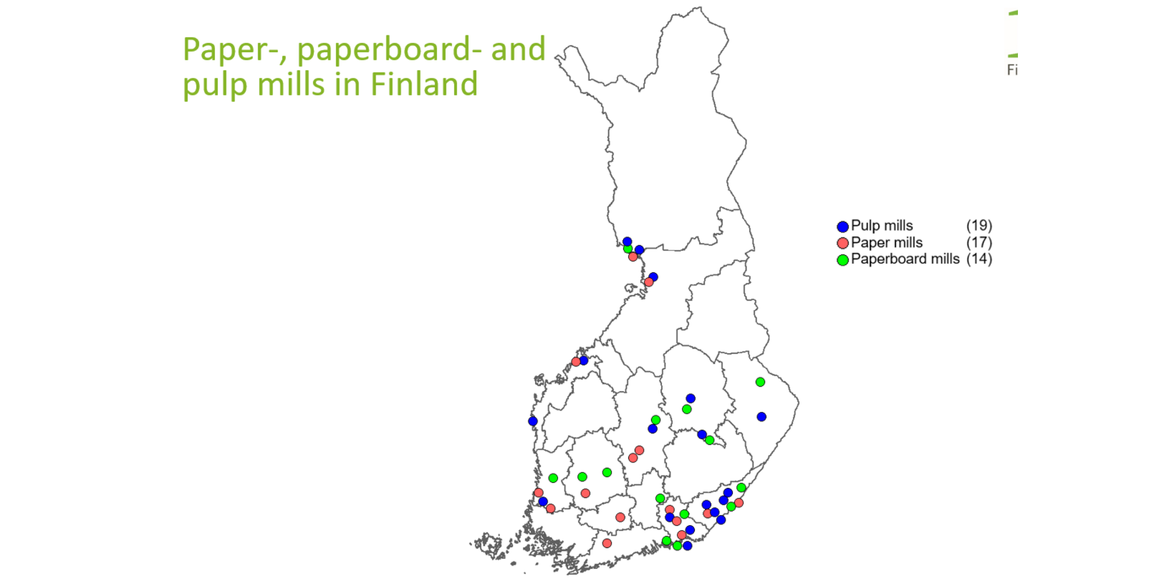


Figure 4.11 Forest industry production plants 2019

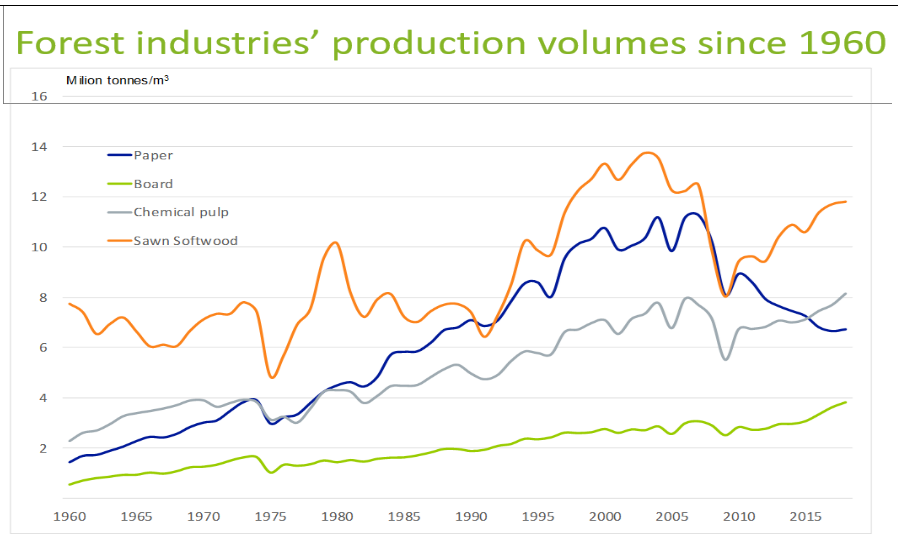


Figure 4.12 Production voljumes volumes (below) in Finland 1980-2018

Sources Finnish Forest Industries Federation (2020)

