CLIMATE CHANGE
56/2024

Development of the iron and steelmaking sector under the EU ETS

Overview and country level analysis from 2005 to 2019

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Publisher:
German Environment Agency

German Environment Agency

CLIMATE CHANGE 56/2024

Ressortforschungsplan of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

Project No. (FKZ) 3719 42 505 0
FB001603/ENG

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On behalf of the German Environment Agency

Imprint

Publisher
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06844 Dessau-Roßlau
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Internet: www.umweltbundesamt.de

Report performed by:
Oeko-Institut e.V.
Borkumstraße 2
13189 Berlin
Germany

Report completed in:
September 2024

Edited by:
Section V 3.3 Economic Aspects of Emissions Trading, Monitoring, Evaluation
Alexandra Zirkel

DOI:
https://doi.org/10.60810/openumwelt-7626

ISSN 1862-4359

Dessau-Roßlau, Dezember 2024

Abstract: Development of the iron and steelmaking sector under the EU ETS

Iron and steelmaking is the industrial sector with the highest absolute CO_2 emissions covered by the European Union Emissions Trading System (EU ETS). This report aims to describe key developments of the sector in the period from 2005 to 2019. It identifies key drivers behind the trends in emissions, production levels, investments, and the market environment on the country and installation level. By providing key information from past developments, it sets a solid basis for future projections and the design of climate policy. The report begins by providing an overview of the EU-28 level, describing emissions sources, production routes as well as trends in investments and the regulatory and market environment. The remainder provides information on the iron and steelmaking sector for eight selected European countries: Germany, Italy, France, Poland, Austria, the United Kingdom, the Netherlands and the Czech Republic in the form of brief fact sheets. Since the introduction of the EU ETS in 2005, total emissions reported in the European Union Transaction Log (EUTL) have declined from around 240 Mt CO_2 to around 200 Mt CO_2 in 2019. The decline can mostly be attributed to a reduction in total production volumes (from 190 Mt crude steel in 2005 to 160 Mt crude steel in 2019), with no significant change in shares of different production routes, nor significant efficiency gains on the respective routes. EU-28 steel consumption is predominantly balanced by domestic supply. In 2019, almost 10 % of net demand was covered by imports with the largest trade partners being Russia and Ukraine, albeit China is the world dominate steel producer with 50 % of steelmaking capacity. On the facility level, no new integrated steelworks have opened in the EU-28 since 2005; in fact most sites look back on a long history of steelmaking. In the aftermath of the economic crisis of 2008–2009 several furnaces were not relined after reaching the end of the lifetime (in particular in the United Kingdom, France, Poland and the Czech Republic). Few new electric arc furnaces were added at existing integrated sites, e.g. in the United Kingdom and Italy.

Kurzbeschreibung: Entwicklung des Eisen- und Stahlerzeugungssektors im Rahmen des EU-ETS

Die Eisen- und Stahlerzeugung ist der Industriesektor mit den höchsten absoluten CO_2-Emissionen, der unter das Emissionshandelssystem der Europäischen Union (EU-ETS) fällt. Dieser Bericht beschreibt die wichtigsten Entwicklungen des Sektors im Zeitraum von 2005 bis 2019. Er identifiziert die Haupttreiber hinter den Trends bei Emissionen, Produktionsniveaus, Investitionen und dem Marktumfeld auf Länder- und Anlagenebene. Durch die Bereitstellung von Schlüsselinformationen aus der Vergangenheit wird eine solide Grundlage für künftige Prognosen und die Gestaltung von Klimapolitik geschaffen. Der Bericht beginnt mit einem Überblick über die EU-28, in dem die Emissionsquellen, die Produktionsrouten sowie die Trends bei den Investitionen und dem Regulierungs- und Marktumfeld beschrieben werden. Der Rest des Berichts enthält Informationen über die Eisen- und Stahlindustrie in acht ausgewählten europäischen Ländern: Deutschland, Italien, Frankreich, Polen, Österreich, das Vereinigte Königreich, die Niederlande und die Tschechische Republik in Form von kurzen Fact Sheets. Seit der Einführung des EU-ETS im Jahr 2005 sind die im Transaktionsprotokoll (EUTL) gemeldeten Gesamtemissionen von rund 240 Mio. t CO_2 auf rund 200 Mio. t CO_2 im Jahr 2019 zurückgegangen. Dieser Rückgang ist hauptsächlich auf eine Verringerung des Gesamtproduktionsvolumens zurückzuführen (von 190 Mio. t Rohstahl im Jahr 2005 auf 160 Mio. t Rohstahl im Jahr 2019), ohne dass sich die Anteile der verschiedenen Produktionsrouten nennenswert verändert hätten oder nennenswerte Effizienzsteigerungen auf den jeweiligen Routen zu verzeichnen gewesen wären. Der Stahlverbrauch der EU-28 wird überwiegend durch das inländische Angebot gedeckt. Im Jahr 2019 wurden knapp 10 % der Netto-Nachfrage durch Einfuhren gedeckt, wobei Russland und die Ukraine die wichtigsten Handelspartner waren, auch wenn China mit 50 % der Stahlerzeugungskapazität der weltweit dominierende Stahlproduzent ist. Was die Anlagen betrifft, so wurden in der EU-28 seit 2005 keine neuen integrierten Stahlwerke eröffnet; die meisten Standorte blicken vielmehr auf eine lange Geschichte der Stahlerzeugung zurück. Nach der Wirtschaftskrise 2008-2009 wurden mehrere Hochöfen nach Ablauf ihrer Lebensdauer nicht mehr neu zugestellt (insbesondere im Vereinigten Königreich, Frankreich, Polen und in der Tschechischen Republik). Nur wenige neue Elektrolichtbogenöfen wurden an bestehenden integrierten Standorten hinzugefügt, z. B. im Vereinigten Königreich und in Italien.

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CO_2	Carbon dioxide
ASU	Apparent steel use
BF	Blast furnaces
BOF	Blast oxygen furnace
BREF	Best available techniques reference document
CCFD	Carbon contracts for difference
DRI	Directly reduced iron
EAF	Electric arc furnace
EU ETS	EU Emissions Trading System
EUTL	European Union transaction log
GVA	Gross value added
IPCEI	Important Project of Common European Interest
Mt	Mega tons
MW	Megawatt
PCI	Pulverized coal injection
SSI	Sahaviriya Steel Industries

Summary

Aim and structure

The EU ETS is the key policy instrument for managing the reduction of greenhouse gas emissions for power generation and industrial facilities in Europe. Iron and steelmaking is the industrial sector with the highest absolute CO_2 emissions. The sector plays an important role for value creation and employment in the EU-28 and induces substantial intra-EU and also international trade.

This report aims at describing key developments of the sector in the period from 2005 to 2019, i.e., before the end of the 3rd ETS trading period in 2020 and before the significant changes of economic activity that have been associated with the COVID pandemic. Likewise, changes in the macroeconomic framework since then are not covered, and also potential impacts of the "fit-for-55" framework that was casted in law in 2023. Among other things, this reform package foresees changes in the ETS cap path and the introduction of a "carbon border adjustment mechanism" (CBAM), which is to gradually replace free allocations for industrial sectors including the iron and steel industry. Furthermore, EU allowance prices have risen substantially since 2018 and continued to do so also after 2019 (see e.g. DEHSt (2024)for a graphical illustration of the observed price developments), which can be attributed at least in part to a growing perception of scarcity in the market.

Our analysis identifies key drivers behind the trends in emissions, production levels, investments, and the market environment on the country and installation level. By providing key information from past developments, it sets a solid basis for future projections and the design of climate policy. Since 2019, emissions on the EU level and in the majority of member states have first dropped strongly in 2020 due to the economic effects of the COVID pandemic, then temporarily recovered in 2021 but have again dropped substantially in 2022 and 2023 (see ERC CM (2023, p. 15) for the EU level, and DEHSt (2024) for Germany as an example for trends on the member state level). These emission trends largely reflect the development in production (mainly that of the primary production route which dominates the CO_2 emissions of the iron and steel sector), which has seen significant declines particularly in 2022 and 2023 not least as a consequence of the Russian war of aggression against Ukraine, both at the EU level and in Germany (EUROFER 2024; World Steel Association 2024; WV Stahl 2024).

The report begins by providing an overview of the EU-28 level, describing emissions sources, production routes as well as trends in investments and the regulatory and market environment. The remainder provides information on the iron and steelmaking sector for eight selected European countries: Germany, Italy, France, Poland, Austria, the United Kingdom, the Netherlands and the Czech Republic in the form of brief fact sheets. The selected countries constitute 70 % of total crude steel production and 75 % of the emissions from iron and steel production in the EU-28 covered by the EU ETS (activity codes 22 - 25 and waste gas power plants listed under activity code 20). They show a varying share of production (0 % - 82 %) with the electric arc furnace (EAF) (on average the EAF-share is 41 % in the EU-28) and a varying share of emissions from iron and steel production in total emissions (3 % - 15 %) (in the EU-28, iron and steelmaking contribute 5 % of total emissions).

EU-28 level

Since the EU ETS was introduced in 2005, the total emissions reported in the EUTL have declined from around 240 Mt CO_2 to around 200 Mt CO_2 in 2019. The decline can be mostly attributed to a reduction in total production volumes (from 190 Mt crude steel in 2005 to 160 Mt crude steel in 2019), with no significant change in shares of different production routes,

nor significant efficiency gains on the respective routes. EU-28 steel consumption is predominately balanced by domestic supply. In 2019, almost 10 % of net demand was covered by imports with the biggest trade partners being Russia and Ukraine, albeit China is the world dominate steel producer with 50 % of steelmaking capacity. On the facility level, no new integrated steelworks have been opened in the EU-28 since 2005, in fact most sites look back on a long history of steelmaking. In the aftermath of the economic crisis of 2008 - 2009 several furnaces were not relined after reaching the end of the lifetime (particularly in the United Kingdom, France, Poland and Czech Republic). A few new electric arc furnaces were added at existing integrated sites, e.g. in the United Kingdom and Italy.

Table 1: Emissions by process in the iron and steelmaking sector based on site-specific assessment from the EUTL for EU 28

Process	Indicator	Unit	2013	2015	2018	2019
Blast furnaces (BF-BOF route)	Emissions[1]	[Mt CO_2]	186.0	188.4	182.2	174.0
	Production	[Mt crude steel]	100.1	100.9	98.1	93.9
	Specific emissions	[t CO_2/t crude steel]	1.86	1.87	1.86	1.85
Electric arc furnace (EAF route)	Emissions[2]	[Mt CO_2]	9.7	9.7	10.2	9.4
	Production[3]	[Mt crude steel]	65.7	64.8	68.9	64.4
	Specific emissions	[t CO_2/t crude steel]	0.15	0.15	0.15	0.15
Directly reduced iron (DRI-EAF route)	Emissions[4]	[Mt CO_2]	0.5	0.5	0.5	0.5
	Production	[Mt direct reduced iron]	0.6	0.7	0.7	0.6
	Specific emissions	[t CO_2/t product]	0.86	0.80	0.80	0.79
Other[5]	Emissions	[Mt CO_2]	13.7	12.4	12.6	11.6
Total	**Emissions**	**[Mt CO_2]**	**210.0**	**211.1**	**205.5**	**195.7**

Note:

[1] Emissions attributed to the BF-BOF route include: emissions from coking plant and sintering plant (either reported seperately, e.g. under activity codes 22 and 23 or as integrated steelworks under code 24), emissions from pig iron and steel production in the BF and BOF (reported under code 24) and emissions from downstream processes that typically use waste gases for the upstream processes as fuel input (reported under code 25, or as integrated steelworks under code 24), and emissions from on-site waste gas power plants (reported under code 20).

[2] Emissions attributed to the EAF route originate from fuel use and electrode wear in the electric arc furnaces (reported under code 24 or in some cases 25) and rolling mills wich often report under the same installation.

[3] Excluding EAF steel production from direct reduced iron.

[4] Emissions attributed to the DRI route include fuel-related and process emissions from DRI installations and the share of the emissions of from the subsequent EAF route that equals the mass share of the DRI in the EAF.

[5] other emissions include all emissions under codes 22-25 that are not attributed to integrated steelworks or one of the three production routes.

Source: Own compilation of data based on (EC n.d.) for emissions data, (Worldsteel Association 2020) for production data.

Table 1 provides an overview of total emissions, production and emission intensity trends for the three main production routes of crude steel. The majority of the emissions from the iron and steelmaking sector are related to pig iron production with blast furnaces (BF-BOF route). Total emissions related to crude steel production in BF-BOF sites amounted to 176 Mt CO_2 in 2019, which is equal to 89 % of the total iron and steelmaking sector emissions covered by the EU ETS. The average direct emission intensity of the BF-BOF route – including waste gas power plants - was approx. 1.85 t CO_2 per ton of crude steel in 2019, which has not changed since 2013. This emission intensity also includes emissions from sintering and coking plants, blast furnaces, basic oxygen furnace and rolling mills when operated at integrated sites.

No significant emission reductions have been achieved on the blast furnace route since the introduction of emissions trading. Specific emissions have decreased only by 2 % in the EU-28 and even increased in many countries, e.g. by 10 % in Germany. The increase in specific emissions on the blast furnace route can be attributed to several factors. The most significant ones are an inefficient use of the integrated infrastructure due to reduced output and a rise in the injection of cheap hard coal (pulverized coal injection (PCI)) replacing natural gas. In the first years of the EU ETS, the carbon price signal was not strong enough to prevent this fuel switch.

Total direct emissions related to EAF sites amounted to 9.4 Mt CO_2 in 2019, which is equal to 5 % of the total iron and steelmaking sector emissions. The average direct emission intensity of the EAF route was about 0.15 t CO_2/t of crude steel in 2019. This emission intensity includes emissions from rolling mills operated at the same site when they report their emissions together with the EAF (which is often the case).

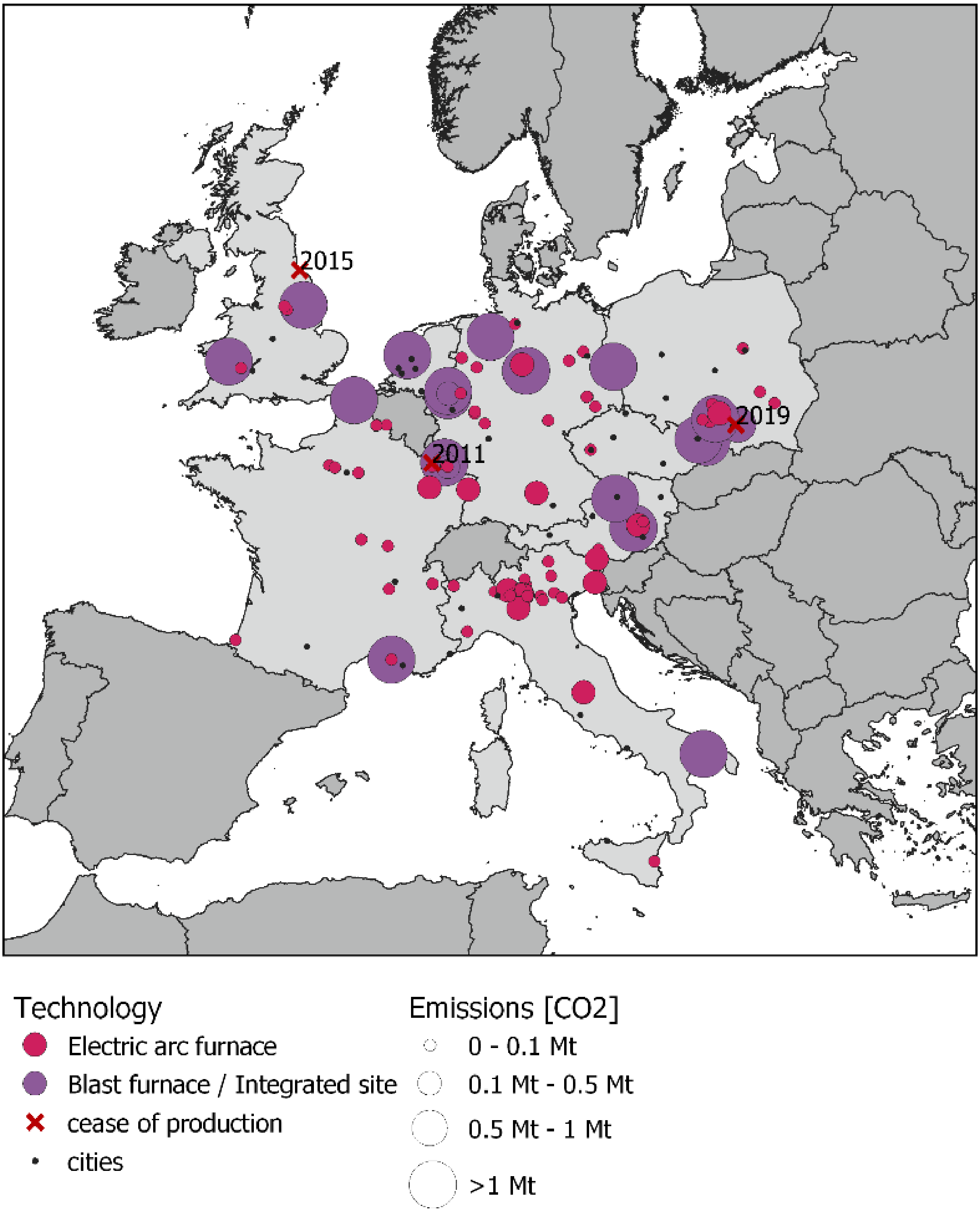
Total direct emissions related to DRI sites amounted to 0.5 Mt CO_2 in 2019, which is equal to 0.2 % of the total iron and steelmaking sector emissions. The average direct emission intensity on the DRI-EAF route was about 0.79 t CO_2/t of crude steel in 2019. This emission intensity includes emissions from the DRI plant and the EAF plant. The only DRI-EAF plant that is further analyzed in the fact sheets is located in Hamburg, Germany. Here, the intensity was 0.5 t CO_2/t DRI in 2019.

Emissions from other processes (including foundries and downstream processes) amounted to 11.6 Mt CO_2 (6 %) in 2019.

Country and facility level

Figure 1 shows the location and 2019 emission levels of integrated sites, blast furnaces, basic oxygen furnaces and electric arc furnaces in the selected eight countries.

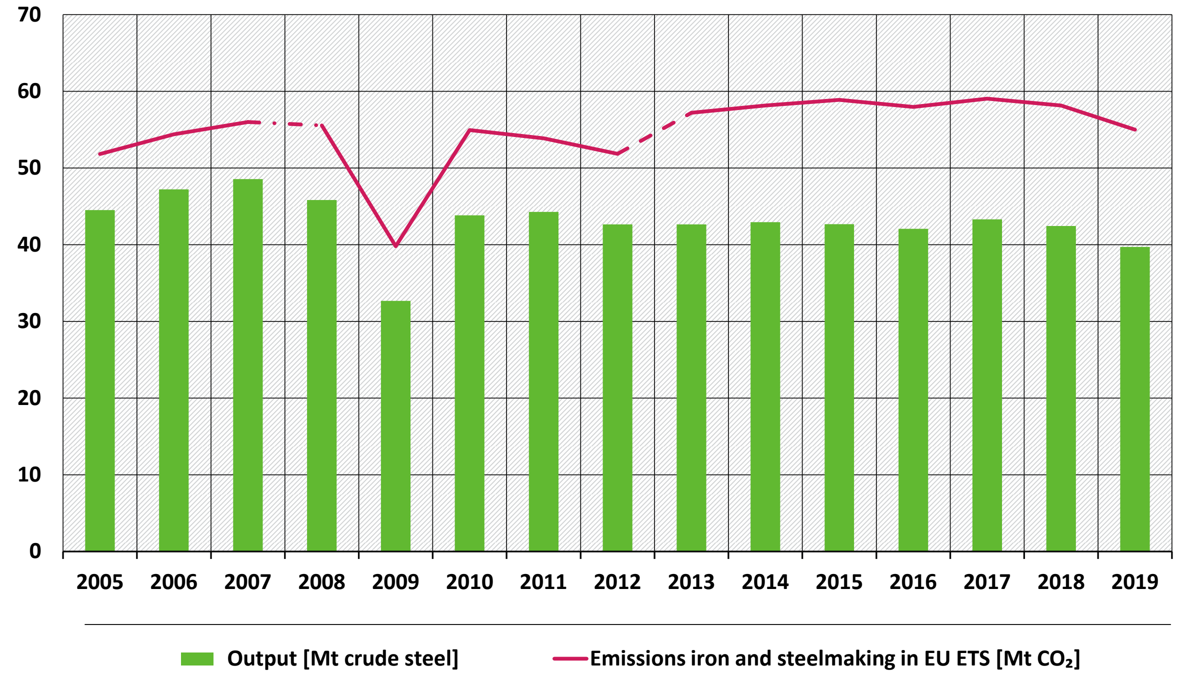
Figure 1: Location and emission levels of blast furnaces, integrated sites and electric arc furnaces in the selected countries, as of end of 2019



Source: Own illustration based on (EC n.d.)

Germany

Figure 2: Germany: Key trends in CO_2 emissions and crude steel production, 2005 - 2019

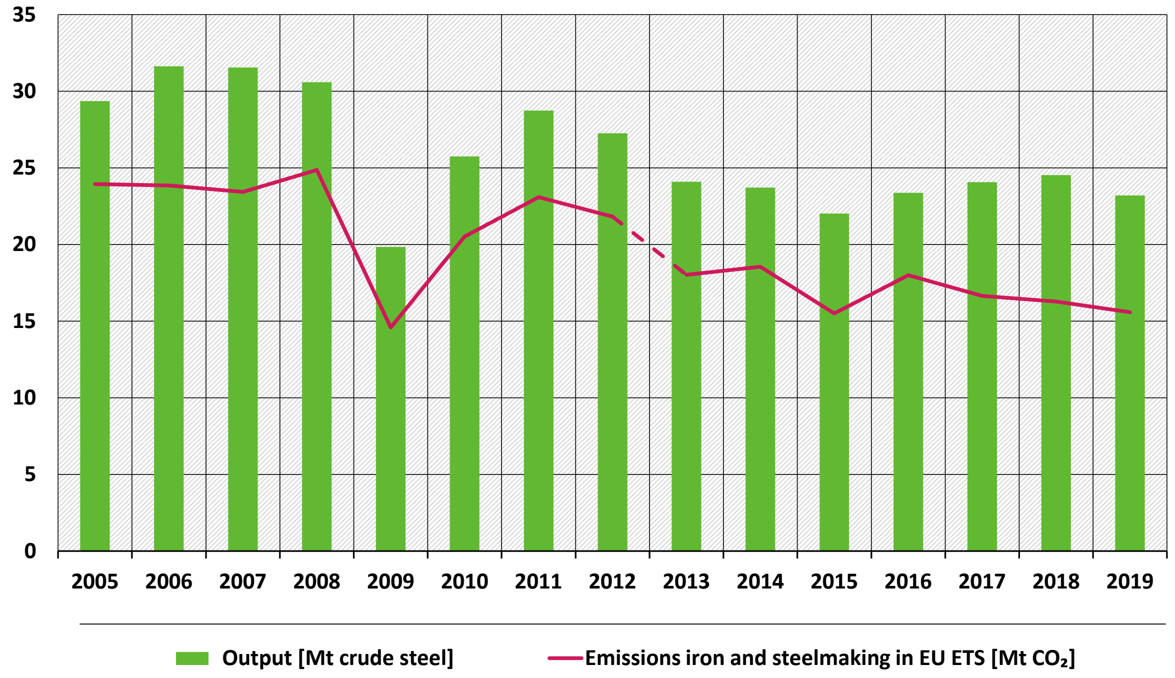


Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2007, between 2008 and 2012 and for 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d..

- Germany has the highest CO_2 emissions from iron and steelmaking in the EU ETS (55 Mt CO_2 in 2019), comprising 28 % of the total EU-28 emissions of the sector.
- It is also the country with the highest crude steel production in the EU-28, contributing about 25 % of total production. Since 2005, no major adjustments in production capacity have been observed.
- Emission trends follow the trend in production, which increased from 2005 to 2007, sharply declined in 2008 and 2009, recovered again, and remained steady until another decline in 2019. The increase in emissions between 2012 and 2013 can be attributed to an extension of the scope of emissions covered by the EU ETS.
- Germany hosts seven integrated steelworks with a diverse ownership structure. The ThyssenKrupp integrated steelworks in Duisburg is the largest BF/BOF site in Europe; it emitted 17 Mt. of CO_2 and had 4 blast furnaces in 2019.
- The EAF production share is about 30 %, which is below the average of the EU-28 (41 %).

Italy

Figure 3: Italy: Key trends in CO_2 emissions and crude steel production, 2005 - 2019

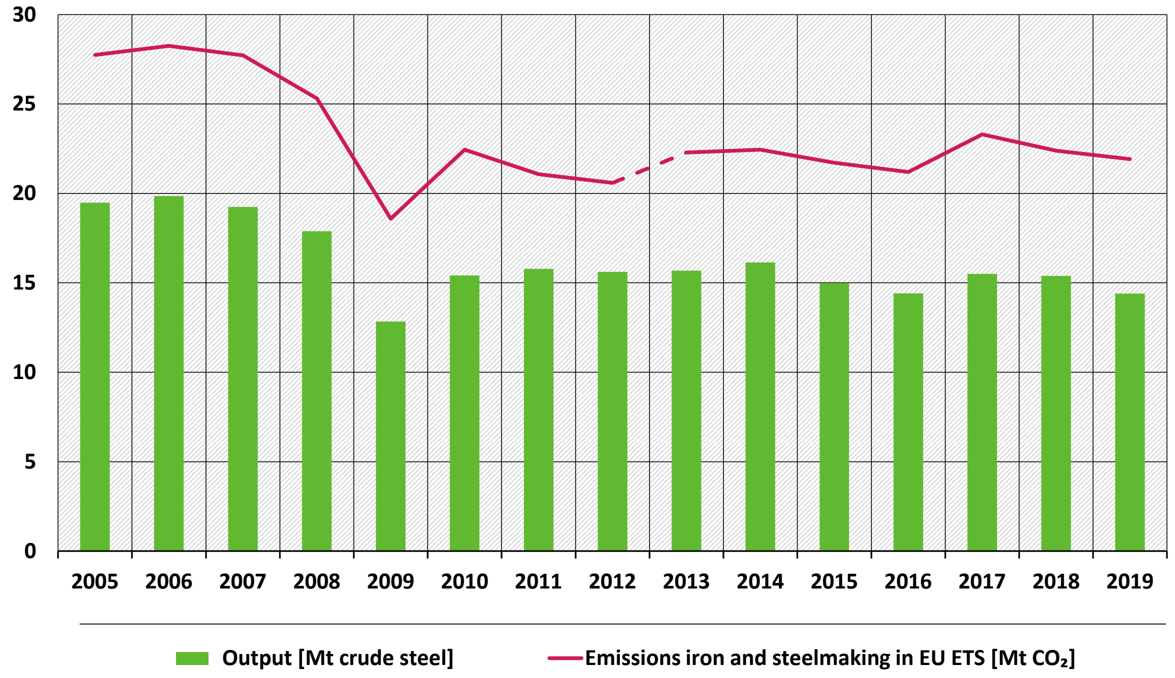


Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d..

- Italy has the 4th highest CO_2 emissions from iron and steelmaking in the EU ETS (15.6 Mt CO_2 in 2019), comprising 8 % of total EU-28 emissions of the sector.
- It is the county with the 2nd highest crude steel production in the EU-28 (19 Mt in 2019), contributing about 15 % in 2019. Steel production in Italy is mainly based on the EAF route; in 2019 the share of crude steel production of BF-BOF route was only 17 %, decreasing from 35 % in 2012. Correspondingly, the EAF share is 83 % (compared to 41 % in the EU-28 average), making Italy the largest producer of steel from the EAF route in the EU-28.
- Dominated by emissions from the BF-BOF route, emissions from the iron and steelmaking sector in Italy have decreased by 35 % between 2005 and 2019, while production only decreased by 20 % in the same period.
- Italy only hosts one integrated steelworks in Taranto in the south of Italy. The plant was owned by the Italian Riva group until 2012, when it was revealed that the plant was responsible for extreme levels of air pollution, after which it was seized by the Italian government. In 2018, the steelworks was purchased by ArcelorMittal. In 2019 emissions of the plant amounted to approx. 10 Mt CO_2. Compared to 2005, CO_2- emissions of the integrated steelworks are currently 50 % lower as a result of the pollution scandal and associated cuts in production levels.

France

Figure 4: France: Key trends in CO_2 emissions and crude steel production, 2005 - 2019

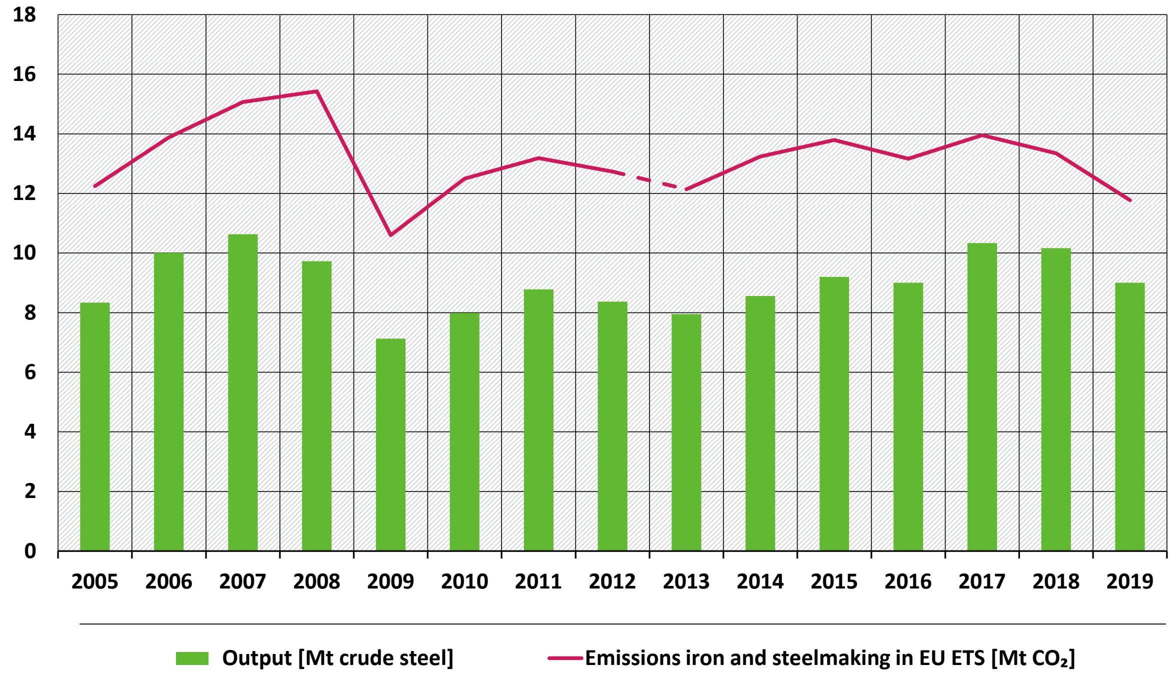


Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), (EC n.d.).

- France has the 2nd highest CO_2 emissions from iron and steelmaking in the EU ETS (22 Mt CO_2 in 2019), making up 11 % of total EU-28 emissions of the sector.
- It is also the country with the 3rd highest crude steel production in the EU-28, contributing about 9 %. The EAF production share is about 30 %, which is below the average of the EU-28 (41 %).
- Historically, France had three integrated steelworks. In 2011 the blast furnaces in Florange – a land-locked site located in the former steel region near the German and Luxembourg borders – ceased production and were eventually closed in 2012 (they comprised 17 % of the initial production capacity). This reduced the number of integrated steelworks in France to two. Both remaining sites have access to sea trade. They have a total hot metal capacity of 12.0 Mt and emissions from the integrated sites totalled 19.8 Mt CO_2 in 2019.
- Both remaining integrated steelworks are owned by ArcelorMittal (Fos sur Mer and Dunkerque).

Poland

Figure 5: Poland: Key trends in CO_2 emissions and crude steel production, 2005 - 2019

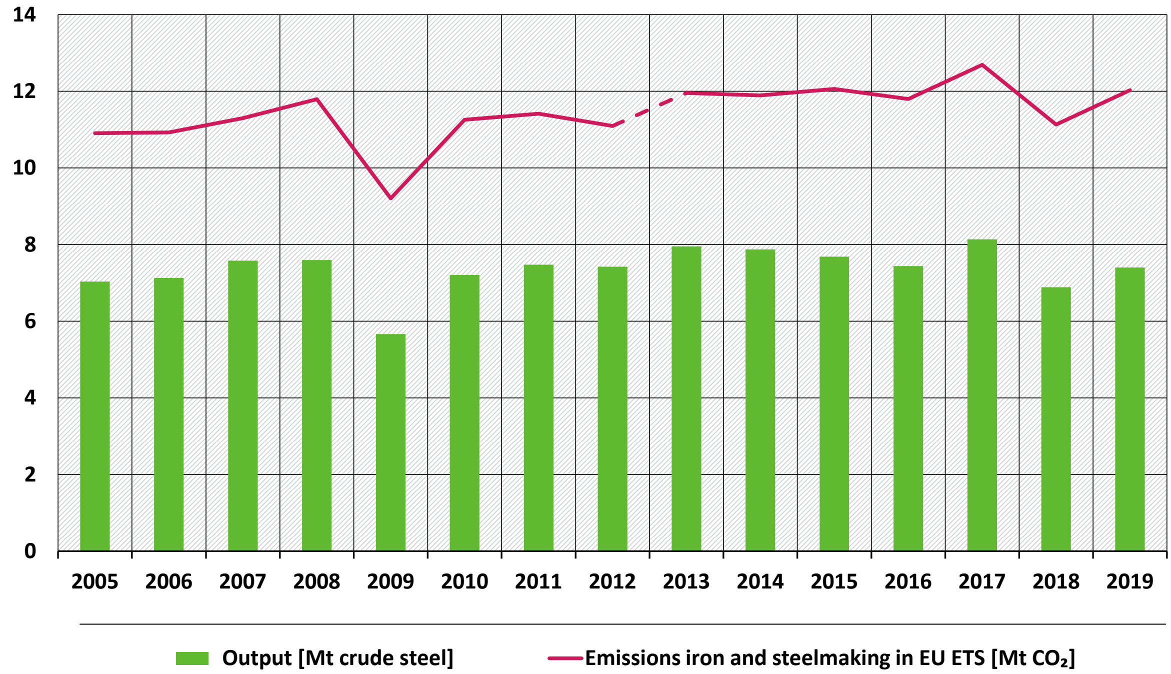


Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed; therefore, the values from before and after 2013 are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d..

- Poland has the 6th highest CO_2 emissions from iron and steelmaking in the EU ETS (12 Mt CO_2 in 2019). The sector accounts only for a small share of emissions under the EU ETS (6 % in 2019). They are dominated by coal and lignite-fired electricity generation (activity code 20), which has decreased by only 19 % since 2005.
- With a production of 9 Mt crude steel, it was the 4th biggest crude steel producer in the EU-28, in 2019. The EAF production share is about 45 %, which is slightly above the EU-28 average (41 %). Between 2005 and 2019, no adjustments in production capacity were observed.
- Emission trends in the sector follow the trend in production, which increased from 2005 to 2008, sharply declined in 2009, recovered again in 2011 and fluctuated around 13-14 Mt until 2017 and decreased in 2018 and 2019. From a peak in 2009, the emissions intensity was on a steady decline until 2019 when it was still about 10 % above the EU-28 average.
- Poland had two integrated steelworks, one in Dąbrowa Górnicza (north-east of Katowice) and one in Kraków. The latter was closed, first temporarily and then the final closure was announced in October 2020. In 2019, the two sites accounted for 9.5 Mt CO_2.

Austria

Figure 6: Austria: Key trends in CO_2 emissions and crude steel production, 2005 - 2019

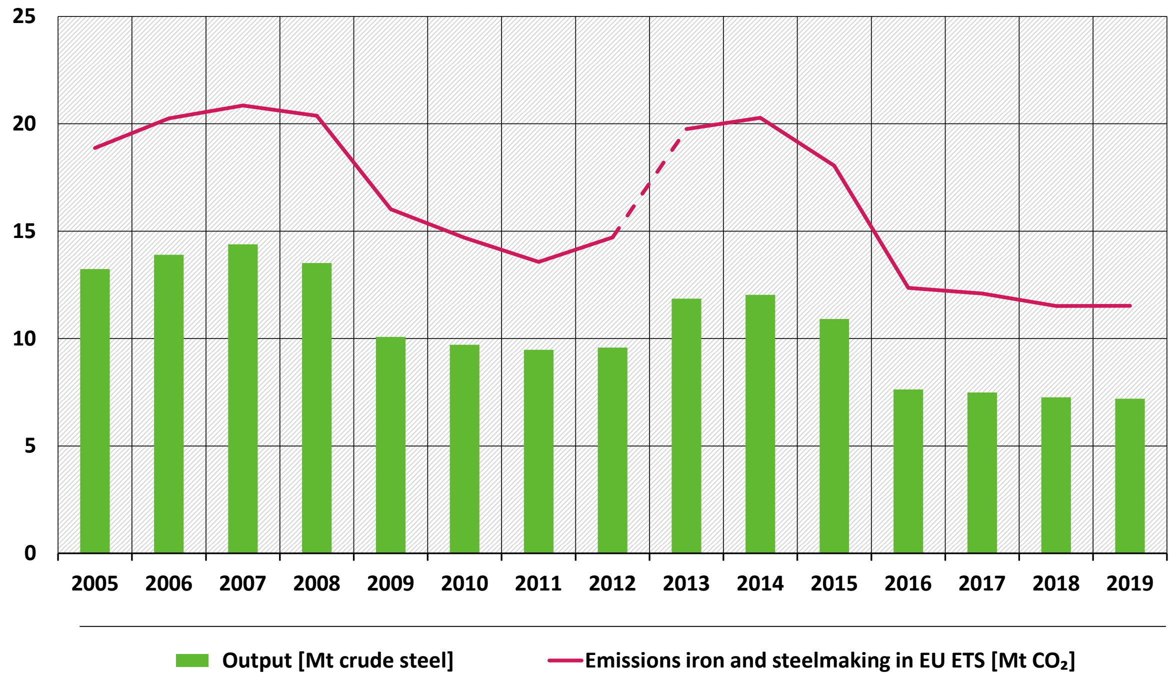


Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d..

- Austria is the country with the 4th highest CO_2 emissions from iron and steelmaking in the EU ETS (12 Mt CO_2 in 2019), making up 6 % of total EU-28 emissions of the sector. The sector has a high and increasing share in total EU ETS emissions in Austria (40 % in 2019).
- It is also the country with the 5th highest crude steel production in the EU-28, contributing about 5 % of total production in the EU-28. Since 2005 iron and steel production has been very stable in Austria, amounting to between 6 Mt and 7 Mt crude steel, except for the financial crisis year of 2009. The emissions trend is dominated by production on the BF-BOF route which has high utilization rates and shows a low emission intensity of 1.75 t CO_2 per ton of crude steel. The factor was even lower in 2014 but has increased since then due to pulverized coal injection at the Linz site replacing reducing agents with lower emission factors.
- The EAF production share is 10 %, which is way below the average of the EU-28 (41 %). The share is not likely to increase due to a new installation in Kapfenberg which only replaces the old EAF. Austria is an exporter to the European scrap market.
- There are two integrated steelworks in Austria: one in Leoben and one in Linz. Both are operated by Voestalpine. They have a hot metal capacity of 5.7 Mt and reported emissions of 11.6 Mt CO_2 in 2019.

United Kingdom

Figure 7: United Kingdom: Key trends in CO_2 emissions and crude steel production, 2005 - 2019

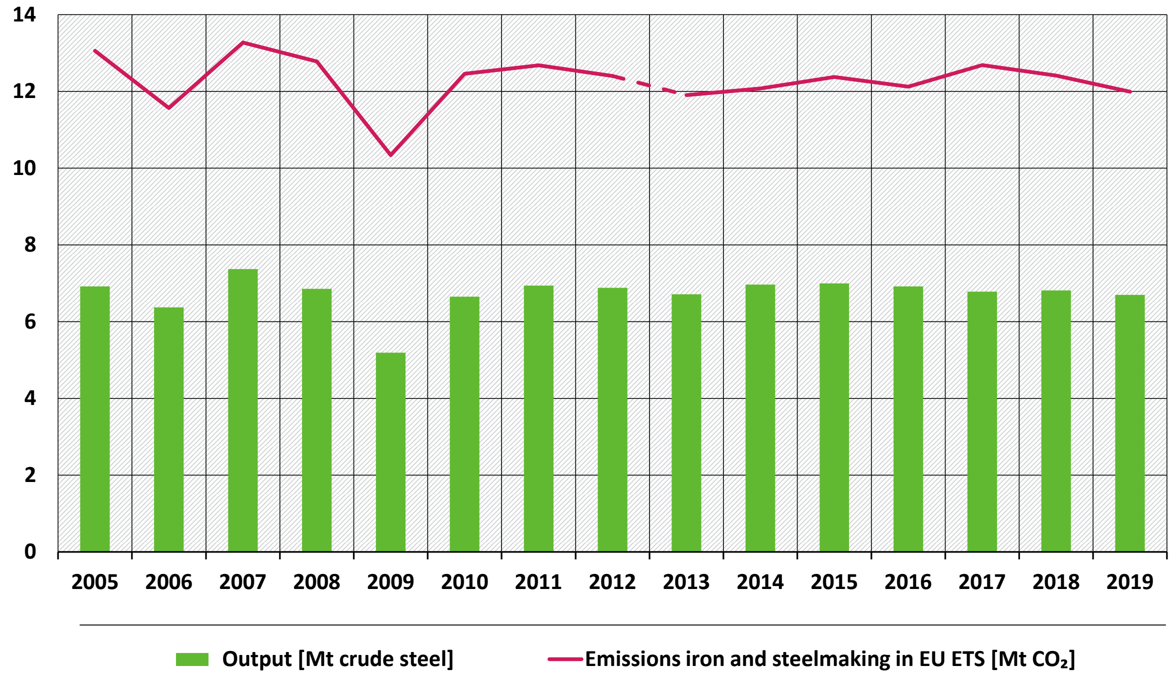


Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants; no scope correction was performed, therefore value from before 2013 and after are not comparible due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d..

- United Kingdom was the country with the 7th highest CO2 emissions from iron and steelmaking in the EU ETS (12 Mt CO2 in 2019), making up 6 % of total EU-28 emissions of the sector.
- In 2019, it was the country with the 8th highest crude steel production in the EU-28, contributing approx. 5 %. The EAF production share was about 21 %, which was far below the average of the EU-28 (41 %), accordingly, UK is an exporter of steel scrap, mainly to the international market.
- Since 2005, production has dropped from a high in 2007 (14.4 Mt) to a low of 9.6 Mt in 2012. The UK steel industry did not recover from the financial crisis but continued with a steel crisis in 2015. In 2019, total crude steel production was only 7.2 Mt. Emissions follow the production levels, which are dominated by the BF-BOF route.
- In 2019, United Kingdom had two integrated steelworks: one in Wales, at Port Talbot east of Cardiff, owned by Tata Steel and one in northern England, south of Hull, owned by British Steel (the Scunthorpe plant, which also belonged to Tata Steel until 2016). A third integrated steelworks in Teesside, has been permanently closed since its owner, Sahaviriya Steel Industries (SSI), was declared insolvent at the end of 2015. In the aftermath of the economic crisis in 2008, it had already been mothballed once by its former owner, Tata Steel. 30 % of the emissions on the BF-BOF route originated from the Teesside site in 2013.

Netherlands

Figure 8: Netherlands: Key trends in CO_2 emissions and crude steel production, 2005-2019

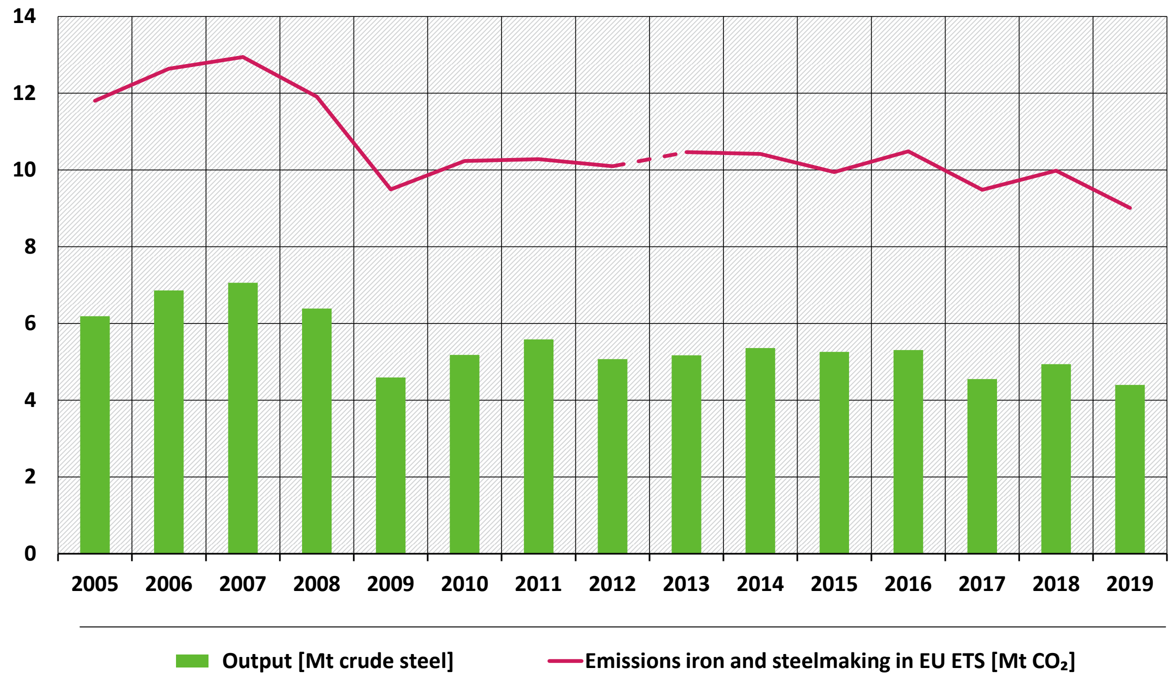


Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d..

