1.A.2.g viii - Stationary Combustion in Manufacturing Industries and Construction: Other

Short description

Source category *1.A.2.g viii - Stationary Combustion in Manufacturing Industries and Construction: Other* comprises stationary combustion systems for heat and power production of industrial power plants and industrial boiler systems.

NFR Code	Method	AD	EF
1.A.2.g viii	T2	NS	CS

Method(s) applied	
D	Default
T1	Tier 1 / Simple Methodology *
T2	Tier 2*
T3	Tier 3 / Detailed Methodology *
C	CORINAIR
CS	Country Specific
M	Model
* as described in the EMEP/EEA Emission Inventory Guidebook - 2019, in category chapters.	
(source for) Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific
As	Associations, business organisations
Q	specific Questionnaires (or surveys)
M	Model / Modelled
C	Confidential
(source for) Emission Factors	
D	Default (EMEP Guidebook)
CS	Country Specific
PS	Plant Specific
M	Model / Modelled
C	Confidential

NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)P	B(b)F	B(k)F	I(x)P	PAH1-4	HCB	PCBs
L/T	-/-	**L/T**	-/-	**L/-**	-/-	**L/T**	-/-	-/-	-/-	**L/-**	**L/T**	**L/T**	**L/T**	**-/T**	**L/T**	-/-	**L/T**	**L/T**	**-/T**	IE	IE	IE	**-/T**	-/-	-/-

Method(s) applied	
D	Default
T1	Tier 1 / Simple Methodology *
T2	Tier 2*
T3	Tier 3 / Detailed Methodology *
C	CORINAIR
CS	Country Specific
M	Model
* as described in the EMEP/EEA Emission Inventory Guidebook - 2019, in category chapters.	
(source for) Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific
As	Associations, business organisations
Q	specific Questionnaires (or surveys)
M	Model / Modelled
C	Confidential
(source for) Emission Factors	
D	Default (EMEP Guidebook)
CS	Country Specific
PS	Plant Specific
M	Model / Modelled
C	Confidential

Method

Generally, the calculation method is based on a Tier 2 approach. This means the use of country-specific data at a more detailed level. Emission factors and activity data are available for different fuel types, different technologies, plant size, etc. The use of plant-specific data for a bottom-up approach is not possible. Emissions from industrial power plants cannot be

allocated clearly to source category 1.A.2, since reality does not follow the definition of the Guidebook. In real life an industrial power plant generates electricity and heat for the industry but also electricity for the public network. Therefore the borderline between these two categories is not fixed. The market is not static. Frequent changes in the cooperate structure of industrial enterprises including the separation of the energy supply via spin-off from the parent company lead to frequent changes between sector 1.A.1.a, 1.A.1.c and 1.A.2. Therefore it was necessary to develop a flexible calculation system, based on robust emission factors, which can be used for all sectors. Source category 1.A.2.g.viii does only include emissions from industrial power plants and boiler systems.

Activity data

Conventional fuels

The key source of all conventional fuel data is the national energy balance [1)]. Moreover the use of additional statistical data is necessary in order to disaggregate data. Data source for fuel inputs for electricity generation in industrial power stations are shown in Energy Balance line 12. The difference resulting after deduction of the fuel inputs for refinery power stations, pit power stations, power stations in the hard-coal-mining sector and, for the period until 1999, for the power stations of German Railways (Deutsche Bahn) consists of the activity data for other industrial power stations. These data cannot be further differentiated. Additional data from the Federal Statistical Office are needed for allocation of fuel inputs to heat production in industrial power stations and boiler systems. For both electricity production and heat production, gas turbines, gas and steam systems and gas engines are differentiated. These detailed information is provided by the national statistic 067 (industrial power stations). The definition of industrial and public power plants follows the National statistics.

Biomass

Along with the main Energy Balance, a Satellite Balance of renewable Energies (Satellitenbilanz Erneuerbarer Energieträger) is also published. This balance describes the growth and use of renewable energies in detail. This is the database for all biomass fuels excluding waste.

Waste

With regard to determination of activity data from waste incineration and co-combustion of waste in combustion system in source category 1.A.2 Energy Balance and energy statistics show smaller waste quantities than the waste statistics of the Federal Statistical Office (Statistisches Bundesamt, Fachserie 19, Reihe 1) [2)]. For that reason activity data were taken from waste statistics.

Emission factors

The emission factors for power stations and other boiler combustion for production of steam and hot water, in source category 1.A.2.g.viii, have been taken from the research project “Determination and evaluation of emission factors for combustion systems in Germany for the years 1995, 2000 and 2010” (RENTZ et al., 2002)[3)]. In 2018 and 2019 SO_2, NOx, TSP, PM, CO, NH_3 and Hg emission factors were revised for all large combustion plants by using data from the large combustion plant reporting (UBA 2019)[4)]. A detailed description of the procedure is presented in Chapter: 1.A.1.a - Public Electricity And Heat Production. This chapter contains also information about emission factors of engines and waste incineration plants. In terms of black carbon default emission factors for the EMEP EEA Guidebook 2019 are used.

