NATUR VÅRDS VERKET

Submitted under
the Convention on Long-Range Transboundary Air Pollution

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1 Annex 1: Uncertainties and Key Sources

1.1 Methodology for analysis of Key Sources

The complete analysis of Sweden's key sources and uncertainties are presented in section 1.3. Key sources are reported together with theirs order of priority. Some important key sources according to level and trend are also discussed in sections 1.3 – 1.4 of the main report.

The key source analysis has been done for 1990 and 2022 level and trend assessment using both the approach 1 and the approach 2 according to the 2006 IPCC Guidelines. The approach 1 method assesses the impacts of various source categories on the level and the trend of the national emission inventory. In the approach 2, emission uncertainties are also considered in the identification and ranking of key sources. Key source analysis is here performed for the following pollutants: As, Cd, CO, Cr, Cu, dioxins/furans, Hg, NH_3, Ni, NMVOC, NO_X, PAH 1-4, Pb, $PM_{2.5}$, PM_{10}, Se, SO_2, TSP and Zn.

1.1.1 Level assessment, approach 1

For each source category and pollutant, the level assessment (LA) is calculated as:

$$L_{x,t} = E_{x,t} / E_t$$

Key sources include those source categories for each pollutant, that when summed together in descending order of magnitude, exceed 95 % of the total emission estimates in the inventory for each year.

1.1.2 Level assessment, approach 2

In the approach 2 analysis the uncertainty of the emissions is also taken into account.

$$LU_{x,t} = L_{x,t} \bullet U_{x,t}$$

The key sources are then those source categories that in descending rank order add up to 90 % of the cumulative sum of $LU_{x,t}$.

1.1.3 Trend assessment, approach 1

The trend is calculated as:

$$T_{x,t} = L_{x,t}\left|\left[\frac{E_{x,t} - E_{x,0}}{\left|E_{x,0}\right|}\right] - \frac{\sum_y E_{y,t} - \sum_y E_{y,0}}{\left|\sum_y E_{y,0}\right|}\right|$$

For each pollutant, the percentage contribution to the overall trend (C%) is then calculated for each source as:

$$C\% = \frac{T_{x,t}}{\sum T_{x,t}}$$

Finally, the cumulative total of percentage contribution is calculated for each pollutant in the same way as for the level assessment. Key source categories are those that for each pollutant, when summed together in descending order of magnitude, add up to more than 95% of the contribution to trend.

1.1.4 Trend assessment, approach 2

In the same way as for the level assessment, in the approach 2 analysis the uncertainty is also considered.

$$TU_{x,t} = T_{x,t} \times U_{x,t}$$

The approach 2 key sources for trend are then those that add up to 90 % of the cumulative value of $T_{x,t}/\sum T_{x,t}$.

1.2 Methodology for estimation of uncertainties

As a basis for the calculations the 95 % confidence intervals have been assessed for all subcategories and substances. This information is documented in Swedish in “Expert Protocols”, describing how and what sources was used to quantify the individual uncertainty ranges. National references on uncertainty estimates of emission factors are used when available (e.g. emission factors for stationary combustion, emission factors for navigation and fisheries). Most other uncertainty estimates for emission factors derive from expert judgments or information from the EMEP/EEA Guidebook. Uncertainty estimates of activity data are mostly based on expert judgments. The data in the Expert Protocols are then used to calculate the 95 % confidence interval for the aggregated emissions reported in section 1.4. The calculations are made according to the 2006 IPCC guidelines. Lack of completeness, i.e. in this context entire source categories missing (NE), are not taken into consideration when quantifying uncertainties.

1.3 Key Sources and Uncertainty results

In Table A1-1 to Table A1-19 the results are presented for the key sources and uncertainty analyses for the following substances: As, Cd, CO, Cr, Cu, dioxins/furans, Hg, NH_3, Ni, NMVOC, NO_X, PAH 1-4, Pb, $PM_{2.5}$, PM_{10}, Se, SO_2, TSP and Zn. The identified key sources for the approach 1 and the approach 2 analyses are presented in the tables. In the bottom of the tables, information on total emissions and total uncertainty in the inventory are given, both for the level and for the trend. Due to confidentiality reasons some emissions and uncertainty results are shown as C in the tables.

Table A1-1. Summary of the key source and uncertainty analysis of As emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	As	0.01	0.05	1.53	306.1	306.1	8.60	899.34	0.083		4	4		2	3
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	As	0.01	0.00	1.26	62.94	62.95	0.00	-68.85	0.000		16				
1 A 1 a Public Electricity and Heat Production: Peat	As	0.05	0.00	1.95	97.29	97.31	0.00	-96.27	0.000	7					
1 A 1 a Public Electricity and Heat Production: Solid Fuels	As	0.11	0.02	1.88	94.16	94.18	0.06	-85.87	0.000	4	8		6		
1 A 1 a Public Electricity and Heat Production: Other Fuels	As	0.03	0.15	1.11	362.4	362.4	85.67	414.70	0.807		1	2	5	1	1
1 A 1 b Petroleum refining: Liquid Fuels	As	0.00	0.00	10.00	100.0	100.5	0.00	-53.30	0.000						
1 A 2 a Iron and Steel: Biomass	As	0.00	0.00	5.00	400.0	400.0	0.00	81.57	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	As	0.00	0.00	5.00	100.0	100.1	0.00	-85.64	0.000						
1 A 2 a Iron and Steel: Solid Fuels	As	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	As	0.00	0.00	5.00	100.0	100.1	0.00	-64.31	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	As	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	As	0.00	0.00	5.00	300.0	300.0	0.00	223.66	0.000						
1 A 2 c Chemicals: Liquid Fuels	As	0.00	0.00	5.00	100.0	100.1	0.00	-72.23	0.000						
1 A 2 c Chemicals: Other Fuels	As	0.00	0.00					-100.00							
1 A 2 c Chemicals: Solid Fuels	As	0.00	0.00	2.00	200.0	200.0	0.00	-95.43	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 d Pulp, Paper and Print: Biomass	As	0.02	0.02	8.00	400.0	400.1	1.92	16.59	0.016		7	5	7	3	4
1 A 2 d Pulp, Paper and Print: Liquid Fuels	As	0.02	0.00	5.00	100.0	100.1	0.01	-78.16	0.000		15				
1 A 2 d Pulp, Paper and Print: Other Fuels	As	0.00	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Solid Fuels	As	0.01	0.00	7.00	100.0	100.2	0.00	-99.22	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	As	0.00	0.00	5.00	400.0	400.0	0.00	377.98	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	As	0.01	0.00	5.00	100.0	100.1	0.00	-93.81	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	As	0.00	0.00					-100.00							
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	As	0.00	0.00	5.00	100.0	100.1	0.00	-93.83	0.000						
1 A 2 f Non-metallic minerals: Biomass	As	0.00	C	4.65	213.9	213.9	0.00	C	C						
1 A 2 f Non-metallic minerals: Liquid Fuels	As	0.00	C	9.78	48.90	49.87	0.00	C	C						
1 A 2 f Non-metallic minerals: Solid Fuels	As	0.03	C	8.57	43.32	44.16	0.00	C	C		11				
1 A 2 g viii Other: Biomass	As	0.01	0.01	4.39	131.61	131.69	0.03	-26.80	0.000		13	13			
1 A 2 g viii Other: Liquid Fuels	As	0.02	0.00	3.89	23.32	23.64	0.00	-75.78	0.000						
1 A 2 g viii Other: Solid Fuels	As	0.00	0.01	4.83	28.97	29.37	0.00	384.79	0.000		10	8			

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b i Road Transportation, Cars: Biomass	As	0.00	0.00	3.54	70.78	70.87	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	As	0.00	0.00	5.00	100.0	100.1	0.00	526.71	0.000						
1 A 3 b i Road Transportation, Cars: Fossil part of biodiesel and biogasoline	As	0.00	0.00	5.00	100.0	100.1	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	As	0.00	0.00	3.00	100.0	100.0	0.00	-58.08	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	As	0.00	0.00	4.76	95.25	95.37	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	As	0.00	0.00	5.00	100.0	100.1	0.00	626.64	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Fossil part of biodiesel and biogasoline	As	0.00	0.00	5.00	100.0	100.1	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	As	0.00	0.00	3.00	100.0	100.0	0.00	-89.80	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	As	0.00	0.00	3.98	79.59	79.69	0.00	17545.3	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	As	0.00	0.00	4.76	95.22	95.33	0.00	-23.75	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Fossil part of biodiesel and biogasoline	As	0.00	0.00	3.56	71.24	71.33	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	As	0.00	0.00	3.00	100.0	100.0	0.00	-86.43	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	As	0.00	0.00	3.00	100.0	100.0	0.00	108.78	0.000						
1 A 3 d Domestic Navigation: Biomass	As	0.00	0.00	5.00	100.0	100.1	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	As	0.00	0.00	3.84	76.74	76.84	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	As	0.09	0.03	15.00	100.0	101.1	0.22	-69.64	0.001	6	6	6	3	7	
1 A 4 a Commercial/Institutional: Biomass	As	0.00	0.00	10.00	400.0	400.1	0.00	127.32	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	As	0.02	0.00	20.00	100.0	101.9	0.00	-97.91	0.000						
1 A 4 b Residential: Biomass	As	0.02	0.01	10.00	400.0	400.1	1.09	-4.83	0.008		9	7	9	5	5
1 A 4 b Residential: Liquid Fuels	As	0.04	0.00	20.00	100.0	101.9	0.00	-97.63	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	As	0.00	0.00	10.00	400.0	400.1	0.01	41.69	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	As	0.00	0.00	30.00	100.0	104.4	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	As	0.00	0.00	20.00	100.0	102.0	0.00	-71.90	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	As	0.01	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 B 2 a Oil	As	0.00	0.00					-100.00							
1 B 2 c Venting and flaring	As	0.00	0.00					-100.00							
2 A 3 Glass Production	As	0.11	C		100.0	100.0	0.00	C	C	5		9	2		
2 B 10 Other	As	0.00	0.00		100.0	100.0	0.00	4220.81	0.000						
2 C 1 Iron and Steel Production	As	0.21	0.03	3.32	33.17	33.34	0.03	-85.92	0.000	2	5	10	4		
2 C 3 Aluminium production	As	0.00	0.00	2.00	50.00	50.04	0.00	-95.45	0.000						
2 C 7 Other	As	4.71	0.12	4.00	50.00	50.16	1.17	-97.40	0.111	1	2	1	1	4	2
2 G 4 Other	As	0.00	0.00	12.01	689.2	689.3	0.07	-17.18	0.001					8	
2 H 1 Pulp and paper	As	0.13	0.12	6.94	49.59	50.07	1.04	-12.66	0.008	3	3	3	8	6	6
2 H 3 Other (NFR 2A5a)	As	0.04	0.00					-100.00		8		14			
2 H 3 Other (NFR 2A6)	As	0.00	0.00		100.0	100.0	0.00	-70.02	0.000						
5 C 1 Waste Incineration	As	0.00	0.01	46.82	196.9	202.4	0.05	43.89	0.000		14	12			
5 E Other	As	0.01	0.01	50.00	68.00	84.40	0.01	-4.71	0.000		12	11			
Total		**5.73**	**0.62**			**91.99**	**100.0**	**-89.22**	**10.179**						

Table A1-2. Summary of the key source and uncertainty analysis of Cd emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	Cd	0.01	0.13	1.54	23.04	23.09	3.10	876.49	0.018	10	1	2		2	3
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	Cd	0.01	0.00	1.24	61.90	61.91	0.00	-66.83	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	Cd	0.01	0.00	1.95	97.29	97.31	0.00	-99.88	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	Cd	0.02	0.00	2.00	100.0	100.02	0.00	-99.38	0.000	9		12	8		
1 A 1 a Public Electricity and Heat Production: Other Fuels	Cd	0.01	0.04	1.11	37.77	37.79	0.62	414.70	0.003		5	5		6	5
1 A 1 b Petroleum refining: Liquid Fuels	Cd	0.00	0.00	10.00	100.0	100.50	0.01	32.02	0.000						
1 A 2 a Iron and Steel: Biomass	Cd	0.00	0.00	5.00	40.00	40.31	0.00	81.57	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	Cd	0.00	0.00	5.00	100.0	100.12	0.00	-85.57	0.000						
1 A 2 a Iron and Steel: Solid Fuels	Cd	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	Cd	0.00	0.00	5.00	100.0	100.12	0.00	-61.40	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	Cd	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	Cd	0.00	0.00	5.00	40.00	40.31	0.00	27.31	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 c Chemicals: Liquid Fuels	Cd	0.00	0.00	5.00	100.0	100.12	0.00	-71.23	0.000						
1 A 2 c Chemicals: Other Fuels	Cd	0.00	0.00					-100.00							
1 A 2 c Chemicals: Solid Fuels	Cd	0.00	0.00	2.00	40.00	40.05	0.00	-97.30	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	Cd	0.06	0.04	8.00	40.00	40.79	0.92	-27.63	0.003	5	4	6	6	4	7
1 A 2 d Pulp, Paper and Print: Liquid Fuels	Cd	0.01	0.00	5.00	100.0	100.12	0.01	-77.44	0.000				11		
1 A 2 d Pulp, Paper and Print: Other Fuels	Cd	0.00	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Solid Fuels	Cd	0.00	0.00	7.00	40.00	40.61	0.00	-99.63	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	Cd	0.00	0.00	5.00	40.00	40.31	0.00	406.39	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	Cd	0.00	0.00	5.00	100.0	100.12	0.00	-93.29	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	Cd	0.00	0.00					-100.00							
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	Cd	0.00	0.00	5.00	40.00	40.31	0.00	-97.03	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 f Non-metallic minerals: Biomass	Cd	0.00	0.00	4.73	18.91	19.50	0.00	1470.2	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	Cd	0.00	0.00	9.53	47.67	48.61	0.00	-67.69	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	Cd	0.00	0.00	8.38	17.01	18.97	0.00	-90.92	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Biomass	Cd	0.00	0.00	4.98	99.50	99.63	0.01		0.000						
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	Cd	0.00	0.00	4.91	98.16	98.28	0.04	17.71	0.000		12	13			
1 A 2 g vii Off-road vehicles and other machinery: Other Fossil Fuels	Cd	0.00	0.00	5.00	100.0	100.12	0.00		0.000						
1 A 2 g viii Other: Biomass	Cd	0.04	0.02	4.58	18.30	18.86	0.03	-53.29	0.000	6	8	8			
1 A 2 g viii Other: Liquid Fuels	Cd	0.01	0.00	3.75	15.00	15.46	0.00	-76.30	0.000						
1 A 2 g viii Other: Solid Fuels	Cd	0.00	0.00	4.92	19.70	20.30	0.00	434.44	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	Cd	0.00	0.00	3.79	75.75	75.85	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	Cd	0.00	0.00	5.00	100.0	100.12	0.00	526.71	0.000						
1 A 3 b i Road Transportation, Cars: Fossil part of biodiesel and biogasoline	Cd	0.00	0.00	5.00	100.0	100.12	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b i Road Transportation, Cars: Gasoline	Cd	0.00	0.00	3.00	100.0	100.04	0.00	-58.08	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	Cd	0.00	0.00	4.69	93.82	93.94	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	Cd	0.00	0.00	5.00	100.0	100.12	0.00	626.64	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Fossil part of biodiesel and biogasoline	Cd	0.00	0.00	5.00	100.0	100.12	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	Cd	0.00	0.00	3.00	100.0	100.04	0.00	-89.80	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	Cd	0.00	0.00	3.96	79.30	79.39	0.00	13184	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	Cd	0.00	0.00	4.76	95.22	95.33	0.00	-23.75	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Fossil part of biodiesel and biogasoline	Cd	0.00	0.00	3.56	71.24	71.33	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	Cd	0.00	0.00	3.00	100.0	100.04	0.00	-86.43	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	Cd	0.00	0.00	3.00	100.0	100.04	0.00	108.78	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	Cd	0.00	0.00		75.00	75.00	0.01	26.53	0.000						
1 A 3 c Railways: Liquid Fuels	Cd	0.00	0.00	5.00	95.00	95.13	0.00	-58.75	0.000						
1 A 3 d Domestic Navigation: Biomass	Cd	0.00	0.00	5.00	100.0	100.12	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	Cd	0.00	0.00	3.84	76.74	76.84	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	Cd	0.00	0.00	15.00	100.0	101.12	0.00	-69.64	0.000						
1 A 3 e Other Transportation: Biomass	Cd	0.00	0.00	5.00	100.0	100.12	0.00		0.000						
1 A 3 e Other Transportation: Other Fossil Fuels	Cd	0.00	0.00	5.00	100.0	100.12	0.00		0.000						
1 A 3 e Other Transportation: Total	Cd	0.00	0.00	5.00	100.0	100.12	0.00	-25.37	0.000						
1 A 4 a Commercial/Institutional: Biomass	Cd	0.00	0.01	9.39	140.9	141.20	0.18	142.25	0.001		10	10		9	9
1 A 4 a Commercial/Institutional: Ethanol	Cd	0.00	0.00	5.00	100.0	100.12	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 a Commercial/Institutional: Gasoline	Cd	0.00	0.00	5.00	100.0	100.12	0.00	-4.24	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	Cd	0.01	0.00	6.47	78.03	78.30	0.00	-90.95	0.000				12		
1 A 4 a Commercial/Institutional: Other Fossil Fuels	Cd	0.00	0.00	5.00	100.0	100.12	0.00		0.000						
1 A 4 b Residential: Biomass	Cd	0.12	0.11	9.99	149.8	150.17	92.29	-4.72	0.328	3	2	3	2	1	1
1 A 4 b Residential: Liquid Fuels	Cd	0.02	0.00	8.09	51.76	52.39	0.00	-94.00	0.000	8			7		
1 A 4 b Residential: Other Fossil Fuels	Cd	0.00	0.00	5.00	100.0	100.12	0.00		0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	Cd	0.01	0.01	9.05	135.8	136.11	1.08	56.69	0.005		9	7	9	3	4
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	Cd	0.00	0.00	30.00	100.0	104.40	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Fossil part of biodiesel and biogasoline	Cd	0.00	0.00	3.54	70.88	70.97	0.00		0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	Cd	0.00	0.00	3.59	71.79	71.88	0.00	159.72	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	Cd	0.00	0.00	3.79	60.89	61.00	0.01	-39.82	0.000		13				
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	Cd	0.01	0.00					-100.00							
1 B 2 a Oil	Cd	0.00	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 B 2 c Venting and flaring	Cd	0.00	0.00					-100.00							
2 A 3 Glass Production	Cd	0.00	0.00		100.0	100.00	0.00	-98.72	0.000						
2 B 10 Other	Cd	0.00	0.00		100.0	100.00	0.00	832.85	0.000						
2 C 1 Iron and Steel Production	Cd	0.45	0.03	3.61	14.44	14.88	0.08	-92.68	0.002	2	6	4	3	10	8
2 C 3 Aluminium production	Cd	0.00	0.00	2.00	100.0	100.02	0.00	-94.74	0.000						
2 C 7 Other	Cd	1.34	0.04	4.00	20.00	20.40	0.25	-96.78	0.048	1	3	1	1	8	2
2 G 4 Other	Cd	0.00	0.00	12.98	724.6	724.74	0.84	-4.62	0.003		14		10	5	6
2 H 1 Pulp and paper	Cd	0.09	0.02	6.54	51.38	51.80	0.40	-75.44	0.000	4	7		4	7	
2 H 3 Other (NFR 2A5a)	Cd	0.00	0.00					-100.00							
2 H 3 Other (NFR 2A6)	Cd	0.02	0.00		92.87	92.87	0.00	-99.47	0.000	7		9	5		10
5 C 1 Waste Incineration	Cd	0.00	0.00	35.85	205.5	208.64	0.07	74.90	0.000		15				11
5 E Other	Cd	0.00	0.00	50.00	67.00	83.60	0.05	-4.75	0.000		11	11			
Total		**2.27**	**0.49**			**35.29**	**100.0**	**-78.19**	**6.419**						

Table A1-3. Summary of the key source and uncertainty analysis of CO emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	CO	0.41	3.85	1.52	56.90	56.92	0.14	842.57	0.000		13	12		11	9
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	CO	0.09	0.02	1.78	26.76	26.82	0.00	-74.38	0.000						
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	CO	0.36	0.10	1.20	24.08	24.11	0.00	-72.40	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	CO	1.64	0.03	1.95	29.19	29.25	0.00	-98.13	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	CO	0.32	0.06	1.92	28.73	28.79	0.00	-79.75	0.000						
1 A 1 a Public Electricity and Heat Production: Other Fuels	CO	0.31	1.45	1.11	33.65	33.67	0.01	373.64	0.000						
1 A 1 b Petroleum refining: Gaseous Fuels	CO	0.00	0.04	2.00	30.00	30.07	0.00		0.000						
1 A 1 b Petroleum refining: Liquid Fuels	CO	0.39	0.39	10.00	40.00	41.23	0.00	-1.04	0.000						
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels	CO	0.04	0.04	5.00	30.00	30.41	0.00	-2.54	0.000						
1 A 2 a Iron and Steel: Biomass	CO	0.00	0.00	5.00	75.00	75.17	0.00	2201.6	0.000						
1 A 2 a Iron and Steel: Gaseous Fuels	CO	0.00	0.04	5.00	30.00	30.41	0.00	791.24	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	CO	0.20	0.12	5.00	35.00	35.36	0.00	-38.73	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base vear	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 a Iron and Steel: Other Fuels	CO	0.00	0.00	10.00	50.00	50.99	0.00		0.000						
1 A 2 a Iron and Steel: Solid Fuels	CO	0.04	0.03	2.00	20.00	20.10	0.00	-23.96	0.000						
1 A 2 b Non-ferrous metals: Gaseous Fuels	CO	0.00	0.00	5.00	30.00	30.41	0.00	129.23	0.000						
1 A 2 b Non-ferrous metals: Liquid Fuels	CO	0.03	0.02	5.00	30.00	30.41	0.00	-32.67	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	CO	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	CO	0.02	0.05	5.00	50.00	50.25	0.00	209.52	0.000						
1 A 2 c Chemicals: Gaseous Fuels	CO	0.03	0.02	5.00	30.00	30.41	0.00	-25.58	0.000						
1 A 2 c Chemicals: Liquid Fuels	CO	0.11	0.09	5.00	40.00	40.31	0.00	-17.65	0.000						
1 A 2 c Chemicals: Other Fuels	CO	0.00	0.01	10.00	50.00	50.99	0.00	772.25	0.000						
1 A 2 c Chemicals: Solid Fuels	CO	0.01	0.00	2.00	30.00	30.07	0.00	-72.26	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	CO	1.23	1.42	8.00	75.00	75.43	0.03	15.38	0.000						
1 A 2 d Pulp, Paper and Print: Gaseous Fuels	CO	0.01	0.01	5.00	30.00	30.41	0.00	-23.31	0.000						
1 A 2 d Pulp, Paper and Print: Liquid Fuels	CO	0.56	0.11	5.00	30.00	30.41	0.00	-79.99	0.000						
1 A 2 d Pulp, Paper and Print: Other Fuels	CO	0.02	0.02	10.00	50.00	50.99	0.00	5.25	0.000						
1 A 2 d Pulp, Paper and Print: Solid Fuels	CO	0.03	0.00	7.00	30.00	30.81	0.00	-98.66	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	CO	0.01	0.05	5.00	75.00	75.17	0.00	693.52	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels	CO	0.04	0.03	5.00	30.00	30.41	0.00	-22.78	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	CO	0.18	0.02	5.00	40.00	40.31	0.00	-87.51	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	CO	0.00	0.00	10.00	50.00	50.99	0.00	-87.86	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	CO	0.01	0.00	5.00	40.00	40.31	0.00	-88.10	0.000						
1 A 2 f Non-metallic minerals: Biomass	CO	0.00	0.05	4.54	36.34	36.62	0.00	1756.98	0.000						
1 A 2 f Non-metallic minerals: Gaseous Fuels	CO	0.01	0.03	4.06	14.74	15.29	0.00	152.30	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	CO	0.17	0.09	9.02	18.12	20.25	0.00	-48.27	0.000						
1 A 2 f Non-metallic minerals: Other Fuels	CO	0.00	0.04	10.00	30.00	31.62	0.00		0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	CO	0.11	0.04	8.49	17.19	19.17	0.00	-61.22	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	CO	10.10	11.16	2.91	14.14	14.44	0.08	10.49	0.000	9	7	10			
1 A 2 g viii Other: Biomass	CO	0.72	0.55	4.22	25.31	25.66	0.00	-24.00	0.000						
1 A 2 g viii Other: Gaseous Fuels	CO	0.02	0.01	2.96	5.91	6.61	0.00	-55.71	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g viii Other: Liquid Fuels	CO	0.75	0.13	2.90	5.80	6.49	0.00	-82.61	0.000						
1 A 2 g viii Other: Other Fuels	CO	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 2 g viii Other: Solid Fuels	CO	0.01	0.18	4.93	19.73	20.34	0.00	1795.39	0.000						
1 A 3 a Domestic Aviation: Aviation Gasoline	CO	0.02	0.00	10.00	10.00	14.14	0.00	-89.72	0.000						
1 A 3 a Domestic Aviation: Biomass	CO	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 A 3 a Domestic Aviation: Jet Kerosene	CO	0.82	0.24	10.00	10.00	14.14	0.00	-70.90	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	CO	0.00	2.76	4.57	45.69	45.92	0.05		0.000		16	13			
1 A 3 b i Road Transportation, Cars: Diesel oil	CO	2.86	3.00	4.99	49.83	50.08	0.07	4.77	0.000		15	15			
1 A 3 b i Road Transportation, Cars: Gasoline	CO	694.36	38.41	3.00	49.87	49.96	10.70	-94.47	0.389	1	2	1	1	2	1
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	CO	0.00	0.12	5.00	50.00	50.25	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	CO	0.86	1.36	5.00	50.00	50.25	0.01	57.21	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gaseous Fuels	CO	0.00	0.17	5.00	50.00	50.25	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	CO	80.37	2.11	3.00	50.00	50.09	0.03	-97.38	0.007	3	18	4	3		3
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	CO	0.01	0.02	3.75	69.75	69.85	0.00	237.53	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	CO	15.63	5.70	3.99	39.90	40.10	0.15	-63.52	0.000	6	10			9	
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	CO	0.17	0.20	4.37	87.27	87.38	0.00	17.02	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: LNG	CO	0.00	0.02	5.00	30.00	30.41	0.00		0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	CO	5.29	3.64	3.00	50.00	50.09	0.10	-31.23	0.000		14	14		13	
1 A 3 c Railways: Liquid Fuels	CO	0.54	0.22	5.00	75.00	75.17	0.00	-60.08	0.000						
1 A 3 d Domestic Navigation: Biomass	CO	0.00	0.03	5.00	20.00	20.62	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	CO	13.34	15.92	4.77	19.07	19.66	0.28	19.34	0.001	7	6	7		8	8
1 A 3 d Domestic Navigation: Gasoline	CO	0.00	0.05	5.00	20.00	20.62	0.00		0.000						
1 A 3 d Domestic Navigation: LNG	CO	0.00	0.22	10.00	30.00	31.62	0.00		0.000						
1 A 3 d Domestic Navigation: Residual Oil	CO	0.23	0.24	15.00	20.00	25.00	0.00	4.56	0.000						
1 A 3 e Other Transportation: Biomass	CO	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 3 e Other Transportation: Gaseous fuels	CO	0.00	0.00	5.00	30.00	30.41	0.00	41.02	0.000						
1 A 3 e Other Transportation: Total	CO	6.97	0.84	5.00	50.00	50.25	0.01	-88.00	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 a Commercial/Institutional: Biomass	CO	2.30	0.58	10.00	75.00	75.66	0.01	-74.97	0.000						
1 A 4 a Commercial/Institutional: Gaseous Fuels	CO	0.04	0.08	10.00	30.00	31.62	0.00	109.74	0.000						
1 A 4 a Commercial/Institutional: Gasoline	CO	24.48	21.95	5.00	20.00	20.62	0.59	-10.36	0.001	5	4	5		6	7
1 A 4 a Commercial/Institutional: Liquid Fuels	CO	2.71	0.74	4.85	18.95	19.56	0.00	-72.75	0.000						
1 A 4 b Residential: Biomass	CO	136.7	69.92	10.00	75.00	75.66	81.34	-48.84	0.067	2	1	2	2	1	2
1 A 4 b Residential: Gaseous Fuels	CO	0.04	0.03	10.00	30.00	31.62	0.00	-30.18	0.000						
1 A 4 b Residential: Liquid Fuels	CO	45.45	37.47	3.30	13.19	13.60	0.75	-17.57	0.001	4	3	3	4	5	6
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	CO	8.30	4.24	10.00	75.00	75.66	0.30	-48.98	0.000	10	12			7	
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	CO	0.32	0.14	30.00	20.00	36.06	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels	CO	0.01	0.00	10.00	30.00	31.62	0.00	-81.17	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	CO	2.49	5.22	3.55	14.19	14.63	0.02	109.74	0.000		11	11			
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	CO	8.29	10.76	2.58	16.95	17.14	0.10	29.79	0.000		8	8		12	
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	CO	0.09	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 B 1 c Fugitive emissions from Solid Fuels	CO	0.00	0.00	50.00	30.00	58.31	0.00	74.96	0.000						
1 B 2 a Oil	CO	0.03	0.00					-100.00							
1 B 2 c Venting and flaring	CO	0.01	0.00	50.00	40.00	64.03	0.00	-99.98	0.000						
1 D International Aviation: Biomass	CO	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 D International Aviation: Jet Kerosene	CO	0.67	0.68	10.00	10.00	14.14	0.00	2.16	0.000						
2 B 10 Other	CO	0.25	0.13		64.17	64.17	0.00	-46.03	0.000						
2 C 1 Iron and Steel Production	CO	2.36	2.35	4.81	96.15	96.27	0.15	-0.16	0.000		17			10	10
2 C 3 Aluminium production	CO	6.85	10.35	2.00	100.0	100.0	3.12	51.10	0.006		9	9		3	4
2 D 3 Other	CO	0.00	C	10.00	216.0	216.2	0.00	C	C						
2 G 4 Other	CO	0.47	0.19	14.30	3.81	14.80	0.00	-60.29	0.000						
2 H 1 Pulp and paper	CO	11.96	16.02	6.65	50.38	50.82	1.93	33.91	0.004	8	5	6		4	5
5 B 1 Composting	CO	0.01	0.13		92.20	92.20	0.00	1051.5	0.000						
5 C 1 Waste Incineration	CO	0.52	0.58	71.04	190.2	203.0	0.04	12.56	0.000						
Total		**1094**	**277.2**			**21.16**	**100.0**	**-74.66**	**6.905**						

Table A1-4. Summary of the key source and uncertainty analysis of Cr emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	Cr	0.04	0.41	1.54	30.76	30.80	0.18	832.40	0.003		3	3		5	5
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	Cr	0.01	0.00	1.21	60.42	60.43	0.00	-60.95	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	Cr	0.05	0.01	1.95	38.91	38.96	0.00	-88.81	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	Cr	0.25	0.00	2.00	50.00	50.04	0.00	-99.22	0.000	3		7			
1 A 1 a Public Electricity and Heat Production: Other Fuels	Cr	0.04	0.18	1.11	39.42	39.43	0.06	414.70	0.001		4	4			6
1 A 1 b Petroleum refining: Liquid Fuels	Cr	0.00	0.05	10.00	100.00	100.50	0.03	2999.07	0.001		8	8			7
1 A 2 a Iron and Steel: Biomass	Cr	0.00	0.00	5.00	40.00	40.31	0.00	81.57	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	Cr	0.00	0.00	5.00	100.00	100.12	0.00	-85.05	0.000						
1 A 2 a Iron and Steel: Solid Fuels	Cr	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	Cr	0.00	0.00	5.00	100.00	100.12	0.00	-53.11	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	Cr	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	Cr	0.00	0.00	5.00	40.00	40.31	0.00	83.35	0.000						
1 A 2 c Chemicals: Liquid Fuels	Cr	0.00	0.00	5.00	100.00	100.12	0.00	-68.43	0.000						
1 A 2 c Chemicals: Other Fuels	Cr	0.00	0.00					-100.00							
1 A 2 c Chemicals: Solid Fuels	Cr	0.01	0.00	2.00	50.00	50.04	0.00	-96.82	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 d Pulp, Paper and Print: Biomass	Cr	0.12	0.12	8.00	40.00	40.79	0.03	2.05	0.000		5	5			
1 A 2 d Pulp, Paper and Print: Liquid Fuels	Cr	0.01	0.00	5.00	100.00	100.12	0.00	-79.12	0.000						
1 A 2 d Pulp, Paper and Print: Other Fuels	Cr	0.00	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Solid Fuels	Cr	0.02	0.00	7.00	50.00	50.49	0.00	-99.38	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	Cr	0.00	0.01	5.00	40.00	40.31	0.00	509.56	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	Cr	0.00	0.00	5.00	100.00	100.12	0.00	-91.85	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	Cr	0.00	0.00					-100.00							
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	Cr	0.01	0.00	5.00	50.00	50.25	0.00	-95.54	0.000						
1 A 2 f Non-metallic minerals: Biomass	Cr	0.00	0.01	4.74	18.98	19.56	0.00	2310.56	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	Cr	0.00	0.00	9.83	49.15	50.12	0.00	37.71	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	Cr	0.10	0.01	8.38	25.52	26.86	0.00	-86.37	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Biomass	Cr	0.00	0.01	4.98	99.50	99.63	0.00		0.000						
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	Cr	0.02	0.02	4.91	98.16	98.28	0.00	17.71	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g vii Off-road vehicles and other machinery: Other Fossil Fuels	Cr	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 2 g viii Other: Biomass	Cr	0.08	0.05	4.59	18.38	18.94	0.00	-34.56	0.000		9	11			
1 A 2 g viii Other: Liquid Fuels	Cr	0.01	0.00	3.74	14.97	15.44	0.00	-69.96	0.000						
1 A 2 g viii Other: Solid Fuels	Cr	0.01	0.04	4.89	19.55	20.15	0.00	438.55	0.000			10			
1 A 3 b i Road Transportation, Cars: Biomass	Cr	0.00	0.01	3.93	78.68	78.78	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	Cr	0.00	0.01	5.00	100.00	100.12	0.00	526.71	0.000						
1 A 3 b i Road Transportation, Cars: Fossil part of biodiesel and biogasoline	Cr	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	Cr	0.02	0.01	3.00	100.00	100.04	0.00	-58.08	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	Cr	0.00	0.00	4.94	98.76	98.88	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	Cr	0.00	0.00	5.00	100.00	100.12	0.00	626.64	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Fossil part of biodiesel and biogasoline	Cr	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	Cr	0.00	0.00	3.00	100.00	100.04	0.00	-89.80	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	Cr	0.00	0.01	4.01	80.26	80.36	0.00	70715.2	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	Cr	0.01	0.01	4.76	95.22	95.33	0.00	-23.75	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Fossil part of biodiesel and biogasoline	Cr	0.00	0.00	3.56	71.24	71.33	0.00		0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	Cr	0.00	0.00	3.00	100.00	100.04	0.00	-86.43	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	Cr	0.00	0.00	3.00	100.00	100.04	0.00	108.78	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	Cr	0.00	0.00		75.00	75.00	0.00	26.63	0.000						
1 A 3 c Railways: Liquid Fuels	Cr	0.00	0.00	5.00	95.00	95.13	0.00	-58.75	0.000						
1 A 3 d Domestic Navigation: Biomass	Cr	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	Cr	0.00	0.01	3.84	76.74	76.84	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	Cr	0.08	0.02	15.00	100.00	101.12	0.01	-69.64	0.000						
1 A 3 e Other Transportation: Biomass	Cr	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 e Other Transportation: Other Fossil Fuels	Cr	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 e Other Transportation: Total	Cr	0.00	0.00	5.00	100.00	100.12	0.00	-25.37	0.000						
1 A 4 a Commercial/Institutional: Biomass	Cr	0.00	0.01	7.63	152.58	152.77	0.00	201.96	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 a Commercial/Institutional: Ethanol	Cr	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 4 a Commercial/Institutional: Gasoline	Cr	0.00	0.00	5.00	100.00	100.12	0.00	-4.24	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	Cr	0.02	0.00	5.23	86.00	86.16	0.00	-83.16	0.000						
1 A 4 a Commercial/Institutional: Other Fossil Fuels	Cr	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 4 b Residential: Biomass	Cr	0.12	0.11	9.95	198.90	199.15	0.56	-4.30	0.005	6	6		3	3	
1 A 4 b Residential: Liquid Fuels	Cr	0.04	0.00	5.35	48.36	48.66	0.00	-90.53	0.000						
1 A 4 b Residential: Other Fossil Fuels	Cr	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	Cr	0.01	0.02	6.65	132.96	133.13	0.01	116.67	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	Cr	0.00	0.00	30.00	100.00	104.40	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Fossil part of biodiesel and biogasoline	Cr	0.00	0.00	3.54	70.88	70.97	0.00		0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	Cr	0.00	0.00	3.59	71.79	71.88	0.00	159.72	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	Cr	0.02	0.01	3.38	64.14	64.23	0.00	-34.87	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	Cr	0.02	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 B 2 a Oil	Cr	0.01	0.00					-100.00							
1 B 2 c Venting and flaring	Cr	0.01	0.00					-100.00							
2 A 3 Glass Production	Cr	0.02	0.00		100.00	100.00	0.00	-95.87	0.000						
2 B 10 Other	Cr	0.00	0.00		100.00	100.00	0.00	472.68	0.000						
2 C 1 Iron and Steel Production	Cr	12.78	1.34	3.83	38.33	38.53	3.00	-89.55	0.157	1	2	1	1	2	2
2 C 2 Ferroalloys production	Cr	8.41	3.87	5.00	75.00	75.17	95.79	-53.97	0.243	2	1	2	2	1	1
2 C 3 Aluminium production	Cr	0.00	0.00	0.17	91.90	91.90	0.00	338.22	0.000						
2 C 7 Other	Cr	0.03	0.05	4.00	45.00	45.18	0.01	83.31	0.000		7	9			
2 G 4 Other	Cr	0.02	0.02	14.20	803.28	803.40	0.32	13.76	0.003					4	4
2 H 1 Pulp and paper	Cr	0.20	0.05	6.54	51.38	51.80	0.01	-74.92	0.000	4	10				
2 H 3 Other (NFR 2A6)	Cr	0.02	0.00		100.00	100.00	0.00	-85.97	0.000						
5 C 1 Waste Incineration	Cr	0.00	0.02	9.01	76.38	76.91	0.00	1381.77	0.000						
5 E Other	Cr	0.01	0.01	50.00	70.00	86.02	0.00	-4.72	0.000						
Total		**22.65**	**6.52**			**45.56**	**100.0**	**-71.20**	**6.426**						

Table A1-5. Summary of the key source and uncertainty analysis of Cu emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	Cu	0.12	1.28	1.53	76.57	76.59	0.16	944.85	0.020		2	4		3	4
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	Cu	0.04	0.02	1.22	60.85	60.86	0.00	-63.57	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	Cu	0.09	0.01	1.95	97.29	97.31	0.00	-88.34	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	Cu	0.25	0.00	2.00	100.00	100.02	0.00	-99.22	0.000			10			
1 A 1 a Public Electricity and Heat Production: Other Fuels	Cu	0.04	0.12	1.11	322.78	322.78	0.02	229.41	0.002						8
1 A 1 b Petroleum refining: Liquid Fuels	Cu	0.01	0.03	10.00	100.00	100.50	0.00	159.56	0.000						
1 A 2 a Iron and Steel: Biomass	Cu	0.00	0.00	5.00	40.00	40.31	0.00	1715.72	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	Cu	0.02	0.00	5.00	100.00	100.12	0.00	-85.47	0.000						
1 A 2 a Iron and Steel: Solid Fuels	Cu	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	Cu	0.00	0.00	5.00	100.00	100.12	0.00	-57.23	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	Cu	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	Cu	0.01	0.01	5.00	40.00	40.31	0.00	35.64	0.000						
1 A 2 c Chemicals: Liquid Fuels	Cu	0.01	0.00	5.00	100.00	100.12	0.00	-69.70	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 c Chemicals: Other Fuels	Cu	0.00	0.00					-100.00							
1 A 2 c Chemicals: Solid Fuels	Cu	0.01	0.00	2.00	40.00	40.05	0.00	-95.95	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	Cu	0.34	0.25	8.00	40.00	40.79	0.00	-26.79	0.000		9				
1 A 2 d Pulp, Paper and Print: Liquid Fuels	Cu	0.07	0.01	5.00	100.00	100.12	0.00	-77.18	0.000						
1 A 2 d Pulp, Paper and Print: Other Fuels	Cu	0.00	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Solid Fuels	Cu	0.02	0.00	7.00	40.00	40.61	0.00	-99.40	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	Cu	0.00	0.01	5.00	40.00	40.31	0.00	566.78	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	Cu	0.02	0.00	5.00	100.00	100.12	0.00	-92.48	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	Cu	0.00	0.00					-100.00							
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	Cu	0.01	0.00	5.00	40.00	40.31	0.00	-95.54	0.000						
1 A 2 f Non-metallic minerals: Biomass	Cu	0.00	0.01	4.76	19.05	19.64	0.00	1920.73	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	Cu	0.02	0.01	9.58	38.34	39.52	0.00	-54.17	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 f Non-metallic minerals: Solid Fuels	Cu	0.10	0.01	8.38	17.01	18.97	0.00	-86.37	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Biomass	Cu	0.00	0.33	4.98	99.50	99.63	0.02		0.003		8	5			7
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	Cu	0.51	0.61	4.91	98.16	98.28	0.06	17.71	0.002	5	3	7		5	
1 A 2 g vii Off-road vehicles and other machinery: Other Fossil Fuels	Cu	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 2 g viii Other: Biomass	Cu	0.22	0.10	4.58	18.33	18.89	0.00	-53.20	0.000						
1 A 2 g viii Other: Liquid Fuels	Cu	0.06	0.02	3.85	15.39	15.86	0.00	-70.68	0.000						
1 A 2 g viii Other: Solid Fuels	Cu	0.01	0.04	4.89	19.55	20.15	0.00	438.55	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	Cu	0.00	0.00	3.41	68.22	68.31	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	Cu	0.00	0.01	5.00	100.00	100.12	0.00	526.71	0.000						
1 A 3 b i Road Transportation, Cars: Fossil part of biodiesel and biogasoline	Cu	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	Cu	0.02	0.01	3.00	100.00	100.04	0.00	-58.08	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	Cu	0.00	0.00	4.93	98.68	98.80	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	Cu	0.00	0.00	5.00	100.00	100.12	0.00	626.64	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b ii Road Transportation, Light duty trucks: Fossil part of biodiesel and biogasoline	Cu	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	Cu	0.00	0.00	3.00	100.00	100.04	0.00	-89.80	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	Cu	0.00	0.00	4.01	80.25	80.35	0.00	66395.1	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	Cu	0.01	0.01	4.76	95.22	95.33	0.00	-23.75	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Fossil part of biodiesel and biogasoline	Cu	0.00	0.00	3.56	71.24	71.33	0.00		0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	Cu	0.00	0.00	3.00	100.00	100.04	0.00	-86.43	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	Cu	0.00	0.00	3.00	100.00	100.04	0.00	108.78	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	Cu	38.84	32.38		75.00	75.00	98.90	-16.63	1.195	1	1	2	1	1	1
1 A 3 c Railways: Liquid Fuels	Cu	0.05	0.02	5.00	95.00	95.13	0.00	-58.75	0.000						
1 A 3 d Domestic Navigation: Biomass	Cu	0.00	0.02	5.00	100.00	100.12	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 d Domestic Navigation: Gas/Diesel Oil	Cu	0.09	0.17	3.84	76.74	76.84	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	Cu	0.17	0.05	15.00	100.00	101.12	0.00	-69.64	0.000						
1 A 3 e Other Transportation: Biomass	Cu	0.00	0.04	5.00	100.00	100.12	0.00		0.000						
1 A 3 e Other Transportation: Other Fossil Fuels	Cu	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 e Other Transportation: Total	Cu	0.11	0.08	5.00	100.00	100.12	0.00	-25.37	0.000						
1 A 4 a Commercial/Institutional: Biomass	Cu	0.00	0.06	4.54	108.58	108.67	0.00	1649.95	0.000						
1 A 4 a Commercial/Institutional: Ethanol	Cu	0.00	0.01	5.00	100.00	100.12	0.00		0.000						
1 A 4 a Commercial/Institutional: Gasoline	Cu	0.04	0.04	5.00	100.00	100.12	0.00	-4.24	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	Cu	0.18	0.10	4.91	97.93	98.05	0.00	-43.44	0.000						
1 A 4 a Commercial/Institutional: Other Fossil Fuels	Cu	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 4 b Residential: Biomass	Cu	0.20	0.21	8.99	449.37	449.46	0.14	5.90	0.004					4	6
1 A 4 b Residential: Liquid Fuels	Cu	0.31	0.11	2.76	53.30	53.38	0.00	-63.79	0.000						
1 A 4 b Residential: Other Fossil Fuels	Cu	0.00	0.00	5.00	100.00	100.12	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	Cu	0.01	0.24	3.28	76.17	76.24	0.01	1571.26	0.001			8			
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	Cu	0.10	0.04	30.00	100.00	104.40	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Fossil part of biodiesel and biogasoline	Cu	0.00	0.00	3.54	70.88	70.97	0.00		0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	Cu	0.01	0.02	3.59	71.79	71.88	0.00	159.72	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	Cu	0.59	0.40	3.35	67.10	67.18	0.01	-31.36	0.000	4	7				
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	Cu	0.02	0.00					-100.00							
1 B 2 a Oil	Cu	0.00	0.00					-100.00							
1 B 2 c Venting and flaring	Cu	0.00	0.00					-100.00							
2 A 3 Glass Production	Cu	0.00	0.00		90.00	90.00	0.00	-37.86	0.000						
2 B 10 Other	Cu	0.00	0.00		100.00	100.00	0.00	-94.49	0.000						
2 C 1 Iron and Steel Production	Cu	3.54	0.42	2.68	26.83	26.96	0.00	-88.04	0.005	3	6	3	4		5
2 C 3 Aluminium production	Cu	0.01	0.00	2.00	100.00	100.02	0.00	-92.37	0.000						
2 C 7 Other	Cu	18.54	0.46	4.00	50.00	50.16	0.01	-97.54	0.620	2	5	1	2		2
2 G 4 Other	Cu	0.44	0.56	14.99	349.69	350.01	0.65	28.18	0.027	6	4	6	3	2	3
2 H 1 Pulp and paper	Cu	0.43	0.10	6.54	51.38	51.80	0.00	-75.88	0.000	7		9			
2 H 3 Other (NFR 2A5a)	Cu	0.10	0.00		50.00	50.00	0.00	-99.65	0.000						
2 H 3 Other (NFR 2A6)	Cu	0.01	0.00		50.00	50.00	0.00	-97.15	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
5 C 1 Waste Incineration	Cu	0.00	0.05	31.04	232.29	234.36	0.00	1309.48	0.000						
5 E Other	Cu	0.02	0.02	50.00	68.00	84.40	0.00	-4.75	0.000						
Total		**65.81**	**38.51**			**63.41**	**100.0**	**-41.48**	**13.710**						