- The Netherlands has the 5th highest CO_2 emissions from iron and steelmaking in the EU ETS (12 Mt CO_2 in 2019), making up 6 % of total EU-28 emissions of the sector. The sector has a fluctuating share in total EU ETS emissions (13 – 16 % in 2005 - 2019) of the country, which is driven by changes in other sectors, most notably by increases in coal-fired generation since 2013 and increases in co-firing of biomass since 2016.
- It is also the county with the 9th highest crude steel production in the EU-28, contributing about 4 %. Since 2005, iron and steel production has been very stable in the Netherlands. Except for the financial crisis year of 2009, it amounted to approx. 7 Mt crude steel per year. The emissions trend is dominated by production on the BF-BOF route, which has high utilization rates and shows an emission intensity below the EU-28 average, with 1.79 tCO_2 per ton of crude steel.
- Production on the BF-BOF route has constituted 98 % of total production since 2005. The last small EAF was closed in 2017; accordingly, the Netherlands is a significant exporter to EU and international scrap markets.
- The Netherlands hosts one integrated steelworks in Ijmuiden, close to Amsterdam. The site has two blast furnaces and a hot metal production capacity of 6.3 Mt per year.

Czech Republic

Figure 9: Czech Republic: Key trends in CO_2 emissions and crude steel production, 2005 - 2019



Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d..

- The Czech Republic has the 10th highest CO_2 emissions from iron and steelmaking in the EU ETS (9 Mt CO_2 in 2019), comprising 5 % of total EU-28 emissions of the sector.
- In 2019, it was the country with the 12th highest crude steel production in the EU-28 (4 Mt), contributing about 3 % of total production in the EU-28. The EAF share has been very low (5 %); still, more than 50 % of domestic scrap volumes were consumed domestically.
- The Czech Republic hosts two integrated steelworks, one in Ostrava now owned by Liberty Steel with a hot metal capacity of 3.2 Mt and one in Třinec owned by Třinecké železárny with a hot metal capacity of 2.1 Mt. Both steelworks are located in the far east of the country close to the Polish sites in Dabrowa Gornizca and Krakow.
- Production decreased by about one third in the aftermath of the economic crisis in 2009. Restructuring and a corresponding decrease in emissions occurred at the Ostrava site while emissions were very stable at the Třinec site.
- By 2023, the Ostrava site owned by Liberty Steel will be transformed from a pure BF-BOF site to a site with two hybrid furnaces of the same capacity that can accept high shares of steel scrap (the authors understand that these are EAF furnaces). This will have strong implications on the emission intensity of steel production and on electricity demand in the Czech Republic.

Zusammenfassung

Ziel und Struktur

Das EU-ETS ist ein zentrales Politikinstrument zur Verringerung der Treibhausgasemissionen von Stromerzeugungs- und Industrieanlagen in Europa. Die Eisen- und Stahlerzeugung ist der Industriesektor mit den höchsten absoluten CO_2-Emissionen. Der Sektor spielt eine wichtige Rolle für die Wertschöpfung und die Beschäftigung in der EU-28 und induziert einen erheblichen innereuropäischen und internationalen Handel.

Dieser Bericht soll die wichtigsten Entwicklungen des Sektors im Zeitraum von 2005 bis 2019 beschreiben, d. h. vor dem Ende der dritten ETS-Handelsperiode im Jahr 2020 und vor den bedeutenden Einschnitten in der Wirtschaftsaktivität, die als Folge der COVID-Pandemie in 2020 und den folgenden Jahren aufgetreten sind. Auch die seit 2019 erfolgten Änderungen der makroökonomischen Rahmenbedingungen konnten ebenso wenig berücksichtigt werden wie die potenziellen Auswirkungen des "Fit-for-55"-Paket, das im Jahr 2023 in Gesetzen niedergelegt wurde. Dieses Reformpaket sieht Änderungen der ETS-Emissionsobergrenzen und die Einführung eines "Kohlenstoffgrenzausgleichsmechanismus" (CBAM) vor, der die kostenlosen Zuteilungen für Industriesektoren, einschließlich der Eisen- und Stahlindustrie, schrittweise ersetzen soll. Darüber hinaus sind die Preise für Emissionsberechtigungen seit 2018 erheblich gestiegen und haben dies auch nach 2019 fortgesetzt (siehe z. B. DEHSt (2024) für eine grafische Darstellung der beobachteten Preisentwicklung), was zumindest teilweise auf eine zunehmende Wahrnehmung der Knappheit auf dem Markt zurückzuführen ist.

Die vorliegende Analyse identifiziert die wichtigsten Treiber hinter den Trends bei Emissionen, Produktionsniveaus, Investitionen und dem Marktumfeld auf Länder- und Anlagenebene. Durch die Bereitstellung von Schlüsselinformationen aus der Vergangenheit schafft er eine solide Grundlage für künftige Prognosen und die Gestaltung von Klimapolitik. Seit 2019 sind die Emissionen auf EU-Ebene und in der Mehrzahl der Mitgliedstaaten zunächst im Jahr 2020 aufgrund der wirtschaftlichen Auswirkungen der COVID-Pandemie stark gesunken, haben sich dann 2021 vorübergehend erholt, sind aber in den Jahren 2022 und 2023 wieder deutlich gesunken (siehe ERC CM (2023, p. 15) für die EU-Ebene und DEHSt (2024) für Deutschland als Beispiel für die Entwicklung auf der Ebene der Mitgliedstaaten). Diese Emissionstrends spiegeln im Wesentlichen die Entwicklung der Produktion (vor allem die des Primärroute, die die CO_2-Emissionen des Eisen- und Stahlsektors dominiert) wider, die insbesondere in den Jahren 2022 und 2023 nicht zuletzt als Folge des russischen Angriffskrieges gegen die Ukraine sowohl auf EU-Ebene als auch in Deutschland deutlich rückläufig waren (EUROFER 2024; World Steel Association 2024; WV Stahl 2024).Der Bericht beginnt mit einem Überblick über die EU-28, in dem die Emissionsquellen, die Produktionsrouten sowie Trends bei Investitionen und Regulierungs- und Marktumfeld beschrieben werden. Der Rest des Berichts enthält in Form von Kurzberichten Informationen über die Eisen- und Stahlindustrie in acht ausgewählten europäischen Ländern: Deutschland, Italien, Frankreich, Polen, Österreich, das Vereinigte Königreich, die Niederlande und Tschechien. Die ausgewählten Länder repräsentieren 70 % der gesamten Rohstahlproduktion und 75 % der Emissionen aus der Eisen-–und Stahlproduktion in der EU-28, die unter das EU-ETS fallen (Activity Code 22 - 25 und Kuppelgaskraftwerke unter Activity Code 20). Sie haben unterschiedliche Anteile der Produktion mit Elektrolichtbogenofen (EAF; 0 % - 82 %) (im Durchschnitt liegt der EAF-Anteil in der EU-28 bei 41 %) und unterschiedliche Anteile der Emissionen aus der Eisen- und Stahlproduktion an den Gesamtemissionen (3 % - 15 %) (in der EU-28 trägt die Eisen- und Stahlproduktion 5 % zu den Gesamtemissionen bei).

EU-28-Ebene

Seit der Einführung des EU-ETS im Jahr 2005 sind die im EUTL gemeldeten Gesamtemissionen von rund 240 Mio. t CO_2 auf rund 200 Mio. t CO_2 im Jahr 2019 zurückgegangen. Der Rückgang ist hauptsächlich auf eine Verringerung des Gesamtproduktionsvolumens zurückzuführen (von 190 Mio. t Rohstahl im Jahr 2005 auf 160 Mio. t Rohstahl im Jahr 2019), ohne dass sich die Anteile der verschiedenen Produktionsrouten wesentlich verändert haben oder signifikante Effizienzsteigerungen auf den jeweiligen Routen zu verzeichnen waren. Der Stahlverbrauch der EU-28 wird überwiegend durch das inländische Angebot gedeckt. In 2019 wurden knapp 10 % der Netto-Nachfrage durch Einfuhren gedeckt, wobei Russland und die Ukraine die wichtigsten Handelspartner waren, auch wenn China mit 50 % der Stahlerzeugungskapazität der weltweit dominierende Stahlproduzent ist. Was die Anlagen betrifft, so wurden in der EU-28 seit 2005 keine neuen integrierten Stahlwerke eröffnet; die meisten Standorte blicken vielmehr auf eine lange Geschichte der Stahlerzeugung zurück. Nach der Wirtschaftskrise von 2008-2009 wurden mehrere Hochöfen nach Ablauf ihrer Lebensdauer nicht mehr neu zugestellt (insbesondere im Vereinigten Königreich und in Frankreich, Polen und Tschechien). Nur wenige neue Elektrolichtbogenöfen wurden an bestehenden integrierten Standorten hinzugefügt, z. B. im Vereinigten Königreich und in Italien.

Tabelle 1 gibt einen Überblick über die Gesamtemissionen, die Produktion und die Entwicklung der Emissionsintensität für die drei wichtigsten Produktionsrouten von Rohstahl. Der größte Teil der Emissionen aus der Eisen- und Stahlerzeugung entfällt auf die Roheisenerzeugung mit Hochöfen (BF-BOF-Route). Die Gesamtemissionen der Rohstahlerzeugung an BF-BOF-Standorten beliefen sich im Jahr 2019 auf 176 Mio. t CO_2, was 89 % der Gesamtemissionen des Eisen- und Stahlsektors entspricht, die unter den EU-ETS fallen. Die durchschnittliche direkte Emissionsintensität der BF-BOF-Route - einschließlich der Kuppelgaskraftwerke - betrug 2019 etwa 1,85 t CO_2 pro Tonne Rohstahl, was sich seit 2013 nicht geändert hat. Diese Emissionsintensität umfasst auch die Emissionen von Sinter- und Kokerei-Anlagen, Hochöfen, Sauerstoffkonvertern und Walzwerken, wenn diese an integrierten Standorten betrieben werden.

Auf der Hochofenroute wurden seit der Einführung des Emissionshandels keine nennenswerten Emissionsminderungen erzielt. Die spezifischen Emissionen sind in der EU-28 nur um 2 % gesunken und in vielen Ländern sogar gestiegen, z. B. um 10 % in Deutschland. Der Anstieg der spezifischen Emissionen auf der Hochofenroute lässt sich auf mehrere Faktoren zurückführen. Die wichtigsten sind die ineffiziente Nutzung der integrierten Infrastruktur aufgrund einer schlechten Auslastung der Produktionskapazitäten und die zunehmende Einblasung von billiger Steinkohle (pulverisierte Kohleeinblasung (PCI)) ersetzt. In den ersten Jahren des EU-ETS war das CO_2-Preissignal nicht stark genug, um diese Brennstoffumstellung zu verhindern.

Die Summe der direkten Emissionen der Elektrostahlwerke beliefen sich im Jahr 2019 auf 9,4 Mio. t CO_2, was 5 % der Gesamtemissionen der Eisen- und Stahlindustrie entspricht. Die durchschnittliche direkte Emissionsintensität der EAF-Route lag im Jahr 2019 bei etwa 0,15 t CO_2/t Rohstahl. Diese Emissionsintensität schließt auch die Emissionen von Walzwerken ein, die am selben Standort betrieben werden, wenn sie ihre Emissionen zusammen mit der Elektrostahlerzeugung melden (was häufig der Fall ist).

Tabelle 1: Emissionen nach Produktionsroute in der Eisen- und Stahlerzeugung für die EU-28 auf Grundlage einer standortspezifischen Auswertung der EUTL

Route	Indicator	Unit	2013	2015	2018	2019
Hochofen (BF-BOF Route)	Emissionen[1]	[Mt CO_2]	186,0	188,4	182,2	174,0
	Produktion	[Mt Rohstahl]	100,1	100,9	98,1	93,9
	Emissionsintensität	[t CO_2/t Rohlstahl]	1,86	1,87	1,86	1,85
Elektrolicht-bogenofen (EAF-Route	Emissionen[2]	[Mt CO_2]	9,7	9,7	10,2	9,4
	Produktion[3]	[Mt Rohstahl]	65,7	64,8	68,9	64,4
	Emissionsintensität	[t CO_2/t Rohlstahl]	0,15	0,15	0,15	0,15
Direkt-reduktion (DRI-EAF Route)	Emissionen[4]	[Mt CO_2]	0,5	0,5	0,5	0,5
	Produktion	[Mt DRI]	0,6	0,7	0,7	0,6
	Emissionsintensität	[t CO_2/t Produkt]	0,86	0,80	0,80	0,79
Andere[5]	Emissionen	[Mt CO_2]	13,7	12,4	12,6	11,6
Summe	**Emissionen**	**[Mt CO_2]**	**210,0**	**211,1**	**205,5**	**195,7**

Anmerkung:

[1] Zu den Emissionen, die der BF-BOF-Route zugeordnet werden, gehören: Emissionen aus Kokereien und Sinteranlage (die entweder separat, z. B. unter den Activity Code 22 und 23, oder als integriertes Stahlwerk unter Code 24 gemeldet werden), Emissionen aus der Roheisen- und Stahlerzeugung im BF und BOF (unter Code 24 gemeldet) und Emissionen aus nachgelagerten Prozessen, die in der Regel Kuppelgase aus den vorgelagerten Prozessen als Brennstoff einsetzen (unter Code 25 oder als integriertes Stahlwerk unter Code 24 gemeldet), sowie Emissionen aus Kuppelgaskraftwerken am Standort (unter Code 20 gemeldet).

[2] Emissionen, die der EOF-Route zugeordnet werden, stammen aus dem Brennstoffeinsatz und dem Elektrodenverschleiß in den Elektrolichtbogenöfen (unter Code 24 oder in einigen Fällen unter Code 25 gemeldet) und den Walzwerken, die häufig unter derselben Anlage gemeldet werden.

[3] Ohne die EAF-Stahlerzeugung aus direkt reduziertem Eisen.

[4] Die der DRI-Route zugeordneten Emissionen umfassen brennstoffbedingte und prozessbedingte Emissionen aus DRI-Anlagen sowie den Anteil der Emissionen aus der nachfolgenden EAF-Route, der dem Massenanteil des DRI im EAF entspricht.

[5] Sonstige Emissionen umfassen alle Emissionen unter den Codes 22-25, die nicht einem integrierten Stahlwerk oder einer der drei Produktionsrouten zugeordnet sind.

Quelle: Eigene Darstellung basierend auf EC n.d. für Emissionsdaten, Worldsteel Association (2020) für Produktionsdaten.

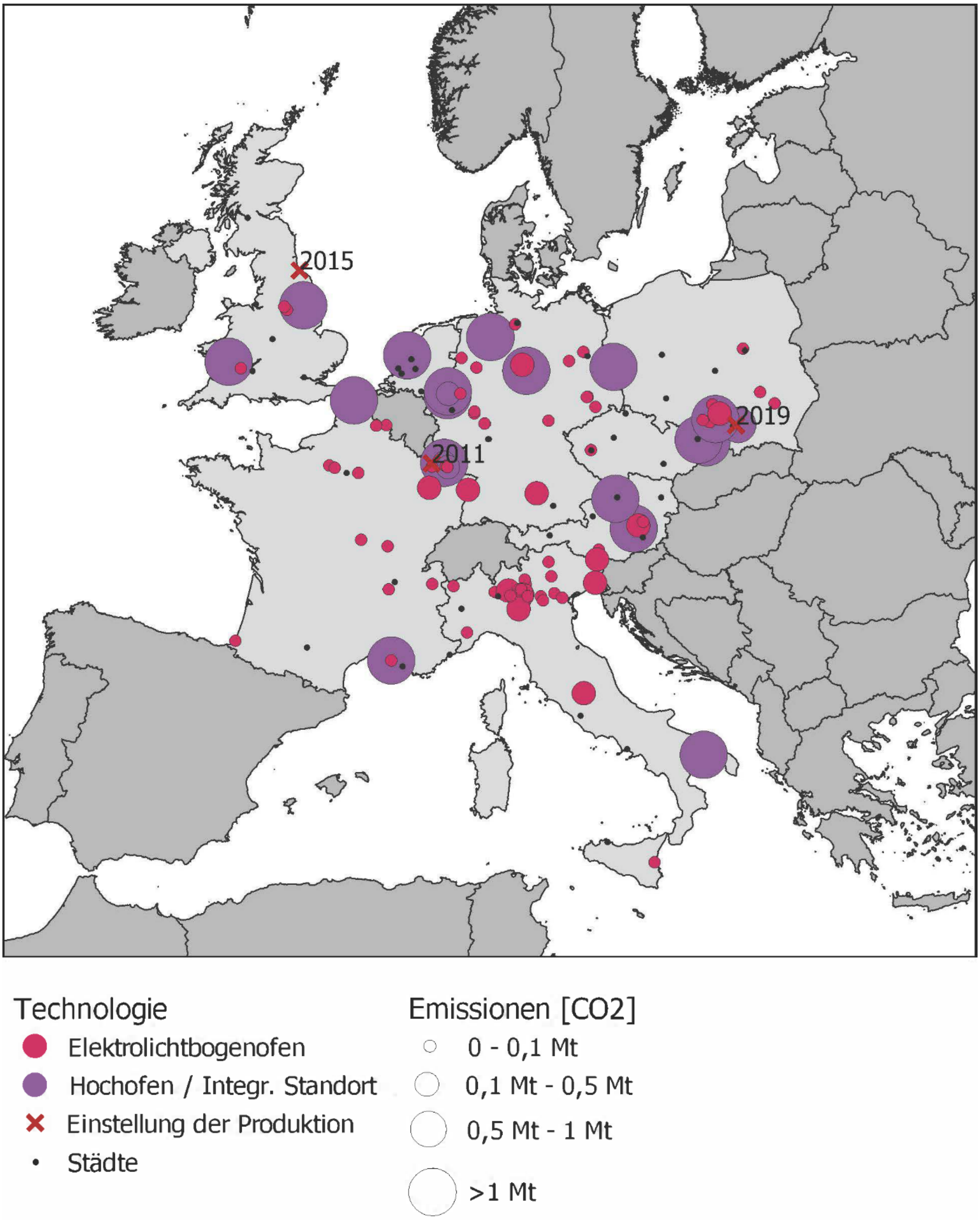
Die gesamten direkten Emissionen der DRI-Standorte beliefen sich 2019 auf 0,5 Mio. t CO_2, was 0,2 % der Gesamtemissionen des Eisen- und Stahlsektors entspricht. Die durchschnittliche direkte Emissionsintensität auf der DRI-EAF-Route betrug im Jahr 2019 etwa 0,79 t CO_2/t Rohstahl. Diese Emissionsintensität umfasst die Emissionen der DRI-Anlage und der EAF-Anlage. Die einzige DRI-EAF-Anlage, die in den Datenblättern näher analysiert wird, befindet sich in Hamburg, Deutschland. Hier lag die Intensität im Jahr 2019 bei 0,5 t CO_2/t DRI.

Die Emissionen aus anderen Prozessen (einschließlich Gießereien und nachgelagerten Prozessen) entsprechen 11,6 Mio. t CO_2 (6 %) im Jahr 2019.

Länder- und Betriebsebene

Abbildung 1 zeigt die Standorte von integrierten Stahlwerken, Hochöfen und Elektrolichtbogenöfen in den acht ausgewählten Ländern.

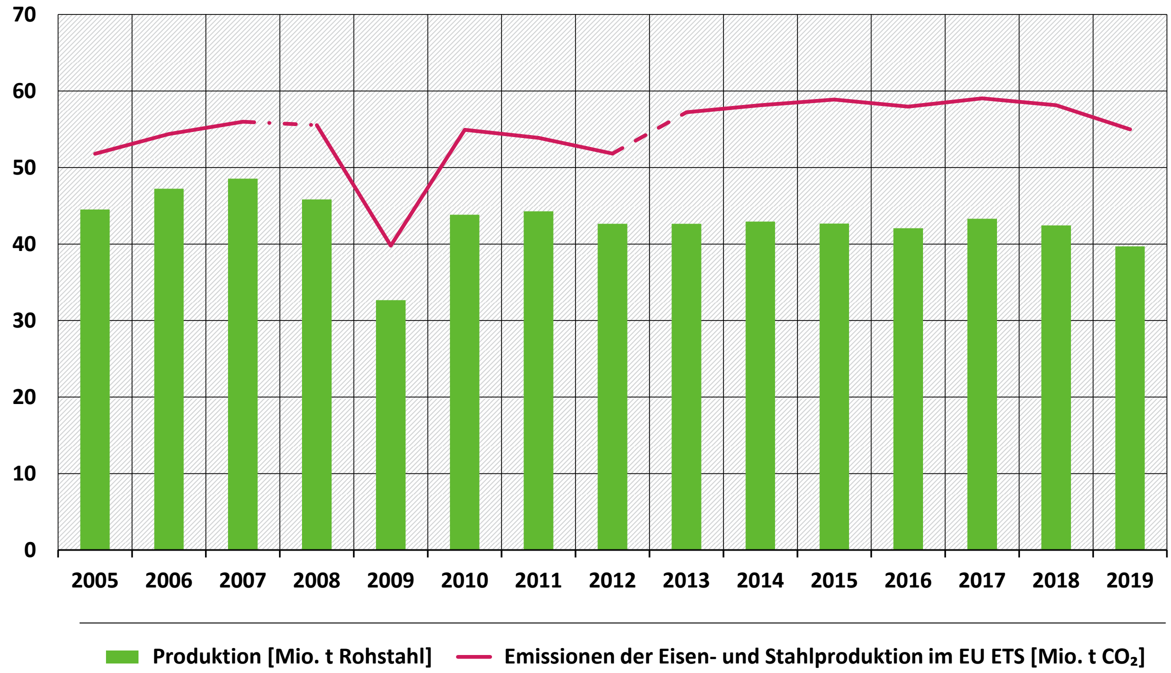
Abbildung 1: Standorte und Emissionen von Hochöfen, integrierten Stahlwerken und Elektrolichtbogenöfen in den ausgewählten Ländern, Stand Ende 2019



Quelle: Eigene Darstellung basierend auf EC n.d..

Deutschland

Abbildung 2: Deutschland: Trends bei CO_2 Emissionen und Rohstahlproduktion, 2005 - 2019

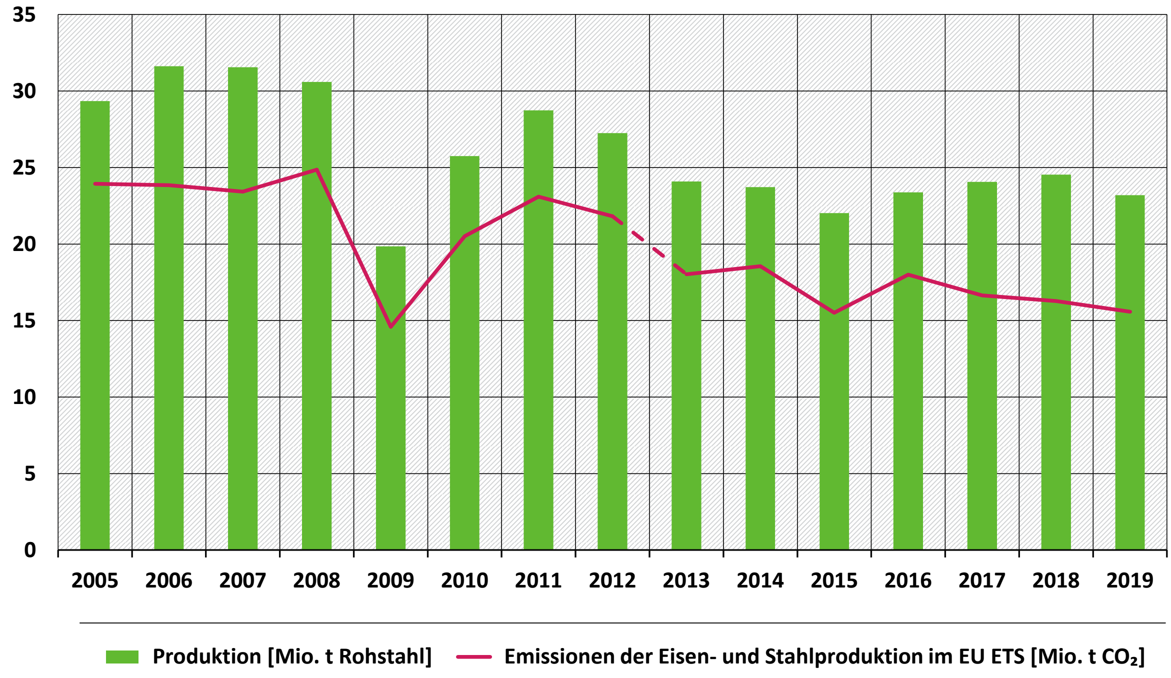


Anmerkung: Die Emissionen umfassen die Activity Codes 22 bis 25 und zugeordnete Kuppelgaskraftwerke. Es wurde keine Berichtigung des Geltungsbereichs des EU-ETS vorgenommen, daher sind die Werte für die Zeit vor 2007, zwischen 2008 und 2012 und für 2013 und danach aufgrund des unterschiedlichen Geltungsbereichs nicht vergleichbar.
Quelle: Worldsteel Association (2020), EC n.d..

- Deutschland ist das Land mit den höchsten $_{CO2}$-Emissionen aus der Eisen- und Stahlerzeugung im EU-ETS (55 Mio. t $_{CO2}$ im Jahr 2019), was 28 % der Gesamtemissionen der EU-28 in diesem Sektor entspricht.
- Deutschland ist auch das Land mit der höchsten Rohstahlproduktion in der EU-28, die etwa 25 % der Gesamtproduktion ausmacht. Seit 2005 wurden keine größeren Anpassungen der Produktionskapazitäten beobachtet.
- Die Emissionstrends folgen dem Trend der Produktion, die von 2005 bis 2007 anstieg, 2008 und 2009 stark zurückging, sich dann wieder erholte und bis zu einem erneuten Rückgang im Jahr 2019 stabil blieb. Der Anstieg der Emissionen zwischen 2012 und 2013 ist auf eine Ausweitung des Geltungsbereichs des EU-Emissionshandels zurückzuführen.
- In Deutschland gibt es sieben integrierte Stahlwerke mit unterschiedlichen Eigentumsverhältnissen. Das integrierte Stahlwerk von ThyssenKrupp in Duisburg ist der größte BF-BOF-Standort in Europa und emittiert 2019 mit 4 Hochöfen 17 Mio. t $_{CO2}$.
- Der Anteil der EAF-Produktion liegt bei etwa 30 % und damit unter dem Durchschnitt der EU-28 (41 %).

Italien

Abbildung 3: Italien: Trends bei CO_2 Emissionen und Rohstahlproduktion, 2005 – 2019

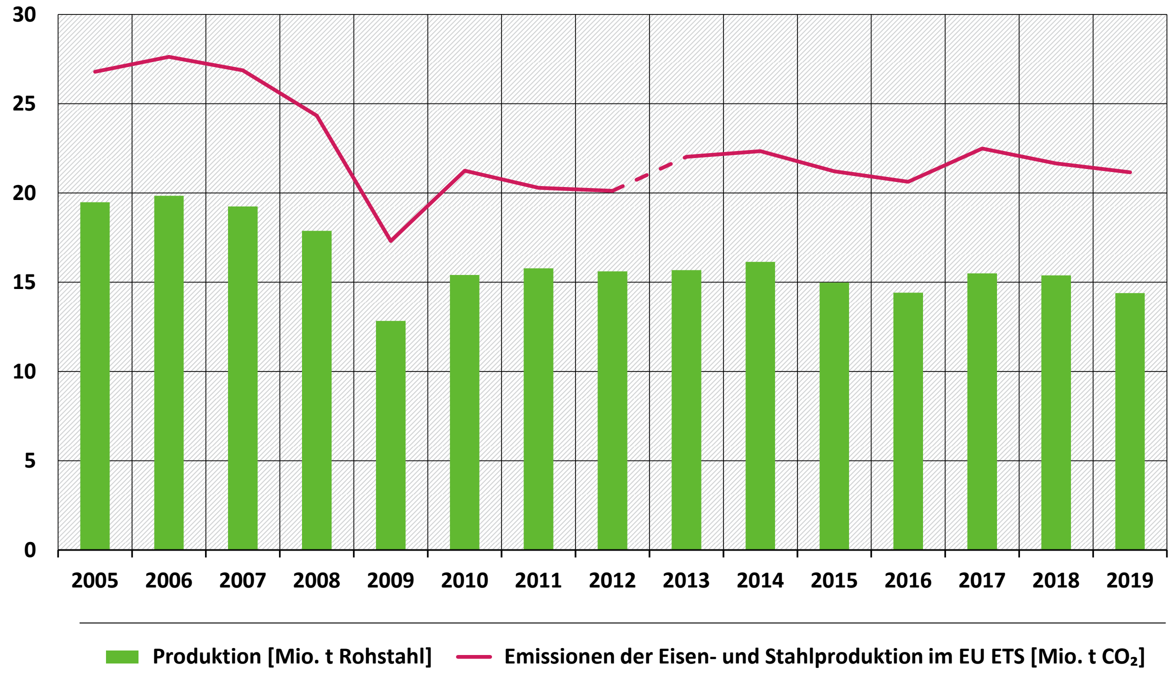


Anmerkung: Emissionen umfassen die Acitivty Codes 22 bis 25 und zugeordnete Kuppelgaskraftwerke. Es wurde keine Korrektur des Geltungsbereichs des EU-ETS vorgenommen, daher sind die Werte von vor 2013 und danach aufgrund des unterschiedlichen Geltungsbereichs nicht vergleichbar.
Quelle: Worldsteel Association (2020), EC n.d..

- Italien ist das Land mit den vierthöchsten CO_2-Emissionen aus der Eisen- und Stahlerzeugung im EU-ETS (15,6 Mio. t CO_2 im Jahr 2019), die 8 % der Gesamtemissionen der EU-28 in diesem Sektor ausmachen.
- Es ist das Land mit der zweithöchsten Rohstahlproduktion in der EU-28 (19 Mio. t im Jahr 2019), die im Jahr 2019 etwa 15 % ausmacht. Die Stahlproduktion in Italien basiert hauptsächlich auf der EAF-Route; 2019 lag der Anteil der BF-BOF-Route an der Rohstahlproduktion bei nur 17 %, ein Rückgang gegenüber 35 % im Jahr 2012. Dementsprechend liegt der EAF-Anteil bei 83 % (im Vergleich zu 41 % im EU-28-Durchschnitt), was Italien zum größten EAF-Stahlproduzenten in der EU-28 macht.
- Die Emissionen der italienischen Eisen- und Stahlindustrie, die von den Emissionen der BF-BOF-Route dominiert werden, sind zwischen 2005 und 2019 um 35 % zurückgegangen, während die Produktion im gleichen Zeitraum nur um 20 % abnahm.
- In Italien gibt es nur ein einziges integriertes Stahlwerk in Taranto im Süden Italiens. Das Werk befand sich bis 2012 im Besitz der italienischen Riva-Gruppe, bis aufgedeckt wurde, dass das Werk für eine extreme Luftverschmutzung verantwortlich war, woraufhin es vom italienischen Staat beschlagnahmt wurde. Im Jahr 2018 wurde das Stahlwerk von ArcelorMittal gekauft. Im Jahr 2019 lagen die Emissionen des Werks bei etwa 10 Mio. t CO_2. Im Vergleich zu 2005 sind die CO_2 Emissionen des integrierten Stahlwerks aufgrund des Verschmutzungsskandals und der damit verbundenen Produktionskürzungen derzeit um 50 % niedriger.

Frankreich

Abbildung 4: Frankreich: Trends bei CO_2 Emissionen und Rohstahlproduktion, 2005 - 2019

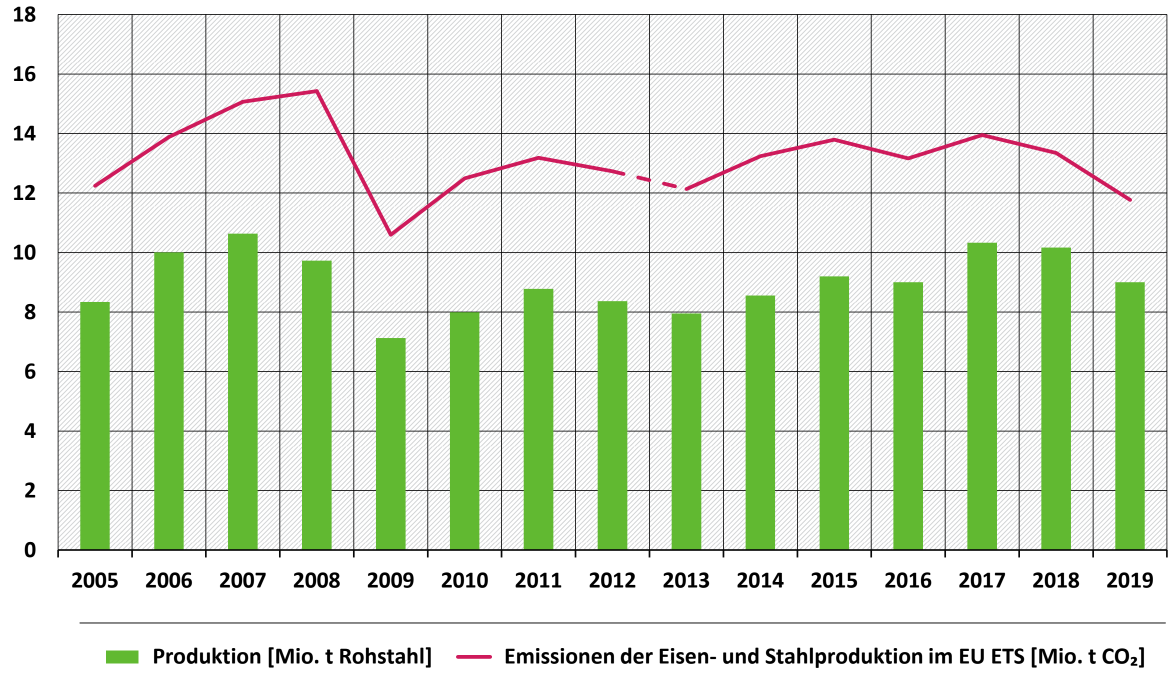


Anmerkung: Emissionen umfassen die Acitivty Codes 22 bis 25 und zugeordnete Kuppelgaskraftwerke. Es wurde keine Korrektur des Geltungsbereichs des EU-ETS vorgenommen, daher sind die Werte von vor 2013 und danach aufgrund des unterschiedlichen Geltungsbereichs nicht vergleichbar.
Quelle: Worldsteel Association (2020), EC n.d..

- Frankreich ist das Land mit den zweithöchsten CO_2 Emissionen aus der Eisen- und Stahlerzeugung im EU-ETS (22 Mio. t CO_2 im Jahr 2019), die 11 % der gesamten EU-28-Emissionen des Sektors ausmachen.
- Es ist auch das Land mit der dritthöchsten Rohstahlproduktion in der EU-28, die etwa 9 % ausmacht. Der Anteil der EAF-Produktion liegt bei etwa 30 % und damit unter dem Durchschnitt der EU-28 (41 %).
- Historisch gesehen gab es in Frankreich drei integrierte Stahlwerkestandorte. Im Jahr 2011 wurde die Produktion der Hochöfen in Florange - einem Binnenstandort in der ehemaligen Stahlregion nahe der deutschen und luxemburgischen Grenze - eingestellt und schließlich 2012 geschlossen (was 17 % der ursprünglichen Produktionskapazität entsprach). Damit verringerte sich die Zahl der integrierten Stahlwerke in Frankreich auf zwei. Die beiden verbleibenden Standorte haben Zugang zum Seehandel. Sie verfügen über eine Gesamtkapazität an Roheisen von 12,0 Mio. t, und die Emissionen der integrierten Standorte belaufen sich 2019 auf 19,8 Mio. t CO_2.
- Die beiden verbleibenden integrierten Stahlwerke befinden sich im Besitz von ArcelorMittal (Fos sur Mer und Dunkerque).

Polen

Abbildung 5: Polen: Trends bei CO_2 Emissionen und Rohstahlproduktion, 2005 - 2019



Anmerkung: Emissionen umfassen die Acitivty Codes 22 bis 25 und zugeordnete Kuppelgaskraftwerke. Es wurde keine Korrektur des Geltungsbereichs des EU-ETS vorgenommen, daher sind die Werte von vor 2013 und danach aufgrund des unterschiedlichen Geltungsbereichs nicht vergleichbar.
Quelle: Worldsteel Association (2020), EC n.d..

- Polen ist das Land mit den sechsthöchsten CO_2 Emissionen aus der Eisen- und Stahlerzeugung im EU-ETS (12 Mio. t CO_2 im Jahr 2019). In Polen macht der Sektor nur einen kleinen Teil der Emissionen im Rahmen des EU-ETS aus (6 % im Jahr 2019). Sie werden von der Stein- und Braunkohleverstromung (Tätigkeitscode 20) dominiert, die seit 2005 nur um 19 % zurückgegangen ist.

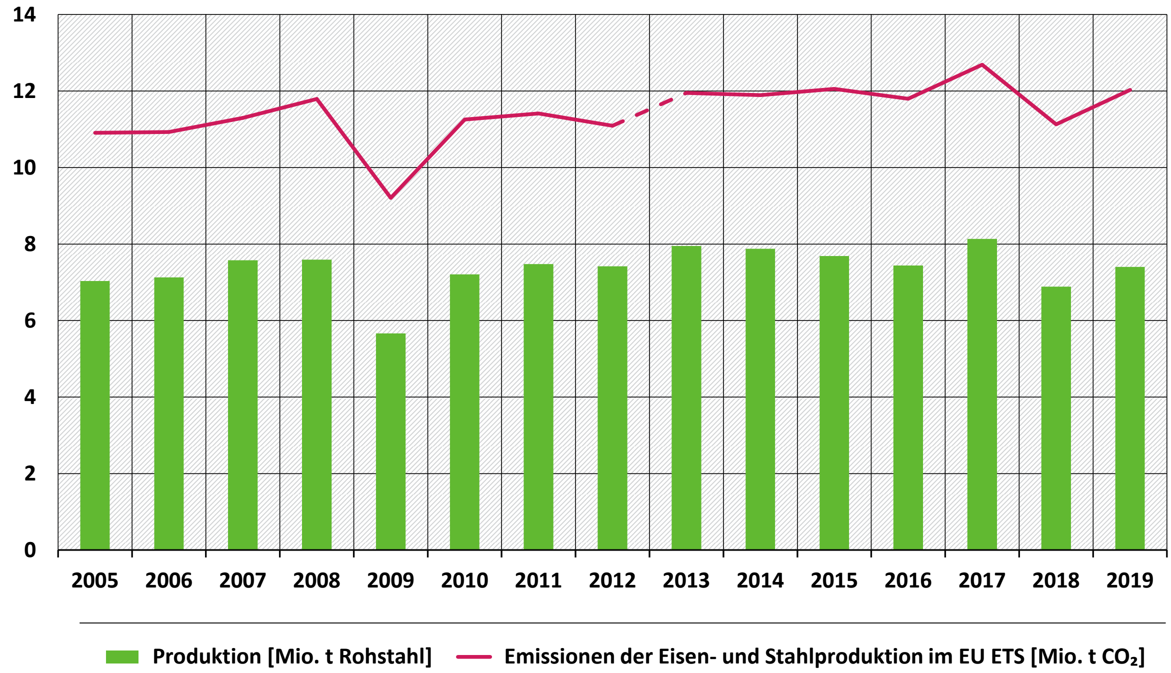
- Mit einer Produktion von 9 Mio. t Rohstahl war das Land 2019 der viertgrößte Rohstahlproduzent in der EU-28. Der Anteil der EAF-Produktion liegt bei etwa 45 % und damit leicht über dem EU-28-Durchschnitt (41 %). Zwischen 2005 und 2019 wurden keine Anpassungen der Produktionskapazität beobachtet.

- Die Emissionstrends des Sektors folgen dem Trend der Produktion. Von 2005 bis 2008 stiegen sie an, 2009 gingen sie stark zurück, 2011 erholten sie sich wieder und schwankten bis 2017 um 13-14 Mio. t, um 2019 auf unter 12 Mt CO_2 zurückzugehen. Nach einem Höchststand im Jahr 2009 ging die Emissionsintensität bis 2019 stetig zurück, lag aber immer noch etwa 10 % über dem Durchschnitt der EU-28.

- Polen verfügte über zwei integrierte Stahlwerke, eines in Dąbrowa Górnicza (nordöstlich von Kattowitz) und eines in Kraków. Letzteres wurde zunächst vorübergehend geschlossen, dann wurde die endgültige Schließung im Oktober 2020 angekündigt. Im Jahr 2019 entfielen auf die beiden Standorte 9,5 Mio. t CO_2.

Österreich

Abbildung 6: Österreich: Trends bei CO_2 Emissionen und Rohstahlproduktion, 2005 - 2019



Anmerkung: Emissionen umfassen die Acitivty Codes 22 bis 25 und zugeordnete Kuppelgaskraftwerke. Es wurde keine Korrektur des Geltungsbereichs des EU-ETS vorgenommen, daher sind die Werte von vor 2013 und danach aufgrund des unterschiedlichen Geltungsbereichs nicht vergleichbar.
Quelle: Worldsteel Association (2020), EC n.d..

- Österreich ist das Land mit den vierthöchsten CO_2 Emissionen aus der Eisen- und Stahlerzeugung im EU-ETS (12 Mio. t CO_2 im Jahr 2019), die 6 % der Gesamtemissionen des Sektors in der EU-28 ausmachen. Der Sektor hat einen hohen und steigenden Anteil an den gesamten EU-ETS-Emissionen in Österreich (40 % im Jahr 2019).

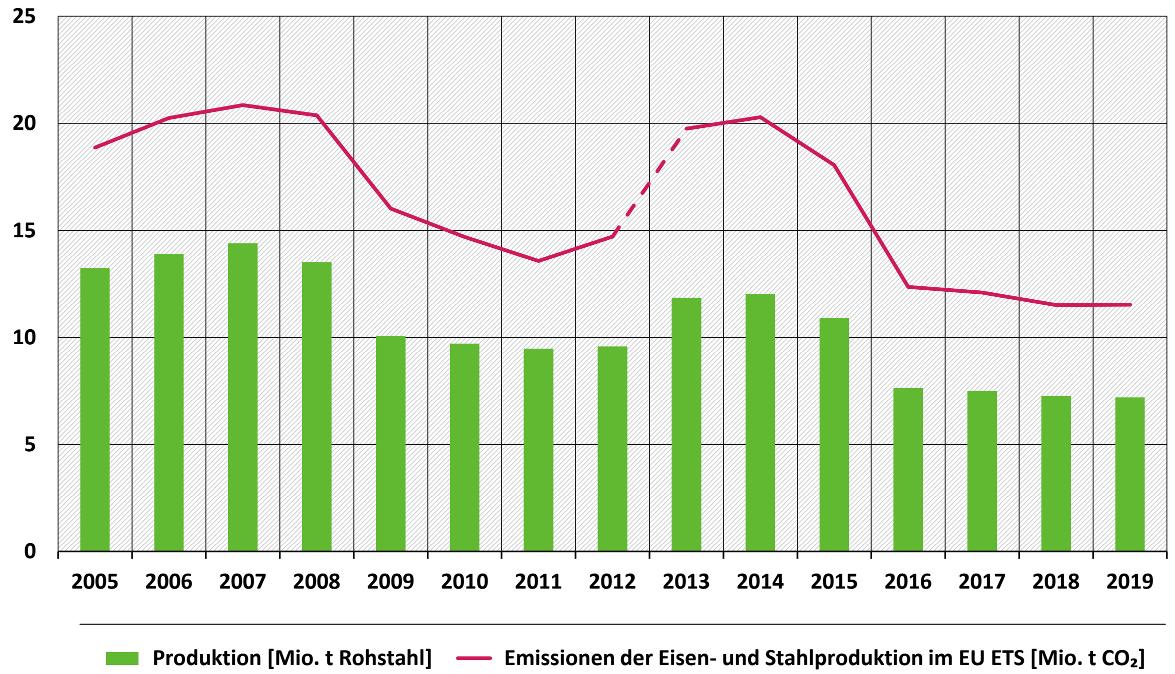
- Österreich ist das Land mit der fünftgrößten Rohstahlproduktion in der EU-28, mit einem Anteil von etwa 5 % an der Gesamtproduktion in der EU-28. Seit 2005 liegt die Eisen- und Stahlproduktion in Österreich sehr stabil zwischen 6 Mio. und 7 Mio. t Rohstahl, mit Ausnahme des Jahres 2009, dem Jahr der Finanzkrise. Die Emissionsentwicklung wird von der Produktion auf der BF-BOF-Route dominiert, die eine hohe Auslastung und eine niedrige Emissionsintensität von 1,75 t CO_2 pro Tonne Rohstahl aufweist. Der Faktor war im Jahr 2014 noch niedriger, ist aber seither gestiegen, da durch die Kohlenstaubeinblasung am Standort Linz Reduktionsmittel mit niedrigeren Emissionsfaktoren ersetzt werden.

