

## 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 <sub>2</sub>	NO <sub>x</sub>	NH <sub>3</sub>	NM VOC	CO	BC	Pb	Hg	Cd	Diox	PAH	HCB	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>
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

<b>D</b>	Default
<b>RA</b>	Reference Approach
<b>T1</b>	Tier 1 / Simple Methodology *
<b>T2</b>	Tier 2*
<b>T3</b>	Tier 3 / Detailed Methodology *
<b>C</b>	CORINAIR
<b>CS</b>	Country Specific
<b>M</b>	Model

\* as described in the EMEP/CORINAIR Emission Inventory Guidebook - 2007, in the group specific chapters.

#### AD - Data Source for Activity Data

<b>NS</b>	National Statistics
<b>RS</b>	Regional Statistics
<b>IS</b>	International Statistics
<b>PS</b>	Plant Specific data
<b>AS</b>	Associations, business organisations
<b>Q</b>	specific questionnaires, surveys

#### EF - Emission Factors

<b>D</b>	Default (EMEP Guidebook)
<b>C</b>	Confidential
<b>CS</b>	Country Specific
<b>PS</b>	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 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 wherever plant-based EF were available, 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

<b>pollutant</b>	<b>Type of source</b>	<b>EF 1990</b>	<b>EF 1995</b>	<b>EF 2000</b>	<b>EF 2005</b>	<b>EF 2010</b>	<b>EF 2016</b>	<b>unit</b>	<b>Trend</b>
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 <sup>1)</sup>	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
SO <sub>2</sub>			IE <sup>2)</sup>	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
PM <sub>10</sub>	channelled		0.445	0.336	0.177		0.07	kg/t	falling
PM <sub>10</sub>	diffuse			0.016				kg/t	new EF
PM <sub>2.5</sub>	channelled		0.214	0.206	0.13		0.056	kg/t	falling

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

<b>pollutant</b>	<b>Type of source</b>	<b>EF 1995</b>	<b>EF 2000</b>	<b>EF 2005</b>	<b>EF 2010</b>	<b>EF 2016</b>	<b>unit</b>	<b>Trend</b>
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
SO <sub>2</sub>	channelled					0.242	g/t	constant
SO <sub>2</sub>	diffuse			0.04			kg/t	constant

<b>pollutant</b>	<b>Type of source</b>	<b>EF 1995</b>	<b>EF 2000</b>	<b>EF 2005</b>	<b>EF 2010</b>	<b>EF 2016</b>	<b>unit</b>	<b>Trend</b>
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

<b>pollutant</b>	<b>Type of source</b>	<b>EF 1995</b>	<b>EF 2000</b>	<b>EF 2005</b>	<b>EF 2010</b>	<b>EF 2016</b>	<b>unit</b>	<b>Trend</b>
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
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

<b>pollutant</b>	<b>Type of source</b>	<b>EF 1995</b>	<b>EF 2000</b>	<b>EF 2005</b>	<b>EF 2010</b>	<b>EF 2016</b>	<b>unit</b>	<b>Trend</b>
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
NM VOC		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
NM VOC				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
NM VOC	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 research 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