Table A1-6. Summary of the key source and uncertainty analysis of Dioxin emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	DIOX	0.01	0.10	1.52	227.84	227.84	0.01	907.07	0.001						
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	DIOX	0.00	0.00	1.78	44.59	44.63	0.00	-82.92	0.000						
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	DIOX	0.04	0.01	1.33	33.25	33.27	0.00	-73.78	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	DIOX	0.02	0.00	1.95	291.86	291.87	0.00	-90.67	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	DIOX	3.15	0.00	2.00	50.00	50.04	0.00	-99.94	0.005	5		5			
1 A 1 a Public Electricity and Heat Production: Other Fuels	DIOX	9.87	2.18	1.11	166.35	166.36	1.60	-77.94	0.017	2	3	7	4	4	
1 A 1 b Petroleum refining: Gaseous Fuels	DIOX	0.00	0.00	2.00	100.00	100.02	0.00		0.000						
1 A 1 b Petroleum refining: Liquid Fuels	DIOX	0.02	0.23	10.00	100.00	100.50	0.01	1029.90	0.002		9	11			
1 A 2 a Iron and Steel: Biomass	DIOX	0.00	0.00	5.00	100.00	100.12	0.00	3110.17	0.000						
1 A 2 a Iron and Steel: Gaseous Fuels	DIOX	0.00	0.00	5.00	100.00	100.12	0.00	451.72	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	DIOX	0.01	0.00	5.00	100.00	100.12	0.00	-64.67	0.000						
1 A 2 a Iron and Steel: Solid Fuels	DIOX	0.01	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 b Non-ferrous metals: Gaseous Fuels	DIOX	0.00	0.00	5.00	50.00	50.25	0.00	52.82	0.000						
1 A 2 b Non-ferrous metals: Liquid Fuels	DIOX	0.00	0.00	5.00	100.00	100.12	0.00	-54.94	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	DIOX	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	DIOX	0.00	0.00	5.00	100.00	100.12	0.00	11.06	0.000						
1 A 2 c Chemicals: Gaseous Fuels	DIOX	0.00	0.00	5.00	50.00	50.25	0.00	-50.39	0.000						
1 A 2 c Chemicals: Liquid Fuels	DIOX	0.01	0.00	5.00	100.00	100.12	0.00	-75.68	0.000						
1 A 2 c Chemicals: Other Fuels	DIOX	0.00	0.00					-100.00							
1 A 2 c Chemicals: Solid Fuels	DIOX	0.11	0.00	2.00	100.00	100.02	0.00	-99.51	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	DIOX	0.12	0.04	8.00	100.00	100.32	0.00	-69.06	0.000						
1 A 2 d Pulp, Paper and Print: Gaseous Fuels	DIOX	0.00	0.00	5.00	50.00	50.25	0.00	-48.88	0.000						
1 A 2 d Pulp, Paper and Print: Liquid Fuels	DIOX	0.07	0.01	5.00	100.00	100.12	0.00	-83.01	0.000						
1 A 2 d Pulp, Paper and Print: Other Fuels	DIOX	0.05	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Solid Fuels	DIOX	0.27	0.00	7.00	100.00	100.24	0.00	-99.83	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	DIOX	0.01	0.00	5.00	100.00	100.12	0.00	-88.81	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels	DIOX	0.00	0.00	5.00	50.00	50.25	0.00	-48.52	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	DIOX	0.01	0.00	5.00	100.00	100.12	0.00	-92.21	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	DIOX	0.01	0.00					-100.00							
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	DIOX	0.10	0.00	5.00	100.00	100.12	0.00	-98.81	0.000						
1 A 2 f Non-metallic minerals: Biomass	DIOX	0.00	0.00	4.58	146.67	146.74	0.00	2566.41	0.000						
1 A 2 f Non-metallic minerals: Gaseous Fuels	DIOX	0.00	0.00	4.06	22.11	22.48	0.00	68.20	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	DIOX	0.01	0.01	9.80	19.60	21.91	0.00	12.75	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	DIOX	1.23	0.04	8.38	25.52	26.86	0.00	-96.37	0.000	7		9			
1 A 2 g viii Other: Biomass	DIOX	0.02	0.02	3.36	67.14	67.23	0.00	5.51	0.000						
1 A 2 g viii Other: Gaseous Fuels	DIOX	0.00	0.00	3.00	12.02	12.39	0.00	-69.50	0.000						
1 A 2 g viii Other: Liquid Fuels	DIOX	0.03	0.00	2.77	11.07	11.41	0.00	-88.23	0.000						
1 A 2 g viii Other: Solid Fuels	DIOX	0.08	0.36	4.96	19.85	20.46	0.00	324.27	0.000		7	8			
1 A 3 b i Road Transportation, Cars: Diesel oil	DIOX	0.02	0.10	5.00	1000.0	1000.0	0.12	526.71	0.026						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b i Road Transportation, Cars: Gasoline	DIOX	3.97	0.16	3.00	1000.0	1000.0	0.31	-96.01	2.299	4	10	4	2	8	3
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	DIOX	0.01	0.04	5.00	1000.0	1000.0	0.02	626.64	0.004						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	DIOX	0.28	0.00	3.00	1000.0	1000.0	0.00	-99.03	0.014						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	DIOX	0.12	0.09	4.76	952.15	952.17	0.09	-23.75	0.008						
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	DIOX	0.01	0.00	3.00	1000.0	1000.0	0.00	-98.71	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	DIOX	0.01	0.00	3.00	1000.0	1000.0	0.00	-80.12	0.000						
1 A 3 d Domestic Navigation: Biomass	DIOX	0.00	0.00	5.00	1000.0	1000.0	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	DIOX	0.01	0.01	3.84	767.43	767.44	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	DIOX	0.05	0.01	15.00	1000.0	1000.1	0.00	-69.64	0.000						
1 A 4 a Commercial/Institutional: Biomass	DIOX	0.05	0.11	10.00	1000.0	1000.1	0.16	127.32	0.028						
1 A 4 b Residential: Biomass	DIOX	2.73	2.60	10.00	1000.0	1000.1	82.58	-4.83	9.805	6	2	3	3	1	2
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	DIOX	0.20	0.32	10.00	1000.0	1000.1	1.22	59.08	0.194		8	10		6	6

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	DIOX	0.01	0.00	30.00	1000.0	1000.4	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	DIOX	0.17	0.00					-100.0							
1 B 2 a Oil	DIOX	0.24	0.00					-100.0							
1 B 2 c Venting and flaring	DIOX	0.00	0.00					-100.0							
2 B 10 Other	DIOX	0.02	0.00		200.00	200.00	0.00	-71.77	0.000						
2 C 1 Iron and Steel Production	DIOX	26.79	0.47	3.32	663.72	663.73	1.21	-98.23	55.036	1	5	1	1	7	1
2 C 3 Aluminium production	DIOX	0.07	0.00	2.00	2900.0	2900.0	0.00	-97.43	0.007						
2 C 7 Other	DIOX	0.90	0.36	4.00	1000.0	1000.0	1.55	-60.61	0.037	8	6			5	
2 G 4 Other	DIOX	0.00	0.00	15.00	100.00	101.12	0.00	-61.63	0.000						
2 H 1 Pulp and paper	DIOX	0.05	0.04	6.74	1002.1	1002.1	0.02	-25.39	0.002						
5 C 1 Waste Incineration	DIOX	0.62	0.89	9.34	797.74	797.80	6.11	43.15	0.929		4	6		2	4
5 E Other	DIOX	8.07	7.73	50.00	66.00	82.80	5.00	-4.25	1.218	3	1	2	5	3	5
Total		**59.65**	**15.97**			**179.15**	**100.00**	**-73.23**	**83.446**						

Table A1-7. Summary of the key source and uncertainty analysis of Hg emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	Hg	0.00	0.04	1.54	30.76	30.80	0.15	894.56	0.006		3	1		3	3
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	Hg	0.00	0.00	1.22	60.82	60.84	0.00	-46.36	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	Hg	0.02	0.00	1.95	38.91	38.96	0.00	-90.67	0.000	9		17			
1 A 1 a Public Electricity and Heat Production: Solid Fuels	Hg	0.09	0.00	1.60	31.93	31.97	0.00	-99.20	0.002	6		4			7
1 A 1 a Public Electricity and Heat Production: Other Fuels	Hg	0.35	0.10	1.11	320.42	320.42	99.25	-71.18	0.061	1	1	8	1	1	1
1 A 1 b Petroleum refining: Liquid Fuels	Hg	0.00	0.00	10.00	100.00	100.50	0.00	46.19	0.000						
1 A 2 a Iron and Steel: Biomass	Hg	0.00	0.00	5.00	40.00	40.31	0.00	81.57	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	Hg	0.00	0.00	5.00	100.00	100.12	0.00	-85.00	0.000						
1 A 2 a Iron and Steel: Solid Fuels	Hg	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	Hg	0.00	0.00	5.00	100.00	100.12	0.00	-42.14	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	Hg	0.00	0.00					-100.0							
1 A 2 c Chemicals: Biomass	Hg	0.00	0.00	5.00	40.00	40.31	0.00	60.50	0.000						
1 A 2 c Chemicals: Liquid Fuels	Hg	0.00	0.00	5.00	100.00	100.12	0.00	-63.09	0.000						
1 A 2 c Chemicals: Other Fuels	Hg	0.00	0.00					-100.0							
1 A 2 c Chemicals: Solid Fuels	Hg	0.00	0.00	2.00	40.00	40.05	0.00	-94.10	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 d Pulp, Paper and Print: Biomass	Hg	0.01	0.01	8.00	40.00	40.79	0.02	-14.35	0.001	12	10	10			12
1 A 2 d Pulp, Paper and Print: Liquid Fuels	Hg	0.00	0.00	5.00	100.00	100.12	0.00	-81.25	0.000						
1 A 2 d Pulp, Paper and Print: Other Fuels	Hg	0.00	0.00					-100.0							
1 A 2 d Pulp, Paper and Print: Solid Fuels	Hg	0.01	0.00	7.00	40.00	40.61	0.00	-99.45	0.000	14		22			
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	Hg	0.00	0.00	5.00	40.00	40.31	0.00	-14.30	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	Hg	0.00	0.00	5.00	100.00	100.12	0.00	-88.91	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	Hg	0.00	0.00					-100.0							
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	Hg	0.00	0.00	5.00	40.00	40.31	0.00	-96.03	0.000						
1 A 2 f Non-metallic minerals: Biomass	Hg	0.00	0.00	4.74	18.98	19.56	0.00	2467.2	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	Hg	0.00	0.00	9.86	49.32	50.30	0.00	166.78	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	Hg	0.04	0.01	8.63	17.44	19.46	0.00	-85.61	0.000	7	13	16			
1 A 2 g viii Other: Biomass	Hg	0.01	0.01	4.59	18.34	18.91	0.00	-30.08	0.000		14	20			
1 A 2 g viii Other: Liquid Fuels	Hg	0.00	0.00	3.49	20.94	21.23	0.00	-70.57	0.000						
1 A 2 g viii Other: Solid Fuels	Hg	0.00	0.01	4.87	19.50	20.10	0.00	331.93	0.000		11	9			17

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b i Road Transportation, Cars: Biomass	Hg	0.00	0.00	3.65	72.93	73.02	0.01		0.000		16	14			13
1 A 3 b i Road Transportation, Cars: Diesel oil	Hg	0.00	0.01	5.00	100.00	100.12	0.03	526.71	0.001		12	13		8	11
1 A 3 b i Road Transportation, Cars: Fossil part of biodiesel and biogasoline	Hg	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	Hg	0.03	0.01	3.00	100.00	100.04	0.18	-58.08	0.001	8	7	11	8	2	10
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	Hg	0.00	0.00	4.87	97.31	97.43	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	Hg	0.00	0.00	5.00	100.00	100.12	0.00	626.64	0.000			23			
1 A 3 b ii Road Transportation, Light duty trucks: Fossil part of biodiesel and biogasoline	Hg	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	Hg	0.00	0.00	3.00	100.00	100.04	0.00	-89.80	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	Hg	0.00	0.00	4.00	79.99	80.09	0.01	31983.7	0.000			19			16
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	Hg	0.01	0.00	4.76	95.22	95.33	0.02	-23.75	0.000		15	21			14
1 A 3 b iii Road Transportation, Heavy duty trucks: Fossil part of biodiesel and biogasoline	Hg	0.00	0.00	3.56	71.24	71.33	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	Hg	0.00	0.00	3.00	100.00	100.04	0.00	-86.43	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	Hg	0.00	0.00	3.00	100.00	100.04	0.00	108.78	0.000						
1 A 3 d Domestic Navigation: Biomass	Hg	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	Hg	0.00	0.00	3.84	76.74	76.84	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	Hg	0.00	0.00	15.00	100.00	101.12	0.00	-13.82	0.000						
1 A 4 a Commercial/Institutional: Biomass	Hg	0.00	0.00	10.00	40.00	41.23	0.00	127.32	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	Hg	0.00	0.00	20.00	100.00	101.98	0.00	-96.26	0.000						
1 A 4 b Residential: Biomass	Hg	0.02	0.02	10.00	40.00	41.23	0.05	-4.83	0.001	11	6	7	6	9	
1 A 4 b Residential: Liquid Fuels	Hg	0.01	0.00	20.00	100.00	101.98	0.00	-97.31	0.000			24			
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	Hg	0.00	0.00	10.00	40.00	41.23	0.00	41.69	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	Hg	0.00	0.00	30.00	100.00	104.40	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	Hg	0.00	0.00	20.00	100.00	101.98	0.00	-64.80	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	Hg	0.01	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 B 2 a Oil	Hg	0.00	0.00					-100.00							
1 B 2 c Venting and flaring	Hg	0.00	0.00					-100.00							
2 A 3 Glass Production	Hg	0.01	0.00		1000.0	1000.0	0.00	-96.38	0.006				4		4
2 B 10 Other	Hg	0.19	0.01		37.30	37.30	0.02	-93.60	0.008	4	9	3	3		2
2 C 1 Iron and Steel Production	Hg	0.32	0.09	2.90	11.60	11.95	0.10	-73.17	0.001	2	2	15	5	4	
2 C 3 Aluminium production	Hg	0.00	0.00	2.00	20.00	20.10	0.00	-99.59	0.000						
2 C 7 Other	Hg	0.19	0.01	4.00	20.00	20.40	0.01	-93.50	0.002	3	8	2	7		6
2 G 4 Other	Hg	0.00	0.00	12.57	166.91	167.39	0.00	-56.02	0.000						
2 H 1 Pulp and paper	Hg	0.01	0.02	6.65	50.38	50.82	0.09	41.90	0.003	13	5	6		5	5
2 H 3 Other (NFR 2A5a)	Hg	0.02	0.00					-100.00		10		12	2		
2 H 3 Other (NFR 2A6)	Hg	0.00	0.00					-100.00							
5 C 1 Waste Incineration	Hg	0.18	0.02	4.61	27.23	27.62	0.04	-86.99	0.002	5	4	5	6	7	8
5 E Other	Hg	0.00	0.00	50.00	67.00	83.60	0.01	-4.75	0.001		17	18			15
Total		1.57	0.40			81.85	100.00	-74.62	3.107						

Table A1-8. Summary of the key source and uncertainty analysis of NH_3 emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	NH3	0.03	0.15	1.52	15.19	15.26	0.00	462.62	0.000						
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	NH3	0.02	0.00	1.78	35.67	35.72	0.00	-91.46	0.000						
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	NH3	0.03	0.01	1.20	24.06	24.09	0.00	-80.70	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	NH3	0.02	0.00	1.95	38.91	38.96	0.00	-90.67	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	NH3	0.02	0.01	1.95	19.51	19.61	0.00	-48.56	0.000						
1 A 1 a Public Electricity and Heat Production: Other Fuels	NH3	0.05	0.22	1.11	16.57	16.61	0.00	380.02	0.000			17			
1 A 1 b Petroleum refining: Gaseous Fuels	NH3	0.00	0.00	2.00	40.00	40.05	0.00		0.000						
1 A 1 b Petroleum refining: Liquid Fuels	NH3	0.06	0.06	10.00	40.00	41.23	0.00	6.64	0.000						
1 A 2 a Iron and Steel: Biomass	NH3	0.00	0.00	5.00	40.00	40.31	0.00	2731.60	0.000						
1 A 2 a Iron and Steel: Gaseous Fuels	NH3	0.00	0.00	5.00	40.00	40.31	0.00	175.86	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	NH3	0.02	0.01	5.00	40.00	40.31	0.00	-66.32	0.000						
1 A 2 a Iron and Steel: Other Fuels	NH3	0.00	0.00	10.00	50.00	50.99	0.00		0.000						
1 A 2 a Iron and Steel: Solid Fuels	NH3	0.00	0.00	5.00	40.00	40.31	0.00	-99.77	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 b Non-ferrous metals: Gaseous Fuels	NH3	0.00	0.00	5.00	40.00	40.31	0.00	-23.59	0.000						
1 A 2 b Non-ferrous metals: Liquid Fuels	NH3	0.00	0.00	5.00	40.00	40.31	0.00	-60.68	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	NH3	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	NH3	0.00	0.00	5.00	40.00	40.31	0.00	445.51	0.000						
1 A 2 c Chemicals: Gaseous Fuels	NH3	0.01	0.00	5.00	40.00	40.31	0.00	-75.19	0.000						
1 A 2 c Chemicals: Liquid Fuels	NH3	0.01	0.01	5.00	40.00	40.31	0.00	-53.76	0.000						
1 A 2 c Chemicals: Other Fuels	NH3	0.00	0.00	10.00	50.00	50.99	0.00	770.23	0.000						
1 A 2 c Chemicals: Solid Fuels	NH3	0.00	0.00	2.00	40.00	40.05	0.00	-68.44	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	NH3	0.05	0.06	8.00	40.00	40.79	0.00	28.14	0.000						
1 A 2 d Pulp, Paper and Print: Gaseous Fuels	NH3	0.00	0.00	5.00	40.00	40.31	0.00	-74.44	0.000						
1 A 2 d Pulp, Paper and Print: Liquid Fuels	NH3	0.05	0.01	5.00	40.00	40.31	0.00	-84.15	0.000						
1 A 2 d Pulp, Paper and Print: Other Fuels	NH3	0.00	0.00	10.00	50.00	50.99	0.00	-19.24	0.000						
1 A 2 d Pulp, Paper and Print: Solid Fuels	NH3	0.00	0.00	7.00	40.00	40.61	0.00	-98.71	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	NH3	0.00	0.00	5.00	40.00	40.31	0.00	677.37	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels	NH3	0.01	0.00	5.00	40.00	40.31	0.00	-74.26	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	NH3	0.02	0.00	5.00	40.00	40.31	0.00	-90.78	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	NH3	0.00	0.00	10.00	50.00	50.99	0.00	-88.12	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	NH3	0.00	0.00	5.00	40.00	40.31	0.00	-88.10	0.000						
1 A 2 f Non-metallic minerals: Biomass	NH3	0.00	C	4.63	18.54	19.11	0.00	C	C						
1 A 2 f Non-metallic minerals: Gaseous Fuels	NH3	0.00	C	4.06	14.74	15.29	0.00	C	C						
1 A 2 f Non-metallic minerals: Liquid Fuels	NH3	0.02	C	8.72	8.79	12.38	0.00	C	C						
1 A 2 f Non-metallic minerals: Other Fuels	NH3	0.00	C	10.00	30.00	31.62	0.00	C	C						
1 A 2 f Non-metallic minerals: Solid Fuels	NH3	0.01	C	8.70	17.55	19.59	0.00	C	C						
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	NH3	0.00	0.00	4.97	29.83	30.24	0.00	72.16	0.000						
1 A 2 g viii Other: Biomass	NH3	0.02	0.02	4.04	16.15	16.64	0.00	-19.68	0.000						
1 A 2 g viii Other: Gaseous Fuels	NH3	0.00	0.00	2.97	11.86	12.23	0.00	-84.84	0.000						
1 A 2 g viii Other: Liquid Fuels	NH3	0.06	0.01	3.02	6.04	6.75	0.00	-85.21	0.000						
1 A 2 g viii Other: Other Fuels	NH3	0.00	0.00	5.00	20.00	20.62	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g viii Other: Solid Fuels	NH3	0.00	0.01	4.91	19.62	20.23	0.00	947.42	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	NH3	0.00	0.09	4.25	339.76	339.78	0.12		0.003						12
1 A 3 b i Road Transportation, Cars: Diesel oil	NH3	0.00	0.11	5.00	399.76	399.79	0.26	4235.55	0.005						9
1 A 3 b i Road Transportation, Cars: Gasoline	NH3	1.66	0.89	3.15	391.91	391.92	15.96	-46.21	0.112	8	12	11	1	3	3
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	NH3	0.00	0.00	5.00	400.00	400.03	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	NH3	0.00	0.04	5.00	400.00	400.03	0.03	5537.39	0.001						
1 A 3 b ii Road Transportation, Light duty trucks: Gaseous Fuels	NH3	0.00	0.00	5.00	400.00	400.03	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	NH3	0.09	0.01	3.00	400.00	400.01	0.00	-87.21	0.002						15
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	NH3	0.01	0.08	4.43	354.54	354.56	0.11	792.11	0.002						14
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	NH3	0.00	0.00	3.00	400.00	400.01	0.00	-85.38	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	NH3	0.00	0.00	3.00	400.00	400.01	0.00	117.13	0.000						
1 A 3 c Railways: Liquid Fuels	NH3	0.00	0.00	5.00	75.00	75.17	0.00	-58.75	0.000						
1 A 3 d Domestic Navigation: Biomass	NH3	0.00	0.00	5.00	40.00	40.31	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 d Domestic Navigation: Gas/Diesel Oil	NH3	0.00	0.00	3.34	26.75	26.96	0.00	166.46	0.000						
1 A 3 d Domestic Navigation: Gasoline	NH3	0.00	0.00	5.00	40.00	40.31	0.00		0.000						
1 A 3 d Domestic Navigation: Residual Oil	NH3	0.00	0.00	15.00	40.00	42.72	0.00	99.76	0.000						
1 A 3 e Other Transportation: Biomass	NH3	0.00	0.00	5.00	30.00	30.41	0.00		0.000						
1 A 3 e Other Transportation: Gaseous fuels	NH3	0.00	0.00	5.00	40.00	40.31	0.00	41.02	0.000						
1 A 3 e Other Transportation: Total	NH3	0.01	0.00	5.00	40.00	40.31	0.00	-47.54	0.000						
1 A 4 a Commercial/Institutional: Biomass	NH3	0.00	0.00	10.00	40.00	41.23	0.00	127.32	0.000						
1 A 4 a Commercial/Institutional: Gaseous Fuels	NH3	0.00	0.00	10.00	40.00	41.23	0.00	34.28	0.000						
1 A 4 a Commercial/Institutional: Gasoline	NH3	0.00	0.00	5.00	30.00	30.41	0.00	16.05	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	NH3	0.07	0.00	14.04	29.35	32.54	0.00	-96.64	0.000						
1 A 4 b Residential: Biomass	NH3	0.12	0.11	10.00	40.00	41.23	0.00	-4.83	0.000						
1 A 4 b Residential: Gaseous Fuels	NH3	0.00	0.00	10.00	40.00	41.23	0.00	-52.46	0.000						
1 A 4 b Residential: Liquid Fuels	NH3	0.16	0.00	17.31	34.67	38.75	0.00	-98.38	0.000			20			
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	NH3	0.01	0.01	10.00	40.00	41.23	0.00	31.52	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	NH3	0.00	0.00	30.00	40.00	50.00	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels	NH3	0.00	0.00	10.00	40.00	41.23	0.00	-88.23	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	NH3	0.00	0.00	3.54	21.23	21.53	0.00	340.47	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	NH3	0.01	0.00	7.07	19.32	20.57	0.00	-62.06	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	NH3	0.00	0.00					-100.00							
1 B 1 b Coke production	NH3	0.00	0.00	5.00	170.00	170.07	0.00	-13.52	0.000						
1 B 2 a Oil	NH3	0.00	0.00					-100.00							
1 B 2 c Venting and flaring	NH3	0.00	0.00	50.00	20.00	53.85	0.00	-99.99	0.000						
2 A 1 Cement Production	NH3	0.00	C	2.00	400.00	400.00	0.02	C	C						
2 A 3 Glass Production	NH3	0.25	0.06		400.00	400.00	0.07	-77.39	0.011			18	9		6
2 B 10 Other	NH3	0.19	0.02		40.11	40.11	0.00	-87.82	0.000			19			
2 B 2 Nitric Acid Production	NH3	0.01	0.00	2.00	5.00	5.39	0.00	-92.00	0.000						
2 C 1 Iron and Steel Production	NH3	0.00	0.00	5.00	20.00	20.62	0.00	0.00	0.000						
2 G 4 Other	NH3	0.04	0.01	15.00	6.00	16.16	0.00	-61.63	0.000						
2 H 1 Pulp and paper	NH3	1.64	1.09	6.97	49.78	50.27	0.39	-33.29	0.001	9	11	14	11	14	
2 H 3 Other (NFR 2A6)	NH3	0.21	0.16		400.00	400.00	0.52	-22.95	0.000					12	
3 B 1 Dairy cattle	NH3	9.41	3.07	20.00	50.00	53.85	3.56	-67.35	0.186	2	6	1	2	6	1
3 B 1 Non-dairy cattle	NH3	6.94	9.80	20.00	50.00	53.85	36.27	41.36	0.316	3	2	2	4	1	2
3 B 3 Swine	NH3	5.03	3.15	20.00	50.00	53.85	3.75	-37.29	0.030	5	5	3	5	5	7
3 B 4 Fur-bearing animals	NH3	0.61	0.28	20.00	50.00	53.85	0.03	-54.53	0.001	12		16			

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
3 B 4 Goats	NH3	0.01	0.02	20.00	50.00	53.85	0.00	188.84	0.000						
3 B 4 Horses	NH3	2.66	3.00	20.00	50.00	53.85	3.40	12.64	0.024	7	7	6	7	7	11
3 B 4 Poultry	NH3	1.55	2.00	14.45	36.13	38.92	0.79	29.14	0.006	10	8	7		10	13
3 B 4 Sheep	NH3	0.39	0.63	20.00	50.00	53.85	0.15	63.24	0.001		14	13			
3 D a 1 Inorganic N fertilizers	NH3	5.93	3.97	5.00	14.00	14.87	0.45	-32.98	0.003	4	4	5	10	13	
3 D a 2 a Animal manure applied to soils	NH3	17.48	14.19	5.00	14.00	14.87	5.79	-18.78	0.028	1	1	8	6	4	
3 D a 2 b Sewage sludge applied to soils	NH3	0.15	0.69	5.00	100.00	100.12	0.62	347.84	0.009		13	10		11	8
3 D a 2 c Other organic fertilizers applied to soils	NH3	0.14	1.18	5.00	100.00	100.12	1.83	770.92	0.032		9	4		9	4
3 D a 3 Urine and dung deposited by grazing animals	NH3	4.05	4.07	20.00	100.00	101.98	22.36	0.49	0.047	6	3	9	3	2	5
5 B 1 Composting	NH3	0.03	0.15		192.60	192.60	0.12	512.73	0.002			21			16
5 B 2 Anaerobic Digestion at Biogas Facilities	NH3	0.00	0.49	10.00	38.00	39.29	0.05	120339.68	0.001			12			17
5 C 1 Waste Incineration	NH3	0.00	0.00	10.00	50.00	50.99	0.00		0.000						
5 D 1 Domestic wastewater	NH3	0.00	0.00		102.00	102.00	0.00	0.00	0.000						
5 E Other	NH3	0.99	1.13	1.11	142.32	142.32	3.35	13.84	0.005	11	10	15	8	8	10
Total		**60.35**	**51.21**			**17.12**	**100.0**	**-15.15**	**9.093**						

Table A1-9. Summary of the key source and uncertainty analysis of Ni emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	Ni	0.06	0.55	1.52	30.48	30.52	2.26	795.05	0.003		5	2		7	4
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	Ni	2.44	0.55	1.48	73.86	73.87	13.42	-77.35	0.000	4	4	14	4	2	11
1 A 1 a Public Electricity and Heat Production: Peat	Ni	0.44	0.00	1.95	38.91	38.96	0.00	-99.07	0.000	13		9			15
1 A 1 a Public Electricity and Heat Production: Solid Fuels	Ni	0.22	0.00	2.00	40.00	40.05	0.00	-99.29	0.000			17			
1 A 1 a Public Electricity and Heat Production: Other Fuels	Ni	0.03	0.15	1.11	150.28	150.29	3.84	414.70	0.006		10	8		5	3
1 A 1 b Petroleum refining: Liquid Fuels	Ni	0.56	0.19	10.00	100.00	100.50	2.82	-66.87	0.001	11	9	12	9	6	10
1 A 2 a Iron and Steel: Biomass	Ni	0.00	0.00	5.00	40.00	40.31	0.00	81.57	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	Ni	0.76	0.11	5.00	100.00	100.12	0.93	-85.94	0.000	9	13	15	8	13	13
1 A 2 a Iron and Steel: Solid Fuels	Ni	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	Ni	0.09	C	5.00	100.00	100.12	0.03	C	C						
1 A 2 b Non-ferrous metals: Solid Fuels	Ni	0.00	C					C	C						
1 A 2 c Chemicals: Biomass	Ni	0.00	0.01	5.00	40.00	40.31	0.00	72.50	0.000						
1 A 2 c Chemicals: Liquid Fuels	Ni	0.34	0.08	5.00	100.00	100.12	0.50	-76.98	0.000	15	16		10	14	
1 A 2 c Chemicals: Other Fuels	Ni	0.00	0.00					-100.00							
1 A 2 c Chemicals: Solid Fuels	Ni	0.01	0.00	2.00	40.00	40.05	0.00	-93.71	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	Ni	0.27	0.28	8.00	40.00	40.79	1.08	3.77	0.001	16	7	5		12	9

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 d Pulp, Paper and Print: Liquid Fuels	Ni	3.64	0.76	5.00	100.00	100.12	46.47	-79.15	0.001	2	1	19	2	1	14
1 A 2 d Pulp, Paper and Print: Other Fuels	Ni	0.00	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Solid Fuels	Ni	0.03	0.00	7.00	40.00	40.61	0.00	-99.50	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	Ni	0.00	0.01	5.00	40.00	40.31	0.00	273.70	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	Ni	0.95	0.04	5.00	100.00	100.12	0.10	-96.25	0.003	8	20	7	7		5
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	Ni	0.00	0.00					-100.00							
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	Ni	0.01	0.00	5.00	40.00	40.31	0.00	-94.27	0.000						
1 A 2 f Non-metallic minerals: Biomass	Ni	0.00	0.01	4.44	17.77	18.32	0.00	805.90	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	Ni	0.76	0.23	10.00	59.97	60.80	1.60	-69.30	0.000	10	8	11		9	12
1 A 2 f Non-metallic minerals: Solid Fuels	Ni	0.08	0.01	8.38	17.01	18.97	0.00	-83.29	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Biomass	Ni	0.00	0.01	4.98	99.50	99.63	0.01		0.000						
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	Ni	0.02	0.02	4.91	98.16	98.28	0.05	17.71	0.000			24			
1 A 2 g vii Off-road vehicles and other machinery: Other Fossil Fuels	Ni	0.00	0.00	5.00	100.00	100.12	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g viii Other: Biomass	Ni	0.17	0.12	4.62	18.48	19.05	0.04	-30.99	0.000		11	10			
1 A 2 g viii Other: Liquid Fuels	Ni	1.75	0.34	4.65	37.17	37.46	1.31	-80.58	0.000	6	6			11	
1 A 2 g viii Other: Solid Fuels	Ni	0.00	0.03	4.86	19.44	20.04	0.00	989.04	0.000			20			
1 A 3 b i Road Transportation, Cars: Biomass	Ni	0.00	0.00	3.21	64.16	64.24	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	Ni	0.00	0.00	5.00	100.00	100.12	0.00	526.71	0.000						
1 A 3 b i Road Transportation, Cars: Fossil part of biodiesel and biogasoline	Ni	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	Ni	0.01	0.00	3.00	100.00	100.04	0.00	-58.08	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	Ni	0.00	0.00	4.26	85.17	85.28	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	Ni	0.00	0.00	5.00	100.00	100.12	0.00	626.64	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Fossil part of biodiesel and biogasoline	Ni	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	Ni	0.00	0.00	3.00	100.00	100.04	0.00	-89.80	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	Ni	0.00	0.00	3.86	77.22	77.32	0.00	4650.19	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	Ni	0.00	0.00	4.76	95.22	95.33	0.00	-23.75	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Fossil part of biodiesel and biogasoline	Ni	0.00	0.00	3.56	71.25	71.34	0.00		0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	Ni	0.00	0.00	3.00	100.00	100.04	0.00	-86.43	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	Ni	0.00	0.00	3.00	100.00	100.04	0.00	108.78	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	Ni	0.00	0.00		1000.0	1000.0	0.07	26.55	0.000						17
1 A 3 c Railways: Liquid Fuels	Ni	0.00	0.00	5.00	95.00	95.13	0.00	-58.75	0.000						
1 A 3 d Domestic Navigation: Biomass	Ni	0.00	0.00	5.00	50.00	50.25	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	Ni	0.03	0.05	3.84	38.37	38.56	0.03	80.98	0.000		17	16			
1 A 3 d Domestic Navigation: Residual Oil	Ni	2.45	0.74	15.00	50.00	52.20	12.15	-69.64	0.005	3	3	4	5	3	6
1 A 3 e Other Transportation: Biomass	Ni	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 e Other Transportation: Other Fossil Fuels	Ni	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 e Other Transportation: Total	Ni	0.00	0.00	5.00	100.00	100.12	0.00	-25.37	0.000						
1 A 4 a Commercial/Institutional: Biomass	Ni	0.00	0.01	6.69	43.91	44.42	0.00	252.72	0.000						
1 A 4 a Commercial/Institutional: Ethanol	Ni	0.00	0.00	5.00	100.00	100.12	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 a Commercial/Institutional: Gasoline	Ni	0.00	0.00	5.00	100.00	100.12	0.00	-4.24	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	Ni	2.23	0.00	5.38	84.56	84.73	0.00	-99.78	0.017	5		3	3		2
1 A 4 a Commercial/Institutional: Other Fossil Fuels	Ni	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 4 b Residential: Biomass	Ni	0.10	0.09	9.91	39.63	40.85	0.12	-3.94	0.000		14	13			16
1 A 4 b Residential: Liquid Fuels	Ni	1.12	0.01	5.80	48.54	48.89	0.00	-99.45	0.001	7		6	6		8
1 A 4 b Residential: Other Fossil Fuels	Ni	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	Ni	0.01	0.02	5.54	38.83	39.22	0.00	167.66	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	Ni	0.06	0.03	30.00	100.00	104.40	0.06	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Fossil part of biodiesel and biogasoline	Ni	0.00	0.00	3.54	70.88	70.97	0.00		0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	Ni	0.00	0.00	3.59	71.79	71.88	0.00	159.72	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	Ni	0.36	0.09	16.19	81.92	83.51	0.42	-75.65	0.000	14	15		11	15	
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	Ni	0.01	0.00					-100.00							
1 B 2 a Oil	Ni	0.00	0.00					-100.00							
1 B 2 c Venting and flaring	Ni	0.01	0.00					-100.00							
2 A 3 Glass Production	Ni	0.18	0.04		300.00	300.00	1.37	-76.09	0.000		19			10	18

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
2 B 10 Other	Ni	0.01	0.00		100.00	100.00	0.00	-98.10	0.000						
2 C 1 Iron and Steel Production	Ni	8.36	0.76	2.94	44.09	44.19	9.02	-90.94	0.020	1	2	1	1	4	1
2 C 2 Ferroalloys production	Ni	0.00	0.02	5.00	75.00	75.17	0.01		0.000						
2 C 3 Aluminium production	Ni	0.00	0.00	0.03	98.46	98.46	0.00	-9.84	0.000						
2 C 7 Other	Ni	0.03	0.03	4.00	53.00	53.15	0.02	-8.53	0.000		21	21			
2 G 4 Other	Ni	0.05	0.05	12.51	329.83	330.07	1.93	-10.82	0.002		18	18		8	7
2 H 1 Pulp and paper	Ni	0.47	0.11	6.54	51.38	51.80	0.29	-75.44	0.000	12	12	23		16	
2 H 3 Other (NFR 2A5a)	Ni	0.00	0.00		50.00	50.00	0.00	13.06	0.000						
2 H 3 Other (NFR 2A6)	Ni	0.05	0.00		39.86	39.86	0.00	-94.56	0.000						
5 C 1 Waste Incineration	Ni	0.00	0.02	9.40	71.76	72.37	0.02	1605.77	0.000			22			
Total		**28.19**	**5.61**			**19.86**	**100.00**	**-80.11**	**2.490**						

Table A1-10. Summary of the key source and uncertainty analysis of NMVOC emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	NMVOC	0.27	2.39	1.52	57.02	57.04	0.23	778.53	0.001		13	10		14	13
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	NMVOC	0.02	0.00	1.84	27.54	27.60	0.00	-88.54	0.000						
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	NMVOC	0.05	0.02	1.22	18.25	18.29	0.00	-66.30	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	NMVOC	0.55	0.05	1.95	48.64	48.68	0.00	-90.67	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	NMVOC	0.25	0.01	1.78	35.61	35.66	0.00	-94.32	0.000						
1 A 1 a Public Electricity and Heat Production: Other Fuels	NMVOC	0.07	0.36	1.11	36.53	36.55	0.00	407.01	0.000						
1 A 1 b Petroleum refining: Gaseous Fuels	NMVOC	0.00	0.00	2.00	30.00	30.07	0.00		0.000						
1 A 1 b Petroleum refining: Liquid Fuels	NMVOC	0.06	7.32	10.00	40.00	41.23	1.12	11852.2	0.007		4	5		8	9
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels	NMVOC	0.01	0.01	5.00	30.00	30.41	0.00	-2.54	0.000						
1 A 2 a Iron and Steel: Biomass	NMVOC	0.00	0.00	5.00	75.00	75.17	0.00	687.29	0.000						
1 A 2 a Iron and Steel: Gaseous Fuels	NMVOC	0.00	0.00	5.00	30.00	30.41	0.00	197.08	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	NMVOC	0.03	0.01	5.00	50.00	50.25	0.00	-62.11	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 a Iron and Steel: Other Fuels	NMVOC	0.00	0.00	10.00	50.00	50.99	0.00		0.000						
1 A 2 a Iron and Steel: Solid Fuels	NMVOC	0.01	0.01	2.00	50.00	50.04	0.00	-30.11	0.000						
1 A 2 b Non-ferrous metals: Gaseous Fuels	NMVOC	0.00	0.00	5.00	30.00	30.41	0.00	-23.59	0.000						
1 A 2 b Non-ferrous metals: Liquid Fuels	NMVOC	0.00	0.00	5.00	50.00	50.25	0.00	-51.04	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	NMVOC	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	NMVOC	0.06	0.02	5.00	50.00	50.25	0.00	-62.57	0.000						
1 A 2 c Chemicals: Gaseous Fuels	NMVOC	0.01	0.00	5.00	30.00	30.41	0.00	-75.19	0.000						
1 A 2 c Chemicals: Liquid Fuels	NMVOC	0.02	0.01	5.00	50.00	50.25	0.00	-52.81	0.000						
1 A 2 c Chemicals: Other Fuels	NMVOC	0.00	0.00	10.00	50.00	50.99	0.00	561.34	0.000						
1 A 2 c Chemicals: Solid Fuels	NMVOC	0.01	0.00	2.00	50.00	50.04	0.00	-52.86	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	NMVOC	3.77	0.82	8.00	75.00	75.43	0.05	-78.26	0.000	15	22	20	11		
1 A 2 d Pulp, Paper and Print: Gaseous Fuels	NMVOC	0.00	0.00	5.00	30.00	30.41	0.00	-74.44	0.000						
1 A 2 d Pulp, Paper and Print: Liquid Fuels	NMVOC	0.07	0.02	5.00	50.00	50.25	0.00	-75.19	0.000						
1 A 2 d Pulp, Paper and Print: Other Fuels	NMVOC	0.00	0.00	10.00	50.00	50.99	0.00	-31.25	0.000						
1 A 2 d Pulp, Paper and Print: Solid Fuels	NMVOC	0.03	0.00	7.00	50.00	50.49	0.00	-98.87	0.000						

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1 A 2 e Food Processing, Beverages and Tobacco: Biomass	NMVOC	0.02	0.03	5.00	50.00	50.25	0.00	75.99	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels	NMVOC	0.01	0.00	5.00	30.00	30.41	0.00	-74.26	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	NMVOC	0.02	0.00	5.00	50.00	50.25	0.00	-89.16	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	NMVOC	0.00	0.00	10.00	50.00	50.99	0.00	-96.99	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	NMVOC	0.01	0.00	5.00	50.00	50.25	0.00	-88.10	0.000						
1 A 2 f Non-metallic minerals: Biomass	NMVOC	0.01	0.02	4.49	26.94	27.32	0.00	114.06	0.000						
1 A 2 f Non-metallic minerals: Gaseous Fuels	NMVOC	0.00	0.00	4.06	14.74	15.29	0.00	-15.90	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	NMVOC	0.02	0.01	9.46	18.94	21.17	0.00	-37.40	0.000						
1 A 2 f Non-metallic minerals: Other Fuels	NMVOC	0.00	0.00	10.00	30.00	31.62	0.00		0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	NMVOC	0.10	0.04	8.41	25.58	26.93	0.00	-63.10	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	NMVOC	1.83	1.09	3.71	15.48	15.92	0.00	-40.59	0.000	20	19				
1 A 2 g viii Other: Biomass	NMVOC	2.39	0.33	4.58	27.47	27.85	0.00	-86.06	0.000	18					
1 A 2 g viii Other: Gaseous Fuels	NMVOC	0.00	0.00	2.97	5.94	6.64	0.00	-84.72	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g viii Other: Liquid Fuels	NMVOC	0.07	0.02	3.22	6.43	7.19	0.00	-75.99	0.000						
1 A 2 g viii Other: Other Fuels	NMVOC	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 2 g viii Other: Solid Fuels	NMVOC	0.01	0.03	4.65	18.61	19.18	0.00	347.56	0.000						
1 A 3 a Domestic Aviation: Aviation Gasoline	NMVOC	0.00	0.00	10.00	10.00	14.14	0.00	-93.03	0.000						
1 A 3 a Domestic Aviation: Biomass	NMVOC	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 A 3 a Domestic Aviation: Jet Kerosene	NMVOC	0.11	0.02	10.00	10.00	14.14	0.00	-80.28	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	NMVOC	0.00	0.27	4.97	49.70	49.95	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	NMVOC	0.64	0.25	5.00	50.00	50.25	0.00	-60.06	0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	NMVOC	85.82	4.34	3.00	49.75	49.84	0.58	-94.94	0.130	2	8	1	1	10	1
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	NMVOC	0.00	0.00	5.00	50.00	50.25	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	NMVOC	0.09	0.06	5.00	50.00	50.25	0.00	-36.12	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gaseous Fuels	NMVOC	0.00	0.00	5.00	50.00	50.25	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	NMVOC	5.57	0.10	3.00	50.00	50.09	0.00	-98.17	0.001	11		13	12		14
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	NMVOC	0.01	0.00	4.57	45.69	45.92	0.00	-62.81	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	NMVOC	5.22	0.21	4.38	43.80	44.02	0.00	-96.04	0.000	13		15			
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	NMVOC	0.15	0.03	2.61	41.80	41.88	0.00	-81.79	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: LNG	NMVOC	0.00	0.00	5.00	50.00	50.25	0.00		0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	NMVOC	1.24	0.52	3.00	50.00	50.09	0.01	-58.53	0.000						
1 A 3 b v Road Transportation, Motorcycles: Gasoline	NMVOC	44.98	2.17	3.00	50.00	50.09	0.15	-95.18	0.037	3	14	3	3		4
1 A 3 c Railways: Liquid Fuels	NMVOC	0.15	0.04	5.00	75.00	75.17	0.00	-71.27	0.000						
1 A 3 d Domestic Navigation: Biomass	NMVOC	0.00	0.01	5.00	20.00	20.62	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	NMVOC	5.22	4.25	4.80	19.22	19.81	0.09	-18.53	0.000	12	9	9			
1 A 3 d Domestic Navigation: Gasoline	NMVOC	0.00	0.01	5.00	50.00	50.25	0.00		0.000						
1 A 3 d Domestic Navigation: LNG	NMVOC	0.00	0.04	10.00	50.00	50.99	0.00		0.000						
1 A 3 d Domestic Navigation: Residual Oil	NMVOC	0.07	0.05	15.00	20.00	25.00	0.00	-24.19	0.000						
1 A 3 e Other Transportation: Biomass	NMVOC	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 3 e Other Transportation: Gaseous fuels	NMVOC	0.00	0.00	5.00	30.00	30.41	0.00	41.02	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 e Other Transportation: Total	NMVOC	1.25	0.12	5.00	50.00	50.25	0.00	-90.57	0.000						
1 A 4 a Commercial/Institutional: Biomass	NMVOC	0.33	0.04	10.00	75.00	75.66	0.00	-87.95	0.000						
1 A 4 a Commercial/Institutional: Gaseous Fuels	NMVOC	0.00	0.00	10.00	30.00	31.62	0.00	162.18	0.000						
1 A 4 a Commercial/Institutional: Gasoline	NMVOC	1.78	0.76	5.00	20.00	20.62	0.00	-57.13	0.000		23				
1 A 4 a Commercial/Institutional: Liquid Fuels	NMVOC	0.42	0.22	4.88	19.40	20.00	0.00	-48.45	0.000						
1 A 4 b Residential: Biomass	NMVOC	17.57	6.80	10.00	75.00	75.66	3.26	-61.32	0.001	5	5		8	7	
1 A 4 b Residential: Gaseous Fuels	NMVOC	0.00	0.00	10.00	30.00	31.62	0.00	-12.73	0.000						
1 A 4 b Residential: Liquid Fuels	NMVOC	4.56	3.34	3.30	13.21	13.62	0.03	-26.79	0.000	14	10	14			
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	NMVOC	1.19	0.52	10.00	75.00	75.66	0.02	-56.40	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	NMVOC	0.06	0.03	30.00	20.00	36.06	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels	NMVOC	0.00	0.00	10.00	30.00	31.62	0.00	-76.47	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	NMVOC	0.87	0.85	4.24	16.95	17.47	0.00	-2.55	0.000		21	21			
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	NMVOC	3.05	1.95	2.56	16.76	16.95	0.01	-36.06	0.000	16	15	18			