- Der Anteil der EAF-Produktion liegt mit 10 % weit unter dem Durchschnitt der EU-28 (41 %). Der Anteil wird sich aufgrund einer neuen Anlage in Kapfenberg, die lediglich die alte Elektrolyse ersetzt, wahrscheinlich nicht erhöhen. Österreich ist ein Exporteur auf dem europäischen Schrottmarkt.

- In Österreich gibt es zwei integrierte Stahlwerkstandorte. Beide werden von der Voestalpine betrieben. Sie verfügen über eine Roheisenkapazität von 5,7 Mio. t und haben für 2019 Emissionen von 11,6 Mio. t CO_2 gemeldet.

Vereinigtes Königreich

Abbildung 7: Vereinigtes Königreich: Trends bei CO_2 Emissionen und Rohstahlproduktion, 2005 - 2019

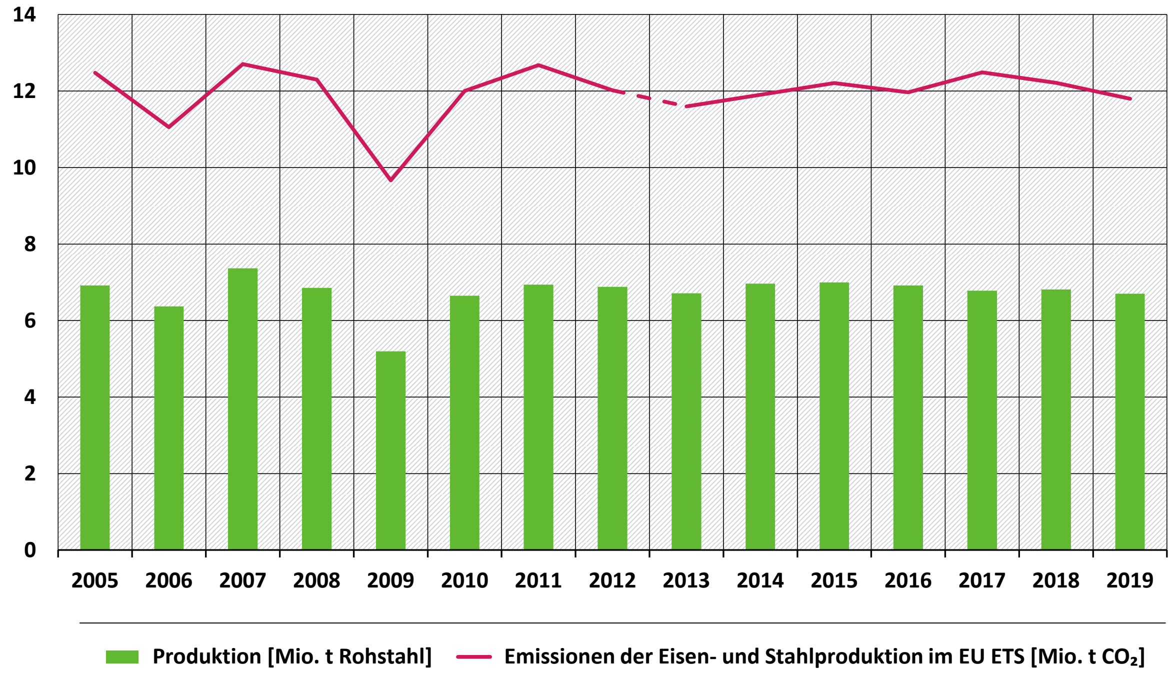


Anmerkung: Emissionen umfassen die Acitivty Codes 22 bis 25 und zugeordnete Kuppelgaskraftwerke. Es wurde keine Korrektur des Geltungsbereichs des EU-ETS vorgenommen, daher sind die Werte von vor 2013 und danach aufgrund des unterschiedlichen Geltungsbereichs nicht vergleichbar.
Quelle: Worldsteel Association (2020), EC n.d..

- Das Vereinigte Königreich war das Land mit den siebthöchsten CO_2 Emissionen aus der Eisen- und Stahlerzeugung im EU-ETS (12 Mio. t CO_2 im Jahr 2019), die 6 % der Gesamtemissionen des Sektors in der EU-28 ausmachten.
- Im Jahr 2019 war es das Land mit der achtgrößten Rohstahlproduktion der EU-28, mit einem Anteil von etwa 5 %. Der Anteil der EAF-Produktion lag bei etwa 21 % und damit weit unter dem Durchschnitt der EU-28 (41 %); dementsprechend ist das Vereinigte Königreich ein Exporteur von Stahlschrott, der hauptsächlich in den internationalen Markt geht.
- Seit 2005 ist die Produktion von einem Höchststand im Jahr 2007 (14,4 Mio. t) auf einen Tiefstand von 9,6 Mio. t im Jahr 2012 gesunken. Die britische Stahlindustrie erholte sich nicht von der Finanzkrise, sondern geriet 2015 in eine Stahlkrise. Im Jahr 2019 betrug die gesamte Rohstahlproduktion nur 7,2 Mio. t. Die Emissionen folgen dem Produktionsniveau, das von der BF-BOF-Route dominiert wird.
- 2019 gab es im Vereinigten Königreich zwei integrierte Standorte: einen in Port Talbot in Wales östlich von Cardiff, das Tata Steel gehört, und einen in Nordengland, südlich von Hull, das British Steel gehört (das Werk Scunthorpe, das bis 2016 ebenfalls zu Tata Steel gehörte). Ein drittes integriertes Stahlwerk in Teesside ist seit der Insolvenz seines Eigentümers Sahaviriya Steel Industries (SSI) Ende 2015 dauerhaft geschlossen. Nach der Wirtschaftskrise im Jahr 2008 wurde es bereits einmal eingemottet. 30 % der Emissionen auf der BF-BOF-Route stammten 2013 vom Standort Teesside.

Niederlande

Abbildung 8: Niederlande: Trends bei CO_2 Emissionen und Rohstahlproduktion, 2005 - 2019

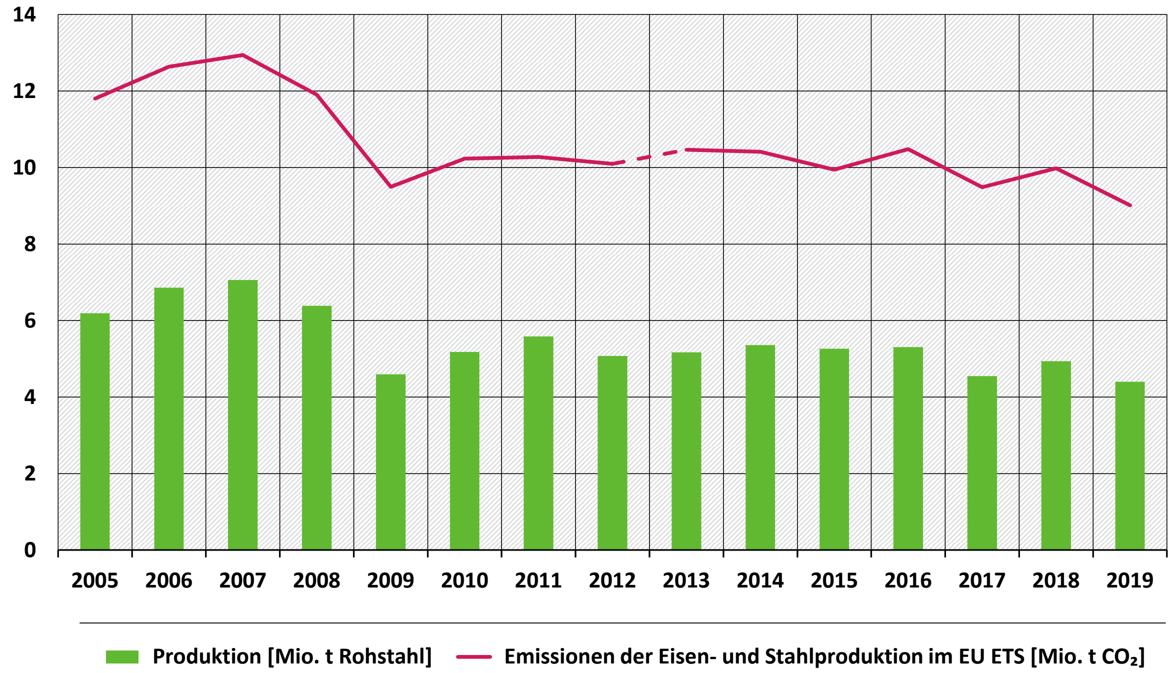


Anmerkung: Emissionen umfassen die Acitivty Codes 22 bis 25 und zugeordnete Kuppelgaskraftwerke. Es wurde keine Korrektur des Geltungsbereichs des EU-ETS vorgenommen, daher sind die Werte von vor 2013 und danach aufgrund des unterschiedlichen Geltungsbereichs nicht vergleichbar.
Quelle: Worldsteel Association (2020), EC n.d..

- Die Niederlande sind das Land mit den fünfthöchsten CO_2-Emissionen aus der Eisen- und Stahlerzeugung im EU-ETS (12 Mio. t CO_2 im Jahr 2019), die 6 % der gesamten EU-28-Emissionen des Sektors ausmachen. Der Anteil des Sektors an den gesamten EU-ETS-Emissionen des Landes schwankt (13 – 16 % im Zeitraum 2005 - 2019), was auf Veränderungen in anderen Sektoren zurückzuführen ist, insbesondere auf die zunehmende Kohleverstromung seit 2013 und die zunehmende Mitverbrennung von Biomasse seit 2016.
- Es ist auch das Land mit der neunthöchsten Rohstahlproduktion in der EU-28, mit einem Anteil von etwa 4 %. Seit 2005 ist die Eisen- und Stahlproduktion in den Niederlanden sehr stabil. Mit Ausnahme von 2009, dem Jahr der Finanzkrise, lag sie bei etwa 7 Mio. t Rohstahl pro Jahr. Der Emissionstrend wird von der Produktion auf der BF-BOF-Route dominiert, die eine hohe Auslastung aufweist und mit 1,79 tCO_2 pro Tonne Rohstahl eine Emissionsintensität unter dem EU-28-Durchschnitt zeigt.
- Die Produktion auf der BF-BOF-Route macht 98 % der Gesamtproduktion seit 2005 aus. Das letzte kleine Elektrostahlwerk wurde 2017 geschlossen; dementsprechend sind die Niederlande ein bedeutender Exporteur auf die EU- und internationalen Schrottmärkte.
- In den Niederlanden gibt es ein integriertes Stahlwerk in IJmuiden, in der Nähe von Amsterdam. Der Standort verfügt über zwei Hochöfen und eine Roheisenproduktionskapazität von 6,3 Mio. t pro Jahr.

Tschechien

Abbildung 9: Tschechien: Trends bei CO_2 Emissionen und Rohstahlproduktion, 2005 - 2019



Anmerkung: Emissionen umfassen die Acitivty Codes 22 bis 25 und zugeordnete Kuppelgaskraftwerke. Es wurde keine Korrektur des Geltungsbereichs des EU-ETS vorgenommen, daher sind die Werte von vor 2013 und danach aufgrund des unterschiedlichen Geltungsbereichs nicht vergleichbar.
Quelle: Worldsteel Association (2020), EC n.d..

- Tschechien ist das Land mit den zehnthöchsten CO_2-Emissionen aus der Eisen- und Stahlerzeugung im EU-ETS (9 Mio. t CO_2 im Jahr 2019, siehe Tabelle 36), die 5 % der Gesamtemissionen des Sektors in der EU-28 ausmachen.
- 2019 war es das Land mit der zwölftgrößten Rohstahlproduktion in der EU-28 (4 Mio. t), was etwa 3 % der Gesamtproduktion in der EU-28 ausmachte. Der EAF-Anteil war sehr gering (5 %); dennoch wurden mehr als 50 % der inländischen Schrottmengen im Inland verbraucht.
- In Tschechien gibt es zwei integrierte Stahlwerke, eines in Ostrava, das seit 2019 Liberty Steel gehört, diese verfügt über eine Roheisen-Kapazität von 3,2 Mio. t und eines in Třinec, das Třinecké železárny gehört, mit einer Roheisen-Kapazität von 2,1 Mio. t. Beide Stahlwerke liegen im äußersten Osten des Landes in der Nähe der polnischen Standorte in Dabrowa Gornizca und Krakau.
- Infolge der Wirtschaftskrise im Jahr 2009 ist die Produktion um etwa ein Drittel zurückgegangen. Am Standort Ostrava kam es zu Umstrukturierungen und einem entsprechenden Rückgang der Emissionen, während die Emissionen am Standort Třinec sehr stabil blieben.
- Bis 2023 wird der Liberty Steel Standort in Ostrava von einem reinen BF-BOF-Standort in einen Standort mit zwei Hybridöfen gleicher Kapazität umgewandelt, die hohe Anteile an Stahlschrott aufnehmen können. Dies wird sich stark auf die Emissionsintensität der Stahlproduktion und auf die Stromnachfrage in Tschechien auswirken.

1 Introduction: Motivation and country selection

The EU ETS is the key policy instrument for managing the reduction of greenhouse gas emissions for power generation and industrial facilities in Europe. Iron and steelmaking is the industrial sector with the highest absolute CO_2 emissions. The sector plays an important role for value creation and employment in the EU-28 and induces substantial intra-EU and also international trade.

Chapter 2 provides an overview of the sector since the EU ETS was introduced in 2005. It allows key drivers behind the development in emissions, production levels, investments, and the market environment to be identified. It thereby provides key information from past developments for the basis for future projections and the design of climate policy.

The chapters 3 to 10 provide information on eight selected European countries (Table 2) in the form of brief fact sheets. Each fact sheet is organized as follows:

- Key messages and figures are summarized in the first section.
- The second section provides data on the sector's role in the economy and in emissions covered by the ETS, describing key trends in production, capacity, trade and derived parameters.
- The subsequent facility level description gives information on emissions and capacities for integrated steelworks sites in each country.

The country selection was based on the contribution of a country to total sector emissions, on data availability and quality, a broad representation of production routes and employed technologies as well as trends in emissions and emission intensity. The following eight countries were selected (listed according to their share in total production of the EU-28): Germany, Italy, France, Poland, Austria, the United Kingdom, the Netherlands, Czech Republic.

Table 2 summarizes key indicators for the selected countries:

- The selected countries comprise 70 % of total crude steel production in the EU-28.
- The countries show a varying share of production (0 % - 82 %) with the electric arc furnace (EAF). On average, the EAF-share is 41 % in the EU-28.
- The selected countries bring about 75 % of the emissions from iron and steel production in the EU-28 covered by the EU ETS (activity codes 22-25 and waste gas power plants listed under activity code 20).
- The share of emissions from iron and steel production in total emissions varies from 3 % to 15 % in the selected countries. In the EU-28, iron and steel making contribute 5 % to total emissions.

Figure 10 shows the location of EU ETS installations in the selected eight countries. Installations are colour-coded by their purpose (blast furnaces and integrated sites are coded violet, coking plants are coded yellow, electric arc furnaces are coded red, waste gas power plants are coded white and other installations associated with the integrated steelmaking sites (e.g. sintering plants, coal grining and drying installations, rolling mills and others) are coded green).

Table 2: Key indicators for selected countries in 2019

Country	Total crude steel production			of which production on the electric arc furnace route		EUTL emissions[1]			Share of sector emissions covered by EU ETS in total emissions
Unit	[Mt crude steel]	[% change relative to 2013]	[% share of EU 28]	[Mt crude steel]	[% share of EU 28]	[Mt CO_2]	[% change relative to 2013]	[% share of EU 28]	[% share]
Germany	39.7	-7 %	25 %	11.9	18 %	55.0	-4 %	28 %	7 %
Italy	23.2	-4 %	15%	19.0	29 %	15.6	-14 %	8 %	4 %
France	14.4	-8 %	9 %	4.4	7 %	21.2	-4 %	11 %	5 %
Poland	9	13 %	6 %	4.1	6 %	11.8	-3 %	6 %	3 %
Austria	7.4	-7 %	5 %	0.7	1 %	12.0	1 %	6 %	15 %
United Kingdom	7.2	-39 %	5 %	1.5	2 %	11.5	-42 %	6 %	3 %
Netherlands	6.7	0 %	4 %	0.0	0 %	11.8	2 %	6 %	7 %
Czech Republic	4.4	-15 %	3 %	0.2	0 %	9.0	-14 %	5 %	7 %
Others	46.9	-1 %	30 %	23.2	36 %	48.4	6 %	25 %	2 %
EU-28	158.9	-5 %	100 %	65.0	100 %	195.7	-7 %	100 %	5 %
Norway	0.6	3 %		0.6		2.4	4 %		5 %
All EU ETS countries	159.5	-4 %		65.6		198.8	-7 %		5 %

Note:

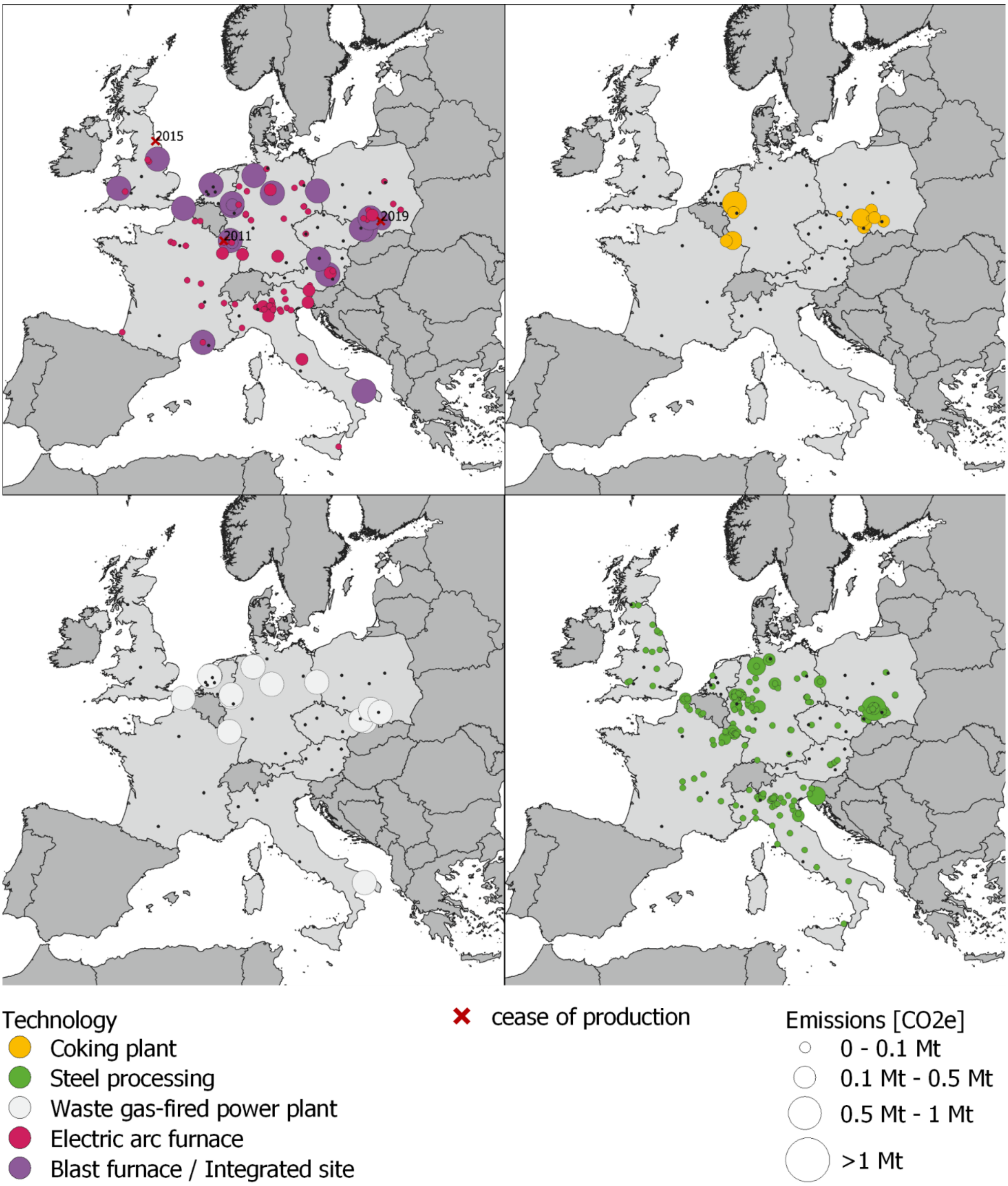
[1] Including activity codes 22-25 and waste gas power plants listed under acitivty code 20.

Source: Worldsteel Association (2020), EC n.d., EEA GHG dataviewer - EEA (2022)

To put the individual country values into perspective, we compare them to values for the EU-28. This is a deliberate choice to allow for easier backward comparability and to ensure consistency between values that are taken from different data sources.[1]

[1] It should be noted that the scope and geographical coverage of the EU ETS have both changed since its introduction in 2005 and the geographical coverage of the EU ETS is different from the EU. Since 2005, Bulgaria, Romania, and Croatia have joined the EU and also the EU ETS, and in 2020 UK has exited the EU, and is not part of the EU ETS since 2021. In 2019, UK contributed 6 % to EU-28 total emissions for iron and steelmaking (11.5 Mt CO_2). Norway, Liechtenstein and Iceland are included in the EU ETS but are not members of the EU. They contributed 3 Mt CO_2 from iron and steelmaking in 2019 and their share in total EU ETS crude steel production was less than 0.5 % in 2019. The scope of the EU ETS has also changed over time. Since 2008 plants for metal processing at integrated sites have entered the scope of the EU ETS (e.g. in Germany). Since 2013, additional CO_2 emitting activities have been included in the EU ETS (e.g. foundries and plants for metal processing at EAF sites in Germany).

Figure 10: Locations of installations from the iron and steelmaking sector in the selected countries based on ETS data



Note: The illustration is based on emissions reporting under the EU ETS. While the EU ETS has activity codes specifying the main activity of an installation, codes are not a fully relialbe indicator in terms of the installation's function in the steelmaking process. Therefore, the assignment is based on a individual asssessment. Moreover, some sites report the emissions of the entire steelmaking process under one installation ID (e.g. this is common practice in the UK and Austria), while in other cases the different stages, functions and respective installations in the steelmaking process are all reported under as separate installations. In the former case, they are depicted as integrated sites colour-coded in violet.

Source: Own presentation based on EC n.d..

2 The iron and steelmaking sector in the EU-28

2.1 Overview of emissions of the iron and steelmaking sector under the EU ETS

The following Table 3 provides an overview of the CO_2-emissions reported in the EUTL for the EU-28, which can be attributed to the iron and steelmaking sector. Each installation in the EUTL is attributed an activity code. The classification of installations by activity codes is not always coherent. If not stated differently, activity codes are used as they are reported in the EUTL for this report, without corrections. Industrial plants involved in the production of iron and steel are recorded under the following activity codes in the EUTL: 22 production of coke, 23 metal ore roasting and sintering, 24 production of pig iron or steel, and 25 production or processing of ferrous metals.

In addition, a substantial share (28 % in 2019) of the iron and steelmaking sector's emissions are recorded under the activity code 20 (combustion of fuels). This is because a substantial share of waste gases generated in the production of crude steel in blast furnaces and basic oxygen furnaces (BF-BOF route) and in coke ovens are used in power plants. While some of these installations are included along with the integrated steelworks in the EUTL (this is the case in Finland, the UK and since 2013 also Austria, as well as for one of two installations in France, Spain, and Sweden), many of them are instead recorded as separate installations under activity code 20 (this is the case in Belgium, Czech Republic, Germany, Spain, Hungary, Italy, the Netherlands, Poland, Romania, Sweden, Slovakia, and until 2013 Austria, as well as for one of two installations in France, Spain, and Sweden).

Table 3: Overview of emissions from the iron and steelmaking sector included in the EUTL (EU-28, 2019)

		Emissions	Share
		Mt CO_2	%
20	Waste gas combustion installations	54.5	28 %
22	Production of coke	10.2	5 %
23	Metal ore roasting and sintering	2.6	1 %
24	Production of pig iron or steel	118.4	61 %
25	Production or processing of ferrous metals	10.0	5 %
Total iron and steelmaking covered by the EU ETS		195.7	100 %

Note:

[1] As described in the report, there is uncertainty about the exact amount of emissions from combustion installations under activity code 20 attributable to waste gas combustion. Like some installation mix fuels (e.g. natural gas), the share of emissions that originates from the combustion of waste gases cannot be singled out. Some site-specific information has been applied but there is no consistent source that singles out the respective fuel inputs. See Table 39 for more details.

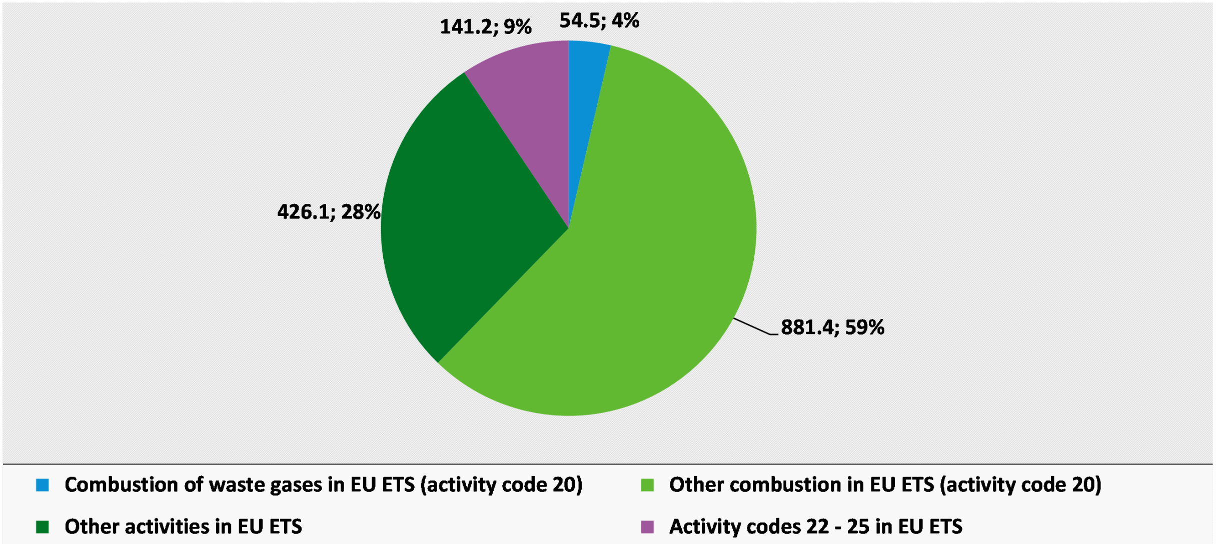
Source: EC n.d..

Therefore, emissions recorded under activity code 22 to 25 do not fully reflect total emissions originating from the production of iron and steel. In order to quantify emissions of the iron and steel industry, it is necessary to also include the emissions of waste gas combusting installations listed in the EUTL under activity code 20. Waste gas combusting installations were identified through individual research in the EUTL and matched to integrated steelworks throughout for all EU-28 countries based on common addresses as well as installation and company names.

Table 39 in the Annex provides a list of identified installations. However, installations that use blast furnace gas may also burn other fuels such as natural gas. There is no consistent source that reports fuel inputs for the respective installations. This leads to uncertainties regarding the exact emissions of the iron and steelmaking sector.

As shown in Figure 11 in 2019, the iron and steelmaking sector accounted for a share of 13 % of EU-28 EU ETS emissions, making it the largest contributor to industrial emissions in the EU ETS. The share of the iron and steelmaking sector in total EU-28 emissions is 5 % (see Table 2).

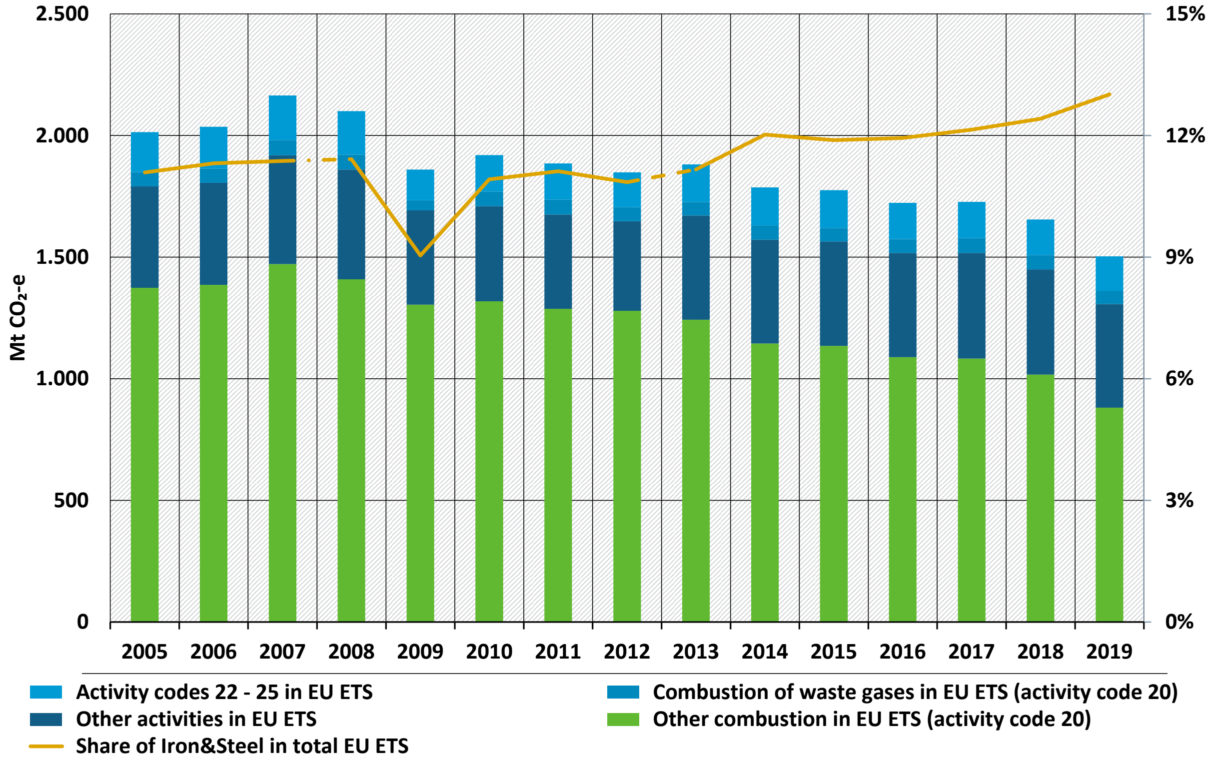
Figure 11: Share of the iron and steelmaking sector in total emissions covered by the EU ETS in the EU-28 in 2019 (Mt, % share)



Source: EC n.d.

Due to the changing geographical coverage and the extension of the scope of the EU ETS (e.g. inclusion of steel processing in 2013), a time trend based on historical EU ETS data for the period from 2005 to 2019 (as illustrated in Figure 12) does not provide reliable insights. In the period from 2013 to 2019, emissions show a clear declining trend for both activity codes 22 - 25 and combustion installations other than waste gas power plants under code 20, while emissions from installation under other codes remained unchanged. The trend is dominated by the reduction code–20 installation (-29 %), emissions from codes 22 - 25 installations decreased by 9 %, only.

Figure 12: Share of the iron and steelmaking sector in total emissions covered by the EU ETS in the EU-28, 2005 - 2019 (Mt, % share)



Source: EC n.d.

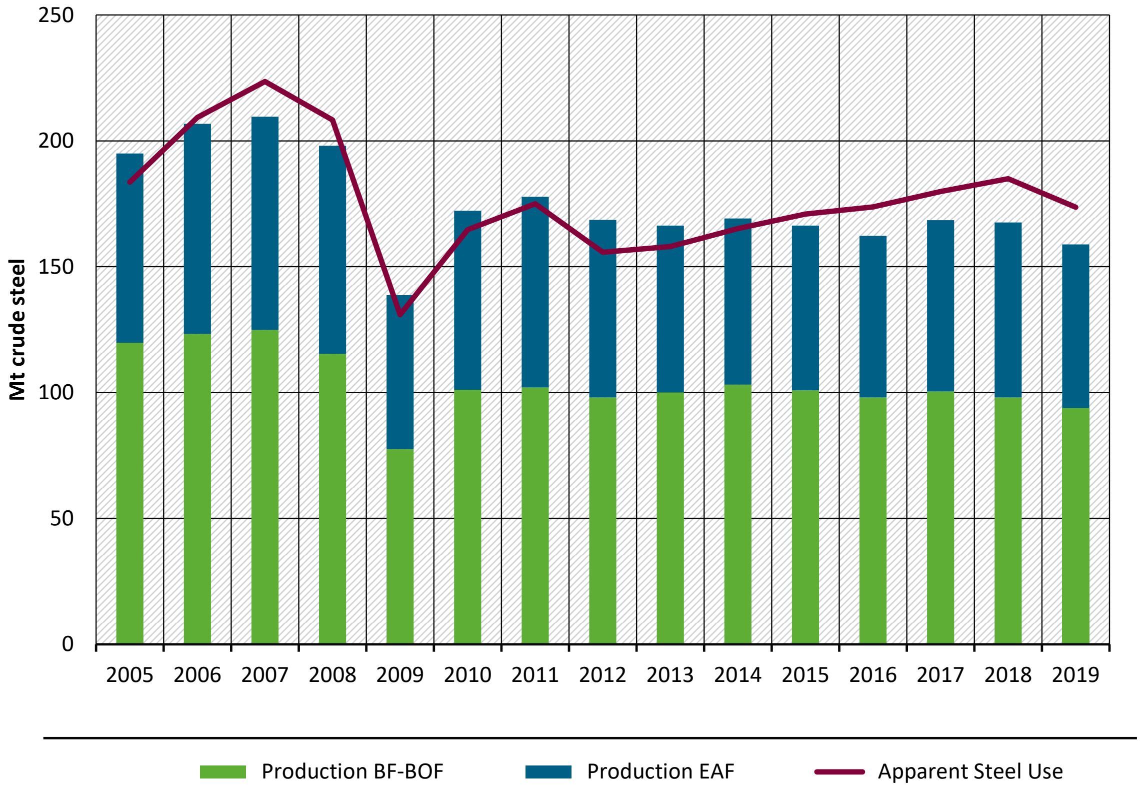
2.2 Production and consumption of crude steel in the EU-28

Total crude steel production in the EU-28 decreased from 191 Mt in 2005 to 154 Mt in 2019. The production level of basic oxygen steel in the EU-28 has roughly been stable with some small fluctuations between 2010 and 2018 at a level of 100 Mt. In 2019, the production of basic oxygen steel decreased to a level of 94 Mt. This means that production levels in 2019 were about 23 % below the level of production before the financial crisis (2005 - 2007). This was due to the closure (or mothballing) of several blast furnaces in 2009 (in Belgium, Bulgaria, France, Czech Republic and UK). The production of electric arc furnaces amounted to 65 Mt in 2019, which is 20 % below the production levels before the financial crisis.

Figure 13 also shows apparent steel use (ASU)[2] measured in crude steel equivalents to allow a comparison with total crude steel production. If crude steel production exceeds apparent steel use net steel exports can be assumed, and vice versa if apparent steel use is larger than steel production in the EU, net imports can be assumed. However, it must be noted that stock changes are also a possible explanation for differences between ASU and crude steel production.

The figure shows that the EU has shifted from being a net exporter of crude steel from 2009 to 2014 to a net importer from 2015. For example, in 2013 net exports amounted to 6 % of apparent steel use and in 2019 net imports made up almost 10 % of apparent steel use.

Figure 13: Production of crude steel in the EU-28

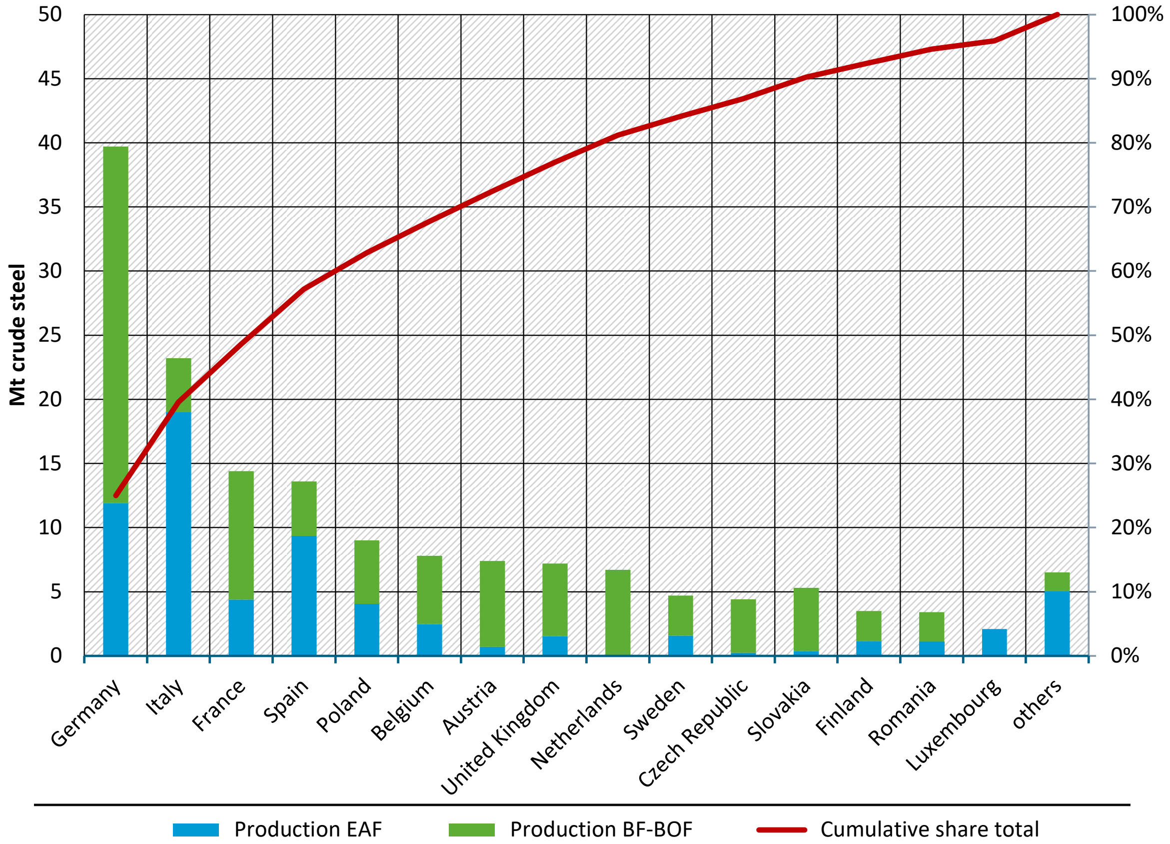


Source: Worldsteel Association (2020)

[2] Apparent steel use (ASU) is defined by worldsteel as: "ASU is obtained by adding up deliveries (defined as what comes out of the steel producer's facility gate) and net direct imports." $ASU_{crude\ steel\ equivalent} = production_{crude\ steel} - exports_{crude\ steel\ equivalent} + imports_{crude\ steel\ equivalent}$ (Molajoni and Szewczyk 2012).

Not all European Countries have iron and steel production sites. Figure 14 shows the quantity of crude steel produced by country. Germany produces a quarter of the total crude steel production of the EU-28. Other important producers are Italy, France, Spain and Poland. Together, these five countries produce about two thirds of the European steel production.

Figure 14: EU crude steel production in 2019 and cumulative share of production



Source: Worldsteel Association (2020).

2.3 Detailed assessment of emissions by process based on site-specific assessment

2.3.1 Description of the general approach and remaining uncertainties

In a next step, the distribution of the total emissions of the iron and steelmaking sector between the different production routes was analyzed. While activities in the sector are reported under different activity codes in the EUTL (see Table 3), the different codes are not sufficient to assign emissions to the different production routes. Integrated steel mills with a blast furnace and basic oxygen furnace, DRI plants and electric arc furnaces all report their emissions under activity code 24. Vice versa, some of the emissions reported in other activity codes (e.g. coking and sintering but also power generation from waste gases) can be clearly attributed to the BF-BOF route but in many cases they are reported as separate installations under different activity codes. For the analysis presented in Table 4, we performed detailed desk research to match installations that belong to one of the three crude steel production routes and where emissions reported in the EUTL can be attributed to the production activity at one integrated steelworks.[3]

The BF-BOF route typically consists of the following facilities:

- at least one coking plant (sometimes reporting emissions as separate installations under activity code 22 and sometimes reporting as part of the integrated steelwork under activity code 24),
- at least one sintering plant (mostly reporting emissions as part of the integrated steelwork under activity code 24),
- at least one blast furnace and one basic oxygen furnace (mostly reporting emissions as part of the integrated steelwork under activity code 24),
- waste gas power plant(s) (reporting under activity code 20),
- plant(s) for drying and processing of pulverized coal (reporting under activity code 20, when not part of a bigger installation), and
- further processing facilities (e.g. hot rolling mills) that use waste gases as the main energy source (which regularly report under activity code 25, however, some plants report under activity code 24).

Uncertainty in the matching, emissions gaps, and the extent to which emissions from a specific installation can be attributed to the BF-BOF route can have the following sources: As coke is an internationally-traded commodity, integrated steelworks on the BF-BOF route can choose to either import coke, produce coke from coking coal in an on-site coking plant for further use in the facility or even export excess coke to other steelworks. It was not possible to identify the strategy chosen for each individual integrated steelworks; however, total emissions increase the more coke is produced on-site. For integrated BF-BOF sites, the share between downstream emissions attributable to the use of waste gases for the upstream processes and additional external fuel input cannot be disentangled. If we assign a power plant to the integrated

[3] The recording of integrated steelworks with blast furnaces (BF-BOF sites) in the EUTL differs across countries and individual sites. While in some cases (e.g. the UK), all emissions of the integrated steelworks are recorded under one installation in the EUTL (typically under activity code 24), in other countries the emissions of integrated steelworks are split across several separate installations (e.g. sintering and coking plants, blast furnaces and rolling mills). When the latter was the case, installations belonging to an integrated steelworks were identified based on common addresses as well as installation and company names. Detailed information on the BF-BOF installations identified is provided in the country factsheets and additional information on the countries not covered in the factsheets is available on request from the authors.

steelworks, we assume that the majority of emissions from this installation originate from waste gases from the BF-BOF route. On-site waste gas power plants can also use other fuels such as natural gas or coal (which is the case for installations in France, in the Netherlands and in Spain, but presumably also for installations in Poland and in the Czech Republic) for additional electricity, partly also heat production. Emissions from these installations reported under code 20 are the sum of emissions from the combustion of all employed fuels. When information on fuel shares was available and reliable (which was the case in France, the Netherlands and Spain, see Annex A.3 for further details), we corrected emissions accordingly. In case no information was available, we assumed that all emissions can be attributed to waste gases from the BF-BOF process. Hence, we tend to overestimate total emissions on the BF-BOF route.

On the EAF route, it is not necessary to aggregate installations and regard them as integrated sites because there is no significant flow of energy carriers between different installations (as it is the case on the BF-BOF route). EAFs are typically reported under activity code 24. For the EAF route uncertainty on total emissions comes from downstream rolling mills which are in some cases reported together with the EAF under codes 24 or 25 as one installation. Hence, we tend to overestimate direct emissions on this route as well.

The DRI-EAF route typically consists of the following facilities:

- at least one synfuel-based[4] shaft furnace reporting emissions under activity code 24), and
- at least one EAF (typically reporting emissions under activity code 24) which can use different mixes of steel scrap and DRI or HBI from the DRI furnace as material input.

For the DRI-EAF route, the uncertainty of total emissions originates from the split of DRI and scrap as input for the respective EAF and the resulting emissions which can vary between the years and is not available as a timeseries. Depending on whether the real share is higher or lower, our estimates tend to under- or overestimate total emissions.

2.3.2 Results on the EU-28 level

As expected, the majority of the emissions from the iron and steelmaking sector are related to pig iron production with blast furnaces (BF-BOF route). Total emissions related to BF-BOF sites amounted to 176 Mt CO_2 in 2019, which corresponds to 89 % of the total iron and steelmaking sector emissions. The average direct emission intensity of the BF-BOF route – including waste gas power plants – was about 1.85 t CO_2 per ton of crude steel in 2019, which did not change since 2013. This emission intensity also includes emissions from sintering and coking plants, blast furnaces, basic oxygen furnace and rolling mills when operated at integrated sites. For the countries analyzed in the fact sheets, it ranges between 1.75 - 2.44 t CO_2/t crude steel in 2019. The lower value is achieved in Austria while the higher one comes from a steelworks in Italy.

Total direct emissions related to EAF sites amounted to 9.4 Mt CO_2 in 2019, which is equal to 5 % of the total iron and steelmaking sector emissions. The average direct emission intensity of the EAF route was about 0.15 t CO_2/t of crude steel in 2019. This emission intensity includes emissions from rolling mills operated at the same site, when they report their emissions together with the EAF (which is often the case). For the countries analyzed in the fact sheets, it ranges between 0.08 - 0.31 t CO_2/t crude steel in 2019. The lower value is achieved in Germany, while the higher comes from steelworks in the Czech Republic.

[4] The synfuel is produced on-site from natural gas or coal; depending on the DRI technology, the synfuel production is integrated and happens directly in the furnace or is produced in a preceding process step.

Total direct emissions related to DRI sites amounted to 0.5 Mt CO_2 in 2019, which corresponds to 0.2 % of the total iron and steelmaking sector emissions. The average direct emission intensity on the DRI-EAF route was about 0.79 t CO_2/t of crude steel in 2019. This emission intensity includes emissions from the DRI plant and the EAF plant. As of 2019, there were only two DRI-EAF plants covered by the EU ETS.[5] The Hamburg ArcelorMittal plant in Germany is analyzed further in the fact sheets. Here, DRI is based on natural gas and the intensity was 0.5 t CO_2/t DRI in 2019. The other European DRI-EAF plant is located in Höganäs, Sweden, where DRI is based on coal gasification which is associated with a higher emissions intensity and hence increases the EU-28 average (Höganäs Group 2022).[6]

Emissions from other processes (foundries, downstream processes) amounted to 11.6 Mt CO_2 (6 %) in 2019.