Table 1: Implied emission factors for industrial electricity and heat generation for 2023

	SO_x	NO_x	TSP	CO	Pb	Hg	Cd
	[kg/TJ]				[g/TJ]		
Hard Coal	142.9	101.2	3.3	25.9	4.98	2.34	0.36
Lignite	190.0	90.0	4.9	45.7	1.53	2.46	0.20
Natural gas	0.1	41.3	0.2	10.5	NA	0.01	NA
Liquid fuels	33.3	53.4	1.4	5.6	0.75	0.24	0.06
Biomass	9.5	131.9	16.7	50.7	0.39	0.17	0.49
Hazardous waste	0.5	69.2	0.2	7.8	4.90	0.34	1.10

The table gives an overview of the implied emission factors. In reality the German inventory compiling process is very complex and includes the use of a considerable number of emission factors, which cannot be published completely in the IIR.

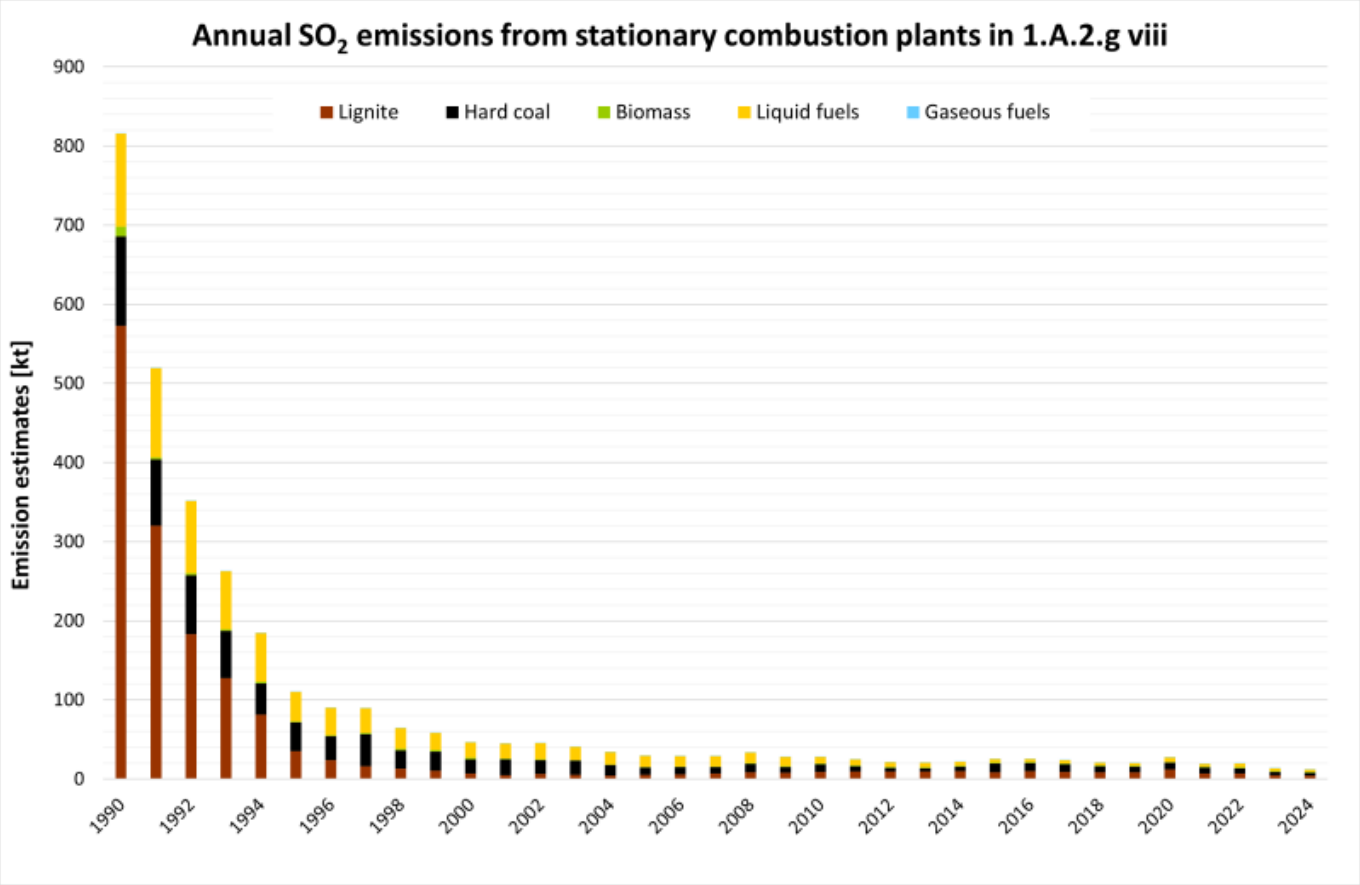
Actually there are different emission factors available for diverse fuel types, various techniques and due to permissions. However, the implied emission factor may give an impression about the order of magnitude. PM_{10} and $PM_{2.5}$ emission factors are calculated as a fraction of TSP. The share of PM_{10} is 90 % and the share of $PM_{2.5}$ is 80 % for solid fuels. This is a simple but also conservative approach, knowing that, in reality, PM emissions depend on fuel, combustion and abatement technologies. In terms of natural gas and biogas PM_{10} and $PM_{2.5}$ fractions are considered as 100 % of TSP. Regarding wood a share of 100% PM_{10} and 90% $PM_{2.5}$ is used. For liquid fuels the default share of 100% PM_{10} and $PM_{2.5}$ is used. In the cases of co-incineration, where liquid fuels are only used for ignition in coal fired plants, the share of coal fired plants is used. PM emission reporting starts in 1995, since no sufficient information about the dust composition of the early 1990s is available.