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	NMVOC	0.17	0.00					-100.00							
1 B 1 b Coke production	NMVOC	0.01	0.01	5.00	900.00	900.01	0.00	-13.52	0.000						
1 B 1 c Fugitive emissions from Solid Fuels	NMVOC	0.00	0.00	50.00	30.00	58.31	0.00	74.96	0.000						
1 B 2 a Oil	NMVOC	30.75	3.28		53.03	53.03	0.37	-89.35	0.013	4	11	4	6	12	7
1 B 2 b Natural gas	NMVOC	0.51	0.32		47.08	47.08	0.00	-37.39	0.000						
1 B 2 c Venting and flaring	NMVOC	0.28	0.00	0.04	49.96	49.96	0.00	-99.93	0.000						
1 D International Aviation: Biomass	NMVOC	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 D International Aviation: Jet Kerosene	NMVOC	0.09	0.07	10.00	10.00	14.14	0.00	-18.71	0.000						
2 A 3 Glass Production	NMVOC	0.04	0.01		400.00	400.00	0.00	-82.84	0.000						
2 B 10 Other	NMVOC	5.97	1.76		39.07	39.07	0.06	-70.61	0.000	10	16		14		
2 C 1 Iron and Steel Production	NMVOC	0.29	0.19	4.97	66.76	66.95	0.00	-33.33	0.000						
2 C 3 Aluminium production	NMVOC	0.01	0.00	2.00	100.00	100.02	0.00	-99.73	0.000						
2 D 3 Other	NMVOC	89.95	50.54	9.81	9.85	13.90	6.08	-43.81	0.039	1	1	2	5	4	10
2 G 4 Other	NMVOC	0.04	0.02	15.00	100.00	101.12	0.00	-61.63	0.000						
2 H 1 Pulp and paper	NMVOC	6.74	6.26	6.20	100.98	101.17	4.95	-7.10	0.011	9	7	8	9	6	8
2 H 2 Food and beverages industry	NMVOC	1.24	1.40	20.00	200.00	201.00	0.98	13.37	0.003		18	17		9	11
2 H 3 Other (NFR 2A6)	NMVOC	0.10	0.04		400.00	400.00	0.00	-60.18	0.000						
3 B 1 Dairy cattle	NMVOC	14.42	7.40	20.00	200.00	201.00	27.28	-48.70	0.017	6	2	12	2	1	6
3 B 1 Non-dairy cattle	NMVOC	7.11	6.56	20.00	200.00	201.00	21.44	-7.74	0.050	8	6	6	7	3	2
3 B 3 Swine	NMVOC	1.34	0.65	20.00	200.00	201.00	0.21	-51.61	0.000				13	15	

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
3 B 4 Fur-bearing animals	NMVOC	0.32	0.15	20.00	200.00	201.00	0.01	-54.53	0.000						
3 B 4 Goats	NMVOC	0.00	0.01	20.00	200.00	201.00	0.00	188.84	0.000						
3 B 4 Horses	NMVOC	2.91	3.27	20.00	200.00	201.00	5.34	12.64	0.015	17	12	11	10	5	5
3 B 4 Poultry	NMVOC	0.84	1.45	13.98	139.79	140.49	0.51	71.92	0.002		17	16		11	12
3 B 4 Sheep	NMVOC	0.24	0.39	20.00	200.00	201.00	0.08	63.24	0.000						
3 D a 2 a Animal manure applied to soils	NMVOC	9.52	7.37	5.00	200.00	200.06	26.79	-22.61	0.046	7	3	7	4	2	3
3 D a 2 b Sewage sludge applied to soils	NMVOC	0.02	0.11	5.00	200.00	200.06	0.01	347.84	0.000						
3 D a 3 Urine and dung deposited by grazing animals	NMVOC	0.26	0.26	20.00	200.00	201.00	0.03	-1.48	0.000						
3 D e Cultivated crops	NMVOC	1.21	1.01	5.00	150.00	150.08	0.28	-16.59	0.001		20	19		13	
5 A 1 Managed waste disposal sites	NMVOC	2.16	0.29	55.00	92.00	107.19	0.01	-86.76	0.000	19					
5 C 1 Waste Incineration	NMVOC	0.01	0.01	63.54	181.98	192.76	0.00	17.81	0.000						
5 D 1 Domestic wastewater	NMVOC	0.03	0.03		168.46	168.46	0.00	-9.59	0.000						
Total		**366.7**	**132.5**			**21.49**	**100.0**	**-63.87**	**6.129**						

Table A1-11. Summary of the key source and uncertainty analysis of NO_X emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	NOx	1.63	8.45	1.53	38.21	38.24	0.90	416.71	0.011	29	4	4		7	8
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	NOx	0.51	0.02	1.78	17.84	17.93	0.00	-95.73	0.000						
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	NOx	2.70	0.43	1.20	12.04	12.10	0.00	-84.12	0.000	21	32	24			
1 A 1 a Public Electricity and Heat Production: Peat	NOx	2.08	0.07	1.95	19.46	19.55	0.00	-96.56	0.000	26		22			
1 A 1 a Public Electricity and Heat Production: Solid Fuels	NOx	6.01	0.10	1.85	18.55	18.64	0.00	-98.34	0.000	10		11			
1 A 1 a Public Electricity and Heat Production: Other Fuels	NOx	1.41	3.63	1.11	22.43	22.46	0.06	157.99	0.001	30	9	8		15	14
1 A 1 b Petroleum refining: Gaseous Fuels	NOx	0.00	0.04	2.00	50.00	50.04	0.00		0.000						
1 A 1 b Petroleum refining: Liquid Fuels	NOx	2.29	0.91	10.00	50.00	50.99	0.02	-60.38	0.000	23	25				
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels	NOx	0.50	0.36	5.00	50.00	50.25	0.00	-28.83	0.000		35				
1 A 2 a Iron and Steel: Biomass	NOx	0.00	0.01	5.00	50.00	50.25	0.00	1925.69	0.000						
1 A 2 a Iron and Steel: Gaseous Fuels	NOx	0.01	0.10	5.00	50.00	50.25	0.00	616.13	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	NOx	1.33	0.44	5.00	50.00	50.25	0.00	-66.61	0.000	31	31				

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 a Iron and Steel: Other Fuels	NOx	0.00	0.00	10.00	50.00	50.99	0.00		0.000						
1 A 2 a Iron and Steel: Solid Fuels	NOx	0.36	0.17	2.00	50.00	50.04	0.00	-52.89	0.000						
1 A 2 b Non-ferrous metals: Gaseous Fuels	NOx	0.01	0.01	5.00	50.00	50.25	0.00	1.88	0.000						
1 A 2 b Non-ferrous metals: Liquid Fuels	NOx	0.16	0.07	5.00	50.00	50.25	0.00	-56.00	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	NOx	0.01	0.00					-100.00							
1 A 2 c Chemicals: Biomass	NOx	0.07	0.14	5.00	50.00	50.25	0.00	98.90	0.000						
1 A 2 c Chemicals: Gaseous Fuels	NOx	0.16	0.05	5.00	50.00	50.25	0.00	-66.93	0.000						
1 A 2 c Chemicals: Liquid Fuels	NOx	0.64	0.36	5.00	50.00	50.25	0.00	-44.77	0.000		36				
1 A 2 c Chemicals: Other Fuels	NOx	0.01	0.02	10.00	50.00	50.99	0.00	191.42	0.000						
1 A 2 c Chemicals: Solid Fuels	NOx	0.21	0.01	2.00	50.00	50.04	0.00	-96.40	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	NOx	4.92	2.45	8.00	50.00	50.64	0.13	-50.16	0.000	12	14	25	10	12	
1 A 2 d Pulp, Paper and Print: Gaseous Fuels	NOx	0.07	0.02	5.00	50.00	50.25	0.00	-72.73	0.000						
1 A 2 d Pulp, Paper and Print: Liquid Fuels	NOx	3.69	0.45	5.00	50.00	50.25	0.00	-87.75	0.000	16	30	19	12		
1 A 2 d Pulp, Paper and Print: Other Fuels	NOx	0.11	0.03	10.00	50.00	50.99	0.00	-70.62	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 d Pulp, Paper and Print: Solid Fuels	NOx	0.57	0.00	7.00	50.00	50.49	0.00	-99.55	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	NOx	0.03	0.14	5.00	50.00	50.25	0.00	396.83	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels	NOx	0.27	0.09	5.00	50.00	50.25	0.00	-65.68	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	NOx	1.09	0.09	5.00	50.00	50.25	0.00	-91.66	0.000			30			
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	NOx	0.01	0.00	10.00	50.00	50.99	0.00	-95.86	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	NOx	0.18	0.01	5.00	50.00	50.25	0.00	-95.62	0.000						
1 A 2 f Non-metallic minerals: Biomass	NOx	0.01	0.15	4.63	27.79	28.17	0.00	1435.86	0.000						
1 A 2 f Non-metallic minerals: Gaseous Fuels	NOx	0.07	0.08	4.06	22.11	22.48	0.00	12.13	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	NOx	2.23	0.39	9.24	18.52	20.69	0.00	-82.53	0.000	24	34	26			
1 A 2 f Non-metallic minerals: Other Fuels	NOx	0.00	0.08	10.00	30.00	31.62	0.00		0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	NOx	4.50	1.05	9.51	28.55	30.09	0.01	-76.79	0.000	14	24	23	16		
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	NOx	12.29	4.60	4.95	19.78	20.39	0.08	-62.56	0.000	4	7		9	13	
1 A 2 g viii Other: Biomass	NOx	2.87	1.09	4.24	16.98	17.50	0.00	-62.05	0.000	20	23				

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g viii Other: Gaseous Fuels	NOx	0.12	0.02	2.97	11.87	12.24	0.00	-79.69	0.000						
1 A 2 g viii Other: Liquid Fuels	NOx	2.91	1.32	4.18	8.36	9.35	0.00	-54.65	0.000	19	20				
1 A 2 g viii Other: Other Fuels	NOx	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 2 g viii Other: Solid Fuels	NOx	0.14	1.96	4.95	19.80	20.41	0.01	1263.83	0.000		16	13			
1 A 3 a Domestic Aviation: Aviation Gasoline	NOx	0.02	0.00	10.00	10.00	14.14	0.00	-89.97	0.000						
1 A 3 a Domestic Aviation: Biomass	NOx	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 A 3 a Domestic Aviation: Jet Kerosene	NOx	0.68	0.19	10.00	10.00	14.14	0.00	-71.63	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	NOx	0.00	0.28	4.34	43.36	43.58	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	NOx	2.17	15.02	4.98	49.79	50.04	4.86	591.48	0.061	25	1	3		3	4
1 A 3 b i Road Transportation, Cars: Gasoline	NOx	69.89	3.52	3.17	49.21	49.31	0.26	-94.97	0.157	2	10	1	2	8	2
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	NOx	0.00	0.00	5.00	50.00	50.25	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	NOx	1.02	7.50	5.00	50.00	50.25	1.22	634.44	0.015		5	6		6	7
1 A 3 b ii Road Transportation, Light duty trucks: Gaseous Fuels	NOx	0.00	0.00	5.00	50.00	50.25	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	NOx	6.08	0.13	3.00	50.00	50.09	0.00	-97.86	0.001	9		12	8		10

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	NOx	0.02	0.04	3.79	38.42	38.61	0.00	125.81	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	NOx	72.84	9.00	4.20	42.01	42.22	1.24	-87.64	0.076	1	3	2	3	5	3
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	NOx	0.22	0.24	4.35	43.87	44.08	0.00	10.62	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: LNG	NOx	0.00	0.02	5.00	30.00	30.41	0.00		0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	NOx	0.06	0.11	3.00	50.00	50.09	0.00	84.57	0.000						
1 A 3 c Railways: Liquid Fuels	NOx	1.89	0.53	5.00	100.00	100.12	0.02	-72.27	0.000	27	29		11		
1 A 3 d Domestic Navigation: Biomass	NOx	0.00	0.26	5.00	10.00	11.18	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	NOx	2.35	3.76	3.03	6.05	6.76	0.01	59.69	0.000	22	8	9			
1 A 3 d Domestic Navigation: Gasoline	NOx	0.00	0.00	5.00	10.00	11.18	0.00		0.000						
1 A 3 d Domestic Navigation: LNG	NOx	0.00	0.29	10.00	30.00	31.62	0.00		0.000			32			
1 A 3 d Domestic Navigation: Residual Oil	NOx	4.52	2.47	15.00	10.00	18.03	0.02	-45.45	0.000	13	13	21			
1 A 3 e Other Transportation: Biomass	NOx	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 3 e Other Transportation: Gaseous fuels	NOx	0.00	0.00	5.00	50.00	50.25	0.00	41.02	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 e Other Transportation: Total	NOx	7.07	1.42	5.00	50.00	50.25	0.04	-79.85	0.001	8	19	17	6	16	
1 A 4 a Commercial/Institutional: Biomass	NOx	0.06	0.11	10.00	50.00	50.99	0.00	92.37	0.000						
1 A 4 a Commercial/Institutional: Gaseous Fuels	NOx	0.06	0.16	10.00	50.00	50.99	0.00	163.77	0.000						
1 A 4 a Commercial/Institutional: Gasoline	NOx	0.09	0.13	5.00	20.00	20.62	0.00	41.57	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	NOx	5.30	1.10	4.86	18.92	19.54	0.00	-79.22	0.000	11	22	20	13		
1 A 4 b Residential: Biomass	NOx	3.20	2.95	10.00	50.00	50.99	0.19	-7.87	0.001	17	11	14	15	10	11
1 A 4 b Residential: Gaseous Fuels	NOx	0.06	0.05	10.00	50.00	50.99	0.00	-10.78	0.000						
1 A 4 b Residential: Liquid Fuels	NOx	7.39	1.28	3.03	10.78	11.19	0.00	-82.73	0.000	7	21	16	7		
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	NOx	0.23	0.34	10.00	50.00	50.99	0.00	52.34	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	NOx	3.80	1.57	30.00	30.00	42.43	0.04	-58.68	0.001	15	18		17		
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels	NOx	0.02	0.01	10.00	50.00	50.99	0.00	-76.47	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	NOx	0.02	0.26	3.74	14.95	15.41	0.00	1248.11	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	NOx	12.34	2.22	3.64	14.39	14.84	0.01	-82.01	0.000	3	15	10	14		

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	NOx	0.34	0.00					-100.00							
1 B 1 b Coke production	NOx	0.00	0.00	5.00	400.00	400.03	0.00	-16.52	0.000						
1 B 1 c Fugitive emissions from Solid Fuels	NOx	0.01	0.01	50.00	20.00	53.85	0.00	13.66	0.000						
1 B 2 a Oil	NOx	0.30	0.00					-100.00							
1 B 2 c Venting and flaring	NOx	0.05	0.00	50.00	20.00	53.85	0.00	-99.99	0.000						
1 D International Aviation: Biomass	NOx	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 D International Aviation: Jet Kerosene	NOx	0.55	0.53	10.00	10.00	14.14	0.00	-3.26	0.000		28	31			
2 A 3 Glass Production	NOx	0.73	0.00					-100.00							
2 B 10 Other	NOx	1.28	0.58		50.70	50.70	0.01	-54.93	0.000	32	27				
2 B 2 Nitric Acid Production	NOx	1.15	0.01	2.00	5.00	5.39	0.00	-98.84	0.000			28			
2 C 1 Iron and Steel Production	NOx	0.99	0.83	2.98	44.77	44.87	0.01	-15.74	0.000		26	27			
2 C 2 Ferroalloys production	NOx	0.30	0.05	5.00	75.00	75.17	0.00	-85.00	0.000						
2 C 3 Aluminium production	NOx	0.05	0.11	2.00	50.00	50.04	0.00	91.46	0.000						
2 C 7 Other	NOx	0.35	0.22	4.00	50.00	50.16	0.00	-38.19	0.000						
2 G 4 Other	NOx	0.02	0.01	14.22	7.79	16.22	0.00	-60.14	0.000						
2 H 1 Pulp and paper	NOx	10.46	11.37	6.73	9.61	11.73	0.15	8.76	0.002	5	2	5	18	11	12

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
2 H 3 Other (NFR 2A5a)	NOx	0.00	0.00		100.00	100.00	0.00		0.000						
3 B 1 Dairy cattle	NOx	0.50	0.04	20.00	80.00	82.46	0.00	-92.44	0.000						
3 B 1 Non-dairy cattle	NOx	0.26	0.12	20.00	80.00	82.46	0.00	-53.55	0.000						
3 B 3 Swine	NOx	0.14	0.02	20.00	80.00	82.46	0.00	-88.50	0.000						
3 B 4 Fur-bearing animals	NOx	0.04	0.02	20.00	80.00	82.46	0.00	-54.53	0.000						
3 B 4 Goats	NOx	0.00	0.00	20.00	80.00	82.46	0.00	188.84	0.000						
3 B 4 Horses	NOx	0.06	0.07	20.00	80.00	82.46	0.00	12.64	0.000						
3 B 4 Poultry	NOx	0.07	0.13	14.65	58.60	60.40	0.00	92.07	0.000						
3 B 4 Sheep	NOx	0.01	0.01	20.00	80.00	82.46	0.00	63.24	0.000						
3 D a 1 Inorganic N fertilizers	NOx	8.98	7.39	5.00	400.00	400.03	75.23	-17.66	0.297	6	6	7	1	1	1
3 D a 2 a Animal manure applied to soils	NOx	3.10	2.82	5.00	400.00	400.03	10.94	-8.96	0.051	18	12	15	4	2	5
3 D a 2 b Sewage sludge applied to soils	NOx	0.05	0.21	5.00	400.00	400.03	0.06	347.84	0.001					14	13
3 D a 2 c Other organic fertilizers applied to soils	NOx	0.07	0.42	5.00	400.00	400.03	0.25	522.03	0.003		33	29		9	9
3 D a 3 Urine and dung deposited by grazing animals	NOx	1.72	1.74	20.00	400.00	400.50	4.17	1.32	0.023	28	17	18	5	4	6
5 C 1 Waste Incineration	NOx	0.09	0.17	14.52	341.82	342.12	0.03	82.56	0.000						
Total		**289.27**	**111.25**			**30.65**	**100.00**	**-61.54**	**8.385**						

Table A1-12. Summary of the key source and uncertainty analysis of PAH 1-4 emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	PAH 1-4	0.04	0.36	1.52	76.04	76.06	0.00	772.53	0.017		4	4			5
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	PAH 1-4	0.00	0.00	1.78	62.43	62.46	0.00	-82.92	0.000						
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	PAH 1-4	0.00	0.00	1.23	61.37	61.38	0.00	-41.47	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	PAH 1-4	0.03	0.00	1.95	97.29	97.31	0.00	-90.67	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	PAH 1-4	0.00	0.00	1.42	71.10	71.11	0.00	-98.48	0.000						
1 A 1 a Public Electricity and Heat Production: Other Fuels	PAH 1-4	0.00	0.00	1.11	114.83	114.84	0.00	414.70	0.000						
1 A 1 b Petroleum refining: Liquid Fuels	PAH 1-4	0.00	0.00	10.00	100.00	100.50	0.00	-50.71	0.000						
1 A 2 a Iron and Steel: Biomass	PAH 1-4	0.00	0.00	5.00	100.00	100.12	0.00	81.57	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	PAH 1-4	0.00	0.00	5.00	100.00	100.12	0.00	-77.70	0.000						
1 A 2 a Iron and Steel: Solid Fuels	PAH 1-4	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	PAH 1-4	0.00	0.00	5.00	100.00	100.12	0.00	-39.16	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	PAH 1-4	0.00	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 c Chemicals: Biomass	PAH 1-4	0.01	0.00	5.00	100.00	100.12	0.00	-71.74	0.000						
1 A 2 c Chemicals: Liquid Fuels	PAH 1-4	0.00	0.00	5.00	100.00	100.12	0.00	-61.54	0.000						
1 A 2 c Chemicals: Other Fuels	PAH 1-4	0.00	0.00					-100.00							
1 A 2 c Chemicals: Solid Fuels	PAH 1-4	0.00	0.00	2.00	100.00	100.02	0.00	210.22	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	PAH 1-4	0.75	0.12	8.00	100.00	100.32	0.00	-83.60	0.005	5	5	5			
1 A 2 d Pulp, Paper and Print: Liquid Fuels	PAH 1-4	0.01	0.00	5.00	100.00	100.12	0.00	-72.25	0.000						
1 A 2 d Pulp, Paper and Print: Other Fuels	PAH 1-4	0.00	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Solid Fuels	PAH 1-4	0.00	0.00	7.00	100.00	100.24	0.00	-99.64	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	PAH 1-4	0.00	0.00	5.00	100.00	100.12	0.00	34.14	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	PAH 1-4	0.00	0.00	5.00	100.00	100.12	0.00	-88.05	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	PAH 1-4	0.00	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	PAH 1-4	0.00	0.00	5.00	100.00	100.12	0.00	-88.10	0.000						
1 A 2 f Non-metallic minerals: Biomass	PAH 1-4	0.00	0.00	4.53	45.26	45.48	0.00	74.92	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	PAH 1-4	0.00	0.00	8.46	34.28	35.31	0.00	-74.29	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	PAH 1-4	0.00	0.00	8.38	42.53	43.35	0.00	-63.66	0.000						
1 A 2 g viii Other: Biomass	PAH 1-4	0.48	0.05	4.57	36.53	36.82	0.00	-89.51	0.000	6		7			
1 A 2 g viii Other: Liquid Fuels	PAH 1-4	0.01	0.00	3.47	20.80	21.08	0.00	-69.87	0.000						
1 A 2 g viii Other: Solid Fuels	PAH 1-4	0.00	0.00	4.95	39.58	39.89	0.00	3037.46	0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	PAH 1-4	0.03	0.01	5.00	1000.00	1000.01	0.00	-52.72	0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	PAH 1-4	0.11	0.04	3.00	1000.00	1000.00	0.01	-60.74	0.001						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	PAH 1-4	0.01	0.00	5.00	1000.00	1000.01	0.00	-42.15	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	PAH 1-4	0.01	0.00	3.00	1000.00	1000.00	0.00	-93.05	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	PAH 1-4	0.06	0.01	4.45	889.80	889.81	0.00	-80.44	0.002						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	PAH 1-4	0.00	0.00	3.00	1000.00	1000.00	0.00	-90.33	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	PAH 1-4	0.00	0.00	3.00	1000.00	1000.00	0.00	26.12	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	PAH 1-4	0.00	0.00		1000.00	1000.00	0.00	26.48	0.000						
1 A 3 d Domestic Navigation: Biomass	PAH 1-4	0.00	0.00	5.00	1000.00	1000.01	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	PAH 1-4	0.00	0.00	3.84	38.37	38.56	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	PAH 1-4	0.01	0.00	15.00	50.00	52.20	0.00	-69.64	0.000						
1 A 4 a Commercial/Institutional: Biomass	PAH 1-4	0.21	0.07	10.00	1000.00	1000.05	0.02	-68.23	0.001						
1 A 4 a Commercial/Institutional: Liquid Fuels	PAH 1-4	0.01	0.00	20.00	100.00	101.98	0.00	-96.14	0.000						
1 A 4 b Residential: Biomass	PAH 1-4	12.62	4.79	10.00	1000.00	1000.05	99.28	-62.07	5.040	1	1	3	1	1	1
1 A 4 b Residential: Liquid Fuels	PAH 1-4	0.04	0.00	20.00	100.00	101.98	0.00	-97.30	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	PAH 1-4	0.77	0.39	10.00	1000.00	1000.05	0.66	-49.26	0.399	4	3	6	2	2	2
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	PAH 1-4	0.00	0.00	30.00	1000.00	1000.45	0.00	-55.86	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	PAH 1-4	0.00	0.00	20.00	100.00	101.98	0.00	-64.18	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	PAH 1-4	0.09	0.00					-100.00				8			
1 B 1 b Coke production	PAH 1-4	0.03	0.04	5.00	100.00	100.12	0.00	16.52	0.000						
1 B 2 a Oil	PAH 1-4	0.00	0.00					-100.00							
1 B 2 c Venting and flaring	PAH 1-4	0.00	0.00					-100.00							
2 C 1 Iron and Steel Production	PAH 1-4	1.17	0.86	4.89	99.63	99.75	0.03	-26.52	0.054	3	2	2			4
2 C 3 Aluminium production	PAH 1-4	3.28	0.01	2.00	100.00	100.02	0.00	-99.57	0.316	2		1			3
2 G 4 Other	PAH 1-4	0.00	0.00	15.00	100.00	101.12	0.00	-61.63	0.000						
2 H 1 Pulp and paper	PAH 1-4	0.02	0.02	6.92	1000.74	1000.76	0.00	48.94	0.008						
5 C 1 Waste Incineration	PAH 1-4	0.00	0.00	11.29	166.29	166.67	0.00	302.56	0.000						
Total		**19.83**	**6.82**			**704.03**	**100.0**	**-65.58**	**24.173**						

Table A1-13. Summary of the key source and uncertainty analysis of Pb emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	Pb	0.18	1.81	1.54	77.05	77.07	64.05	922.35	0.001		1	2		1	1
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	Pb	0.18	0.05	1.34	66.80	66.81	0.03	-73.21	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	Pb	0.35	0.00	1.95	97.29	97.31	0.00	-99.42	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	Pb	0.63	0.00	2.00	100.00	100.02	0.00	-99.88	0.000						
1 A 1 a Public Electricity and Heat Production: Other Fuels	Pb	1.41	0.51	1.11	55.45	55.46	2.61	-63.97	0.000		6	5		6	5
1 A 1 b Petroleum refining: Liquid Fuels	Pb	0.04	0.01	10.00	100.00	100.50	0.00	-70.82	0.000						
1 A 2 a Iron and Steel: Biomass	Pb	0.00	0.00	5.00	100.00	100.12	0.00	81.57	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	Pb	0.06	0.01	5.00	100.00	100.12	0.00	-85.80	0.000						
1 A 2 a Iron and Steel: Solid Fuels	Pb	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	Pb	0.01	0.00	5.00	100.00	100.12	0.00	-71.68	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	Pb	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	Pb	0.01	0.02	5.00	100.00	100.12	0.01	89.80	0.000						
1 A 2 c Chemicals: Liquid Fuels	Pb	0.03	0.01	5.00	100.00	100.12	0.00	-74.55	0.000						
1 A 2 c Chemicals: Other Fuels	Pb	0.00	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 c Chemicals: Solid Fuels	Pb	0.02	0.00	2.00	40.00	40.05	0.00	-98.28	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	Pb	0.62	0.66	8.00	100.00	100.32	14.24	6.61	0.000		4	3		2	3
1 A 2 d Pulp, Paper and Print: Liquid Fuels	Pb	0.27	0.06	5.00	100.00	100.12	0.11	-78.47	0.000		15				
1 A 2 d Pulp, Paper and Print: Other Fuels	Pb	0.01	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Solid Fuels	Pb	0.06	0.00	7.00	40.00	40.61	0.00	-99.69	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	Pb	0.01	0.03	5.00	100.00	100.12	0.02	344.51	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	Pb	0.07	0.00	5.00	100.00	100.12	0.00	-95.01	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	Pb	0.00	0.00					-100.00							
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	Pb	0.02	0.00	5.00	40.00	40.31	0.00	-97.18	0.000						
1 A 2 f Non-metallic minerals: Biomass	Pb	0.00	0.03	4.73	94.69	94.81	0.03	2323.67	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	Pb	0.06	0.02	9.82	39.28	40.48	0.00	-63.94	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	Pb	0.22	0.02	8.38	17.01	18.97	0.00	-91.97	0.000						
1 A 2 g viii Other: Biomass	Pb	0.38	0.27	4.60	91.99	92.10	1.99	-30.32	0.000		8	8		7	7
1 A 2 g viii Other: Liquid Fuels	Pb	0.16	0.03	4.11	24.67	25.01	0.00	-79.05	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g viii Other: Solid Fuels	Pb	0.00	0.09	4.94	19.75	20.35	0.01	2062.97	0.000		13	15			
1 A 3 a Domestic Aviation: Aviation Gasoline	Pb	0.95	0.13	10.00	100.00	100.50	0.52	-86.81	0.000		9	12		10	10
1 A 3 b i Road Transportation, Cars: Gasoline	Pb	256.40	0.00	3.00	14.96	15.26	0.00	-100.00	0.000	1		1	1		2
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	Pb	17.83	0.00	3.00	15.00	15.30	0.00	-100.00	0.000	4		7	5		
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	Pb	0.41	0.00	3.00	15.00	15.30	0.00	-100.00	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	Pb	0.84	0.00	3.00	15.00	15.30	0.00	-100.00	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	Pb	6.09	0.46		75.00	75.00	3.87	-92.49	0.000	5	7	6	4	4	6
1 A 3 d Domestic Navigation: Gas/Diesel Oil	Pb	0.01	0.01	3.84	76.74	76.84	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	Pb	0.02	0.00	15.00	100.00	101.12	0.00	-69.64	0.000						
1 A 3 e Other Transportation: Biomass	Pb	0.00	0.00	5.00	15.00	15.81	0.00		0.000						
1 A 3 e Other Transportation: Total	Pb	1.93	0.01	5.00	100.00	100.12	0.00	-99.57	0.000						
1 A 4 a Commercial/Institutional: Biomass	Pb	0.01	0.02	10.00	50.00	50.99	0.01	127.32	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	Pb	0.19	0.00	20.00	100.00	101.98	0.00	-98.69	0.000						
1 A 4 b Residential: Biomass	Pb	0.59	0.56	10.00	50.00	50.99	2.65	-4.83	0.000		5	4		5	4

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 b Residential: Liquid Fuels	Pb	0.25	0.01	20.00	100.00	101.98	0.00	-97.96	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	Pb	0.04	0.06	10.00	50.00	50.99	0.03	41.69	0.000		14				
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	Pb	0.01	0.00	30.00	100.00	104.40	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	Pb	0.03	0.01	20.00	100.00	101.98	0.00	-74.77	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	Pb	0.04	0.00					-100.00							
1 B 2 c Venting and flaring	Pb	0.00	0.00					-100.00							
2 A 3 Glass Production	Pb	1.31	0.01		50.00	50.00	0.00	-99.32	0.000						
2 B 10 Other	Pb	0.09	0.11		98.93	98.93	0.41	21.87	0.000		10	11		11	9
2 C 1 Iron and Steel Production	Pb	24.45	0.69	3.52	34.90	35.08	1.93	-97.18	0.000	3	3	9	3	8	11
2 C 2 Ferroalloys production	Pb	0.03	0.02	5.00	100.00	100.12	0.01	-36.88	0.000						
2 C 3 Aluminium production	Pb	0.02	0.00	2.00	100.00	100.02	0.00	-99.53	0.000						
2 C 7 Other	Pb	52.03	0.83	4.00	50.00	50.16	5.77	-98.40	0.000	2	2	10	2	3	12
2 G 4 Other	Pb	0.00	0.00	15.00	100.00	101.12	0.00	-61.63	0.000						
2 H 1 Pulp and paper	Pb	0.40	0.10	6.54	51.38	51.80	0.09	-75.44	0.000		11	13			
2 H 3 Other (NFR 2A5a)	Pb	0.32	0.00		50.00	50.00	0.00	-99.95	0.000						
2 H 3 Other (NFR 2A6)	Pb	0.14	0.00		50.00	50.00	0.00	-99.31	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
5 C 1 Waste Incineration	Pb	0.01	0.09	33.53	250.93	253.16	1.60	1196.46	0.000	12	14		9	8	
5 E Other	Pb	0.00	0.00	50.00	74.00	89.31	0.00	-4.76	0.000						
Total		**369.21**	**6.74**			**25.86**	**100.00**	**-98.17**	**0.486**						

Table A1-14. Summary of the key source and uncertainty analysis of $PM_{2.5}$ emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	$PM_{2.5}$	0.57	0.74	1.52	30.47	30.51	0.38	29.43	0.001	16	6	5	25	7	9
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	1.78	89.19	89.20	0.00	-82.92	0.000						
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	$PM_{2.5}$	0.05	0.02	1.20	24.08	24.11	0.00	-61.96	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	$PM_{2.5}$	0.46	0.00	1.95	38.91	38.96	0.00	-99.78	0.000	19		14			17
1 A 1 a Public Electricity and Heat Production: Solid Fuels	$PM_{2.5}$	0.92	0.00	1.94	38.73	38.78	0.00	-99.72	0.001	10		10	13		11
1 A 1 a Public Electricity and Heat Production: Other Fuels	$PM_{2.5}$	0.41	0.01	1.11	22.18	22.21	0.00	-96.44	0.000	20		17	14		28
1 A 1 b Petroleum refining: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	2.00	100.00	100.02	0.00		0.000						
1 A 1 b Petroleum refining: Liquid Fuels	$PM_{2.5}$	0.33	0.07	10.00	100.00	100.50	0.04	-78.44	0.000	24	28	29	12	18	21
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels	$PM_{2.5}$	0.07	0.02	5.00	100.00	100.12	0.00	-69.07	0.000						
1 A 2 a Iron and Steel: Biomass	$PM_{2.5}$	0.00	0.00	5.00	100.00	100.12	0.00	7.64	0.000						
1 A 2 a Iron and Steel: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	5.00	100.00	100.12	0.00	467.23	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	$PM_{2.5}$	0.05	0.01	5.00	100.00	100.12	0.00	-83.36	0.000						
1 A 2 a Iron and Steel: Other Fuels	$PM_{2.5}$	0.00	0.00	10.00	100.00	100.50	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 a Iron and Steel: Solid Fuels	$PM_{2.5}$	0.01	0.00	2.00	99.98	100.00	0.00	-83.22	0.000						
1 A 2 b Non-ferrous metals: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	5.00	100.00	100.12	0.00	52.82	0.000						
1 A 2 b Non-ferrous metals: Liquid Fuels	$PM_{2.5}$	0.01	0.00	5.00	100.00	100.12	0.00	-76.12	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	$PM_{2.5}$	0.01	0.00					-100.00							
1 A 2 c Chemicals: Biomass	$PM_{2.5}$	0.03	0.01	5.00	100.00	100.12	0.00	-70.45	0.000						
1 A 2 c Chemicals: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	5.00	100.00	100.12	0.00	-50.39	0.000						
1 A 2 c Chemicals: Liquid Fuels	$PM_{2.5}$	0.02	0.01	5.00	100.00	100.12	0.00	-77.04	0.000						
1 A 2 c Chemicals: Other Fuels	$PM_{2.5}$	0.02	0.01	10.00	100.00	100.50	0.00	-65.47	0.000						
1 A 2 c Chemicals: Solid Fuels	$PM_{2.5}$	0.04	0.00	2.00	100.00	100.02	0.00	-99.85	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	$PM_{2.5}$	1.73	0.21	8.00	100.00	100.32	0.35	-87.62	0.007	6	12	9	3	8	2
1 A 2 d Pulp, Paper and Print: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	5.00	100.00	100.12	0.00	-59.10	0.000						
1 A 2 d Pulp, Paper and Print: Liquid Fuels	$PM_{2.5}$	0.18	0.03	5.00	100.00	100.12	0.01	-83.75	0.000	34		38	23		26
1 A 2 d Pulp, Paper and Print: Other Fuels	$PM_{2.5}$	0.25	0.01	10.00	100.00	100.50	0.00	-97.73	0.000	29		21	16		15
1 A 2 d Pulp, Paper and Print: Solid Fuels	$PM_{2.5}$	0.11	0.00	7.00	100.00	100.24	0.00	-99.99	0.000			35			24

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	$PM_{2.5}$	0.01	0.01	5.00	100.00	100.12	0.00	17.50	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	5.00	100.00	100.12	0.00	-48.52	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	$PM_{2.5}$	0.05	0.00	5.00	100.00	100.12	0.00	-95.29	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	$PM_{2.5}$	0.03	0.00	10.00	100.00	100.50	0.00	-99.47	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	$PM_{2.5}$	0.04	0.00	5.00	100.00	100.12	0.00	-99.95	0.000						
1 A 2 f Non-metallic minerals: Biomass	$PM_{2.5}$	0.00	0.00	3.53	35.35	35.52	0.00	-64.45	0.000						
1 A 2 f Non-metallic minerals: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	4.06	44.21	44.40	0.00	68.20	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	$PM_{2.5}$	0.04	0.01	9.68	58.10	58.90	0.00	-68.57	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	$PM_{2.5}$	0.12	0.00	7.93	32.57	33.52	0.00	-99.51	0.000			31			
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	$PM_{2.5}$	0.80	0.26	4.89	29.34	29.74	0.05	-67.26	0.000	13	10		17	17	
1 A 2 g viii Other: Biomass	$PM_{2.5}$	1.09	0.11	4.49	35.91	36.19	0.01	-90.14	0.000	9	20	11	8		12
1 A 2 g viii Other: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	2.85	22.77	22.95	0.00	-70.57	0.000						
1 A 2 g viii Other: Liquid Fuels	$PM_{2.5}$	0.18	0.02	3.89	23.35	23.67	0.00	-87.04	0.000	35		34			
1 A 2 g viii Other: Other Fuels	$PM_{2.5}$	0.00	0.00	5.00	40.00	40.31	0.00		0.000						

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1 A 2 g viii Other: Solid Fuels	$PM_{2.5}$	0.04	0.03	4.99	39.94	40.25	0.00	-15.66	0.000						
1 A 3 a Domestic Aviation: Aviation Gasoline	$PM_{2.5}$	0.00	0.00	10.00	10.00	14.14	0.00	-90.07	0.000						
1 A 3 a Domestic Aviation: Biomass	$PM_{2.5}$	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 A 3 a Domestic Aviation: Jet Kerosene	$PM_{2.5}$	0.02	0.01	10.00	10.00	14.14	0.00	-71.90	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	$PM_{2.5}$	0.00	0.00	3.54	10.63	11.21	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	$PM_{2.5}$	0.37	0.08	5.35	17.16	17.98	0.00	-77.45	0.000	22	24	28			
1 A 3 b i Road Transportation, Cars: Gasoline	$PM_{2.5}$	0.20	0.04	3.00	14.97	15.26	0.00	-81.72	0.000	33		39			
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	$PM_{2.5}$	0.00	0.00	5.00	15.00	15.81	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	$PM_{2.5}$	0.24	0.10	5.00	15.00	15.81	0.00	-55.72	0.000	30	21				
1 A 3 b ii Road Transportation, Light duty trucks: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	5.00	15.00	15.81	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	$PM_{2.5}$	0.04	0.00	3.00	15.00	15.30	0.00	-95.38	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	$PM_{2.5}$	0.00	0.00	3.54	10.61	11.18	0.00	-4.72	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	$PM_{2.5}$	3.17	0.13	4.26	12.78	13.47	0.00	-95.83	0.001	4	18	2	9		10

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1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	5.00	15.00	15.81	0.00	20071	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: LNG	$PM_{2.5}$	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	$PM_{2.5}$	0.04	0.03	3.00	15.00	15.30	0.00	-24.76	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	$PM_{2.5}$	0.13	0.16		15.00	15.00	0.00	26.43	0.000		15	19			
1 A 3 b vii Road Transportation: Automobile road abrasion	$PM_{2.5}$	2.37	3.03		15.00	15.00	1.56	27.94	0.005	5	2	1	11	4	4
1 A 3 c Railways: Liquid Fuels	$PM_{2.5}$	0.04	0.02	5.00	10.00	11.18	0.00	-58.75	0.000						
1 A 3 d Domestic Navigation: Biomass	$PM_{2.5}$	0.00	0.01	5.00	40.00	40.31	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	$PM_{2.5}$	0.41	0.35	3.15	25.18	25.37	0.06	-12.97	0.000	21	9	13		15	18
1 A 3 d Domestic Navigation: Gasoline	$PM_{2.5}$	0.00	0.00	5.00	40.00	40.31	0.00		0.000						
1 A 3 d Domestic Navigation: LNG	$PM_{2.5}$	0.00	0.00	10.00	300.00	300.17	0.00		0.000						
1 A 3 d Domestic Navigation: Residual Oil	$PM_{2.5}$	0.46	0.17	15.00	50.00	52.20	0.06	-63.83	0.000	18	14		21	16	
1 A 3 e Other Transportation: Biomass	$PM_{2.5}$	0.00	0.00	5.00	30.00	30.41	0.00		0.000						
1 A 3 e Other Transportation: Gaseous fuels	$PM_{2.5}$	0.00	0.00	5.00	10.00	11.18	0.00	41.02	0.000						
1 A 3 e Other Transportation: Total	$PM_{2.5}$	0.33	0.03	5.00	30.00	30.41	0.00	-89.52	0.000	23		22			

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1 A 4 a Commercial/Institutional: Biomass	$PM_{2.5}$	0.23	0.07	10.00	10.00	14.14	0.00	-69.05	0.000	31	27				
1 A 4 a Commercial/Institutional: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	10.00	10.00	14.14	0.00	162.18	0.000						
1 A 4 a Commercial/Institutional: Gasoline	$PM_{2.5}$	0.03	0.04	5.00	30.00	30.41	0.00	29.67	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	$PM_{2.5}$	0.46	0.09	4.87	28.93	29.34	0.01	-80.30	0.000	17	23	23			
1 A 4 b Residential: Biomass	$PM_{2.5}$	12.35	4.86	10.00	65.00	65.76	76.87	-60.66	0.026	1	1	6	1	1	5
1 A 4 b Residential: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	10.00	65.00	65.76	0.00	-12.73	0.000						
1 A 4 b Residential: Liquid Fuels	$PM_{2.5}$	0.82	0.15	2.86	16.60	16.84	0.00	-82.21	0.000	12	17	16	10		
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	$PM_{2.5}$	0.82	0.38	10.00	30.00	31.62	0.11	-53.53	0.000	11	8	20	15	12	
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	$PM_{2.5}$	0.06	0.03	30.00	40.00	50.00	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels	$PM_{2.5}$	0.00	0.00	10.00	30.00	31.62	0.00	-76.47	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	$PM_{2.5}$	0.02	0.02	4.49	26.95	27.32	0.00	25.34	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	$PM_{2.5}$	1.13	0.17	2.90	17.70	17.94	0.01	-84.64	0.000	8	13	12	19		23
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	$PM_{2.5}$	0.06	0.00					-100.00							
1 B 1 c Fugitive emissions from Solid Fuels	$PM_{2.5}$	0.10	0.02	5.99	19.96	20.84	0.00	-79.11	0.000						

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1 B 2 a Oil	$PM_{2.5}$	0.08	0.00					-100.00							
1 B 2 c Venting and flaring	$PM_{2.5}$	0.01	0.00	50.00	100.00	111.80	0.00	-100.00	0.000						
1 D International Aviation: Biomass	$PM_{2.5}$	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 D International Aviation: Jet Kerosene	$PM_{2.5}$	0.01	0.01	10.00	10.00	14.14	0.00	21.16	0.000						
2 A 1 Cement Production	$PM_{2.5}$	0.57	C	2.00	30.00	30.07	0.00	C	C	15		15	24		22
2 A 2 Lime Production	$PM_{2.5}$	0.27	0.07	5.36	51.60	51.88	0.01	-74.37	0.000	28	29				
2 A 3 Glass Production	$PM_{2.5}$	0.22	C		100.00	100.00	0.01	C	C	32		36	20		25
2 B 10 Other	$PM_{2.5}$	0.10	0.01		51.97	51.97	0.00	-85.72	0.000						
2 B 5 Carbide production	$PM_{2.5}$	0.10	C	10.00	50.00	50.99	0.00	C	C						
2 C 1 Iron and Steel Production	$PM_{2.5}$	3.71	0.58	4.17	33.37	33.63	0.29	-84.35	0.003	3	7	4	5	9	6
2 C 2 Ferroalloys production	$PM_{2.5}$	0.06	0.06	5.00	40.00	40.31	0.00	5.90	0.000		30	32			
2 C 3 Aluminium production	$PM_{2.5}$	0.15	0.04	1.99	39.85	39.90	0.00	-75.22	0.000						
2 C 7 Other	$PM_{2.5}$	0.17	0.01	4.00	40.00	40.20	0.00	-95.21	0.000	36		27			
2 D 3 Other	$PM_{2.5}$	0.00	0.00	10.00	100.00	100.50	0.00	4.53	0.000						
2 G 4 Other	$PM_{2.5}$	0.28	0.15	10.71	34.86	36.47	0.02	-45.14	0.000	27	16	26			
2 H 1 Pulp and paper	$PM_{2.5}$	6.23	1.42	6.54	20.55	21.57	0.71	-77.21	0.002	2	3	3	4	6	8
2 H 3 Other (NFR 2A5a)	$PM_{2.5}$	0.08	0.05		50.00	50.00	0.01	-33.39	0.000						

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2 H 3 Other (NFR 2A5b)	$PM_{2.5}$	1.38	0.93		151.00	151.00	14.86	-32.74	0.020	7	4	8	2	2	1
2 H 3 Other (NFR 2A6)	$PM_{2.5}$	0.30	0.07		50.00	50.00	0.01	-76.43	0.000	25	26	37	26		
3 B 1 Dairy cattle	$PM_{2.5}$	0.16	0.12	20.00	150.00	151.33	0.23	-25.33	0.000	37	19	25	18	10	14
3 B 1 Non-dairy cattle	$PM_{2.5}$	0.10	0.10	20.00	150.00	151.33	0.17	2.90	0.000		22	24		11	13
3 B 3 Swine	$PM_{2.5}$	0.12	0.08	20.00	150.00	151.33	0.10	-38.30	0.000		25		22	13	20
3 B 4 Fur-bearing animals	$PM_{2.5}$	0.00	0.00	20.00	200.00	201.00	0.00	-54.53	0.000						
3 B 4 Goats	$PM_{2.5}$	0.00	0.00	20.00	200.00	201.00	0.00	188.84	0.000						
3 B 4 Horses	$PM_{2.5}$	0.02	0.02	20.00	200.00	201.00	0.02	12.64	0.000						27
3 B 4 Poultry	$PM_{2.5}$	0.04	0.06	13.54	117.94	118.72	0.04	54.80	0.000		31	30			19
3 B 4 Sheep	$PM_{2.5}$	0.00	0.00	20.00	200.00	201.00	0.00	63.24	0.000						
3 D c Farm-level agricultural operations	$PM_{2.5}$	0.30	0.23	20.00	150.00	151.33	0.88	-24.32	0.002	26	11	18	7	5	7
5 A Solid waste disposal	$PM_{2.5}$	0.00	0.00	10.00	385.00	385.13	0.00	-57.90	0.000						
5 C 1 Waste Incineration	$PM_{2.5}$	0.04	0.05	57.66	167.91	177.54	0.07	33.52	0.000			33		14	16
5 E Other	$PM_{2.5}$	0.80	0.76	50.00	67.00	83.60	3.04	-4.51	0.018	14	5	7	6	3	3
Total		**46.83**	**16.60**			**21.96**	**100.00**	**-64.57**	**2.982**						