Table 4: Emissions by process in the iron and steelmaking sector based on site-specific assessment from the EUTL for EU-28

Process	Indicator	Unit	2013	2015	2018	2019
Blast furnaces (BF-BOF route)	Emissions[1]	[Mt CO_2]	186.0	188.4	182.2	174.0
	Production	[Mt crude steel]	100.1	100.9	98.1	93.9
	Specific emissions (Range from facts sheets)	[t CO_2/t crude steel]	1.86	1.87	1.86	1.85 (1.75-2.44)
Electric arc furnace (EAF route)	Emissions[2]	[Mt CO_2]	9.7	9.7	10.2	9.4
	Production[3]	[Mt crude steel]	65.7	64.8	68.9	64.4
	Specific emissions (Range from facts sheets)	[t CO_2/t crude steel]	0.15	0.15	0.15	0.15 (0.08-0.31)
Directly reduced iron (DRI-EAF route)	Emissions[4]	[Mt CO_2]	0.5	0.5	0.5	0.5
	Production	[Mt direct reduced iron]	0.6	0.7	0.7	0.6
	Specific emissions	[t CO_2/t product]	0.86	0.80	0.80	0.79
Other[5]	Emissions	[Mt CO_2]	13.7	12.4	12.6	11.6
Total	**Emissions**	**[Mt CO_2]**	**210.0**	**211.1**	**205.5**	**195.7**

Note:

[1] Emissions attributed to the BF-BOF route include: emissions from coking plant and sintering plant (either reported seperately, e.g. under activity codes 22 and 23 or as integrated steelworks under code 24), emissions from pig iron and steel production in the BF and BOF (reported under code 24) and emissions from downstream processes that typically use waste gases for the upstream processes as fuel input (reported under code 25, or as integrated steelworks under code 24), and emissions from on-site waste gas power plants (reported under code 20).

[2] Emissions attributed to the EAF route originate from fuel use and electrode wear in the electric arc furnaces (reported under code 24 or in some cases 25) and rolling mills wich often report under the same installation.

[3] Excluding EAF steel production from direct reduced iron.

[5] As there is no separate activity code for DRI-EAF plants in the EU ETS. The classification is based on EUTL data and further information referenced in the respective section.

[6] Based on the information available on the company website and the emission levels reported in the EUTL, the installation can be clearly identified as a DRI-EAF plant.

[4] Emissions attributed to the DRI route include fuel-related and process emissions from DRI installations and the share of the emissions from the subsequent EAF route that equals the mass share of the DRI in the EAF.
[5] Other emissions include all emissions under codes 22-25 that are not attributed to integrated steelworks or one of the three production routes.
Source: Own compilation of data based on EC n.d. for emissions data, Worldsteel Association (2020) for production data.

2.4 Investment plans on the company and country level

In the past, technological development of the blast furnace route was focused on cost reductions, e.g. by pulverized coal injection. In recent decades, the technological progress regarding emission abatement on the BF-BOF route was slow. Only in recent years has the possibility for a fuel switch from coking coal to natural gas or hydrogen been increasingly taken into account. Now there are concrete plans to build new plants using the direct reduced iron technology (DRI) with hydrogen used as reducing agent. Currently government support ((e.g. the EU Innovation fund and the German support program "Dekarbonisierung in der Industrie", KEI 2024)) drives this trend (EC 2022). Furthermore, in Germany, carbon contracts for difference (CCFDs) to support investments into low carbon steelmaking are being discussed.

This chapter presents current discussions in the countries in more detail and summarizes findings of the Green Steel Tracker (Vogl et al. 2021):

On the company level, the following emission reduction targets were announced by the largest steel producers in the EU-28:

- ArcelorMittal aims at reducing emissions in Europe by 30 % until 2030 and to achieve carbon neutrality on the company level until 2050.
- Liberty Steel has announced to become a carbon neutral company by 2030.
- Voestalpine plans to reduce emissions by 30 % to 35 % by 2030 to 2035 if economically feasible, and by more than 80 % by 2050. In 2017, the company opened a DRI unit in Corpus Christi, Texas (USA). The HBI produced at this site is also used as input for its integrated sites in Austria in order to reduce specific energy demand and emissions covered by the EU ETS (Voestalpine 2017b).
- Salzgitter GmbH plans to reduce emissions by 30 % by 2026, 50 % by 2030 and 95 % by 2050.
- ThyssenKrupp has announced that it aims to reduce emissions by 30 % by 2030 compared to 2018 and to become climate-neutral by 2050.
- SSAB plans to reduce emissions by 26 % by 2030 compared to 2018 levels and become fossil-free by 2045.
- Tata Steel has announced to reduce emissions by 30 % by 2030 compared to 2013 levels and aims for carbon neutrality by 2050.

On the facility level the following plans were announced:

Germany

- In Bremen (EUTL ID DE60) and Eisenhüttenstadt (EUTL-ID DE70), ArcelorMittal will start natural gas injection in the existing BF-BOF route in 2021, which will reduce emissions by 5 %. In Bremen, ArcelorMittal plans to build a full-scale DRI unit by 2026. Initially, it will be fuelled with natural gas and switch to hydrogen once it is available. In a transition phase, the Bremen unit will supply iron sponge for both sites (Stahleisen 2021).
- In Hamburg, ArcelorMittal plans to build a new pure hydrogen-based pilot DRI plant with an annual production capacity of 0.1 Mt of iron sponge by 2024. In the initial phase, hydrogen will be supplied from natural gas-based steam reforming until green hydrogen supply becomes available, e.g. from an electrolyser also planned to become operational in 2025 in Hamburg (future.hamburg 2022).
- Salzgitter Flachstahl GmbH (EUTL ID DE43) is currently building a DRI pilot plant that can flexibly operate with natural gas and hydrogen. The plant is built by Tenova using direct reduction technology. Production is planned to start in the second half of 2022 (Salzgitter AG 2021). The next step in the SALCOS project is the construction of a full scale DRI unit by the end of 2025, which will replace one of the three blast furnaces at the Salzgitter site. The final investment decision was approved in July 2022 (Salzgitter AG 2022).
- ThyssenKrupp announced two full-scale hydrogen-based projects: one based on green hydrogen from a nearby 500 MW electrolyser in Walsum. Final investment decision is planned for 2025 and the first stage of operation could start in 2027 (iqony 2023). The partners intent to apply for IPCEI. One project is based on blue hydrogen. Here, natural gas imported from Norway will be reformed to hydrogen either on the Dutch coast in Eemshaven or on two other potential sites on the German North Sea coast with a reforming capacity of 1.7-2.4 GW. The feasibility study favours CO_2 storage using the Norwegian Northern Lights site. The entire value chain could be operational by 2027 at the earliest (Thyssenkrupp 2021). It is planned that the hydrogen will replace PCI in the existing blast furnace. In the medium term, ThyssenKrupp is working on the design of a hydrogen- and electricity-based direct reducing plant with melting units that can be integrated into the existing metallurgical infrastructure (Thyssenkrupp 2022).
- The ROGESA in Saarland (EUTL ID DE52) started to inject hydrogen rich coke oven gas into their blast furnaces in summer 2020 (Dillinger 2019).

France

- In Dunkerque (EUTL ID FR956), a part of a Horizon 2020 project pilots CCS from the existing BF-BOF process, with a capture capacity of 5 kt CO_2 per year. The project was to begin operation in 2021. The target is to scale up to 1 Mt CO_2 by 2025 and 10 Mt CO_2 by 2035. At the same site, an application as Important Project of Common European Interest (IPCEI) and plans to use "low-carbon" hydrogen where announced. A change to a full-scale hydrogen-based direct reduction and steam reforming-based CCS is envisioned, but with no concrete time plan published insofar.
- Also in Dunkerque, Liberty Steel, together with Luxembourg-based Paul Wurth and the German SHS-Group have signed a statement of intent to construct a new 2 Mt per year steelworks based on DRI. The unit is planned to shift from natural gas-based DRI to full hydrogen-based DRI once the (integrated) electrolysis production is complete (Jendrischik 2021).
- At its global research centre in Maizières-lès-Metz, ArcelorMittal progresses research on the introduction of ironmaking technology using the direct electrolysis of iron ore. The research project is planned to end by 2022 (Siderwin 2021).

Austria

- At Donawitz (EUTL ID AT13), several hydrogen-based pilot plants, with hydrogen supplied from off-site production, were planned to start operation in 2021 (Voestalpine 2022a):
  - The Hyfor project producing HBI
  - The SuSteel project testing plasma smelting reduction
  - Moreover, a project evaluating different pyrolysis of natural gas is carried out. It is planned that a basis for a technology choice will be delivered for a demonstration plant to be constructed in the period 2022 to 2027.
- At its Linz plant (EUTL ID AT16), Voestalpine is testing green hydrogen production via PEM electrolysis (6 MW), which could be used as input for DRI steelmaking as part of the H2FUTURE project.

United Kingdom

- British Steel plans a full-scale project for its site in Scunthorpe (EUTL ID UK321). It entails a carbon capture, utilization and storage unit, projected to be partially functional in 2023 and fully operational by 2040. This is part of a bigger decarbonising project for the entire Humber region (Zero Carbon Humber 2022).

Czech Republic

- Liberty Steel has announced that it will replace the four blast furnaces at the Ostrava site (EUTL ID CZ 73) with two hybrid furnaces of the same capacity by 2023. The new furnaces will be able to use scrap shares of up to 70 %. The full use of the new technology depends on the access to a 400kV line to be constructed by 2025 (Liberty Steel 2020b).

Romania

- For its plant in Galati (EUTL ID RO44), Liberty Steel has projected a full-scale transition to first natural gas-based, then hydrogen-based direct reduction of iron ore by 2025, with a DRI capacity of 2.5 Mt per year and an expansion of existing EAF capacity to 4 Mt of liquid steel. The company also signed a Memorandum of Understanding with the Romanian government (Liberty Steel 2020a).

Spain

- Plan to integrate the Gijon facility (EUTL ES212) are at a very preliminary stage with no concrete decisions on technology choices taken and heavily relies on funding from the IPCEI Green Spider project.

Sweden

- For its site in Lulea (EUTL ID SE495) SSAB is currently running the HYBRIT pilot project (2021-2024) to test a hydrogen-based direct reduction of iron ore (Hybrit 2022).
- Also as part of HYBRIT SSAB plans to convert its blast furnace in Oxelösund (EUTL ID SE494) to an EAF fed by DRI and steel scrap until 2025 (SSAB 2020).
- As an overarching strategy, SSAB which is active in Sweden and Finland, plans to phase out all blast furnaces by 2030 (SSAB 2022).

2.5 Regulatory and market environment

2.5.1 Free allocation in the EU ETS

Since 2005 iron and steel production is covered by the EU ETS. Installations from the iron and steelmaking sector receive free allocation of allowances based on benchmarks. Table 5 shows free allocation of allowances to each EUTL code for the iron and steel processes in the years 2013 to 2019. Combustion installations using waste gases reporting under EUTL code 20 were identified by the authors (compare Table 39).

Table 5: Overview of free allocation for the iron and steelmaking sector in the EU-28 (Mt CO_2)

	2013	2014	2015	2016	2017	2018	2019
22 Production of coke	11.3	11.1	10.8	10.5	10.1	9.9	9.6
23 Metal ore roasting or sintering	2.0	1.9	1.8	1.8	1.8	1.7	1.7
24 Production of pig iron or steel	171.8	167.6	163.0	162.3	153.7	146.8	146.2
25 Ferrous metals	11.0	10.6	10.1	10.0	9.8	9.6	9.3
20 Power plants	1.9	1.8	1.7	1.5	1.5	1.2	1.1
Total iron and steel	199.4	194.8	189.4	188.8	179.6	172.1	170.8

Source: EC n.d..

The activity code 24 (*production of pig iron or steel)* receives the majority of allowances as it is the most emissions-intensive part of the production process. Here, it is important to also acknowledge the complexity of the sector, especially regarding waste gas flows between different parts of the production process. Free allocation for hot metal production – also including free allocation for waste gases generated in the blast furnace -– is reported under activity code 24. Since 2013, there is no free allocation for electricity generation which reports under activity code 20. Therefore, the waste gas power plants under activity code 20 also receive almost no free allocation. Their remaining allocation is mainly given for heat production.

For each activity, the amount of free allocation received is calculated based on of three elements:

- The ambition level of the benchmark,
- the historic activity levels,
- and the cross sectoral correction factor.

The benchmarks are explained in more detail below. The historic activity levels refer to the production in the base period and are fix for the allocation periods 2021-2025 and 2026-2030 unless major changes in production levels occur. The cross sectoral correction factor is only applied if preliminary allocation exceeds the total amount of allowances available for allocation; in the 2021-2025 period, there is no need for such a correction.

The iron and steelmaking sector has six product benchmarks, which are outlined in Table 6.[7] In addition, the fallback approach is used for downstream processes such as hot rolling and for DRI.

[7] The benchmark for hot metal comprises the emissions of the blast furnace and the basic oxygen converter.

The decision to implement benchmarks in the EU ETS was taken at the end of 2008. While free allocation to electricity generation was phased out, industrial sectors continued to receive free allocation to avoid carbon leakage. However, it was the aim to limit the free allocation to the emission intensity of new and modern plants, so that every installation would still have an incentive to reduce emissions up to the emission level of CO_2-efficient plants. For most sectors, the benchmarks reflect the average emissions of the 10 % most efficient installations covered by the EU ETS (based on data collected for the years 2007 and 2008). However, the benchmarks for coke, sinter and hot metal have been calculated based on information from the relevant Best Available Techniques reference documents (BREFs) published in 2001.

The exact level of the benchmarks was decided in 2011 (EC 2011); the benchmarks were used for free allocation in Phase III from 2013 to 2020. For free allocation from 2021 onwards, a comprehensive data collection for the years 2016 and 2017 was realized. The emission values for the years 2007/2008 and 2016/2017 were compared to derive the annual reduction rate for each product depending on emission abatement achieved within the considered period. This annual reduction rate is between 0.2 % and 1.6 % per year in which 0.2 % is the minimum value even if no emission reduction was achieved between 2007/2008 and 2016/2017 and 1.6 % reflects the maximum possible reduction rate EC 2021a. For the derivation of the benchmark values (2021-2025) the respective annual reduction rate is extrapolated for a period of 15 years and applied to the benchmark value of the Phase III. This leads to minimum lowering of 3 % and to a maximum lowering of 24 % of the Phase III benchmark values applied in the period 2021-2025. The benchmark values for the 2026-2030 period will not be set until further historical data is collected in future years.

The minimum rate of 0.2 % is applied for hot metal for the calculation of the benchmark for the period from 2021 to 2025 (Article 10a paragraph 2 EU ETS directive). Thus, the hot metal benchmark for the period from 2021 to 2025 is 1.288 t CO_2/ t of hot metal (EC 2021a). The benchmark for hot metal for the period 2013 to 2020 was 1.328 t CO_2/t (EC 2011), which was close to the average specific emissions of the 10 % most efficient installations in 2016 and 2017 (1.331 t CO_2/ t of hot metal) (EC 2021a).

Table 6 also shows how the benchmark values for the period from 2026 to 2030 would look like, if the current annual reduction rates remained constant (the Fit-for-55-proposal is not taken into account in Table 6).

Table 6: Product benchmarks for the iron and steelmaking sector

Product benchmark	Unit	BM value in Phase III	BM value in 2021-25	BM value in 2026-30 (own estimation based on trend)
Coke	EUA/t coke	0.286	0.217	0.194
Sintered Ore	EUA/t sintered ore	0.171	0.157	0.152
Hot metal[1]	EUA/t hot metal	1.328	1.288	1.275
EAF carbon steel	EUA/t EAF carbon steel	0.283	0.215	0.192
EAF high alloy steel	EUA/t EAF high alloy steel	0.352	0.268	0.240
Iron casting	EUA/t casted iron	0.325	0.282	0.268

Notes:
[1] The benchmark for hot metal only comprises the emissions of the blast furnace and the basic oxygen converter.
Source: EC 2011, EC (2021a) own calculation of BM values in 2026-2030

There is no benchmark for DRI. The free allocation for the two DRI plants in Europe is calculated based on the fall-back approach. The resulting allocation of the German plant is about 0.5 t CO_2/t DRI in the phase from 2021-2025).[8]

These benchmarks are not directly comparable to the average emission intensities presented in Table 4. For the BF-BOF route, values in Table 4 refer to the emissions associated with all underlying processes to produce one ton of crude steel. In order to compare with the benchmarks, the benchmark values for coke and sintered ore would need to multiply with the respective input factor in terms of tons of coke/sintered ore per ton of hot metal and added to the hot metal benchmark.[9] Moreover, converting from a ton of hot metal as the basic unit to a ton of crude steel requires information on the share of scrap steel that is added into the BOF, which is again a site-specific value that can also change over time.

Values for benchmark values for EAF steel also include indirect emissions (from electricity). The allocation is reduced by the exchangeability factor derived for each installation, taking into account electricity used within the system boundaries as well as heat flows. Indirect emissions are not accounted for in the emissions balance for the individual EAF installation that is used for our intensity figures reported in Table 4.

For a detailed discussion about the adjustments that need to be made to the EU ETS in order to improve the incentives for decarbonisation in the iron and steelmaking sector, see chapter 5.4.2 and chapter 8.2.3 in Matthes et al. (2021).

[8] Own calculation based on the free allocation for installation DE 204543 for the year 2018: Free allocation equivalent to 0.25 Mt. of CO_2 reported in the EUTL for the year 2018 and a production of 0.56 Mt of DRI reported by Worldsteel for 2018. This does not include the free allocation to the EAF plant operated at the same site. For the period from 2021 to 2025, the free allocation of this plant is 0.27 Mt. CO_2 per year. With the production data for 2018, this corresponds to a specific free allocation of 0.5 t CO_2 per ton DRI.
[9] The input factors of coke and sintered ore are site-specific and depend on the concrete configuration of the integrated site.

2.5.2 Compensation for indirect carbon cost

The direct emissions reported by EU ETS installations do not include emissions for electricity generation unless the electricity is generated in the installation itself. Purchased electricity therefore comprises indirect emissions (and indirect CO_2 costs) as purchased electricity causes emissions outside of the iron and steelmaking sector. Furthermore, the electricity prices generally include the carbon cost induced by the EU ETS and thus industrial operators face carbon costs additional to the direct emissions. Electricity generation is not, however, eligible for free allocation. Instead, Article 10a (6) of the ETS Directive allows Member States to compensate the most electro-intensive sectors for increases in electricity costs as a result of the EU ETS, through national state aid schemes.

The compensation of indirect costs is, however, only partial and regressive and is available at the discretion of Member States (which are free to decide if they want to compensate indirect costs or not). The aid intensity started with 85 % of the eligible costs incurred in 2013 and was reduced to 75 % of the eligible costs incurred in 2019 and 2020 (EC 2012). In the revision of the state aid guidelines for post 2021 the aid intensity will continue to be limited to 75 % of the eligible indirect emission cost incurred (EC 2020).[10] The compensation is partly based on benchmarks for electricity consumption.

For the year 2020 16 countries, 15 Member States (including the UK)[11] plus Norway have implemented a scheme for indirect compensation (EC 2021c; Ferrara and Giua 2020) . Of the countries assessed Austria is the only one not granting state aid in the form of indirect compensation. Italy and the Czech Republic implemented their schemes for costs incurred starting from 2020, thus later than the period assessed in this report. National information on the distribution of compensation on the sub-process level is rarely available. For Germany an electricity consumption of 18 TWh was compensated in the iron and steelmaking sector in 2019 (DEHSt 2021):

- About 50 % of this indirect compensation is given to non-benchmarked processes (e.g. pig iron production in the blast furnace, rolling mills, other downstream processes).
- Electric Arc Furnaces (EAF) make up about 40 % of the electricity consumption that is compensated (including foundries).
- Crude steel production in the oxygen blown converters only comprises 8 % of total compensation.

Total compensation was 131 million € at a CO_2 price of 16.15 € (corresponding to a compensation of 8 Mt of indirect emissions in 2019). Based on the simplified assumption that 60 % of the compensation is accounted for by the BF-BOF route and 40 % by the EAF route, this roughly corresponds to an indirect compensation of 0.25 t CO_2 per ton of crude steel from EAF plants on average and 0.16 t CO_2 per ton crude steel from oxygen blown converters, that is paid in addition to the free allocation.

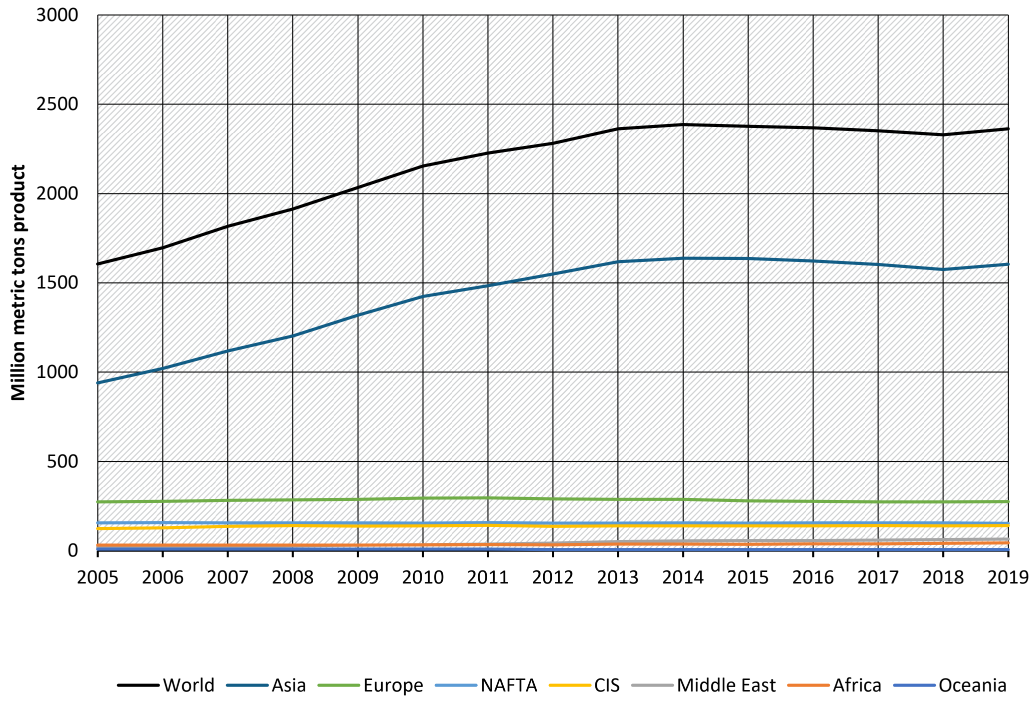
[10] According to recital 31 a higher aid intensity is possible, but the indirect cost compensation of the companies needs to be limited to 1.5 % of the value added of that company.

[11] Belgium (2013), Czech Republic (2020), Finland (2016), France (2015), Germany (2013), Greece (2013), Italy (2021), Lithuania (2014), Luxembourg (2017), Netherlands (2013), Poland (2019), Romania (2019), Slovakia (2014), Spain (2013) and United Kingdom (2013). The first year of application of the respective schemes is shown in brackets.

2.5.3 Development in the market environment and EU-import tariffs

Since 2005, worldwide steel making capacities have increased by 50 % – a trend driven by emerging economies such as China (OECD)(2020). Many countries regard national steelmaking as a strategic priority to support national industries. Nominal crude steelmaking capacity in China is largely state owned and has increased from 640 Mt in 2005 to 1.230 Mt in 2014. Since then, it has decreased slightly to 1.150 Mt, which corresponds to nearly 50 % of worldwide capacity. Steel production in China has surpassed domestic demand and its increasing exports in the years 2013 to 2016 have put downward pressure on the price for steel products at global level (World Steel Association 2019), (OECD 2018) with the country being accused of exporting below the cost of production (Illmer 2016).

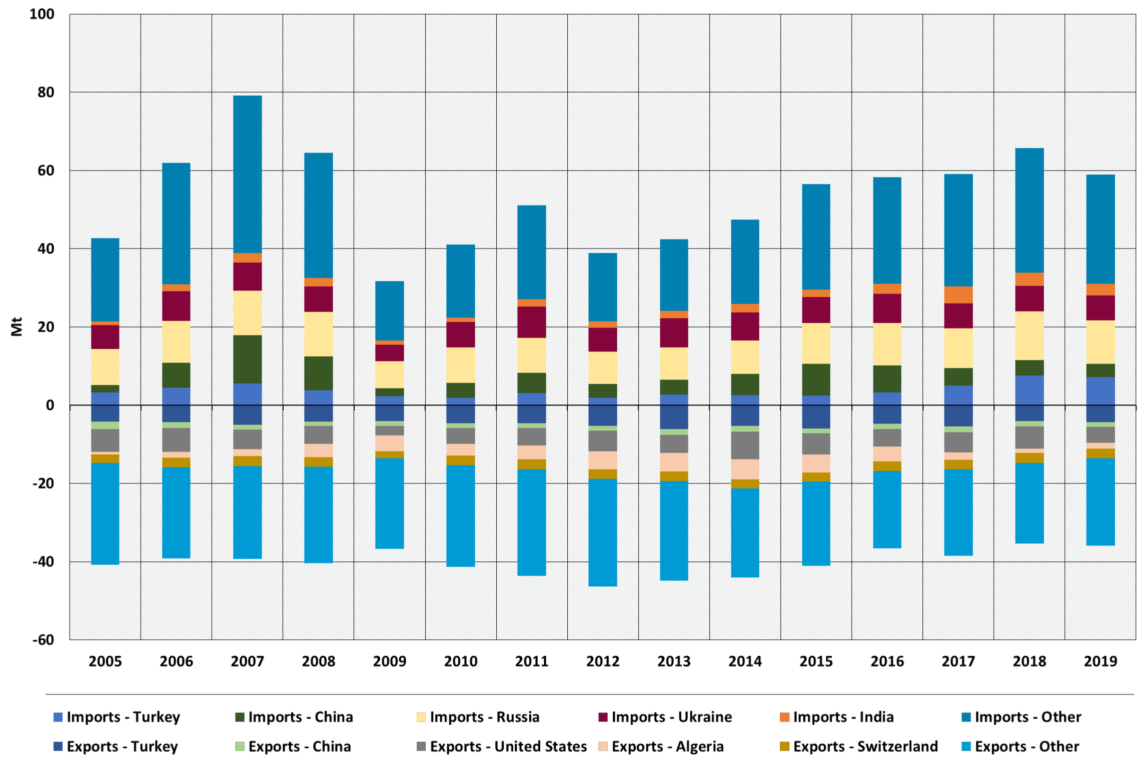
Figure 15: Worldwide nominal crude steelmaking capacity (million metric tons)



Source: OECD 2020.

At the same time, steelmaking capacity in the EU-28 has declined by 10 % since 2011 and now contributes about 10 % to worldwide capacity. Nevertheless, imports and exports play a minor role compared to domestic production and consumption in the European Union: 8 % of domestic consumption is covered by imports (compare chapter 2.2). Trade between EU countries surpasses trade with countries outside of the Union by 2 to 3 times. As installations in all EU countries face the same CO_2 price, Figure 16 focuses on extra EU trade. EU exports vary between 30 and 40 Mt products; main export destinations in the years 2005-2019 were the United States, Turkey, Algeria, Switzerland and China. Imports are characterized by higher fluctuations and vary between 30 and 60 Mt. The largest imports stem from Russia and Ukraine, which together comprise more than a third of the imports. Chinese imports account for 12 % of total imports on average but show large fluctuations and have dropped from 18 % in 2015 to 8 % on average in the years 2017 - 2019. This is in line with the declining trend in total exports by China: with increasing domestic demand and tariffs imposed in 2016 on certain Chinese exports for example by the EU, exports of semi-finished and finished steel products have declined in the last few years (World Steel Association 2019).

Figure 16: Extra EU-28 steel product imports and exports in Mt of product

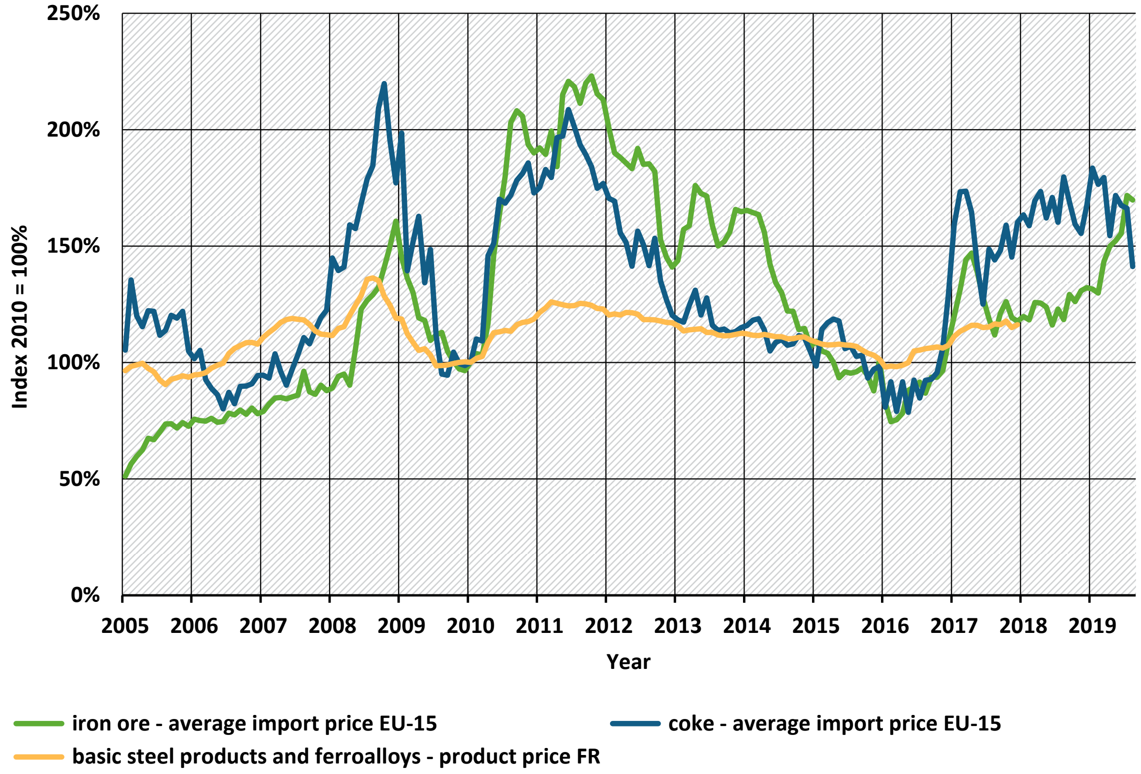


Note: CPA 2.1, NACE codes: 24.10, 24.20, 24.30, 24.51, 24.52.
Source: Eurostat (2020b).

In June 2021, the European Commission has prolonged import tariffs of 25 % for 23 steel categories from all countries outside of the EU imposed in July 2018 for another three years (EC 2021b). The measure was taken in response to the import tariffs on steel introduced by the United States in 2018 and was in force until the end of 2021 (U.S. Department of Commerce 2021). The aim of the tariffs was to avoid a diversion of steel trade flows to the EU, which could have put pressure on domestic steelmakers. The tariffs are only imposed when the level of steel imports exceeds the average level observed in previous years.

Product prices have been highest in years with strong domestic demand and net-imports to the EU, for example in 2008 and 2009 (see Figure 17). Product prices follow the same dynamic as import prices for key import factors to the blast furnace route which are iron ore and coke (as an example, Figure 17 shows prices for basic steel products and ferroalloys for France). Prices are, however, less volatile.

Figure 17: Prices for key inputs in blast furnace-based steel production and basic steel products and ferroalloys



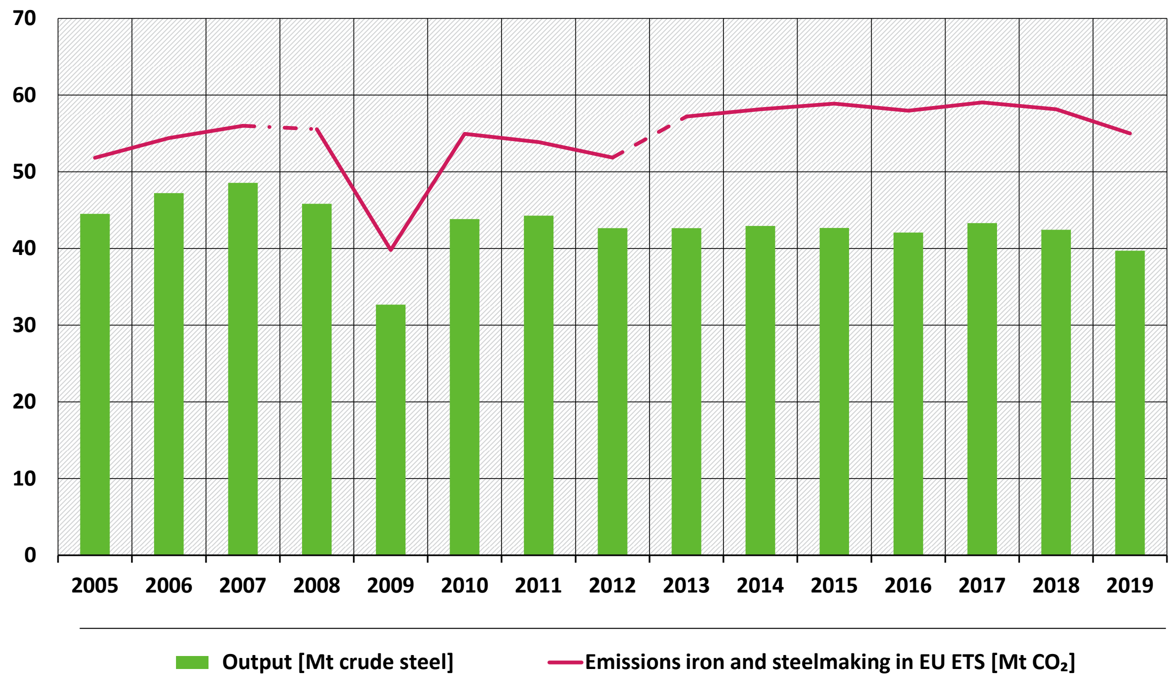
Source: A3M (2022).

3 Country fact sheet: Germany

3.1 Key messages

- Germany has the highest CO_2 emissions from iron and steelmaking in the EU ETS (55 CO_2CO_2 in 2019, see Table 7), comprising 28 % of total EU-28 emissions of the sector.
- It is also the country with the highest crude steel production in the EU-28, contributing about 25 % of total production. Since 2005 no major adjustments in production capacity were observed.
- Emission trends follow the trend in production, which increased from 2005 to 2007, sharply declined in 2008 and 2009, recovered again, and remained steady until another decline in 2019. The increase in emissions between 2012 and 2013 can be attributed to an extension of the scope of emissions covered by the EU ETS (see Figure 18).
- Germany hosts seven integrated steelworks with a diverse ownership structure. The ThyssenKrupp integrated steelworks in Duisburg is the largest BF/BOF site in Europe emitting 17 Mt CO_2 with four blast furnaces in 2019.
- The EAF production share is about 30 %, which is below the average of the EU-28 (41 %).

Figure 18: Germany: Key trends in CO_2 emissions and crude steel production, 2005-2019



Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2007, between 2008 and 2012 and for 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d.

Table 7: Germany: Key data on the iron and steelmaking sector in 2019

General information	2019	% change compared to 2013
Total CO_2 emissions in EU ETS in 2019 from iron and steelmaking[1] (share in total CO_2 emissions in EU ETS)	55 Mt CO_2 (15 %)	-4 %
Total crude steel production in 2019 (share of EU-28)	39.7 Mt (26 %)	-7 %
Total CO_2 emissions from BF-BOF sites[2] (total CO_2 emissions from EAF-sites)	51 Mt CO_2 (1.0 Mt CO_2)	-2 %
Crude steel production of BF-BOF sites (crude steel production from EAF sites)	28 Mt (11.9 Mt)	-5 %
Estimated emission intensity of crude steel production from BF-BOF-sites (relative to EU 28 average)	1.8 t CO_2/t crude steel (98 %)	3 %

Site-specific information of integrated sites for 2019

Main EUTL-ID	Site name	Number of blast furnaces	Hot metal capacity Mt	CO_2 emissions Mt CO_2	% change in CO_2 emissions compared to 2013
DE 69	Duisburg TKS	4	11.6	17.4	-5 %
DE 43	Salzgitter	3	4.8	7.9	2 %
DE 53	Duisburg HKM	2	5.5	7.9	-8 %
DE 52	Dillingen/Saar	2	4.8	7.4	2 %
DE 60	Bremen	2	4.0	5.6	-4 %
DE 70	Eisenhüttenstadt	2	2.3	3.6	6 %
Total		15	33.0	49.9	-2 %

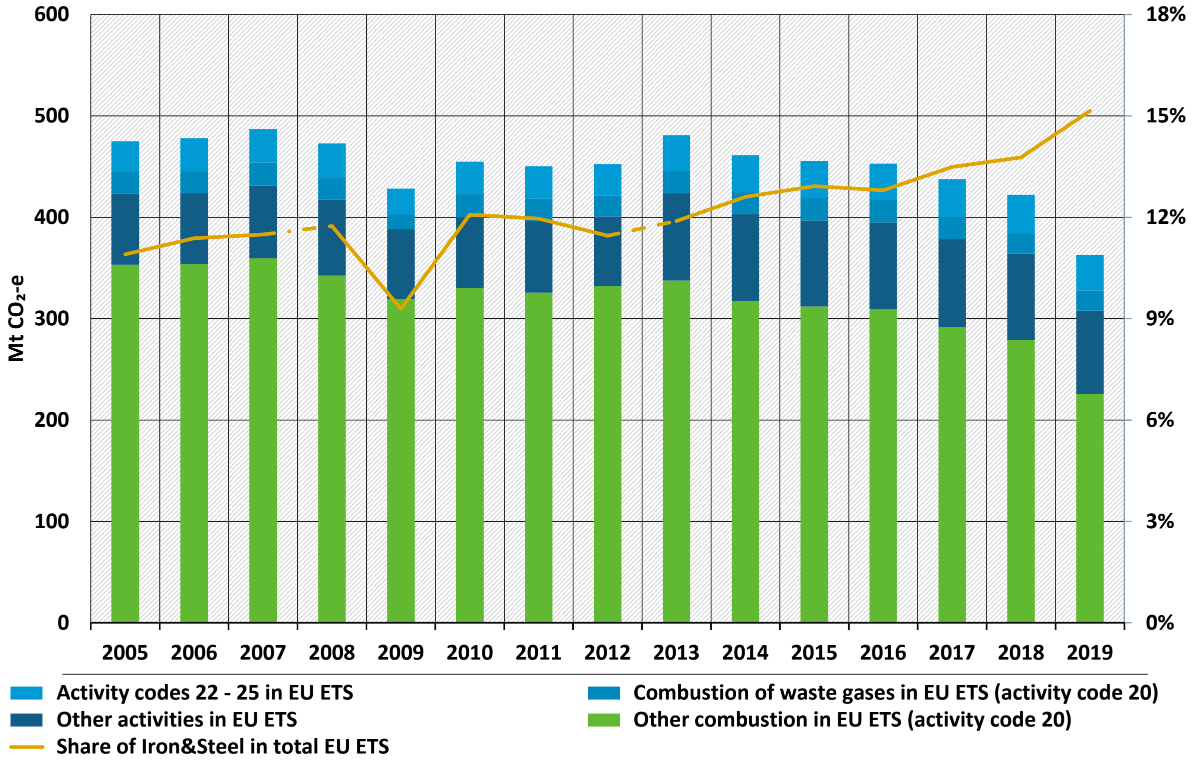
Notes:
[1] Activity codes 22-25; also including waste gas power plants from activity code 20.
[2] Installations belonging to one integrated site (including coking plants, sinter plants, blast furnaces, basic oxygen furnaces,coal and downstream processing plants and waste gas-fuelled power plants) were allocated manually. Emissions from waste gas power plants can also include co-firing with other fuels which adds uncertainty to the exact total emission levels. For a broad discussion of uncertainties, see section 2.3.1. The respective sources are given in details of the facility level description.
Source: own table based on EC n.d., EUROFER (2020), Worldsteel Association (2020).

3.2 Short description of the sector in the context of the country's economic and GHG pollution

In Germany iron and steel production as an industrial sector, accounts for 2 % of gross value added (GVA) of the entire manufacturing sector. As shown in Figure 66, the share of manufacturing GVA in total GVA in Germany was stable between 2010 and 2017.[12] At the same time, the share of steel making GVA in manufacturing GVA also remained stable at about 2 %. Following the economic downturn, employment in the steel sector saw a moderate decline from 95,000 workers in 2008 to 90,000 workers in 2010 (see Figure 66 in the Annex). Since then, the number of workers directly employed in the industry has declined at a much slower pace, amounting to about 85,000 workers in 2017.

3.2.1 Emission trends

Figure 19: Germany: Emission trends in stationary EU ETS



Note: Emissions from power plants that use waste gases from iron and steel making as fuel are attributed to the iron and steelmaking sector instead of the combustion sector.
Source: EC n.d..

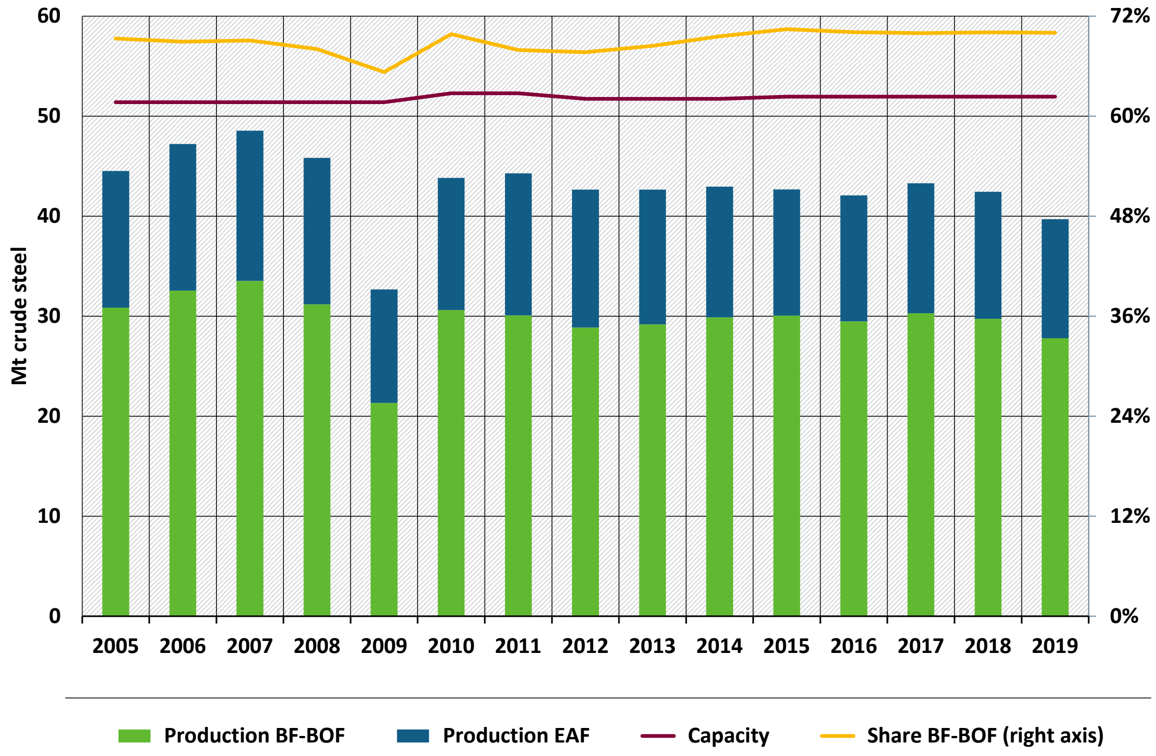
The iron and steelmaking sector in Germany was responsible for 55 Mt of CO_2 emissions in 2019, which is by far the largest amount in the EU-28 (28 %). The share of the iron and steelmaking sector in Germany's EU ETS emissions reached 15 % in 2019, which is a substantial increase since 2005, when the sector only accounted for 11 % of EU ETS emissions in Germany. This increase is the result of declining emissions from fuel combustion and a simultaneous increase in emissions from the iron and steelmaking sector. The increase in the share between 2012 and 2013 can also be attributed to an extension of the scope of emissions covered by the EU ETS. Compared to overall emissions, the iron and steelmaking sector accounted for a share of 7 % in

[12] There is no data available for prior years from the same sources.

Germany (see Table 2). In the iron and steelmaking sector, emission trends follow the trend in production, which increased from 2005 to 2007, sharply declined in 2008 and 2009, recovered again, and remained steady until another decline in 2019. Between 2013 and 2019, emissions from the sector decreased by 4 %.

3.2.2 Trends in production, capacity and trade

Figure 20: German iron and steelmaking industry: Trends in production and capacity



Source: Worldsteel Association (2020), and OECD Steelmaking Capacity Database (OECD 2020).