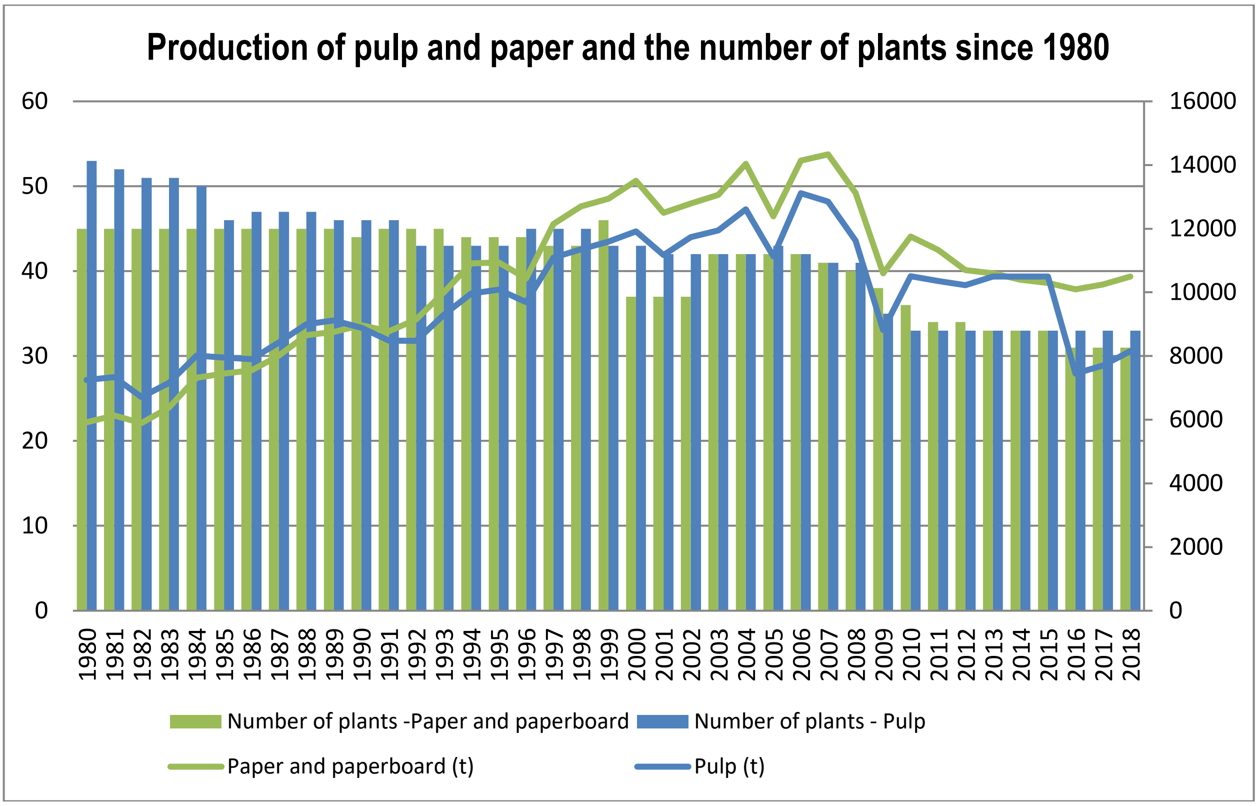


Figure 4.13 Production volumes and number of pulp and paper plants 1980-2018.

Table 4.89 Pulp and paper production since 1988.

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	13.1	included in produced pulp	14.1
2007	12.9	included in produced pulp	14.3
2008	12.0	included in produced pulp	13.1
2009	8.7	included in produced pulp	10.6
2010	10.7	included in produced pulp	11.9
2011	10.4	included in produced pulp	11.4
2012	10.2	included in produced pulp	10.7
2013	7.1	included in produced pulp	10.6
2014	7.0	included in produced pulp	10.4
2015	10.6	included in produced pulp	11.5
2016	7.7	included in produced pulp	9.9
2017	7.7	included in produced pulp	10.3
2018	8.2	included in produced pulp	10.5

Emission trends

Emissions reported under this NFR category include process based SO2 emissions calculated from reduced sulphur compounds (TRS), ammonia, particle and NMVOC emissions. Also from the early 90's HCB and PCB emissions have been reported due the use of chlorinated solvents.