Table A1-15. Summary of the key source and uncertainty analysis of PM_{10} emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2020 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	PM_{10}	0.76	1.10	1.52	30.47	30.50	0.05	43.90	0.001	16	6	9		9	13
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	PM_{10}	0.00	0.00	1.78	89.19	89.20	0.00	-82.92	0.000						
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	PM_{10}	0.11	0.02	1.21	24.22	24.25	0.00	-78.65	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	PM_{10}	0.60	0.00	1.95	38.91	38.96	0.00	-99.83	0.000	20		16			15
1 A 1 a Public Electricity and Heat Production: Solid Fuels	PM_{10}	1.04	0.00	1.94	38.73	38.78	0.00	-99.76	0.001	11		11	14		11
1 A 1 a Public Electricity and Heat Production: Other Fuels	PM_{10}	0.45	0.01	1.11	22.18	22.21	0.00	-96.74	0.000	24		19	17		
1 A 1 b Petroleum refining: Gaseous Fuels	PM_{10}	0.00	0.00	2.00	100.00	100.02	0.00		0.000						
1 A 1 b Petroleum refining: Liquid Fuels	PM_{10}	0.34	0.08	10.00	100.00	100.50	0.00	-75.90	0.000	30		28	16		17
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels	PM_{10}	0.10	0.07	5.00	100.00	100.12	0.00	-35.40	0.000						
1 A 2 a Iron and Steel: Biomass	PM_{10}	0.00	0.00	5.00	100.00	100.12	0.00	4.57	0.000						
1 A 2 a Iron and Steel: Gaseous Fuels	PM_{10}	0.00	0.00	5.00	100.00	100.12	0.00	473.94	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	PM_{10}	0.07	0.01	5.00	100.00	100.12	0.00	-84.84	0.000						
1 A 2 a Iron and Steel: Other Fuels	PM_{10}	0.00	0.00	10.00	100.00	100.50	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2020 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year		Level in 2022		Trend		Level in base year (Approach 2)		Level in 2022 (Approach 2)		Trend (Approach 2)	
1 A 2 a Iron and Steel: Solid Fuels	PM_{10}	0.01	0.00	2.00	99.98	100.00	0.00	-86.37	0.000												
1 A 2 b Non-ferrous metals: Gaseous Fuels	PM_{10}	0.00	0.00	5.00	100.00	100.12	0.00	52.82	0.000												
1 A 2 b Non-ferrous metals: Liquid Fuels	PM_{10}	0.01	0.00	5.00	100.00	100.12	0.00	-76.62	0.000												
1 A 2 b Non-ferrous metals: Solid Fuels	PM_{10}	0.01	0.00					-100.00													
1 A 2 c Chemicals: Biomass	PM_{10}	0.04	0.01	5.00	100.00	100.12	0.00	-72.06	0.000												
1 A 2 c Chemicals: Gaseous Fuels	PM_{10}	0.00	0.00	5.00	100.00	100.12	0.00	-50.39	0.000												
1 A 2 c Chemicals: Liquid Fuels	PM_{10}	0.03	0.01	5.00	100.00	100.12	0.00	-77.04	0.000												
1 A 2 c Chemicals: Other Fuels	PM_{10}	0.02	0.01	10.00	100.00	100.50	0.00	-64.71	0.000												
1 A 2 c Chemicals: Solid Fuels	PM_{10}	0.05	0.00	2.00	100.00	100.02	0.00	-99.84	0.000												
1 A 2 d Pulp, Paper and Print: Biomass	PM_{10}	2.36	0.29	8.00	100.00	100.32	0.04	-87.76	0.015	8		14		7		4		10		5	
1 A 2 d Pulp, Paper and Print: Gaseous Fuels	PM_{10}	0.00	0.00	5.00	100.00	100.12	0.00	-59.10	0.000												
1 A 2 d Pulp, Paper and Print: Liquid Fuels	PM_{10}	0.22	0.04	5.00	100.00	100.12	0.00	-83.77	0.000					33						20	
1 A 2 d Pulp, Paper and Print: Other Fuels	PM_{10}	0.28	0.01	10.00	100.00	100.50	0.00	-97.73	0.000	35				23		18				14	
1 A 2 d Pulp, Paper and Print: Solid Fuels	PM_{10}	0.13	0.00	7.00	100.00	100.24	0.00	-99.99	0.000												

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2020 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	PM_{10}	0.01	0.01	5.00	100.00	100.12	0.00	18.51	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels	PM_{10}	0.00	0.00	5.00	100.00	100.12	0.00	-48.52	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	PM_{10}	0.06	0.00	5.00	100.00	100.12	0.00	-95.42	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	PM_{10}	0.03	0.00	10.00	100.00	100.50	0.00	-99.46	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	PM_{10}	0.04	0.00	5.00	100.00	100.12	0.00	-99.95	0.000						
1 A 2 f Non-metallic minerals: Biomass	PM_{10}	0.01	C	3.53	35.35	35.52	0.00	C	C						
1 A 2 f Non-metallic minerals: Gaseous Fuels	PM_{10}	0.00	C	4.06	44.21	44.40	0.00	C	C						
1 A 2 f Non-metallic minerals: Liquid Fuels	PM_{10}	0.04	C	9.73	48.67	49.63	0.00	C	C						
1 A 2 f Non-metallic minerals: Solid Fuels	PM_{10}	0.14	C	7.82	32.25	33.19	0.00	C	C						
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	PM_{10}	0.85	0.28	4.89	29.34	29.74	0.00	-67.26	0.000	13	15	20			
1 A 2 g viii Other: Biomass	PM_{10}	1.48	0.15	4.53	36.22	36.51	0.00	-90.21	0.001	9		10	10		10
1 A 2 g viii Other: Gaseous Fuels	PM_{10}	0.00	0.00	2.85	22.77	22.95	0.00	-70.57	0.000						
1 A 2 g viii Other: Liquid Fuels	PM_{10}	0.19	0.03	3.95	23.72	24.05	0.00	-86.88	0.000						
1 A 2 g viii Other: Other Fuels	PM_{10}	0.00	0.00	5.00	40.00	40.31	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2020 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g viii Other: Solid Fuels	PM_{10}	0.05	0.07	5.00	39.97	40.28	0.00	50.01	0.000						
1 A 3 a Domestic Aviation: Aviation Gasoline	PM_{10}	0.00	0.00	10.00	10.00	14.14	0.00	-90.07	0.000						
1 A 3 a Domestic Aviation: Biomass	PM_{10}	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 A 3 a Domestic Aviation: Jet Kerosene	PM_{10}	0.02	0.01	10.00	10.00	14.14	0.00	-71.90	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	PM_{10}	0.00	0.00	3.54	10.63	11.21	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	PM_{10}	0.37	0.08	5.35	17.16	17.98	0.00	-77.45	0.000	28		26			
1 A 3 b i Road Transportation, Cars: Gasoline	PM_{10}	0.20	0.04	3.00	14.97	15.26	0.00	-81.72	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	PM_{10}	0.00	0.00	5.00	15.00	15.81	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	PM_{10}	0.24	0.10	5.00	15.00	15.81	0.00	-55.72	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gaseous Fuels	PM_{10}	0.00	0.00	5.00	15.00	15.81	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	PM_{10}	0.04	0.00	3.00	15.00	15.30	0.00	-95.38	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	PM_{10}	0.00	0.00	3.54	49.91	50.03	0.00	-4.72	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	PM_{10}	3.17	0.13	4.26	12.78	13.47	0.00	-95.83	0.001	6		6	13		12

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2020 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	PM_{10}	0.00	0.00	5.00	100.00	100.12	0.00	20071	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: LNG	PM_{10}	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	PM_{10}	0.04	0.03	3.00	15.00	15.30	0.00	-24.76	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	PM_{10}	0.64	0.81		15.00	15.00	0.01	26.43	0.000	19	7	12			
1 A 3 b vii Road Transportation: Automobile road abrasion	PM_{10}	11.86	15.17		15.00	15.00	2.46	27.94	0.027	3	1	1	6	4	2
1 A 3 c Railways: Liquid Fuels	PM_{10}	0.05	0.02	5.00	10.00	11.18	0.00	-58.75	0.000						
1 A 3 d Domestic Navigation: Biomass	PM_{10}	0.00	0.01	5.00	40.00	40.31	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	PM_{10}	0.41	0.35	3.15	25.18	25.37	0.00	-12.97	0.000	25	13	24			
1 A 3 d Domestic Navigation: Gasoline	PM_{10}	0.00	0.00	5.00	40.00	40.31	0.00		0.000						
1 A 3 d Domestic Navigation: LNG	PM_{10}	0.00	0.00	10.00	300.00	300.17	0.00		0.000						
1 A 3 d Domestic Navigation: Residual Oil	PM_{10}	0.50	0.18	15.00	50.00	52.20	0.00	-63.66	0.000	21	19	31			
1 A 3 e Other Transportation: Biomass	PM_{10}	0.00	0.00	5.00	30.00	30.41	0.00		0.000						
1 A 3 e Other Transportation: Gaseous fuels	PM_{10}	0.00	0.00	5.00	10.00	11.18	0.00	41.02	0.000						
1 A 3 e Other Transportation: Total	PM_{10}	0.34	0.04	5.00	30.00	30.41	0.00	-89.50	0.000	29		22			

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2020 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 a Commercial/Institutional: Biomass	PM_{10}	0.24	0.07	10.00	10.00	14.14	0.00	-69.14	0.000						
1 A 4 a Commercial/Institutional: Gaseous Fuels	PM_{10}	0.00	0.00	10.00	10.00	14.14	0.00	162.18	0.000						
1 A 4 a Commercial/Institutional: Gasoline	PM_{10}	0.03	0.04	5.00	30.00	30.41	0.00	29.67	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	PM_{10}	0.50	0.10	4.88	28.99	29.40	0.00	-80.66	0.000	22		21			
1 A 4 b Residential: Biomass	PM_{10}	13.01	5.12	10.00	65.00	65.76	5.38	-60.65	0.031	2	3	4	2	2	3
1 A 4 b Residential: Gaseous Fuels	PM_{10}	0.00	0.00	10.00	65.00	65.76	0.00	-12.73	0.000						
1 A 4 b Residential: Liquid Fuels	PM_{10}	0.84	0.15	2.85	16.61	16.85	0.00	-81.80	0.000	14	21	18	12		
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	PM_{10}	0.87	0.40	10.00	30.00	31.62	0.01	-53.56	0.000	12	12		19		
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	PM_{10}	0.06	0.03	30.00	40.00	50.00	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels	PM_{10}	0.00	0.00	10.00	30.00	31.62	0.00	-76.47	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	PM_{10}	0.02	0.03	4.49	26.95	27.32	0.00	25.34	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	PM_{10}	1.19	0.18	2.91	17.67	17.91	0.00	-84.62	0.000	10	18	13			21
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	PM_{10}	0.12	0.00					-100.00							
1 B 1 c Fugitive emissions from Solid Fuels	PM_{10}	0.33	0.14	6.00	19.99	20.87	0.00	-56.80	0.000	33					

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2020 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 B 2 a Oil	PM_{10}	0.09	0.00					-100.00							
1 B 2 c Venting and flaring	PM_{10}	0.01	0.00	50.00	100.00	111.80	0.00	-100.00	0.000						
1 D International Aviation: Biomass	PM_{10}	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 D International Aviation: Jet Kerosene	PM_{10}	0.01	0.01	10.00	10.00	14.14	0.00	21.16	0.000						
2 A 1 Cement Production	PM_{10}	0.71	C	2.00	30.00	30.07	0.00	C	C	17		17			18
2 A 2 Lime Production	PM_{10}	0.30	0.08	5.36	51.60	51.88	0.00	-74.37	0.000	34		32			
2 A 3 Glass Production	PM_{10}	0.26	0.05		100.00	100.00	0.00	-80.96	0.000			30			19
2 B 10 Other	PM_{10}	0.11	0.02		75.55	75.55	0.00	-85.69	0.000						
2 B 5 Carbide production	PM_{10}	0.11	C	10.00	50.00	50.99	0.00	C	C						
2 C 1 Iron and Steel Production	PM_{10}	4.37	0.71	3.76	30.09	30.32	0.02	-83.74	0.004	5	9	5	7		8
2 C 2 Ferroalloys production	PM_{10}	0.08	0.09	5.00	40.00	40.31	0.00	5.90	0.000						
2 C 3 Aluminium production	PM_{10}	0.33	0.08	1.99	39.83	39.88	0.00	-75.22	0.000	31		29			
2 C 7 Other	PM_{10}	0.22	0.01	4.00	40.00	40.20	0.00	-95.69	0.000			27			
2 D 3 Other	PM_{10}	0.02	0.02	10.00	97.00	97.51	0.00	7.23	0.000						
2 G 4 Other	PM_{10}	0.33	0.21	10.78	35.73	37.32	0.00	-34.50	0.000	32	17				
2 H 1 Pulp and paper	PM_{10}	8.62	1.80	6.54	20.55	21.57	0.07	-79.15	0.006	4	5	2	5	8	6
2 H 3 Other (NFR 2A5a)	PM_{10}	0.40	0.27		49.00	49.00	0.01	-33.01	0.000	26	16				

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2020 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
2 H 3 Other (NFR 2A5b)	PM_{10}	13.83	9.30		145.00	145.00	86.42	-32.74	0.119	1	2	3	1	1	1
2 H 3 Other (NFR 2A6)	PM_{10}	0.39	0.09		49.00	49.00	0.00	-76.43	0.000	27		25			
3 B 1 Dairy cattle	PM_{10}	0.24	0.18	20.00	150.00	151.33	0.03	-25.30	0.000		20		15		22
3 B 1 Non-dairy cattle	PM_{10}	0.15	0.15	20.00	150.00	151.33	0.02	2.85	0.000		22				16
3 B 3 Swine	PM_{10}	0.67	0.41	20.00	150.00	151.33	0.18	-39.02	0.000	18	11		8	7	23
3 B 4 Fur-bearing animals	PM_{10}	0.00	0.00	20.00	200.00	201.00	0.00	-54.53	0.000						
3 B 4 Goats	PM_{10}	0.00	0.00	20.00	200.00	201.00	0.00	188.84	0.000						
3 B 4 Horses	PM_{10}	0.03	0.04	20.00	200.00	201.00	0.00	12.64	0.000						
3 B 4 Poultry	PM_{10}	0.45	0.66	14.10	117.88	118.72	0.29	47.69	0.004	23	10	14	11	5	7
3 B 4 Sheep	PM_{10}	0.00	0.01	20.00	200.00	201.00	0.00	63.24	0.000						
3 D c Farm-level agricultural operations	PM_{10}	2.58	2.10	20.00	150.00	151.33	4.77	-18.70	0.024	7	4	8	3	3	4
5 A Solid waste disposal	PM_{10}	0.00	0.00	10.00	379.00	379.13	0.00	-57.90	0.000						
5 C 1 Waste Incineration	PM_{10}	0.04	0.06	57.43	167.09	176.68	0.01	34.38	0.000						
5 E Other	PM_{10}	0.80	0.76	50.00	67.00	83.60	0.19	-4.51	0.005	15	8	15	9	6	9
Total		**79.74**	**42.68**			**34.00**	**100.00**	**-46.48**	**4.902**						

Table A1-16. Summary of the key source and uncertainty analysis of Se emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	Se	0.03	0.11	1.54	77.14	77.16	0.04	337.78	0.420	10	3	3			4
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	Se	0.02	0.00	1.36	68.22	68.23	0.00	-74.29	0.011	12		13			
1 A 1 a Public Electricity and Heat Production: Peat	Se	0.05	0.00	1.95	97.29	97.31	0.00	-98.34	0.244	6		5			5
1 A 1 a Public Electricity and Heat Production: Solid Fuels	Se	0.08	0.00	2.00	100.00	100.02	0.00	-99.85	0.681	4		4	4		3
1 A 1 a Public Electricity and Heat Production: Other Fuels	Se	0.01	0.04	1.11	158.68	158.69	0.02	157.35	0.109	16	5	10			
1 A 1 b Petroleum refining: Liquid Fuels	Se	0.00	0.00	10.00	100.00	100.50	0.00	-51.88	0.001						
1 A 2 a Iron and Steel: Biomass	Se	0.00	C	5.00	40.00	40.31	0.00	C	C						
1 A 2 a Iron and Steel: Liquid Fuels	Se	0.01	C	5.00	100.00	100.12	0.00	C	C			19			
1 A 2 a Iron and Steel: Solid Fuels	Se	0.00	C					C	C						
1 A 2 b Non-ferrous metals: Liquid Fuels	Se	0.00	0.00	5.00	100.00	100.12	0.00	-73.66	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	Se	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	Se	0.00	0.00	5.00	40.00	40.31	0.00	-12.38	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 c Chemicals: Liquid Fuels	Se	0.00	0.00	5.00	100.00	100.12	0.00	-75.15	0.001						
1 A 2 c Chemicals: Solid Fuels	Se	0.00	0.00	2.00	40.00	40.05	0.00	-97.30	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	Se	0.07	0.03	8.00	40.00	40.79	0.00	-53.45	0.030	5	6	6			
1 A 2 d Pulp, Paper and Print: Liquid Fuels	Se	0.03	0.01	5.00	100.00	100.12	0.00	-78.69	0.058	8		9			
1 A 2 d Pulp, Paper and Print: Solid Fuels	Se	0.01	0.00	7.00	40.00	40.61	0.00	-99.64	0.001	18		17			
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	Se	0.00	0.00	5.00	40.00	40.31	0.00	280.85	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	Se	0.01	0.00	5.00	100.00	100.12	0.00	-95.32	0.006	17		18			
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	Se	0.00	0.00	5.00	40.00	40.31	0.00	-96.65	0.000						
1 A 2 f Non-metallic minerals: Biomass	Se	0.00	0.00	4.77	19.09	19.67	0.00	1245.28	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	Se	0.01	0.00	9.87	39.49	40.71	0.00	-60.61	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	Se	0.03	0.00	8.38	17.01	18.97	0.00	-90.41	0.002	9		8			
1 A 2 g vii Off-road vehicles and other machinery: Biomass	Se	0.00	0.00	4.98	99.50	99.63	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	Se	0.00	0.00	4.91	98.16	98.28	0.00	17.71	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Other Fossil Fuels	Se	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 2 g viii Other: Biomass	Se	0.05	0.01	4.56	18.24	18.81	0.00	-70.30	0.004	7	8	7			
1 A 2 g viii Other: Liquid Fuels	Se	0.02	0.00	4.18	25.07	25.41	0.00	-80.48	0.001	15		14			
1 A 2 g viii Other: Solid Fuels	Se	0.00	0.01	4.92	19.70	20.30	0.00	1767.28	0.000		9	15			
1 A 3 b i Road Transportation, Cars: Biomass	Se	0.00	0.00	3.58	71.59	71.68	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	Se	0.00	0.00	5.00	100.00	100.12	0.00	526.71	0.000						
1 A 3 b i Road Transportation, Cars: Fossil part of biodiesel and biogasoline	Se	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	Se	0.00	0.00	3.00	100.00	100.04	0.00	-58.08	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	Se	0.00	0.00	4.84	96.75	96.87	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	Se	0.00	0.00	5.00	100.00	100.12	0.00	626.64	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Fossil part of biodiesel and biogasoline	Se	0.00	0.00	5.00	100.00	100.12	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	Se	0.00	0.00	3.00	100.00	100.04	0.00	-89.80	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	Se	0.00	0.00	3.99	79.88	79.98	0.00	26268.50	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	Se	0.00	0.00	4.76	95.22	95.33	0.00	-23.75	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Fossil part of biodiesel and biogasoline	Se	0.00	0.00	3.56	71.24	71.33	0.00		0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	Se	0.00	0.00	3.00	100.00	100.04	0.00	-86.43	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	Se	0.00	0.00	3.00	100.00	100.04	0.00	108.78	0.000						
1 A 3 c Railways: Liquid Fuels	Se	0.00	0.00	5.00	95.00	95.13	0.00	-58.75	0.000						
1 A 3 d Domestic Navigation: Biomass	Se	0.00	0.00	5.00	10.00	11.18	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	Se	0.00	0.00	3.84	71.15	71.25	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	Se	0.00	0.00	15.00	100.00	101.12	0.00	-69.64	0.000						
1 A 3 e Other Transportation: Biomass	Se	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 e Other Transportation: Other Fossil Fuels	Se	0.00	0.00	5.00	100.00	100.12	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 e Other Transportation: Total	Se	0.00	0.00	5.00	100.00	100.12	0.00	-25.37	0.000						
1 A 4 a Commercial/Institutional: Biomass	Se	0.00	0.00	9.19	37.62	38.73	0.00	147.68	0.000						
1 A 4 a Commercial/Institutional: Ethanol	Se	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 4 a Commercial/Institutional: Gasoline	Se	0.00	0.00	5.00	100.00	100.12	0.00	-4.24	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	Se	0.02	0.00	5.97	80.50	80.72	0.00	-95.84	0.021	14		12			
1 A 4 a Commercial/Institutional: Other Fossil Fuels	Se	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 4 b Residential: Biomass	Se	0.09	0.08	9.98	39.94	41.17	0.01	-4.68	0.014	3	4	16			
1 A 4 b Residential: Liquid Fuels	Se	0.02	0.00	7.17	50.04	50.56	0.00	-95.02	0.010	11		11			
1 A 4 b Residential: Other Fossil Fuels	Se	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	Se	0.01	0.01	8.75	36.03	37.07	0.00	62.14	0.000	19	10				
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	Se	0.00	0.00	30.00	100.00	104.40	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Fossil part of biodiesel and biogasoline	Se	0.00	0.00	3.54	70.88	70.97	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	Se	0.00	0.00	3.59	71.79	71.88	0.00	159.72	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	Se	0.01	0.00	4.84	57.69	57.89	0.00	-49.60	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	Se	0.01	0.00					-100.00				20			
1 B 1 b Coke production	Se	0.02	0.02	5.00	900.00	900.01	0.12	-13.52	0.114	13	7		3		
1 B 2 c Venting and flaring	Se	0.00	0.00					-100.00							
2 A 3 Glass Production	Se	0.14	0.27		500.00	500.00	10.33	101.06	38.792	2	2	2	2	2	2
2 C 1 Iron and Steel Production	Se	0.29	C	4.88	878.64	878.65	89.48	C	C	1	1	1	1	1	1
5 C 1 Waste Incineration	Se	0.00	0.00	21.56	578.38	578.78	0.00	35.80	0.001						
Total		**1.02**	**1.09**			**387.61**	**100.00**	**6.97**	**137.201**						

Table A1-17. Summary of the key source and uncertainty analysis of SO_2 emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	SO_2	0.54	2.15	1.54	15.42	15.50	6.59	293.84	0.001	33	3	2		5	5
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	SO_2	0.02	0.00					-100.00							
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	SO_2	3.45	0.36	1.30	12.98	13.04	0.13	-89.55	0.000	12	9	26	18	19	
1 A 1 a Public Electricity and Heat Production: Peat	SO_2	2.41	0.07	1.95	19.46	19.55	0.01	-97.20	0.000	16	27	16	23		24
1 A 1 a Public Electricity and Heat Production: Solid Fuels	SO_2	8.39	0.03	1.69	16.88	16.96	0.00	-99.62	0.000	2		3	10		8
1 A 1 a Public Electricity and Heat Production: Other Fuels	SO_2	0.52	0.15	1.11	11.09	11.15	0.02	-72.12	0.000		18				
1 A 1 b Petroleum refining: Liquid Fuels	SO_2	2.50	0.46	10.00	70.00	70.71	6.36	-81.49	0.000	15	7	27	7	6	19
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels	SO_2	0.54	0.15	5.00	70.00	70.18	0.64	-72.42	0.000	34	17		24	10	25
1 A 2 a Iron and Steel: Biomass	SO_2	0.00	0.00	5.00	70.00	70.18	0.00	-27.37	0.000						
1 A 2 a Iron and Steel: Gaseous Fuels	SO_2	0.00	0.00					-100.00							
1 A 2 a Iron and Steel: Liquid Fuels	SO_2	1.33	0.10	5.00	70.00	70.18	0.32	-92.12	0.000	20	23	32	15	15	22
1 A 2 a Iron and Steel: Other Fuels	SO_2	0.00	0.00	10.00	70.00	70.71	0.00		0.000						
1 A 2 a Iron and Steel: Solid Fuels	SO_2	0.30	0.14	2.00	70.00	70.03	0.56	-53.18	0.000		19	28		11	20

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 b Non-ferrous metals: Gaseous Fuels	SO_2	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	SO_2	0.14	0.02	5.00	70.00	70.18	0.01	-88.17	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	SO_2	0.02	0.00					-100.00							
1 A 2 c Chemicals: Biomass	SO_2	0.02	0.07	5.00	70.00	70.18	0.12	182.86	0.000					20	
1 A 2 c Chemicals: Gaseous Fuels	SO_2	0.01	0.00					-100.00							
1 A 2 c Chemicals: Liquid Fuels	SO_2	0.50	0.05	5.00	70.00	70.18	0.07	-89.97	0.000				25		
1 A 2 c Chemicals: Other Fuels	SO_2	0.01	0.00	10.00	70.00	70.71	0.00	-83.99	0.000						
1 A 2 c Chemicals: Solid Fuels	SO_2	0.39	0.02	2.00	70.00	70.03	0.01	-94.79	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	SO_2	2.06	0.52	8.00	70.00	70.46	8.15	-74.48	0.000	17	5	19	9	4	11
1 A 2 d Pulp, Paper and Print: Gaseous Fuels	SO_2	0.00	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Liquid Fuels	SO_2	4.98	0.22	5.00	70.00	70.18	1.46	-95.53	0.001	6	14	10	2	9	4
1 A 2 d Pulp, Paper and Print: Other Fuels	SO_2	0.12	0.00	10.00	70.00	70.71	0.00	-97.71	0.000						
1 A 2 d Pulp, Paper and Print: Solid Fuels	SO_2	1.01	0.00	7.00	70.00	70.35	0.00	-99.75	0.000	23		25	17		17
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	SO_2	0.02	0.03	5.00	70.00	70.18	0.03	93.62	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels	SO_2	0.01	0.00					-100.00							
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	SO_2	1.33	0.03	5.00	70.00	70.18	0.02	-97.89	0.000	19		22	14		15
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	SO_2	0.01	0.00	10.00	70.00	70.71	0.00	-99.76	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	SO_2	0.35	0.04	5.00	70.00	70.18	0.05	-88.10	0.000						
1 A 2 f Non-metallic minerals: Biomass	SO_2	0.00	0.01	4.25	25.49	25.85	0.00	78.98	0.000						
1 A 2 f Non-metallic minerals: Gaseous Fuels	SO_2	0.00	0.00					-100.00							
1 A 2 f Non-metallic minerals: Liquid Fuels	SO_2	0.78	0.19	9.85	39.39	40.60	0.37	-75.24	0.000	26	15	36		14	
1 A 2 f Non-metallic minerals: Solid Fuels	SO_2	0.80	0.35	4.49	24.04	24.46	0.43	-56.35	0.000	25	10	18		12	23
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	SO_2	1.08	0.00	4.87	19.48	20.07	0.00	-99.80	0.000	22		23			
1 A 2 g vii Off-road vehicles and other machinery: Other Fossil Fuels	SO_2	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 2 g viii Other: Biomass	SO_2	0.96	0.23	3.56	21.35	21.65	0.15	-75.90	0.000	24	13	29		18	
1 A 2 g viii Other: Gaseous Fuels	SO_2	0.00	0.00					-100.00							
1 A 2 g viii Other: Liquid Fuels	SO_2	3.10	0.18	3.87	15.48	15.95	0.05	-94.32	0.000	14	16	17			
1 A 2 g viii Other: Other Fuels	SO_2	0.00	0.00	5.00	30.00	30.41	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g viii Other: Solid Fuels	SO_2	0.32	0.24	3.59	14.34	14.79	0.08	-25.98	0.000		12	21			
1 A 3 a Domestic Aviation: Aviation Gasoline	SO_2	0.00	0.00	10.00	50.00	50.99	0.00	-86.81	0.000						
1 A 3 a Domestic Aviation: Biomass	SO_2	0.00	0.00	10.00	50.00	50.99	0.00		0.000						
1 A 3 a Domestic Aviation: Jet Kerosene	SO_2	0.05	0.02	10.00	50.00	50.99	0.01	-62.67	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	SO_2	0.00	0.00	3.88	159.96	160.01	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	SO_2	0.59	0.01	4.99	19.96	20.57	0.00	-98.98	0.000	30					
1 A 3 b i Road Transportation, Cars: Fossil part of biodiesel and biogasoline	SO_2	0.00	0.00	4.99	19.96	20.57	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	SO_2	0.68	0.01	3.00	19.94	20.16	0.00	-97.98	0.000	27		33			
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	SO_2	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	SO_2	0.19	0.00	5.00	20.00	20.62	0.00	-98.81	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Fossil part of biodiesel and biogasoline	SO_2	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gaseous Fuels	SO_2	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	SO_2	0.05	0.00	3.00	20.00	20.22	0.00	-99.51	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	SO_2	0.00	0.00	3.76	15.24	15.69	0.00		0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	SO_2	4.27	0.01	4.76	19.04	19.63	0.00	-99.88	0.000	8		7	16		14
1 A 3 b iii Road Transportation, Heavy duty trucks: Fossil part of biodiesel and biogasoline	SO_2	0.00	0.00	3.56	14.25	14.69	0.00		0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	SO_2	0.00	0.00	4.97	39.79	40.10	0.00	21.41	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	SO_2	0.00	0.00	3.00	20.00	20.22	0.00	-89.99	0.000						
1 A 3 c Railways: Liquid Fuels	SO_2	0.12	0.00	5.00	20.00	20.62	0.00	-99.94	0.000						
1 A 3 d Domestic Navigation: Biomass	SO_2	0.00	0.00	5.00	10.00	11.18	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	SO_2	0.67	0.07	4.96	39.68	39.99	0.05	-89.44	0.000	28	25				
1 A 3 d Domestic Navigation: Gasoline	SO_2	0.00	0.00	5.00	40.00	40.31	0.00		0.000						
1 A 3 d Domestic Navigation: LNG	SO_2	0.00	0.00	10.00	200.00	200.25	0.00		0.000						
1 A 3 d Domestic Navigation: Residual Oil	SO_2	3.31	0.10	15.00	40.00	42.72	0.11	-96.99	0.000	13	24	12	11	21	10
1 A 3 e Other Transportation: Gaseous fuels	SO_2	0.00	0.00	5.00	70.00	70.18	0.00	41.02	0.000						
1 A 3 e Other Transportation: Other Fossil Fuels	SO_2	0.00	0.00	5.00	20.00	20.62	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 e Other Transportation: Total	SO_2	0.57	0.05	5.00	30.00	30.41	0.01	-91.91	0.000	32					
1 A 4 a Commercial/Institutional: Biomass	SO_2	0.01	0.02	10.00	75.00	75.66	0.01	127.32	0.000						
1 A 4 a Commercial/Institutional: Gaseous Fuels	SO_2	0.00	0.00					-100.00							
1 A 4 a Commercial/Institutional: Gasoline	SO_2	0.00	0.00	5.00	20.00	20.62	0.00	-95.41	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	SO_2	4.20	0.03	19.74	69.09	71.86	0.02	-99.37	0.002	9		8	3		3
1 A 4 a Commercial/Institutional: Other Fossil Fuels	SO_2	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 4 b Residential: Biomass	SO_2	0.42	0.41	10.00	75.00	75.66	5.60	-3.87	0.001		8	14		7	6
1 A 4 b Residential: Gaseous Fuels	SO_2	0.00	0.00					-100.00							
1 A 4 b Residential: Liquid Fuels	SO_2	7.18	0.05	19.80	69.30	72.07	0.09	-99.27	0.004	3		4	1	23	1
1 A 4 b Residential: Other Fossil Fuels	SO_2	0.00	0.00	5.00	20.00	20.62	0.00		0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	SO_2	0.03	0.07	10.00	75.00	75.66	0.15	134.80	0.000					17	26
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	SO_2	1.27	0.03	30.00	40.00	50.00	0.01	-97.62	0.000	21		24	19		18
1 A 4 c Agriculture/Forestry/Fisheries: Fossil part of biodiesel and biogasoline	SO_2	0.00	0.00	3.54	14.18	14.61	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels	SO_2	0.00	0.00					-100.00							
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	SO_2	0.00	0.00	3.59	14.36	14.80	0.00	-87.55	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	SO_2	1.75	0.05	19.45	68.07	70.79	0.08	-97.03	0.000	18		20	22	24	12
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	SO_2	0.63	0.00					-100.00		29		30	21		
1 B 1 b Coke production	SO_2	0.08	0.02	5.00	50.00	50.25	0.01	-68.91	0.000						
1 B 1 c Fugitive emissions from Solid Fuels	SO_2	0.02	0.01	50.00	50.00	70.71	0.00	-68.03	0.000						
1 B 2 a Oil	SO_2	3.72	0.00					-100.00		11		9	8		
1 B 2 c Venting and flaring	SO_2	0.58	0.00					-100.00		31		35	20		
1 D International Aviation: Biomass	SO_2	0.00	0.00	10.00	50.00	50.99	0.00		0.000						
1 D International Aviation: Jet Kerosene	SO_2	0.04	0.05	10.00	50.00	50.99	0.04	10.25	0.000						
2 A 1 Cement Production	SO_2	5.26	C	2.00	20.00	20.10	0.04	C	C	5	20	6	12		13
2 A 2 Lime Production	SO_2	0.09	C	5.12	19.91	20.56	0.24	C	C		11	15		16	21
2 A 3 Glass Production	SO_2	0.26	0.12		30.00	30.00	0.08	-52.49	0.000		22	34			
2 B 10 Other	SO_2	5.92	0.50		32.16	32.16	1.54	-91.54	0.000	4	6	13	6	8	16
2 C 1 Iron and Steel Production	SO_2	4.11	0.98	3.22	64.39	64.47	23.68	-76.22	0.001	10	4	11	5	1	7

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
2 C 2 Ferroalloys production	SO_2	0.30	0.07	5.00	30.00	30.41	0.03	-77.33	0.000		26				
2 C 3 Aluminium production	SO_2	0.26	0.13	2.00	30.00	30.07	0.09	-51.55	0.000		21	31		22	
2 C 7 Other	SO_2	4.89	2.95	4.00	20.00	20.40	21.61	-39.66	0.002	7	1	1	13	2	2
2 G 4 Other	SO_2	0.00	0.00	15.00	50.00	52.20	0.00	28.44	0.000						
2 H 1 Pulp and paper	SO_2	12.82	2.77	5.92	20.30	21.14	20.49	-78.37	0.001	1	2	5	4	3	9
5 C 1 Waste Incineration	SO_2	0.05	0.01	7.86	659.43	659.48	0.38	-77.39	0.000					13	
Total		**102.40**	**14.78**			**8.76**	**100.00**	**-85.56**	**1.207**						

Table A1-18. Summary of the key source and uncertainty analysis of TSP emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	TSP	0.82	1.10	1.52	15.23	15.31	0.00	34.31	0.000	18	7	13			23
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels	TSP	0.00	0.00	1.78	89.19	89.20	0.00	-82.92	0.000						
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	TSP	0.13	0.04	1.28	12.77	12.84	0.00	-71.47	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	TSP	0.71	0.00	1.95	19.46	19.55	0.00	-99.86	0.000	22		15			24
1 A 1 a Public Electricity and Heat Production: Solid Fuels	TSP	1.10	0.00	1.94	19.37	19.46	0.00	-99.77	0.000	13		11			17
1 A 1 a Public Electricity and Heat Production: Other Fuels	TSP	0.45	0.01	1.11	11.09	11.15	0.00	-96.79	0.000	27		17			
1 A 1 b Petroleum refining: Gaseous Fuels	TSP	0.00	0.00	2.00	100.00	100.02	0.00		0.000						
1 A 1 b Petroleum refining: Liquid Fuels	TSP	0.40	0.09	10.00	100.00	100.50	0.00	-77.25	0.000	30		24			14
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels	TSP	0.36	0.08	5.00	100.00	100.12	0.00	-76.93	0.000			29			16
1 A 2 a Iron and Steel: Biomass	TSP	0.00	0.00	5.00	100.00	100.12	0.00	4.57	0.000						
1 A 2 a Iron and Steel: Gaseous Fuels	TSP	0.00	0.00	5.00	100.00	100.12	0.00	502.98	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	TSP	0.13	0.01	5.00	100.00	100.12	0.00	-89.05	0.000						
1 A 2 a Iron and Steel: Other Fuels	TSP	0.00	0.00	10.00	100.00	100.50	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 a Iron and Steel: Solid Fuels	TSP	0.03	0.00	2.00	49.99	50.03	0.00	-88.14	0.000						
1 A 2 b Non-ferrous metals: Gaseous Fuels	TSP	0.00	0.00	5.00	100.00	100.12	0.00	52.82	0.000						
1 A 2 b Non-ferrous metals: Liquid Fuels	TSP	0.01	0.00	5.00	100.00	100.12	0.00	-76.62	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	TSP	0.02	0.00					-100.00							
1 A 2 c Chemicals: Biomass	TSP	0.04	0.01	5.00	100.00	100.12	0.00	-72.45	0.000						
1 A 2 c Chemicals: Gaseous Fuels	TSP	0.00	0.00	5.00	100.00	100.12	0.00	-50.39	0.000						
1 A 2 c Chemicals: Liquid Fuels	TSP	0.03	0.01	5.00	100.00	100.12	0.00	-77.04	0.000						
1 A 2 c Chemicals: Other Fuels	TSP	0.02	0.01	10.00	100.00	100.50	0.00	-64.71	0.000						
1 A 2 c Chemicals: Solid Fuels	TSP	0.05	0.00	2.00	100.00	100.02	0.00	-99.83	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	TSP	2.47	0.30	8.00	100.00	100.32	0.00	-87.81	0.009	7		7	6		5
1 A 2 d Pulp, Paper and Print: Gaseous Fuels	TSP	0.00	0.00	5.00	100.00	100.12	0.00	-59.10	0.000						
1 A 2 d Pulp, Paper and Print: Liquid Fuels	TSP	0.22	0.04	5.00	100.00	100.12	0.00	-83.80	0.000						21
1 A 2 d Pulp, Paper and Print: Other Fuels	TSP	0.28	0.01	10.00	100.00	100.50	0.00	-97.73	0.000			23			13
1 A 2 d Pulp, Paper and Print: Solid Fuels	TSP	0.13	0.00	7.00	100.00	100.24	0.00	-99.99	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	TSP	0.01	0.01	5.00	100.00	100.12	0.00	18.03	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels	TSP	0.00	0.00	5.00	100.00	100.12	0.00	-48.52	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	TSP	0.06	0.00	5.00	100.00	100.12	0.00	-95.42	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	TSP	0.03	0.00	10.00	100.00	100.50	0.00	-99.46	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	TSP	0.04	0.00	5.00	100.00	100.12	0.00	-99.95	0.000						
1 A 2 f Non-metallic minerals: Biomass	TSP	0.01	0.00	3.53	35.35	35.53	0.00	-65.43	0.000						
1 A 2 f Non-metallic minerals: Gaseous Fuels	TSP	0.00	0.00	4.06	44.21	44.40	0.00	68.20	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	TSP	0.04	0.01	9.73	58.41	59.21	0.00	-67.17	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	TSP	0.15	0.00	7.77	32.11	33.04	0.00	-99.57	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	TSP	0.89	0.29	4.89	29.34	29.74	0.00	-67.26	0.000	14		18			
1 A 2 g viii Other: Biomass	TSP	1.55	0.15	4.53	36.27	36.55	0.00	-90.24	0.001	9		9			8
1 A 2 g viii Other: Gaseous Fuels	TSP	0.00	0.00	2.85	22.77	22.95	0.00	-70.57	0.000						
1 A 2 g viii Other: Liquid Fuels	TSP	0.19	0.03	3.95	23.72	24.05	0.00	-86.88	0.000						
1 A 2 g viii Other: Other Fuels	TSP	0.00	0.00	5.00	40.00	40.31	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g viii Other: Solid Fuels	TSP	0.06	0.11	5.00	39.98	40.29	0.00	83.23	0.000						
1 A 3 a Domestic Aviation: Aviation Gasoline	TSP	0.00	0.00	10.00	10.00	14.14	0.00	-90.07	0.000						
1 A 3 a Domestic Aviation: Biomass	TSP	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 A 3 a Domestic Aviation: Jet Kerosene	TSP	0.02	0.01	10.00	10.00	14.14	0.00	-71.90	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	TSP	0.00	0.00	3.54	10.63	11.21	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	TSP	0.37	0.08	5.35	17.16	17.98	0.00	-77.45	0.000	31		27			
1 A 3 b i Road Transportation, Cars: Gasoline	TSP	0.20	0.04	3.00	14.97	15.26	0.00	-81.72	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	TSP	0.00	0.00	5.00	15.00	15.81	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	TSP	0.24	0.10	5.00	15.00	15.81	0.00	-55.72	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gaseous Fuels	TSP	0.00	0.00	5.00	15.00	15.81	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	TSP	0.04	0.00	3.00	15.00	15.30	0.00	-95.38	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	TSP	0.00	0.00	3.54	49.91	50.03	0.00	-4.72	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	TSP	3.17	0.13	4.26	12.78	13.47	0.00	-95.83	0.000	6		6			9

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	TSP	0.00	0.00	5.00	100.00	100.12	0.00	20071.03	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: LNG	TSP	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	TSP	0.04	0.03	3.00	15.00	15.30	0.00	-24.76	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	TSP	1.26	1.59		15.00	15.00	0.00	26.47	0.000	11	6	10			19
1 A 3 b vii Road Transportation: Automobile road abrasion	TSP	23.09	29.55		15.00	15.00	0.93	27.98	0.030	2	2	1	4	2	2
1 A 3 c Railways: Liquid Fuels	TSP	0.05	0.02	5.00	10.00	11.18	0.00	-58.75	0.000						
1 A 3 d Domestic Navigation: Biomass	TSP	0.00	0.01	5.00	40.00	40.31	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	TSP	0.41	0.35	3.15	25.18	25.37	0.00	-12.97	0.000	29	15				
1 A 3 d Domestic Navigation: Gasoline	TSP	0.00	0.00	5.00	40.00	40.31	0.00		0.000						
1 A 3 d Domestic Navigation: LNG	TSP	0.00	0.00	10.00	300.00	300.17	0.00		0.000						
1 A 3 d Domestic Navigation: Residual Oil	TSP	0.50	0.18	15.00	50.00	52.20	0.00	-63.66	0.000	26		32			
1 A 3 e Other Transportation: Biomass	TSP	0.00	0.00	5.00	30.00	30.41	0.00		0.000						
1 A 3 e Other Transportation: Total	TSP	0.35	0.04	5.00	30.00	30.41	0.00	-89.48	0.000			21			
1 A 4 a Commercial/Institutional: Biomass	TSP	0.24	0.08	10.00	10.00	14.14	0.00	-69.08	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 a Commercial/Institutional: Gaseous Fuels	TSP	0.00	0.00	10.00	10.00	14.14	0.00	162.18	0.000						
1 A 4 a Commercial/Institutional: Gasoline	TSP	0.03	0.04	5.00	30.00	30.41	0.00	29.67	0.000						
1 A 4 a Commercial/Institutional: Liquid Fuels	TSP	0.51	0.10	4.88	29.04	29.44	0.00	-80.10	0.000	25		20			
1 A 4 b Residential: Biomass	TSP	13.27	5.22	10.00	65.00	65.76	0.56	-60.63	0.027	3	3	3	2	4	3
1 A 4 b Residential: Gaseous Fuels	TSP	0.00	0.00	10.00	65.00	65.76	0.00	-12.73	0.000						
1 A 4 b Residential: Liquid Fuels	TSP	0.85	0.16	2.85	16.62	16.87	0.00	-81.18	0.000	17		16			
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	TSP	0.89	0.41	10.00	30.00	31.62	0.00	-53.59	0.000	15	13	28			
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	TSP	0.06	0.03	30.00	40.00	50.00	0.00	-55.86	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels	TSP	0.00	0.00	10.00	30.00	31.62	0.00	-76.47	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	TSP	0.02	0.03	4.49	26.95	27.32	0.00	25.34	0.000						
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	TSP	1.25	0.19	2.90	17.70	17.94	0.00	-84.63	0.000	12		12			20
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	TSP	0.24	0.00					-100.00				25			
1 B 1 c Fugitive emissions from Solid Fuels	TSP	0.78	0.35	6.00	19.99	20.87	0.00	-55.08	0.000	21	16	30			
1 B 2 a Oil	TSP	0.09	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 B 2 c Venting and flaring	TSP	0.01	0.00	50.00	100.00	111.80	0.00	-100.00	0.000						
1 D International Aviation: Biomass	TSP	0.00	0.00	10.00	10.00	14.14	0.00		0.000						
1 D International Aviation: Jet Kerosene	TSP	0.01	0.01	10.00	10.00	14.14	0.00	21.16	0.000						
2 A 1 Cement Production	TSP	0.88	C	2.00	30.00	30.07	0.00	C	C	16		14			15
2 A 2 Lime Production	TSP	0.33	0.08	5.36	51.60	51.88	0.00	-74.37	0.000						
2 A 3 Glass Production	TSP	0.29	0.06		100.00	100.00	0.00	-80.96	0.000						18
2 B 10 Other	TSP	0.16	0.02		58.82	58.82	0.00	-86.00	0.000						
2 B 5 Carbide production	TSP	0.12	C	10.00	50.00	50.99	0.00	C	C						
2 C 1 Iron and Steel Production	TSP	6.13	0.94	3.46	27.70	27.91	0.00	-84.59	0.004	5	8	4	9		7
2 C 2 Ferroalloys production	TSP	0.09	0.09	5.00	40.00	40.31	0.00	0.61	0.000						
2 C 3 Aluminium production	TSP	0.35	0.09	1.99	39.77	39.82	0.00	-75.21	0.000			31			
2 C 7 Other	TSP	0.26	0.01	4.00	40.00	40.20	0.00	-95.93	0.000			26			
2 D 3 Other	TSP	0.11	0.12	10.00	109.00	109.46	0.00	7.76	0.000						
2 G 4 Other	TSP	0.34	0.23	10.88	30.96	32.82	0.00	-32.67	0.000						
2 H 1 Pulp and paper	TSP	9.58	1.89	6.54	20.55	21.57	0.01	-80.25	0.004	4	5	2	8		6
2 H 3 Other (NFR 2A5a)	TSP	0.81	0.54		49.00	49.00	0.00	-33.01	0.000	19	11				
2 H 3 Other (NFR 2A5b)	TSP	46.28	31.08		146.00	146.00	97.18	-32.84	0.051	1	1	5	1	1	1

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
2 H 3 Other (NFR 2A6)	TSP	0.43	0.10		49.00	49.00	0.00	-76.43	0.000	28		22			
2 I Wood processing	TSP	0.67	0.44	15.00	900.00	900.12	0.76	-33.34	0.000	23	12		3	3	10
3 B 1 Dairy cattle	TSP	0.52	0.39	20.00	150.00	151.33	0.02	-25.39	0.000	24	14				22
3 B 1 Non-dairy cattle	TSP	0.32	0.33	20.00	150.00	151.33	0.01	2.70	0.000						12
3 B 3 Swine	TSP	1.49	0.91	20.00	150.00	151.33	0.09	-38.83	0.000	10	9		7		
3 B 4 Fur-bearing animals	TSP	0.01	0.00	20.00	200.00	201.00	0.00	-54.53	0.000						
3 B 4 Goats	TSP	0.00	0.00	20.00	200.00	201.00	0.00	188.84	0.000						
3 B 4 Horses	TSP	0.08	0.09	20.00	200.00	201.00	0.00	12.64	0.000						
3 B 4 Poultry	TSP	1.83	2.37	16.10	124.17	125.21	0.41	29.53	0.015	8	4	8	5	5	4
3 B 4 Sheep	TSP	0.01	0.02	20.00	200.00	201.00	0.00	63.24	0.000						
5 A Solid waste disposal	TSP	0.00	0.00	10.00	377.00	377.13	0.00	-57.90	0.000						
5 C 1 Waste Incineration	TSP	0.05	0.06	57.50	167.74	177.32	0.00	33.70	0.000						
5 E Other	TSP	0.80	0.76	50.00	67.00	83.60	0.02	-4.51	0.002	20	10	19			11
Total		**130.36**	**81.85**			**56.24**	**100.00**	**-37.21**	**3.822**						

Table A1-19. Summary of the key source and uncertainty analysis of Zn emissions 1990 and 2022, submission 2024.

