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

The last Siemens-Martin steel works (Stahlwerk Brandenburg) was shut down shortly after 1990; the last Thomas steel works (Maxhütte Sulzbach-Rosenberg) discontinued the 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.
The other structural elements are sinter production, hot iron production, hot rolling, iron and steel foundries (including malleable casting). Energy-related emissions from steel production for the years

1990 - 1994 (for individual pollutants until 1999) are reported under 1.A.2.a.

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.

Method

Activity data

Activity data are surveyed plant specific and submitted by national statistics. After discontinuation of the special 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. 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. To date, these materials have not yet been included in the national statistics and in the Energy Balance. For this reason, the data used was provided by the steel trade association (Wirtschaftsvereinigung Stahl).

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

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).
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 now also cover diffuse emissions from sources that were not covered in previous reporting periods, nor 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	Trend
Cd		0.098			0.052	0.017		g/t	falling
CO		19.152		17.325	15.497	14.4		kg/t	falling
Cr		0.077			0.044	0.02		g/t	falling
HCB		0.03						mg/t	constant
Hg		0.059			0.028	0.005		g/t	falling
Ni		0.139			0.068	0.015		g/t	falling
NMVOC		0.12						kg/t	constant
NOx		IE		0.558	0.46	0.401		kg/t	falling
PAH		320.00	248.571	177.143	120			mg/t	falling
Pb		5.299			3.242	1.7		g/t	falling
PCB		3.0	2.285714	1.571429	1			mg/t	falling
PCDD/F		6.0	4.575	3.149	1.724	0.796	0.578	µg/t	falling
SO2		IE		1.08	0.837	0.691		kg/t	falling
TSP	channelled		0.65	0.465	0.234	0.096		kg/t	falling
TSP	diffuse	0.046						kg/t	new EF
PM10	channelled		0.445	0.336	0.177	0.07		kg/t	falling
PM10	diffuse	0.016						kg/t	new EF
PM2.5	channelled		0.214	0.206	0.13	0.056		kg/t	falling

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	Trend
B(a)P		0.05					mg/t	constant
Cd	channelled	0.004					g/t	constant
Cd	diffuse	0.000203					g/t	constant
CO	channelled	1.18	0.915	0.65	0.491	0.491	kg/t	falling
CO	diffuse	0.398					kg/t	constant
Cr	channelled	0.019	0.006	0.002	0.001	0.001	g/t	falling
Cr	diffuse	0.008					g/t	constant
Hg	channelled	0.002436	0.000192	0.000015	0.000003	0.000003	g/t	falling
Hg	diffuse	0.005					mg/t	constant
Ni	channelled	0.021	0.006	0.002	0.001	0.001	g/t	falling
Ni	diffuse	0.008					g/t	constant
NMVOC		0.018525					kg/t	constant
NOx	channelled	0.051938	0.051938	0.051938	0.0517	0.0517	kg/t	falling
NOx	diffuse	0.001					g/t	constant
Pb	channelled	0.022					kg/t	constant
Pb	diffuse	0.011					g/t	constant
PCDD/F		0.026	0.009	0.004	0.004	0.004	µg/t	falling
SO2	channelled	0.242					g/t	constant
SO2	diffuse	0.04					kg/t	constant
TSP	channelled	0.022	0.015	0.01	0.008	0.008	kg/t	falling
TSP	diffuse	0.016					g/t	constant
PM10	channelled	0.013	0.009	0.006	0.006	0.006	kg/t	falling
PM10	diffuse	0.007					kg/t	constant
PM2.5	channelled	0.009	0.007	0.005	0.004	0.004	kg/t	falling

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	Trend
Cd		0.053	0.038	0.024	0.016	0.016	g/t	falling
CO		11.500	11.077	10.654	10.400	10.400	kg/t	falling
Cr	channelled	0.715	0.306	0.125	0.028	0.028	g/t	falling
Cr	diffuse	0.069					g/t	new EF, constant
Ni	channelled	0.090	0.060	0.030	0.006	0.006	g/t	falling
Ni	diffuse	0.004					g/t	new EF, constant
NOx	channelled	0.006	0.005	0.005	0.004	0.004	kg/t	falling
NOx	diffuse	0.0037					kg/t	constant
PAH		0.100					mg/t	constant
Pb	channelled	2.941	1.883	0.824	0.189	0.189	g/t	falling
Pb	diffuse	0.278					g/t	new EF, constant
PCB		2.670	1.740	1	1	1	mg/t	falling
PCDD/F		0.070	0.070	0.070	0.069	0.069	µg/t	falling
SO2	diffuse	0.001					kg/t	constant
TSP	channelled	0.155	0.145	0.145	0.024	0.024	kg/t	falling
TSP	diffuse	0.049					kg/t	new EF, constant
PM10	channelled	0.099	0.093	0.093	0.020	0.020	kg/t	falling

pollutant	Type of source	EF 1995	EF 2000	EF 2005	EF 2010	EF 2016	unit	Trend
PM10	diffuse			0.019			kg/t	new EF, constant
PM2.5	channelled	0.025	0.023	0.023	0.017	0.017	kg/t	falling

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

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	new EF, constant
TSP	diffuse				0.010	0.010	kg/t	new EF, constant
PM10	channelled				0.304	0.304	g/t	new EF, constant
PM10	diffuse				0.645	0.645	g/t	new EF, constant
PM2.5	channelled				0.266	0.266	g/t	new EF, 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

Uncertainties

[Text einfügen]

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 year 2017.

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 have not been included in iron production till German Informative Inventory Report 2021 due to lack of emission data (notation key NE). And the standard emission factor is not seen as appropriate. In order to overcome this data gap, information search will be done within the scope of a Project for actualizing several emission factors. The project should start in 2021 and is designed to run three years. As long as there is no country specific emission factor for HCB 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.