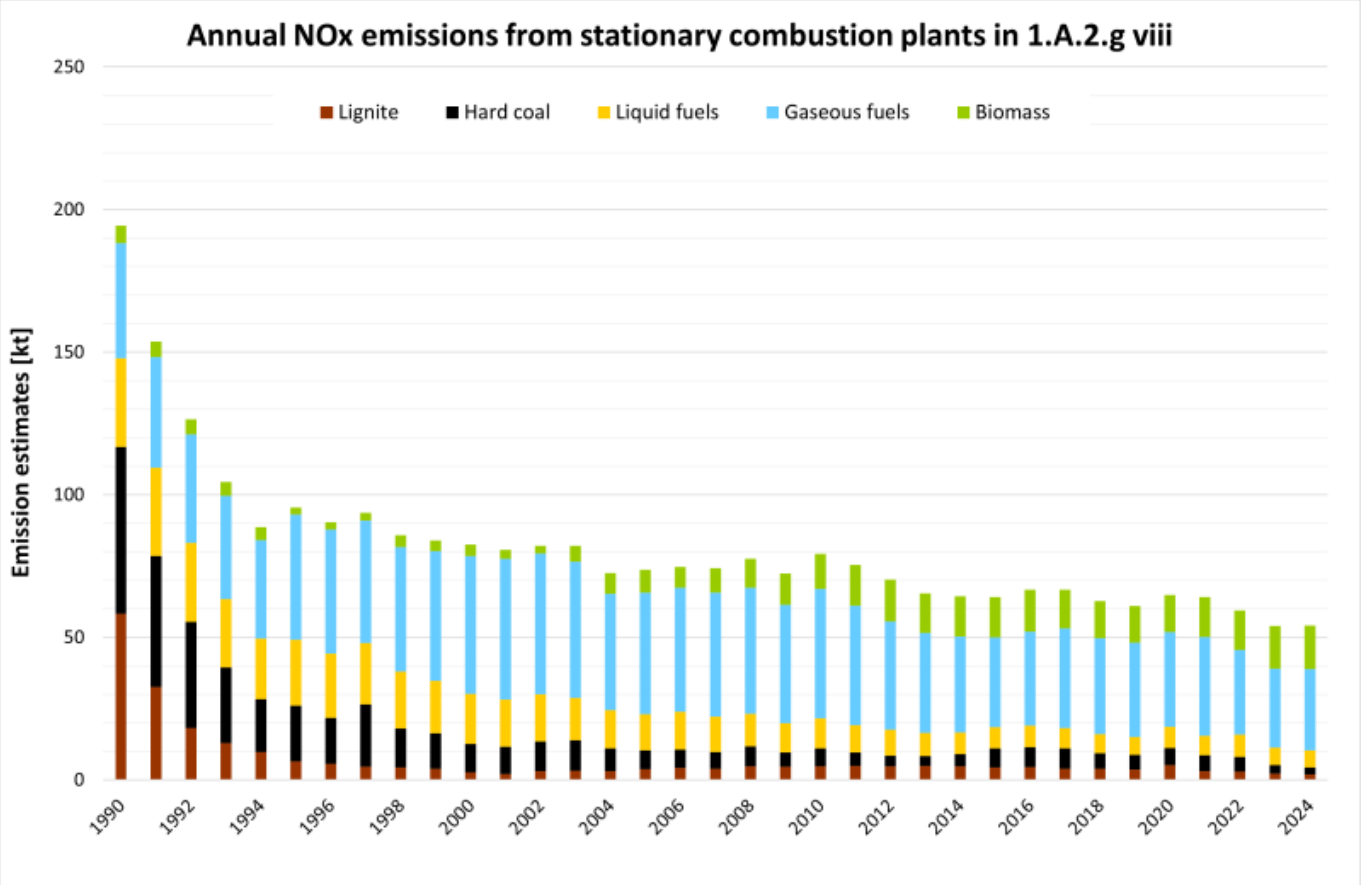
Trend Discussion for Key Sources

The following diagrams give an overview and assistance for explaining dominant emission trends of selected pollutant.

Sulfur Oxides & Nitrogen Oxides - SOx & NOx

As already discussed in source category 1.A.1.c, SO_x emission trend is very much influenced by emissions from lignite fired plants. The strong decline of lignite use in the East German industry and the installation of flue gas desulfurisation plants in the remaining heat and power stations are the main reasons for decreasing SO_x emissions.