The time series have been recalculated in 2018 submission. Variations in the emission levels do not fully represent actual variations in emissions. This is due to the use of point source data reported by the plants, which cannot be separated for energy and process sources unless energy related emissions are calculated separately and deducted from the total emissions reported

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.90

Table 4.90 Contribution of Pulp and paper industry (2H1) to total emissions in 2018 Note: NOx emissions are allocated to 1A2d)

Pollutant	Emissions from 2H1	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.759	85.317	Gg	2.1	13.7
SOx (as	0.903	33.127	Gg	2.7	100
NH3	0.199	32.189	Gg	0.6	100
PM2.5	0.157	17.798	Gg	0.9	0
PM10	0.196	31.116	Gg	0.6	0
TSP	0.262	45.069	Gg	0.6	100
BC	0.004	4.014	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 has been calculated.

Activity data

Emissions not reported by the plants are calculated from total production volumes (Table 4.91). Until 2005 the data was available by pulp types. Since 2005 the plant specific statistics collected by the Finnish Forest Industries Federation (FIFF) covers only the total volume of produced pulp.

Nitrogen dioxide

Nitrogen dioxide emissions from the pulp and paper industry are based on data reported by the plants to the supervising authorities[12] according to the monitoring requirements in their environmental permits. NO_2 emissions from the pulp and paper industry are allocated in the inventory as fuel based emissions under NFR 1A2d though they include also process emissions of these compounds.

Sulphur emissions reported as SO2

Sulphur dioxide emissions are based on data reported by the plants to the supervising authorities[13] according to the monitoring requirements in their environmental permits. SO_2 emissions are partly allocated in the inventory as fuel based emissions under NFR 1A2d though they may include also process emissions of these compounds. It has not been possible to split all SO_2 emissions between fuel based and non-fuel based due to the fact that the reporting obligations given to the plants are for the total emissions.

The process-based emissions include different sulphur compounds such as TRS (total reduced sulphur) and calculated as SO_2 equivalents. Most of the smelly gases are nowadays collected and incinerated due to the requirements for smell 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% (PM10) and 86.3 % (PM2.5) for recovery boiler and with factors 98 % (PM10) and 96% (PM2.5) 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 PM2.5 (Guidebook 2019, EEA 2019).

Heavy metals

As, Cr, Ni, V, Pb, Cd and Hg emissions from process boilers are included
The occurrence and level of Cu and Zn emissions will be studied for the next submission in 2019.

NMVOC

NMVOC emissions from the pulp and paper industry are partly included in the compliance reporting of the plants and thus available in VAHTI. 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 4.91 are based on the actual levels observed at the plants (Reino Lammi, 2000). NMVOC emissions from pulp and paper sector are presented in Table 4.92.

Table 4.90 NMVOC emission factors kg/t of pulp (Finnish Forest Industries Federation).

<table>
<tr><th>Year</th><th>chemical pulp</th><th>mechanical pulp</th><th>paper</th><th>Year</th><th>chemical pulp</th><th>mechanical pulp</th><th>paper</th></tr>
<tr><td>1988</td><td>0.7</td><td rowspan="12">0.2</td><td rowspan="12">0.01</td><td rowspan="2">2000-2005</td><td rowspan="2">0.1</td><td rowspan="2">0.2</td><td rowspan="2">0.01</td></tr>
<tr><td>1989</td><td>0.65</td></tr>
<tr><td>1990</td><td>0.4</td><td rowspan="2">from 2006</td><td rowspan="2" colspan="2">0.14</td><td rowspan="2">0.01</td></tr>
<tr><td>1991</td><td>0.37</td></tr>
<tr><td>1992</td><td>0.34</td><td rowspan="8" colspan="4"><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</td></tr>
<tr><td>1993</td><td>0.31</td></tr>
<tr><td>1994</td><td>0.28</td></tr>
<tr><td>1995</td><td>0.25</td></tr>
<tr><td>1996</td><td>0.22</td></tr>
<tr><td>1997</td><td>0.19</td></tr>
<tr><td>1998</td><td>0.16</td></tr>
<tr><td>1999</td><td>0.13</td></tr>
</table>

Table 4.91 NMVOC emissions from pulp and paper sector

Year	NMVOC (t)	Year	NMVOC (t)	Year	NMVOC (t)
1990	2966	2000	2110	2010	2162
1991	3376	2001	2737	2011	1583
1992	2464	2002	2021	2012	1467
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	1704
1999	1958	2009	1901		

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 4.92.