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 1 a Public Electricity and Heat Production: Biomass	Zn	5.45	12.81	1.53	76.57	76.58	0.25	135.10	0.191	7	3	3		3	3
1 A 1 a Public Electricity and Heat Production: Liquid Fuels	Zn	0.15	0.04	1.34	67.08	67.09	0.00	-73.45	0.000						
1 A 1 a Public Electricity and Heat Production: Peat	Zn	0.33	0.03	1.95	97.29	97.31	0.00	-90.67	0.000						
1 A 1 a Public Electricity and Heat Production: Solid Fuels	Zn	0.32	0.00	2.00	100.00	100.02	0.00	-99.38	0.000						
1 A 1 a Public Electricity and Heat Production: Other Fuels	Zn	0.03	0.15	1.11	287.58	287.58	0.00	414.70	0.000						
1 A 1 b Petroleum refining: Liquid Fuels	Zn	0.03	0.04	10.00	100.00	100.50	0.00	17.90	0.000						
1 A 2 a Iron and Steel: Biomass	Zn	0.00	0.00	5.00	40.00	40.31	0.00	81.57	0.000						
1 A 2 a Iron and Steel: Liquid Fuels	Zn	0.05	0.01	5.00	100.00	100.12	0.00	-85.87	0.000						
1 A 2 a Iron and Steel: Solid Fuels	Zn	0.00	0.00					-100.00							
1 A 2 b Non-ferrous metals: Liquid Fuels	Zn	0.01	0.00	5.00	100.00	100.12	0.00	-72.36	0.000						
1 A 2 b Non-ferrous metals: Solid Fuels	Zn	0.00	0.00					-100.00							
1 A 2 c Chemicals: Biomass	Zn	0.23	0.11	5.00	40.00	40.31	0.00	-54.52	0.000						
1 A 2 c Chemicals: Liquid Fuels	Zn	0.02	0.01	5.00	100.00	100.12	0.00	-74.71	0.000						
1 A 2 c Chemicals: Other Fuels	Zn	0.00	0.00					-100.00							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 c Chemicals: Solid Fuels	Zn	0.01	0.00	2.00	700.00	700.00	0.00	-90.60	0.000						
1 A 2 d Pulp, Paper and Print: Biomass	Zn	15.10	4.06	8.00	40.00	40.79	0.01	-73.14	0.001	5	5	7			
1 A 2 d Pulp, Paper and Print: Liquid Fuels	Zn	0.23	0.05	5.00	100.00	100.12	0.00	-78.64	0.000						
1 A 2 d Pulp, Paper and Print: Other Fuels	Zn	0.03	0.00					-100.00							
1 A 2 d Pulp, Paper and Print: Solid Fuels	Zn	0.03	0.00	7.00	700.00	700.03	0.00	-98.37	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Biomass	Zn	0.08	0.15	5.00	40.00	40.31	0.00	102.45	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels	Zn	0.06	0.00	5.00	100.00	100.12	0.00	-95.08	0.000						
1 A 2 e Food Processing, Beverages and Tobacco: Other Fuels	Zn	0.01	0.00					-100.00							
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels	Zn	0.01	0.00	5.00	700.00	700.02	0.00	-88.10	0.000						
1 A 2 f Non-metallic minerals: Biomass	Zn	0.03	0.16	4.69	18.75	19.32	0.00	375.03	0.000						
1 A 2 f Non-metallic minerals: Liquid Fuels	Zn	0.05	0.02	9.88	39.52	40.74	0.00	-49.90	0.000						
1 A 2 f Non-metallic minerals: Solid Fuels	Zn	0.12	0.04	8.38	306.22	306.34	0.00	-63.66	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Biomass	Zn	0.00	0.19	4.98	99.50	99.63	0.00		0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 2 g vii Off-road vehicles and other machinery: Liquid Fuels	Zn	0.30	0.36	4.91	98.16	98.28	0.00	17.71	0.000						
1 A 2 g vii Off-road vehicles and other machinery: Other Fossil Fuels	Zn	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 2 g viii Other: Biomass	Zn	9.56	1.66	4.61	18.44	19.01	0.00	-82.64	0.000	6	7	6			
1 A 2 g viii Other: Liquid Fuels	Zn	0.13	0.03	4.12	24.70	25.04	0.00	-80.44	0.000						
1 A 2 g viii Other: Solid Fuels	Zn	0.01	0.04	4.65	232.61	232.66	0.00	353.82	0.000						
1 A 3 b i Road Transportation, Cars: Biomass	Zn	0.00	0.07	3.66	73.17	73.26	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Diesel oil	Zn	0.00	0.02	5.00	100.00	100.12	0.00	526.71	0.000						
1 A 3 b i Road Transportation, Cars: Fossil part of biodiesel and biogasoline	Zn	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b i Road Transportation, Cars: Gasoline	Zn	0.13	0.05	3.00	100.00	100.04	0.00	-58.08	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Biomass	Zn	0.00	0.00	4.85	97.01	97.13	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Diesel oil	Zn	0.00	0.01	5.00	100.00	100.12	0.00	626.64	0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Fossil part of biodiesel and biogasoline	Zn	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 b ii Road Transportation, Light duty trucks: Gasoline	Zn	0.01	0.00	3.00	100.00	100.04	0.00	-89.80	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 3 b iii Road Transportation, Heavy duty trucks: Biomass	Zn	0.00	0.01	4.00	79.93	80.03	0.00	28647.54	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Diesel oil	Zn	0.02	0.02	4.76	95.22	95.33	0.00	-23.75	0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Fossil part of biodiesel and biogasoline	Zn	0.00	0.00	3.56	71.24	71.33	0.00		0.000						
1 A 3 b iii Road Transportation, Heavy duty trucks: Gaseous Fuels	Zn	0.00	0.00	3.00	100.00	100.04	0.00	-86.43	0.000						
1 A 3 b iv Road Transportation, Motorcycles: Gasoline	Zn	0.00	0.00	3.00	100.00	100.04	0.00	108.78	0.000						
1 A 3 b vi Road Transportation: Automobile tyre and brake wear	Zn	15.41	19.53		1000.00	1000.00	97.42	26.74	54.024	4	1	2			
1 A 3 c Railways: Liquid Fuels	Zn	0.03	0.01	5.00	95.00	95.13	0.00	-58.75	0.000				1	1	1
1 A 3 d Domestic Navigation: Biomass	Zn	0.00	0.01	5.00	50.00	50.25	0.00		0.000						
1 A 3 d Domestic Navigation: Gas/Diesel Oil	Zn	0.04	0.08	3.84	38.37	38.56	0.00	80.98	0.000						
1 A 3 d Domestic Navigation: Residual Oil	Zn	0.17	0.05	15.00	100.00	101.12	0.00	-69.64	0.000						
1 A 3 e Other Transportation: Biomass	Zn	0.00	0.03	5.00	100.00	100.12	0.00		0.000						
1 A 3 e Other Transportation: Other Fossil Fuels	Zn	0.00	0.00	5.00	100.00	100.12	0.00		0.000						
1 A 3 e Other Transportation: Total	Zn	0.06	0.05	5.00	100.00	100.12	0.00	-25.37	0.000						

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Trend (Approach 2)	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 a Commercial/Institutional: Biomass	Zn	0.28	0.68	9.53	190.67	190.91	0.00	138.52	0.003		10					
1 A 4 a Commercial/Institutional: Ethanol	Zn	0.00	0.00	5.00	100.00	100.12	0.00		0.000							
1 A 4 a Commercial/Institutional: Gasoline	Zn	0.02	0.02	5.00	100.00	100.12	0.00	-4.24	0.000							
1 A 4 a Commercial/Institutional: Liquid Fuels	Zn	0.20	0.06	4.89	97.21	97.34	0.00	-69.86	0.000							
1 A 4 a Commercial/Institutional: Other Fossil Fuels	Zn	0.00	0.00	5.00	100.00	100.12	0.00		0.000							
1 A 4 b Residential: Biomass	Zn	15.61	14.87	9.99	199.83	200.08	2.26	-4.75	0.955	3	2	5				
1 A 4 b Residential: Liquid Fuels	Zn	0.25	0.07	2.81	52.71	52.78	0.00	-73.63	0.000							
1 A 4 b Residential: Other Fossil Fuels	Zn	0.00	0.00	5.00	100.00	100.12	0.00		0.000				3	2	2	
1 A 4 c Agriculture/Forestry/Fisheries: Biomass	Zn	1.13	1.73	9.27	185.36	185.59	0.03	52.94	0.017		6	8				
1 A 4 c Agriculture/Forestry/Fisheries: Domestic Heating Oil	Zn	0.06	0.03	30.00	100.00	104.40	0.00	-55.86	0.000							
1 A 4 c Agriculture/Forestry/Fisheries: Fossil part of biodiesel and biogasoline	Zn	0.00	0.00	3.54	70.88	70.97	0.00		0.000							
1 A 4 c Agriculture/Forestry/Fisheries: Gasoline	Zn	0.00	0.01	3.59	71.79	71.88	0.00	159.72	0.000							
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels	Zn	0.36	0.24	3.33	66.29	66.37	0.00	-33.09	0.000							

IPCC Source Category	Substance	Base year emissions or removals (t)	Year 2022 emissions or removals (t)	Activity data uncertainty in 2022 (%)	Emission factor uncertainty in 2022 (%)	Combined uncertainty in 2022 (%)	Contribution to variance in 2022 (%)	Inventory trend for 2022 with respect to base year (%)	Uncertainty introduced into the trend (%)	Level in base year	Level in 2022	Trend	Level in 2022 (Approach 2)	Level in base year (Approach 2)	Level in 2022 (Approach 2)	Trend (Approach 2)
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels	Zn	0.36	0.00					-100.00								
1 B 2 a Oil	Zn	0.01	0.00					-100.00								
1 B 2 c Venting and flaring	Zn	0.01	0.00					-100.00								
2 A 3 Glass Production	Zn	0.01	0.00		50.00	50.00	0.00	-98.85	0.000							
2 C 1 Iron and Steel Production	Zn	86.08	7.80	2.85	32.64	32.76	0.02	-90.94	0.158	1	4	1				
2 C 2 Ferroalloys production	Zn	1.21	0.74	5.00	50.00	50.25	0.00	-38.93	0.000		9					
2 C 3 Aluminium production	Zn	0.01	0.00	2.00	100.00	100.02	0.00	-88.32	0.000				2			4
2 C 7 Other	Zn	33.64	1.51	4.00	50.00	50.16	0.00	-95.52	0.078	2	8	4				
2 G 4 Other	Zn	0.28	0.34	14.62	681.89	682.04	0.01	21.07	0.007							
2 H 1 Pulp and paper	Zn	0.80	0.20	6.54	51.38	51.80	0.00	-75.44	0.000				4			
2 H 3 Other (NFR 2A5a)	Zn	1.10	0.00		50.00	50.00	0.00	-99.55	0.000							
2 H 3 Other (NFR 2A6)	Zn	0.11	0.01		50.00	50.00	0.00	-89.77	0.000							
5 C 1 Waste Incineration	Zn	0.17	0.29	46.72	165.59	172.06	0.00	72.89	0.001							
Total		**189.98**	**68.49**			**288.91**	**100.00**	**-63.95**	**74.457**							

2 Annex 2: Detailed discussion of methodology and data for estimating emissions from fossil fuel combustion.

2.1 Sources for activity data in NFR 1A and parts of NFR 1B

Activity data used in the energy sector is mainly based on statistics on fuel consumption. In the sections below, the various energy surveys, produced by Statistics Sweden and other data sources are described. For stationary combustion within Other sector, activity data from the annual energy balances is used in order to ensure that all activities are covered, and no activities are double-counted. The energy balances are based on a number of surveys, which are all described below.

A number of activity data sources are used and the UNFCCC-ERT has asked for the rationale for choosing a certain data source, an explanation of how these sources are deemed accurate or inaccurate, and how time series consistency is ensured. In numerous development projects during the last ten years, several of them quoted in IIR section 3, different data sources have been compared and checked against each other, and in some of these projects industrial facilities have been contacted by phone or e-mail to verify data. Generally, the quarterly fuel statistics is considered to be more complete than the Energy use in manufacturing industry, because the industrial energy survey has not always included all back pressure power. In recent years, the main reason for choosing the quarterly fuel statistics is that the annual industrial energy survey is not ready in time for the emission inventory. On an aggregate level, the final results for the two surveys are very coherent. In a study performed by Statistics Sweden in 2009[1], a detailed comparison between the quarterly fuel statistics, the annual industrial energy survey and the energy balances was made. This study showed some differences between the two surveys, but the differences did not indicate systematic errors in any of the surveys, and hence it gave no reason to believe that the quarterly fuel statistics would not be of sufficient quality.

Environmental reports are often a good source for emission data, but generally they do not contain sufficient activity data for the energy sector, and facilities with small emissions are not obliged to submit environmental reports. The EU ETS system has very good coverage of the trading facilities, but presently it is not possible to use as main data source due to several reasons. Firstly, the database is not adapted to automated data processing, and secondly, some facilities only report carbon

[1] Statistics Sweden, 2009

balances. Furthermore, to produce correct estimates for the non-trading facilities, one must be able to separate trading facilities from non-trading ones in the Quarterly fuel statistics, and this is currently not possible due to different definitions of administrative units in the energy statistics and the EU-ETS, respectively.

For the Other sector, energy balances are used because none of the underlying surveys covers all emission sources in the different sub-sectors, but in the energy balances, complementary calculations are made in order to obtain full coverage and avoid double counting. Data for NFR 1A4 has been verified against the underlying surveys described in the sections below, and the coherence was good for biomass fuels and oils, whereas the coverage of use of e.g. LPG was considered to be better in the energy balances.

In Tables A2-1 and Table A2-2 below, the descriptions of the different data sources and reasons for the choice of certain data sources are summarized.

Table A2-1. Summary of the main activity data sources used in the inventory for stationary combustion.

CRF	Main activity data sources	Comments
1A2	Energy use in the manufacturing industry (ISEN), Quarterly fuel statistics (KvBr) and environmental reports.	1990-1996 and 2000-2002: ISEN. 1997-1999 and 2003 and onwards: KvBr.
1A2g + 1A4	Energy balances.	For the parts of 1A2g and 1A4 that are not covered by regular surveys.
1A1b and 1A2c	Emissions reported to EU ETS.	Parts of 1A2c since 2005/2008.
1A1c + 1A2a	Environmental reports	AD and CO_2 for the two integrated iron and steel plants (see Annex 3.5).

Table A2-2. Summarized properties of activity data sources used in the inventory for stationary combustion.

Activity data source	Description	Comments
Energy use in manufacturing industry (ISEN)	Total survey of industrial facilities with 10 or more employees.	Data for year t finalized in February/March year t+2, which is too late for the inventory. Used as main AD source for 1A2 for earlier years.
Quarterly fuel statistics (KvBr)	Total survey for the energy sector, cut-off sample survey for manufacturing industry (ISEN is the sample frame)	Data for year t finalized in March year t+1. Several studies have shown that this data source is complete and consistent.
Emissions reported to EU ETS	Facilities included in the EU Emission trading scheme 2005-. Emission data is complete, activity data and/or NCVs not always reported.	The definition of "facility" is different from the one used in official energy statistics (KvBr or ISEN). Population definitions changes between trading periods. No standardization of fuel types.
Environmental reports	All operators whose activities have an impact on the environment are obliged to report environmental reports to the authority responsible for the emission permits.	Quality and completeness is very variable. Activity data is not always included. Most of the information is only available in text reports, which means that data cannot be processed in an automatized way. The reports are also used for verification and occasionally for plant specific NCVs
Energy balances	Includes all supply and use of fuels and other energy types on aggregated levels.	See discussions in later sections.

2.1.1 Quarterly fuel statistics

Quarterly fuel statistics are used as follows:

- All years for data on stationary combustion in the NRF sector 1A1a, parts of 1A1c 1A2, with the exception of 1A2 for the years 1990-1996 and 2000-2002 (where Energy use in manufacturing industry (ISEN) is used) and for some sub-categories in 1A2g (where the Energy Balances is used).
- 1990-1996 for information on in-house (own-produced) fuels in NRF 1A1b and 1A2 since the statistics on energy use in manufacturing industry did not cover own-produced fuels during these years.
- 2000-2002 for data on fuel combustion for back pressure power in NRF 1A2c-e, both sold and consumed at the producing plant. This is due to that the Energy use in manufacturing industry (which is the main data source for industries 2000-2002) has been found not to cover fuel consumption for back pressure power.

Quarterly fuel statistics are carried out as a as a web-based sample survey sent to all working units[2]. The sample to the quarterly fuel statistics is based on the sample

[2] A company may consist of several working units, that is could be located in several places (factories).

for the yearly statistics of energy use in manufacturing industry, except for electricity and heat production for which the quarterly fuel statistics is a total survey. Data are collected from all companies in electricity and heat production and all companies in the manufacturing industry with more than nine employees and annual fuel combustion of more than 325 tonne oil equivalents.

The survey should cover all fuel consumption, both own-produced and purchased fuels. However, in some cases it has been noted by the inventory staff that not all in house fuels are covered. In those cases, supplementary data has been collected to assure complete time series. In the survey form, respondents are also asked to specify whether fuels are used as raw materials or for energy purposes.
The sample frame is updated annually based on the latest results of the Energy use in manufacturing industry (ISEN). The response rate to the quarterly fuel statistics is almost 100 % for ISIC 40 (that is, NFR 1A1a) and about 90 % for manufacturing industries. The non-respondents among the industries are often small companies, which means that much more than 90 % of consumed energy is covered in responses to the survey. To compensate for companies not included in the sample and companies not responding to the survey, all fuel consumption is raised with a factor which is produced from information on the line of business, number of employees and business volume from the most recent year when the statistics on energy use in manufacturing industry was a total survey (as discussed above). By definition, the survey does not cover energy consumption in working units with less than ten employees. The energy consumption in these “small industries” is estimated with a calculation model and published in the energy balances. This estimate covers all industrial branches, and the fuel consumption and emissions are reported under NFR 1A2g.

The quarterly fuel statistics for each year are compiled and ready for use at approximately the end of March the year after. This gives enough time to process the data for the greenhouse gas inventory.

2.1.2 Annual statistics on energy use in manufacturing industry

The statistics on energy use in manufacturing industry is used for emissions from stationary combustion in the NFR sectors 1A1b, 1A1c and 1A2 1990-1996 and 2000-2002. The Quarterly fuel statistics (KvBr) for these years did not include fuel consumption for back pressure power, because data on that activity was collected via a different survey (Electricity supply, district heating and supply of natural and gasworks gas (AREL)).

Since submission 2005, for calculation of emissions in 2003 and later years, energy use in manufacturing industry statistics is not used as a base for estimating emissions in the inventory. This is, as discussed above, mainly because the inventory must be submitted before the energy use in manufacturing industry statistics is completed. The energy use in manufacturing industry statistics is only used to

verify or correct data for single plants if errors are suspected in the quarterly fuel statistics for specific years described before.

The energy use in manufacturing industry statistics is based on an annual survey of manufacturing companies. In 1990-1996, 2000 and from 2004, all companies with more than 9 employees are included. In 1997-1999 and in 2001-2003 it was conducted as a sample survey to companies with less than 50 and more than 9 employees, and as a total survey to all companies with more than 50 employees. In 1990-1996, only purchased fuels were surveyed but, since 1997, information on all fuel consumption has been collected.

The response rate to the energy use in manufacturing industry statistics in the years for which this survey is used in the GHG emission inventory was about 85 %. To compensate for non-response, fuel consumption is raised with a raising factor based on the line of business, number of employees and business volume. There is no adjustment for manufacturing industries with less than 10 employees.

A special form is sent to electricity producing companies within manufacturing industries, where the amounts of fuels used for electricity production and manufacturing purposes are specified. All manufacturing industries with electricity production are included in the survey every year. In the inventory, all data used are on plant level and by fuel type. An overview of the activity data on energy consumption used in the inventory for 1990-2002 is given in Table A2-3.

Table A2-3. Summarized properties of the Annual statistics on energy use in manufacturing industry used in the inventory.

Year	Type of survey	Coverage	Adjustments	Quality
1990-1996	Annual total survey to all companies with more than nine employees	Working units, purchased fuels, quantity and economic value of purchased fuels	Raising to represent all companies with more than 9 employees	Not so good quality for quantity, good quality for economic value
1997-1999	Annual total survey to all companies with at least 50 employees and a stratified sample of companies with 10-49 employees	Working units purchased and own-produced fuels	Raising to represent all companies with more than 9 employees	Good on national level and on coarse branch level, poor for single fuel types and single branches
2000	Annual total survey to all companies with more than nine employees	Working units, purchased and own-produced fuels	No adjustments	Excellent
2001-2002	Annual total survey to all companies with at least 50 employees and a stratified sample of companies with 10-49 employees	Working units, purchased and own-produced fuels	Raising to represent all companies with more than 9 employees	Good

2.1.3 One- and two-dwelling statistics

One- and two-dwelling statistics are, together with holiday cottages statistics and multi-dwelling statistics, the main data sources for biomass combustion in households in the energy balances, which in turn are used to calculate emissions from stationary combustion in households, NFR 1A4b i.

This sample survey is conducted every second or third year to collect data on the use of electricity and heat for a total of 7,000 one- and two-dwellings. The years in between, the energy use is modelled based on changes in temperature between the years. Until 1999, the survey has a random sample from a real estate assessment, which includes all dwellings with a value higher than 50,000 SEK (about 5,600 €). From 2000, all dwellings used as permanent dwelling are included in the sample. Every third year, a postal survey collects data from agricultural properties. The sample in this sector is 3,000 objects. Activity data in the inventory is taken from annual reports prepared by Statistics Sweden[3]. Data is on national level by fuel type and considered to be of relatively good quality. To make sure that all emissions from households are included and that no double-counting occurs, activity data is taken from the annual energy balance sheets. However, the fuel consumption reported under the household category in the energy balance is based on the surveys described here.

2.1.4 Holiday cottages statistics

Holiday cottages statistics, together with one- and two-dwelling statistics and multi-dwelling statistics, is used to calculate emissions from stationary combustion in households, NFR 1A4b. As described above, an aggregate from the energy balances is used as activity data for stationary combustion in NFR 1A4b i.

Holiday cottages are defined as residences with no permanent residents. Energy consumption in holiday cottages has been surveyed with large time intervals, i.e. in 1976, 2001 and 2012. In 2012, Statistics Sweden carried out a stratified sample survey to house owners, covering 4,500 of the 589,525 objects in the sample frame. The net sample, excluding over coverage, included 4024 objects and the response rate was 44%. Because of difficulties regarding classification, houses with type codes other than recreational dwellings were also included in the sample frame. The questionnaire form used in 2012 was based on the one used in 2002. Results show that electricity and biomass combustion are the two predominating heating sources in holiday cottages, both in 2001 and 2011[4].

[3] Statistics Sweden. Yearly Energy Balances.

[4] Statistic Sweden ES, 2012:03.

2.1.5 Multi-dwelling statistics

Multi-dwelling statistics, together with one- and two-dwelling statistics and holiday cottages statistics, is used to calculate emissions from stationary combustion of biomass in households, NFR 1A4b.

This is a sample survey carried out every second or third year, sent to the owners of 7,000 multi-dwelling buildings, covering the use of electricity and heat. For the years in between, the energy use is modelled based on changes in temperature between the years. The survey is based on a random sample from a real estate assessment. The real estate assessment includes all dwellings with an economic value higher than 50,000 SEK (about 5,600 €). Data is on national level by fuel type and of relatively good quality. Statistics on biomass consumption in multi-dwelling buildings was not included in the survey until 2001. However, the time series for 1A4b indicates that this data gap does not lead to any significant under-estimation as biomass use in multi-dwellings is sparse compared to the consumption in one- and two-dwellings.

2.1.6 Premises statistics

Premises statistics are used to calculate emissions from stationary combustion in the commercial and institutional sector, NFR 1A4a i.

This survey is a sample survey carried out each second or third years, covering the use of electricity, heat and fuel combustion for heat production of about 8,000 premises. For the years in-between, the energy use is modelled based on change in temperature between the years. Premises situated in an industrial area are not covered in the dataset. Some of these premises are covered in the Annual statistics on energy use in manufacturing industry as well as in the quarterly fuel statistics and are reported in Manufacturing Industries and Construction (NFR 1A2). To get full coverage, supplementary corrections are made for under or over coverage based on the assumption that these are distributed on over and under cover are as in the answers in the energy balance[5]. Data is on national level by fuel type and of relatively good quality. Statistics on biomass consumption in premises was not included in the survey until 2001.

2.1.7 Monthly fuel gas and inventory statistics

Statistics on supply and delivery of petroleum products[6] has in previous submission (until submission 2019) been one of the main sources used to estimate the emissions from mobile combustion in NFR 1A2gii, 1A3a-e, 1A4b-c ii, 1A4ciii and 1A5b. Data from the survey is used at a national level and by fuel type.

[5] Statistics Sweden EN20SM, 1990-2010, and Swedish Energy Agency (2011 and later)

[6] Monthly fuel, gas and inventory statistics. https://www.scb.se/en/finding-statistics/statistics-by-subject-area/energy/energy-supply-and-use/monthly-fuel-gas-and-inventory-statistics/

The survey is also the data source for stationary combustion of heating oils in households and premises reported in the energy balances, which is used as activity data source for CRF 1.A.4.a and 1.A.4.b, stationary. The data from the survey is also used for reference approach in CRF 1Ab for all fuels except biomass, waste and peat

Data in the survey is collected from all oil companies and other sellers who keep stocks of petroleum products, biofuels and coal. The survey also collects stock data from companies with a large consumption of oil in the manufacturing industries and energy industries. The survey covers around 70 companies.

A revised version of the survey was introduced in 2018 (submission 2020) and some uncertainties regarding the quality of the statistics were identified, resulting in the use of an alternative data source, the Swedish Fuel Quality Act.

2.1.8 The Swedish Fuel Quality Act

As the same oil companies covered by the monthly fuel, gas and inventory survey are obliged to collect and report fuel data under the "Swedish fuel quality act", this data source was used for diesel, gasoline and liquid biofuels in 2018-2022 The amount of diesel and gasoline collected and reported by the "Monthly fuel, gas and inventory" survey and the "Swedish fuel quality act" only differed around 1 percent for the 3-4 years preceding the change of data source. So, despite the change of data source that took place in 2018, the activity data used in submission 2024 is considered to be consistent and of good quality.

2.1.9 Statistics on the delivery of gas products

Statistics on the delivery of gas products are used to calculate emissions from natural gas and biogas from road transport (NFR 1A3b), pressure levelling losses of natural gas (NFR 1A5a) and transfer losses of gas works gas (NFR 1B2avi). Annual questionnaires are sent to all companies in Sweden that deliver natural gas, biogas and gasworks gas (less than ten companies). Consumption purposes are specified in the survey. Results of this survey are published by Statistics Sweden[7].

2.1.10 Other statistics from Statistics Sweden

Data used in the inventory for stationary fuel consumption in the construction sector, in all companies with less than 10 employees (NFR 1A2g) and stationary combustion in NFR 1A4a-1A4c is taken from the annual energy balances[8]. Data is on national level and by fuel type. Total consumption for these sectors is checked against fuel deliveries, so that possible errors only occur in the allocation between these sectors.

[7] Statistics Sweden. *Delieveries of motor fuel gas*. http://www.scb.se/en_/Finding-statistics/Statistics-by-subject-area/Energy/Energy-supply-and-use/Delieveries-of-motor-fuel-gas/

[8] Statistics Sweden 1990-2012, EN0202

Data on fuel consumption for the construction sector 1990-2003 is based on a survey from 1985[9], adjusted according to the number of working hours for each year. The fuel consumption for the construction sector 2004 and later is based on a survey from 2005[10]. Data on fuel consumption in the agricultural sector is based on two intermittent surveys, for gardening[11] and agriculture[12]. The first survey is a sample survey that collects data on energy use in greenhouses and has been carried out for 1990, 1993, 1996, 1999, 2002 and 2008. Data for intermediate years is estimated using number of working hours. The second sample survey collects data for energy use in the other parts of the agricultural business and has been performed for 1994, 2002 and 2007 (fuel consumption in households in the agricultural sector is not included here but is included in the one- and two-dwellings statistics). Data for intermediate years is estimated using annual changes in value added.

Fuel consumption in the forestry sector has been studied thoroughly in 1985 and 2007[13]. Estimates for the years before 2005 are upgraded from the 1985 study with available statistics on the annual felling volume 1990-1995 and from 1996 value added are used.

Fuel consumption in small companies (9 employees or less) reported in the annual energy balances is estimated using a model for the years 1990-2010. Fuel consumption for companies with 10-49 employees is taken from Annual statistics on energy use in manufacturing industry and the average use of fuel per employee is calculated. The two information sources are combined to estimate the fuel consumption in small companies. In 2012, the annual statistics on energy use in manufacturing industries (ISEN) for the reference year 2011 included a sample survey to small companies as well. The results were not published in ISEN but in the annual energy balance for 2011, which was published in 2013 and used in submission 2014 as activity data source for small enterprises.

2.1.11 European Union Emission Trading System (EU-ETS)

Data from the EU Emission Trading System (EU-ETS) is used, since submission 2007 and emission years 2005 and later, for oil refineries (NFR 1A1b, 1B2a and 1B2C21), as a SMED study during 2006[14] showed that this is the most accurate data source for these facilities. In addition, EU-ETS data is used for the three cement producing facilities for 2008 and onwards, one plant in NFR 1A2e for 2006 and one plant in NFR 1A2c for 2008 and onwards, since the EU-ETS data contains

[9] Statistics Sweden, 1986

[10] Statistics Sweden, 2005

[11] Statistics Sweden JO36SM, 1991, 94, 97, 2000, 2003, 2006, 2010

[12] Statistics Sweden JO63SM, 1995, 2003, 2008

[13] ER 2007:15. Energianvändningen inom skogsbruket 2005

[14] Backman & Gustafsson, 2006

more detailed information on fuel types for these facilities. EU-ETS data is also used for verification of other data sources, e.g. Quarterly fuel statistics and environmental reports. For example, Quarterly fuel statistics for large facilities within the chemical industry and the steel producing industry are regularly compared with ETS data, and if major differences should be discovered, further investigations are made. As mentioned above, for technical reasons, it is not possible to use EU-ETS data as major source of activity data for stationary combustion. Another reason not to use EU-ETS data, for stationary combustion, as the main data source is that in some facilities, only some of the installations within the facility are included in the trading scheme, and the definition of which installations that should be included has changed between the first and second trading periods.

2.1.12 Environmental reports

Before the EU-ETS was launched, data on fuel consumption in refineries, NFR 1A1b and 1B2, was often collected from environmental reports in cases when the data sources mentioned above (i.e. various energy surveys) were not considered to be accurate. For one refinery, environmental reports are the only data source for the years 2002-2007. For earlier years, environmental reports are also an important data source for fuel consumption in chemical industries, NFR 1A2c. For 2007, environmental report data was partly used for one plant in the primary steel industry, NFR 1A2a. NMVOC emissions from gasoline handling and storage reported in NFR 1B2av are based on environmental reports as well.

2.1.13 Contacts with operators

For earlier years, i.e. 2005 and before, data on fuel consumption in refineries, NFR 1A1b, and chemical industries, NFR 1A2c, was in many cases collected by means of direct contacts with the operators, as activity data was not sufficiently covered in regular surveys or administrative sources. Operators are sometimes also contacted to verify or correct data that is suspected to contain errors. Since submission 2010, the largest iron and steel company has been involved in the improvements in methodology and data for these sectors (1A1c, 1A2a, 1B1b, 1B1c, 2C1). The operator of the gas transmission pipeline and storage in Sweden is contacted each year for information on amounts of vented and flared natural gas (NFR 1B2c) as well as on number of facilities included in the transmission and storage network (NFR 1B2b). They also provide us with information regarding the amount of gas combusted for transportation of natural gas in pipelines (NFR 1A3ei).

2.1.14 Data sources for navigation

The fuel consumption for both national and international navigation, except for leisure boats, has in previous submissions (prior to submission 2019) been based on the monthly survey on supply and delivery of petroleum products[15]. But it has been problematic for the suppliers of fuel to separate the fuel used by national

[15] Statistic Sweden. Monthly fuel, gas and inventory statistics. See annex 2 for more information regarding different surveys.

respectively international navigation. As the monthly survey of fuel supply statistics was revised[16], the fuel for national and international navigation was no longer split up in the survey. Instead, the result from the survey showed the total supply of fuel in Sweden for both national and international navigation.

The fuel consumption for domestic navigation[17] is estimated by the Shipair model as from submission 2020. Shipair is developed by the Swedish meteorological and hydrological institute (SMHI) and collects AIS data (Automatic Identification System), which is used by the ships to transmit identity and position information and shows how the ships move between Swedish ports. Information regarding the ships, such as size, engine power and type of vessel is also collected. This enables the Shipair model to estimate the energy consumption and the amount of fuel.

Beside the Shipair model, the energy consumption from domestic navigation is based on a survey of the largest shipping actors for national navigation, with the exception of cargo ships.[18] The survey asks for the fuel consumption by fuel type since Shipair does not have any specific information regarding which type of fuel is used. The difference between the energy consumption estimated by Shipair and by the survey, is assumed to be the energy consumption by cargo ships.

The consumption of LNG (liquid natural gas) by navigation was first included in submission 2021 for the year 2019. In submission 2024, data for the years 2018-2022 is included. The data is based on a survey, which has taken place annually since 2020, aiming to map the consumption of LNG by both national and international navigation[19][20][21][22]. The emission factors for LNG are based on a study from 2020.[23]

The fuel consumption of international navigation is estimated as the difference between the total supply of fuel for navigation in the monthly survey of fuel supply statistics and the estimated energy consumption for domestic navigation.

[16] The revised monthly survey of fuel supply statistics was implemented in January 2018.

[17] Excluding leisure boats.

[18] EN0118, Transportsektorns energianvändning (inrikes sjöfart). Eklund, V. et al. 2019. Analys och implementering av data från nya MåBra.

[19] Eklund et al. 2021. Sjöfartens förbrukning av LNG 2020

[20] Eklund, et al. 2020. Sjöfartens förbrukning av LNG.

[21] Eklund et al. 2022 Sjöfartens förbrukning av LNG 2021

[22] Eklund et al. 2023 Sjöfartens förbrukning av LNG 2022

[23] Hult, C. et al. 2020. Emission factors for methane engines on vehicles and ships

2.1.15 Fuel allocation

Activity data for stationary combustion is based on fuels consumption at fuel type level and is for the inventory aggregated into fuel groups according to Table A2-4.

Table A2-4. Fuel type allocation in submission 2022.

Activity Data Fuel Type	CRF Fuel Group
Domestic fuel oil, Residual fuel oil, LPG, Kerosene, Petroleum coke, Other petroleum fuels, Refinery gas, Fuel oil, Methane and fuel gases	Liquid Fuels
Natural gas & LNG	Gaseous Fuels
Coke oven gas, Blast furnace gas, LD-gas, Coking coal, Coke, Coal, Other solid fuels, Carbide furnace gas, Charcoal,	Solid Fuels
Fossil fraction of waste & Other non-specified fossil fuels	Other fossil Fuels
Peat	Peat
Wood Fuels, Spent Liquor, Tall and Pitch Oil, Land fill gas, Other Biomass, Biogenic fraction of waste	Biomass

2.1.16 Other data sources for mobile combustion

Beside using statistics on supply and delivery of petroleum products[24], data reported according to the Swedish fuel quality act, data from the Shipair model (SMHI) and the survey of the largest shipping actors for national navigation, the following sources are used:

- Swedish Transport Administration (emission data for road traffic and railways),
- the Swedish Transport Agency (emission data for aviation),
- the Swedish Energy Agency (net calorific values and emission factors),
- the Swedish Armed Forces (fuel consumption),
- the Swedish Biogas Association (consumption of biogas)
- and several official reports.

2.2 Net calorific values

Unless otherwise stated, NCVs for each fuel type are produced by Statistics Sweden based on information from energy surveys. All NCVs refer to net calorific values (NCV) as recommended by the IPCC Guidelines. All NCVs are shown in Table A2-5. Most NCVs are calculated on basis of chemical qualities and are considered to be of good quality.

In the inventory, activity data for 1990-2006 on many fuel types are reported in tonne oil equivalents (toe), which is an energy unit. For these fuels the conversion factor of 41.87 GJ/toe is applied. In the energy surveys done by Statistics Sweden, these fuels are reported in mass unit/volume unit as well as the energy content (due

[24] Monthly fuel, gas and inventory statistics. https://www.scb.se/en/finding-statistics/statistics-by-subject-area/energy/energy-supply-and-use/monthly-fuel-gas-and-inventory-statistics/

to that the NCV often varies a lot for these fuel types). To facilitate data processing, Statistics Sweden calculates the energy content in toe from this information and the result is then used in the greenhouse gas inventory. This implies that the energy content of fuels concerned is very precise.

For 2007 and later years, energy data are taken directly from the Quarterly fuel statistics bases, enabling the use of facility specific NCVs in the inventory without performing the calculation of toe. NCVs for 2007 and later years are considered to be of excellent quality. The time series is considered to be consistent, since the conversions to toe made 2006 and earlier, made use of the same information that is used to calculate energy amounts 2007 and onwards. The only difference is that prior to 2007, the energy statistics department made these calculations, and 2007 and later, the calculations are made by the inventory staff.

Fuels that are standardized products, such as for instance residual fuel oil or liquefied petroleum gas (LPG) have calorific values that do not change between years. In submission 2010 some revisions were made. In earlier submissions, the NCV for biogas used for transports (this amount increases each year) was not known and therefore the NCV for natural gas was used for this fuel. In a SMED study[25] performed in 2009, a correct NCV for biogas was provided from the biogas supplier AGA. The same study also resulted in revision of the NCVs for ethanol (new NCV taken from Handbook of Chemistry and Physics) and Fatty Acid Methyl Ester (FAME).

An overview of NCVs used is shown below in Table A2-5. For all mobile combustion, and for standard fuels for stationary combustion, national emission factors are used. For non-standard fuels, median, maximum and minimum NCVs are shown.

Table A2-5. Thermal values (NCV) used in submission 2024.

Fuel type	Unit	Median	Min	Max	Remark
Blast furnace gas	GJ/1000m3	2.91	2.86	2.96	Less than 20 observations 1990-2022
Coke	GJ/tonne	28.04	27	28.08	Less than 20 observations 1990-2022
Coke oven gas	GJ/1000m3	17.51	17.39	17.92	Less than 20 observations 1990-2022
Coking coal	GJ/tonne	26.12	25.05	28.39	Less than 20 observations 1990-2022
Diesel Oil	GJ/m3	35.29	35.29	35.29	Stationary combustion
Domestic Heating Oil	GJ/m3	35.82	35.82	35.82	Stationary combustion
Kerosene	GJ/m3	34.34	34.34	34.34	Less than 20 observations 1990-2022

[25] Paulrud et al. 2010

Fuel type	Unit	Median	Min	Max	Remark
LNG	GJ/tonne	48.89	48.89	48.89	Less than 20 observations 1990-2022
LPG	GJ/tonne	46.04	46.04	46.05	
Landfill gas	GJ/1000m3	36.33	9	46.04	20-99 observations 1990-2022
Landfill gas	GJ/tonne	48.89	36	48.89	Less than 20 observations 1990-2022
Natural Gas	GJ/1000m3	39.6	39.6	39.6	Year specific NCV:s, www.ens.dk
Other biomass	GJ/m3	33.55	29.99	41.96	
Other biomass	GJ/tonne	32.94	5.6	38.16	20-99 observations 1990-2022
Other non specified	GJ/1000m3	6.47	6.47	6.47	Less than 20 observations 1990-2022
Other non specified	GJ/m3	27.61	21.67	33.55	Less than 20 observations 1990-2022
Other petroleum fuels	GJ/m3	22.64	22.64	22.64	Less than 20 observations 1990-2022
Other petroleum fuels	GJ/tonne	42.62	41.18	44.07	Less than 20 observations 1990-2022
Other solid fuels	GJ/m3	31.32	31.32	31.32	Less than 20 observations 1990-2022
Peat	GJ/tonne	10.62	8.82	17.46	Less than 20 observations 1990-2022
Petroleum coke	GJ/tonne	35.29	35.29	35.29	Less than 20 observations 1990-2022
Residual Fuel Oil	GJ/m3	38.34	37.44	38.34	
Steel converter gas	GJ/1000m3	7.8	7.8	7.9	Less than 20 observations 1990-2022
Tall oil	GJ/m3	37.06	34.13	39.92	Less than 20 observations 1990-2022
Tall oil	GJ/tonne	37.56	36.72	39.38	Less than 20 observations 1990-2022
Waste	GJ/tonne	11.81	2.88	14.73	
Wooden fuels	GJ/m3	2.8	1.16	17.64	
Wooden fuels	GJ/tonne	17.28	6.67	18.72	
Gasoline	GJ/m^3	32.78			Mobile combustion, all sources
Biogas	GJ/1000 m^3	34.9			Mobile combustion, all sources
Diesel oil	GJ/m^3	35.28			Railways
Diesel oil	GJ/m^3	35.28			Navigation
Marine Gasoil	GJ/m^3	35.868			Navigation
Diesel oil	GJ/m^3	*			Year specific NCVs, see separate table
Residual fuel oil	GJ/m^3	39.53			Navigation
Ethanol	GJ/m^3	21.20			Road traffic
ETBE	GJ/m^3	25.99			Road traffic
FAME	GJ/m^3	33.00			Road traffic
HVO	GJ/m^3	33.98			Road traffic

Fuel type	Unit	Median	Min	Max	Remark
Aviation Gasoline	GJ/m^3	31.45			Aviation
Aviation Kerosene fossil	GJ/m^3	35.28			Aviation
Aviation Kerosene bio	GJ/m^3	34.0			Aviation
Jet Gasoline	GJ/m^3	32.7			Aviation
Natural gas (CNG)	GJ/ 1000 m^3	39.6			Road traffic
LNG	GJ/ m^3	22.19			Navigation
LNG	GJ/ m^3	22.19			Road traffic
LBG	GJ/ m^3	21.55			Navigation
LBG	GJ/ m^3	21.55			Road traffic

Note: refinery gas and petrochemical by product gases are reported in various units and plant specific NCVs are used.

2.2.1 Liquid fuels

For diesel oil the NCV used in the inventory shows a decreasing trend. In Sweden, this fuel type is separated into three different fuel classes: diesel of environmental classes (EC) 1-3. EC 1 has the best environmental qualities, for instance lower content on aromatic hydrocarbons. EC 1 also has a lower NCV. EC 3 affects the environment most and has a higher NCV[26]. In 1990, EC 3 was the most common type of diesel. Over the years, the use of environmental class 3 has decreased and instead environmental class 2 and 1 are more common. In the inventory the mix of environmental class 1-3 used each year is taken into account when calculating NCV, which is appropriate for each year. Year specific NCVs for diesel are shown in Table A2-6.

Table A2-6. Thermal values (NCVs) for diesel.

Years	NCV (GJ/m^3)
1990	35.82
1991	35.69
1992	35.55
1993	35.40
1994	35.43
1995	35.44
1996	35.36
1997	35.34
1998	35.33
1999-2000	35.31
2001-2006	35.29
2007-2022	35.28

[26] https://drivkraftsverige.se/uppslagsverk/fakta/berakningsfaktorer/energiinnehall-densitet-och-koldioxidemission/ 2023-01-04

NCVs for different oils (except oils used in navigation) are based on information from Drivkraft Sverige (formerly the Swedish Petroleum and Biofuel Institute, SPBI), which in turn is based on information from oil companies and is cross-checked with Swedish standards for calculating NCVs. NCVs for marine diesel oil, marine gas oil and residual fuel oil used for navigation are based on a SMED study from 2004[27].

NCVs for refinery gases and other oils in refineries are specific for each operator and fuel. Data on consumption of fuels in t (or sometimes m^3) and corresponding NCVs are collected. Activity data for these fuels, used by refineries and chemical industries, is for 2007 and later mainly taken from the EU ETS system, and in most cases plant specific NCVs of excellent quality are also reported and used in the GHG inventory. In other cases, NCVs from the environmental reports are used.

In submission 2010, the NCVs for gasoline, aviation kerosene and aviation gasoline were revised following a SMED Study. The conclusion of the study was that NCVs used for these fuels before submission 2010 were not well documented. NCVs according to the 2006 IPCC Guidelines are now used, since the NCVs used earlier for these fuels were concluded to be of questionable quality. There is no indication that carbon content or NCV for aviation kerosene and aviation gasoline in Sweden should differ from international standards. The properties of aviation fuels are normally the same in all countries, and hence it is appropriate to use the values recommended by IPCC. The NCV for gasoline used since submission 2010 is from Drivkraft Sverige and relies on fuel analyses[28].

The NCV for petroleum coke is based on information from consumers taken from the different energy surveys done by Statistics Sweden and is therefore considered to be of good quality. The NCV for diesel used for stationary combustion is according to SPI likely approximately the same mix of environmental classes as mobile diesel for each year. Using the same NCVs as for mobile diesel therefore give correct time series.

In 1990-2010, naphtha was used as raw material for production of gas works gas. Since 2011, liquefied natural gas is used instead. However, the gas is mixed with air and the quality of the gas delivered to the transmission net (in terms of methane content and NCV) is stated to be similar to how it was before the change of feedstock[29]. Hence, the same NCVs and emission factors are used for gas works gas for 2011 as for earlier years. Since natural gas liquids are allocated to liquid fuels in the NFR code 1Ab, we have chosen to allocate the gas works gas consumed in 2011 to liquid fuels also in the sectoral approach.

[27] Cooper & Gustafsson, 2004.

[28] Paulrud et al. 2010

[29] Stockholm Gas, 2012

2.2.2 Solid fuels and peat

For coke oven gas, blast furnace gas and steel converter gas the NCVs change between years, but there is no trend in the changes, just annual fluctuations due to the quality of used primary fuels each year. NCVs used in the inventory are based on annual information from the consumers (quite few) on actual energy content, and the quality of the NCV is considered to be very good.

For carbon products such as coal and coke, it is difficult to establish the NCV due to lack of information on energy content in imported fuels. For 2007, NCVs reported from the consumers are used when available. Slightly more than half of the reported observations of combusted coal in the Quarterly fuel statistics include specific NCVs. For coke, this share is about 75 %.

Where no NCV is reported, the standard NCV provided from the Swedish Energy Agency is used.

2.2.3 Gaseous fuels

Natural gas is a non-processed primary fuel, and hence the NCV changes between years, however without any trend. All natural gas consumed in Sweden is imported from Denmark, except for LNG which is imported from Norway and northern Europe.

Since submission 2019, Sweden uses the same NCVs for the natural gas imported from Denmark as reported in Denmark's National Inventory[30]. The NCVs used are shown in Table A2-7. The NCV used for LNG is based on values from the Swedish Energy Agency.

Table A2-7. Net calorific values (NCVs) for natural gas, all consumption.

Years	NCV CNG (GJ/1000 m^3)	NCV LNG (GJ/m^3)
1990-1992	39	-
1993-1996	39.3	-
1997	39.6	-
1998	39.9	-
1999	40	-
2000	40.15	-
2001	39.97	-
2002	40.03	-
2003	39.94	-
2004	39.77	-
2005	39.67	-
2006	39.54	-
2007	39.59	-

[30] Energistyrelsen, 2023-01-10 (https://ens.dk/sites/ens.dk/files/CO2/energistyrelsens_standardfaktorer_for_2021-25-01-2022.pdf)

2008	39.49	-
2009-2016	39.46	-
2017	39.62	-
2018	39.60	-
2019-2022	39.60	22.194

2.2.4 Biomass

Data for 2006 and earlier for wood, black liquor, tall oil, landfill gas and other biomass, other petroleum fuels, other solid fuels and other not specified fuels is reported to Statistics Sweden by surveyed consumers in toe, and the conversion factors are thereby set to 41.87 GJ/toe for these fuels. For 2007 and later years, this is true for NFR 1A4. For the other sectors, only black liquor is reported in toe. Other biomass is reported in several different units, e.g. t, m^3 or MWh, and thermal values are often reported together with the quantity. These NCVs are considered to be accurate.

