2.C.1 - Iron & Steel Production

Short description

The source subcategory *NFR 2.C.1 - Iron & Steel Production* comprises process-related emissions from oxygen steel and electric steel production.

Category Code	Method					AD					EF				
2.C.1	T2					NS					CS				
	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	Diox	PAH	HCB
Key Category:	-/-	-/-	L/-	-/-	L/T	L/T	L/T	-	L/-	L/T	L/T	L/T	L/T	L/T	L/-

T = key source by Trend **L** = key source by Level

Methods	
D	Default
RA	Reference Approach
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/CORINAIR Emission Inventory Guidebook - 2007, in the group specific chapters.

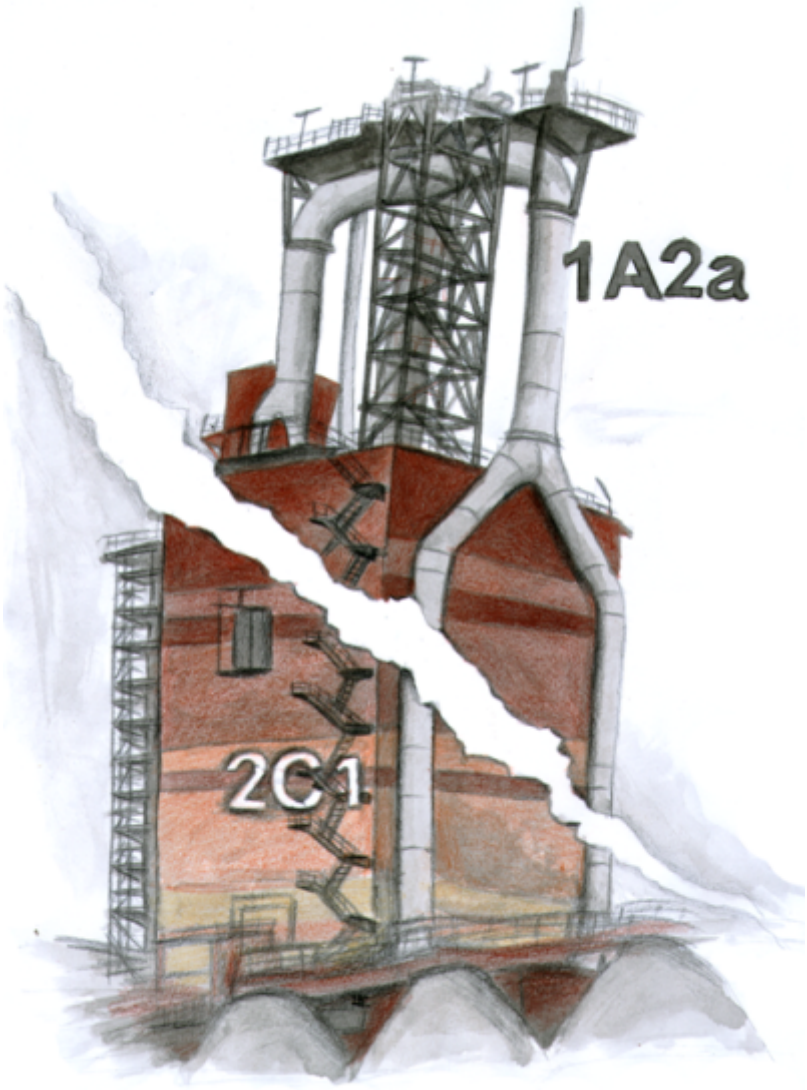
AD - Data Source for Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific data
AS	Associations, business organisations
Q	specific questionnaires, surveys

EF - Emission Factors	
D	Default (EMEP Guidebook)
C	Confidential
CS	Country Specific
PS	Plant Specific data

In 2019 a total of 27.7 million tonnes of raw steel were produced in six integrated steelworks. Electrical steel production amounted to another 11.9 million tonnes.

Other structural elements are sinter production, hot iron production, hot rolling, iron and steel foundries (including malleable casting). The last Siemens-Martin steelworks (Stahlwerk Brandenburg) was shut down shortly after 1990. The last Thomas steelworks (Maxhütte Sulzbach-Rosenberg) discontinued its production in 2002. Due to their minor relevance and their phase-out, the emissions from Siemens-Martin and Thomas steel production are jointly calculated with the emissions from oxygen steel production.

Energy-related emissions from steel production for the years 1990 to 1994 (for individual pollutants until 1999) are reported under 1.A Fuel combustions in the respective subcategory 1.A.2.a. A detailed explanation for the individual pollutants is also found there.



Method

Activity data

Activity data is collected from plant operators by national institutions. Since the discontinuation of the special public statistics for iron and steel production (FS. 4, R. 8.1), the information is collected by the German steel trade association Wirtschaftsvereinigung Stahl (WV Stahl) based on a formal agreement.