Table 4.92 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

NH3

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. NH3 emissions are reported by plants to the supervising authorities. NH3 emissions total annually to 0.01-0.05 kt and are allocated under NFR 2H1. In 2018 NH3 emisssion are quite large, due the use of sulphite liquir in a one plant.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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

2020

- BC emissions calculated for the plants were recalculated for the years 1990-1995, 2000 and 2004-2017 due to inclusion of emissions from seven plants that were previously missing from the inventory (slight increase in emissions).

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	
January 2020	JMP KS

Source category description

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 as summarized in Table 4.93.

Air pollutant emissions from food and drink depend on the production and use volumes over the years.

Table 4.93 Emissions reported under NFR 2H2

	Number of plants in VAHTI allocated to this sector	**Emissions reported by plants**	**Emissions calculated**
Bread, bisquits	-		NMVOC
Wine	-		NMVOC
Beer	-		NMVOC
Spirits	< 5	NMVOC	NMVOC
Sugar production	-		TSP, PM10, PM2.5, NMVOC
Meat, fish etc. frying/curing	-		TSP, PM10, PM2.5
Coffee	-		NMVOC
Yeast	-		NMVOC
Dairies	< 5	TSP	PM10, PM2.5
Animal feed and raw material for animal feed	< 5	TSP, NMVOC	PM10, PM2.5, NMVOC
Food production	< 5	TSP	PM10, PM2.5

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.94

Table 4.94 Contribution of Food and beverages industry (NFR 2H2) to total emissions in 2018.

Pollutant	Emissions from food and drink industry	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.661	85.317	Gg	2	0.2
PM2.5	0.396	17.798	Gg	2.2	0
PM10	0.411	31.116	Gg	1.3	0
TSP	0.43	45.069	Gg	1.0	19.6

Emission trends

Food and beverages industry is minor source of NMVOC and particle emissions, the share of total emissions is only 1-2 %. Emissions depend on production rates, that have been quite constat over the timeseries.

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 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 4.95.

Table 4.95 NMVOC emission factors for Food and beverage production

Product	EF	Reference
Wholemeal bread products	3 kg/t	Guidebook 2019
other breads	4.5 kg/t	Guidebook 2019
cakes and bisquits	1 kg/t	Guidebook 2019
roasting of coffee	0.6 kg/t	Guidebook 2019
sugar production	10 kg/t	Guidebook 2019
yeast production, no method in the GB	18 kg/t	National based on expert knowledge (SYKE 2007)
wine production	0.8 kg/m3	Guidebook 2019
beer production factor	0.35 kg/m3	Guidebook 2019

All emission factors except roasting of coffee and yeast production are from the EMEP/EEA Guidebook, (2019). 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 4.96.

Table 4.96 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 Healt)

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
Year	**Yeast production (t)**	**Wine production (m3)**	**Beer production (m3)**		
1990	7540	18111	413130		
1991	7440	16028	432563		
1992	7620	19938	454064		
1993	8130	24043	458237		
1994	9140	26606	433660		
1995	9610	40383	454468		
1996	10360	42583	464307		
1997	9680	43675	469614		
1998	8810	58964	454751		
1999	7940	67441	464932		
2000	7640	67500	465000		
2001	7642	68000	465000		
2002	8354	18520	400868		
2003	7700	18500	381451		
2004	7700	17380	444500		
2005	7750	66159	456544		
2006	7934	66886	449956		
2007	7942	67271	442342		
2008	8224	68736	433484		
2009	7395	58223	409427		
2010	7897	59008	395072		
2011	10029	51905	397800		
2012	9835	43559	378418		
2013	9416	43559	378418		
2014	8628	53427	388468		
2015	5832	55818	407119		
2016	7465	55392	410443		
2017	7800	51710	403630		
2018	6400	47592	392401		

* 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 VAHTI. PM_{10} and $PM_{2.5}$ particle size fraction emissions are calculated from TSP emissions with factors 75 % (PM10) and 60 % (PM2.5) 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 (2018). For meat frying emission factor 0.0013 t/t meat consumed is used for TSP, PM10 and PM2.5 as well as for barbeques factor 8.9 kg/ton meat is used for TSP, PM10 and PM2.5.