Germany is the largest producer of iron and steel in the EU (see Figure 14). Figure 20 shows the development of production capacity and actual output over recent years.[13] The reported production capacity has been relatively stable since the EU ETS was introduced in 2005 and corresponded to 52 Mt in 2019. The total production of crude steel peaked in 2007 at 48.6 Mt, but then dropped sharply in the course of the financial crisis to a low of 32.7 Mt in 2009. Since then, total production has fluctuated slightly around a level of 43 Mt, of which about 30 Mt are produced by the BF-BOF route and about 13 Mt by EAFs. The share of BF-BOF production has been relatively stable at about 70 % over the entire period except for 2009 when it dropped to 65 %. In line with the developments described above, the utilization rate was the highest in 2007 at 94 %, lowest in 2009 at 64 % and has fluctuated between 81 % and 84 % since 2010.

Iron and steelmaking on the EAF route partly depends on the availability of steel scrap. It is an internationally-traded commodity but also a resource that is domestically available in all EU-28 countries. Figure 74 in the Appendix shows the domestic steel scrap quantity and the scrap import and export balance. The majority of the domestic steel scrap is consumed domestically (about 25 Mt of scrap annually). However, Germany has constantly been a net exporter of steel

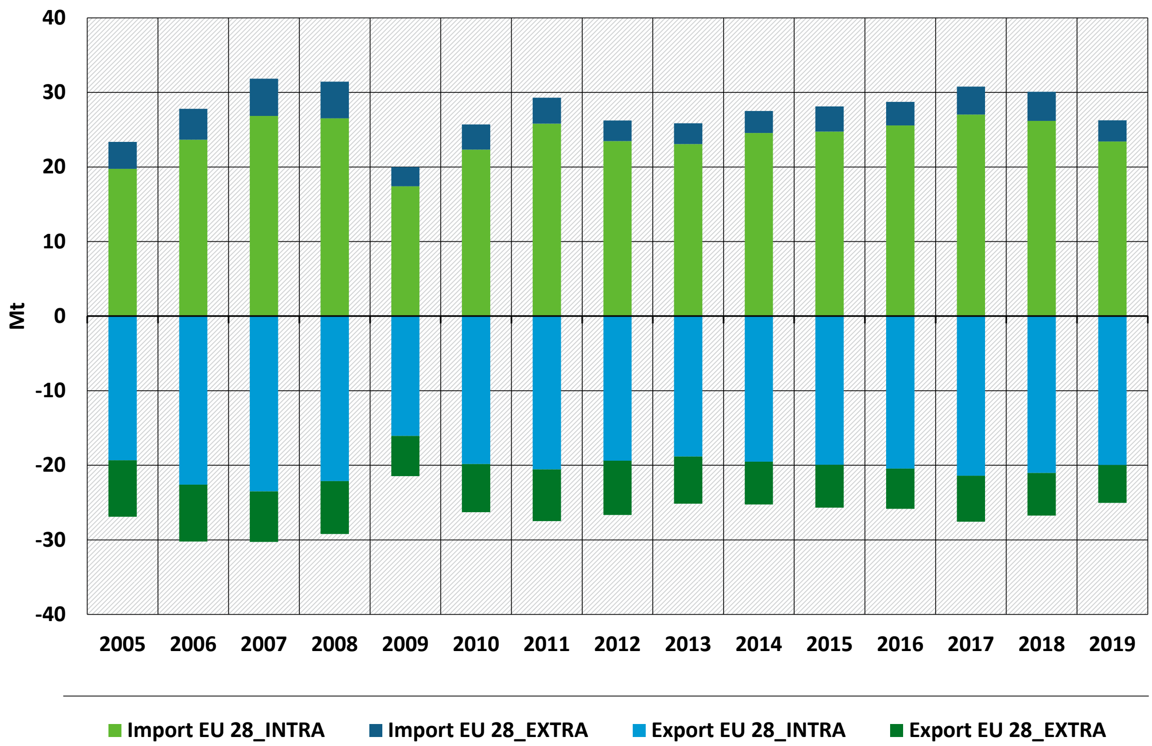
[13] The production of the DRI plant in Hamburg (between about 400 and 600 kt/year) is not shown separately as the produced directly reduced iron is further processed in an EAF (and included in EAF production).

scrap since 2010. No data is available for prior years. The share of net-exports from domestic volumes was about 25 % in recent years.

Even though the 2009 economic crisis marked a steep decrease in exports and imports (see Figure 21), Germany managed to quickly redress, especially in terms of imports whose levels after the crisis are only slightly smaller than before. The peak in trade achieved in 2007 was almost reached again ten years later in 2017, but a slight decreasing trend has been observable since then.

Germany's trade balance for basic and semi-finished iron and steel products was negative (imports exceed exports) for intra-EU trade in 2019 but is offset by the positive trade balance in extra-EU trade. Imports from outside the EU accounted for only 11 % of all imports whereas extra-EU exports comprised 20 % of exports in 2019.

Figure 21: German trade balance: imports and exports of basic and semi-finished iron and steel products to/from Germany



Source: Eurostat (2020b).

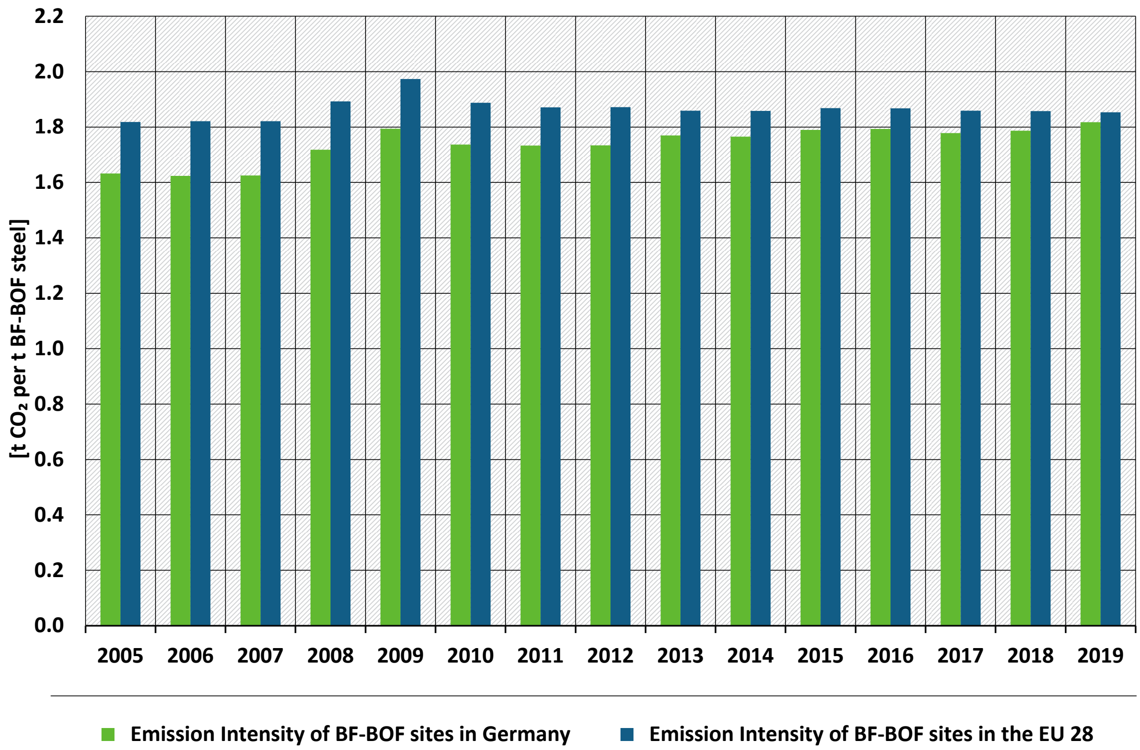
The most important countries for basic and semi-finished steel product imports to Germany are Belgium, Italy, the Netherlands, France and Austria, which overall accounted for 69 % of total basic and semi-finished steel product imports in 2019. For exports, France, Poland, Italy, the Netherlands and Belgium together make up almost half of German exports, with each country's share being approximately 10 %. A non-EU country is not among the first ten countries for export nor the first ten countries for imports in 2019.

3.2.3 Trends in emission intensity on the BF-BOF route

Figure 22 shows the emission intensity of steel production on the BF-BOF route for Germany. The emission intensity is derived in a bottom-up calculation by dividing the total emissions related to integrated BF-BOF sites (including emissions from coking plants, sintering plants, blast furnaces, basic oxygen furnaces and waste gas power plants) by the total production of steel in BOFs (see Table 8 for the emissions of integrated sites and the following section for more details).

In 2019, the emission intensity of the BF-BOF route was equal to 1.81 t CO_2 per ton of crude steel production, which is about 9 % higher than in 2005 (1.63 t CO_2 per ton steel). There are several possible reasons for the significant increase in the emission intensity: changes in the quality of raw materials (ores, coke, coal), the mutual substitution of natural gas and more emission intensive hard coal, higher own production of coke, replacing coke imports[14] and the extension of the scope of the EU ETS from 2007 to 2008 and 2012 to 2013, i.e. the inclusion of emissions from steel processing.

Figure 22: German BF-BOF route: Development of specific emission indicators



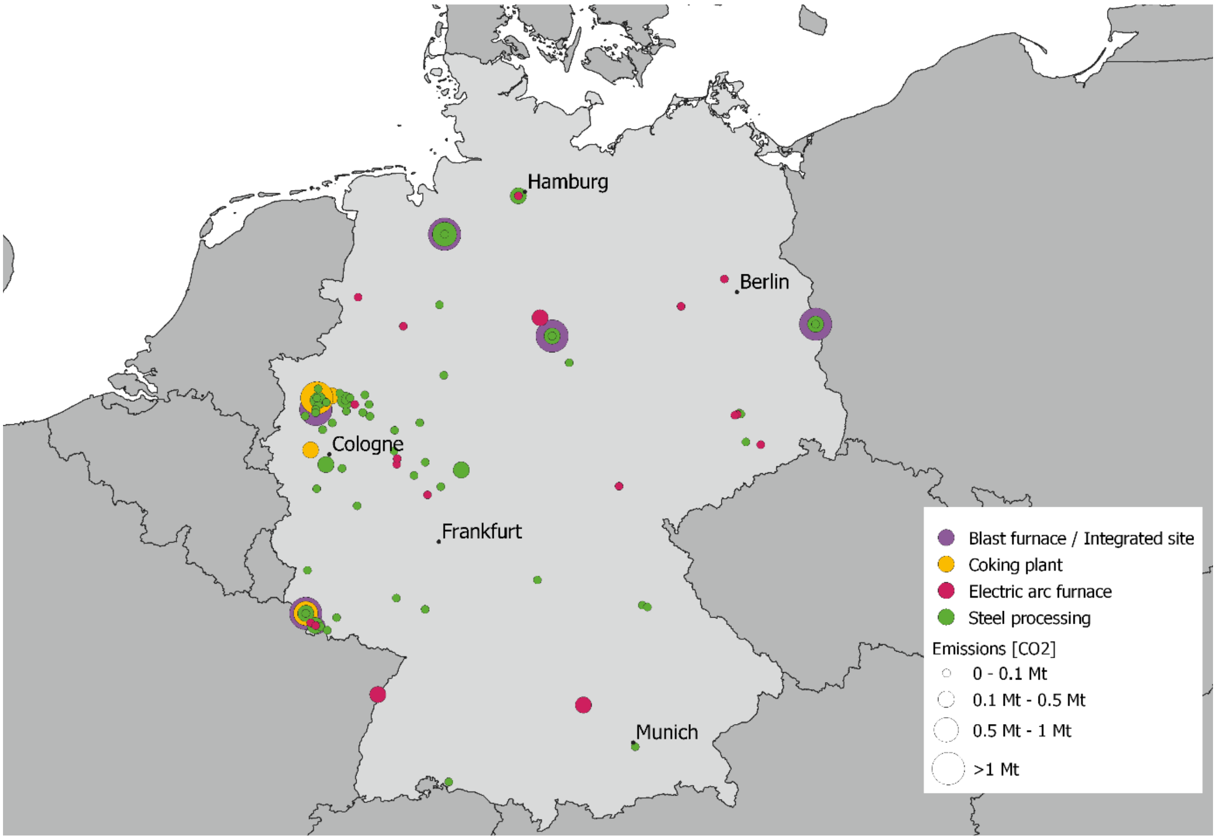
Note: Emission values also include emissions from power plants that use waste gases from iron and steel making as fuel.
Source: Data for Germany based on based on Table 8, data for EU-28 based on Table 4.

[14] For 2019 compared to 2013, it was found that slightly more than 460,000 tons of coke were self-produced, which may have replaced coke imports. Direct emissions from coke production, which previously occurred outside the EU ETS, now occur within the EU ETS, resulting in a relative increase in emissions. Compare (2020).

3.3 Facility level description

This section provides details on large facilities reported under activity codes 22-25 in Germany.

Figure 23: Germany: Location map of major CO_2 emission sources from the iron and steelmaking sector verified emissions in 2019 based on ETS data



Note:

[1] The illustration is based on emissions reporting under the EU ETS. While the EU ETS has activity codes specifying the main activity of an installation, the codes are not a fully reliable indicator in terms of the installation's function in the steelmaking process. The practice of grouping different facilities under one installation ID and the allocation of emissions between different installations at one integrated site diverge for different sites. Detailed information on the functions and facilities present at individual sites is given below in this section.

[2] Waste gas power plants listed as separate installations in the EU ETS are not displayed here but in Figure 10 (lower-left panel), due to overlap with blast furnace/integrated sites.

Source: Own illustration based on EC n.d..

Figure 23 shows the location of sites listed separately under the EUTL activity codes 22 - 25. Please remember that some plants (e.g. coking plants) may be part of an integrated site and are therefore not listed separately in EUTL. The map indicates the location of the facility and the facility purpose and differentiates between EAF sites, BF-BOF sites and associated waste gas power plants and coking plants, and other types of facilities (e.g. rolling mills and foundries) involved in the iron and steelmaking process. It also ranks the facility emissions into bins: below 0.1 Mt CO_2, 0.1 Mt CO_2 to 0.5 Mt CO_2, 0.5 Mt CO_2 to 1 Mt CO_2 and facilities emitting more than 1 Mt CO_2 per year.

Since the BF-BOF route dominates the development of emissions of the iron and steelmaking sector, the following section provides a detailed facility level description of installations on this route and their emission trends. Germany hosts 7 integrated sites where steel is produced with blast furnaces (Table 8).[15] In total, these sites accounted for about 92 % of the iron and steelmaking sector's emissions in Germany.[16] The steps taken to match emissions to integrated steelworks and associated sources of uncertainty regarding the completeness and correct assignment are discussed in detail in section 2.3. In the following, the sites and its installations are described in more detail.

Table 8: Germany: Overview of emissions of integrated steel sites (BF-BOF)

Site	Emissions (Mt CO_2)					
	2005	**2009**	**2010**	**2015**	**2018**	**2019**
Duisburg TKS	19.2	15.0	20.9	19.2	18.8	17.4
Salzgitter	6.7	5.8	7.4	7.4	8.2	7.9
Duisburg HKM	8.7	5.0	8.9	8.5	7.8	7.9
Dillingen/Saar	7.1	5.3	6.6	7.9	7.8	7.4
Bremen	4.9	4.0	5.1	6.2	6.1	5.6
Eisenhüttenstadt	3.3	2.8	3.6	4.0	3.8	3.6
DK Recycling und Roheisen	0.5	0.4	0.6	0.6	0.7	0.6
Total of integrated sites	50.4	38.3	53.2	53.8	53.1	50.5
Total production of crude steel (BF-BOF route, in Mt)	30.9	21.3	30.6	30.1	29.7	27.8
Emission intensity of BF-BOF sites (t CO_2 per t crude steel)	**1.63**	**1.79**	**1.74**	**1.79**	**1.79**	**1.82**

Note: Totals per integrated site are based on Table 15 to Table 16, emissions from DK Recycling are included here,despite the fact that it is a special case in Table 12.
Source: Worldsteel Association (2020), EC n.d.

[15] Note that this includes the blast furnaces of DK Recycling that produce pig iron for foundries and no steel.

[16] Total iron and steel emissions are defined as emissions of installations with the activity codes 22-25 plus waste gas power plants emissions. Please note that this scope leaves some uncertainty in terms of an exact definition of emissions that can be attributed to the iron and steelmaking sector (also see Section 2.3.1 on the attribution of emissions to the different steelmaking routes and sources of uncertainty). The two ArcelorMittal's rolling and wire mills in Duisburg (EUTL 202863 and 206226, activity code 20) are not included.

The standard setup of an integrated site is that blast furnaces and basic oxygen furnaces are operated at the same site. In Germany, there are two exemptions from this standard set-up. These are presented in Table 9.

- The blast furnaces from the Duisburg TKS site supply hot metal to basic oxygen furnaces onsite. Additionally, approx. 10 % of the hot metal is supplied to basic oxygen furnaces in Duisburg Hochfeld.
- Dillingen is the only blast furnace site in Germany that is licensed independently of its oxygen steelworks. The site supplies hot metal to two basic oxygen furnaces in Dillingen and in Völklingen.

Table 9: Germany: Special cases of integrated sites for primary iron (BF) and steel production (BOF)

EUTL ID	Plant Type	Company	City	Hot metal capacity (Mt)	Finished steel capacity (Mt)	No. of BF furnaces
Duisburg TKS						
DE 69	BF-BOF	ThyssenKrupp Steel Europe AG	Duisburg	11.6	11.56	4
DE 44	BOF	ArcelorMittal Hochfeld GmbH	Duisburg	0	1.3	0
Dillingen/Saar						
DE 52	BF	ROGESA Roheisengesellschaft Saar mbH	Dillingen/ Saar	4.79	0	2
DE 56	BOF	Aktien-Gesellschaft der Dillinger Hüttenwerke	Dillingen	0	2.76	0
DE 59	BOF	Saarstahl Aktiengesellschaft	Völklingen	0	3.24	0

Source: EC n.d., EUROFER (2020), EUROSIDER (2019).

The largest German site is the ThyssenKrupp site in Duisburg. It hosts four blast furnaces and five basic oxygen furnaces. A related coking plant is recorded as a separate installation in the EUTL. About 90 % of the pig iron produced in the blast furnaces is transformed into crude steel by the BOFs on site. However, about 10 % of the pig iron is transported to a nearby basic oxygen furnace in Duisburg-Ruhrort (Hochfeld)[17] owned by ArcelorMittal. The blast furnace gas is used by three power plants owned by ThyssenKrupp as well as ThyssenKrupp's coking plant. With total emissions fluctuating around a level of 19 Mt of CO_2 per year, the integrated ThyssenKrupp site accounts for about 32 % of total iron and steel emissions in Germany (in 2019).

[17] Calculated based on capacities.

Table 10: EU ETS Installations related to the integrated site in Duisburg (TKS)

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
DE 65	22	Coking plant	ThyssenKrupp	Duisburg	1.7	2.1	2.1	1.9
DE 203863	20	Pulverizing/drying	Emscher Aufbereitung	Duisburg	-	-	0.03	0.07
DE 69	24	BF-BOF	ThyssenKrupp	Duisburg	7.7	8.7	8.2	7.8
DE 1415	20	Power plant	ThyssenKrupp	Duisburg	3.7	4.3	3.2	2.3
DE 1850	20	Power plant	ThyssenKrupp	Duisburg	3.3	3.2	3.3	3.1
DE 1411	20	Power plant	ThyssenKrupp	Duisburg	2.5	2.3	2.2	2.0
DE 44	24	BOF	ArcelorMittal	Duisburg	0.3	0.2	0.2	0.2
Total integrated steelwork Duisburg TKS					**19.2**	**20.9**	**19.2**	**17.4**

Source: EC n.d..

There is a second integrated site for primary steel production in Duisburg. This site is operated by “Hüttenwerke Krupp Mannesmann” (HKM), which is owned with a 50 % share by ThyssenKrupp, a 30 % share by Salzgitter Flachstahl AG and a 20 % share by the French steelmaker Vallourec. Although only about half the size of the ThyssenKrupp site, the HKM site is comparable in size and emissions to the steelworks in Salzgitter and Dillingen/Völklingen. The blast furnace gas is used by the HKM-owned power plant. Furthermore, ThyssenKrupp operates a neighbouring rolling mill which mostly uses crude steel from the HKM steelworks (Wessel 2021). At this site, emissions have mostly been in a steady decline since they peaked at 9.0 Mt of CO_2 in 2011; they fell to 7.2 Mt of CO_2 in 2016 and amounted to 7.9 Mt of CO_2 in 2019.

Table 11: EU ETS installations related to the integrated site in Duisburg (HKM)

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
DE 53	24	BF-BOF	Hüttenwerke Krupp Mannesmann	Duisburg	4.6	4.8	4.8	5.1
DE 202983	24	Rolling mill	ThyssenKrupp	Duisburg	0.0	0.0	0.1	0.1
DE 203771	20	PCI	Hüttenwerke Krupp Mannesmann	Duisburg	-	-	0.1	0.1
DE 1486	20	Power plant	Hüttenwerke Krupp Mannesmann	Duisburg	4.1	4.2	3.6	2.7
Total integrated steelwork Duisburg HKM					**8.7**	**8.9**	**8.5**	**7.9**

Source: EC n.d..

There is a third site with blast furnaces in Duisburg, although this site can be considered a special case. The two blast furnaces (of which usually only one is operated) owned by "DK Recycling und Roheisen" produce pig iron from iron-rich residues. With a production of only about 300 thousand tons of hot metal per year, this site is significantly smaller than the standard integrated steelworks. It is the only one in Germany which does not have a blast basic oxygen furnace and at which the sintering plant is recorded as a separate installation in the EUTL. The company also owns a power plant that uses waste gases from the blast furnace on site (Table 12).

Table 12: EU ETS Installations operated at the integrated site in Duisburg (DK Recycling & Roheisen)

EUTL ID	Activity Code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
DE 66	23	Sintering plant	DK Recycling und Roheisen	Duisburg	0.3	0.3	0.1	0.1
DE 206009	24	BF	DK Recycling und Roheisen	Duisburg	-	-	0.2	0.2
DE 1320	20	Power plant	DK Recycling und Roheisen	Duisburg	0.2	0.3	0.4	0.4
Total special case Duisburg DK Recycling & Roheisen					**0.5**	**0.6**	**0.6**	**0.6**

Source: EC n.d..

The integrated site in Salzgitter, operated by the steelmaker Salzgitter Flachstahl GmbH, is another steelworks with a standard BF-BOF setup. The blast furnaces, basic oxygen furnaces and the coking plant operated at the site are grouped together as one EU ETS installation. Waste gases are used by a power plant and a rolling mill, which are both located at the site and operated by Salzgitter Flachstahl GmbH. With the exception of 2015, the total emissions of the integrated site in Salzgitter have been relatively stable at about 8 million tons of CO_2 per year since 2011, which is higher than the level recorded in pre-crisis years.

Table 13: EU ETS Installations related to the integrated site in Salzgitter

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
DE 43	24	BF-BOF	Salzgitter Flachstahl	Salzgitter	3.6	4.0	4.0	4.1
DE 42	24	BF	Salzgitter Flachstahl	Salzgitter	0.3	0.0	0.0	0.0
DE 2495	25	Rolling mill	Salzgitter Flachstahl	Salzgitter	0.0	0.3	0.3	0.3
DE 1132	20	Power plant	Salzgitter Flachstahl	Salzgitter	2.8	3.1	3.1	3.5
Total integrated steelworks Salzgitter					**6.7**	**7.4**	**7.4**	**7.9**

Source: EC n.d..

In the federal state of Saarland, the two steelmakers Dillinger Hüttenwerke and Saarstahl cooperate in the production of coke and pig iron. The two companies each own a 50 % share of the Rogesa, which operates two blast furnaces in Dillingen, and the Zentralkokerei Saar, which produces coke at the site in Dillingen (Dr. Karsten Schreiber, Martin Zwick, Sahrah Engel 2020). About half of the pig iron produced in the blast furnaces is used by the BOF in Dillingen, owned by Dillinger Hüttenwerke, and half is transported by rail about 20 km to the BOF of Saarstahl in Völklingen (ROGESA 2022). Furthermore, the integrated site comprises of two power plants in Dillingen which use the waste gases and rolling mills which are operated in both Dillingen and Völklingen. Taken together, the production capacity and emissions are comparable in size to the site in Salzgitter. In most years, total CO_2 emissions have been fluctuating between 7 and 8 million tons per year.

Table 14: EU ETS Installations related to the integrated site in Dillingen (Saarland)

EUTL ID	EUTL activity Code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
DE 49	22	Coking plant	Zentralkokerei Saar	Dillingen	0.9	0.7	0.9	1.0
DE 52	24	BF	ROGESA	Dillingen	5.1	4.0	4.5	4.2
DE 59	24	BOF	Saarstahl	Völklingen	0.1	0.1	0.2	0.2
DE 56	24	BOF	Dillinger Hüttenwerke	Dillingen	0.4	0.4	0.4	0.4
DE 3902	24	Rolling mill	Dillinger Hüttenwerke	Dillingen	-	0.3	0.3	0.3
DE 2496	24	Rolling mill	Saarstahl	Völklingen	-	0.1	0.2	0.1
DE 1086	20	Power plant	Dillinger Hüttenwerke	Dillingen	0.5	0.3	0.2	0.1
DE 4137	20	Power plant	DH, ROGESA and ZKS	Dillingen	0.0	0.7	1.2	1.1
Total integrated steelworks Dillingen (Saarland)					**7.1**	**6.6**	**7.9**	**7.4**

Source: EC n.d..

The integrated site in Bremen is operated by ArcelorMittal and has a standard set-up with two blast furnaces that feed pig iron into basic oxygen furnaces. Coke is delivered by a coking plant in Bottrop that ArcelorMittal purchased in 2011 (WDR 2011). Waste gases are used by a power plant at the site in Bremen that used to consist of two units, one of which was closed in 2013. Furthermore, Brema Warmwalz operates a rolling mill on the site of the steelworks and since it has relatively high emissions at about half a million tons of CO_2 per year, it is likely that this plant also uses a share of the waste gases. Overall, the site in Bremen is one of the smaller steelworks in Germany. CO_2 emissions of the site have had an upward trend since the financial crisis in 2009 and reached its highest level in 2016 at 6.5 million tons of CO_2, followed by a slight decrease to 5.6Mt in 2019.

Table 15: EU ETS Installations related to the integrated site Bremen[18]

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	**2010**	**2015**	**2019**
DE 45	22	Coking plant	ArcelorMittal	Bottrop	0.3	0.4	0.3	0.4
DE 60	24	BF-BOF	ArcelorMittal	Bremen	2.6	2.2	2.8	2.2
DE 4151	24	Rolling mill	BRE.M.A Warmwalz	Bremen	-	-	0.5	0.5
DE 1228	20	Power plant	ArcelorMittal	Bremen	0.8	1.0	2.5	2.5
DE 1230	20	Power plant	swb Erzeugung	Bremen	1.2	1.5	0.0	0.0
Total integrated steelworks Bremen					**4.9**	**5.1**	**6.2**	**5.6**

Source: EC n.d..

The second German BF-BOF site operated by ArcelorMittal is located in Eisenhüttenstadt. Waste gases of the two blast furnaces are used by a power plant owned by Vulkan Energiewirtschaft Oderbrücke (VEO) and potentially by the ArcelorMittal-owned rolling mill and galvanizing plant at the site. In Eisenhüttenstadt, there is no coking plant (Ghenda 2011). With a capacity of 2.4 million tons of finished steel and emissions fluctuating between 3 and 4 million tons of CO_2 per year, it is the smallest integrated steelworks in Germany.

[18] The coking plant is not located in Bremen but is recorded in this table for completeness.

Table 16: EU ETS Installations related to the integrated site in Eisenhüttenstadt

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
DE 70	24	BF-BOF	ArcelorMittal	Eisenhüttenstadt	1.5	1.4	1.6	1.5
DE 1892	25	Rolling mill	ArcelorMittal	Eisenhüttenstadt	-	0.10	0.11	0.11
DE 1891	25	Galva-nizing	ArcelorMittal	Eisenhüttenstadt	-	0.06	0.05	0.05
DE 4150	25	Rolling mill	ArcelorMittal Eisenhüttenstadt GmbH	Eisenhüttenstadt	-	-	0.02	0.03
DE 1386	20	Power plant	Vulkan Energie-wirtschaft Oderbrücke	Eisenhüttenstadt	1.8	2.1	2.2	1.9
Total integrated steelworks Eisenhüttenstadt					**3.3**	**3.6**	**4.0**	**3.6**

Source: EC n.d..

The DRI plant in Hamburg produces sponge iron. With a DRI to scrap ratio of 9 to 11 it is fed in the EAF on site to produce finished steel (ArcelorMittal 2022). The installation has an annual capacity of 600 thousand tons of sponge iron per year, its production has been fluctuating between 400 and 600 thousand tons per year but has been closer to the latter in recent years. Since the inclusion in the EU ETS in 2013, the emissions of the reduction plant fluctuated between 0.2 and 0.3 Mt of CO_2 per year. Specific emissions equal 0.5 t CO_2/t DRI and a 0.57 tCO_2/t of crude steel including the EAF (attributing 45 % of the emissions of the EAF to the DRI route).

Table 17: Overview of emissions of the DRI plant in Hamburg

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)		
					2015	2018	2019
DE 204543	25	DRI	ArcelorMittal	Hamburg	0.27	0.27	0.24
DE 67	24	EAF	ArcelorMittal	Hamburg	0.09	0.08	0.07
Total production of direct reduced iron (in Mt)					**0.55**	**0.56**	**0.47**
Emission intensity of DRI plant (t CO_2 per t DRI) excluding EAF					0.48	0.49	0.50

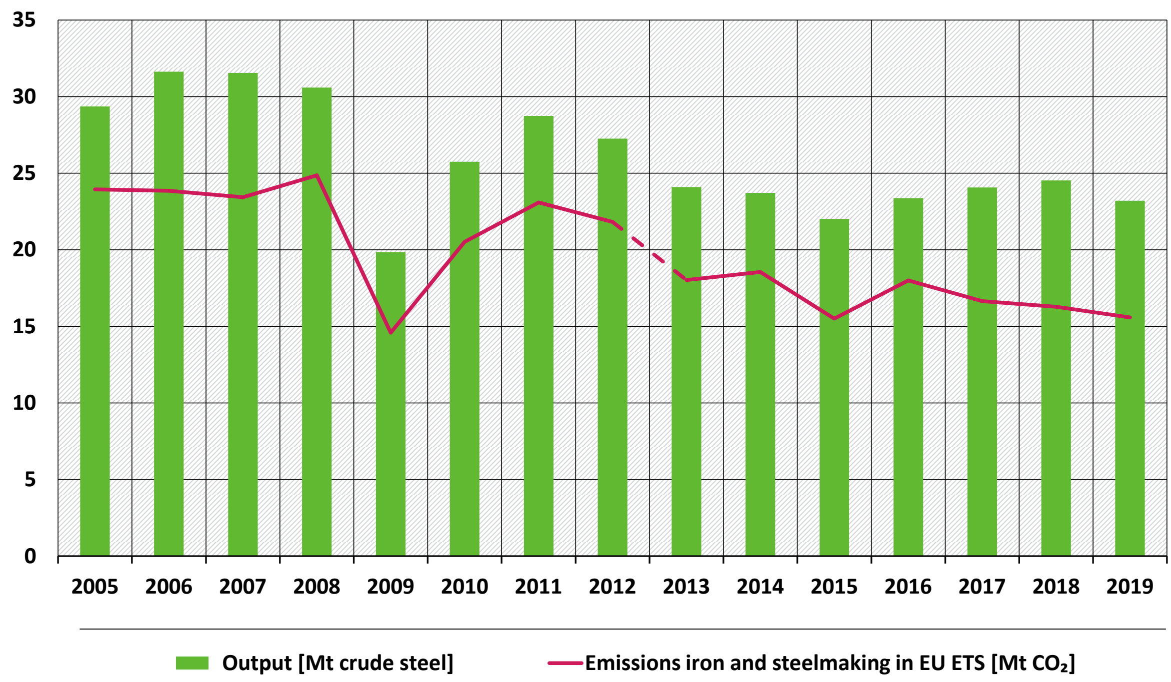
Source: EC n.d.., Worldsteel Association (2020)

4 Country fact sheet: Italy

4.1 Key messages

- Italy has the 4th highest CO_2 emissions from iron and steelmaking in the EU ETS (15.6 Mt CO_2 in 2019, see Table 18), comprising 8 % of total EU-28 emissions of the sector.
- It is the county with the 2nd highest crude steel production in the EU-28 (19 Mt in 2019), contributing about 15 % in 2019. Steel production in Italy is mainly based on the EAF route; in 2019 the share of crude steel production attributable to the BF-BOF route was only 17 %, having decreased from 35 % in 2012. Correspondingly, the EAF share is 83 % (compared to 41 % in the EU-28 average), making Italy the largest producer of steel from the EAF route in the EU-28.
- Dominated by emissions from the BF-BOF route, emissions from the iron and steelmaking sector in Italy decreased by 35 % between 2005 and 2019 (see Figure 24), while production only decreased by 20 % in the same period.
- Italy only hosts one integrated steelworks in Taranto in the south of Italy. The plant was owned by the Italian Riva group until 2012. When it was revealed that the plant was responsible for extreme levels of air pollution, it was seized by the Italian government. In 2018, the steelworks was purchased by ArcelorMittal. In 2019 emissions of the plant amounted to approx. 10 Mt CO_2. Compared to 2005, CO_2 emissions of the integrated steelworks are currently 50 % lower as a result of the pollution scandal and associated cuts in production levels.

Figure 24: Italy: Key trends in CO_2 emissions and crude steel production, 2005 - 2019



Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d..

Table 18: Italy: Key data on the iron and steelmaking sector in 2019

General information		
	2019	**% change compared to 2013**
Total CO_2 emissions in EU ETS in 2019 from iron and steelmaking[1] (share in total CO_2 emissions in EU ETS)	16 Mt CO_2 (11 %)	-14 %
Total crude steel production in 2019 (share of EU-28)	23.2 Mt (15 %)	-4 %
Total CO_2 emissions from BF-BOF sites[2] (total CO_2 emissions from EAF-sites)	10 Mt CO_2 (2.9 Mt CO_2)	-19 %
Crude steel production of BF-BOF sites (crude steel production from EAF sites)	4 Mt (19 Mt)	-38 %
Estimated emission intensity of crude steel production from BF-BOFsites (relative to EU-28 average)	2.4 t CO_2/t crude steel (132 %)	31 %

Site-specific information of integrated sites for year 2019					
Main EUTL-ID	**Site name**	**Number of blast furnaces**	**Hot metal capacity Mt**	**CO_2 emissions Mt CO_2**	**% change in CO_2 emissions compared to 2013**
IT 515	Taranto	4	9.6 Mt	10.3 Mt	-19 %

Notes:

[1] Activity codes 22-25; also including waste gas power plants from activity code 20.

[2] Installations belonging to one integrated site (including coking plants, sinter plants, blast furnaces, basic oxygen furnaces, coal and downstream processing plants and waste gas-fuelled power plants) were allocated manually. Emissions from waste gas power plants can also include co-firing with other fuels which adds uncertainty to the exact total emission levels. For a broad discussion of uncertainties see section 2.3.1. Respective sources are given in details of the facility leveldescription.

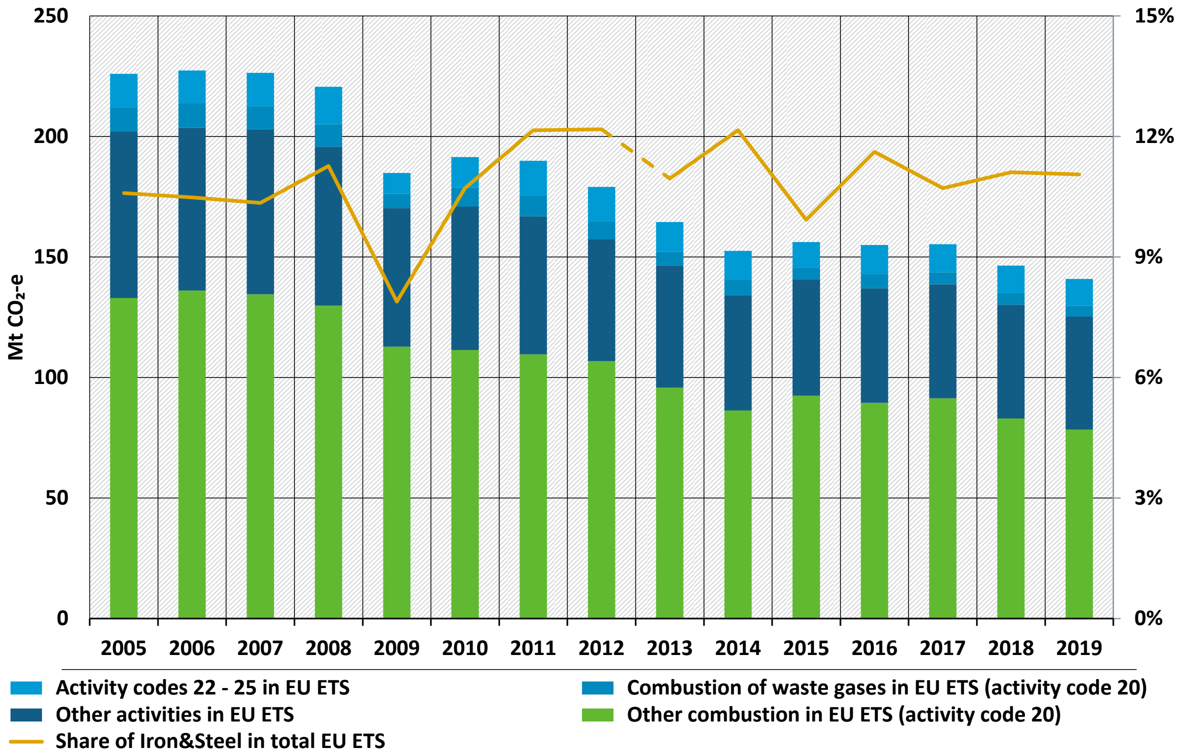
Source: Own table based on EC n.d., EUROFER (2020), Worldsteel Association (2020)

4.2 Short description of the sector in the context of the country's economic and GHG pollution

Iron and steel production is an important industrial sector in Italy: it accounts for 3 % of gross value added (GVA) of the entire manufacturing sector. As shown in Annex A, the share of manufacturing GVA in total GVA in Italy has been stable between 2010 and 2017.[19] At the same time, the share of steel making GVA in manufacturing GVA has been fluctuating at around 2.5 %. As also shown in Annex A, there has been a gradual decline in the number of workers directly employed in the iron and steelmaking industry, decreasing from 39,000 in 2008 to 34,000 in 2017.

4.2.1 Emission trends

Figure 25: Italy: Emission trends in stationary EU ETS



Note: Emissions from power plants that use waste gases from iron and steelmaking as fuel are attributed to the iron and steelmaking sector instead of the combustion sector.
Source: EC n.d..

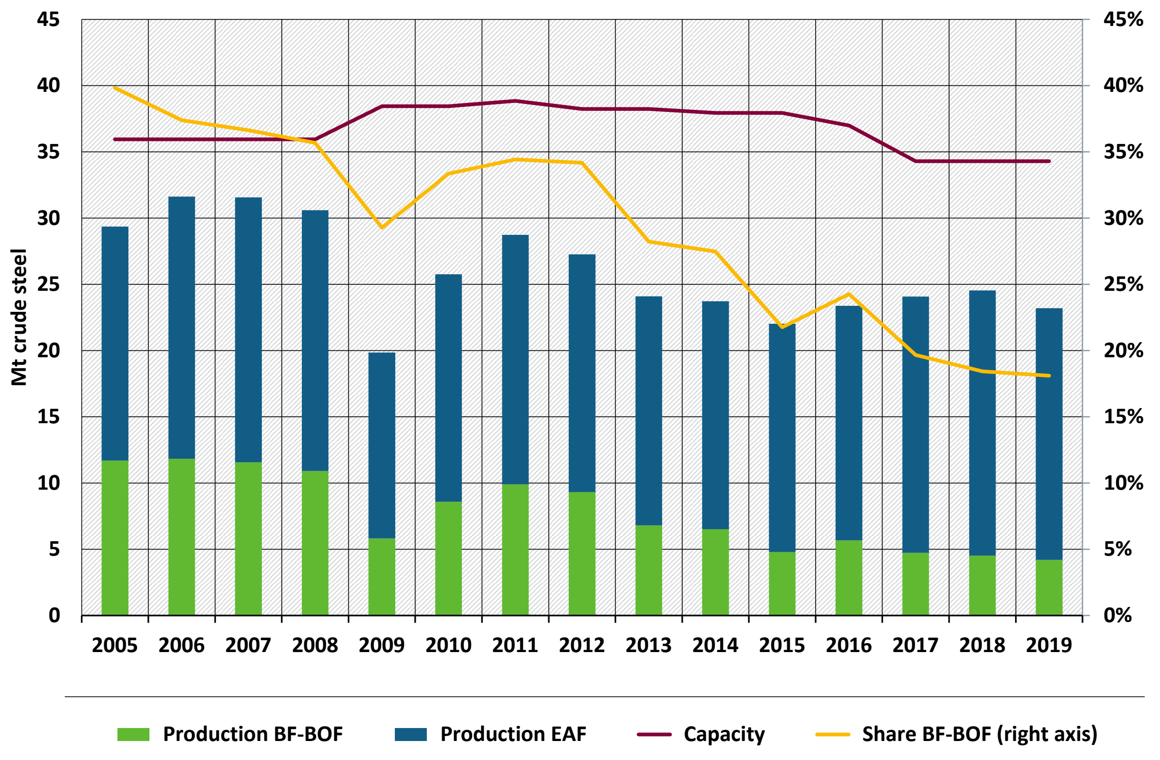
Emissions in Italian ETS installations show a falling trend. The trend is driven by a strong decline in emissions from combustion under activity code 20 (-41 % between 2005 and 2019) but also from other activity codes, where emissions deceased by 32 % in the same period. The same trend can be observed for the iron and steelmaking sector, where emissions decreased from their all-time peak in 24.9 Mt CO_2 in 2008 to around 15.6 Mt CO_2 in 2019. Dominated by emissions from the BF-BOF route, they have followed reductions in production on this route (see below). In 2019 emissions from the single integrated BF-BOF plant were about 10 Mt of CO_2. Compared to 2005 CO_2 emissions of the integrated steelworks are currently 50 % lower as a result of the pollution scandal and associated cuts in production levels. The share of the iron and

[19] There is no data available for prior years from the same sources.

steel industry in Italian EU ETS emissions is (with small fluctuations) about 11 %. The share in total emissions is about 4 %.

4.2.2 Trends in production, capacity and trade

Figure 26: Italian iron and steel industry: Trends in production and capacity



Source: Worldsteel Association (2020), OECD 2020 Steelmaking Capacity Database.

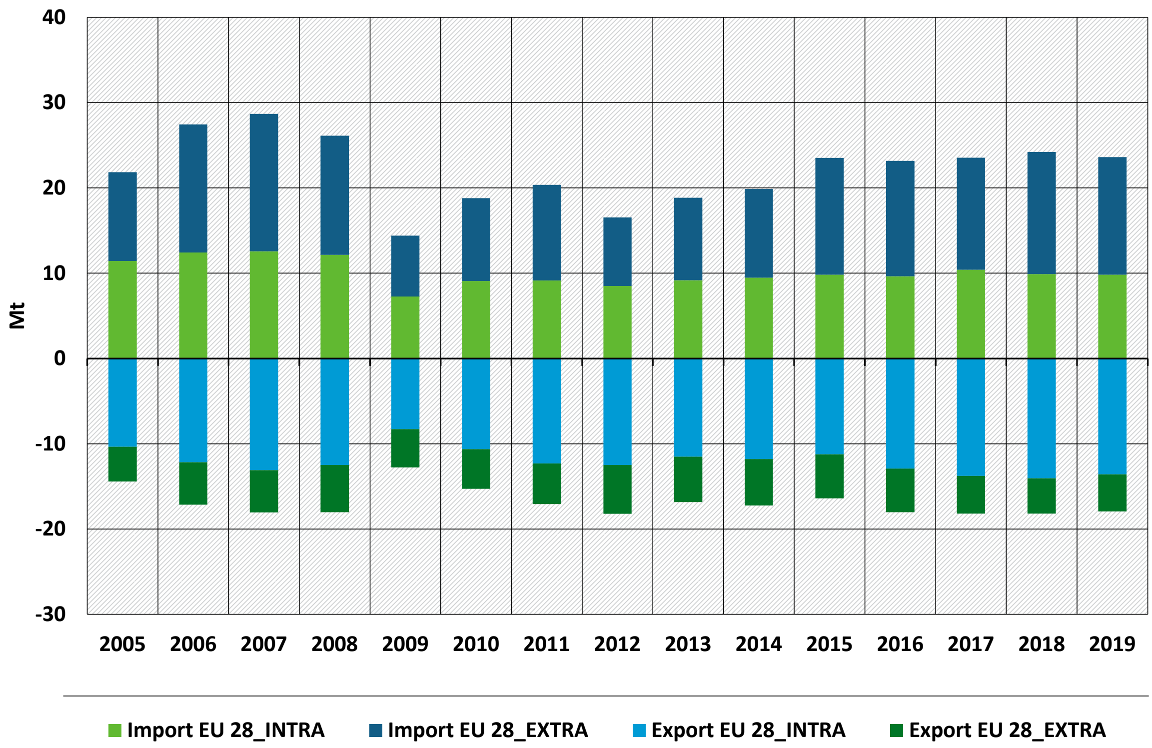
Crude steel production in Italy is the second highest in the EU; it comprises 15 % of EU's production and 16 % of EU's capacities. Production has not reached pre-2009 levels again and has remained at about 24 Mt in the last seven years, after another decline as a consequence of the 2012-2013 Euro crisis.

