2.C.1 - Iron & Steel Production

Short description

Source category *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				
Key Category	**SO_2**	**NO_x**	**NH_3**	**NMVOC**	**CO**	**BC**	**Pb**	**Hg**	**Cd**	**Diox**	**PAH**	**HCB**	**TSP**	**PM_{10}**	**$PM_{2.5}$**
2.C.1	L/-	-	-	-	L/-	-	L/T	L/T	L/T	L/T	-	-	L/T	L/T	L/T

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.

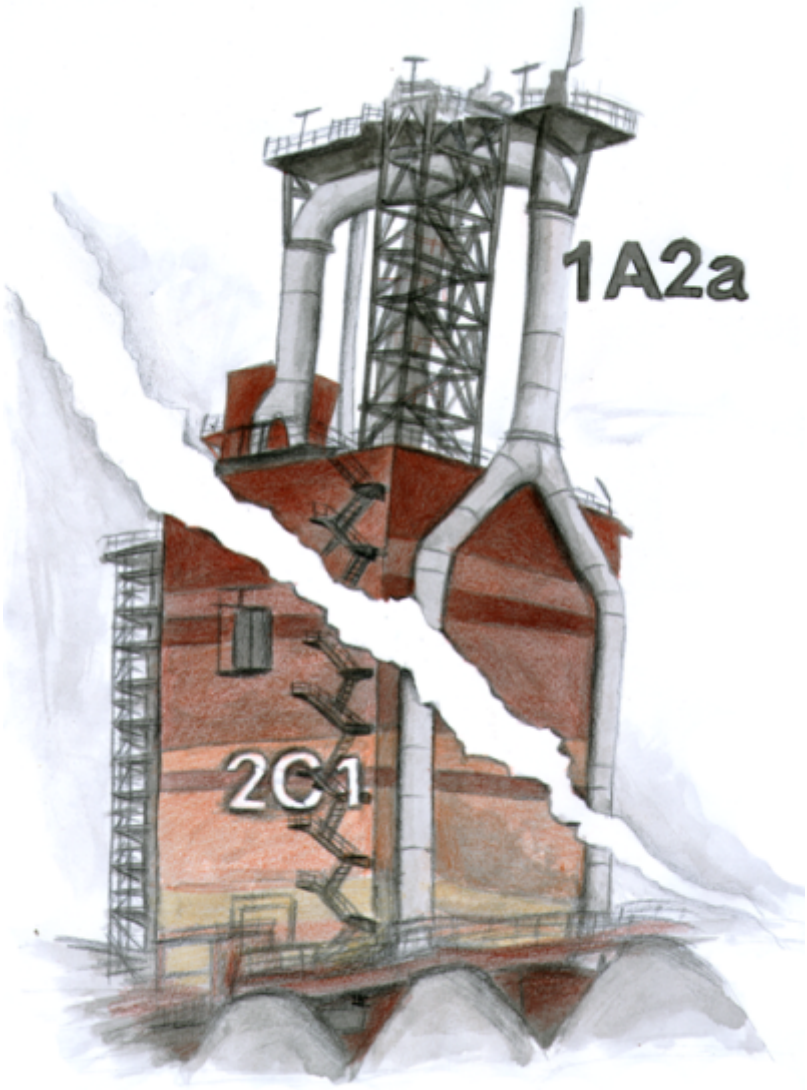
AD - Data Source for Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific data
AS	Associations, business organisations
Q	specific questionnaires, surveys

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

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

Other structural elements are sinter production, hot iron production, hot rolling, iron and steel foundries (including malleable casting). The last Siemens-Martin steel works (Stahlwerk Brandenburg) was shut down shortly after 1990; the last Thomas steel works (Maxhütte Sulzbach-Rosenberg) discontinued its production in 2002. Due to their minor relevance and the phasing 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 - 1994 (for individual pollutants until 1999) are reported under 1.A.2.a.



Method

Activity data

Activity data are is collected from plant operators by national institutions. After 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 has been verified against comparative figures for previous years. The deviations were less than 1%, only in sinter production they are 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, instead of coke and coal. To date, these materials have not yet been included in the national statistics and in the Energy Balance. For this reason, the data used is also provided by the steel trade association (WV Stahl).

Emission factors

The emission factors used for emissions calculation are based on emission data from individual plants, either determined by the Umweltbundesamt (UBA) itself (emission factors for 1995 - 2001) or by a research project (emission factors for 2008 and

later).

As the EF for the years 1995 - 2001 as well as for 2008 are based on real stack emission data, it is not possible to distinguish between combustion and process emissions (they are emitted via the same stacks). Hence whereever plant-based EF were availaible, i.e. 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 hardly significant for the diffuse emissions from other plants. The emission factors given below were calculated as the weighted average of pollution loads reported for individual diffuse sources by the plant operators, in relation to their corresponding production amounts.