For the 2017 submission, the emission factors for food heating in barbeques were revised for whole time series. The new emission factors for TSP, PM10 and PM2.5 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 4.97. 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 4.98.

Table 4.97 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%

Table 4.98 NMVOC and particle emissions from food and beverages industry

Year	NMVOC (t)	TSP	PM10	PM2.5
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

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 7 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

2020
- TSP, PM2.5 and PM10 emissions were recalculated due to inclusion of facility reported TSP emissions in the YLVA system previously missing from the inventory for two plants. (TSP emissions are reported by the plants and PM2.5 and PM10 emissions calculated for these plants).

Source-specific planned improvements

- Particle emission fraction factors will be checked and Guidebook 2019 will be taken in use when available.

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	
January 2020	KS JMP

Source category description

Activities reported under NFR 2I include mechanical wood processing, such as saw mills and production of plywood, chipboard and fibreboard.

Emission trends

Mechanical wood processing is a minor source of several air pollutants as presented in Table 4.99.

Table 4.99 Contribution of Mechanical wood processing (NFR 2I) to total emissions in 2018

Pollutant	Emissions from mechanical wood processing	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1,322	85.317	Gg	1,6	28.5
PM2.5	<0.001	17.798	Gg	<0.1	0
PM10	0,024	31.116	Gg	<0.1	0
TSP	0,122	45.069	Gg	0,3	100

Methodological issues

19 production plants allocated to this sector reported emissions to supervising authorities in 2016.

Particle emissions

The plants report total suspended particle according to monitoring requirements in their environmental permits and this data is available in VAHTI. 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**.** Due to the separation process of fuel and non-fuel based emissions in the inventory reporting system IPTJ, small part (0.03 kt) of the fuel-based $PM_{2.5}$ emissions was allocated to NFR 2I. The allocation will be checked to the next submission.

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 4.100 a and b. In addition, NMVOCs are reported by several plants according their monitoring requirements to supervising authorities and available in VAHTI.

Table 4.100a 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/m^3 (NPI; 2002)		Emissions (t)
1988	650 000 m^3	130
1989	650 000 m^3	130
1990	600 000 m^3	120
1991	385 000 m^3	77
1992	354 000 m^3	71
1993	439 000 m^3	88
1994	477 000 m^3	95
1995	485 000 m^3	97
1996	498 000 m^3	100
1997	475 000 m^3	95
1998	455 000 m^3	91
1999	439 000 m^3	88
2000	462 000 m^3	92
2001	430 000 m^3	86
2002	410 000 m^3	82
2003	400 000 m^3	80
2004	448 000 m^3	90
2005	452 000 m^3	90
2006	400 000 m^3	88
2007	400 000 m^3	80
2008	250 000 m^3	50
2009	170 000 m^3	34
2010	220 000 m^3	44
2011	170 000 m^3	34
2012	100 000 m3	20
2013	*	*
2014	*	*
2015	*	*
2016	*	*
2017	*	*
2018	*	*

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	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

Table 4.100b 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/m^3 (NPI 1999)		Emissions (t)
1988	600 000 m^3	90
1989	600 000 m^3	90
1990	650 000 m^3	98
1991	477 000 m^3	72
1992	462 000 m^3	69
1993	621 000 m^3	93
1994	700 000 m^3	105
1995	778 000 m^3	117
1996	869 000 m^3	130
1997	987 000 m^3	148
1998	992 000 m^3	149
1999	1 076 000 m^3	161
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