The net calorific value for ethanol is provided by Drivkraft Sverige[31] and is 21.2 GJ/m3 or 26.9 MJ/kg. The net calorific values for ETBE (25.992 GJ/m3) and HVO (33.984 GJ/m3) are based on information from the Swedish Energy Agency32. The net calorific value for FAME (33 GJ/m^3) is based on a SMED report[33].

2.2.5 Other fuels

Data for waste and other not specified fuels is reported to Statistics Sweden through a survey to consumers in toe, and the conversion factors are thereby set to 41.87 GJ/toe for these fuels. In 2007 and later, waste was combusted within NFR 1A1a only and the reporting units used were t and MWh. The NCVs for waste reported by the consumers are considered to be accurate, and thus these thermal values were used for 2007 and later. For other not specified fuels the reporting units vary, and reported NCVs are used (sometimes, the fuel quantities are reported in an energy unit, e.g. MWh).

2.3 Emission factors

Emission factors for SO_2 depend on the content of sulphur in the fuels and on the efficiency of existing emission abatement equipment, for instance if scrubbers are used.

Other emission factors depend on area of consumption and/or the combustion technique used. The efficiency of emission control in the plant or vehicle is also important. Therefore, these emission factors change over the years as ovens,

[31] Drivkraft Sverige (drivkraftsverige.se)

[32] http://www.energimyndigheten.se/statistik/den-officiella-statistiken/statistikprodukter/varmevarden-och-densiteter/

[33] Paulrud, S, Fridell, E, Stripple, H, Gustafsson, T. 2010. *Uppdatering av klimatrelaterade emissionsfaktorer.* SMED report 92:2010

combustion techniques and emission control used becomes better. All emission factors used in stationary combustion in submission 2024 are published on Swedish EPA's website[34].

The spread sheets also contain implied emission factors for mobile combustion. Emission factors for selected substances and years are also shown in tables in the following section.

2.3.1 Stationary combustion and fugitive emissions

National emission factors are mainly used for all years. The values of the emission factors have been continuously developed and updated since 2004[35], [36]. The emission factors are based on results of measurements and national studies as well as studies of international emission factors and judgements of their relevance to national conditions. Emission factors depend on the type of fuel, and the type of plant and abatement equipment. Often and in cases where information is available, the emission factors are updated for the whole time series in order to avoid inconsistencies.

For some fuels, no specific emission factors are available and thus emission factors from similar, more common fuels are used. Fuels concerned are specified in Table A2-8. For all substances, the emission factors for combustion of solid waste are the same for the biogenic and the fossil fraction.

Table A2-8. Fuel types for which specific emission factors are not available in the inventory.

Fuel type	Emission factor used
Kerosene	Gas/diesel oil
Landfill gas	Natural gas
Other biomass	Wood
Other petroleum fuels	Swedish default for "other fuels"
Other solid fuels	Swedish default for "other fuels"
Other not specified fuels	Swedish default for "other fuels"
Refinery gases	Swedish default for "other fuels" except for SO_2 and NO_X where national values are used

In submission 2023, a major revision of emission factors was made affecting almost all fuel types for all emissions. The focus on the revision was on emission factors for biomass and other fuels, and to update factors with non-transparent references[37]. The emission factors and fuels that were revised are summarized in table

[34] www.naturvardsverket.se

[35] Boström et al., 2004

[36] Nyström & Skårman, 2006

[37] Mawdsley, I., Danielsson, H., Yaramenka, K., Josefsson Ortiz, C., Guban, P. 2022. Översyn av emissionsfaktorer inom stationär förbränning. SMED rapport nr 8. Avtal: 250-21-001.

A2-9. Further effects of the revision of emission factors on the emissions are further discussed and explained under each chapter of emission factors.

Table A2-9. Revision of emission factors in submission 2023

Emission factors revised	Fuel type
CO	Black liquor, domestic heating oil, Kerosene, refinery gas, Other solid fuels, Other petroleum fuels, Other non-specified fuels, Other biomass
NH3	Black liquor, solid waste, Other biomass, Other petroleum fuels
NMVOC	Black liquor, Other solid fuels, Other petroleum fuels, Other non-specified fuels, Other biomass
NOx	Black liquor, Land fill gas, Diesel oil, domestic heating oil, Residual fuel oil, Coke, Coking coal, Other solid fuels, Other petroleum fuels, Other non-specified fuels, Other biomass
SO2	Other solid fuels, Other petroleum fuels, Other non-specified fuels, Other biomass
TSP	Other solid fuels, Other petroleum fuels, Other non-specified fuels, Other biomass
PM10	Other solid fuels, Other petroleum fuels, Other non-specified fuels, Other biomass
PM2.5	Other solid fuels, Other petroleum fuels, Other non-specified fuels, Other biomass
BC	Other solid fuels, Other petroleum fuels, Other non-specified fuels, Other biomass
BaP	Other biomass
Bbf	Other biomass
BkF	Other biomass
Cd	Other biomass
Cr	Other biomass
Cu	Other biomass
Hg	Other biomass
InP	Other biomass
Ni	Other biomass
PAH 1-4	Other biomass
Pb	Other biomass
PCB	Other biomass
Se	Other biomass
Zn	Other biomass
Dioxin	Wooden fuels, peat, Other biomass

2.3.1.1 NMVOC

Emission factors for stationary combustion within the energy sector for 1990 to 2001 were derived and used together with activity data from the official national Quarterly fuel statistics to calculate emissions and are based on knowledge on the technical development and he general effects of that[38]. The known effects of this general development have been combined with information from companies legal Environmental Reports, where actual emission factors can be derived, and information from trade associations where experts have contributed their specific

[38] Kindbom et al., 2003.

knowledge on the different sectors where combustion occurs. These emission factors have been used since submission 2003.

The revision of emission factors for NMVOC in submission 2023, resulted in a decrease of NMVOC emission at the most by 55% (1.4 kt NMVOC) in 1990 in NFR 1A1a. The effect of the revision was lower in more recent years between 0 and 3% for all stationary NF codes (1A1, 1A2 and 1A4).

Emission factors used in submission 2024, are shown below in Table A2-10 (selected years). Emission factors for small scale biomass combustion in households are additionally described in a separate table (Table A2-20). All the emission factors for Other biomass are presented in Table A2-21, occurring mainly in 1A4c.

Table A2-10. Emission factors for NMVOC (kg/GJ), stationary combustion.

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Blast furnace gas	Power plants, district heating, industry (1A1-2)	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Charcoal	Other consumption (1A4)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Coke	Industry (1A2)	0.008	0.008	0.008	0.008	0.008	0.008	0.008
Coke	Other consumption (1A4)	0.1	NO	NO	NO	NO	NO	NO
Coke oven gas	Power plants, district heating, industry (1A1-2)	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Coal	District heating (1A1a)	0.008	0.008	0.008	0.008	0.008	0.008	0.008
Coal	Publ. electricity and power plants (1A1a)	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Coal	Industry (1A2)	0.008	0.008	0.008	0.008	0.008	0.008	0.008
Coal	Other consumption (1A4)	0.1	0.1	NO	NO	NO	NO	NO
Diesel Oil	Power plants, district heating, industry (1A1-2)	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Domestic heating oil	Power plants, district heating, industry (1A1-2)	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Domestic heating oil	Other consumption (1A4)	0.003	0.006	0.006	0.006	0.006	0.006	0.006
Gas works gas	All consumption (1A1, 1A2, 1A4)	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Kerosene	Power plants, district heating, industry (1A1-2)	0.002	0.002	0.002	0.002	0.002	0.002	0.002
LNG	Power plants, district heating and industries (1A1, 1A2)	NO	NO	NO	0.001	0.001	0.001	0.001
LPG	District heating (1A1a)	0.002	0.001	0.001	0.001	0.001	0.001	0.001
LPG	Industry (1A2)	0.002	0.001	0.001	0.001	0.001	0.001	0.001
LPG	Other consumption (1A4)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
LPG	Publ. electricity and power plants (1A1a)	0.002	0.002	NO	NO	NO	NO	NO
Landfill gas	District heating (1A1a)	NO	0.001	0.001	0.001	0.001	0.001	0.001
Landfill gas	Industry (1A2)	NO	0.001	0.001	0.001	0.001	0.001	0.001
Landfill gas	Publ. electricity and power plants (1A1a)	NO	0.002	0.002	0.002	0.002	0.002	0.002
Landfill gas	Other consumption (1A4)	NO	NO	0.001	0.001	0.001	0.001	0.001
Methane etc.	Industry (1A2)	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Natural gas	District heating (1A1a)	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Natural gas	Industry (1A2)	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Natural gas	Other consumption (1A4)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Natural gas	Publ. electricity and power plants (1A1a)	0.002	0.002	0.002	0.002	0.002	0.002	0.002

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Other biomass	Power plants, district heating, industry (1A1-2)	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Other biomass	Other consumption (1A4)	0.059	0.059	0.059	0.059	0.059	0.059	0.059
Other non specified	Power plants, district heating, industry (1A1-2)	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Other petroleum fuels	Power plants, district heating, industry (1A1-2)	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Other solid fuels	Power plants, district heating, industry (1A1-2)	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Peat	Power plants, district heating, industry (1A1-2)	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Petroleum coke	Industry (1A2)	0.008	0.008	0.008	0.008	0.008	0.008	0.008
Refinery gas	Industry (1A1b)	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Refinery oil	Industry (1A1b)	0.003	0.003	0.003	NO	NO	NO	NO
Residual fuel oil	Other consumption (1A4)	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Residual fuel oil	Power plants, district heating, industry (1A1,1A2)	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Steel converter gas	Power plants, district heating (1A1)	NO	0.002	0.002	0.002	0.002	0.002	0.002
Solid waste	District heating (1A1a)	0.025	0.005	0.005	0.005	0.005	0.005	0.005
Solid waste	Industry (1A2)	0.025	0.01	NO	NO	NO	NO	NO
Tall oil	Power plants, district heating, industry (1A1-1A2)	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108
Wooden fuels	District heating (1A1a)	0.1	0.02	0.02	0.02	0.02	0.02	0.02
Wooden fuels	Industry (1A2)	0.1	0.02	0.02	0.02	0.02	0.02	0.02
Wooden fuels	Publ. electricity and power plants (1A1a)	0.05	0.02	0.02	0.02	0.02	0.02	0.02
Wooden fuels	Other consumption: Boilers: pellets	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Wooden fuels	Other consumption: Boilers: wood chips	0.059	0.059	0.059	0.059	0.059	0.059	0.059
Wooden fuels	Other consumption: Boilers: wood logs Modern	0.087	0.087	0.087	0.087	0.087	0.087	0.087
Wooden fuels	Other consumption: Boilers: wood logs Traditional	0.552	0.552	0.552	0.552	0.552	0.552	0.552
Wooden fuels	Other consumption: Stoves: pellets	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Wooden fuels	Other consumption: Stoves: wood logs Modern	0.084	0.084	0.084	0.084	0.084	0.084	0.084
Wooden fuels	Other consumption: Stoves: wood logs Traditional	0.199	0.199	0.199	0.199	0.199	0.199	0.199
Wooden fuels	Other consumption: Open fireplaces	0.22	0.22	0.22	0.22	0.22	0.22	0.22

2.3.1.2 EMISSION FACTORS FOR SO_2 AND NO_X

Normally, national emission factors for SO_2, NO_X and particles are used for stationary combustion of all fuels in NFR 1A1 and 1A2, see Table A2-11 and Table A2-12. For the pulp and paper industry, however, a study performed in 2009 showed that these emission factors give systematic overestimations of the emissions of SO_2, NO_X and particles in this industry. The study covered the years 2001-2007 and plants accounting for 80-90% of the emissions within NFR 1A2d. As there was not enough information to trace the overestimation to certain fuels, it was decided to apply "reduction factors" calculated in the study for emissions of SO_2, NO_X and particles from the pulp and paper industry for emission years 2000 and later. These reduction factors are used for all fuels and calculated as the average ratio between total combustion-related emissions from environmental reports and the corresponding emissions calculated with national emission factors. The average ratios over the period 2002-2007 are used since submission 2010 for all years 2000 and later[39]. However, when implementing the revised emission factors for NFR 1A2[40] in submission 2018, these reduction factors were adjusted accordingly, in order to not underestimate the emissions.

In submission 2023, the major revision of emission factors affected SO_2 and NO_x emissions in all stationary sectors[41]. The major effects of the revised emissions, in submission 2023, were:

- SO2: In NFR 1A1 a decrease of around 20%, starting with 0 in 1990 and ending with 18% in 2020. The decrease in NFR 1A2 was around 20% at maximum in 2005, but in average around 10%.
- NOx: For all stationary NFR codes the total effect was maximum 3 % (in 2020). In NFR 1A1, the effects were greatest with a decrease of 6% in 2020.
- Particles: The effect of revisions for TSP was for all stationary NFR codes at the maximum of 4 % decrease (in 2020). In general, the effects were around 2 % through the whole time series. NFR 1A1 was mostly affected with a maximum decrease in 2020 by 13%.

Detailed description and effects of revisions of emission factors at fuel type level are found in Mawdsley et al. 2022.

[39] The study was never published but the results were documented in Excel files submitted to SEPA in 2009.

[40] Mawdsley & Stripple, 2017

[41] Mawdsley, I., Danielsson, H., Yaramenka, K., Josefsson Ortiz, C., Guban, P. 2022. Översyn av emissionsfaktorer inom stationär förbränning. SMED rapport nr 8. Avtal: 250-21-001.

Table A2-11. Emission factors for NO_X (kg/GJ), stationary combustion.

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Black liquor	Industry	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Charcoal	Other consumption (1A4)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Coke	All consumption	0.15	0.12	0.09	0.07	0.07	0.07	0.07
Coal	Industry (1A2)	0.2	0.12	0.09	0.07	0.07	0.07	0.07
Coal	Lime production (part of 1A2g)	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Coal	Mining industry (part of 1A2g)	NO	0.6	0.55	0.55	0.55	0.55	0.55
Coal	Other consumption (1A4)	0.2	0.15	NO	NO	NO	NO	NO
Coal	Power plants and district heating (1A1a)	0.2	0.04	0.03	0.03	0.03	0.03	0.03
Domestic heating oil	Gas turbine/diesel Power generation (part of 1A1a)	0.6	0.17	0.17	0.17	0.17	0.17	0.17
Domestic heating oil	Power plants and district heating (part of 1A1a)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Domestic heating oil	Industry(1A1b,1A2)	0.07	0.09	0.09	0,09	0,09	0,09	0,09
Gas works gas	Other consumption (1A4)	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Gas works gas	Power plants, district heating (1A1)	0.07	0.04	0.02	NO	NO	NO	NO
Gas works gas	Industries (1A2)	0.07	0.06	0.047	0.04	0.04	0.04	0.04
Hydrogen	Industry (1A2)	NO	NO	NO	NO	NO	NO	NO
Kerosene	Power plants, district heating and industries (1A1, 1A2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
LNG	Power plants, district heating and industries (1A1, 1A2)	NO	NO	NO	0.015	0.015	0.015	0.015
LPG	Other consumption (1A4)	0.05	0.05	0.05	0.05	0.05	0.05	0.05
LPG	Power plants, district heating (1A1)	0.07	0.07	0.02	0.015	0.015	0.015	0.015
LPG	Industries (1A2)	0.07	0.06	0.047	0.04	0.04	0.04	0.04
Landfill gas	Other consumption	NO	NO	NO	0.05	0.05	0.05	0.05
Landfill gas	Power plants, district heating (1A1)	NO	0.04	0.02	0.015	0.015	0.015	0.015
Landfill gas	Industries (1A2)	NO	0.06	0.047	0.04	0.04	0.04	0.04
Methane etc.	Industry (1A2)	0.06	0.06	0.05	0.05	0.05	0.05	0.05
Natural gas	Power- and heating plants and industries (1A1, 1A2)	NO	NO	0.05	0.05	0.05	0.05	0.05

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Other biomass	Power plants, district heating (1A1)	NO	NO	0.08	0.07	0.07	0.07	0.07
Other biomass	Industry (1A2)	0.09	0.08	0.07	0.07	0.07	0.07	0.07
Other biomass	Other consumption (1a4)	NO	NO	0.1	0.08	0.08	0.08	0.08
Other biomass	Other consumption Agriculture (1a4c)	0.08	0.08	0.11	0.11	0.11	0.11	0.11
Other biomass	Industry (1A2)	0.09	0.08	0.07	0.07	0.07	0.07	0.07
Other biomass	Power plants, district heating (1A1)	NO	0.08	0.07	0.07	0.07	0.07	0.07
Other non specified	Power plants, district heating (1A1)	0.09	0.05	0.04	0.03	0.03	0.03	0.03
Other non specified	Other consumption (1A4)	NO	NO	0.18	0.14	0.14	0.14	0.14
Other petroleum fuels	Industry (1A2)	0.1	0.08	NO	NO	NO	NO	NO
Other solid fuels	Power plants, district heating (1A1)	NO	NO	0.05	0.04	0.04	0.04	0.04
Other solid fuels	Industry (1A2)	0.12	0.06	NO	NO	NO	0.04	0.04
Peat	Industry (1A2)	0.19	0.073	0.065	0.06	0.06	0.06	0.06
Peat	Power plants, district heating (1A1)	0.19	0.08	0.07	0.07	0.07	0.07	0.07
Petroleum coke	All consumption	0.15	0.12	0.12	NO	NO	0.12	0.12
Refinery gas	All consumption	0.0456	0.036	0.0282	0.024	0.024	0.024	0.024
Refinery oil	Industry	0.353	0.16	0.06	0.06	0.06	0.06	0.06
Residual fuel oil	Gas turbine/diesel Power generation (part of 1A1a)	0.6	NO	NO	NO	NO	NO	NO
Residual fuel oil	Mining industry (part of 1A2g)	0.17	0.25	0.28	NO	NO	NO	NO
Residual fuel oil	Power- and heating plants and industries (1A1, 1A2)	0.17	0.07	0.06	0.06	0.06	0.65	0.65
Residual fuel oil	Other consumption (1A4)	0.17	0.1	0.1	0.1	0.1	0.1	0.1
Solid waste	Industry (1A2)	0.09	0.06	NO	NO	NO	NO	NO
Solid waste	Power plants and district heating (1A1a)	0.09	0.06	0.05	0.05	0.05	0.05	0.05
Tall oil	Industry (1A2)	0.1	0.09	0.07	0.07	0.07	0.07	0.07
Tall oil	Power plants and district heating (1A1a)	NO	0.09	0.07	0.07	0.07	0.07	0.07
Wooden fuels	Industry (1A2)	0.12	0.073	0.065	0.06	0.06	0.06	0.06
Wooden fuels	Other consumption (1A4)	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Wooden fuels	Power plants and district heating (1A1a)	0.12	0.07	0.06	0.06	0.06	0.06	0.06

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Wooden fuels	Other consumption: Boilers: pellets	NO	0.065	0.065	0.065	0.065	0.065	0.065
Wooden fuels	Other consumption: Boilers: wood chips	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Wooden fuels	Other consumption: Stoves: pellets	NO	0.065	0.065	0.065	0.065	0.065	0.065
Wooden fuels	Other consumption: Stoves: wood chips	NO	0.08	NO	NO	NO	NO	NO
Wooden fuels	Other consumption: Open fireplaces	0.08	0.08	0.08	0.08	0.08	0.08	0.08

Table A2-12. Emission factors for SO_2 (kg/GJ), stationary combustion.

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Charcoal	Other consumption (1A4)	NO	NO	0.04	0.04	0.04	0.04	0.04
Coke	Other consumption (1A4)	0.48	NO	NO	NO	NO	NO	NO
Coke	Power plants, district heating and industries (1A1, 1A2)	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Coal	Power plants and district heating (1A1)	0.36	0.081	0.033	0.009	0.009	0.009	0.05
Coal	Lime production (part of 1A2g)	0.1	0.05	0.05	0.05	0.05	0.05	0.04
Coal	Mining industry (part of 1A2g)	NO	0.12	0.12	0.04	0.04	0.04	0.009
Coal	Other consumption (1A4)	0.36	0.2	NO	NO	NO	NO	NO
Coal	Other industries, Power plants and district heating (1A1, 1A2)	0.36	0.10	0.10	0.10	0.10	0.10	0.10
Diesel oil	All consumption	0.083	0.0008	0.00011	0.00022	0.00022	0.00022	0.00022
Domestic heating oil	All consumption	0.04	0.025	0.025	0.025	0.025	0.025	0.025
Kerosene	All consumption	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Landfill gas	Power plants and district heating	NO	0.008	0.008	0.008	0.008	0.008	0.008
Methane etc.	Industry (1A2)	0.002	NA	NA	NA	NA	NA	NA
Natural gas	All consumption	0.002	NA	NA	NA	NA	NA	NA
Other biomass	Other consumption Agriculture (1A4c)	0.01	0.01	0.04	0.04	0.04	0.04	0.04
Other biomass	Other consumption (1A4)	NO	NO	0.1	0.1	0.1	0.1	0.1
Other biomass	Power plants and district heating (1a1a)	NO	0.07	0.05	0.04	0.04	0.04	0.04
Other biomass	Industry (1A2)	0.01	0.07	0.05	0.04	0.04	0.04	0.04

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Other non specified	Other consumption (1A4)	NO	NO	0.01	0.2	0.2	0.2	NO
Other non specified	Power plants and district heating (1a1a)	0.11	0.03	0.01	0.002	0.002	0.002	NO
Other petroleum fuels	Industry (1A2)	0.006	0.006	NO	NO	NO	NO	NO
Other solid fuels	Power plants and district heating (1a1a)	NO	NO	0.14	0.003	0.003	0.003	0.003
Other solid fuels	Industry (1A2)	0.17	0.04	NO	NO	NO	0.003	0.003
Peat	Power plants and district heating (1a1a)	0.22	0.12	0.084	0.066	0.066	0.066	0.066
Peat	Industry (1A2)	0.22	0.12	0.08	0.07	0.07	0.07	0.07
Petroleum coke	Industry (1A2)	0.36	0.360	NO	NO	NO	0.36	0.36
Refinery gas	All consumption	0.011	0.002	0.002	0.002	0.002	0.002	0.002
Refinery oil	All consumption	0.71	0.32	0.2	0.2	0.2	0.2	0.2
Residual fuel oil	Power- and heating plants and industries and Other consumption (1A1, 1A2, 1A4)	0.24	0.12	0.09	0.09	0.09	0.09	0.09
Residual fuel oil	Gas turbine/diesel Power generation (part of 1A1a)	0.48	NO	NO	NO	NO	NO	NO
Residual fuel oil	Lime production (part of 1A2f)	NO	NO	0.15	0.15	0.15	0.15	0.15
Residual fuel oil	Mining industry (part of 1A2g)	NO	NO	0.09	0.09	0.09	0.09	0.09
Solid waste	Industry (1A2)	0.025	0.025	NO	NO	NO	NO	NO
Solid waste	Power plants and district heating (1A1a)	0.025	0.025	0.01	0.002	0.002	0.002	0.002
Tall oil	All consumption	0.14	0.1	0.073	0.06	0.06	0.06	0.06
Wooden fuels	Other consumption (1A4)	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Wooden fuels	Power plants, district heating and industries (1A1, 1A2)	0.04	0.018	0.013	0.01	0.01	0.01	0.01

2.3.1.3 PARTICLES, METALS, DIOXIN

The emission factors developed by SMED for calculation of emissions of particles, metals, dioxin from stationary combustion are based on information from many different sources[42]. The emission factors for 1990-2003 are based on knowledge on the general effects of technical development combined with information from companies' environmental reports (where actual emission factors can be derived), and information from trade associations where experts on different sectors have contributed with their specific knowledge. The emission factors from 2004 are derived through extrapolation of the 2003 values.

From approximately 1990, emissions have decreased for most stationary sources due to the technical development of abatement measures in combination with regulations and requirements from authorities. Installation of electrostatic precipitator or bag house filters, as an example, has become standard on large combustion sources. This primarily reduces the TSP emissions. Combustion of MSW also became strictly regulated, and as a consequence of that, flue gas cleaning equipment of different types was installed to reduce emissions primarily of dioxins and mercury. In the district heating sector, installation of flue gas condensation equipment has become common since the beginning of the 1990´s to increase the heat output, but it also reduces emissions to air of many substances.

Reporting of BaP emissions was introduced in the Swedish inventory for 1990 and later years in submission 2008. Emission factors were developed by SMED[43] and are applied to the Quarterly fuel statistics since submission 2008.

In submission 2023, the major revision of emission factors affected particles, metals, and dioxin emissions in all stationary sectors[44]. The major effects of the revised emissions, in submission 2023, were:

- Particles: The effect of revisions for TSP was for all stationary NFR codes at the maximum of 4 % decrease (in 2020). In general, the effects were around 2 % through the whole time series. NFR 1A1 was mostly affected with a maximum decrease in 2020 by 13%.
- Metals: emission factors for Cd, Cr, Cu, Hg, Ni , Pb , Se, Zn were revised for fuel type other biomass. The revision of emission factors affected.

Emission factors for Metals used for stationary combustion in submission 2024 are shown in Table A2-13.

[42] Boström et al., 2004

[43] Paulrud et al., 2010

[44] Mawdsley, I., Danielsson, H., Yaramenka, K., Josefsson Ortiz, C., Guban, P. 2022. Översyn av emissionsfaktorer inom stationär förbränning. SMED rapport nr 8. Avtal: 250-21-001.

Table A2-13. Emission factors for other biomass in stationary combustion for metals between submission 2024

Metal	NFR	EF submission 2024
Cd (t/GJ)	1A1, 1A2	0.0000009
Cd (t/GJ)	1A4	0.000003
Cr (t/GJ)	1A1	0.000003
Cr (t/GJ)	1A4	0.000003
Cu (t/GJ)	1A1	0.000007
Cu (t/GJ)	1A2	0.000007
Cu (t/GJ)	1A4	0.000007
Hg (t/GJ)	1A4	0.0000005
Ni (t/GJ)	1A1	0.000002
Ni (t/GJ)	1A2	0.000002
Ni (t/GJ)	1A4	0.000002
Pb (t/GJ)	1A1	0.000015
Pb (t/GJ)	1A2	0.000015
Pb (t/GJ)	1A4	0.000014
Se (t/GJ)	1A1, 1A2	0.000001
Se (t/GJ)	1A4	0.000002
Zn (t/GJ)	1A1	0.00007
Zn (t/GJ)	1A2	0.00007
Zn (t/GJ)	1A4	0.0001

- Dioxin: Emission factors for Dioxin emission were during submission 2023 revised for NFR 1A1 and 1A2 for combustion of biomass fuels wooden fuels, other biomass, and peat[45]. The effects of the revised emissions of Dioxin in submission 2023 are large. For all stationary NFR codes, the total effect was a decrease from 34 % (in 2990) to 70 % (in 2006). Detailed description and effects of revisions of emission factors at fuel type level are found in Mawdsley et al. 2022.

Emission factors for TSP, PM_{10} and $PM_{2.5}$ used for stationary combustion are shown in Table A2-14 to Table A2-16. Emission factors for small scale biomass combustion in households are additionally shown in a separate table (Table A2-21).

[45] Mawdsley, I., Danielsson, H., Yaramenka, K., Josefsson Ortiz, C., Guban, P. 2022. Översyn av emissionsfaktorer inom stationär förbränning. SMED rapport nr 8. Avtal: 250-21-001.

Table A2-14. Emission factors for TSP (kg/GJ), stationary combustion.

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Black liquor	Industry (1A2)	0.070	0.060	0.060	0.060	0.060	0.060	0.060
Coke	Industry (1A2)	0.045	0.03	0.01	0.0002	0.0002	0.0002	0.0002
Coke	Other consumption (1A4)	0.14	NO	NO	NO	NO	NO	NO
Coal	Industry (1A2)	0.045	0.03	0.01	0.0002	0.0002	0.0002	0.0002
Coal	Other consumption (1A4)	0.14	0.10	NO	NO	NO	NO	NO
Coal	Power plants and district heating	0.035	0.02	0.007	0.0002	0.0002	0.0002	0.0002
Diesel Oil	All consumption	0.006	0.002	0.002	0.002	0.002	0.002	0.002
Domestic heating oil	Other consumption (1A4)	0.007	0.003	0.003	0.003	0.003	0.003	0.003
Domestic heating oil	Power plants, district heating	0.006	0.003	0.003	0.003	0.003	0.003	0.003
Domestic heating oil	Industry	0.006	0.002	0.002	0.002	0.002	0.002	0.002
Gas works gas	Other consumption (1A4)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Gas works gas	Power plants, district heating and industries and industry (1A1, 1A2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Kerosene	All consumption	0.006	0.002	0.002	0.002	0.002	0.002	0.002
LNG	Power plants, district heating and industries (1A1, 1A2)	NO	NO	NO	0.0001	0.0001	0.0001	
LPG	Other consumption (1A4)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
LPG	Power plants, district heating and industries	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Landfill gas	Power plants, district heating and industries	NO	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Methane etc.	Industry (1A2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Natural gas	Other consumption (1A4)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Natural gas	Power plants, district heating and industries	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Other biomass	Power plants and district heating and Industry (1A1, 1A2)	0.011	0.006	0.005	0.004	0.004	0.004	0.004
Other biomass	Other consumption (1A4)	NO	NO	0.04	0.04	0.04	0.04	0.04
Other biomass	Other consumption Agriculture (1A4c)	0.063	0.063	0.063	0.063	0.063	0.063	0.063
Other non specified	All consumption	0.250	0.060	0.030	0.010	0.010	0.010	NO
Other petroleum fuels	All consumption	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Other solid fuels	All consumption	0.150	0.040	0.020	0.006	0.006	0.006	0.006
Peat	Power plants, district heating and industries, Industry (1A1, 1A2)	0.065	0.030	0.008	0.001	0.001	0.001	0.001
Petroleum coke	Industry (1A2)	0.045	0.03	0.01	0.0002	0.0002	0.0002	0.0002
Refinery gas	Industry (1A1b)	0.012	0.001	0.001	0.001	0.001	0.001	0.001
Refinery oil	Industry (1A1b)	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Residual fuel oil	Other consumption (1A4)	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Residual fuel oil	Power plants and district heating	0.009	0.009	0.009	0.009	0.009	0.009	0.009
Residual fuel oil	Industry	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Solid waste	Power plants and district heating and Industry (1A1, 1A2)	0.005	0.0012	0.0005	0.0002	0.0002	0.0002	0.0002
Tall oil	All consumption	0.006	0.002	0.002	0.002	0.002	0.002	0.002
Wooden fuels	Industry (1A2)	0.065	0.043	0.020	0.009	0.009	0.009	0.009
Wooden fuels	Power plants and district heating	0.06	0.034	0.015	0.009	0.009	0.009	0.009
Wooden fuels	Other consumption: Boilers: pellets	NO	0.043	0.043	0.043	0.043	0.043	0.043
Wooden fuels	Other consumption: Boilers: wood chips	0.063	0.063	0.063	0.063	0.063	0.063	0.063
Wooden fuels	Other consumption: Boilers: wood logs Modern	NO	0.039	0.039	0.039	0.039	0.039	0.039
Wooden fuels	Other consumption: Boilers: wood logs Traditional	0.404	0.404	0.404	0.404	0.404	0.404	0.404
Wooden fuels	Other consumption: Stoves: pellets	NO	0.118	0.118	0.118	0.118	0.118	0.118
Wooden fuels	Other consumption: Stoves: wood chips	NO	0.099	NO	NO	NO	NO	NO
Wooden fuels	Other consumption: Stoves: wood logs Modern	NO	0.099	0.099	0.099	0.099	0.099	0.099
Wooden fuels	Other consumption: Stoves: wood logs Traditional	0.204	0.204	0.204	0.204	0.204	0.204	0.204
Wooden fuels	Other consumption: Open fireplaces	0.204	0.204	0.204	0.204	0.204	0.204	0.204

Table A2-15. Emission factors for PM_{10} (kg/GJ), stationary combustion.

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Black liquor	Industry (1A2)	0.070	0.060	0.060	0.060	0.060	0.060	0.060
Coke	Industry (1A2)	0.043	0.029	0.010	0.00019	0.00019	0.00019	0.00019
Coke	Other consumption (1A4)	0.07	NO	NO	NO	NO	NO	NO
Coal	Industry (1A2)	0.043	0.029	0.010	0.00019	0.00019	0.00019	0.00019
Coal	Other consumption (1A4)	0.07	0.05	NO	NO	NO	NO	NO
Coal	Power plants and district heating	0.0333	0.019	0.0065	0.0002	0.0002	0.0002	0.0002
Diesel oil	All consumption	0.006	0.002	0.002	0.002	0.002	0.002	0.002
Domestic heating oil	Other consumption (1A4)	0.007	0.003	0.003	0.003	0.003	0.003	0.003
Domestic heating oil	Power plants, district heating (1A1)	0.006	0.003	0.003	0.003	0.003	0.003	0.003
Domestic heating oil	Industry (1A2)	0.006	0.002	0.002	0.002	0.002	0.002	0.002
Gas works gas	Other consumption (1A4)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Gas works gas	Power plants, district heating and industries (1A1, 1A2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Kerosene	All consumption	0.006	0.002	0.002	0.002	0.002	0.002	0.002
LNG	Power plants, district heating and industries (1A1, 1A2)	NO	NO	NO	0.0001	0.0001	0.0001	0.0001
LPG	Other consumption (1A4)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
LPG	Power plants, district heating and industries (1A1, 1A2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Landfill gas	Power plants, district heating and industries	NO	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Methane etc.	Industry (1A2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Natural gas	Other consumption (1A4)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Natural gas	Power plants, district heating and industries (1A1, 1A2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Other biomass	Power plants and district heating and Industry (1A1, 1A2)	0.011	0.006	0.005	0.004	0.004	0.004	0.004
Other biomass	Other consumption Agri-culture (1A4)	0.062	0.062	0.062	0.062	0.062	0.062	0.062
Other biomass	Other consumption (1A4)	NO	NO	0.040	0.040	0.040	0.040	0.040
Other non speci-fied	All consumption	0.250	0. 060	0.030	0.010	0.010	0.010	0.010
Other petroleum fuels	All consumption	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Other solid fuels	All consumption	0.100	0. 020	0.011	0.004	0.004	0.004	0.004
Peat	Power plants, district heating (1A1)	0.055	0.027	0.007	0.001	0.001	0.001	0.001
Peat	Industry (1A2)	0.059	0.035	0.012	0.0009	0.0009	0.0009	0.0009
Petroleum coke	Industry (1A2)	0.043	0.029	0.010	0.00019	0.00019	0.00019	0.00019
Refinery gas	Industry (1A1b)	0.012	0.001	0.001	0.001	0.001	0.001	0.001
Refinery oil	Industry (1A1b)	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Residual fuel oil	Other consumption (1A4)	0.015	0.015	0.015	0.015	0.015	0.015	0.015

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Residual fuel oil	Power plants, district heating (1A1)	0.007	0.007	0.004	0.004	0.004	0.004	0.004
Residual fuel oil	Industry (1A2)	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Solid waste	Industry (1A2)	0.005	0.0012	NO	NO	NO	NO	NO
Solid waste	Power plants and district heating	0.0045	0.0011	0.0005	0.0002	0.0002	0.0002	0.0002
Tall oil	All consumption	0.006	0.002	0.002	0.002	0.002	0.002	0.002
Wooden fuels	Industry (1A2)	0.062	0.040	0.019	0.0086	0.0086	0.0086	0.0086
Wooden fuels	Power plants and district heating	0.056	0.032	0.015	0.009	0.009	0.009	0.009
Wooden fuels	Other consumption: Boilers: pellets	NO	0.042	0.042	0.042	0.042	0.042	0.042
Wooden fuels	Other consumption: Boilers: wood chips	0.062	0.062	0.062	0.062	0.062	0.062	0.062
Wooden fuels	Other consumption: Boilers: wood logs Modern	NO	0.038	0.038	0.038	0.038	0.038	0.038
Wooden fuels	Other consumption: Boilers: wood logs Traditional	0.396	0.396	0.396	0.396	0.396	0.396	0.396
Wooden fuels	Other consumption: Stoves: pellets	NO	0.116	0.116	0.116	0.116	0.116	0.116
Wooden fuels	Other consumption: Stoves: wood chips	NO	0.097	NO	NO	NO	NO	NO
Wooden fuels	Other consumption: Stoves: wood logs Modern	NO	0.097	0.097	0.097	0.097	0.097	0.097
Wooden fuels	Other consumption: Stoves: wood logs Traditional	0.200	0.200	0.200	0.200	0.200	0.200	0.200
Wooden fuels	Other consumption: Open fireplaces	0.200	0.200	0.200	0.200	0.200	0.200	0.200

Table A2-16. Emission factors for $PM_{2.5}$ (kg/GJ), stationary combustion.

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Black liquor	Industry (1A2)	0.056	0.048	0.048	0.048	0.048	0.048	0.048
Coke	Industry (1A2)	0.037	0.025	0.0084	0.00017	0.00017	0.00017	0.00017
Coke	Other consumption (1A4)	0.035	NO	NO	NO	NO	NO	NO
Coking coal	Power plants, district heating (1A1)	0.029	0.017	0.0056	0.0002	0.0002	0.0002	0.0002
Coking coal	Industry (1A2)	0.037	0.025	0.0084	0.00017	0.00017	0.00017	0.00017
Coking coal	Other consumption (1A4)	0.035	0.025	NO	NO	NO	NO	NO
Coal	Industry (1A2)	0.037	0.025	0.0084	0.00017	0.00017	0.00017	0.00017
Coal	Other consumption (1A4)	0.035	0.025	NO	NO	NO	NO	NO
Coal	Power plants and district heating (1A1)	0.029	0.017	0.0056	0.0002	0.0002	0.0002	0.0002
Diesel oil	Power plants and district heating and Industry (1A1, 1A2)	0.006	0.002	0.002	0.002	0.002	0.002	0.002
Domestic heating oil	Power plants, district heating and Other consumption (1A1, 1A4)	0.006	0.003	0.003	0.003	0.003	0.003	0.003
Domestic heating oil	Industry (1A2)	0.007	0.002	0.002	0.002	0.002	0.002	0.002
Gas works gas	Other consumption (1A4)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Gas works gas	Power plants, district heating and industries (1A1)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Kerosene	All consumption	0.006	0.002	0.002	0.002	0.002	0.002	0.002
LNG	Power plants, district heating and industries (1A1, 1A2)	NO	NO	NO	0.0001	0.0001	0.0001	0.0001
LPG	Other consumption (1A4)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
LPG	Power plants, district heating and industries (1A1)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Landfill gas	All consumption	NO	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Methane etc.	Industry (1A2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Natural gas	Other consumption (1A4)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Natural gas	Power plants, district heating and industries (1A1, 1A2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Other biomass	Power plants and district heating and Industry (1A1, 1A2)	0.009	0.005	0.003	0.003	0.003	0.003	0.003
Other biomass	Other consumption (1A4)	0.059	0.059	0.059	0.059	0.059	0.059	0.059
Other non specified	All consumption	0.230	0.050	0.020	0.009	0.009	0.009	0.009
Other petroleum fuels	All consumption	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Other solid fuels	All consumption	0.050	0.012	0.005	0.002	0.002	0.002	0.002
Peat	Power plants, district heating	0.042	0.021	0.005	0.001	0.001	0.001	0.001
Peat	Industry (1A2)	0.046	0.028	0.001	0.0007	0.0007	0.0007	0.0007

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Petroleum coke	Industry (1A2)	0.037	0.025	0.0084	0.00017	0.00017	0.00017	0.00017
Refinery gas	Industry (1A1b)	0.012	0.001	0.001	0.001	0.001	0.001	0.001
Refinery oil	Industry (1A1b)	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Residual fuel oil	Other consumption (1A4)	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Residual fuel oil	Power plants, district	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Residual fuel oil	Industry (1A2)	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083
Solid waste	Industry (1A2)	0.004	0.0011	NO	NO	NO	NO	NO
Solid waste	Power plants and district heating	0.004	0.0011	0.0005	0.0002	0.0002	0.0002	0.0002
Tall oil	All consumption	0.006	0.002	0.002	0.002	0.002	0.002	0.002
Wooden fuels	Power plants and district heating and Industry (1A1, 1A2)	0.006	0.002	0.002	0.002	0.002	0.002	0.002
Wooden fuels	Other consumption: Boilers: pellets	NO	0.040	0.040	0.040	0.040	0.040	0.040
Wooden fuels	Other consumption: Boilers: wood chips	0.059	0.059	0.059	0.059	0.059	0.059	0.059
Wooden fuels	Other consumption: Boilers: wood logs Modern	NO	0.036	0.036	0.036	0.036	0.036	0.036
Wooden fuels	Other consumption: Boilers: wood logs Traditional	0.376	0.376	0.376	0.376	0.376	0.376	0.376
Wooden fuels	Other consumption: Stoves: pellets	NO	0.110	0.110	0.110	0.110	0.110	0.110
Wooden fuels	Other consumption: Stoves: wood logs Modern	NO	0.092	0.092	0.092	0.092	0.092	0.092
Wooden fuels	Other consumption: Stoves: wood logs Traditional	0.190	0.190	0.190	0.190	0.190	0.190	0.190
Wooden fuels	Other consumption: Open fireplaces	0.190	0.190	0.190	0.190	0.190	0.190	0.190

2.3.1.4 EMISSION FACTORS FOR BLACK CARBON

An inventory of emissions of black carbon in Sweden was made for the first time in 2014. Emissions are reported for the years 2000 and later. BC emissions from stationary combustion were estimated according to the EMEP/EEA guidebook[46] throughout the sectors 1.A.1, 1.A.2 and 1.A.4. The general approach is to multiply the emission factor for $PM_{2.5}$ with a fraction as specified in the guidebook[47].

Emission factors for BC were during submission 2023 revised for NFR 1A1 and 1A2 for combustion of other fuel types, other fossil fuels, other biomass, other petroleum fuels and other solid fuels[48]. The effects on the BC emissions were for all

[46] EEA, 2019

[47] Skårman et.al., 2014

[48] Mawdsley, I., Danielsson, H., Yaramenka, K., Josefsson Ortiz, C., Guban, P. 2022. Översyn av emissionsfaktorer inom stationär förbränning. SMED rapport nr 8. Avtal: 250-21-001.

stationary NFR codes around 0 to 3% decrease at the maximum. The revision was mainly in NFR codes 1A1 and 1A2.

2.3.1.5 EMISSONS FACTORS FOR PCB, HCB AND PAH

Emission factors for PAHs were estimated according to the sum of PAH1-4[49]. The sum of PAH-4 and benzo(a)pyrene was fractionised in benzo(b)flourathene, benzo(k)flourathene and indeno(1,2,3-cd)pyrene according to the EMEP/EEA guidebook[50]. Thus, the emissions for the total PAHs will be the same as reported before but the fraction is now enabled. Emission factors for PCB and HFC were taken from the EMEP/EEA guidebook.

Emission factors for PAH 1-4 were during submission 2023 revised for NFR 1A1 and 1A2 for combustion of other fuel types, other fossil fuels, other biomass, other petroleum fuels and other solid fuels[51]. The revision resulted in a decrease of PAH 1-4 emissions of around 1-2 % for all stationary NFR codes. The effects on NFR 1A1 was a decrease between 0 and 8% decrease and for NFR 1A2 a decrease between 0% and 25%.

Emission factors for PCB are found in Table A2-17. New emission factors for HCB are found in Table A2-18. Emission factors for PAHs in submission 2024 are found in Table A2-19.

[49] Allerup et al., 2015

[50] EEA, 2019

[51] Mawdsley, I., Danielsson, H., Yaramenka, K., Josefsson Ortiz, C., Guban, P. 2022. Översyn av emissionsfaktorer inom stationär förbränning. SMED rapport nr 8. Avtal: 250-21-001.

Table A2-17. Emission factors for PCB (µg/GJ), stationary combustion.

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Coke	Industry (1A2)	170	170	170	170	170	170	170
Coking coal	Industry (1A2)	170	170	170	170	170	170	170
Coking coal	Power pl. and district heating	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Other biomass	Industry (1A2)	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Other biomass	Power pl. and district heating (1A1)	NA	3	3	3	3	3	3
Other biomass	Small scale combustion	0.06	0.06	0.05	0.05	0.05	0.05	0.05
Other non specified	All consumption	0.00034	0.00034	0.00034	0.00034	0.00034	0.00034	0.00034
Other solid fuels	All consumption	0.00034	0.00034	0.00034	0.00034	0.00034	0.00034	0.00034
Peat	Industry (1A2)	170	170	170	170	170	170	170
Peat	Power pl. and district heating (1A1)	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Tall oil	Industry (1A2)	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Tall oil	Power pl. and district heating (1A1)	NA	3.5	3.5	3.5	3.5	3.5	3.5
Waste	Power pl. and district heating and Industry (1A1, 1A2)	0.00034	0.00034	0.00034	0.00034	0.00034	0.00034	0.00034
Wooden fuels	Industry (1A2)	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Wooden fuels	Power pl. and district heating (1A1)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Wooden fuels	Household combustion	0.06	0.06	0.06	0.06	0.06	0.06	0.06

Table A2-18. Emission factors for HCB (µg/GJ), stationary combustion.

Fuel type	Sector	1990	2000	2010	2019	2020	2021	2022
Coke	Industry (1A2)	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Coking coal	Industry (1A2)	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Coking coal	Power plants and district heating (1A1)	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Other biomass	All consumption	5	5	5	5	5	5	5
Other non specified	All consumption	4.52	4.52	4.52	4.52	4.52	4.52	4.52
Other solid fuels	Power plants and district heating and Industry (1A1, 1A2)	4.52	4.52	4.52	4.52	4.52	4.52	4.52
Peat	Industry (1A2)	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Peat	Power plants and district heating (1A1)	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Tall oil	Power plants and district heating and Industry (1A1, 1A2)	5	5	5	5	5	5	5
Waste	Power plants and district heating and Industry (1A1, 1A2)	4.52	4.52	4.52	4.52	4.52	4.52	4.52
Wooden fuels	All consumption	5	5	5	5	5	5	5

Table A2-19. Emission factors for PAH (µg/GJ), stationary combustion.