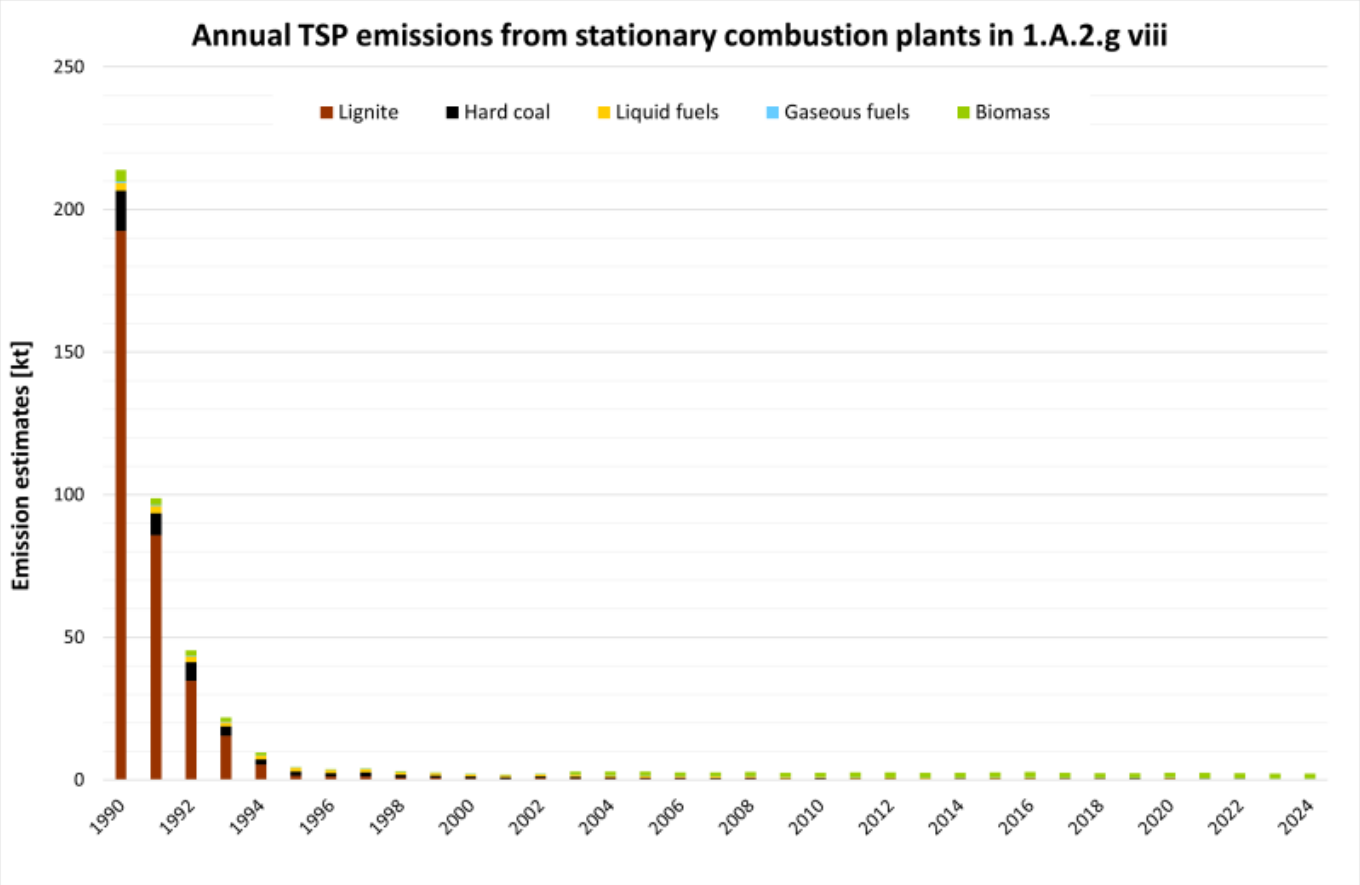


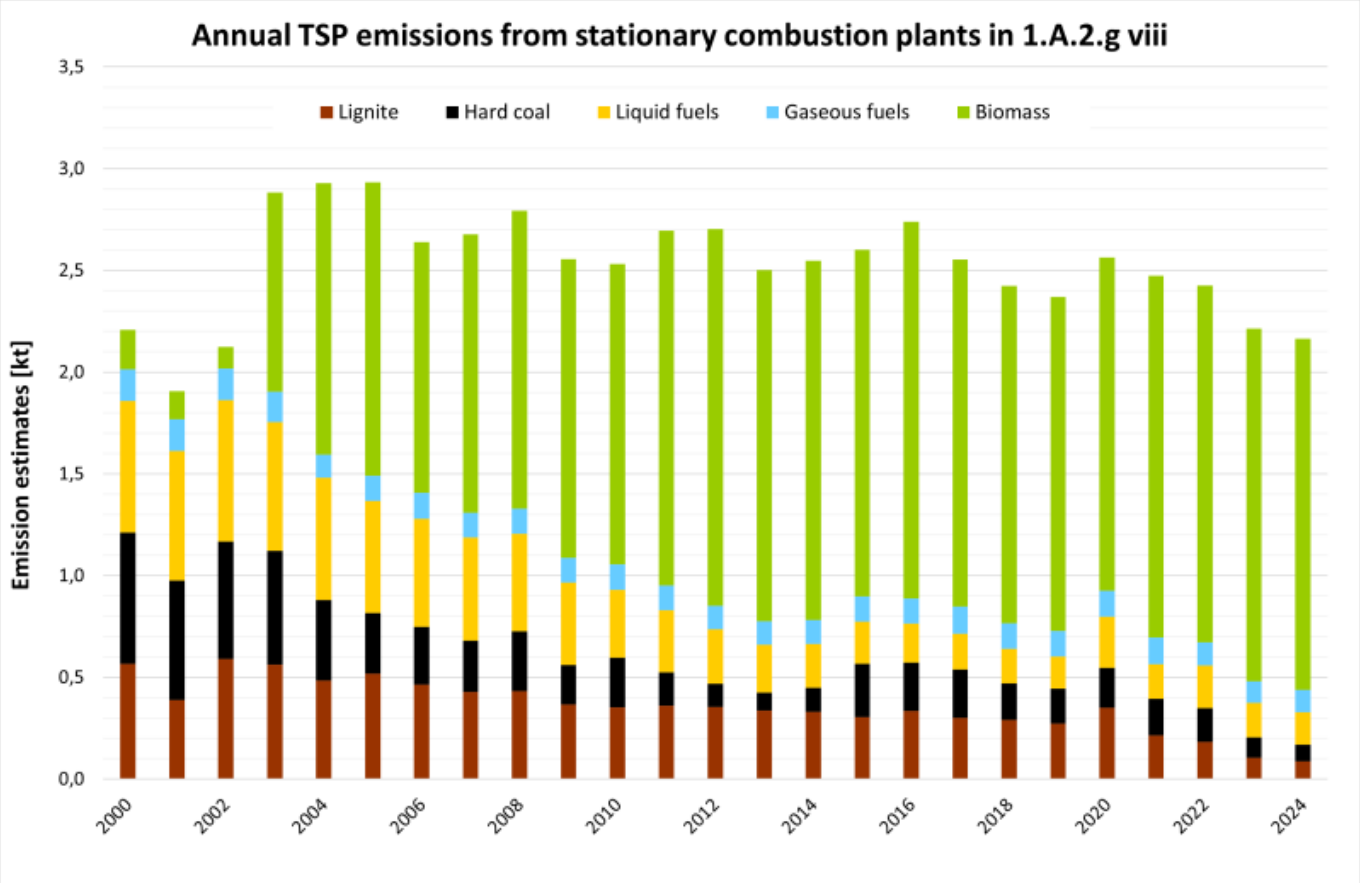