Somewhat distinct from other Central and Western European countries, the share of production on the BF-BOF route comprises only 17 % in 2019 and has decreased by more than half since 2005, with the strongest decreases having occurred since 2012. With the exception of the crisis year 2008, EAF production fluctuated between 17 and 20 Mt per year from 2005 to 2019. Hence, the increase in the EAF share is due to a decrease in production on the BF-BOF route rather than an expansion of the EAF production route. Capacity utilization has decreased from 88 % in 2007 to only 68 % in 2019, which was also driven by the decrease in production on the BF-BOF route.

Iron and steelmaking on the EAF route partly depends on the availability of steel scrap. It is an internationally traded commodity but also a resource that is domestically available in all EU-28 countries. Figure 75 in the Appendix shows the domestic steel scrap quantity and the scrap import and export balance. All domestic steel scrap is consumed domestically (about 18 Mt of scrap annually). To supply its large EAF fleet, Italy has consistently been an importer of steel scrap since 2010, importing approx. 3 Mt per year. No data is available for prior years.

Italy has been a net importer of basic and semi-finished steel products for all years between 2005 and 2019, except for 2012 when net exports amounted to approx. 2 Mt. As with most countries evaluated, Italy's steel market has never again reached pre-crisis levels, with a peak both in exports and imports in 2007 and a very steep decline in 2009 (see Figure 27). However, exports have remained relatively stable and close to pre-crisis levels ever since 2012 (around 18 Mt per year) and there have been no fluctuations in the quantities imported since 2015 (approx. 23 Mt per year).

Figure 27: Italian trade balance: Imports and exports of basic and semi-finished iron and steel products to/from Italy



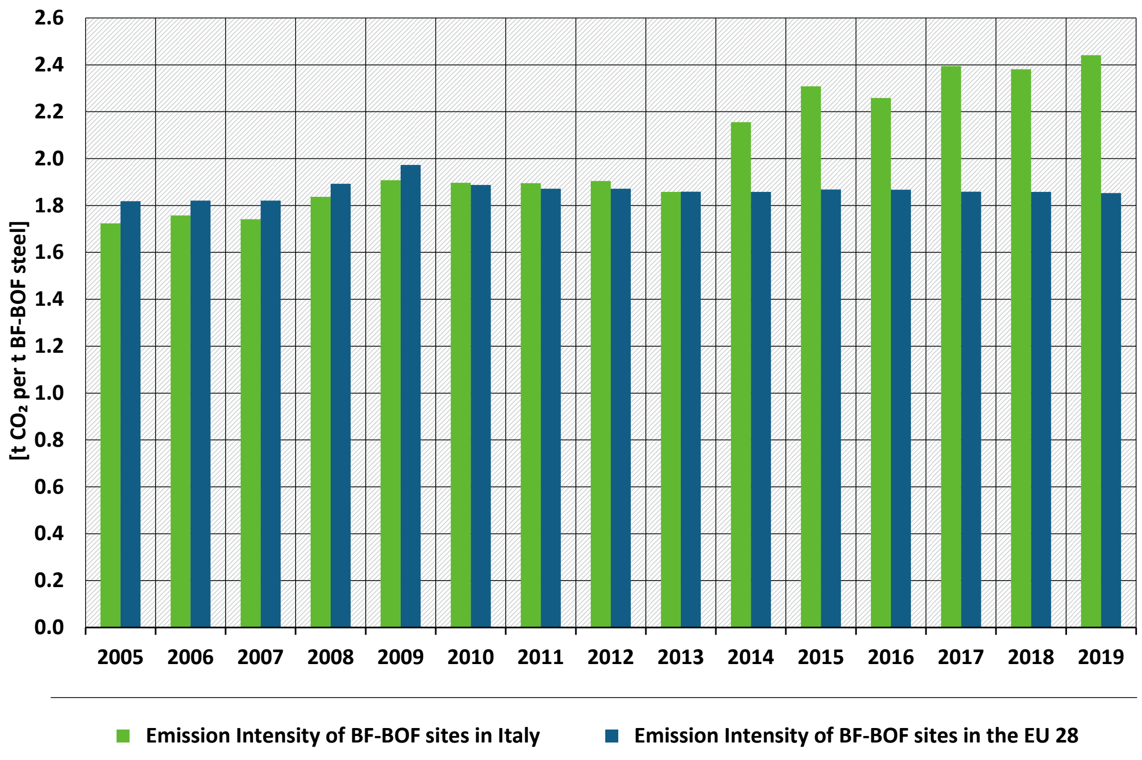
Source: Eurostat (2020b)

More surprising perhaps is the larger share, in comparison to other countries, of extra-EU imports (roughly 60 % in 2019). Italy's largest partners for imports are Germany and France, followed by Turkey, India and China. Its exports have continued to be more EU-centered (intra-EU exports account for 75 % of the total Italian exports in 2019), with Germany, France, Spain, Austria and Poland being the largest importers of Italian steel. More generally, the intra-EU trade balance is positive (with more exports than imports), while the extra-EU trade balance is negative (imports from extra-EU are more than three times higher than extra-EU exports).

4.2.3 Trends in emission intensity on the BF-BOF route

For years, the emission intensity of Italian steel production on the BF-BOF route was close to the European average, with even better results than other countries during the economic crisis in 2009. However, there has been an important disruption since 2014, at which time the emission intensity increased strongly. The intensity levels reached as much as 2.4 t CO_2 per ton of production in BF-BOF route (including emissions from coking plants, sintering plants, blast furnaces, basic oxygen furnaces and waste gas power plants) compared to the average of 1.85 t CO_2, exceeding the EU-28 average by more than 30 %. The increase began in parallel to strong reductions in production volumes at the integrated steelworks in Taranto. This could be caused by the low capacity utilization rate (39 % in 2018) as the energy flows and processes are tailored to high utilization rates. Moreover, data on the Italian energy balance of iron and steelmaking suggests that coke production was not reduced in parallel to the reduction in crude steel production but rather substituted coke imports (Eurostat 2022). This could mean that the emission intensity before the decline in production was relatively low because some of the emissions for the production of Italian steel – namely the emissions for the production of a share of the required coke – were emitted outside of Italy.

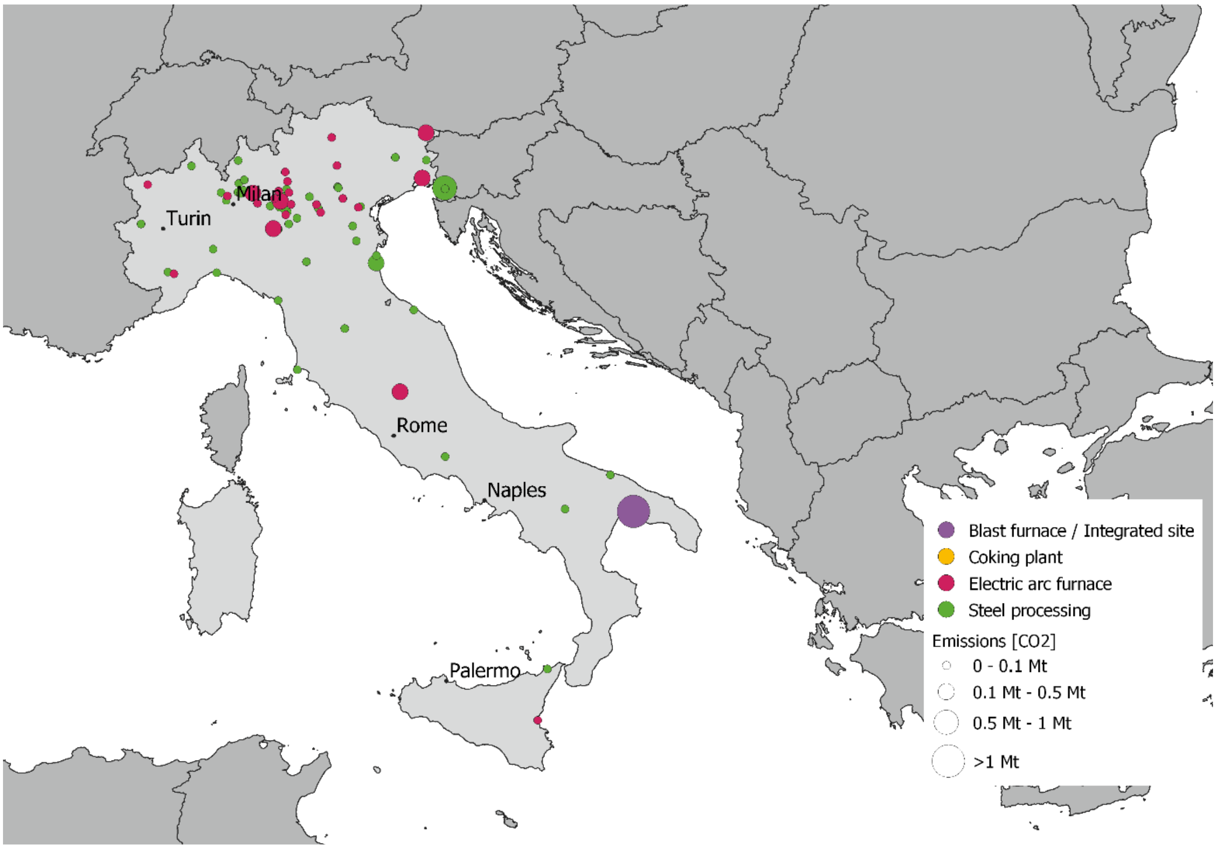
Figure 28: Italian BF-BOF route: Development of specific emission indicators



Note: Emission values also include emissions from power plants that use waste gases from iron and steel making as fuel.
Source: Data for Italy based on based on Table 20, data for EU-28 based on Table 4.

4.3 Facility level description

Figure 29: Italy: Location map of major CO_2 emission sources from the iron and steelmaking sector verified emissions in 2019



Note:
[1] The illustration is based on emissions reporting under the EU ETS. While the EU ETS has activity codes specifying the main activity of an installation, the codes are not a fully reliable indicator in terms of the installation's function in the steelmaking process. The practice of grouping different facilities under one installation ID and the allocation of emissions between different installations at one integrated site diverge for different sites. Detailed information on the functions and facilities present at individual site is given in this section, below.
[2] Waste gas power plants listed as separate installations in the EU ETS are not displayed here but in Figure 10 (lower-left panel), due to overlap with blast furnace / integrated sites.
Source: Own illustration based on EC n.d..

Figure 29 shows the location of sites listed separately under the EUTL activity codes 22 - 25. The map indicates the location of the facility and the facility purpose; and differentiates between EAF sites, BF-BOF sites and coking plants and other types of facilities (e.g. rolling mills and foundries) involved in the iron and steelmaking process. It also ranks the facility emissions into bins: below 0.1 Mt CO_2, 0.1 Mt CO_2 to 0.5 Mt CO_2, 0.5 Mt CO_2 to 1 Mt CO_2 and facilities emitting more than 1 Mt CO_2 per year.

Since the BF-BOF route dominates the development of emissions of the iron and steelmaking sector, the following section provides a detailed facility level description of installations on this route and their emission trends. The steps taken to match emissions to integrated steelworks and associated sources of uncertainty regarding the completeness and correct assignment are discussed in detail in section 2.3. Located in the south of Italy, the coastal city Taranto hosts the only integrated site for primary iron and steel production in the country. With a capacity of about 9.6 Mt hot metal and 11.5 Mt finished steel per year, it is the second-largest integrated steelworks in the EU ETS. The plant was owned by the Italian Riva group until 2012 when it was revealed that the plant was responsible for extreme levels of air pollution, after which it was seized by the Italian government. In 2018, the steelworks was purchased by ArcelorMittal.

Table 19: Italy: Overview of integrated sites for primary iron and steel production (BOF)

EUTL ID	EUTL activity code	Company	City	Hot metal Capacity (Mt)	Finished steel Capacity (Mt)	No. of BFs
IT 515	24	ArcelorMittal Italia S.p.A	Taranto	9.59	11.5	4

Source: EC n.d., EUROFER (2020)

In 2019, the Taranto steelworks accounted for 10.3 Mt of CO_2 emissions, of which 5.9 Mt CO_2 are recorded under the BF-BOF installations and the rest under an ArcelorMittal-owned waste gas power plant. Since 2005, the site's emissions have fluctuated significantly. While in pre-crisis years, the steelworks was still responsible for about 20 Mt of CO_2 emissions, they dropped by almost 50 % in 2009. After rising to 18.7 Mt CO_2 in 2011, emissions dropped sharply again in 2013 as well as in the subsequent years as a result of the pollution scandal and associated cuts in production levels.

Table 20: Italy: Emissions of integrated sites for primary iron and steel production (BOF)

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
IT 515	24	BF-BOF	ArcelorMittal	Taranto	10.1	8.6	6.3	5.9
IT 511	20	Power plant	ArcelorMittal	Taranto	10.0	7.7	4.8	4.4
Total of BF-BOF sites					**20.1**	**16.3**	**11.1**	**10.3**
Total iron and steel in Italy					**23.9**	**20.5**	**15.5**	**15.6**
Total production of crude steel (BF-BOF route, in Mt)					**11.7**	**8.6**	**4.8**	**4.2**
Emission intensity of BF-BOF sites (t CO_2 per t crude steel)					**1.72**	**1.90**	**2.31**	**2.44**

Source: EC n.d., Worldsteel Association (2020)

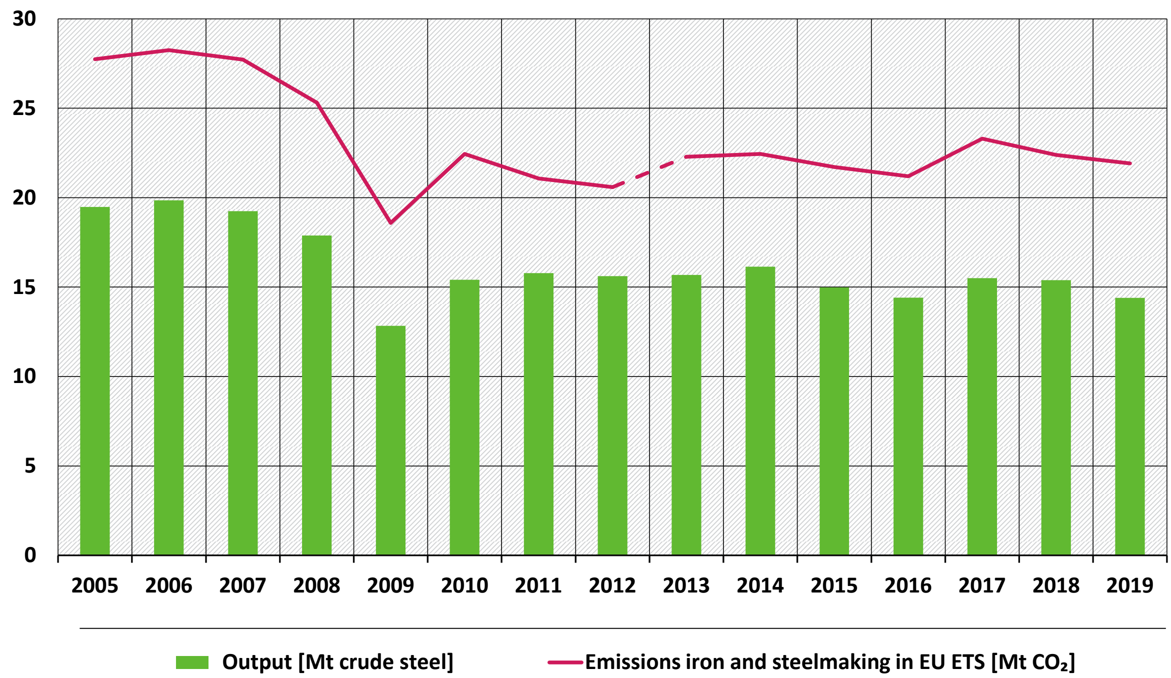
BF-BOF sites account for 66 % of the total emissions related to iron and steel production in Italy.

5 Country fact sheet: France

5.1 Key messages

- France has the 2nd highest CO_2 emissions from iron and steelmaking in the EU ETS (22 Mt CO_2 in 2019, see Table 21), comprising 11 % of total EU-28 emissions of the sector.
- It is also the country with the 3rd highest crude steel production in the EU-28, contributing about 9 %. The EAF production share is about 30 %, which is below the average of the EU-28 (41 %).
- Historically France had three integrated steelworks. In 2011 the blast furnaces in Florange – a land-locked site located in the former steel region near the German and Luxembourg borders – ceased production and were eventually closed in 2012 (comprising 17 % of the initial production capacity). This reduced the number of integrated steelworks in France to two. Both remaining sites have access to sea trade. They have a total hot metal capacity of 12.0 Mt and emissions from the integrated sites sum up to 19.8 Mt CO_2 in 2019.
- Both remaining integrated steelworks are owned by ArcelorMittal (Fos sur Mer and Dunkerque).

Figure 30: France: Key trends in CO_2 emissions and crude steel production, 2005-2019



Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d.

Table 21: France: Key data on the iron and steelmaking sector in 2019

General information					
				2019	**% change compared to 2013**
Total CO_2 emissions in EU ETS in 2019 from iron and steelmaking[1] (share in total CO_2 emissions in EU ETS)				21 Mt CO_2 (23 %)	-4 %
Total crude steel production in 2019 (share of EU-28)				14.4 Mt (9 %)	-8 %
Total CO_2 emissions from BF-BOF sites[2] (total CO_2 emissions from EAF sites)				19 Mt CO_2 (0.7 Mt CO_2)	-3 %
Crude steel production of BF-BOF sites (crude steel production from EAF sites)				10 Mt (4.4 Mt)	-2 %
Estimated emission intensity of crude steel production from BF-BOF-sites (relative to EU-28 average)				1.9 t CO_2/t crude steel (104 %)	-1 %
Site-specific information of integrated sites for year 2019					
Main EUTL-ID	**Site name**	**Number of blast furnaces**	**Hot metal capacity Mt**	**CO_2 emissions Mt CO_2**	**% change in CO_2 emissions compared to 2013**
FR 956	Dunkerque	3	6.8 Mt	11.3 Mt	-5 %
FR 628	Fos sur Mer	2	5.2 Mt	7.7 Mt	-6 %

Notes:

[1] Activity codes 22 - 25; also including waste gas power plants from activity code 20.

[2] Installations belonging to one integrated site (including coking plants, sinter plants, blast furnaces, basic oxygen furnaces,coal and downstream processing plants and waste gas-fuelled power plants) were allocated manually. Emissions from waste gas power plants can also include co-firing with other fuels which adds uncertainty to the exact total emission levels. For a broad discussion of uncertainties see section 2.3.1. The respective sources are given in the details of the facility level description.

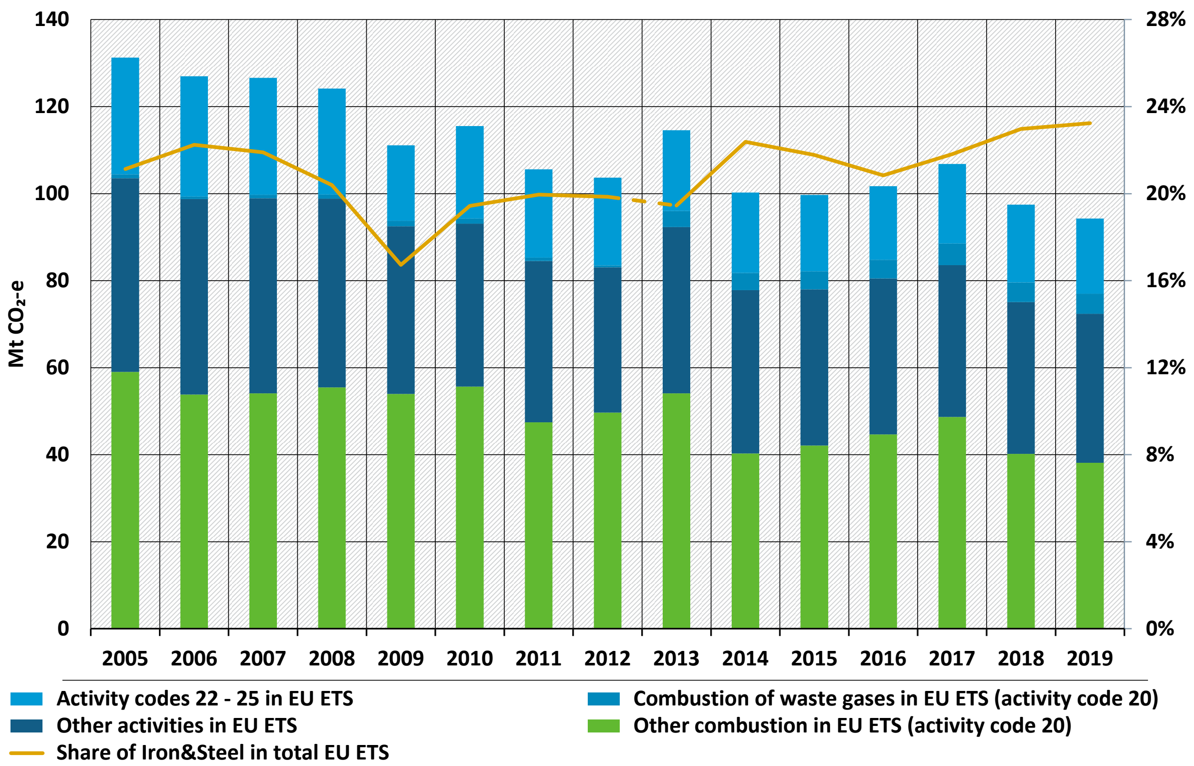
Source: Own table based on EC n.d., EUROFER (2020), Worldsteel Association (2020)

5.2 Short description of the sector in the context of the country's economic and GHG pollution

Iron and steel production is an important industrial sector in France: it accounts for 2 % of gross value added (GVA) of the entire manufacturing sector. As shown in Figure 68 (see Annex A), the share of manufacturing GVA in total GVA in France has been stable between 2010 and 2017.[20] At the same time, the share of steel making GVA in manufacturing GVA declined from 1.8 % in 2010 to 1.3 % in 2012 and rose again to 1.5 % in 2017. As also shown in Figure 68, following the economic downturn, employment in the steel sector saw a strong decline from 33,000 workers in 2008 to 24,000 workers in 2010. Since then, the number of workers directly employed in the industry has declined at a much slower pace to about 22,000 workers in 2017.

5.2.1 Emission trends

Figure 31: France: Emission trends in stationary EU ETS



Note: Emissions from power plants that use waste gases from iron and steel making as fuel are attributed to the iron and steelmaking sector instead of the combustion sector.
Source: EC n.d..

In France, the iron and steelmaking sector accounts for a large share of stationary EU ETS emissions. As shown in Figure 31, the share was about 23 % in 2019 (compared to 13 % on the EU level), which is equivalent to 22 Mt of CO_2 and makes the sector the largest contributor to industrial emissions in France. In France, the iron and steelmaking sector accounts for about 5 % of total emissions (in 2018).

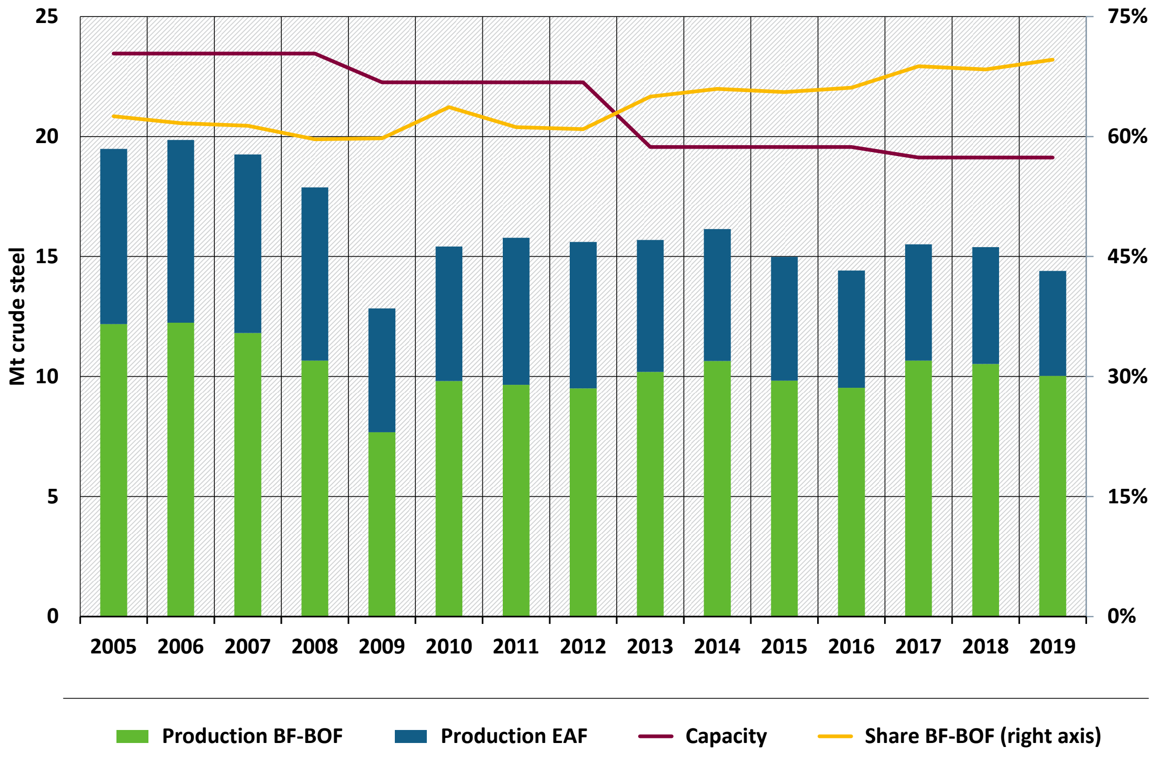
After the introduction of the EU ETS in 2005, the share of the iron and steelmaking sector's emissions in total EU ETS emissions has first decreased in the course of the financial crisis, as

[20] There is no data available for prior years from the same sources.

emissions from the iron and steelmaking sector dropped sharply from close to 28 Mt CO_2 in 2005-2007 to 18.6 Mt CO_2 in 2009. The sector's emissions increased significantly again after the financial crisis, when production returned to higher levels, and in 2013, when the scope of the EU ETS was extended (although the latter did not increase the share in total EU ETS emissions). In 2017, the sector's emissions increased again and were at its highest level since 2008. The emissions trend is dominated by the development in production on the BF-BOF route (the most emission-intensive route). Hence the drop in emissions coincides with the strong reduction in production, in particular at the site in Fos sur Mer and Florange.

5.2.2 Trends in production, capacity and trade

Figure 32: French iron and steel industry: Trends in production and capacity



Source: Worldsteel Association (2020), OECD 2020 Steelmaking Capacity Database.

With a total crude steel production capacity of 19.1 Mt in 2019, France ranks 4th in iron and steelmaking capacity in the EU (9 % of the EU-28 capacity in 2019). Figure 32 shows the development of production capacity and actual output over recent years. In terms of total crude steel production in 2019, France ranks 3rd in the EU. After the evident drop in the production of steel during the economic crisis in 2008/2009, total production levels have not returned to pre-crisis levels of close to 20 Mt and are instead at around 14-15 Mt per year. Due to the decrease in production and subsequent closure at the Florange site, production of crude steel from basic oxygen furnaces (BOF) has been about 10 Mt per year since 2010, which is almost 20 % lower than prior to the economic crisis. Between 2010 and 2019 the share of steel produced via the BF-BOF route varied between 62 % and 70 % (fluctuations of the BF-BOF share at the EU level were much smaller: 58 %-60 %). Regarding the production from electric arc furnaces (EAF), the production was more than 7 Mt in the years 2005 to 2007. Since 2010, production from EAF has fluctuated between 5 and 6 Mt per year. The decrease in production levels is also associated with a reduced capacity which was caused by the closure of an EAF in Gandrange in 2009 and the closure of the integrated steelworks in Florange in 2012. The utilization rate has recovered from its lowest point of 58 % in 2009, increasing to 81 % in 2017, which was only slightly lower than in 2005-2007; however, it dropped again to 75 % in 2019. On average, the utilization rate of iron and steelmaking plants in France was 76 % between 2005 and 2019 (only slightly higher than the EU-28 of 75 % for the same time period).

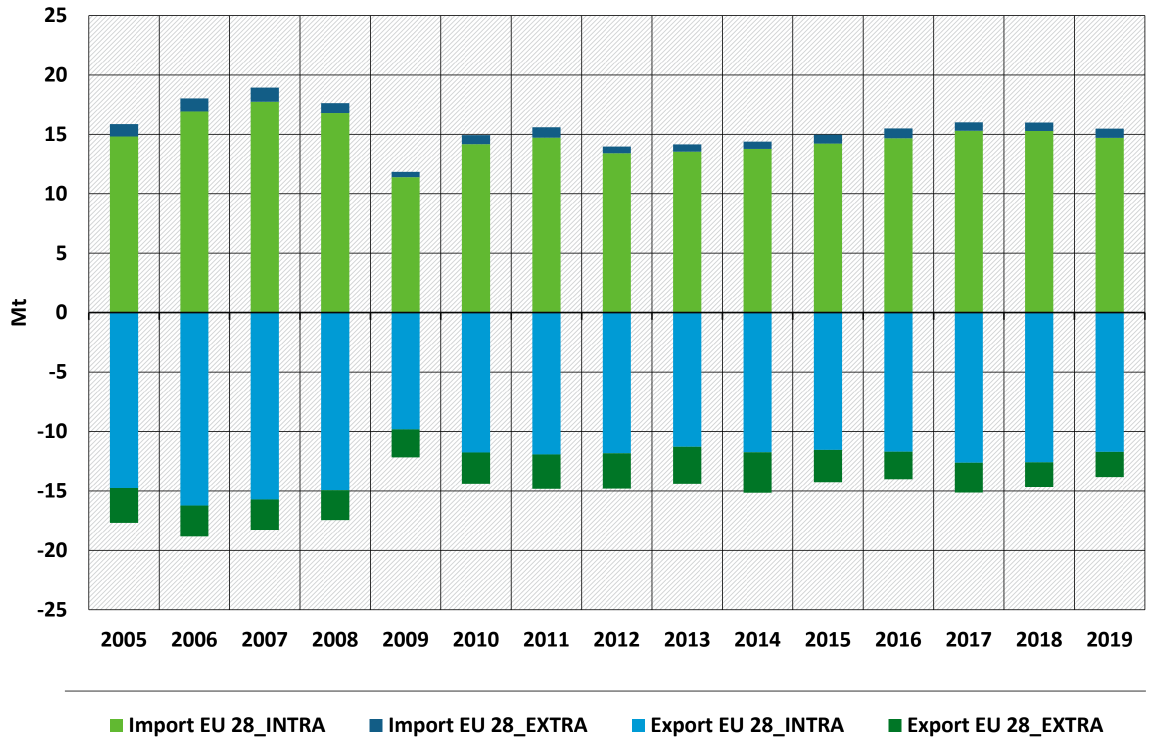
Iron and steelmaking on the EAF route partly depends on the availability of steel scrap. Steel scrap is an internationally traded commodity but also a resource that is domestically available in all EU-28 countries. As shown in Figure 76, France has constantly been a net exporter of steel scrap, since 2010. No data is available for prior years. Domestic steel scrap volumes[21] have been fluctuating between a low of 11 Mt in 2014 and a high of 13 Mt in 2011. At the same time, steel scrap consumption has declined from a high of 9 Mt in 2011 to a low of 7 Mt in 2017, while the share of exports from domestic volumes has been around 50 % over the entire time horizon.

France is an important market for basic and semi-finished iron and steel products in Europe. Figure 33 shows the evolution of imports and exports of France from 2005 to 2019, showing that the level of imports and exports since the financial crisis in 2009 is generally lower than before the crisis. In France, intra-EU trade makes up the dominant share of trade volumes. Imports from the EU-28 accounted for 96 % of all imports in 2018, while exports to EU-28 countries accounted for 85 % in the same year.

France's trade balance for basic and semi-finished iron and steel products was negative for intra-EU trade in 2018 and was not entirely offset by the positive trade balance in extra-EU trade.

[21] Calculated as scrap steel consumption plus total exports minus EU-internal imports. Country-level data for EU-external imports is not available, but its levels are assumed to be low as total imports to the EU amounted to less than 3 Mt in 2019 ((BIR: Bureau of International Recycling 2022)).

Figure 33: French trade balance: imports and exports of basic and semi-finished iron and steel products to/from France



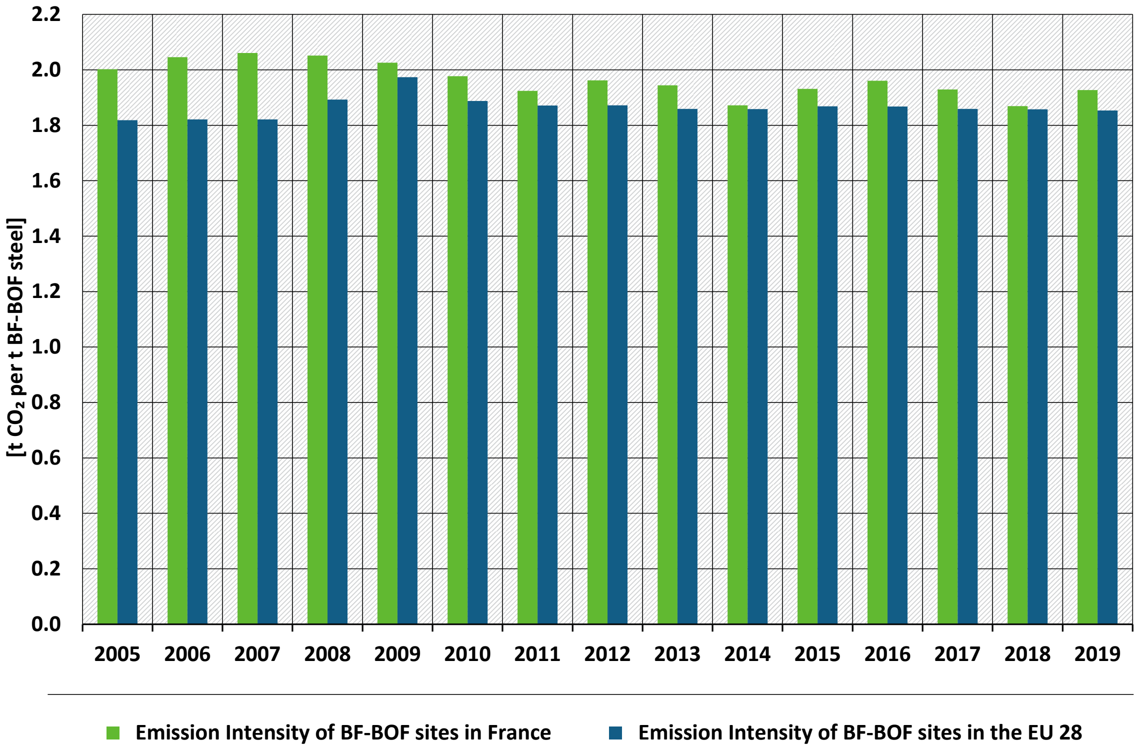
Source: Eurostat (2020b).

The most important countries for basic and semi-finished iron and steel products imports to France are Belgium, Germany, Spain and Italy, which together accounted for 74 % of total imports in 2019. The first non-EU-28 country, Turkey, comes only in 9th place and has a share of 1 %. For exports of basic and semi-finished iron and steel products, the situation is similar, with Belgium, Germany, Spain and Italy accounting for a share of two thirds of total exports from France. The first non-EU-28 country, the United States, ranks 12th with a share of 1 %.

5.2.3 Trends in emission intensity on the BF-BOF route

Figure 34 shows the trend in specific emission intensity of the BF-BOF route in France compared to the EU average. Between 2005 and 2019, the share of production on this route was 63 % to 70 %. The emission intensity is derived in a bottom-up calculation by dividing the total emissions related to integrated BF-BOF sites (including emissions from coking plants, sintering plants, blast furnaces, basic oxygen furnaces and waste gas power plants) by the total production of steel in BOFs. In 2019, the specific emission factor was at 1.93 t CO_2 per ton of production in BF-BOF route (returning to the level from 2011, with a low of 1.87 in 2014). This is only slightly higher compared to the EU average of about 1.85 t CO_2 per ton of production (2019). Due to the co-firing of natural gas in the Dunkerque power plant named “DK6,” emissions attributed to natural gas-firing have been subtracted (see notes under Table 23 and Annex A.3 for details on the methodology). Historically, the emission intensity first increased from 2005 to 2007. While the EU-28 average increased up to 2009, emissions intensity in France decreased up to 2009 and again up to 2011. One explanatory factor could be the increase in net coke imports for steelmaking, despite the decrease in crude steel production because of the closure of the Florange blast furnace (Eurostat 2022).Subsequently, the emission intensity slightly fluctuated around the level observed in 2017.

Figure 34: French BF-BOF route: Development of specific emission indicators

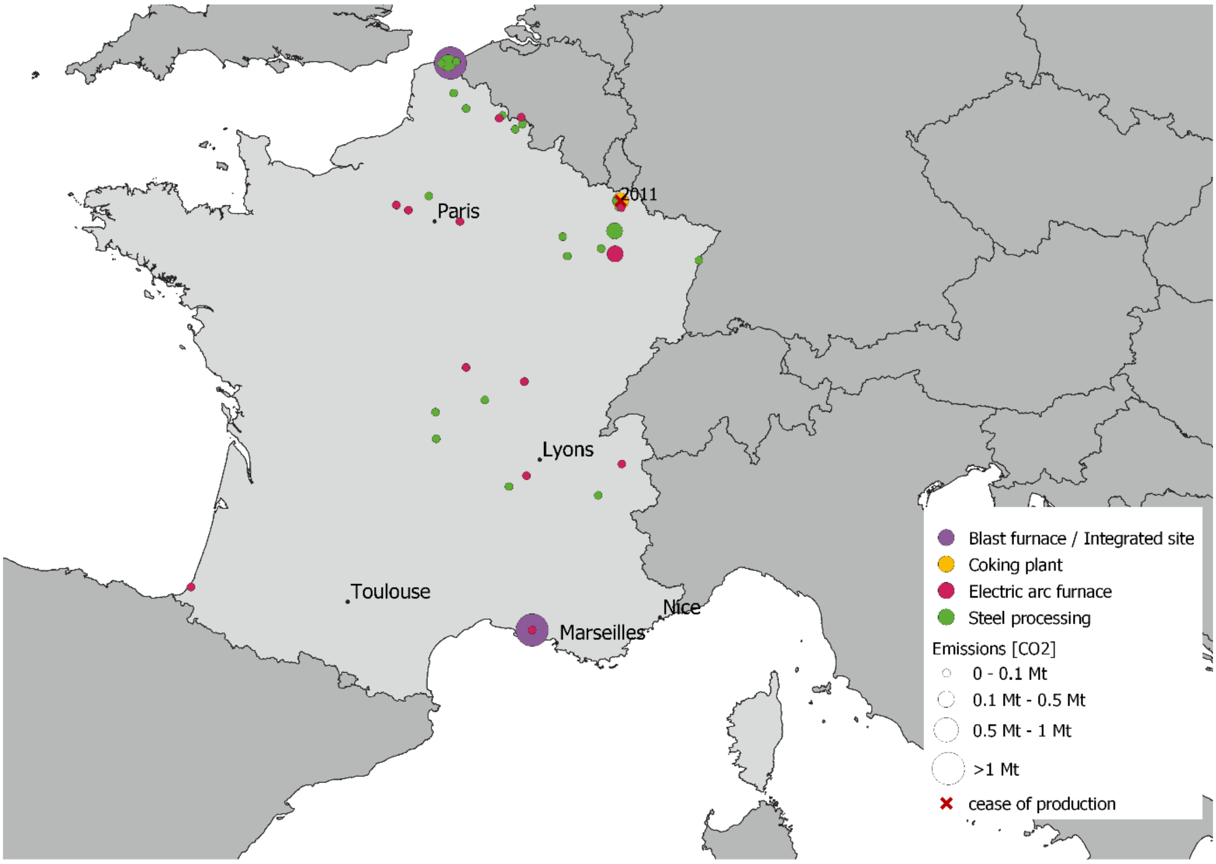


Note: Emission values also include emissions from power plants that use waste gases from iron and steel making as fuel.
Source: Data for France based on Table 23, data for EU-28 based on Table 4.

5.3 Facility level description

This section provides details on large facilities reported under activity codes 24 and 25 in France. In France, no installations are separately recorded under activity codes 22 and 23, but they report their emissions as part of the integrated steelworks. After the closure of primary crude steel production at the Florange site, the remaining coking plant in Florange reports under code 24.

Figure 35: France: Location map of major CO_2 emission sources from the iron and steelmaking sector verified emissions in 2019



Note:

[1] The illustration is based on emissions reporting under the EU ETS. While the EU ETS has activity codes specifying the main activity of an installation, the codes are not a fully reliable indicator in terms of the installation's function in the steelmaking process. The practice of grouping different facilities under one installation ID and the allocation of emissions between different installations at one integrated site diverge for different sites. Detailed information on the functions and facilities present at individual site is given in this section, below.

[2] Waste gas power plants listed as separate installations in the EU ETS are not displayed here but in Figure 10 (lower-left panel), due to overlap with blast furnace / integrated sites.

Source: Own illustration based on EC n.d..

Figure 35 shows the location of sites listed under the EUTL activity codes 22-25. The map indicates the location of the facility and the facility purpose and differentiates between EAF sites, BF-BOF sites and coking plants and other types of facilities (e.g. rolling mills and foundries) involved in the iron and steelmaking process. It also ranks the facility emissions into bins: below 0.1 Mt CO_2, 0.1 Mt CO_2 to 0.5 Mt CO_2, 0.5 Mt CO_2 to 1 Mt CO_2 and facilities emitting more than 1 Mt CO_2 per year. Moreover, it shows the location and year for the cease of production of the Florange site.

Since the BF-BOF route dominates the development of emissions of the iron and steelmaking sector, the following section provides a detailed facility level description of installations on this route and their emission trends. The steps taken to match emissions to integrated steelworks and associated sources of uncertainty regarding the completeness and correct assignment are discussed in detail in section 2.3. In 2018, integrated sites with a blast furnace were responsible for about 90 % of all CO_2 emissions from the iron and steel industry in France. A significant event in terms of CO_2 emission sources was the end of hot metal production in Florange in 2011 and the subsequent closure of the blast furnaces in 2012. The remaining emissions of about 0.3 Mt. CO2 since then originate from the coking plant which is still operated at this site (Tageblatt Letzebuerg 11 Feb 2020).

The two blast furnaces still in operation in France are both located at the coast. The plant in Dunkerque is located at the North Sea and the plant in Fos Sur Mer at the Mediterranean Sea. In Dunkerque, electricity is produced from waste gases in a separate installation called "DK6". This combined cycle power plant with a total capacity of 790 MW was built in 2005. It consists of two units, each with a gas turbine (165 MW) and a steam turbine (230 MW). The waste gases are used to power the steam turbines (Wikipedia 2022). The gas turbines are powered with natural gas only. For the reporting in the EUTL for Fos sur Mer, the waste gas power plant is included in the integrated steelworks and not listed as a separate installation, as in Dunkerque.

Larger EAF sites and some processing facilities are concentrated in the North-East, while agglomerations of smaller sites exist along the Belgian border, in the Paris area and in the centre of the country.

Table 22 provides more details on blast furnaces on the facility level. In 2019, the Dunkerque site had a total of three blast furnaces and an annual hot metal capacity of 6.8 Mt production and a similar finished steel capacity.[22] The Fos sur Mer site is smaller with two blast furnaces of about equal hot metal capacity totaling 5.2 Mt per year.

Table 22: France: Overview of integrated sites for primary iron and steel production (BF/BOF)

EUTL ID	EUTL activity code	Company	City	Hot metal capacity [Mt]	Finished steel capacity [Mt]	No. of BFs
FR 956	24	ArcelorMittal	Dunkerque	6.8	6.8	3
FR 628	24	ArcelorMittal	Fos sur Mer	5.2	5.1	2
FR 485	24	ArcelorMittal	Florange	Closed 2012		

Source: EC n.d., EUROFER (2020).

Table 23 lists the CO_2 emissions that originate from integrated primary iron and steel making production facilities in France. The combined emissions of the integrated steelworks and the waste gas power plant in Dunkerque reached a low of 10.4 Mt CO_2 in 2009 and have otherwise fluctuated between 11.4 and 13.2 Mt CO_2. The site in Dunkerque is therefore responsible for more than half of total sector emissions in France (55 % in 2019). The integrated steelworks in Fos sur Mer accounted for another third (35 %) of total emissions from the iron and steelmaking sector in France in 2019. By way of comparison, the coking plant that is still operated at the site in Florange emitted 0.3 Mt CO_2 in 2019. Since the closure of the steelworks, it has only made minor contributions to the sector's total CO_2 emissions. Even before the closure of the melt

[22] Eurofer gives capacities for "hot metal" and "finished steel" of BF-BOF sites. We assume that the first refers to the capacity of the blast furnace and the latter to the capacity of the basic oxygen furnaces ((EUROFER 2020)).

shops, the site was significantly smaller in terms of CO_2 than the other two integrated steelworks.