Fuel type	Sector	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(k)fluorathene	Indenopyrene	PAH_1-4
Coke	Industry (1A2)	0.7	37	29	1.1	67.8
Coking coal	Power pl. and district heating and Industry (1A1, 1A2)	0.7	37	29	1.1	67.8
Coking coal	Mining industry (parts of 1A2g)	250	146	59	46	500
Diesel Oil	Power pl. and district heating (1A1)	30	388	44	39	500
Diesel Oil	Industry (1A2)	30	133	133	204	500
Domestic heating oil	Power pl. and district heating (1A1)	30	133	133	204	500
Domestic heating oil	Industry (1A2)	30	388	44	39	500
Domestic heating oil	Small scale combustion	30	70	122	279	500
Kerosene	Power pl. and district heating (1A1)	250	71	71	109	500
Landfill gas	Power pl. and district heating (1A1)	0.56	0.84	0.84	0.84	3.1
LNG	Power pl. and district heating (1A1)	0.56	0.84	0.84	0.84	3.1
LPG	Power pl. and district heating (1A1)	0.56	0.84	0.84	0.84	3.1
Natural gas	Power pl. and district heating (1A1)	0.56	0.84	0.84	0.84	3.1
Other biomass	Power pl. and district heating (1A1)	400	300	110	150	960
Other biomass	Industry (1A2)	400	400	140	230	1170
Other biomass	Small scale combustion	2800	4300	1300	1100	9500
Other biomass	Other consumption Agriculture	20000	32000	10000	8000	70000
Peat	Industry (1A2)	1000	1280	400	320	3000
Peat	Power pl. and district heating (1A1)	1000	897	323	780	3000
Residual fuel oil	Power pl. and district heating (1A1)	15	66	66	102	250
Residual fuel oil	Industry and other consumption (1A2, 1A4)	15	194	22	19	250
Tall oil	Industry (1A2)	250	160	50	40	500
Tall oil	Power pl. and district heating (1A1)	250	112	40.4	98	50
Waste	Industry (1A2)	NA	NA	NA	NA	NA
Waste	Power pl. and district heating (1A1)	0.8	1.7	0.9	1.1	4.5

Fuel type	Sector	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(k)flouranthene	Indenopyrene	PAH_1-4
Wooden fuels	Industry (1A2)	1000	1280	400	320	3000
Wooden fuels	Power pl. and district heating (1A1)	1000	897	323	780	3000
Wooden fuels	Other consumption: Boilers: pellets	10	16	5	4	35
Wooden fuels	Other consumption: Boilers: wood chips	20	32	10	8	70
Wooden fuels	Other consumption: Boilers: wood logs Modern	10	16	5	4	35
Wooden fuels	Other consumption: Boilers: wood logs Traditional	121	111	42	71	345
Wooden fuels	Other consumption: Stoves: pellets	10	16	5	4	35
Wooden fuels	Other consumption: Stoves: wood logs Modern	10	16	5	4	35
Wooden fuels	Other consumption: Stoves: wood logs Traditional	121	111	42	71	345
Wooden fuels	Other consumption: Open fireplaces	121	111	42	71	345

2.3.1.6 EMISSION FACTORS FOR COMBUSTION OF BIOMASS IN HOUSEHOLDS

Emission factors for combustion of biomass in households for each emission include all technologies and all biomass fuel types.

Time series of activity data and CH_4 emission factors were reviewed and updated in submission 2016[52]. New methane emission factors for small scale combustion of wood log, pellets and wood chips/sawdust were determined and an improved method was used to calculate the emissions. In order to match the activity data categories, the emission factors were grouped by heating system category and fuel type. In addition, emission factors for NO_X, CO, NMVOC, SO_2, NH_3, total suspended particles (TSP), PM_{10}, $PM_{2.5}$, dioxins, PAH and metals 1990-2004 for small scale combustion of biomass were reviewed and occasionally revised[53]. For N_2O emission factors, no new measurement studies were carried out and no new information from the literature was found, and thus no adjustments were made. For NO_X emission factors, data from mainly six Swedish studies was used. The emission of NO_X for pellets varied between 30-80 mg/MJ and for wood logs between 20-120 mg/MJ. The emission factors for CO were mainly based on measured emission

[52] Paulrud et al., 2005

[53] Paulrud et al., 2006

data from Swedish residential biomass combustion experiments in the field as well as in the laboratory.

In Swedish emission inventories 2005 and earlier, the SO_2 emission factors were based on an S-content of (0.07 wt % dry fuel) and the assumption that a majority of the sulphur is bound to the ash. In the 2006 study, a lower S-content was applied (0.01 wt %), but with the assumption that no sulphur is bound in the ash.

The NH_3 emissions from wood combustion are generally low and since no new information on NH_3 emission factors was found, the emission factors for NH_3 were not revised.

The emission factors for dioxin from small scale combustion are based on the results from two Swedish and six international studies. The chemical content, for example the chlorine content of the fuel, is a parameter of major significance. It is assumed that most wood boilers and stoves in Sweden are fired with local wood, i.e. uncontaminated wood. The emission factors for PCDD/F varied in the range of 0.012-2.6 ng/MJ for the wood log boilers, 0.02-1.18 ng/MJ for the wood log stoves, 0.002-0.84 ng/MJ for the pellets burners, 0.003-0.11 for the wood chips boilers and 0.005-4.5 for the open fireplaces. Some of the combustion experiments with pellets showed surprisingly high values. There were no explanations for these high values and in the study it was assumed that combustion of pellets in general have more similar levels of PCDD/F as wood log boilers.

Emission factors for PCB and HCB are default values from the EMEP/EEA Guidebook 2019.

In submission 2019, a revision of the emission factors for CO, NMVOC, particles, metals and PAHs for small scale wooden combustion was made, according to Table A2-20 below. The new emission factors were updated and enhanced a new division of modern and traditional technology for stoves and boilers[54].

Table A2-20. Emission factors for 1990-2022 from small scale combustion of wood logs, pellets and wood chip using different combustion technologies.

Technology	Unit	Boiler - pellets	Boiler - wood chips	Traditional boiler - wood	Modern boiler - wood	Stove - pellets	Stove - wood chips	Traditional stove - wood	Modern stove - wood	Open fireplace
CO	g/GJ	339	430	3842	1189	208	208	2371	1740	2610
NMVOC	g/GJ	17	59	552	87	4	4	199	83	220
TSP (total particles)	g/GJ	43	63	404	39	118	118	204	99	225

[54] Helbig et al., 2018

Technology	Unit	Boiler - pellets	Boiler - wood chips	Traditional boiler - wood	Modern boiler - wood	Stove - pellets	Stove - wood chips	Traditional stove - wood	Modern stove - wood	Open fireplace
PM_{10} (total particles)	g/GJ	42	62	395	38	116	116	200	97	220
$PM_{2.5}$ (total particles)	g/GJ	40	59	376	36	110	110	190	92	210
BC (based on total particles)	g/GJ	6	2	26	6	11	11	74	22	82
Pb	mg/GJ	15	15	15	15	15	15	15	15	15
Cd	mg/GJ	3	3	3	3	3	3	3	3	3
Hg	mg/GJ	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
As	mg/GJ	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cr	mg/GJ	3	3	3	3	3	3	3	3	3
Cu	mg/GJ	5	5	5	5	5	5	5	5	5
Ni	mg/GJ	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Se	mg/GJ	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Zn	mg/GJ	400	400	400	400	400	400	400	400	400
Benzo(a)pyrene	mg/GJ	10	20	121	10	10	10	121	10	121
Benzo(b)fluoranthene	mg/GJ	16	32	111	16	16	16	111	16	111
Benzo(k)fluoranthene	mg/GJ	5	10	42	5	5	5	42	5	42
Indeno(1,2,3-cd)pyrene	mg/GJ	4	8	71	4	4	4	71	4	71
PAH	g/GJ	0.035	0.07	0.345	0.035	0.035	0.035	0.345	0.035	0.345

2.3.1.7 EMISSION FACTORS FOR COMBUSTION OF BIOMASS IN THE COMMERCIAL/INSTITUTIONAL SECTOR AND AGRICULTURE/FORESTRY/FISHERY SECTOR

In submission 2020, new calculations of emissions from combustion of biomass in the commercial/institutional sector (NFR 1A4a) and agriculture/forestry/fishery sector (NFR 1A4c) have been developed for particulate matter, CO, NMVOC, PAHs NRF1A4c. The calculations are based on technology-specific emission factors from a previous project in 2018. In order to apply these technology-specific emission factors, shares of firewood, wood chips and wood pellets in total wood fuel amount were calculated per subsector and across the entire time series. As implemented for the household sector (NFR 1A4b), emissions from firewood are calculated by considering different shares of modern and traditional combustion units over time. The effect of these recalculations are lower emission and a more stable time series with lower year-by-year variation[55].

In submission 2022, revised emission factors for fuel type Other biomass were implemented in the inventory for 1.A.4[56]. The emission factors used for Other biomass were in accordance with the emission factors revised for wooden combustion of Boiler - wood chips of revision in submission 2019. The emission factors for submission 2024 for Other biomass are presented in Table A2-21.

[55] Helbig et al., 2019

[56] Helbig, T. & Josefsson Ortiz, C. 2021. Uppdateringar av utsläppsberäkningar för småskalig biomassaeldning inom övrigsektorn (CRF/NFR 1A4) 2017-2021. SMED Rapport Nr 19 2021.

Table A2-21. Emission factors for particulate matter, CO, NMVOC, PAHs determined - combustion of wood logs, pellets and wood chip using different combustion technologies for Commercial/Institutional sector and Agriculture/Forestry/Fishery sector.

Technology	Unit	1A4a COMMERCIAL/INSTITUTIONAL				1A4c AGRICULTURE/FORESTRY/FISHERY			
		Boiler - pellets	Boiler - wood chips	Traditional boiler - wood	Modern boiler - wood	Boiler - pellets	Boiler - wood chips	Traditional boiler - wood	Modern boiler - wood
CO	g/GJ	339	430	3842	1189	339	430	3842	1189
NMVOC	g/GJ	17	59	552	87	17	59	552	87
CH4	g/GJ	6	6	88	15	6	6	88	15
TSP (total particles)	g/GJ	43	63	404	39	43	63	404	39
PM_{10} (total particles)	g/GJ	42	62	395	38	42	62	395	38
$PM_{2.5}$ (total particles)	g/GJ	40	59	376	36	40	59	376	36
BC (based on total particles)	g/GJ	6	2	26	6	6	2	26	6
Pb	mg/GJ	15	15	15	15	15	15	15	15
Cd	mg/GJ	3	3	3	3	3	3	3	3
Hg	mg/GJ	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
As	mg/GJ	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cr	mg/GJ	3	3	3	3	3	3	3	3
Cu	mg/GJ	5	5	5	5	5	5	5	5
Ni	mg/GJ	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Se	mg/GJ	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Zn	mg/GJ	400	400	400	400	400	400	400	400
Benzo(a)pyrene	mg/GJ	10	20	121	10	10	20	121	10
Benzo(b)fluoranthene	mg/GJ	16	32	111	16	16	32	111	16
Benzo(k)fluoranthene	mg/GJ	5	10	42	5	5	10	42	5
Indeno(1,2,3-cd)pyrene	mg/GJ	4	8	71	4	4	8	71	4
PAH	g/GJ	0.035	0.07	0.345	0.035	0.035	0.07	0.345	0.035

2.3.2 Mobile combustion

Emission factors used for mobile combustion calculations are both country-specific and default values from the IPCC Guidelines and the EMEP/EEA air pollutant emission inventory guidebook. These emission factors are further described in IIR section 3.2.

In submission 2023, version 4.2 of the road model HBEFA was implemented along with other updates of the model. This upgrade entailed a number of changes in BC, CO, NO_x and NMVOC emission factors for several vehicle types. Apart from the changes made in HBEFA, the SO_2 emission factors for gasoline and diesel was harmonised with the values reported annually in accordance with the EU Fuel Quality Directive. This led to relatively large changes in SO_2 emissions from small boats and passenger cars.

2.3.3 Inclusion/exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors

The size of $PM_{2.5}$ and PM_{10} emissions depends on whether combustion emissions are measured in hot or cold flue gases, where measurements in cold flue gases include the condensable component and measurements in hot flue gases do not. Information on whether the emission factors used in the Swedish emission inventory include the condensable component is presented in Table A2-22 below. In many cases it is not known for certain whether the measurements that the emission factors are based on include the condensable component.

Table A2-22. Inclusion /exclusion of the condensable component from $PM_{2.5}$ and PM_{10} in emission factors.

NFR	Source/sector name	The condensable component is:			EF reference	Comment
		Included	Excluded	Uncertain		
1A1a	Public electricity and heat production		X*			
1A1b	Petroleum refining		X*			
1A1c	Manufacture of solid fuels and other energy industries		X*			
1A2g, 1a3e, 1A4a, 1A4b, 1A4c	Non-road mobile machinery			X	National model for Non-Road Mobile Machinery	
1A3b	Road Transportation	X			HBEFA	Considering the measuring procedure and the maximum temperature of 52°C, it can be assumed that PM condensables are also included in the measurements. The installed technology also plays a role in this context (petrol engines with/without catalytic converter, diesel engines with/without particulate filter, etc.)[57]
1A3c	Railways			X	EMEP/EEA Guidebook 2019, threshold values	
1A3d	Domestic navigation	X			Country specific emission values produced by IVL Swedish Environmental Research Institute.	
1A4a, 1A4b, 1A4c	Other stationary combustion	X			Country-specific emission factors based on measurements from NKL project	
1B excluding 1B1c			X*		1B2A1, 1B2C21, 1B2C22 – national EF 1B2A4 – env. reports	

[57] FOEN, 2021

NFR	Source/sector name	The condensable component is:			EF reference	Comment
		Included	Excluded	Uncertain		
1B1c	COG flaring		X*		Emissions from env. reports (no EF) (Nuutinen et al., 2007	
1B1c	Handling of solid fuels			X	Emission factors from TNO and	No condensable component exists (no combustion). Total PM=filterable PM
2A excluding 2A5a and 2A5b	Mineral products		X*		2A1 – TSP emissions from env. reports (no EF), PM fractions – from personal communication with the company. 2A2 – national EF 2A3 – emissions from env. reports (no EF)	
2A5a	Quarrying and mining of minerals other than coal			X	Emission factors from TNO	No condensable component exists (no combustion). Total PM=filterable PM
2A5b	Construction and demolition			X	EMEP/EEA Guidebook 2023	No condensable component exists (no combustion). Total PM=filterable PM
2A5c	Mineral wool production		X*		Env. reports	
2B5	Carbide production		X*		Env. reports	
2B10	Other chemical industry			X	Env. reports and EMEP/EEA Guidebook 2019	Some emissions may include condensable component and some not.
2C	Metal production		X*		TSP emissions from env. reports (no EF)	
2D3b	Other solvent and product use – Road paving		X		EF from EMEP/EEA Guidebook 2019	According to EMEP/EEA, EF represents filterable PM emissions.
2D3c	Other solvent and product use – Asphalt roofing			X	Expert judgement	No condensable component exists (no combustion). Total PM=filterable PM
2G4	Other product use			X	EF from EMEP/EEA Guidebook 2019	
2H1	Pulp and paper industry		X*		Env. reports	

NFR	Source/sector name	The condensable component is:			EF reference	Comment
		Included	Excluded	Uncertain		
5A	Solid waste disposal on land			X	EF from EMEP/EEA Guidebook 2019	
5C1bii	Incineration of hazardous waste		X*		Env. reports	
5C1bv	Cremation, carcasses			X	EF from EMEP/EEA Guidebook 2019	
5E	House and car fires			X	EF from EMEP/EEA Guidebook 2019	

* Condensable component is most likely excluded since emission factors/estimates in general are based on measurements in the flue stack, i.e. not in diluted flue gases.

2.3.4 References Annex 2.1 – 2.3

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The Swedish Energy Agency http://www.energimyndigheten.se/statistik/den-officiella-statistiken/statistikprodukter/varmevarden-och-densiteter/

Stockholm Gas, 2012. www.stockholmgas.se/industri/

Drivkraft Sverige (drivkraftsverige.se)

2.4 Allocation of fuels for mobile combustion

This section describes the allocation and distribution of the delivered amount of fuels on subsectors.

2.4.1 Gasoline

Data on the delivered amounts of gasoline at a national level is provided by the national statistics on supply and delivery of petroleum products for 1990-2017 and data reported under the Swedish fuel quality act is used for 2018-2022 (see chapter 2.1.7).

National total delivered amounts of gasoline includes low blended ethanol and ETBE. To separate biofuel emissions from fossil fuel emissions, all ethanol used by road traffic is reported as biomass under CRF 1.A.3.b. But a small part of ETBE is considered fossil and the energy consumption and the emissions of CO_2 from the fossil part are included in the national total of CO_2.

Ethanol has been used by buses since 1990, but low blended ethanol started in 2000 and increased significantly in 2003. The gasoline sold at gas stations consisted of 95% fossil petrol and 5% ethanol until the 1'st of August 2021, when the ethanol fraction increased to 10%. The total amount of ethanol reported as biomass includes, besides low blended ethanol, the volume of ethanol used by E85 vehicles and ethanol buses.

The allocation of gasoline to different subsectors takes place in three steps and is illustrated in Figure A2-1 below.

1. In the first step, the low blended ethanol/ETBE in gasoline is subtracted from the total delivered amounts of gasoline at a national level.
2. In the next step, the gasoline consumption by domestic navigation as well as the estimated consumption by road traffic (HBEFA data) and off-road vehicles (model estimated) is subtracted.
3. The remaining volume of gasoline is proportionally distributed to civil road traffic and to off-road vehicles.

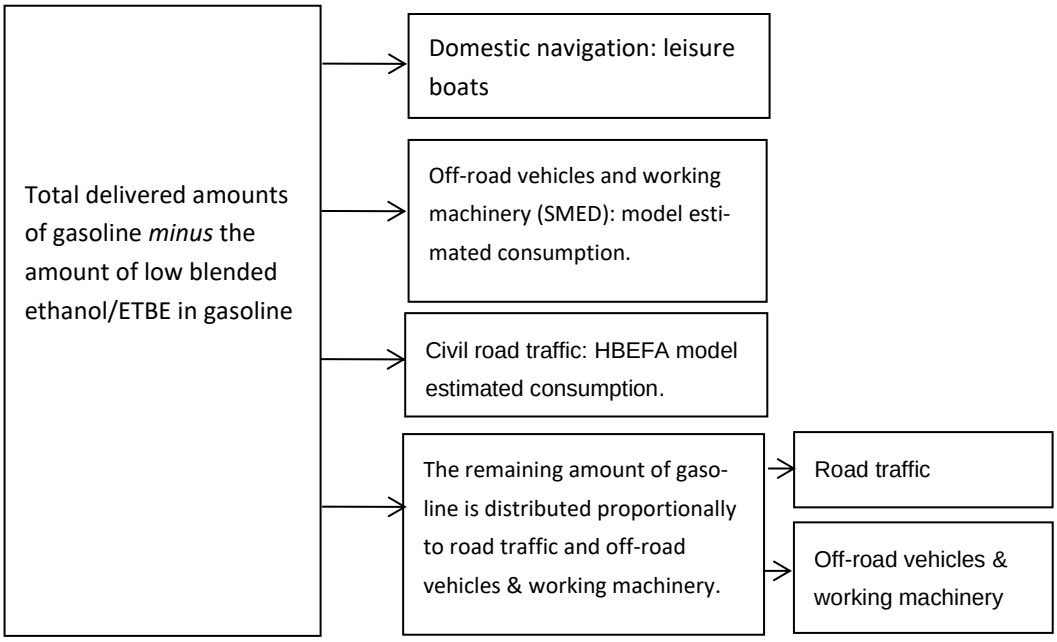

Figure A2-1. Gasoline distribution by subsector and source.

The gasoline consumption by road traffic is estimated by the European road vehicle emission model HBEFA (se chapter 2.5). The gasoline consumption by off-road vehicles (CRF 1.A.2.gvii, 1.A.3.eii, 1.A.4.aii, 1.A.4.bii and 1.A.4.cii) is estimated using a model based on a study carried out in 2008 (se chapter 2.6)[58].

The consumption of gasoline by domestic navigation is dominated by leisure boats and is based on four different surveys[59]. The last three studies have only indicated a range for the fuel consumption, which has led to separate analyzes to determine the fuel consumption [60, 61, 62]. The gasoline consumption in between the studies is estimated by interpolation based on the assessed consumption in each survey[63]. No domestic ferries or bigger ships run on gasoline.

Figure A2-2 shows a comparison between the volume of fossil and biogenic gasoline through a top-down and bottom-up approach; where the top-down approach shows the total estimated gasoline consumption for all sectors while the top-down approach shows the total deliveries of gasoline. The residual is distributed proportionally to road traffic and off-road vehicles.

[58] Fridell, Jernström & Lindgren, 2008

[59] https://www.transportstyrelsen.se/sv/sjofart/Fritidsbatar/Statistik-och-fakta--fritidsbatar/batlivsundersokningen/

[60] Gustafsson, 2005.

[61] Eklund V. 2014.

[62] Fridell, Mawdsley & Wisell. SMED Report No 9 2017.

[63] 2005-2009, 2010-2014 and 2016-2020

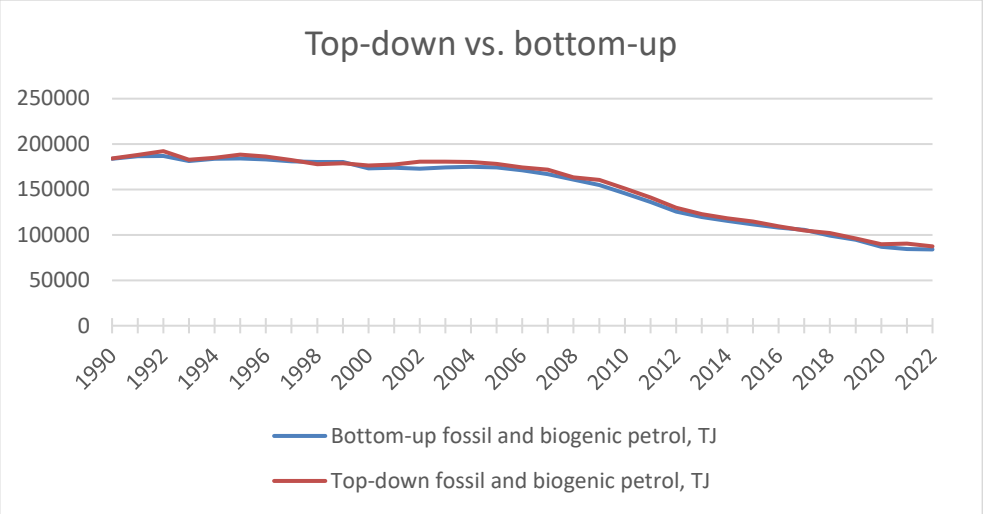

Figure A2-2. Bottom-up vs. top-down approach for petrol in submission 2024.

The approximate distribution of gasoline deliveries allocated to the civil road traffic to subsectors in 2022 is shown in Figure A2-3. Civil road traffic accounts for almost all gasoline consumption, followed by off-road vehicles and other machinery. Gasoline consumption by domestic navigation activities is relatively low.

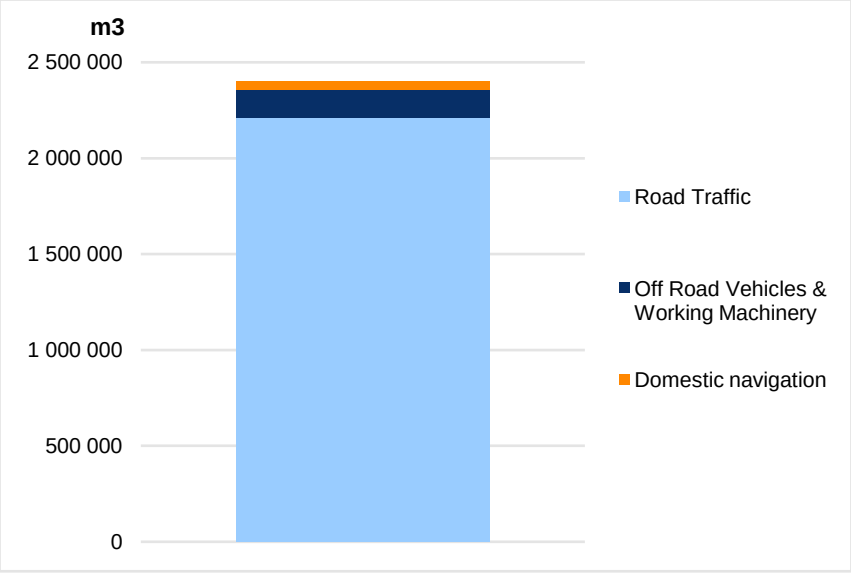

Figure A2-3. Distribution of gasoline by subsector in 2022.

2.4.2 Diesel

Data on the total amount of diesel oil delivered at a national level is provided by the statistics on supply and delivery of petroleum products[64] for 1990-2017 while

[64] Statistic Sweden. Monthly fuel, gas and inventory statistics. http://www.scb.se/en_/Finding-statistics/Statistics-by-subject-area/Energy/Energy-supply-and-use/Monthly-fuel-gas-and-inventory-statistics/

data reported under the Swedish fuel quality act is used for 2018-2022 (See section 2.1.7). The use of diesel by international bunkers is specified as discussed in IIR section 3.2.9.

The diesel for national consumption is distributed to different subsectors following a three-step process and is illustrated in figure A2.4 below.

1. *In the first step*, the diesel used for stationary combustion and the low blended FAME/HVO is subtracted from the total delivered amounts of diesel.
    - The total volume of HVO is reported as biomass under CRF 1.A.3.b, but a small part of FAME is considered fossil and the emissions of CO_2 from the fossil part of FAME is included in the national emissions of GHG.
2. In the *second* step, the diesel consumption by road traffic (model estimated (HBEFA)), off road vehicles (model estimated), railways and domestic navigation including leisure boats is subtracted.
3. *In the third and last step*, the remaining volume of diesel is proportionally distributed between road traffic and off-road vehicles. The allocation is made in proportion to the estimated consumption of diesel in each subsector. As of submission 2022, the fishing sector is no longer included in this step, since a SMED study in 2021[65] showed that the fuel used by the fishing fleet is domestic heating oil and not diesel as was previously assumed.

The consumption estimates of each subsector is based on the sources according to table A2-23.

Table A2-23. Subsectors with a diesel consumption that is subtracted in the 2'nd step.

Subsector	CRF	Estimation of amount of diesel consumed
Road traffic	1A3b	HBEFA: road emission model 4.2
Working machinery	1A2gvii, 1A3eii, 1A4aii-1A4cii	Model for off road vehicles
Railway	1A3c	Survey by the Swedish Energy Agency
Domestic navigation	1A3d	Shipair (SMHI) and a survey of fuel consumption for domestic navigation (Swedish Energy Agency).
Leisure boats	1A3d	SMED report, 2005. SMED PM, 2014. SMED Report No 9 2017

Figure A2-4 gives a brief overview of the distribution of diesel among different subsectors.

[65] Eklund, V. Kellner, M. Parsmo, R. 2021. Fiskenäringen – uppdatering av bränsleförbrukning samt emissionsfaktorer

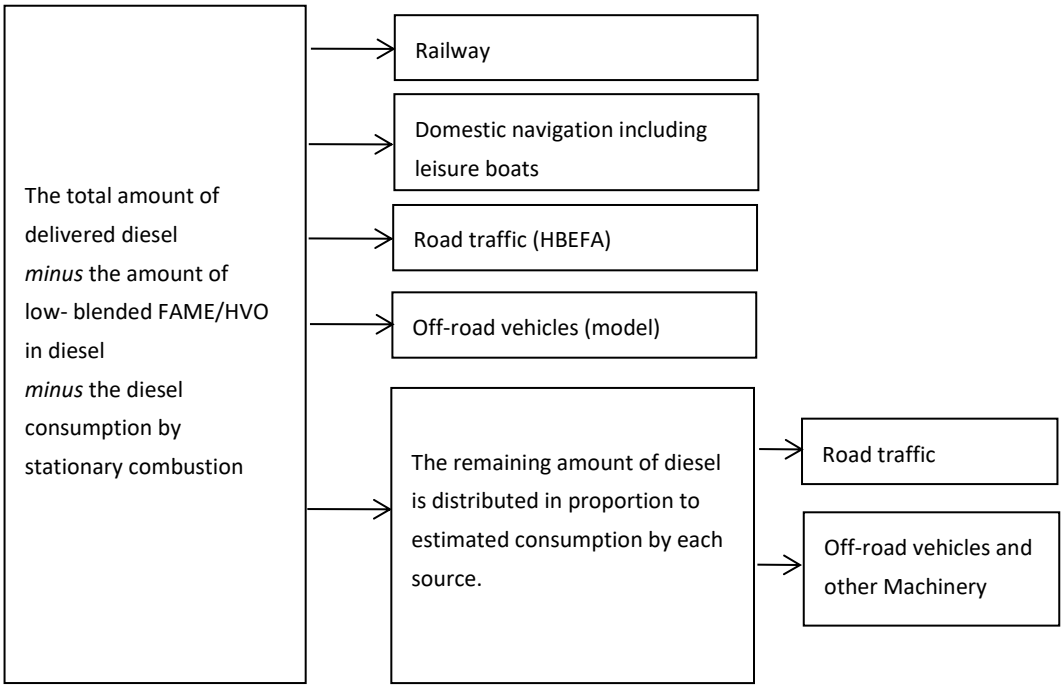

Figure A2-4. Model for allocating the total amount of delivered diesel on subsectors.

Just as for petrol, Figure A2-5 shows a comparison between the volume of fossil and biogenic diesel oil through a top-down and a bottom-up approach; where the top-down approach shows the total estimated diesel consumption of diesel by all sectors while the top-down approach shows the total deliveries of diesel. The is distributed proportionally to road traffic and off-road vehicles. The discrepancy between the bottom-up approach and the top-down approach is bigger for diesel oil than for petrol.

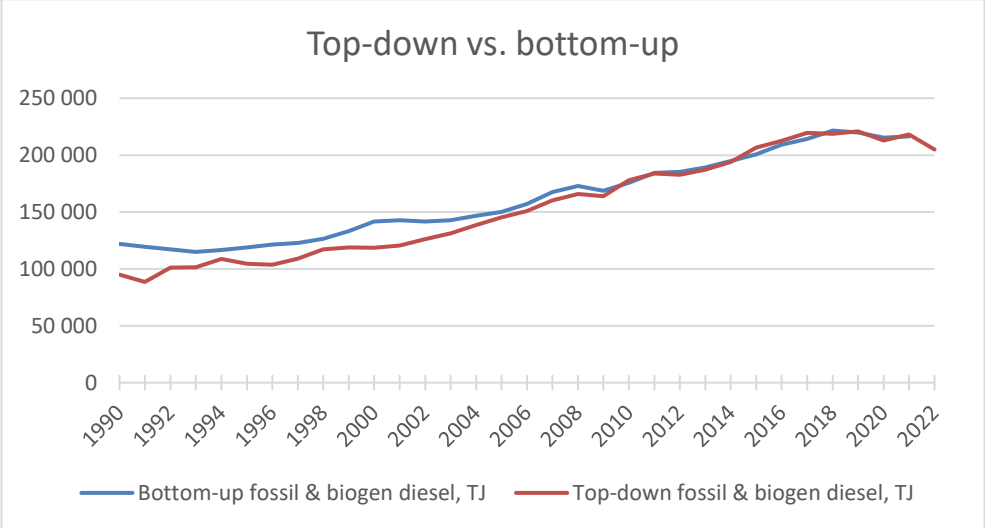

Figure A2-5. Bottom-up vs. top-down approach for diesel in submission 2024.

The diesel consumption by off-road vehicles and other machinery is estimated by a model, which is based on a SMED study from 2008[66], and was implemented in submission 2009. The model has been updated with new data and improved by each submission. See section 2.6 for more information.

Before submission 2020, the estimate for diesel consumption from domestic navigation[67] (also called marine diesel oil) was provided by the statistics on supply and delivery of petroleum products[68]. As from submission 2020, the energy consumption from domestic navigation is based on a model called Shipair, developed by the Swedish meteorological and hydrological institute (SMHI), and information collected from the largest shipping actors for domestic navigation[69]. See section 2.4.3 below for more information.

The consumption of diesel by recreational boats is based on four different surveys[70]. The last three studies have only indicated different ranges for fuel consumption, which has led to separate analyzes to determine the fuel consumption [71, 72, 73]. The consumption of diesel in between the studies was estimated by interpolation based on the assessed consumption in each survey[74].

Figure A2-6 shows the approximate distribution of the delivered amount of fossil diesel oil in 2022. As for gasoline, diesel from civil road traffic accounts for most of the consumption. However, diesel from off-road vehicles and other machinery also contributes to a considerable amount (21%) of the total consumption.

[66] Fridell, Jernström & Lindgren 2008

[67] Except for leisure boats.

[68] Statistic Sweden. Monthly fuel, gas and inventory statistics. http://www.scb.se/sv_/Hitta-statistik/Statistik-efter-amne/Energi/Tillforsel-och-anvandning-av-energi/Manatlig-bransle--gas--och-lagerstatistik/

[69] Eklund, V. et al. 2019. Analys och implementering av data från nya MåBra.

[70] https://www.transportstyrelsen.se/sv/sjofart/Fritidsbatar/Statistik-och-fakta--fritidsbatar/batlivsundersokningen/

[71] Gustafsson, 2005.

[72] Eklund V. 2014.

[73] Fridell, Mawdsley & Wisell. SMED Report No 9 2017.

[74] 2005–2009, 2010–2014 and 2016–2020

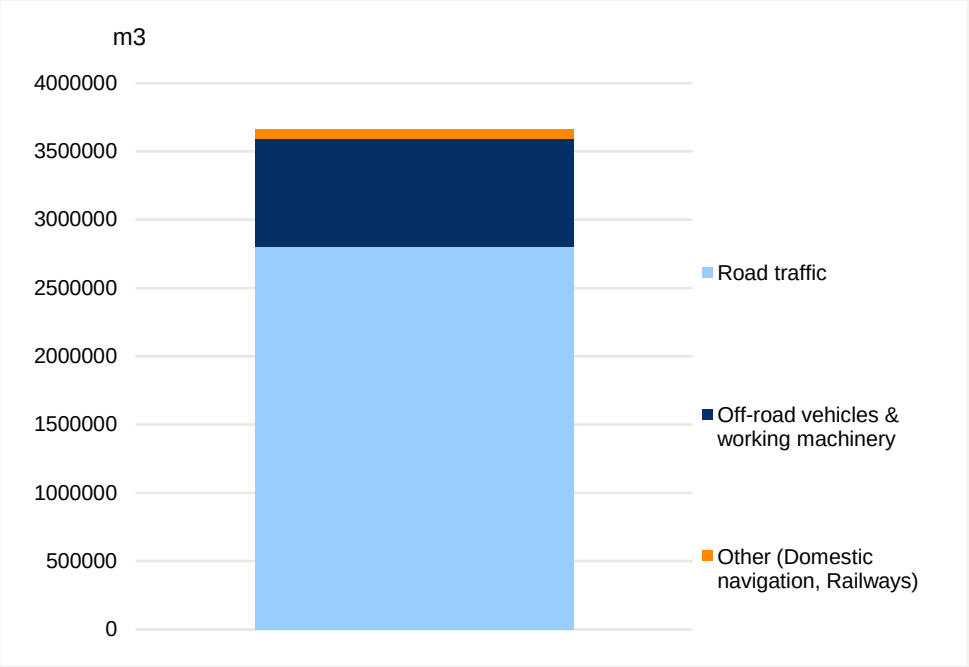

Figure A2-6. Distribution of diesel oil by subsector in 2022.

2.4.2.1 ENVIRONMENTAL CLASSES OF DIESEL OIL

Diesel oil is refined into three categories, so called environmental classes 1-3. These have been gradually introduced from 1991. Today, environmental class 1 diesel accounts for about 99 % of the total delivered amount of diesel. The shift in consumption of diesels of different environmental classes has a significant impact on the emissions.

Table A2-24 shows the characteristics for environmental class 1-3 regarding thermal values. Information on the diesel distribution on environmental classes has been collected from the Swedish National Road Administration for the years 1990-1993 and from Statistics Sweden for 1994 and later years. Drivkraft Sverige (formerly known as The Swedish Petroleum and Biofuel Institute, SPBI) have assisted with information regarding thermal values[75]. SMED has calculated yearly averages of thermal values and emission factors.

Information on the diesel distribution on environmental classes has been collected from the former Swedish National Road Administration for the years 1990-1993 and from Statistics Sweden for 1994 and later years. Drivkraft Sverige has assisted with information regarding NCVs and emission factors for CO_2[76]. SMED has calculated yearly averages of NCVs and emission factors.

[75] https://drivkraftsverige.se/

[76] https://drivkraftsverige.se/

Table A2-24. Impact from different environmental class diesel on NCV and emission factors for CO_2.

Diesel	NCV (GJ/m^3)	Emission factor CO_2 (t/TJ)	Weight 1990 (%)	Weight 2000 (%)	Weight 2013 (%)
Environmental class 1	35.28	72.2	0	94	99
Environmental class 2	35.28	72.2	0	0	0
Environmental class 3	35.82	72.2	100	6	1
Average 1990	35.82	72.2			
Average 2000	35.31	72.2			
Average 2010	35.28	72.2			
Average 2018	35.28	72.2			
Average 2020	35.28	72.2			

2.4.3 Marine distillate fuel

Marine distillate fuel is a group name covering diesel oil used for navigation and marine gasoil. Emissions from these fuels are reported as gas/diesel oil in the NFR. The source for the activity data (AD) used for national navigation changed in submission 2020. In previous submissions, the AD was based on the monthly survey on supply and delivery of petroleum products[77]. As from submission 2020, the energy consumption by domestic shipping is mainly based on a methodology called Shipair, which was developed by the Swedish meteorological and hydrological institute (SMHI). The Shipair model collects data from AIS (Automatic Identification System), which ships use to continuously transmit identity and position information. The AIS data shows how the ships move between Swedish ports. Information regarding the ships, such as size, engine power and type of vessel is also collected. This enables the Shipair model to estimate the amount of energy needed for the ships to move and the amount of fuel consumed.

Beside the Shipair model, the energy consumption from domestic navigation is based on information collected from the largest shipping actors for national navigation, with the exception for cargo ships.[78] Information regarding the fuel consumption, by fuel type, is collected as Shipair only estimate the energy consumption. Shipair does not know which fuel types are used. The difference between the energy consumption estimated by Shipair and the survey, is assumed to be the energy consumption by cargo ships

The diesel consumption by leisure boats is based on four different surveys regarding leisure boats from 2004, 2010, 2015 and 2021[79] and three different studies by

[77] Statistic Sweden. Monthly fuel, gas and inventory statistics. See annex 2 for more information regarding different surveys.

[78] Eklund, V. et al. 2019. Analys och implementering av data från nya MåBra.

[79] Statistics Sweden, 2005. Transportsstyrelsen. 2010. Transportstyrelsen 2015.

SMED[80]. Marine diesel oil for domestic navigation is discussed under the diesel section, 2.4.2. The statistics on marine distillate fuels are reported separately for domestic and international navigation and the split is based on the information provided by the respondents to the survey on supply and delivery of petroleum products.

The estimated fuel consumption by the Swedish fishing fleet in 2005, is based on a survey to the fishing industry carried out by Statistics Sweden[81]. The estimated fuel consumption for 2005 serves as a reference year. The fuel consumption in 1995-2004 and 2006-2022 are adjusted relative to the total installed effect for each year. Information of the Swedish fishing fleet's installed effect is provided by the Swedish Agency for Marine and Water Management (SwAM). The installed effect is available from 1995 and for the years prior to 1995, it is estimated through extrapolation.

The amount of marine distillate fuel used for domestic navigation and leisure boats (CRF 1.A.3.d) is shown in figure A2.7. The stricter rules regarding the sulphur content in marine fuels, which took effect in January 2015, led to a shift from heavy oil fuel oil to lighter oil products with a lower sulphur content in 2015. But in 2018 there was a shift to heavy marine oils again but with a reduced sulphur content, so called "hybrid oils" and LNG. This can be seen in Figures A2-7 and A2-8.

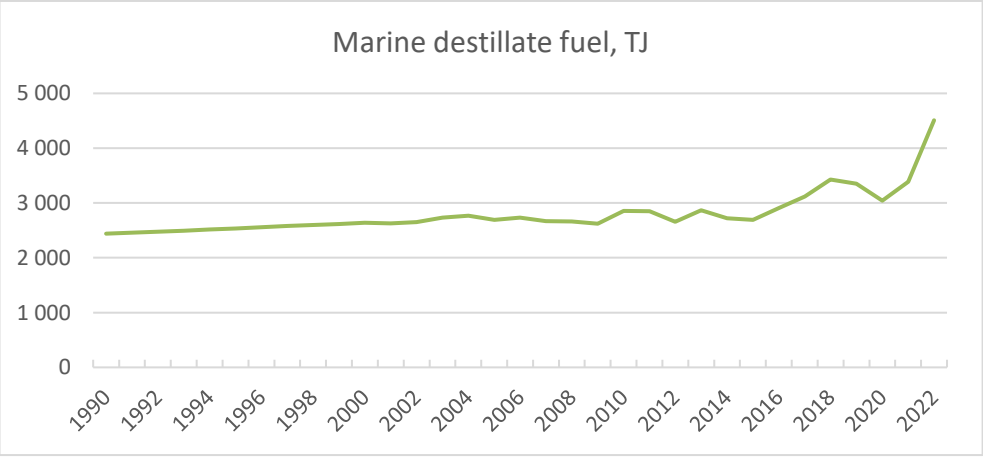

Figure A2-7. Total consumption of diesel and marine gasoil used by domestic navigation (marine distillate fuel) 1990-2022.

[80] Gustafsson, T. 2005. Eklund, V. 2014. Fridell, E., Mawdsley, I., Wisell T. 2017

[81] Statistics Sweden 2006

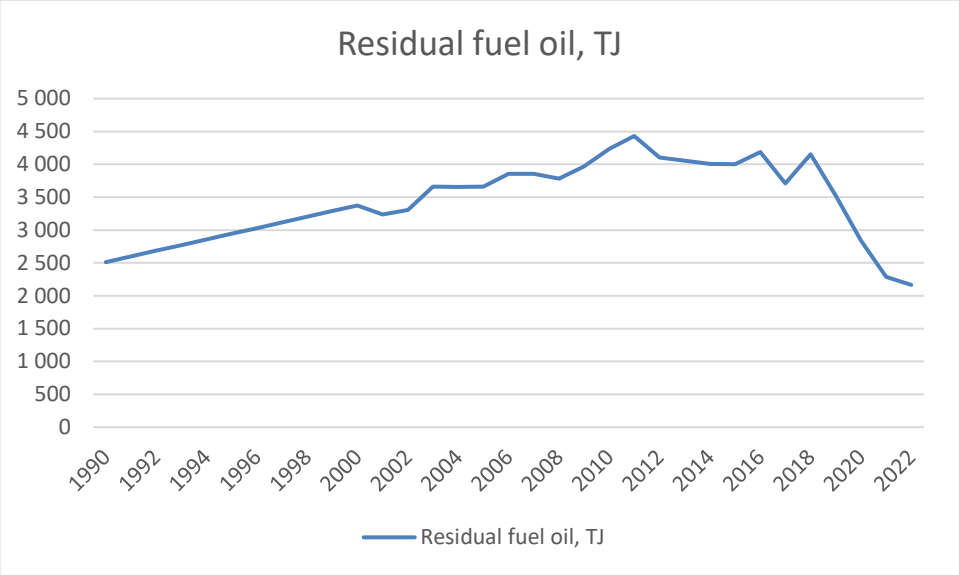

Figure A2-8. Consumption of marine Residual fuel TJ by domestic navigation for 1990-2022.

2.4.4 Residual fuel oils

As from submission 2020, the energy consumption from domestic shipping is mainly based on a methodology called Shipair and the fuel consumption by fuel type collected from the largest shipping actors for national navigation, with the exception for cargo ships.[82] See section 2.4.3 and figure A2.8 above for more information.

2.4.5 Jet kerosene, jet gasoline and aviation gasoline

All jet kerosene, jet gasoline and aviation gasoline are assumed to be used for aviation. Delivered amounts of these fuels are provided at national level by the statistics on supply and delivery of petroleum products (see section 2.1.7).

2.4.6 Natural Gas and biofuels

Other fuels used for transport are ethanol, FAME, HVO, natural gas, liquid natural gas (LNG) and biogas. Ethanol and FAME/HVO are partly used as admixtures in gasoline and diesel, and partly used in more pure forms in bi-fuel vehicles. Information on delivered amounts of ethanol and FAME/HVO are provided at national level by the statistics on supply and delivery of petroleum products. Data on delivered amount of natural gas for transport is provided by the statistics on the delivery

[82] Eklund, V. et al. 2019. Analys och implementering av data från nya MåBra.

of gas products (see above). The LNG data is based on a survey[83],[84],[85],[86], which was performed in 2020, 2021 and 2022, aiming to map the consumption of LNG by both national and international navigation. Data on the consumption of biogas from 1996 is provided by the Swedish Biogas Association. Data for 1990-1995 is not available.

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[83] Eklund, et al. 2021. Sjöfartens förbrukning av LNG 2020

[84] Eklund, et al. 2020. Sjöfartens förbrukning av LNG.

[85] Eklund, V. & Kellner, M. 2022. Sjöfartens förbrukning av LNG 2021

[86] Eklund, V. & Kellner, M. 2023. Sjöfartens förbrukning av LNG 2022

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Transportsstyrelsen, 2010. Båtlivsundersökningen 2010 (Swedish leisure boat survey 2010).

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2.5 The HBEFA road model

The HBEFA (Handbook of Emissions Factors) emission model builds on the former ARTEMIS road model (used from submission 2006 to submission 2011). To a large extent, the two models are principally the same, since the HBEFA road model was developed from a merging of the ARTEMIS road model and the former version of HBEFA. 2.1. Since then the model has undergone many updates and the most recent version named 4.2[87] was used for the first time in submission 2023.

HBEFA provides emission factors and calculates emissions for segments and sub-segments of six main vehicle categories - passenger cars (PC), light commercial vehicles (LCV), heavy goods vehicles (HGV), urban busses, coaches, and motorcycles including mopeds (MC). Segments are defined as groups of vehicles of similar size (e.g. light commercial vehicles with kerb weight less than 1305 kg and rigid trucks with weight between 14 and 20 tonnes) which are using the same type of fuel/technology (petrol, diesel, CNG/petrol, LNG, electricity, etc.), whereas sub-segments are defined as groups of vehicles of similar size, fuel/technology and emission concept (e.g. pre-Euro, Euro 1, 2, 3, etc.).

HBEFA calculates emissions separated into hot emissions, cold start emissions and evaporative emissions. An overview of the model structure with input and output parameters is given by Figure A2.9. The hot emission factors are calculated with the PHEM model[88] and are representative for typical European driving conditions.