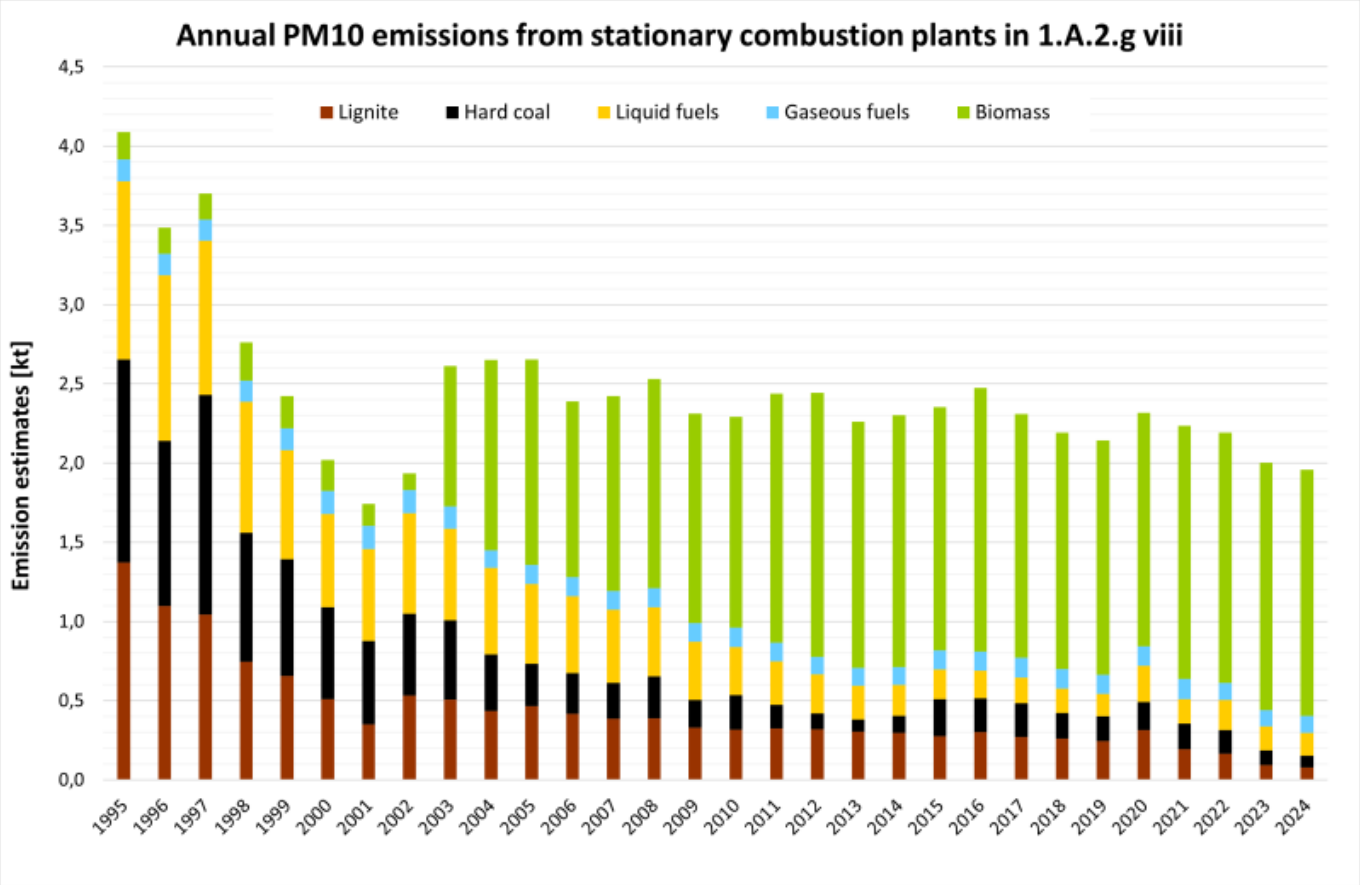
Particulate Matter (TSP, PM10) and Priority Heavy Metals (Hg & Cd)