As the activity rates for 2017 could not be provided by WV Stahl as a result of compliance issues, aggregated figures from emissions trading were used instead. The consistency of emissions trading data was verified against comparative figures for previous years. The deviations were less than 1%; only in sinter production were they noticeably higher (maximum + 8%).

In the iron and steel industry, only minor amounts of secondary fuels are used for pig iron production in individual blast furnaces. They are used as substitute reducing agents of coke and coal. To date, these materials have not yet been included in the national statistics nor in the Energy Balance. For this reason, the data used is also provided by WV Stahl.

Emission factors

The emission factors used to calculate emissions are based on emission data from individual plants. The emission factors for 1995 to 2001 were determined by the German Environment Agency (UBA for its initials in German) itself and those for 2008 and later through a research project.

As the EF for the years 1995 to 2001 as well as for 2008 are based on real stack emission data. Since both combustion and process-related emissions are released through the same stacks, emission factors could not be calculated individually for combustion or process-related emissions. Hence, wherever plant-based EF were availaible, as it the case for most pollutants for the years 1995 and later, all emissions are reported under 2.C.1.

Please note that the reported emissions also cover diffuse emissions from sources that are not covered in the EMEP/EEA Guidebook. For many pollutants and sources, individual EFs for channelled as well as diffuse emissions have been determined. While there is sufficient knowledge and measurement data of channelled emissions, the emission data concerning diffuse sources is usually based on estimations using parameters adapted to the local conditions of the individual emission source. Therefore, emission data for one source of diffuse emissions is not significant for the diffuse emissions from other plants. The emission factors given below were calculated as the weighted average of the pollution loads reported by the plant operators for individual diffuse sources, in relation to their corresponding production amounts.

Table 1: Overview of the emission factors applied for sinter production

Pollutant	Type of source	EF 1990	EF 1995	EF 2000	EF 2005	EF 2010	Unit
Cd		0.098			0.052	0.017	g/t
CO		19.152		17.325	15.497	14.4	kg/t
Cr		0.077			0.044	0.02	g/t
HCB		0.03					mg/t
Hg		0.059			0.028	0.005	g/t
Ni		0.139			0.068	0.015	g/t
NMVOC		0.12					kg/t
NO_x		IE[1)]		0.558	0.46	0.401	kg/t
PAH		320.00	248.571	177.143	120		mg/t
Pb		5.299			3.242	1.7	g/t
PCB		3.0	2.285714	1.571429	1		mg/t
PCDD/F		6.0	4.575	3.149	1.724	0.796	µg/t
SO_2		IE[2)]		1.08	0.837	0.691	kg/t
TSP	channelled		0.65	0.465	0.234	0.096	kg/t
TSP	diffuse					0.046	kg/t
PM_{10}	channelled		0.445	0.336	0.177	0.07	kg/t
PM_{10}	diffuse					0.016	kg/t
$PM_{2.5}$	channelled		0.214	0.206	0.13	0.056	kg/t

Table 2: Overview of the emission factors applied for pig iron production

Pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	Unit
B(a)P		0.05				mg/t
Cd	channelled	4.0				mg/t
Cd	diffuse	0.203				mg/t
CO	channelled	1.18	0.915	0.65	0.491	kg/t
CO	diffuse	0.398				kg/t
Cr	channelled	0.019	0.006	0.002	0.001	g/t
Cr	diffuse	0.008				g/t
Hg	channelled	2.436	0.192	0.015	0.003	mg/t
Hg	diffuse	0.005				mg/t
Ni	channelled	21.0	6.0	2.0	1.0	mg/t
Ni	diffuse	8.0				mg/t
NMVOC		18.525				g/t
NO_x	channelled	0.051938	0.051938	0.051938	0.0517	kg/t
NO_x	diffuse	0.001				g/t
Pb	channelled	0.022				g/t
Pb	diffuse	0.011				g/t
PCDD/F		0.026	0.009	0.004	0.004	µg/t
SO_2	channelled	0.242				kg/t
SO_2	diffuse	0.04				kg/t
TSP	channelled	0.022	0.015	0.01	0.008	kg/t

Pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	Unit
TSP	diffuse	0.016				kg/t
PM_{10}	channelled	0.013	0.009	0.006	0.006	kg/t
PM_{10}	diffuse	0.007				kg/t
$PM_{2.5}$	channelled	0.009	0.007	0.005	0.004	kg/t