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

pollutant	Type of source	EF 1990	EF 1995	EF 2000	EF 2005	EF 2010	EF 2016	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
NOx		IE[1)]		0.558	0.46	0.401		kg/t
PAH		320.00	248.571	177.143	120			
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	0.578	µg/t
SO2		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
PM10	channelled		0.445	0.336	0.177	0.07		kg/t
PM10	diffuse	0.016						kg/t
PM2.5	channelled		0.214	0.206	0.13	0.056		kg/t

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

pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	EF 2016	unit
B(a)P		0.05					mg/t
Cd	channelled	0.004					g/t
Cd	diffuse	0.000203					g/t
CO	channelled	1.18	0.915	0.65	0.491	0.491	kg/t
CO	diffuse	0.398					kg/t
Cr	channelled	0.019	0.006	0.002	0.001	0.001	g/t
Cr	diffuse	0.008					g/t
Hg	channelled	0.002436	0.000192	0.000015	0.000003	0.000003	g/t
Hg	diffuse	0.005					mg/t
Ni	channelled	0.021	0.006	0.002	0.001	0.001	g/t
Ni	diffuse	0.008					g/t
NMVOC		0.018525					kg/t
NOx	channelled	0.051938	0.051938	0.051938	0.0517	0.0517	kg/t
NOx	diffuse	0.001					g/t
Pb	channelled	0.022					kg/t
Pb	diffuse	0.011					g/t
PCDD/F		0.026	0.009	0.004	0.004	0.004	µg/t
SO2	channelled	0.242					g/t
SO2	diffuse	0.04					kg/t

pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	EF 2016	unit
TSP	channelled	0.022	0.015	0.01	0.008	0.008	kg/t
TSP	diffuse	0.016					g/t
PM10	channelled	0.013	0.009	0.006	0.006	0.006	kg/t
PM10	diffuse	0.007					kg/t
PM2.5	channelled	0.009	0.007	0.005	0.004	0.004	kg/t

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

pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	EF 2016	unit
Cd		0.053	0.038	0.024	0.016	0.016	g/t
CO		11.500	11.077	10.654	10.400	10.400	kg/t
Cr	channelled	0.715	0.306	0.125	0.028	0.028	g/t
Cr	diffuse	0.069					g/t
Ni	channelled	0.090	0.060	0.030	0.006	0.006	g/t
Ni	diffuse	0.004					g/t
NOx	channelled	0.006	0.005	0.005	0.004	0.004	kg/t
NOx	diffuse	0.0037					kg/t
PAH		0.100					mg/t
Pb	channelled	2.941	1.883	0.824	0.189	0.189	g/t
Pb	diffuse	0.278					g/t
PCB		2.670	1.740	1	1	1	mg/t
PCDD/F		0.070	0.070	0.070	0.069	0.069	µg/t
SO2	diffuse	0.001					kg/t
TSP	channelled	0.155	0.145	0.145	0.024	0.024	kg/t
TSP	diffuse	0.049					kg/t
PM10	channelled	0.099	0.093	0.093	0.020	0.020	kg/t
PM10	diffuse	0.019					kg/t
PM2.5	channelled	0.025	0.023	0.023	0.017	0.017	kg/t

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

pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	EF 2016	unit
B(a)P		2.531	1.661	0.792	0.271	0.271	mg/t
Cd		0.240	0.157	0.065	0.016	0.016	g/t
CO	channelled	1.700	1.187	0.674	0.366	0.366	kg/t
CO	diffuse	0.001					kg/t
Cr	channelled	0.481	0.206	0.258	0.323	0.323	g/t
Cr	diffuse	0.851					g/t
Hg	channelled	0.306	0.288	0.154	0.070	0.070	g/t
Ni	channelled	0.483	0.207	0.145	0.124	0.124	g/t
Ni	diffuse	0.284					g/t
NMVOC		0.035	0.024	0.012	0.006	0.006	kg/t
NOx	channelled	0.122	0.12	0.106	0.098	0.098	kg/t
NOx	diffuse	0.014					kg/t
PAH		45	22	3.793	3.790	3.793	mg/t
Pb	channelled	4.075	1.747	0.720	0.170	0.170	g/t
Pb	diffuse	0.056					g/t
PCB		5.68	3.360	1.500	1.500	1.500	mg/t
PCDD/F		0.466	0.295	0.158	0.158	0.158	µg/t
SO2	channelled	0.113					kg/t
SO2	diffuse	0.004					kg/t
TSP	channelled	0.28	0.12	0.074	0.018	0.018	kg/t
TSP	diffuse				0.043	0.043	kg/t
PM10	channelled	0.179	0.08	0.051	0.013	0.013	kg/t
PM10	diffuse				0.007	0.007	kg/t
PM2.5	channelled	0.045	0.04	0.038	0.011	0.011	kg/t

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

pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	EF 2016	unit	Trend
CO					0.005	0.005	kg/t	constant
NH3			0.700				g/t	constant
NMVOC			0.003				kg/t	constant
NOx			0.410	0.276	0.196	0.196	kg/t	falling
SO2			0.059	0.050	0.044	0.044	kg/t	falling
TSP	channelled				0.020	0.020	kg/t	constant
TSP	diffuse				0.010	0.010	kg/t	constant
PM10	channelled				0.304	0.304	g/t	constant
PM10	diffuse				0.645	0.645	g/t	constant
PM2.5	channelled				0.266	0.266	g/t	constant

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

pollutant	EF 2010	unit	Trend
B(a)P	10	mg/t	constant
NH3	0.027	kg/t	falling
NMVOC	0.150	kg/t	constant
NOx	0.242	kg/t	falling
PAH	0.100	g/t	constant
PCDD/F	0.190	µg/t	constant
SO2	0.256	kg/t	falling
TSP	0.200	kg/t	constant
PM10	0.137	kg/t	constant
PM2.5	0.0836	kg/t	constant

Discussion of emission trends

Trends in emissions correspond to trends of emission factors in the table above, in many cases due to regulatory measures. Since 2010, the main driver for the emission trends in most cases is the activity data.

Recalculations

Replacing data of the preliminary energy balance with data of the final energy balance leads to restatements for the years 2017 and 2018.

For more information on recalculated emission estimates for Base Year and 2018, please see the pollutant specific recalculation tables 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 three years.

As long as no country specific emission factor for HCB has been derived, the standard emission factor is used. In 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