The main driver of TSP and heavy metal emission trends is the declining lignite combustion due to the closure of industrial plants in the East German industry especially from 1990 to 1994. Furthermore, the noticeable improvement of dust extraction installations and the optimisation of the combustion process resulted in considerably decreasing TSP and heavy metal emissions.

In recent years the use of biomass gains influence.


Annual TSP emissions from stationary combustion plants in 1.A.2.g viii
Lignite
Hard coal
Liquid fuels
Gaseous fuels
Biomass
Emission estimates [kt]
250
200
150
100
50
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


Annual TSP emissions from stationary combustion plants in 1.A.2.g viii
Lignite
Hard coal
Liquid fuels
Gaseous fuels
Biomass
Emission estimates [kt]
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


Annual PM10 emissions from stationary combustion plants in 1.A.2.g viii
Lignite
Hard coal
Liquid fuels
Gaseous fuels
Biomass
Emission estimates [kt]
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
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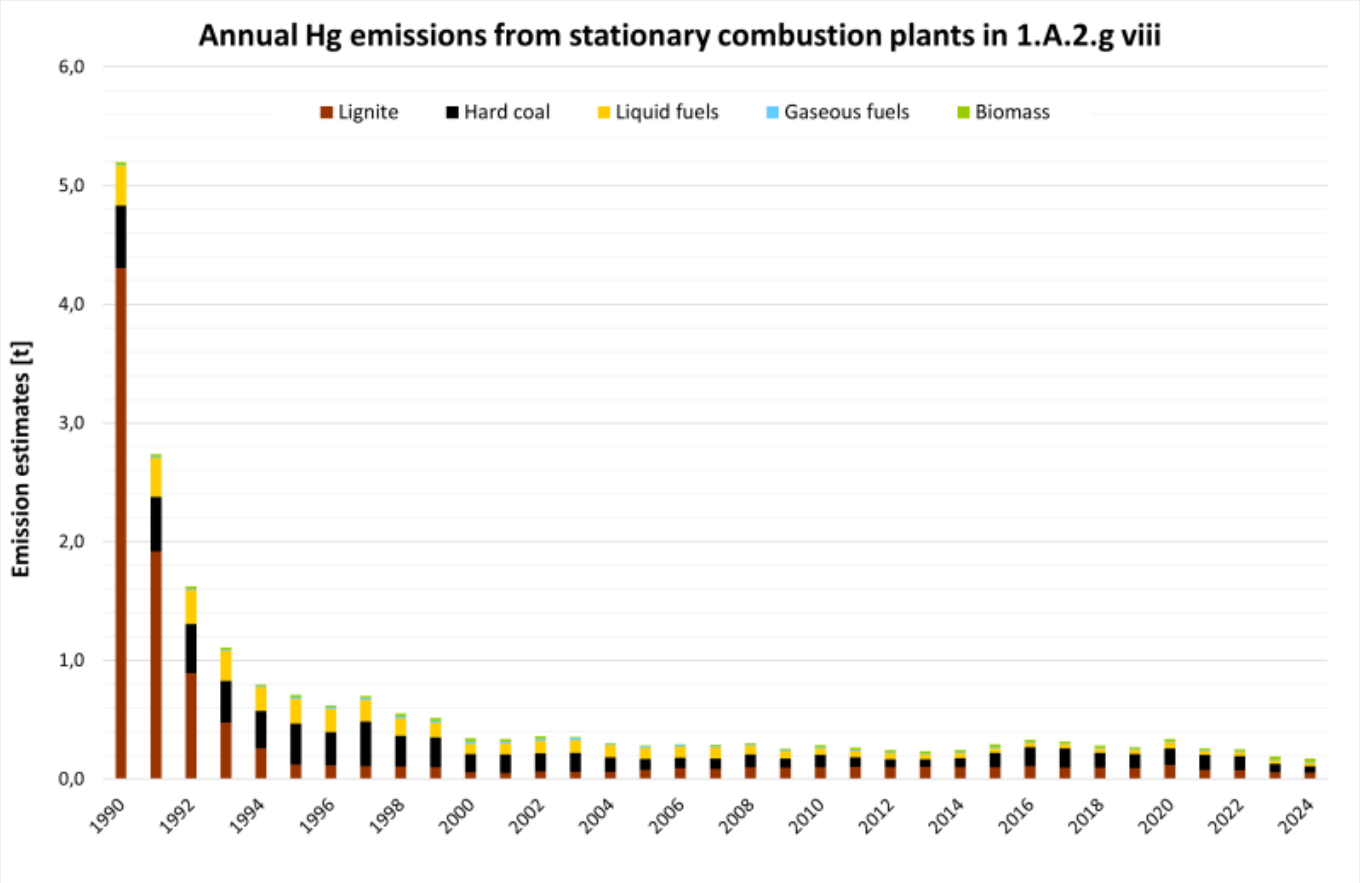
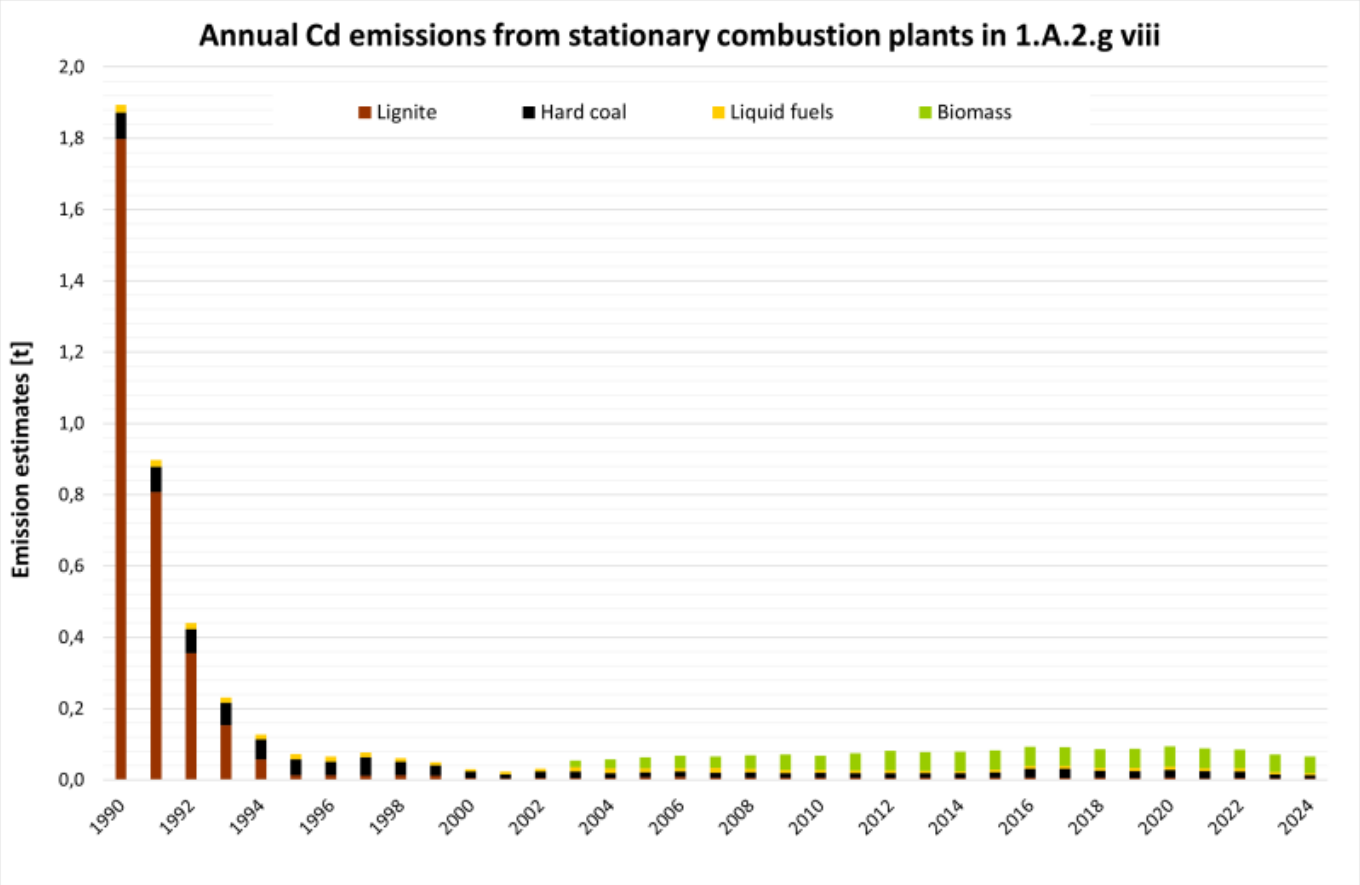
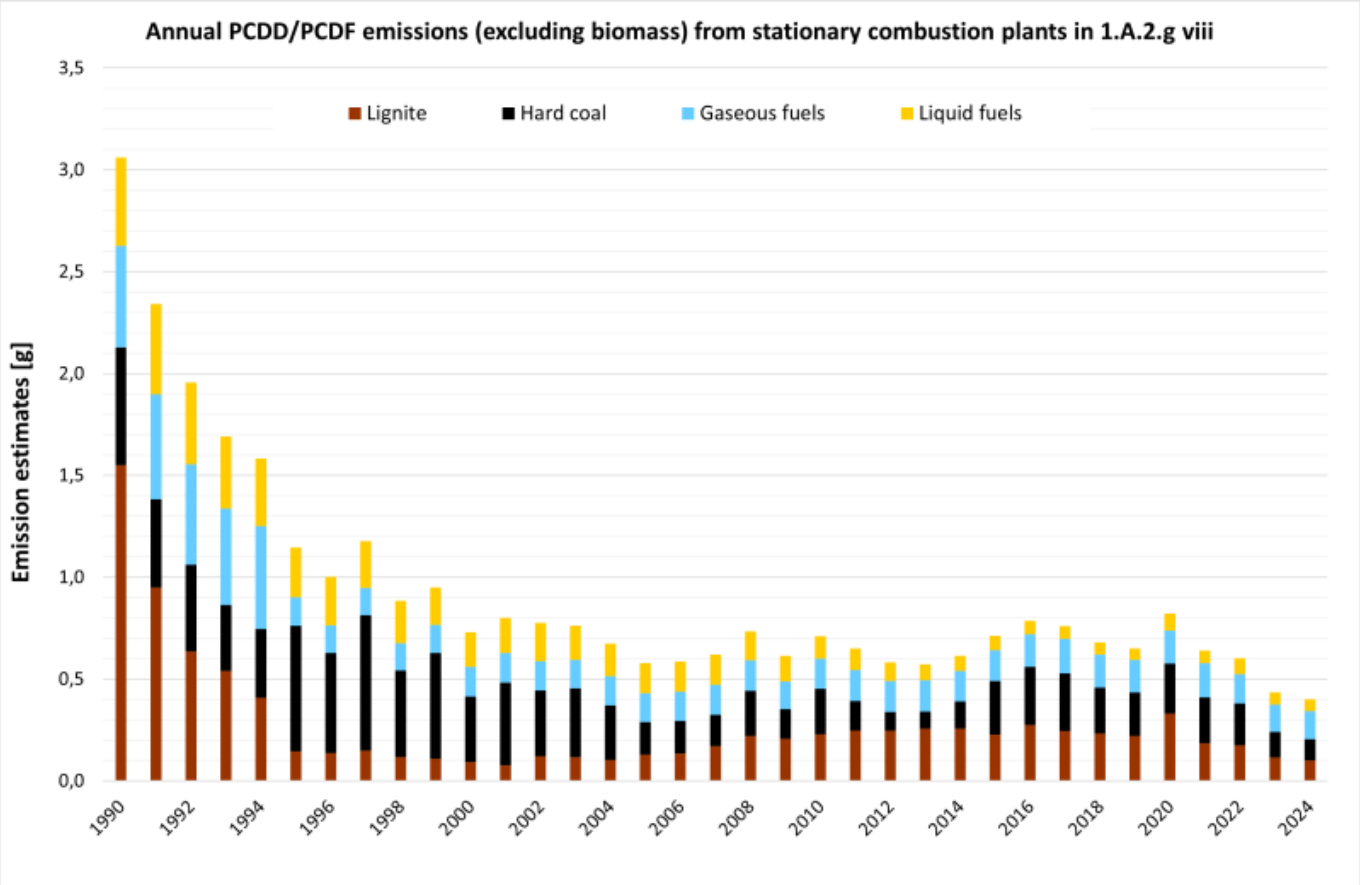
2019
2020
2021
2022
2023
2024