Table 23: France: Emissions of installations related to integrated sites for primary iron and steel production (BF-BOF)

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	**2010**	**2015**	**2019**
FR 956	24	BF-BOF	ArcelorMittal	Dunkerque	11.5	10.2	7.2	7.5
FR 988	20	Power plant	Engie Thermique	Dunkerque	0.9	1.2	4.1	4.6
FR 628	24	BF-BOF	ArcelorMittal	Fos sur Mer	8.5	6.1	7.9	7.7
FR 485	24	BF-BOF	ArcelorMittal	Florange	4.4	3.1	0.2	0.3
Correction for non-waste gas use in power plant[1]					**-0.9**	**-1.2**	**-0.5**	**-0.7**
Total of BF-BOF sites					**24.4**	**19.4**	**19.0**	**19.3**
Total iron and steel in France					**27.7**	**22.5**	**21.7**	**21.9**
Total production of crude steel (BF-BOF route, in Mt)					**12.2**	**9.8**	**9.8**	**10.0**
Emission intensity of BF-BOF sites (t CO_2 per t crude steel)					**2.00**	**1.98**	**1.93**	**1.93**

Note:

[1] The Dunkerque power plant uses both waste gases and natural gas as fuel input. Based on data from the Large Combustion Plant Direct Database which reports fuel input for large installations we corrected total emissions substracting emissions attributed to burning of natural gas.

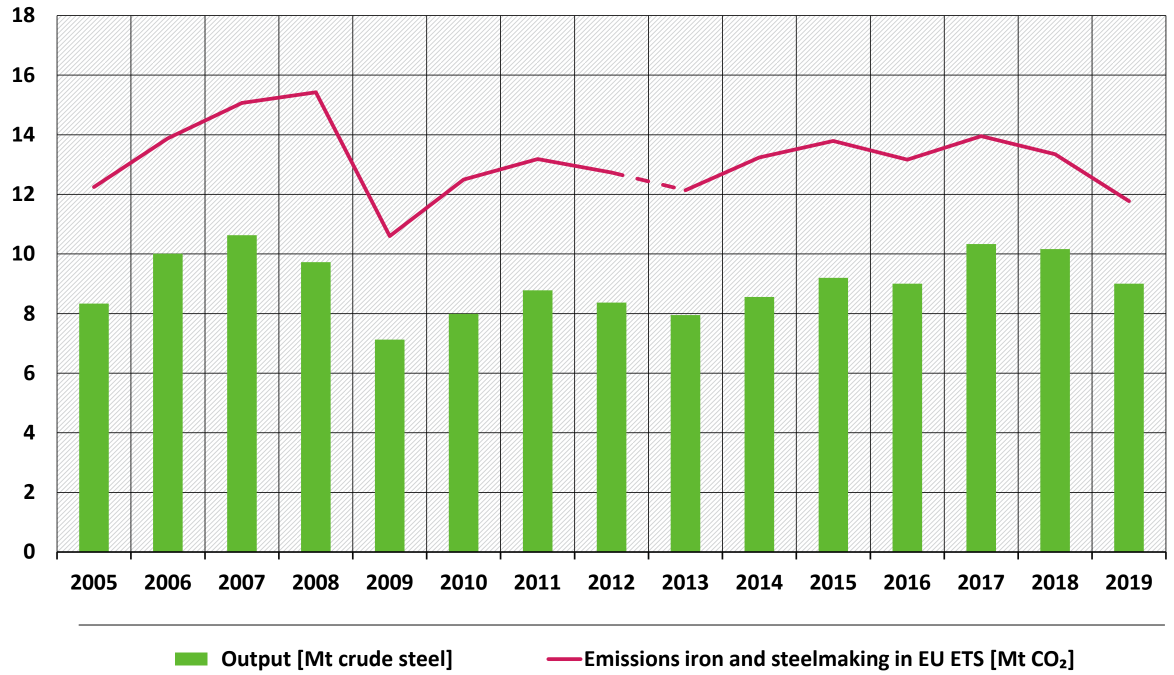
Source: EC n.d., EEA n.d., Worldsteel Association (2020)

6 Country fact sheet: Poland

6.1 Key messages

- Poland has the 6th highest CO_2 emissions from iron and steelmaking in the EU ETS (12 Mt CO_2 in 2019, see Table 24). The sector accounts only for a small share of emissions under the EU ETS (6 % in 2019). They are dominated by coal and lignite-fired electricity generation (activity code 20), which has decreased by only 19 % since 2005.
- With a production of 9 Mt, it was the 4th biggest crude steel producer in the EU-28 in 2019. The EAF production share amounts to approx. 45 %, which is slightly above the EU-28 average (41 %). Between 2005 and 2019, no adjustments in production capacity were observed.
- Emission trends in the sector follow the trend in production, which increased from 2005 to 2008, sharply declined in 2009, recovered again in 2011, fluctuated at around 13-14 Mt until 2017 and decreased in 2018 and 2019. From a peak in 2009, emissions intensity steadily declined until 2019, which was still approx. 10 % above the EU-28 average.
- Poland had two integrated steelworks, one in Dąbrowa Górnicza (north-east of Katowice) and one in Kraków. The latter was closed, first temporarily before the final closure was announced in October 2020. In 2019, the two sites accounted for 9.5 Mt CO_2.

Figure 36: Poland: Key trends in CO_2 emissions and crude steel production, 2005-2019



Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed; therefore, values from before 2013 and after are not comparable due to a difference in scope.
Source: Worldsteel Association (2020), EC n.d..

Table 24: Key data on the iron and steelmaking sector in Poland in 2019

General information	2019	% change compared to 2013
Total CO_2 emissions in EU ETS in 2019 from iron and steelmaking[1] (share in total CO_2 emissions in EU ETS)	12 Mt CO_2 (6 %)	-3 %
Total crude steel production in 2019 (share of EU-28)	9 Mt (6 %)	13 %
Total CO_2 emissions from BF-BOF sites[2] (total CO_2 emissions from EAF sites)	10 Mt CO_2 (0.4 Mt CO_2)	-3 %
Crude steel production of BF-BOF sites (crude steel production from EAF sites)	5 Mt (4.1 Mt)	12 %
Estimated emission intensity of crude steel production from BF-BOF sites (relative to EU-28 average)	2.0 t CO_2/t crude steel (110 %)	-13 %

Site-specific information of integrated sites for year 2019

Main EUTL-ID	Site name	Number of blast furnaces	Hot metal capacity Mt	CO_2 emissions Mt CO_2	% change in CO_2 emissions compared to 2013
PL 886	Dąbrowa Górnicza	2	4.5 Mt	7.3 Mt	10 %
PL 885	Kraków	1	2.0 Mt	2.2 Mt	-18 %

Notes:

[1]Activity codes 22 - 25; also including waste gas power plants from activity code 20.

[2]Installations belonging to one integrated site (including coking plants, sinter plants, blast furnaces, basic oxygen furnaces,coal and downstream processing plants and waste gas-fuelled power plants) were allocated manually. The emissions from waste gas power plants can also include co-firing with other fuels, which adds uncertainty to the exact total emission levels For a broad discussion of uncertainties see section 2.3.1. The respective sources are provided in the details of the facility level desciption.

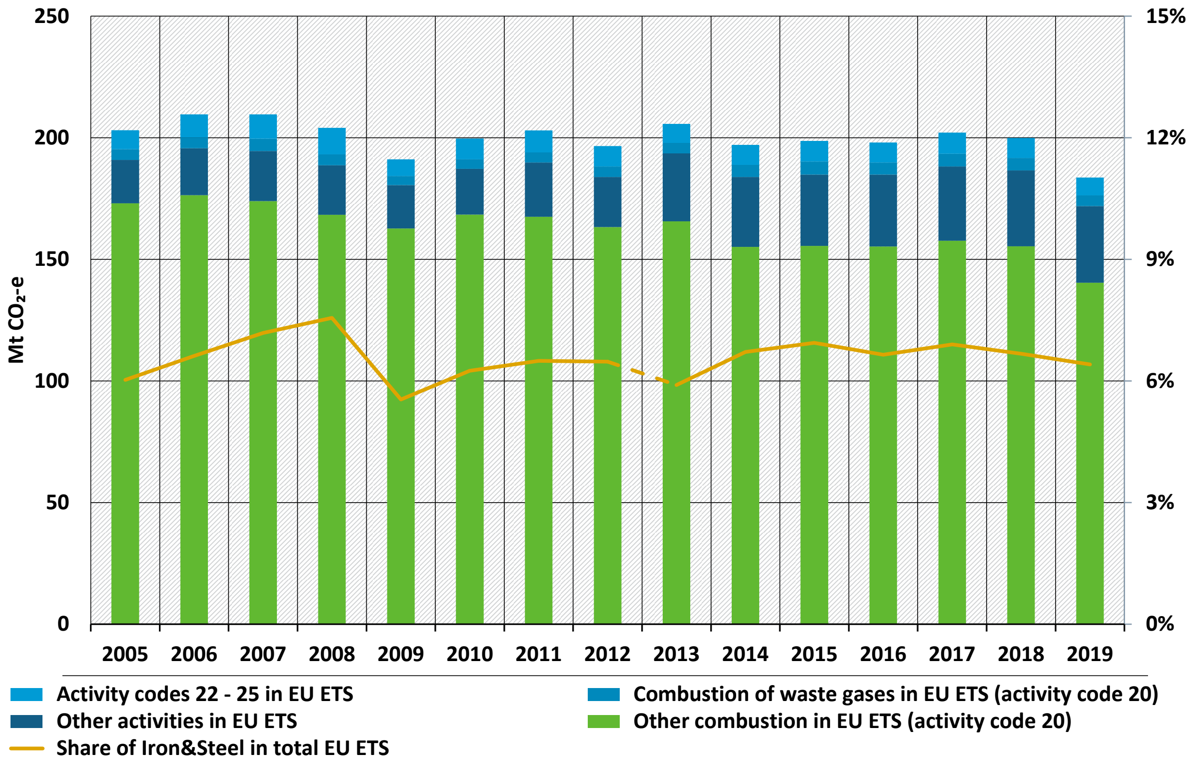
Source: Own table based on EC n.d., EUROFER (2020), Worldsteel Association (2020).

6.2 Short description of the sector in the context of the country's economic and GHG pollution

Iron and steel production is an important industrial sector in Poland: it accounts for 2 % of gross value added (GVA) of the entire manufacturing sector. As shown in Figure 69, the share of manufacturing GVA in total GVA in Poland was stable between 2010 and 2017.[23] The same is true for the share of steel making GVA in manufacturing. As Figure 69 also shows, employment in the steel sector saw a decline from 29,000 workers in 2008 to 21,000 workers in 2014. Since then, the number of workers directly employed in the industry has risen again, reaching about 23,000 workers in 2017.

6.2.1 Emission trends

Figure 37: Poland: Emission trends in stationary EU ETS



Note: Emissions from power plants that use waste gases from iron and steelmaking as fuel are attributed to the iron and steelmaking sector instead of the combustion sector.
Source: EC n.d..

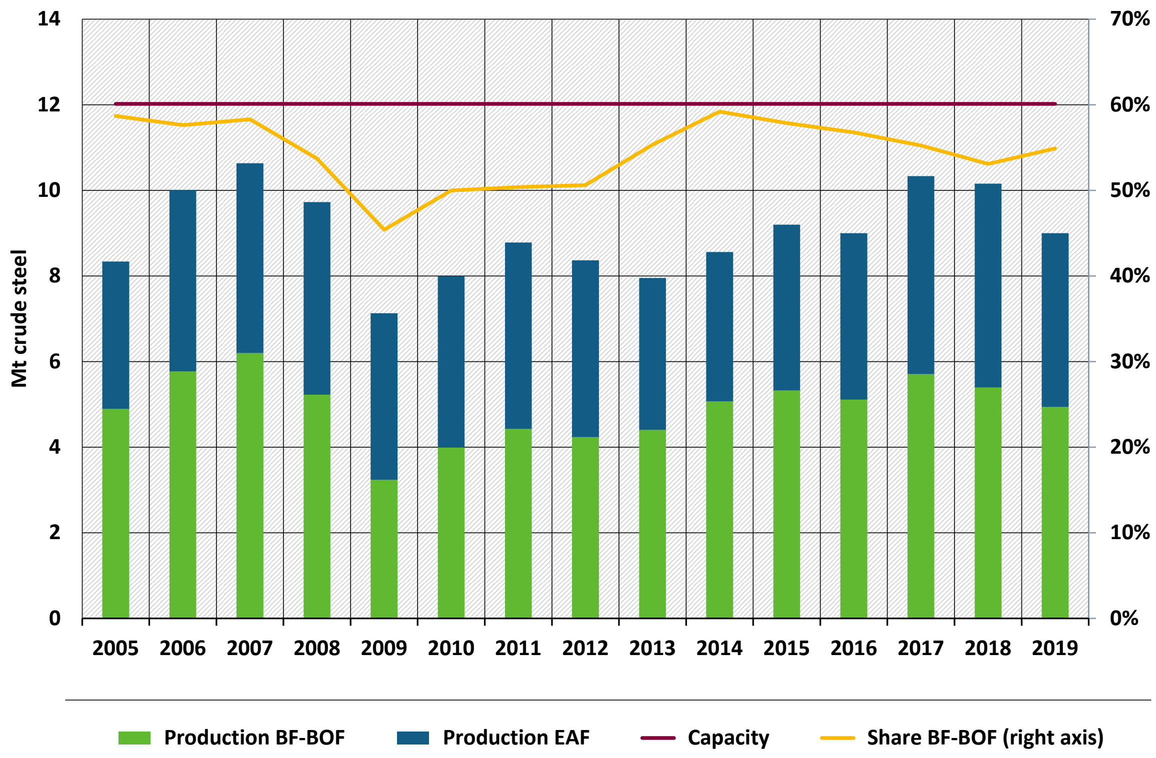
In Poland, the iron and steelmaking sector accounts for a relatively small share of total emissions covered under the EU ETS, with around 6 – 7 % between 2005 and 2019. EU ETS emissions are dominated by coal and lignite-fired electricity generation (activity code 20), which decreased by only 19 % since 2005. After the economic crisis, the sector emissions increased again but did not reach the 2008 peak of 15.4 Mt CO_2. Between 2011 and 2019, the sector emitted around 13 Mt CO_2 yearly, with a small decrease in 2019 (11.8 Mt CO_2). The emission trends in the sector follow the trend in production on the BF-BOF route. After a peak in 2009, the emissions intensity steadily declined up to 2019, which was still approx. 10 % above the EU-28

[23] There is no data available for prior years from the same sources.

average (see below). A possible explanation for this trend is the higher capacity utilization of the BF-BOF route and the more efficient utilization of the respective infrastructure. Poland's total emissions amounted to 412.9 Mt CO_2 in 2018, of which 3 % originated from the iron and steelmaking sector.

6.2.2 Trends in production, capacity and trade

Figure 38: Polish iron and steel industry: Trends in production and capacity



Source: Worldsteel Association (2020), OECD 2020 Steelmaking Capacity Database.

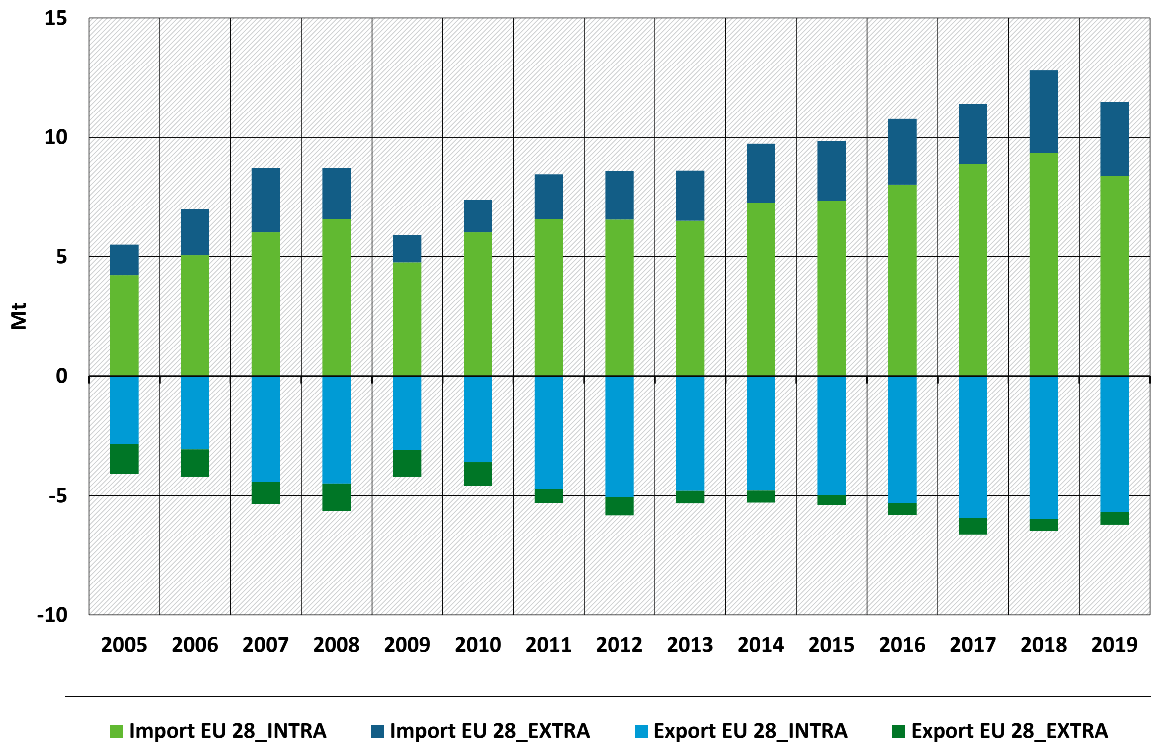
Poland comprises 6 % of EU's iron and steel production, with 9 Mt of crude steel produced in 2019. After a heavy decline during the financial crisis in 2009, production levels showed a fluctuating but ascendant slope, reaching a maximum of 10.2 Mt in 2017, which was almost as high as the level before the crisis (2007: 10.6 Mt). Despite these significant variations, Polish producers did not decrease their capacities at all until the closure of the Krakow plant in 2020.

Figure 38 shows that in 2009 the decrease in production was over-proportionally carried by facilities on the BF-BOF route, whereas the most recent decline of production in 2019 was due to a decline in production on the EAF route. Overall, the production share of the BF-BOF route has fluctuated at approx. 55 % in recent years.

Iron and steelmaking on the EAF route partly depends on the availability of steel scrap. It is an internationally traded commodity but also a resource that is domestically available in all EU-28 countries. Figure 77 in the Appendix shows the domestic steel scrap quantity and the scrap import and export balance. The majority of the domestic steel scrap is consumed domestically (about 5 - 6 Mt of scrap annually). Poland has constantly been an exporter of steel scrap since 2010, with annual exports of about 1.5 Mt. No data is available for prior years. The share of net-exports from domestic volumes was about 20–25 % in recent years.

Poland has been a net importer of basic and semi-finished iron and steel products to/from Poland since the introduction of the EU ETS (see Figure 39), with net imports increasing from 1.4 Mt in 2005 to 6.3 Mt in 2018. Exports from Poland do not show such a strong trend; rather, they show more fluctuations. Nevertheless, one can observe that a maximum of exports was reached in 2017, reaching 6.6 Mt of basic and semi-finished iron and steel products. It is also noticeable that the share of exports outside the EU has decreased in recent years compared to pre-crisis levels. In 2019, the Czech Republic, Germany and Slovakia together accounted for 52 % of all Polish exports, and Ukraine is the only non-Member State among the top 10 importers of Polish steel, accounting for only 2 %. The EU is also the predominant trading partner in terms of Polish imports, with Germany, Slovakia, the Czech Republic, and Italy, which together accounted for about 50 %. Among the largest extra-EU exporters to Poland, the Russian Federation and Ukraine, are the single largest partners.

Figure 39: Polish trade balance: imports and exports of basic and semi-finished iron and steel products to/from Poland

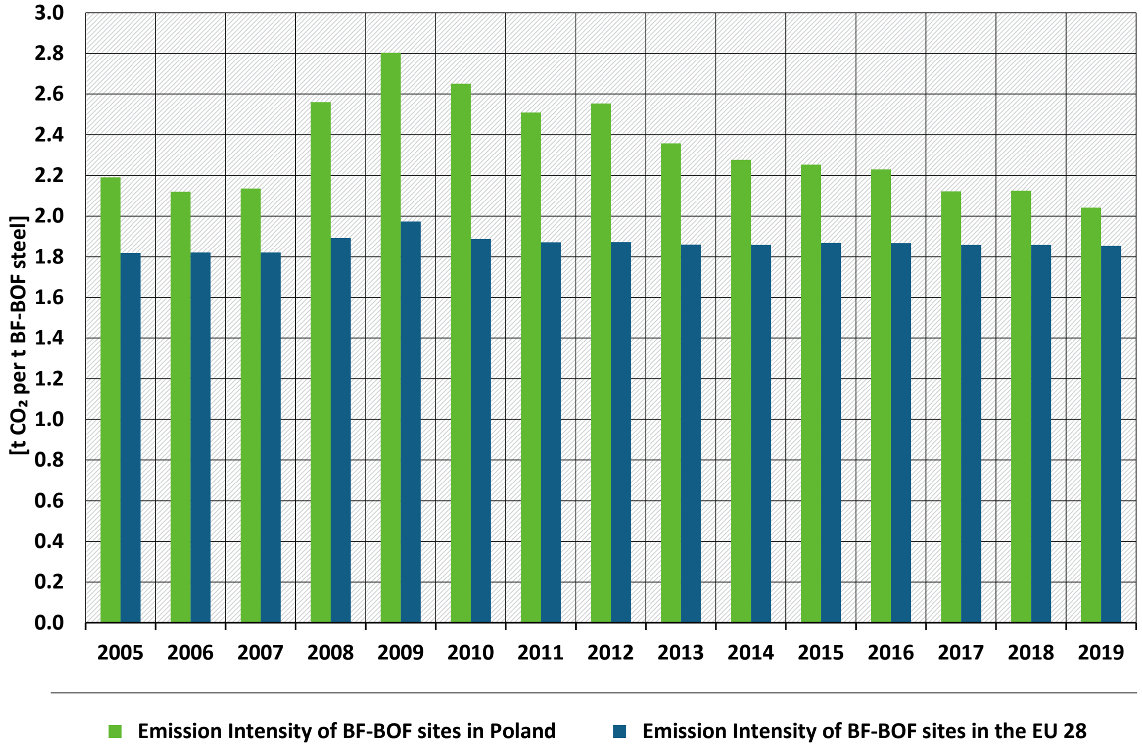


Source: Eurostat (2020b)

6.2.3 Trends in emission intensity on the BF-BOF route

The emission intensity is derived in a bottom-up calculation by dividing the total emissions related to integrated BF-BOF sites (including emissions from coking plants, sintering plants, blast furnaces, basic oxygen furnaces and waste gas power plants) by the total production of steel in BOFs.

Figure 40: Polish BF-BOF route: Development of specific emission indicators

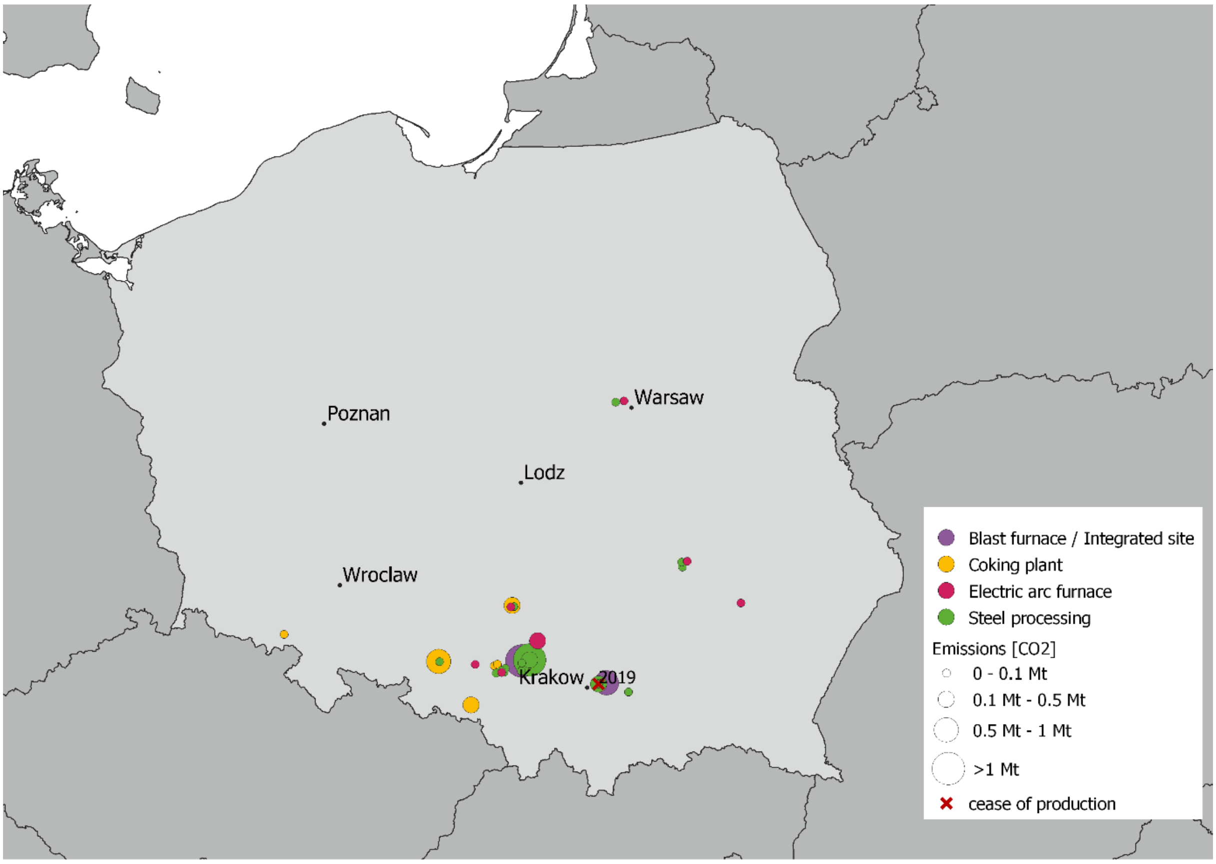


Note: Emission values also include emissions from power plants that use waste gases from iron and steelmaking as fuel.
Source: Data for Poland based on based on Table 26, data for EU-28 based on Table 4.

Poland's emission intensity factor followed the European trend to some extent until 2012, with a increase around 2009 followed by a decrease, however with much higher values, in 2009. In the latter year, it reached as much as 2.8 t CO_2 per ton of production in the BF-BOF route compared to the European average of 2.01 t CO_2 in the same year (39 % more). Since then, the trend has been that Poland is closing the gap to the other Member States. In 2019, values reached an all-time low of 2.0 t CO_2, which was 10 % above the EU-28 average. This decrease coincides with the relining of the Dabrowa Gornicza blast furnaces, in 2013 and 2018, respectively (ArcelorMittal 2023, Dąbrowa Górnicza Nasze Miasto 2014). Moreover, the period of high emission intensity coincides with times of low crude steel output on the BF-BOF route. Hence, the inefficient use of the infrastructures at the integrated steelworks was another driver of high emission intensity. Additionally, waste gas power plants that are included in the integrated steelworks also have used significant amounts of coal for co-firing (Tameh-Tauron ArcelorMittal Energy Holding 2022a). Due to a lack of data, emissions from co-firing could not be subtracted from total power plant emissions, hence leading to a potential overestimation of emissions associated with the BF-BOF route in Poland.

6.3 Facility level description

Figure 41: Poland: Location map of major CO_2 emission sources from the iron and steelmaking sector verified emissions in 2019



Note:

[1] The illustration is based on emissions reporting under the EU ETS. While the EU ETS has activity codes specifying the main activity of an installation, the codes are not a fully reliable indicator in terms of the installation's function in the steelmaking process. The practice of grouping different facilities under one installation ID and the allocation of emissions between different installations at one integrated site diverge for different sites. Detailed information on the functions and facilities present at individual site is given below in this section.

[2] Waste gas power plants listed as separate installations in the EU ETS are not shown here but in Figure 10 (lower-left panel) due to the overlap with blast furnace / integrated sites.

Source: Own illustration based on EC n.d..

Figure 41 shows the location of sites listed under the EUTL activity codes 22 - 25. The map indicates the location of the facility and the facility purpose and differentiates between EAF sites, BF-BOF sites and coking plants and other types of facilities (e.g. rolling mills and foundries) involved in the iron and steelmaking process. It also ranks the facility emissions into bins: below 0.1 Mt CO_2, 0.1 Mt CO_2 to 0.5 Mt CO_2, 0.5 Mt CO_2 to 1 Mt CO_2 and facilities emitting more than 1 Mt CO_2 per year. Moreover, it shows the location and year of closure of the Krakow plant.

Since the BF-BOF route dominates the development of emissions of the iron and steelmaking sector, the following section provides a detailed facility level description of installations on this route and their emission trends. In 2019, Poland hosted two integrated sites for primary iron and steel production, which are both located in the south and owned by ArcelorMittal. The integrated site in Krakow is a relatively small site with 1.3 Mt hot metal capacity per year, whereas the second site in Dabrowa Gornicza is substantially larger with a capacity of 4.5 Mt hot metal per year. The steps taken to match emissions to integrated steelworks and associated sources of uncertainty regarding the completeness and correct assignment are discussed in detail in section 2.3.

The total emissions of the integrated site in Krakow have ranged between 2 and 4 Mt of CO_2 in recent years. The Krakow site has been idle since November 2019; in October 2020, ArcelorMittal announced the permanent closure of the blast furnace (Eurometal 2020). The downstream processes (e.g. rolling mills) as well as the coke plant remain in operation.

Table 25: Poland: Overview of integrated sites for primary iron and steel production (BOF)

EUTL ID	EUTL activity code	Company	City	Hot metal mapacity [Mt]	Finished steel capacity [Mt]	No. of BFs
PL 886	24	ArcelorMittal P	Dąbrowa Górnicza	4.5	5	2
PL 885	24	ArcelorMittal P	Kraków	1.3	2.6	1

Source: EC n.d., EUROFER (2020).

The steelworks in Dabrowa Gornicza consists of a BF-BOF installation, a sintering plant and a rolling mill in the EUTL (Zbigniew Golas 2020).[24] Total emissions of the site were 7.3 Mt CO_2 in 2019 and have been fluctuating around this level (between 6.7 and 8.2 Mt CO_2) since 2007, with the exception of 2009. Notably, this steelworks is one of the few in the EU ETS for which the emissions were higher in recent years compared to 2005; emissions at the Dabrowa Gornicza site amounted to only 5.8 Mt CO_2.

[24] The BF-BOF installation was separately included in the ETS in 2008. In the preceding years, it is assumed that emissions have been reported at the sintering plant.

Table 26: Poland: Emissions of integrated sites for primary iron and steel production (BOF)

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
Integrated steelworks Dąbrowa Górnicza					**5.8**	**7.1**	**8.2**	**7.3**
PL 886	24	BF-BOF	ArcelorMittal	Dąbrowa Górnicza	0.0	2.9	2.6	2.3
PL 375	23	Sintering	ArcelorMittal	Dąbrowa Górnicza	3.2	1.2	1.7	1.5
PL 897	25	Rolling mill	ArcelorMittal	Dąbrowa Górnicza	0.0	0.3	0.3	0.2
PL 31	20	Power plant	TAMEH Polska	Dąbrowa Górnicza	2.6	2.7	3.7	3.3
Integrated steelworks Kraków					**3.7**	**2.1**	**2.8**	**2.2**
PL 885	24	BF-BOF	ArcelorMittal	Kraków	0.0	0.4	0.9	0.8
PL 898	25	Rolling mill	ArcelorMittal	Kraków	0.0	0.2	0.2	0.2
PL 367	22	Coking	ArcelorMittal	Kraków	0.2	0.1	0.1	0.1
PL 374	23	Sintering	ArcelorMittal	Kraków	1.7	0.2	0.0	0.0
PL 457	20	Power plant	TAMEH Polska	Kraków	1.8	1.2	1.6	1.1
PL 928	20	Rolling mill	ArcelorMittal	Kraków	0.0	0.02	0.02	0.02
PL 370	22	Coking	ArcelorMittal	Zdzieszo-wice	1.3	1.4	0.9	0.5
Total of BF-BOF and associated sites					**10.7**	**10.6**	**12.0**	**10.1**
Total iron and steel in Poland					**12.2**	**12.6**	**14.0**	**12.1**
Total production of crude steel (BF-BOF route, in Mt)					**4.9**	**4.0**	**5.3**	**4.9**
Emission intensity of BF-BOF sites (t CO_2 per t crude steel)					**2.19**	**2.65**	**2.25**	**2.04**

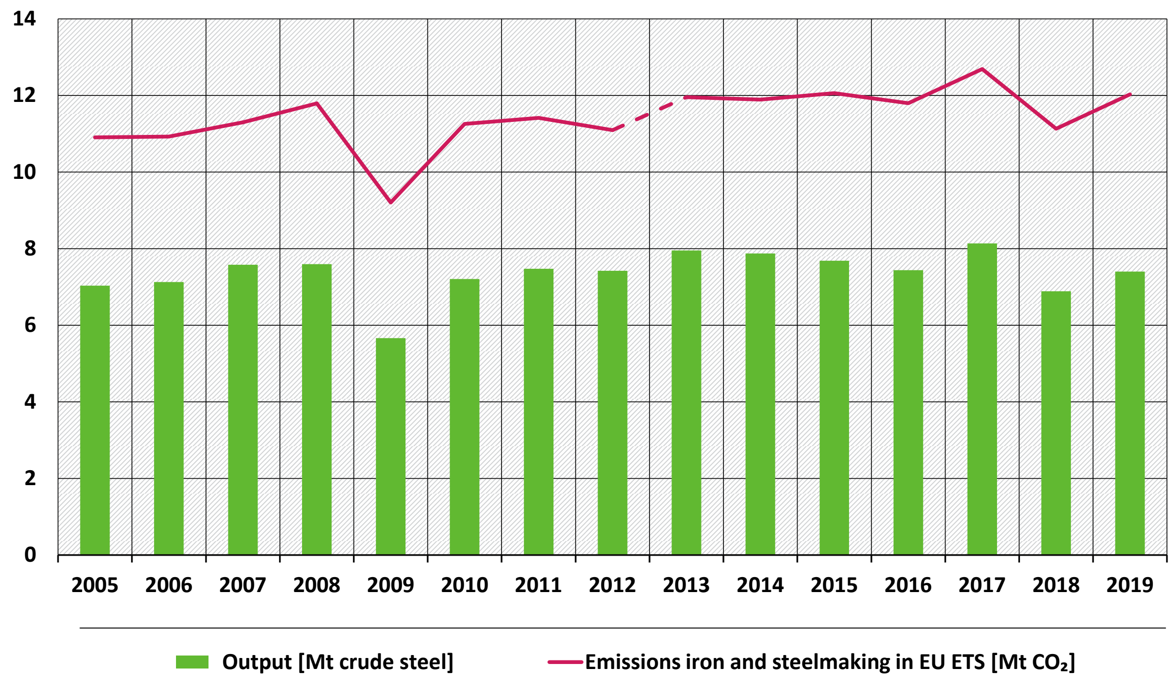
Source: EC n.d.,Worldsteel Association (2020)

7 Country fact sheet: Austria

7.1 Key messages

- Austria has the 4th highest CO_2 emissions from iron and steelmaking in the EU ETS (12 Mt CO_2 in 2019, see Table 27), comprising 6 % of total EU-28 emissions of the sector. The sector has a high and increasing share in total EU ETS emissions in Austria (40 % in 2019).
- Austria also has the 5th highest crude steel production in the EU-28, contributing about 5 % of total production in the EU-28. Since 2005, iron and steel production has been very stable in Austria, amounting to between 6 Mt and 7 Mt crude steel, except for the financial crisis year of 2009. The emissions trend is dominated by production on the BF-BOF route which has high utilization rates and a low emission intensity of 1.75 t CO_2 per ton of crude steel. The factor was even lower in 2014 but has increased since then due to pulverized coal injection at the Linz site which replaced reducing agents with lower emission factors.
- The EAF production share is 10 %, which is way below the average of the EU-28 (41 %). The share is not likely to increase due to a new installation in Kapfenberg, which only replaces the old EAF; Austria is an exporter to the European scrap market.
- There are two integrated steelworks in Austria: one in Leoben and one in Linz. Both are operated by Voestalpine. They have a hot metal capacity of 5.7 Mt and reported emissions of 11.6 Mt CO_2 in 2019.

Figure 42: Austria: Key trends in CO_2 emissions and crude steel production, 2005-2019



Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: EC n.d.,Worldsteel Association (2020).

Table 27: Key data on the iron and steelmaking sector in Austria in 2019

General information					
				2019	**% change compared to 2013**
Total CO_2 emissions in EU ETS in 2019 from iron and steelmaking[1] (share in total CO_2 emissions in EU ETS)				12 Mt CO_2 (41 %)	1 %
Total crude steel production in 2019 (share of EU-28)				7.4 Mt (5 %)	-7 %
Total CO_2 emissions from BF-BOF sites[2] (total CO_2 emissions from EAF sites)				12 Mt CO_2 (0.2 Mt CO_2)	1 %
Crude steel production of BF-BOF sites (crude steel production from EAF sites)				7 Mt (0.7 Mt)	-8 %
Estimated emission intensity of crude steel production from BF-BOF sites (relative to EU-28 average)				1.8 t CO_2/t crude steel (94 %)	10 %
Site-specific information of integrated sites for year 2019					
Main EUTL-ID	**Site name**	**Number of blast furnaces**	**Hot metal capacity Mt**	**CO_2 emissions Mt CO_2**	**% change in CO_2 emissions compared to 2013**
AT 16	Linz	3	4.3 Mt	8.8 Mt	2 %
AT 13	Leoben	2	1.4 Mt	2.9 Mt	-2 %

Notes:

[1] Activity codes 22 - 25; also including waste gas power plants from activity code 20.

[2] Installations belonging to one integrated site (including coking plants, sinter plants, blast furnaces, basic oxygen furnaces, coal and downstream processing plants and waste gas-fuelled power plants) were allocated manually. Emissions from waste gas power plants can also include co-firing with other fuels which adds uncertainty to the exact total emission levels For a broad discussion of uncertainties, see section 2.3.1. Respective sources are provided in the facility level desciption.

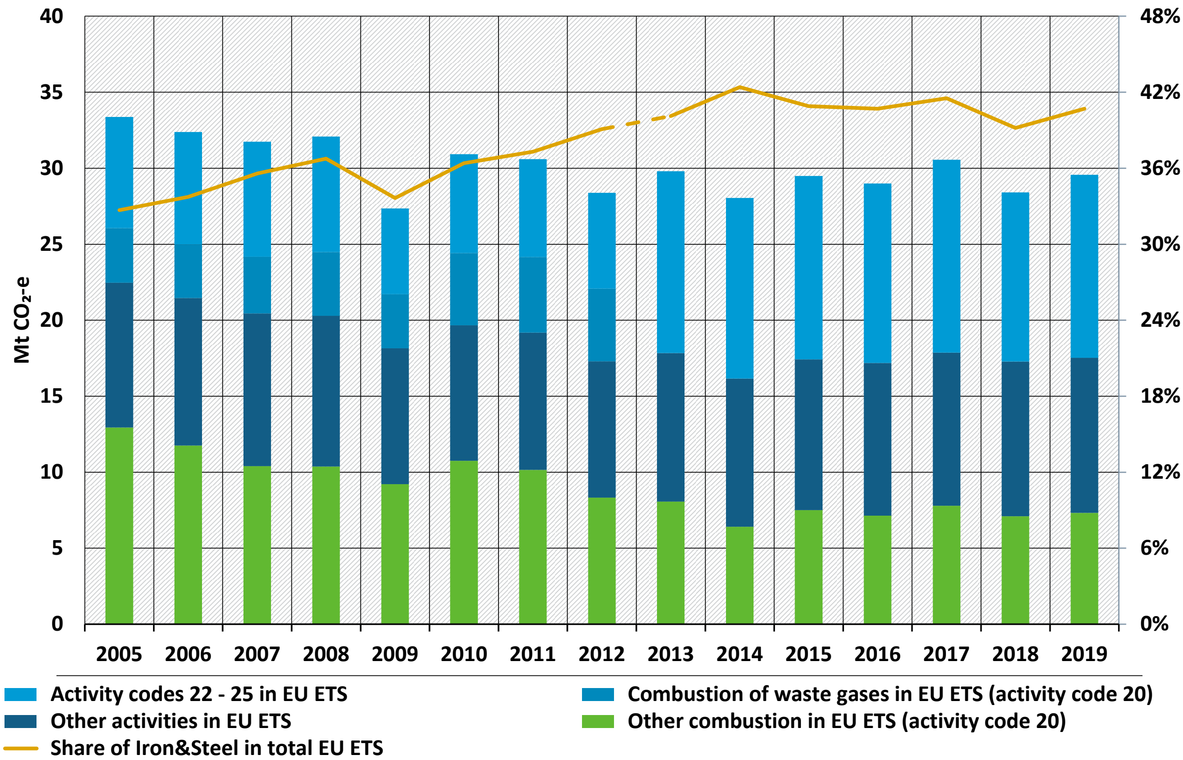
Source: Own table based on EC n.d.,Worldsteel Association (2020), EUROFER (2020) and EUROSIDER (2019).

7.2 Short description of the sector in the context of the country's economic and GHG pollution

Iron and steel production is an important industrial sector in Austria: it accounts for 4 – 5 % of gross value added (GVA) of the entire manufacturing sector. This is twice as high as in other European countries such as France or Germany. As shown in Figure 70, the share of manufacturing GVA in total GVA in Austria has been stable between 2010 and 2017.[25] The same is true for the share of steelmaking GVA in manufacturing GVA. As Figure 70 also shows, employment in the steel sector was more or less stable, amounting to 13 - 14,000 workers during that period.

7.2.1 Emission trends

Figure 43: Austria: Emission trends in stationary EU ETS



Note: Emissions from power plants that use waste gases from iron and steel making as fuel are attributed to the iron and steelmaking sector instead of the combustion sector. Since 2013, these emissions have not been reported seperately in Austria, but as part of the emissions of the integrated steelworks.
Source: EC n.d..

Compared to other countries evaluated in this report, Austria's iron and steelmaking industry has a significantly larger weighting when its share in the country's total emissions is examined (15 % in 2019, see Table 2). The share of the iron and steelmaking sector in Austria's EU ETS emissions has increased since 2005 and been stable at around 40 – 41 % since 2014. This increase can be understood on the grounds of a decrease in emissions attributable to other installations covered by the EU ETS (especially electricity generation). The total emissions from the iron and steelmaking sector were also very stable at 11 – 12 Mt CO_2. The emissions trend is

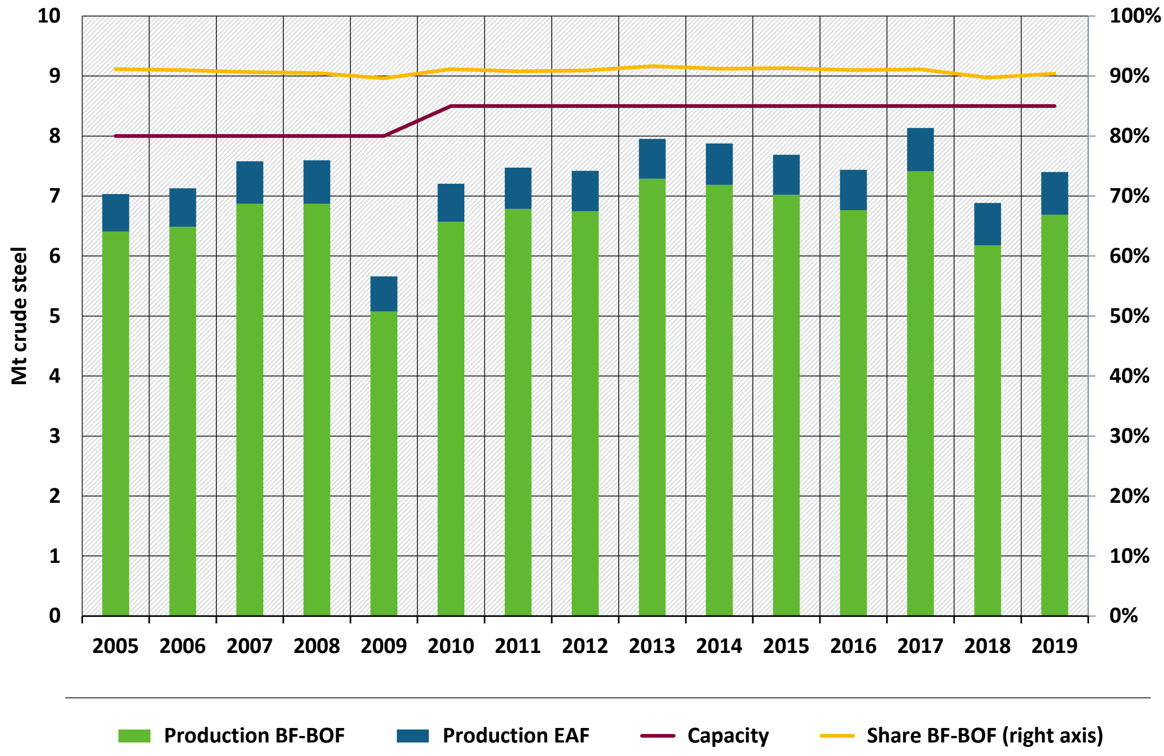
[25]There is no data available for prior years from the same sources.

dominated by production on the BF-BOF route which has high utilization rates and shows a low emission intensity of 1.75 Mt CO_2 per ton of crude steel.

The small decrease in 2018 can be explained by the relining of two important blast furnaces, one in Leoben and one in Linz, and the respective cuts in production (Voestalpine 2018). In 2019, the iron and steel industry emitted 12 Mt CO_2. In the first and second trading period of the EU ETS, waste gas power plants in Austria reported their emissions as separate installations under activity code 20. Since 2013, their emissions are reported under activity code 24 as part of the respective integrated steelworks.