Production of fibreboard (FiFF Yearbook)		
Emission factor 1.3 kg/m^3 (NPI 1999)		Emissions (t)
1988	90 000 m^3	117
1989	80 000 m^3	104
1990	100 000 m^3	130
1991	69 000 m^3	90
1992	73 000 m^3	95
1993	85 000 m^3	111
1994	86 000 m^3	112
1995	79 000 m^3	103
1996	77 000 m^3	100
1997	88 000 m^3	114
1998	100 000 m^3	130
1999	96 000 m^3	125
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	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

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	*	*

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

2020

- Particle emissions for 2012-2017 were recalculated due to correction of facility reported emissions for one plant. Particle emissions for one plant were split between energy (1A2gviii) and IPPU (2I) for the whole time series. In the 2019 submission the split was done only for the years prior to 2012. This resulted in slight increase of TSP and PM10 emissions but a significant increase in PM2.5 emissions 2014-2015 and 2017.

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	
January 2020	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 1970's and PCB containing products have been banned since the 1990's.

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 1990's. Mercury in products has been restricted since the 2000's 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 http://www.stat.fi/til/khki/index_en.html

3.41 Other industrial production including production, consumption, storage, transportation or handling of bulk products (NFR 2L)

Changes in chapter	
January 2020	KS JMP

Source category description

Activities reported under NFR 2L "Other sector" are presented in Table 4.101 This 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.

Table 4.101 Activites and emissions reported under NFR 2L Other

SNAP code	SNAP	Detailed description	Emissions reported
040617	Other	Light gravel manufacturing	NMVOC, SOx 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	

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 4.102

Table 4.102 Contribution of Other production, consumption, storage, transportation or handling of bulk products (NFR 2L) to total emissions in 2018.

Pollutant	Emissions from other processes	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	<0.001	85.317	Gg	<0.1	100
SOx (as SO2)	0.001	33.127	Gg	<0.1	100
NH3	0.025	32.189	Gg	<0.1	2.8
PM2.5	0.028	17.798	Gg	0.2	0
PM10	0.043	31.116	Gg	0.1	0
TSP	0.056	45.069	Gg	0.1	100
PCDD/ PCDF	0.009	14.356	g I-Teq	<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 has been calculated.

NMVOC, SOx, and particles

Emissions are based on emission data reported by the plants and available in VAHTI.

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 4.103. It is assumed that one brick weights 3 kg.

Table 4.103 Activity data for brick production (Confederation of Finnish Construction Industries)

Year	Production of Bricks (t)	Year	Production of Bricks (t)	Year	Production of Bricks (t)
1990	339 000	2000	188 715	2010	111 600
1991	270 000	2001	183 000	2011	108 900
1992	198 000	2002	171 000	2012	100 994
1993	183 000	2003	174 000	2013	100 994*
1994	171 000	2004	177 000	2014	100 994*
1995	156 000	2005	162 000	2015	100 994*
1996	120 000	2006	156 000	2016	100 994*
1997	219 270	2007	143 700	2017	100 994*
1998	200 145	2008	129 000	2018	100 994*
1999	194 430	2009	91 500		

*due the lack of data, years 2012 activity data is used also for years 2013-2015

Calculated emissions dioxin and furines (PCDD/PCDF) from other industrial production sector are presented in Table 4.104

Table 4.104 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)
1990	0.0295	2000	0.0164	2010	0.0097
1991	0.0235	2001	0.0159	2011	0.0095
1992	0.0172	2002	0.0149	2012	0.0088
1993	0.0159	2003	0.0151	2013	0.0088
1994	0.0149	2004	0.0154	2014	0.0088
1995	0.0136	2005	0.0141	2015	0.0088
1996	0.0104	2006	0.0136	2016	0.0088
1997	0.0191	2007	0.0125	2017	0.0088
1998	0.0174	2008	0.0112	2018	0.0088
1999	0.0169	2009	0.0080		

The results of the uncertainty analysis are presented in Annex 7 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

2020

- NMVOC emissions for 2016 were recalculated due to inclusion of facility reported emissions in the YLVA system previously missing from the inventory for one plant and lead to significant increase of emissions.

Source-specific planned improvements

None.