Table 3: Overview of the emission factors applied for oxygen steel production

Pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	Unit
Cd		0.053	0.038	0.024	0.016	g/t
CO		11.500	11.077	10.654	10.400	kg/t
Cr	channelled	0.715	0.306	0.125	0.028	g/t
Cr	diffuse	0.069				g/t
Ni	channelled	0.090	0.060	0.030	0.006	g/t
Ni	diffuse	0.004				g/t
NO_x	channelled	0.006	0.005	0.005	0.004	kg/t
NO_x	diffuse	0.0037				kg/t
PAH		0.100				mg/t
Pb	channelled	2.941	1.883	0.824	0.189	g/t
Pb	diffuse	0.278				g/t
PCB		2.670	1.740	1	1	mg/t
PCDD/F		0.070	0.070	0.070	0.069	µg/t
SO_2	diffuse	0.001				kg/t
TSP	channelled	0.155	0.145	0.145	0.024	kg/t
TSP	diffuse	0.049				kg/t
PM_{10}	channelled	0.099	0.093	0.093	0.020	kg/t
PM_{10}	diffuse	0.019				kg/t
$PM_{2.5}$	channelled	0.025	0.023	0.023	0.017	kg/t

Table 4: Overview of the emission factors applied for electric steel production

Pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	Unit
B(a)P		2.531	1.661	0.792	0.271	mg/t
Cd		0.240	0.157	0.065	0.016	g/t
CO	channelled	1.700	1.187	0.674	0.366	kg/t
CO	diffuse	0.001				kg/t
Cr	channelled	0.481	0.206	0.258	0.323	g/t
Cr	diffuse	0.851				g/t
Hg	channelled	0.306	0.288	0.154	0.070	g/t
Ni	channelled	0.483	0.207	0.145	0.124	g/t
Ni	diffuse	0.284				g/t
NMVOC		0.035	0.024	0.012	0.006	kg/t
NO_x	channelled	0.122	0.12	0.106	0.098	kg/t
NO_x	diffuse	0.014				kg/t
PAH		45	22	3.793	3.793	mg/t
Pb	channelled	4.075	1.747	0.720	0.170	g/t
Pb	diffuse	0.056				g/t
PCB		5.68	3.360	1.500	1.500	mg/t
PCDD/F		0.466	0.295	0.158	0.158	µg/t
SO_2	channelled	0.113				kg/t
SO_2	diffuse	0.004				kg/t
TSP	channelled	0.28	0.12	0.074	0.018	kg/t
TSP	diffuse				0.043	kg/t
PM_{10}	channelled	0.179	0.08	0.051	0.013	kg/t
PM_{10}	diffuse				0.007	kg/t
$PM_{2.5}$	channelled	0.045	0.04	0.038	0.011	kg/t

Table 5: Overview of the emission factors applied for hot and cold rolling

Pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	unit	Trend
CO					5.0	g/t	constant
NH_3				0.700		g/t	constant
NMVOC				3.0		g/t	constant
NO_x			0.410	0.276	0.196	kg/t	falling
SO_2			0.059	0.050	0.044	kg/t	falling
TSP	channelled				0.020	kg/t	constant
TSP	diffuse				0.010	kg/t	constant
PM_{10}	channelled				0.304	g/t	constant
PM_{10}	diffuse				0.645	g/t	constant
$PM_{2.5}$	channelled				0.266	g/t	constant

Table 6: Overview of the emission factors applied for iron and steel casting

Pollutant	EF 2010	Unit	Trend
B(a)P	10	mg/t	constant
NH_3	0.027	kg/t	falling
NMVOC	0.150	kg/t	constant
NO_x	0.242	kg/t	falling
PAH	0.100	g/t	constant
PCDD/F	0.190	µg/t	constant
SO_2	0.256	kg/t	falling
TSP	0.200	kg/t	constant
PM_{10}	0.137	kg/t	constant
$PM_{2.5}$	0.0836	kg/t	constant

Discussion of emission trends

The trends in emissions correspond to the trends of emission factors given in the tables above, which are often driven by regulatory measures.

However, since 2010, the main driver of the emission trends in most cases is the activity data.

Recalculations

For more **information on recalculated emission estimates for the Base Year and 2019**, please see the pollutant specific recalculation tables in the following chapter 8.1 - Recalculations.

Planned improvements

HCB emissions from **iron and steel production** have not been included so far due to a lack of emission data (notation key NE). In the past, the standard emission factor was not considered as appropriate, because it was unclear from what kind of data the factor was derived from and to which process/activity rate it actually referred to. In order to overcome this data gap, information will be collected within the scope of a reserach project for updating and completing the emission factors for the sector. The project will start in 2021 and is designed to run for three years.

For **sinter production**, as long as no country specific emission factor for HCB has been derived, the standard emission factor is used. By implementing the EMEP/EEA Guidebook standard emission factor, Germany is following recommendations provided by the Expert Review Team for the NECD-Review in 2020.

[1] , [2]

Emissions were reported under NRF Code 1.A.2.a