Annual Hg emissions from stationary combustion plants in 1.A.2.g viii
Lignite
Hard coal
Liquid fuels
Gaseous fuels
Biomass
Emission estimates [t]
6,0
5,0
4,0
3,0
2,0
1,0
0,0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024



Persistent Organic Pollutants

PCDD and PCDF emissions show a decreasing trend over the whole timeseries due to decreasing fuel consumption in the industry sector.



Recalculations

At the time of compiling the inventory, national energy balance is only available provisionally. Therefore, the finalization of the Energy Balance for 2022 led to recalculations. In addition, to ensure that consumption of fuels in the official data sources is consistently included in the inventory, reallocation of fuel data between 1A1b, 1A1c and 1A2gviii took place for the years 2003-2022.

For **pollutant-specific information on recalculated emission estimates for Base Year and 2022**, please see the pollutant specific recalculation tables following chapter 8.1 - Recalculations.

Planned improvements

At the moment, no category-specific improvements are planned.

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[1] AGEB, 2022: National energy balance and Satellite balance for renewable energy: https://ag-energiebilanzen.de/en/data-and-facts/energy-balance-2000-to-2030/

[2] Statistisches Bundesamt, Fachserie 19, Reihe 1: Abfallentsorgung (now data on waste management are available from the GENESIS-Online database) - URL: http://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Umwelt/Abfallwirtschaft/_inhalt.html#sprg238672

[3] Rentz, O. ; Karl, U. ; Peter, H.: Ermittlung und Evaluierung von Emissionsfaktoren für Feuerungsanlagen in Deutschland für die Jahre 1995, 2000 und 2010: Forschungsbericht 299 43 142; Forschungsvorhaben im Auftrag des Umweltbundesamt; Endbericht; Karlsruhe: Deutsch-Französisches Inst. f. Umweltforschung, Univ. (TH); 2002

[4] Umweltbundesamt, 2019: Kristina Juhrich, Rolf Beckers: “Updating the Emission Factors for Large Combustion Plants”: https://www.umweltbundesamt.de/publikationen/updating-emission-factors-large-combustion-plants