[87] Infras, 2022

[88] FVT, 2022

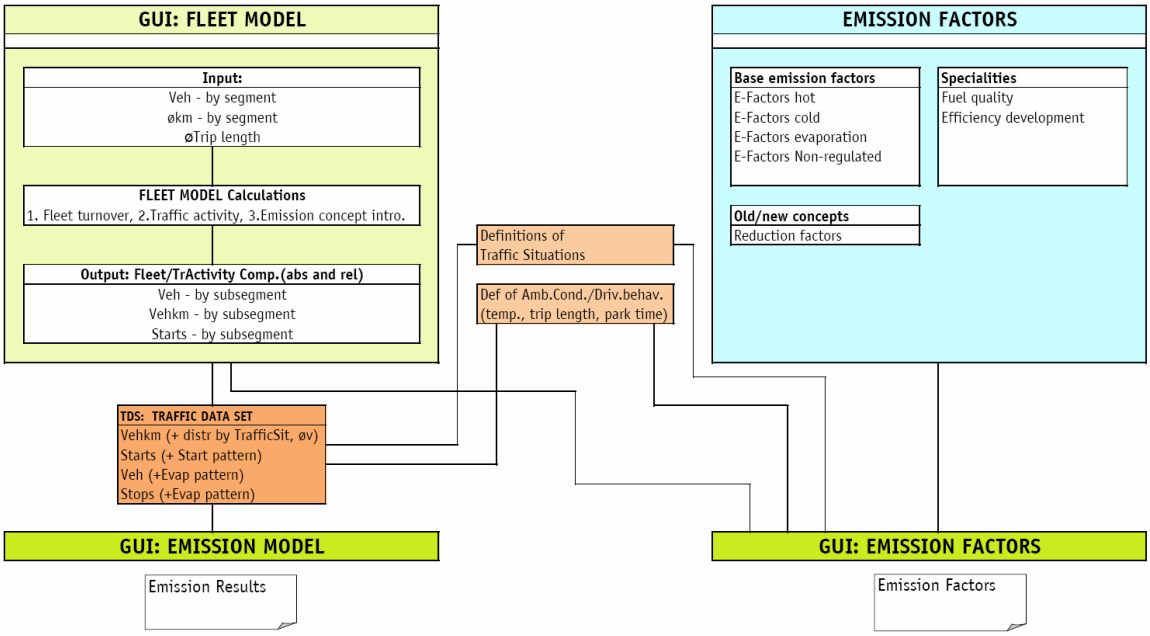

Figure A2.9. HBEFA model structure.

2.5.1 National fleet data

The Swedish vehicle fleet is in HBEFA described by means of the number of vehicles on segment level and age distributions on segment level derived from the Swedish national vehicle register.

For buses HBEFA distinguishes between two types of buses: urban buses, mainly used for urban driving, and coaches, mainly used for rural and motorway driving. Over the years different methods have been used to determine which HBEFA category each bus registered in Sweden should belong to. In the current method buses classified as Class I, Class II or Class A in the national register is considered to be Urban buses in HBEFA and Class III and class B buses are considered to be coaches.

Trucks are in HBEFA split into two main categories 1) rigid trucks and 2) articulated trucks/trucks with trailers. Since there is no information in the Swedish vehicle register on the use of trailers this is described by means of so called vehicle transformation patterns in HBEFA. A transformation pattern defines the mileage distributions for each weight class, with and without trailer, respectively. The truck category "with trailer" is split further into different sizes of trailers expressed as the maximum permissible (i.e. weight range, e.g. 20-28 tonne) of the truck and trailer combination. The transformation patterns for Sweden were derived from traffic measurements on Swedish roads. Vehicle fleet data is shown in Figure A2.10.

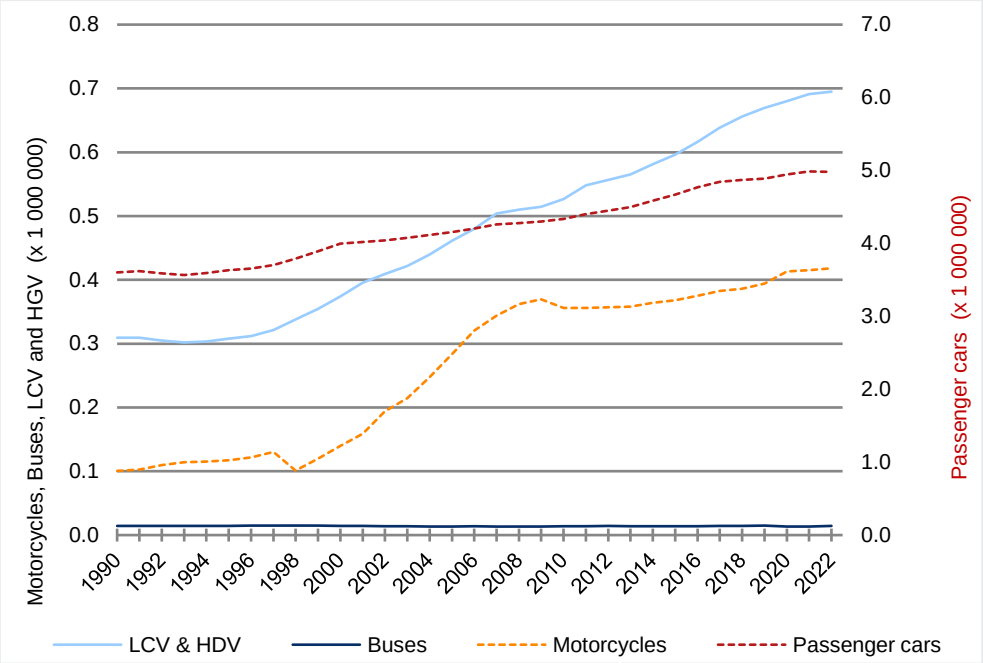

Figure A2-10. Vehicle fleet data by December 31, numbers, 1990-2022 according to the car register available at Statistics Sweden.

2.5.2 Traffic activity data

2.5.2.1 VEHICLE MILEAGES, LOADS, TRIP LENGTHS AND FUELS

The HBEFA model requires annual average vehicle kilometers travelled per vehicle category (Figure A2.11). The source used for this data later years is the official statistics on Vehicle mileage for Swedish registered vehicles[89]. This statistic gives the total vehicle kilometers travelled in Sweden per vehicle category. For trucks the data takes into account the kilometers driven with foreign trucks in Sweden and the kilometers driven abroad with trucks registered in Sweden. For the other vehicle categories it is assumed that the total number of kilometers driven abroad by Swedish vehicles is the same as the total kilometers driven by foreign vehicles in Sweden, and thus these driving distances are considered to cancel each other out.

HBEFA also required average annual driving distances per vehicle segments which is used to distribute the total vehicle kilometers travelled on the different segments. To do this, data on annual milage on a vehicle level is used. This data is provided by Trafikanalys and is based on yearly odometer readings within the Swedish inspection & maintenance (I/M) program[90]. This data is used for deriving both mileage per vehicle segment, and mileage as a function of vehicle age.

[89] Trafikanalys, 2022

[90] Trafikanalys, 2011

For heavy duty vehicles, HBEFA requires a distributions of load between empty (0% load), half-load (50% load), and fully loaded (100% load) vehicles by segment and age. This data was derived from a major national survey on Swedish domestic road goods transport[91].

In order to estimate evaporative and cold start emissions, information on distributions of trip lengths and parking times, and on the seasonal and diurnal variation of ambient temperature is needed. Trip lengths and parking times can be derived from surveys, or from data from instrumented cars. For Sweden, an average trip length according to surveys is 12 km, and according to instrumented cars 7 km[92]. Instrumented cars provide the trip length from engine start to engine stop. Even if instrumented car data just represents a few vehicles and use in few families, this data set has been considered more representative than the survey data, since the information requested is the distance travelled from engine start to engine stop[93]. Thus, available instrumented vehicle data was used to estimate trip lengths and parking times in Sweden.

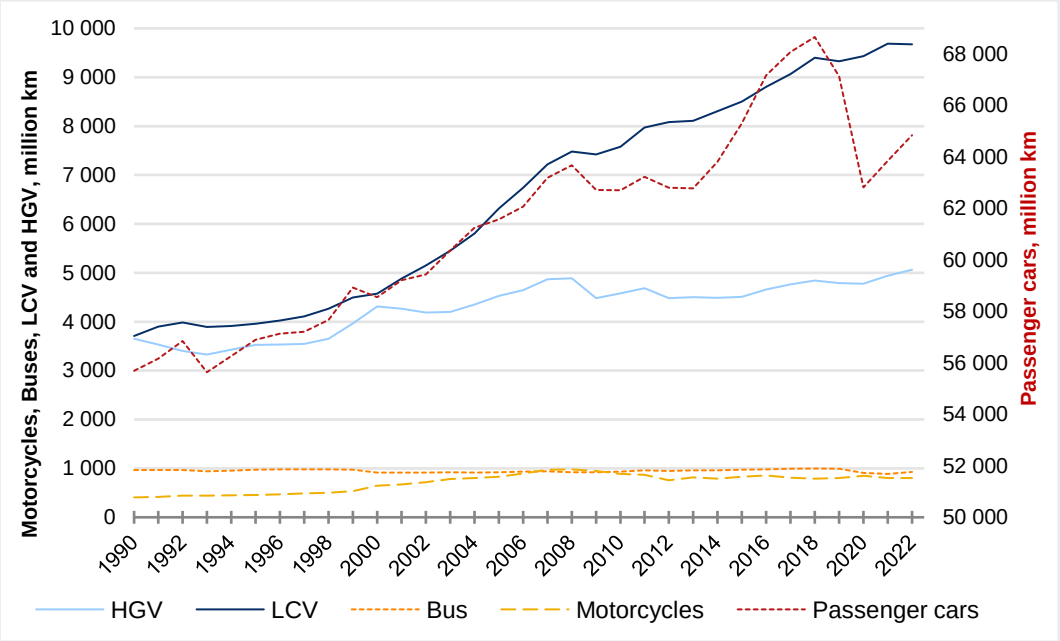

Figure A2-11. Vehicle mileages 1990-2022 according to HBEFA 4.2.

2.5.2.2 TRAFFIC SITUATIONS

The HBEFA model includes 369 traffic situations, i.e. combinations of road type, speed limit, area (rural and urban) and level of service. The level of service

[91] Hammarström and Yahya, 2000

[92] SNRA 1999

[93] André et al., 1999

describes how disturbed the traffic is relative to undisturbed traffic and there are five different levels - 1) Free Flow, 2) Heavy Traffic, 3) Saturated 4) Stop and Go and 5) Heavy Stop and Go conditions (see Table A2-25). Furthermore, different level of road grade can be attributed to each traffic situation.

Table A2-25. Definition of the five classes of traffic conditions.

Class	Definition
Freeflow	Free flowing conditions, low and steady traffic flow. Constant and quite high speed. Indicative speeds: 90-120 km/h on motorways, 45-60 km/h on a road with speed limit of 50 km/h. LOS A-B according to HCM.
Heavy	Free flow conditions with heavy traffic, fairly constant speed. Indicative speeds: 70-90 km/h on motorways, 30-45 km/h on a road with a speed limit of 50 km/h. LOS C-D according to HCM.
Saturated	Unsteady flow, saturated traffic. Variable intermediate speeds, with possible stops. Indicative speeds: 30-70 km/h on motorways, 15-30 km/h on a road with speed limit of 50 km/h. LOS E according to HCM.
Stop + go	Stop and go. Congested flow, stop and go or gridlock. Variable and low speed and stops. Indicative speeds: 30-70 km/h on motorways, 15-30 km/h on a road with speed limit of 50 km/h. LOS E according to HCM.
Heavy stop+go	Heavily congested flow. Average speed range from 5.5 km/h to 7.2 km/h

Distributions of total vehicle kilometers travelled over the traffic situations have been produced for periods of two or three years since 1990. The method has changes slightly over the years and the work has been documented in reports available in Swedish. The most recent report describes the process used for producing a distribution for 2021[94].

Of all traffic situations in HBEFA, 200 were considered in Sweden 2021. In those traffic situations 62 different road categories were represented, for which the traffic condition "Free Flow" was predominant. In fact, as much as 96.7% of the overall vehicle kilometers travelled by passenger cars was characterised by free flow conditions. In Table A2-26 the ten most abundant HBEFA traffic situations for passenger cars are presented. 65% of the vehicle kilometers travelled with passenger cars in 2021 was allocated to 0% road gradient and 28% to ± 2% road gradient.

Table A2-26. The ten most common traffic situations in Sweden in 2021, and their share of the total vehicle mileage for passenger cars.

Description of traffic situations	Share of national vehicle kilometers travelled Vehicle mileage
Rural / Motorway / 110 / Freeflow / 0%	8.8%
Rural / Trunk / 70 / Freeflow / 0%	7.2%

[94] Ericsson et al (2022)

Rural / Trunk / 100 / Freeflow / 0%	6.3%
Rural / Trunk / 80 / Freeflow / 0%	5.7%
Rural / Trunk / 80 / Freeflow / ± 2%	4.3%
URB / Access / 40 / Freeflow / 0%	4.1%
Rural / Trunk / 70 / Freeflow / ± 2%	3.8%
Rural / Motorway / 120 / Freeflow / 0%	2.7%
Rural / Motorway / 110 / Freeflow / ± 2%	2.6%
Rural / Trunk / 100 / Freeflow / ± 2%	2.3%
Total	**47.9%**

2.5.3 Most recent updates

In submission 2023 HBEFA 4.2 was used for the first time. That version includes some updates that are listed in Table A2-27:

Table A2-27. Overview of input updates in HBEFA 4.2

Update	Remarks
New hot emission factors for Euro-VI heavy duty vehicles	Differentiated by steps A-C vs. D-E
New deterioration functions for heavy duty vehicles	Based on remote sensing data; new speed-dependent input format due to SCR behaviour of HDV
New deterioration functions for NO2/NOx ratios	Accounting for lower NO2 shares in NOx for aged catalysts
Additional software updates of Diesel PC	The model now also accounts for Software-updated Diesel Euro-5 passenger cars other than vehicles with the EA189 engine and also for Euro-6ab
Energy use for battery passenger cars	Accounting for PHEM model updates
Real-world energy consumption of electric vehicles	Integration of TA electricity consumption of BEV from EEA CO2 monitoring DB, real-world electricity consumption of BEVs and fuel consumption of PHEVs from Spritmonitor, and PHEV utility factors based on ICCT White Paper (Plötz et al. 2020)
Update of cumulative mileage methodology	Transformation of registered tractors to tractor-trailor combinations is now reflected in cumulative mileage; mileage-weighted averages by subsegment and reference year; cumulative mileage also calculated for fleet sub-scenarios that do not include vehicle stock
Emission factors for vehicles using alternative fuels	Emission factors changes to the following subsegments ▪ passenger cars CNG/Petrol Euro 2-3 ▪ passenger cars LPG/Petrol all Euro 2-6

Update	Remarks
	▪ passenger cars FFV Euro 4-6 ▪ Light commercial vehicles CNG/Petrol and LNG/Petrol Euro 6 ▪ Urban bus CNG Euro II-IV and LNG Euro IV-VI ▪ Urban bus Ethanol Euro II-VI

2.5.4 References

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SNRA (1999) Initial study of driving patterns and exhaust emissions in urban areas and development of a method in order to measure changes in acceleration and speed around road junctions. Driving behaviour 1998. SNRA Publication 1999:137.

Trafikanalys, 2011. Reviderad modell för beräkning av körsträckor – nya data för vägtrafiken 1999-2009. PM 2011:4

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2.6 Methodology for off-road vehicles and working machinery

Fuel consumption and emissions from working machinery are estimated with a model developed by SMED in 2008. The model is considered to correspond to Tier 3. Working machinery in this context means mobile machinery with a combustion engine that is not used on roads, waterways or railways. Included are e.g. construction machinery, hand held garden machines and snow mobiles.

Emissions and fuel consumption are calculated in the model with the equations below:[95]

$$E = N \times Hr \times P \times Lf \times EF_{adj} \quad (1)$$

- E = Emissions in Gg
- N = number of vehicles,
- Hr = yearly running time in hours,
- P = engine power in kW,
- Lf = load factor, and
- EF_{adj} =adjusted emission factors in g kWh^{-1} according to equation below (applied for larger off-road vehicles and snow scooters).

$$EF_{adj} = EF_l \times CAF \times TAF \times DF \times FAF \quad (2)$$

- EF_l = emission regulations according to EU legislation in g kWh^{-1},
- CAF = adjustment factor for difference between regulation and value measured at certification,
- TAF = adjustment factor for transient (i.e. difference between static test cycle and real use of the machine),
- DF = adjustment factor for decline of the motor by increasing age, and
- FAF = adjustment factor for difference between certification fuel and Swedish diesel of type "MK1".

All variables in the equations are described as vectors with data for every model year the last 25 years.

2.6.1 Emission factors

Emissions of SO_2 are estimated using the same emission factors as for diesel and gasoline used for road traffic and are considered to correspond to Tier 2. The emission factors for SO_2 are adjusted according to fuel specifications for each year.

Emission factors for diesel and gasoline machinery are taken from EMEP/EEA Guidebook 2016. An exception is emission factors for snow mobiles that are taken from Winther and Nielsen 2006.[96] except the emission factors for hydrocarbons, carbon monoxide and particles which are taken from USEPA (2005). Fuel

[95] Fridell, Jernström and Lindgren, 2008

[96] Winther, M., Nielsen, O.-K., 2006.

consumption for snowmobiles were updated to submission 2020 as described in section 2.6.5.

2.6.2 Vehicle Stocks

The number of diesel machinery 37 – 560 kW of different types is mainly based on a bottom-up inventory for the year 2006. [97] In submission 2014 the model was updated[98] with new information about number of machines for some of the diesel vehicles in the range of 37 kW – 560 kW. In this update also improved estimates of vehicle lifetime were obtained from the new data and are now used in the model. In submission 2018 the model was updated with sales data for some off-road vehicles for 2005-2016. The sales data was provided by the Swedish trade association for suppliers of mobile machines.[99] Sales data is from submission 2019 and onwards used annually for updating the model with number of new machineries.

The number of tractors per sector, model year and engine power interval are for most of the years taken from Statistics Sweden's registers. For some years where statistical data is not available, numbers are interpolated (the proportions of different vehicle types are assumed to be constant).

The total number of machines >560 kW for earlier years is taken from an IVL study conducted on behalf of the Swedish Transport Agency[100]. The total number of machines < 37 kW are based on a bottom-up inventory for the year 2002[101]. Number of machines for other years are estimated on e.g. sales data provided by the Swedish trade association for suppliers of garden machinery, estimates of lifetime or set as unchanged from 2002. Different methods are used for different types of machines.

The number of snow mobiles and all-terrain vehicles (ATVs) is taken from Statistics Sweden's register for each year.

2.6.3 Other parameters

Yearly running time, engine power and the load factor in equation (1) above are taken from Wetterberg[102] and Flodström[103]. Load factors for some of the machines are from an IVL study made in 2015[104]. The fuel adjustment factor, FAF, and the certification adjustment factor, CAF, for larger vehicles in equation (2) are taken

[97] Wetterberg C, Magnusson R, Lindgren M, Åström S. 2007.

[98] Jerksjö, M. 2013.

[99] Eklund, V., Lidén, M., Jerksjö, M., 2017.

[100] Transportstyrelsen 2014

[101] Flodström, E., Sjödin, Å., Gustafsson, T. 2004.

[102] Wetterberg C, Magnusson R, Lindgren M, Åström S. 2007.

[103] Flodström, E., Sjödin, Å., Gustafsson, T. 2004.

[104] Jerksjö, M., Fridell, E., Wisell, T. 2015

from Lindgren (2007).[105] The TAF and DF factors are taken from EMEP/EEA Guidebook 2016.

2.6.4 Allocation to NFR-sectors

Allocation of emissions from working machinery is mainly based on a report by Flodström et al[106]. This is the most recent Swedish inventory including an allocation of working machinery to the different NFR-sectors. There have also been some changes of the allocation proposed in Flodström et. al. Most of these changes have been done by expert judgements in cases where the allocation did not seem to be accurate. Emissions from tractors are allocated to the sector where the machines are used due to the national vehicle register.

Table A2-28 shows emissions of NO_X, CO, $PM_{2.5}$ and NMVOC from all working machinery in 2022, split by sector and fuel type.

Table A2-28. Emissions of NO_X, CO, $PM_{2.5}$ and NMVOC from working machinery 2022.

NFR code	Category	Fuel type	NO_X (Gg)	CO (Gg)	$PM_{2.5}$ (Gg)	NMVOC (Gg)
1A2g vii	Industry	Diesel	4.6	5.6	0.3	0.8
1A4a ii	Commercial/institutional	Diesel	1.0	0.7	0.1	0.2
1A4b ii	Residential	Diesel	0.2	0.2	0.03	0.1
1A4c ii	Agriculture	Diesel	1.4	0.9	0.1	0.2
1A4c ii	Forestry	Diesel	0.7	0.8	0.05	0.1
1A2g vii	Industry	Gasoline	0.05	5.6	0.01	0.3
1A4a ii	Commercial/institutional	Gasoline	0.1	22	0.04	0.8
1A4b ii	Residential	Gasoline	0.9	37.2	0.1	3.3
1A4c ii	Agriculture	Gasoline	0.3	5.2	0.02	0.9
1A4c ii	Forestry	Gasoline	0.03	9.0	0.04	1.6
1A3e ii	Other Transport	Diesel + Gasoline	1.4	0.8	0.03	0.1
Total	**Total**	**Total**	**10.7**	**88**	**0.8**	**8.4**

2.6.5 Most recent updates

In submission 2020, the model was updated according to the EMEP/EEA Guidebook 2016. Fuel consumption factors and emission factors for CO, NMVOC, NOx, TSP, PM_{10}, $PM_{2.5}$ and BC for both diesel and gasoline engines have been updated with respect to engine power and emission standards. Moreover, the transient operation adjustment factors (TAF) for diesel engines with emission standard up to EURO IIIA as well as deterioration factors (DF) have been updated, as new

[105] Lindgren M. 2007.

[106] Flodström, E., Sjödin, Å., Gustafsson, T. 2004.

information was provided in EMEP/EEA Guidebook 2016. In addition to the changes due to the updates in EMEP/EEA Guidebook 2016, the NMVOC emissions from gasoline evaporation have been included in the emission calculations.

Moreover, fuel consumption factors (in g/kWh) for 4-stroke snow mobiles and all-terrain vehicles as well as modern 2-stroke engines were updated in submission 2020. Also load factors for these machine types were updated. Both types of factors were adjusted partly to data used in Finland's national emission inventory but also to fuel consumption in l/km during real world driving conditions presented by the Swedish snowmobile magazine "Snöskoter". The magazine has done measurements on different snowmobile models during a period of several years.
In submission 2022, emission calculations for machinery >560kW and lawn mowers were improved.

The amount of mining trucks and excavators >560kW was revised based on direct information from mining companies and resellers of mining machinery. While adjusting the number of those machines in operation, it was made sure that especially the number of machines fulfilling the stage V emission standards[107] is in accordance with information obtained from the industry. Furthermore, the average lifetime for those machines was halved from twenty to ten years and annual operation hours were decreased from 6750 to 5700 hours.

The emission factors for NO_x, CO, NMVOC and particles for all machinery >560kW was updated in accordance with information from the industry that all machinery in operation is fulfilling US EPA tier 1 emission standards[108]. Additionally, all machinery >560kW delivered to the market from January 1st, 2019 on is assumed to fulfil the European stage V emission standards.

In submission 2023, snow scooters and all-terrain vehicles have been separated into two different machine types in the model. Sweden has tried to obtain more precise information on e.g. annual operation hours and lifetime for both machine types but no reliable data was obtained so far. Therefore, all parameters for all-terrain vehicles are set to be equal to snow mobiles with the exception that all-terrain vehicles are assumed to run on 4-stroke engines only.

In submission 2024 the A-tractor car, a modified regular car registered as a tractor with certain operation constraints (modified power train and maximum speed of 30 km/h), was until submission 2024 part of the tractor segment within the national non-road mobile machine model. During submission 2024 these machines were moved to 1.A.3.b. Statistics Sweden also reviewed the tractor fleet throughout the time series which led to changes in the number of tractors included in the model. Moreover, all-terrain vehicles (ATV) registered as tractors were moved from the

[107] EU Regulation 2016/1628 of the European Parliament and of the Council

[108] 40 CFR 89.112 2013

machine segment Tractors to the machine segment ATV which resulted in fewer diesel tractors in operation and a larger number of gasoline driven all-terrain vehicles in operation.

2.6.6 References

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Winther, M., Nielsen, O.-K., 2006. Fuel use and emissions from non-road machinery in Denmark from 1985-2004 - and projections from 2005-2030. Danish Ministry of the Environment project 1092, 2006.

3 Annex 3: Other detailed methodological descriptions for individual sources

Annex 3.1. Methodological issues for emissions from solvent use (in NFR sector 2D3)

In 2016, Swedish Environmental Emissions Data (SMED) in cooperation with the Swedish Chemicals Agency (Skårman et al., 2016[109]), has further developed the calculation model for estimating the national emissions of NMVOC and CO_2 from use of solvents in Sweden. The model has been revised in order to meet international reporting requirements according to CLRTAP and UNFCCC as well as to support national needs. The model makes it possible to test different sets of emission factors within the solvent use sector. This function can be used to assess different actions and emission reduction potentials. Furthermore, the model can generate emissions per user category and product group. This information can be used when following-up the Swedish environmental quality objectives.

The calculation model is consumption-based with a product-related approach. Amounts of NMVOC and C in solvents and solvent-based products, produced in, imported to, used in, and exported from Sweden, were derived from the Swedish Product Register hosted by the Swedish Chemicals Agency. Emission factors from the literature have been used as far as possible, but in the case when emission factors are unavailable, country specific emission factors have been developed.

3.1.1 Definition of NMVOC

According to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006), NMVOCs are defined as:
"any non-methane organic compound having at 293.15 K a vapour pressure of 0.01 kP or more or having a corresponding volatility under the particular conditions of use."

3.1.2 Substance list

A manual selection has been made in order to select each substance with vapour pressure of 0.01 kPa or more at 293.15° K according to the chosen definition of NMVOC. The final substance list for 2013 contains 427 substances defined as NMVOC. The list includes CAS-number, name, molecular formula and carbon share for each substance. The carbon share for each substance has been calculated based on the molecular formula. In some cases, a mixture of substances is included in the substance list, and for the mixtures the carbon content has been estimated by

[109] Skårman et al., 2016. Swedish method for estimating emissions from Solvent Use. Further development of the calculation model. SMED report 192.

the Swedish Chemicals Agency as 85% of NMVOC, based on information in the Products Register. In cases where the carbon content cannot be derived from the Products Register, the default value of 60%, given in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, has been used

Emission of CO_2 has been calculated with the following equation:

$$\text{Emission } (CO_2) = C_{quantity} \times \text{Emission Factor} \times \frac{44}{12}$$

$C_{quantity}$ is the carbon quantity of the solvents. 44 and 12 are the molecular weights of CO_2 and C, respectively.

3.1.3 Activity data

The substance list has been used to extract quantities of NMVOC and C in substances found in the Products Register. Data extractions have been made for each year from 1992. The extractions show for each year:

- The intended use of the product, the product type (functional code)
- Industry to which the product is sold (industry category)
- Quantity NMVOC
- Quantity C
- Number of products

When analysing the extractions from the Products Register, data for 1992-1994 showed not to be reliable to use for quantitative estimates of NMVOC and C emissions. The reason is that during this period the emissions of many substances still were reported as intervals, even if work has been done by the Swedish Chemicals Agency in order to further specify the amounts. There were also changes in the code system during this period. Therefore, data from the Products Register are only used for 1995 and onwards.

Due to the two-year delay in official statistics from the Products Register, activity data for the last year in the reported time series is not published in time to be used in the latest submission and hence Sweden has chosen to equal data for the last year with data for the year before that. Estimated values for last year of one submission will always be updated with official data in the next submission.

Table A3-1. Activity data and emission factors for the individual SNAP codes 060412i (not diluted), 060412i (not diluted, raw material), 060412ii (diluted and 060412ii (diluted, raw material).

Year	AD 060412i (kt, not diluted)	AD: 060412ii (kt, diluted)	AD 060412i (kt not diluted, raw material)	AD 060412ii (kt, diluted, raw material)	EF 060412i (not diluted)	EF 060412ii (diluted)	EF 060412 (raw material)
1997	10	6	3	0	0.95[1]	0.275[2]	0.001
1998	11	8	4	0	0.95[1]	0.275[2]	0.001
1999	11	9	3	0	0.95[1]	0.275[2]	0.001
2000	11	10	2	0	0.95[1]	0.275[2]	0.001
2001	11	12	1	0	0.95[1]	0.275[2]	0.001
2002	15	12	1	0	0.95[1]	0.275[2]	0.001
2003	17	15	2	0	0.95[1]	0.275[2]	0.001
2004	19	15	1	0	0.95[1]	0.275[2]	0.001
2005	19	15	1	0	0.95[1]	0.275[2]	0.001
2006	20	16	1	0	0.95[1]	0.275[2]	0.001
2007	21	16	1	0	0.95[1]	0.275[2]	0.001
2008	22	18	1	0	0.95[1]	0.275[2]	0.001
2009	21	19	1	0	0.95[1]	0.275[2]	0.001
2010	23	17	3	0	0.95[1]	0.275[2]	0.001
2011	26	22	3	0	0.95[1]	0.275[2]	0.001
2012	25	23	1	0	0.95[1]	0.275[2]	0.001
2013	25	23	3	0	0.95[1]	0.275[2]	0.001
2014	27	21	1	0	0.95[1]	0.275[2]	0.001
2015	30	21	<1	0	0.95[1]	0.275[2]	0.001
2016	24	22	<1	0	0.95[1]	0.275[2]	0.001
2017	22	21	<1	0	0.95[1]	0.275[2]	0.001
2018	24	22	<1	0	0.95[1]	0.275[2]	0.001
2019	27	23	<1	0	0.95[1]	0.275[2]	0.001
2020	31	14	<1	0	0.95[1]	0.275[2]	0.001
2021	28	15	<1	0	0.95[1]	0.275[2]	0.001
2022	28	14	<1	0	0.95[1]	0.275[2]	0.001

[1] Skårman, T., Danielsson, H., Henningsson, E., Östman, M. 2006. Revised Method for Estimating Emissions of NMVOC from Solvent and Other Product Use in Sweden. SMED Report no 75

[2] EMEP/EEA air pollutant emission inventory guidebook - 2019. 2.D.3.a Domestic solvent use including fungicides.

3.1.4 Allocation

The extractions from the Products Register for 1995 and onwards have been used in order to compile a connection diagram with all combinations of "product codes" and "industry categories". For all combinations, decisions whether to include or exclude from reporting are based on expert judgements in order to avoid double-counting. If the combination should be included, it has been given a specific:

- SNAP-code (according to EMEP/EEA guidebook)
- Industry group (grouping industry categories)
- Product group (grouping of product codes)
- Use category (industry, consumer and other)

Furthermore, it has to be determined if the product is used as raw material or not. Quantities of NMVOC used as raw material have been identified and handled separately from other quantities, since most of the solvents used as raw material will not be emitted but bound in products.

In order to avoid double-counting of reported emissions within other sectors an expert judgement has been made on both industry category and product function. All industrial activities reported in other CRF-codes are excluded from the extractions from the Products Register.

The sold amount of solvent is not always identical to the amount of solvent used, i.e. stock of solvents. Up until submission 2019, activity data has therefore been recalculated using a running average over three years. This led to the need for updating of reported emissions for the latest three years in the time series in every new submission. In submission 2020, the recalculation of activity data has been updated[110] based on the assumption that sold amounts of solvents in a specific year are not used entirely within the same year. For a sold amount of a specific solvent, the amounts of this specific solvent used, and the corresponding emissions are distributed over three consecutive years, the first year being the year where the respective solvents are sold. This is done by defining consumption rates of solvents per CRF subcategory sector (see Table A3-2).

Table A3-2. Consumption rates for product groups sold in year X, estimated per NFR category.

NFR category	X	X+1	X+2
2D3a Domestic solvent use including fungicides	70%	20%	10%
2D3d Coating applications	80%	15%	5%
2D3e Degreasing	85%	10%	5%
2D3f Dry cleaning	85%	10%	5%
2D3g Chemical products	85%	10%	5%
2D3h Printing	85%	10%	5%
2D3i Other solvent use	75%	15%	10%

[110] Helbig, T., Danielsson, H. (2019)

When calculating amounts used and emissions from products containing solvents sold in 2016 allocated to domestic solvent use including fungicides, 70 % of these solvents are assumed be used in 2016, 20 % in 2017 and 10 % in 2018. Calculated emissions from usage of these solvents are distributed likewise. Therefore, reported emissions for a certain year after 1996 always include emissions from solvent use from solvents sold within the two previous years. Emissions and activity data for 1995 and 1996 have been interpolated due to the calculation approach suggesting allocating a share of emissions from solvent use in 1993 and 1994 to 1995 and 1996 respectively. However, based on expert judgement it was decided that emissions and activity data for the years 1990-1994 are not changed.

3.1.5 Emission factors

Emission factors given in the literature, for example the EMEP/EEA guidebook (EEA, 2019), EU legislations and other countries IIR´s, have been compiled and included in the model. Two emission factors have been developed for each activity; one for solvents used as raw material and one for the remaining quantities. The emission factors for raw material have been set to 0.001 for all SNAP codes, since most of the solvents will end up in the product and will not be emitted during production. A new emission factor for products used diluted in water or removed with water has been introduced in the new model for NFR 2D3a and 2D3i. The new emission factor is set to 0.275 and it has been calculated as average of 0.05 and 0.5 according to the information in the EMEP/EEA Guidebook 2019 for NFR 2D3a section 3.2.4 (p.15). In the previous estimates these products were not treated separately and consequently the emission factor of 0.95 was used also for water diluted products. The country specific emission factors have been developed in order to adjust to the old time series 1990-2001, developed by SMED in 2002 (Kindbom et. al., 2004). However, for some activities errors have been identified in previously reported data for 1990, and consequently those emissions have been corrected. Furthermore, application techniques, available information in the environmental reports for specific industries, as well as other pathways of release (e.g., water), have been considered when developing the country specific emission factors.

Table A3-3. Country specific emission factors for SNAP codes in NFR 2D3a "Domestic solvent use including fungicides". Emission factor references given at the end of Annex 3.1. All emissions factors constant throughout the timeseries.

Year	060408ei	060408eii	060408fi	060408fii	060408gi	060408gii	060408hi	060408hii	060408i	060411
1995	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.95[1]
2000	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.95[1]
2010	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.95[1]
2015-2022	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.275[2]	0.95[1]	0.95[1]

Table A3-4. Country specific emission factors for SNAP codes in NFR 2D3d "Coating applications". Emission factor references given at the end of Annex 3.1. EFs in italic are interpolated.

Year	060101	060102	060103	060104	060105	060106	060107	060108	060109
1995	0.95[1]	0.95[1]	0.95[1]	0.95[1]	0.25[4]	0.84[3]	0.29[1]	0.95[1]	0.95[1]
2000	0.79	0.79	0.95[1]	0.95[1]	0.25[4]	0.84[3]	0.17[3]	*0.83*	0.95[1]
2010	0.54	0.54	0.95[1]	0.95[1]	0.25[4]	0.84[3]	0.17[3]	*0.59*	0.95[1]
2015-2022	0.45[3]	0.45[3]	0.95[1]	0.95[1]	0.25[4]	0.84[3]	0.17[3]	0.50[3]	0.95[1]

Table A3-5. Country specific emission factors for SNAP codes in NFR 2D3e "Degreasing", NFR 2D3f "Dry cleaning" and NFR 2D3h "Printing". Emission factor references given at the end of Annex 3.1. EFs in italic are interpolated.

Year	060201	060203	060204	060202	060403
1995	0.61[5]	0.61[5]	0.61[5]	0.30[6]	0.65[1]
2000	0.47[5]	0.47[5]	0.47[5]	0.30[6]	0.59
2015-2022	0.19[5]	0.19[5]	0.19[5]	0.30[6]	0.30[3]

Table A3-6. Country specific emission factors for SNAP codes in NFR 2D3g "Chemical products". Emission factor references given at the end of Annex 3.1. EFs in italic are interpolated.

Year	060305	060307	060308	060309	060311	060312	060313	060314
1995	0.30[1]	0.004[1]	0.004[1]	0.004[1]	0.004[1]	0.03[3]	0.010[1]	0.50[1]
2000	0.27[1]	0.003[3]	0.003[3]	0.003[3]	0.003[3]	0.03[3]	0.008[1]	0.29[1]
2010	0.25[1]	0.003[3]	0.003[3]	0.003[3]	0.003[3]	0.03[3]	0.003[3]	0.20[1]
2015-2022	0.25[1]	0.003[3]	0.003[3]	0.003[3]	0.003[3]	0.03[3]	0.002[3]	0.20[1]

Table A3-7. Country specific emission factors for SNAP codes in NFR 2D3i "Other solvent and product use". Emission factor references given at the end of Annex 3.1. EFs in italic are interpolated.'

Year	060405	060406	060407	060409	060412i	060412ii
1995	0.56[7]	0.64[1]	0.95[1]	0.95[1]	0.95[1]	0.275[2]
2000	0.56[7]	*0.59*	0.95[1]	0.95[1]	0.95[1]	0.275[2]
2010	0.56[7]	*0.33*	0.95[1]	0.95[1]	0.95[1]	0.275[2]
2015-2022	0.56[7]	0.22[3]	0.95[1]	0.95[1]	0.95[1]	0.275[2]

[1] Skårman, T., Danielsson, H., Henningsson, E., Östman, M. 2006. Revised Method for Estimating Emissions of NMVOC from Solvent and Other Product Use in Sweden. SMED Report no 75

[2] EMEP/EEA air pollutant emission inventory guidebook - 2019. 2.D.3.a Domestic solvent use including fungicides.

[3] Environmental reports

[4] EMEP/EEA air pollutant emission inventory guidebook - 2019. 2.D.3.d Coating applications. Table 3-20.

[5] EMEP/EEA air pollutant emission inventory guidebook - 2019. 2.D.3.e Degreasing. Table 3-4. Abatement efficiency from the GAINS model.

[6] EMEP/EEA air pollutant emission inventory guidebook - 2019. 2.D.3.f Dry cleaning. Table 3-3.

[7] EMEP/EEA air pollutant emission inventory guidebook - 2019. 2.D.3.i, 2.G Other solvent and product use. Table 3-11.

Annex 3.2. Size distribution for PM_{10} and $PM_{2.5}$ as fraction of TSP

Table A3-8. Size distribution for PM_{10} and $PM_{2.5}$ as fraction of TSP.

NFR code	Fraction of TSP	
	PM_{10}	$PM_{2.5}$
2A1 - Cement production	0.90	0.80
2A2 - Lime production (Carbide production)	0.90	0.80
2A2 - Lime production (Lime production plants)	0.90	0.80
2A2 - Lime production (Sugar industry)	0.90	0.80
2A2 - Lime production (Pulp and paper industry)	IE*	IE*
2A3 - Glass wool production	0.90	0.70
2A3 – Other glass production	0.90	0.80
2A5a - Quarrying and mining of minerals other than coal	0.50	0.07
2A5b - Construction and demolition	0.30	0.03
2A5c - Storage, handling and transport of mineral products	IE**	IE**
2A6 - Mineral wool production	0.90	0.70
2B10a – Other organic chemical production***	1	1
2B10a - Other inorganic chemical production***	0.90	0.80
2B10a - Other inorganic chemical production***	0.38	0.02
2B10a - Other inorganic chemical production***	Based on production of phos-phate fertilizers	
2C1 - Iron and steel production (secondary)	0.80	0.70
2C1 - Iron and steel production (primary)	Based on data from producers	
2C1 - Iron and steel production (iron sponge)	0.60	0.47
2C1 - Iron ore mining, dressing and concentration	0.50	0.07
2C1 - Iron ore pellets production	1.00	1.00
2C2 - Ferroalloy production	1.00	0.71
2C3 - Aluminium production	0.95	0.43
2C7c - Other metal production	0.95	0.80
2D3b - Road paving with asphalt	0.18	0.03
2D3c - Asphalt Roofing	0.90	0.85
2G - Other product use (fireworks)	0.91	0.47
2G - Other product use (tobacco smoking)	1.00	1.00
2H1 - Pulp and paper	0.95	0.75

*= Included in 2H1
**= included in respective source category
***= different EFs for different types of production

4 Annex 4: Environmental reports in Sweden

In Sweden, approximately 6,000 “environmental hazardous activities” must have a permit to operate. Such activities are conducted on a real estate and result or may result in discharges or other disturbances to the environment, e.g. water and air pollution or noise. The number includes activities regulated in EC-directives, e.g. under the Industrial Emissions Directive (IED)[111] and Seveso directive[112].

According to chapter 9 of the Environmental Code (SFS 1998:808)[113] permits must be obtained for the establishment, operation and in some cases modification of environmentally hazardous activities on a certain scale. The structures and operations for which permits must be obtained are covered by two ordinances:

- Ordinance on Environmental Assessment (SFS 2013:251)[114]
- Ordinance on Environmentally Hazardous Activities and the Protection of Public Health (SFS 1998:899)[115]

For permitting procedures the Code divides competence between the regional administrations and the Environmental Courts. Permits are granted by the Environmental Courts and the Environmental Permitting Committees (EPC). The EPC is a special function at the County Administrative Board (CAB). There are 21 EPCs, one in each county, and five Environmental Courts. The allocation of licensing tasks between the EPCs and the Courts is regulated in the Ordinance on Environmental Assessment. For activities that entail a significant environmental impact (classed as A-activities in the list and totalling less than 400), the proponent must apply for a permit to the Court. For activities with less impact on the environment (classed as B-activities in the list and totally around 5,500) the proponent must apply for a permit to the CAB.

Rules on the operator's responsibility for self-monitoring and environmental reports are given in chapter 26 of the Environmental Code. All operations regulated by permit must return an annual environmental report. All activities and measures that require permission or notification are subject to the Ordinance on Operators’ self-monitoring (SFS 1998:901)[116]. The requirements concerning environmental reports

[111] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)

[112] Directive 2003/105/EC of the European Parliament and of the Council of 16 December 2003 amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances.

[113] SFS 1998:808. Miljöbalken

[114] SFS 2013:251, Miljöprövningsförordning

[115] SFS 1998:899, Förordning om miljöfarlig verksamhet och hälsoskydd

[116] SFS 1998:901, Förordning om verksamhetsutövares egenkontrol

are given in the regulation on environmental reports (NFS 2016:8)[117] issued by the Swedish Environmental Protection Agency (Swedish EPA). The environmental report consists of three parts:

- Administrative information about the facility.
- Text section (for example, a description of the facility and the processes, the use of energy, chemicals and raw materials, emissions and conditions in the permit).
- Emission declaration (for example, production data, fuel consumption data, emission data and, information on how emission data have been determined i.e. measured, calculated or estimated).

The data in the environmental reports often originates from measurements or mass balances. The use of default emission factors is limited.

All environmental reports have to be submitted electronically via the Swedish Portal for Environmental Reporting (SMP)[118].

The environmental reporting system is essential to the credibility of the self-monitoring. The authority checks the operator performance, asks for additional measures and monitoring. The operator is obliged to keep himself informed about the activity's impact on the environment. This is done by initiating studies and measurements, or by other means. The operator should also have routines for responding to new knowledge and new information, e.g. by taking appropriate counter-measures.

[117] NFS 2016:8, Naturvårdsverkets föreskrifter om miljörapport https://www.naturvardsverket.se/Documents/foreskrifter/nfs2016/nfs-2016-8.pdf 2019-01-30

[118] Svenska Miljörapporteringsportalen. https://smp.lansstyrelsen.se

4.1 References

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SFS 1998:901, Förordning om verksamhetsutövares egenkontroll. http://www.riksdagen.se/sv/Dokument-Lagar/Lagar/Svenskforfattningssamling/Forordning-1998901-om-verks_sfs-1998-901/ 2014-12-18

Swedish Portal for Environmental Reporting, Svenska Miljörapporteringsportalen. https://smp.lansstyrelsen.se// 2013-10-16

5 Annex 5: Units and Abbreviations

t	1 (metric) tonne = 1 megagram (Mg) = 10^6 g
g	1 gram
Mg	1 megagram = 10^6 g = 1 tonne
Gg	1 gigagram = 10^9 g = 1 kilotonne (kt)
Tg	1 teragram = 10^{12} g = 1 megatonne (Mt)
TJ	1 terajoule
ARTEMIS	Assessment and Reliability of Transport Emission Models and Inventory Systems
EMIR	Emission database of the County Administrative Boards
CEPMEIP	Coordinated European Programme on Particulate Matter Emission Inventories. Projections and Guidance
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CO	Carbon monoxide
COP	Conference of the Parties
CORINAIR	CORe Inventory of AIR emissions. EMEP/CORINAIR Emission Inventory Guidebook - 3rd edition
CTMP	Chemo Thermo Mechanical Pulp
CV	Calorific value
EC	European Community
EC	Environmental Class
EEA	European Environment Agency
EF	Emission Factor
EU	European Union
EMV	Emission Model for Road Traffic
EMEP	Co-operative Programme for Monitoring and Evaluation of Long-Range Transmission of Air pollutants in Europe
FAME	Fatty Acid Methyl Ester (earlier called RME)
FMV	Swedish Defence Material Administration
FOI	Swedish Defence Research Agency
FORTV	Swedish Fortification Department
FRA	National Defence Radio Institute
GHG	Greenhouse gases
Good Practice Guidance	Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories IPCC-NGGIP
HARP	Hasselrot's Reviewed Pollutions
HBEFA	The Handbook Emission Factors for Road Transport
HELCOM	The Helsinki Commission
ICAO	International Civil Aviation Organization
IE	Included Elsewhere'
IEF	Implied emission Factor
IIR	Informative Inventory Report
Industrial statistics	Industrial energy statistics
IPCC	Intergovernmental Panel on Climate Change
IVL	Swedish Environmental Research Institute Ltd
ISEN	Energy use in manufacturing industry
JTI	Swedish Institute of Agricultural and Environmental Engineering

Jernkontoret	Swedish Steel Producers' Association
KEMI	Swedish Chemicals Inspectorate
LD-gas	Steel converter gas
LPG	Liquefied Petroleum Gas
LTO	Landing and Take-Off
MSW	Municipal solid waste
MTC	Motor Test Center
NA	Not Applicable
NACE	Pan-European classification system grouping organisations according to their business activities
NASN	National Administration of Shipping and Navigation
NBF	National Board of Forestry
NE	Not Estimated
NFR	Nomenclature for Reporting
NH_3	Ammonia
NMVOC	Non methane volatile organic compounds
NO	Not Occurring
NO_X	Nitrogen oxides
O3	Ozone
PAH	Polycyclic Aromatic Hydrocarbons
PAH-4	Polycyclic Aromatic Hydrocarbons (4 species as defined in the Reporting Guidelines)
PIANO	Project Interactive Analysis and Optimization
PM_{10}	Particulate matter less than 10 micrometers
$PM_{2.5}$	Particulate matter less than 2.5 micrometers
QA/QC	Quality assurance and Quality control
Quarterly fuel statistics	Quarterly fuel statistics
RME	Rapeseed Methyl Ester fuel
RVF	Swedish Association of Waste Management
SCAA	Swedish Civil Aviation Authority
SJV	Swedish Board of Agriculture
SGU	Geological Survey of Sweden
SLU	Swedish University of Agricultural Sciences
SMED	Swedish Environmental Emissions Data
SMHI	Swedish Meteorological and Hydrological Institute
SNRA	Swedish National Road Administration
SO_2	Sulphur dioxide
SPI	Swedish Petroleum Institute
SVEFF	Swedish Paint and Print Ink Makers Association
Swedish EPA	Swedish Environmental Protection Agency
TEQ	Toxic Equivalents. Used to report the toxicity-weighted masses of dioxins and furans
TIM	Times in Mode
TMP	Thermo Mechanical Pulp
TNO	The Netherlands Organisation for Applied Scientific Research
TSP	Total suspended particulate matter
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
VETO	Mechanistic model for simulations on road traffic
VTI	Swedish Road- and Transport Research Institute