7.2.2 Trends in production, capacity and trade

Figure 44: Austrian iron and steel industry: Trends in production and capacity



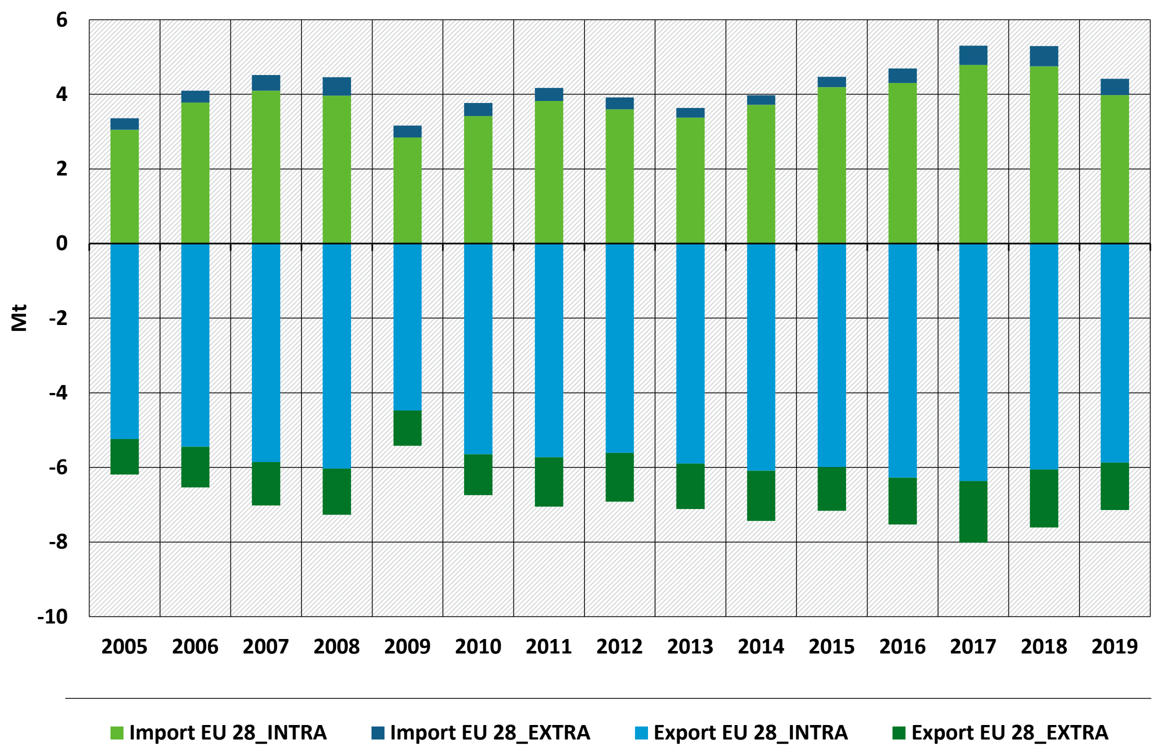
Note: The increase in production capacity between 2009 and 2010 already occurred in the period 2006 and 2007, when blast furnace 6 in Linz was added (see 7.3 for more details).
Source: Worldsteel Association (2020), OECD 2020 Steelmaking Capacity Database.

Austria produced 7.4 Mt of crude steel t in 2019, which comprised approx. 5 % of EU-28's production. Austria has a high share of production on the BF-BOF route at 90 %, which has remained unchanged since 2005. Accordingly, the EAF production share is 10 %, which is substantially below the average of the EU-28 (41 %). The share is not likely to increase due to a new installation in Kapfenberg which only replaces the old EAF (Voestalpine 2017a). Like most other countries, Austria also saw a decline in production during the economic crisis; however, this decrease was less pronounced in Austria and immediately returned to pre-crisis levels. Moreover, it reached even higher production levels than before (2018 brought a record production of 8.1 Mt and a utilization rate as high as 96 %).

Iron and steelmaking on the EAF route partly depends on the availability of steel scrap. It is an internationally traded commodity but also a resource that is domestically available in all EU-28 countries. Figure 78 in the Appendix shows the domestic steel scrap quantity and the scrap import and export balance. The majority of the domestic steel scrap is consumed domestically (about 2.5 Mt of scrap annually). Austria has consistently been an exporter of steel scrap since 2010, with annual exports of around 1 Mt. No data is available for prior years. The share of net-exports from domestic volumes amounted to approx. 24 % in recent years.

Austria is a net exporter of basic and semi-finished iron and steel products, with annual volumes amounting to around 2 Mt of products. The 2008 economic crisis only had a minor impact on steel trade in Austria. As a landlocked country in central Europe, both imports and exports are dominated by intra-EU trade. In 2019, Austria exported 7.1 Mt of basic and semi-finished iron and steel products. The US is the only non-European country among the top 10 importers of Austrian steel; Germany's share amounted to as much as 31 %, followed by Italy (12 %) and the Czech Republic (6 %). Germany and Italy are also the most important exporters to Austria, with 49 % of Austrian imports in 2019 coming from those countries.

Figure 45: Austrian trade balance: imports and exports of basic and semi-finished iron and steel products to/from Austria

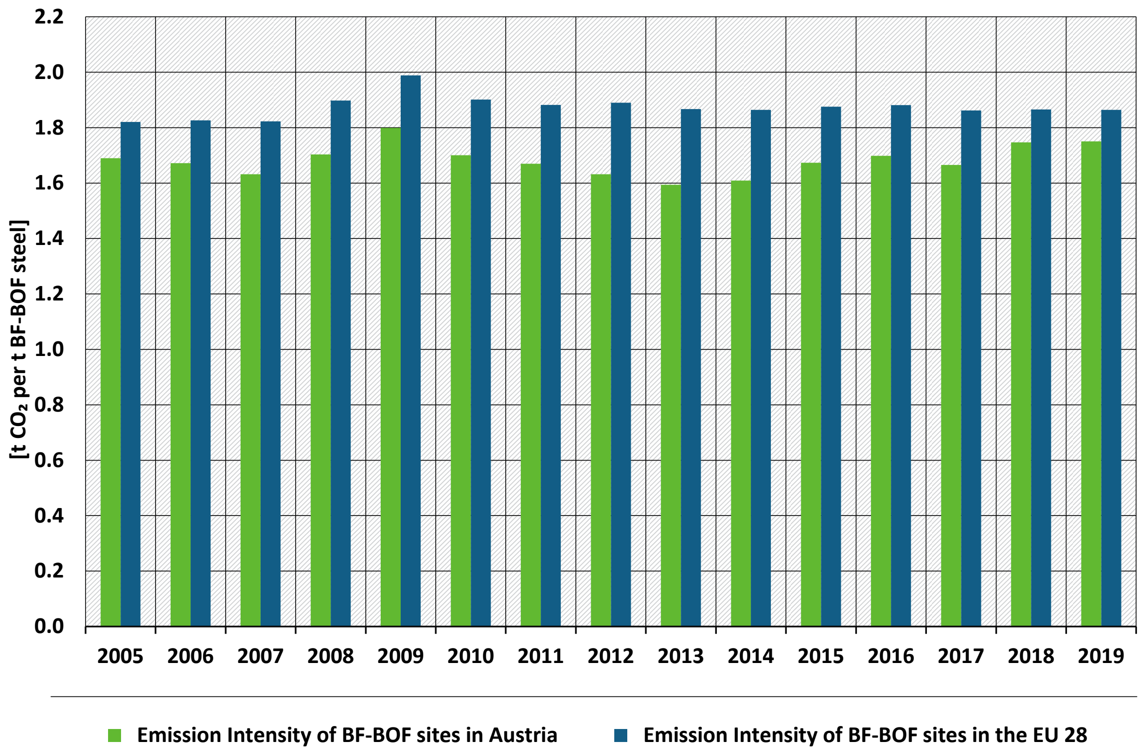


Source: Eurostat (2020b).

7.2.3 Trends in emission intensity on the BF-BOF route

The emission intensity is derived in a bottom-up calculation by dividing the total emissions related to integrated BF-BOF sites (including emissions from coking plants, sintering plants, blast furnaces, basic oxygen furnaces and waste gas power plants) by the total production of steel in BOFs.

Figure 46: Austrian BF-BOF route: Development of specific emission indicators

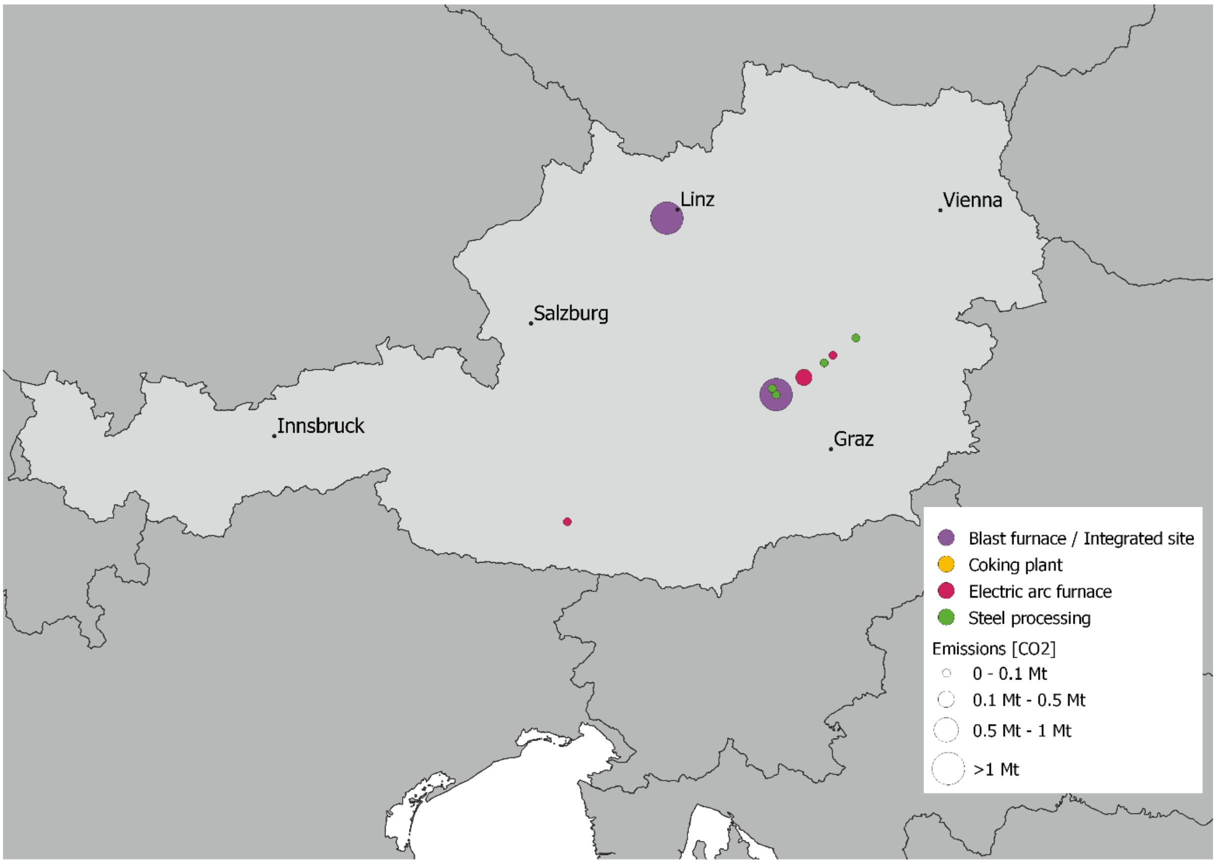


Note: Emission values also include emissions from power plants that use waste gases from iron and steel making as fuel.
Source: Data for Austria based on based on Table 29, data for EU-28 based on Table 4.

For the year 2019, Austria has the lowest specific emission factor of all the countries covered in this report, with 1.75 t CO_2 per ton of production in the BF-BOF route compared to the European average of 1.86 t CO_2 and a stable gap between its values and the average. However, in recent years specific emissions have increased from a low of 1.6 t CO_2 in 2013. The significant increase in the emission intensity can be attributed to pulverized coal injection into the blast furnaces at the Linz site, which replaced heavy oil, crude tar, coke oven gas, waste plastics, and natural gas (Rummer et al. 2017).

7.3 Facility level description

Figure 47: Austria: Location map of major CO_2 emission sources from the iron and steelmaking sector verified emissions in 2019



Note:
[1]The illustration is based on emissions reporting under the EU ETS. While the EU ETS has activity codes specifying the main activity of an installation, the codes are not a fully reliable indicator in terms of the installation's function in the steelmaking process. The practice of grouping different facilities under one installation ID and the allocation of emissions between different installations at one integrated site diverge for different sites. Detailed information on the functions and facilities present at individual site is given in this section, below.
[2]Waste gas power plants listed as separate installations in the EU ETS are not displayed here but in Figure 10 (lower-left panel), due to overlap with blast furnace / integrated sites.
Source: Own illustration based on EC n.d..

Figure 47 shows the location of sites listed under the EUTL activity codes 22-25. The map indicates the location of the facility and the facility purpose and differentiates between EAF sites, BF-BOF sites and coking plants and other types of facilities (e.g. rolling mills and foundries) involved in the iron and steelmaking process. It also ranks the facility emissions into bins: below 0.1 Mt CO_2, 0.1 Mt CO_2 to 0.5 Mt CO_2, 0.5 Mt CO_2 to 1 Mt CO_2 and facilities emitting more than 1 Mt CO_2 per year.

Since the BF-BOF route dominates the development of emissions of the iron and steelmaking sector, the following section provides a detailed facility level description of installations on this route and their emission trends. The steps taken to match emissions to integrated steelworks and associated sources of uncertainty regarding the completeness and correct assignment are discussed in detail in section 2.3. Austria has two integrated steelworks (see Table 28): a large one located at the Danube in Linz, in the north of the country and a smaller site in Leoben, often times referred to as Donawitz (the district of Leoben where the steelworks is located), north-east of Graz. The site in Linz comprises a coking plant, a sintering unit, three blast furnaces (a large own and two smaller ones), three corresponding basic oxygen furnaces, a waste gas power plant as well as further processing facilities such as hot rolling and casting. The furnaces have been recently relined. Together, they have a hot metal capacity of 4.4 Mt and a finished steel capacity of 6 Mt. This constitutes the final stage of modernization at the site. The 3rd blast furnace at the site began operation in 2007 increasing finished steel capacity by about 0.6 Mt per year (Voestalpine 2022b). The site in Leoben comprises a sintering unit, two smaller blast furnaces, the respective basic oxygen furnaces as well as a waste gas power plant and further steel processing units, including a rail rolling mill. The furnaces have been recently relined. Together, they have a hot metal capacity of 1.4 Mt and a finished steel capacity of 1.6 Mt.

Table 28: Austria: Overview of integrated sites for primary iron and steel production (BOF)

EUTL ID	EUTL activity code	Company	City	Hot metal capacity (Mt)	Finished steel capacity (Mt)	No. of furnaces
AT 16	24	Voestalpine Stahl GmbH	Linz	4.4	6	3
AT 13	24	Voestalpine Stahl GmbH	Leoben	1.4	1.6	2

Source: EC n.d., EUROFER (2020)

Table 29 reports the development of emissions at the two integrated sites. Until 2013, emissions were reported separately for the different units and processes in the integrated steelworks, since then they are all reported under the codes of the BF-BOFs. Until 2015, specific emissions were on a declining trend. Since then, they have increased again due to higher shares of pulverized coal injection (Rummer et al. 2017), which has overcompensated the effect of recent relinings.

Table 29: Austria: Emissions of integrated sites for primary iron and steel production (BOF)

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
Integrated Steelworks Linz					**8.1**	**8.6**	**8.7**	**8.8**
AT 14	22	Coking plant	Voestalpine	Linz	1.4	0.9	0.0	0.0
AT 16	24	BF-BOF	Voestalpine	Linz	4.1	3.5	8.7	8.8
AT 208	24	BF-BOF	Voestalpine	Linz	0.0	0.6	0.0	0.0
AT 231	20	Other	Voestalpine	Linz	0.0	0.5	0.0	0.0
AT 15	20	Power plant	Voestalpine	Linz	2.7	3.2	0.0	0.0
Integrated Steelworks Loeben					**2.7**	**2.5**	**3.0**	**2.9**
AT 13	24	BF-BOF	Voestalpine	Leoben	1.8	1.5	3.0	2.8
AT 209	24	Coal Injection	Voestalpine	Leoben	0.0	0.01	0.0	0.0
AT 201690	25	Other	Voestalpine	Leoben	0.0	0.0	0.1	0.0
AT 12	20	Power plant	Voestalpine	Leoben	0.9	1.1	0.0	0.0
Total of BF-BOF sites					**10.8**	**11.2**	**11.7**	**11.7**
Total iron and steel in Austria					**10.9**	**11.3**	**12.1**	**12.0**
Total production of crude steel (BF-BOF route in Mt)					**6.4**	**6.6**	**7.0**	**6.7**
Emission intensity of BF-BOF sites (t CO_2 per t crude steel)					1.69	1.70	1.67	1.75

Source: EC n.d., Worldsteel Association (2020).

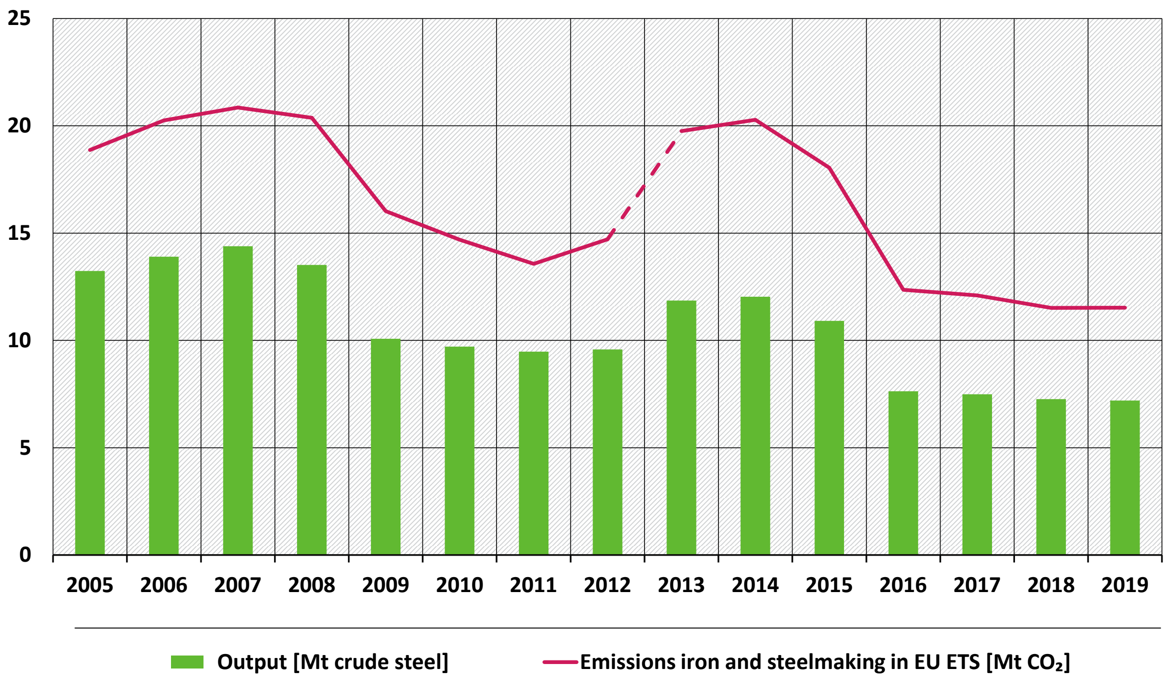
Austria has three EAF sites with a total finished steel capacity of 0.8 Mt. The site in Kapfenberg is owned by Voestalpine; a new facility is planned on the same site with a similar capacity by the end of 2025.

8 Country fact sheet: United Kingdom

8.1 Key messages

- United Kingdom has the 7th highest CO_2 emissions from iron and steelmaking in the EU ETS (12 Mt CO_2 in 2019, see Table 30), comprising 6 % of total EU-28 emissions of the sector.
- In 2019, it had the 8th highest crude steel production in the EU-28, contributing about 5 %. The EAF production share was about 21 %, which was far below the average of the EU-28 (41 %); accordingly, UK is an exporter of steel scrap, mainly catering to the international market.
- Since 2005 production dropped from a high in 2007 (14.4 Mt) to a low of 9.6 Mt in 2012. UK steel industry did not recover from the financial crisis; a steel crisis followed in 2015. In 2019 total crude steel production amounted to only 7.2 Mt. Emissions follow the production levels, which are dominated by the BF-BOF route.
- In 2019, the United Kingdom had two integrated steelworks: one in Wales at Port Talbot, east of Cardiff, owned by Tata Steel and one in northern England, south of Hull, owned by British Steel (the Scunthorpe plant also belonged to Tata Steel until 2016). A third integrated steelworks in Teesside, has been permanently closed since its owner, Sahaviriya Steel Industries (SSI), was declared insolvent at the end of 2015. In the aftermath of the economic crisis in 2008, it was mothballed once by its former owner, Tata Steel. 30 % of emissions on the BF-BOF route originated from the Teesside site in 2013.

Figure 48: United Kingdom: Key trends in CO_2 emissions and crude steel production, 2005-2019



Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed; therefore, values from before 2013 and after are not comparible due to a difference in scope.
Source: EC n.d.,Worldsteel Association (2020)

Table 30: Key data on the iron and steelmaking sector in the United Kingdom in 2019

General information		
	2019	**% change compared to 2013**
Total CO_2 emissions in EU ETS in 2019 from iron and steelmaking[1] (share in total CO_2 emissions in EU ETS)	12 Mt CO_2 (10 %)	-42 %
Total crude steel production in 2019 (share of EU-28)	7.2 Mt (5 %)	-39 %
Total CO_2 emissions from BF-BOF sites[2] (total CO_2 emissions from EAF sites)	11 Mt CO_2 (0.2 Mt CO_2)	-42 %
Crude steel production of BF-BOF sites (crude steel production from EAF sites)	6 Mt (1.5 Mt)	-43 %
Estimated emission intensity of crude steel production from BF-BOF sites (relative to EU-28 average)	1.9 t CO_2/t crude steel (105 %)	1 %

Site-specific information of integrated sites for year 2019

Main EUTL-ID	**Site name**	**Number of blast furnaces**	**Hot metal capacity Mt**	**CO_2 emissions Mt CO_2**	**% change in CO_2 emissions compared to 2013**
GB 325	Port Talbot	2	4.8 Mt	6.5 Mt	-16 %
GB 321	Scunthorpe	3	3.6 Mt	4.5 Mt	-18 %

Notes:

[1] Activity codes 22 - 25; also including waste gas power plants from activity code 20.

[2] Installations belonging to one integrated site (including coking plants, sinter plants, blast furnaces, basic oxygen furnaces, coal and downstream processing plants and waste gas-fuelled power plants) were allocated manually. Emissions from waste gas power plants can also include co-firing with other fuels, which adds uncertainty to the exact total emission levels. For a broad discussion of uncertainties, see section 2.3.1. The respective sources are provided in the details of the facility level description.

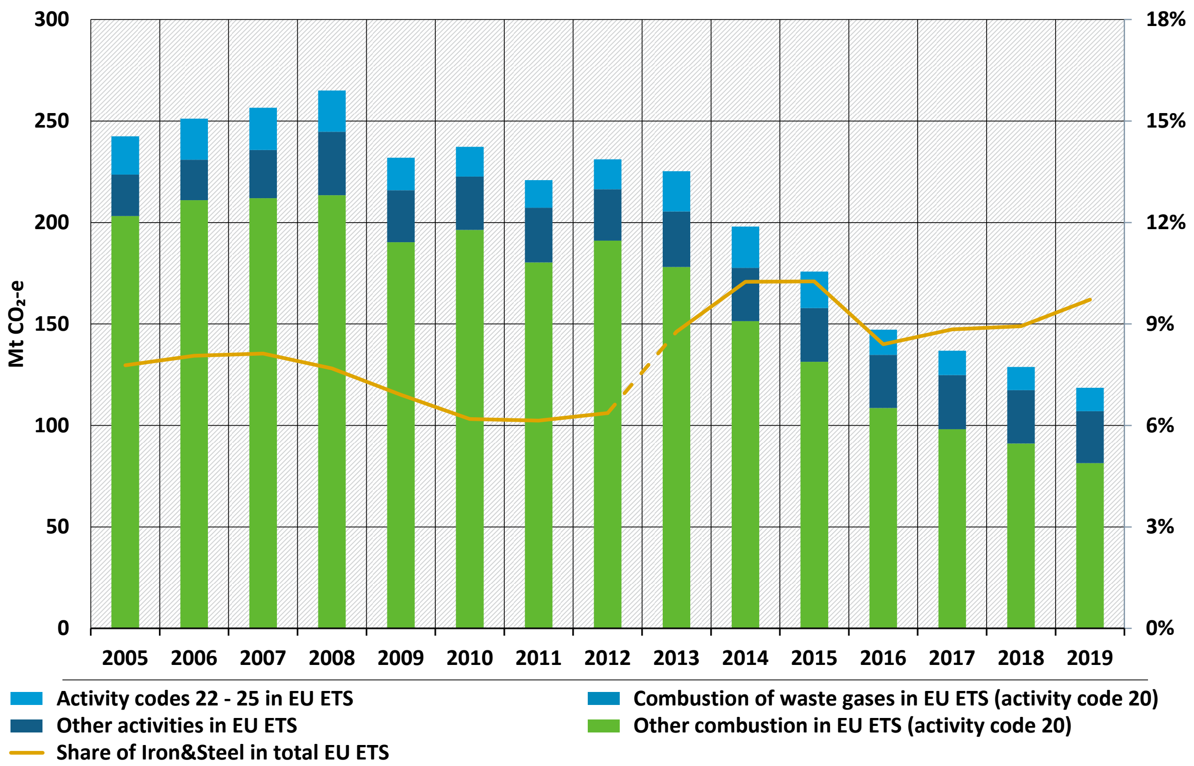
Source: Own table based on EC n.d., EUROFER (2020), Worldsteel Association (2020).

8.2 Short description of the sector in the context of the country's economic and GHG pollution

Iron and steel production is not a very important industrial sector in the United Kingdom: it accounts for 1 % of gross value added (GVA) of the entire manufacturing sector. As shown in Figure 71 the share of manufacturing GVA in total GVA in the United Kingdom has been stable between 2010 and 2017.[26] The same is true for the share of steel making GVA in manufacturing. As also shown in Figure 71, following the economic downturn and subsequent further decline of the industry in the UK, employment in the steel sector saw a strong decline from 23,000 workers in 2008 to 13,000 workers in 2015. Since then, the number of workers directly employed in the industry has recovered somewhat and amounted to about 16,000 workers in 2017.

8.2.1 Emission trends

Figure 49: United Kingdom: Emission trends in stationary EU ETS



Note: In the United Kingdom, emissions from waste gas power plants are reported as part of the emissions of integrated steelworks under the EU ETS, hence emissions from waste gas power plant reporting under code 20 are zero.
Source: EC n.d..

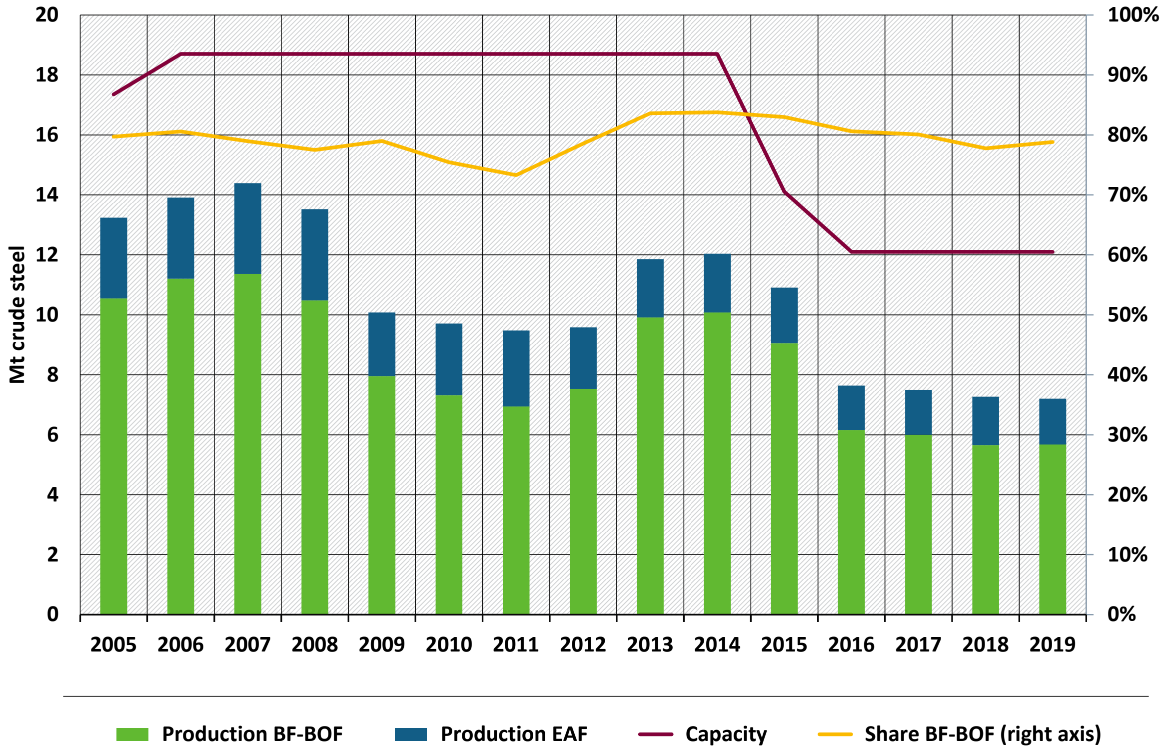
In the UK, emissions in the EU ETS have decreased substantially since 2005. Emissions from combustion (excluding waste gases) have dropped by 60 % since 2005. This is due to a strong reduction in coal-fired generation. In parallel, emissions from the British iron and steelmaking sector are dominated by trends in production on the BF-BOF route. They have an irregular development over the last years, which follows the ups and downs in total production and the mothballing, reopening and final closure of the integrated steelworks in Teesside (see section 8.3 for further details). Before the financial crisis in 2009, the British iron and steelmaking sector used to emit around 20 Mt CO_2 yearly. In 2019, the sector emitted 11.5 Mt CO_2. This

[26] There is no data available for prior years from the same sources.

comprises 10 % of the total EU ETS emissions in the UK. The iron and steelmaking sector produced only 2.5 % of total UK emissions in 2018.

8.2.2 Trends in production, capacity and trade

Figure 50: British iron and steelmaking industry: Trends in production and capacity



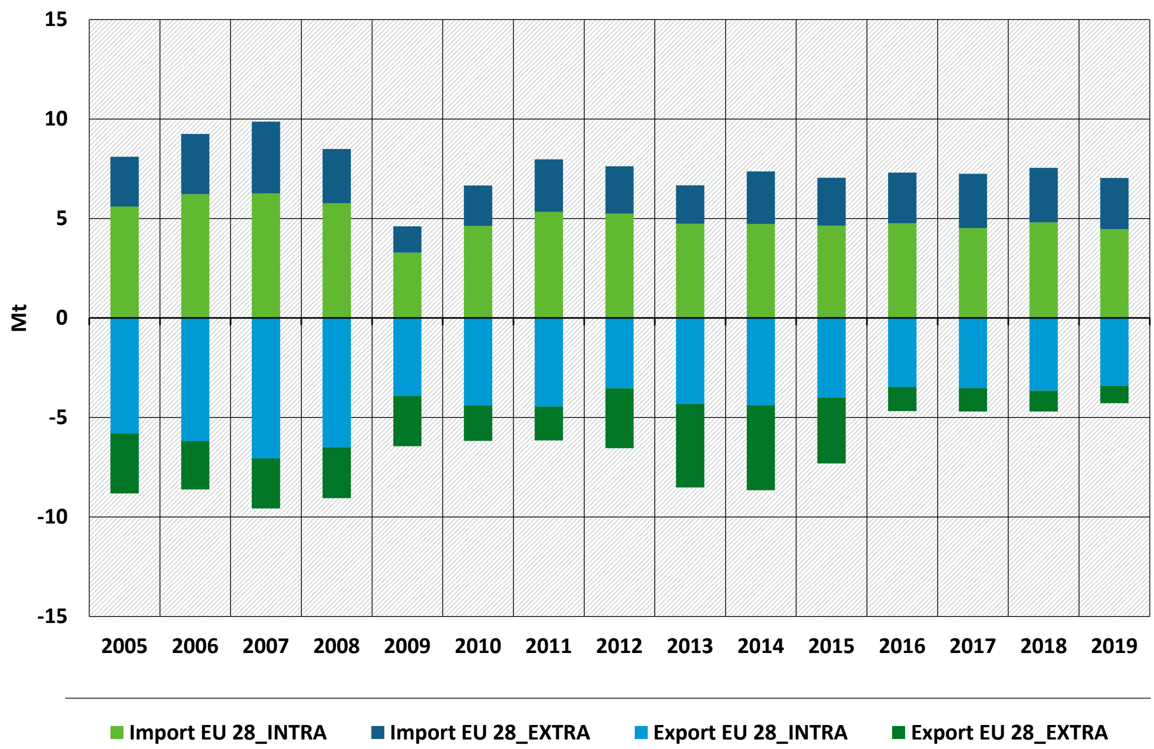
Source: Worldsteel Association (2020), OECD 2020 Steelmaking Capacity Database.

Compared to other EU Member States, the UK saw a much more difficult recovery in this sector after the 2009 economic crisis. In 2015, the industry in the UK faced a steel crisis resulting from a combination of strong supply on the international market that had pushed prices down and high domestic overhead costs combined with a strong pound (Hutton et al. 2021). The reduction in capacity in 2015 is driven by the closure of the integrated steelworks in Teesside. In 2019, total crude steel production reached 7.2 Mt. Around 20 % was produced in EAFs. Noteworthy is also the low utilization rate, even after facility closure, which corresponded to approx. 60 %. However, the trend in emission intensity on the BF-BOF route suggests that capacity utilization was high before 2008 and was reduced afterwards. The trend is confirmed by the OECD data but the level seems to include fully idle capacities.

Iron and steelmaking on the EAF route partly depends on the availability of steel scrap. It is an internationally traded commodity but also a resource that is domestically available in all EU-28 countries. Figure 79 in the Appendix shows the domestic steel scrap quantity and the scrap import and export balance. The United Kingdom has consistently been an exporter of steel scrap since 2010. No data is available for prior years. The majority of the domestic steel scrap volumes (about 11 Mt annually) are exported to the international market with annual volumes of 5 – 7 Mt annually. The supply to the European market is much smaller with volumes of around 2 Mt annually.

The economic crisis left a clear mark on the UK steel trade. Compared to other countries, which were somewhat developing an ascendant trend when the crisis struck, UK imports were consistently high before 2009 and never again reached that level. In parallel, UK exports were also developing well before 2009 and peaked again in 2014; it has repeatedly reached all-time lows since 2016. This latter peak is due to a sharp increase, and then an even sharper decrease, in exports to extra-EU countries. The top importers of UK basic and semi-finished iron and steel products in 2014 were the United States, Turkey and Thailand, which accounted for 84 % of exports, whereas in 2019 the United States accounted for 2 % and Turkey for 6 % of UK exports. In 2019, the UK imported 7 Mt basic and semi-finished iron and steel products, mostly from EU Member States (Belgium, Spain, Germany, the Netherlands and France account for 51 % of imports). Compared to the imports, total exports were 40 % lower (4.3 Mt); they went predominantly to the EU (France, Ireland, the Netherlands, Germany and Spain were the most important importers of British steel, together comprising 51 %).

Figure 51: British trade balance: imports and exports of basic and semi-finished iron and steel products to/from the United Kingdom

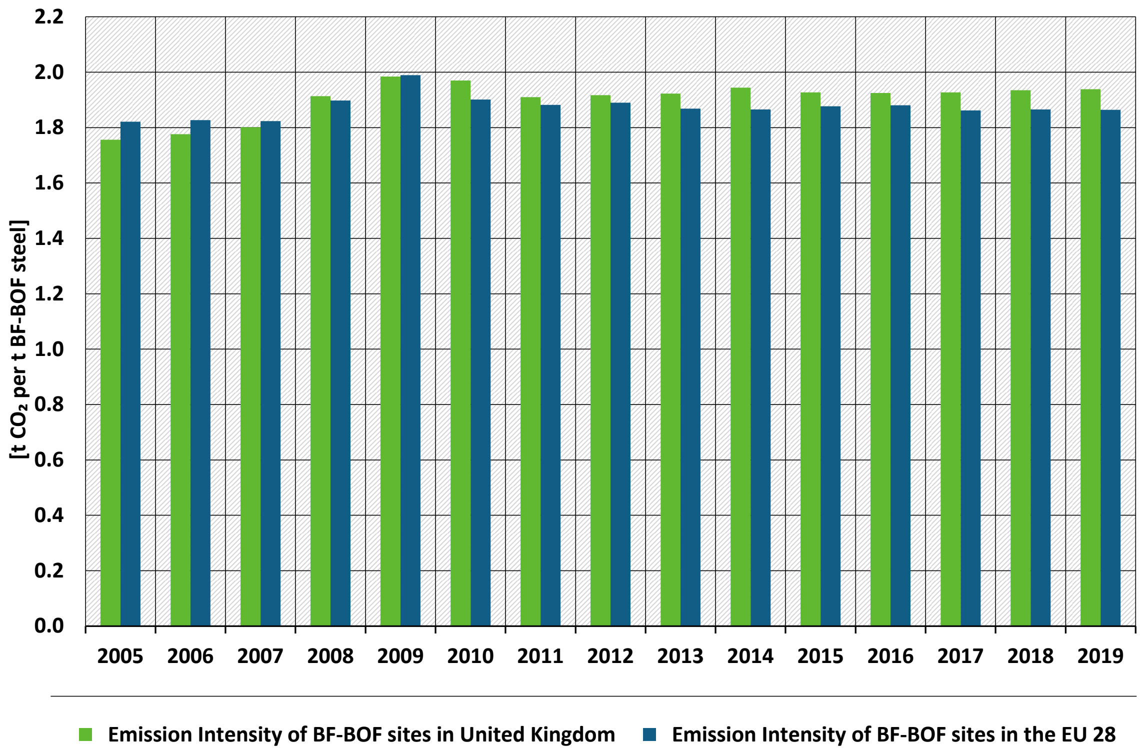


Source: Eurostat (2020b).

8.2.3 Trends in emission intensity on the BF-BOF route

The emission intensity is derived in a bottom-up calculation by dividing the total emissions related to integrated BF-BOF sites (including emissions from coking plants, sintering plants, blast furnaces, basic oxygen furnaces and waste gas power plants) by the total production of steel in BOFs.

Figure 52: British BF-BOF route: Development of specific emission indicators

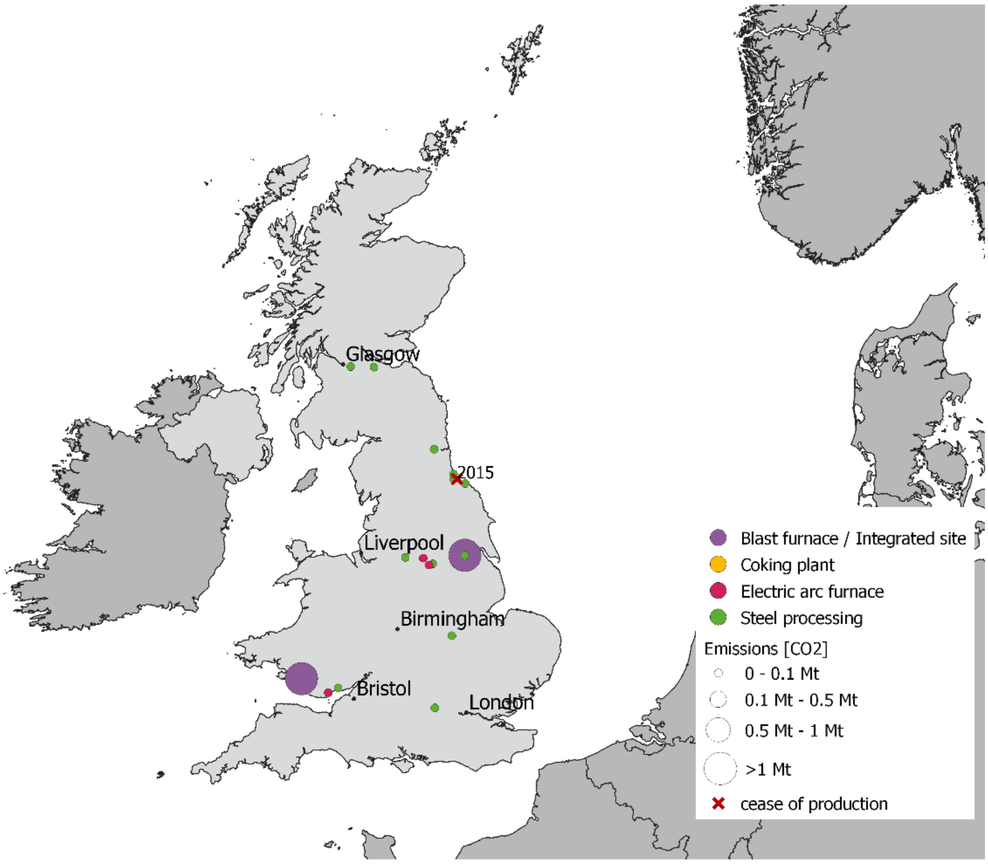


Note: Emission values also include emissions from power plants that use waste gases from iron and steel making as fuel.
Source: Data for UK based on Table 32, data for EU-28 based on Table 4.

UK-specific emissions of steel production on the BF-BOF route are very close to the EU average. However, since 2010 there has been a consistently rising gap with higher-than-average emissions in the UK though there is just a 4 % difference. In 2019, the UK emissions intensity on the BF-BOF route was 1.94 t CO_2 per ton of crude steel. In the UK, integrated steelworks typically report their emissions as one installation. While the EU-28 average has been declining, specific emissions have remained unchanged in the UK since 2016.

8.3 Facility level description

Figure 53: United Kingdom: Location map of major CO_2 emission sources from the iron and steelmaking sector verified emissions in 2019



Note:

[1] The illustration is based on emissions reporting under the EU ETS. While the EU ETS has activity codes specifying the main activity of an installation, the codes are not a fully reliable indicator in terms of the installation's function in the steelmaking process. The practice of grouping different facilities under one installation ID and the allocation of emissions between different installations at one integrated site diverge for different sites. Detailed information on the functions and facilities present at individual site is given below in this section.

[2] Waste gas power plants listed as separate installations in the EU ETS are not shown here but in Figure 10 (lower-left panel), due to the overlap with blast furnace / integrated sites.

Source: Own illustration based on EC n.d..

Figure 53 shows the location of sites listed under the EUTL activity codes 22 - 25. The map indicates the location of the facility and the facility purpose and differentiates between EAF sites, BF-BOF sites and coking plants and other types of facilities (e.g. rolling mills and foundries) involved in the iron and steel making process. It also ranks the facility emissions into bins: below 0.1 Mt CO_2, 0.1 Mt CO_2 to 0.5 Mt CO_2, 0.5 Mt CO_2 to 1 Mt CO_2 and facilities emitting more than 1 Mt CO_2 per year. Moreover, it shows the location and year of closures for BF and BOF, which were shut down in recent years.

Since the BF-BOF route dominates the development of emissions of the iron and steelmaking sector, the following section provides a detailed facility level description of installations on this route and their emission trends. The steps taken to match emissions to integrated steelworks and associated sources of uncertainty regarding the completeness and correct assignment are discussed in detail in section 2.3. The UK has two active integrated steel plants. One is owned by

Tata Steel (the Port Talbot plant in Wales, east of Cardiff) and one is owned by British Steel (the Scunthorpe plant in northern England, south of Hull, which also belonged to Tata Steel until 2016). The third integrated steelworks in Teesside has been permanently closed since the end of 2015; it had also been mothballed in the aftermath of the economic crisis in 2008 by its former owner Tata Steel (Hutton et al. 2021). The 2015 crisis in the UK steel industry resulted from a combination of strong supply on the international market that had pushed prices down and high domestic overhead costs combined with a strong pound. As a result, Sahaviriya Steel Industries (SSI) closed its plant in Redcar, Teesside in September 2015; Tata Steel reduced its capacity at the Port Talbot plant in South Wales through late 2015 and early 2016 and sold its Scunthorpe plant to British Steel in April 2016. With continuing financial problems, the insolvency of British Steel in 2019 and its subsequent acquisition by the Chinese firm Jingye, it can also be seen as part of the continuing crisis in the UK steel industry. The Teesside Beams Mill and some support services now owned by British Steel still operate at the Lackenby part of the site. Their feedstock is transported by rail from the Scunthorpe integrated steelworks (British Steel 2018).

The steel industry is also part of the UK government's industrial decarbonisation strategy, which plans to support the industry's transition via an Industrial Energy Transformation Fund and a Clean Steel Fund (Hutton et al. 2021; Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy 2021; 2019; Department for Business, Energy & Industrial Strategy 2019).

Table 31: United Kingdom: Overview of integrated sites for primary iron and steel production (BF-BOF)

EUTL ID	EUTL activity code	Company	City	Operating status	Hot metal capacity (Mt)	Finished steel capacity (Mt)	No. of furnaces
GB 325	24	Tata Steel	Port Talbot (Rotherham)	Active	4.77	4.9	2
GB 321	22	British Steel	Scunthrope	Active	3.59	3.2	3
GB 1263 GB 330	24 25	Sahaviriya Steel (SSI) Tata Steel	Teesside Middlesbrough	Closed	N/A	N/A	N/A

Notes: Rotherham is the place of business of Tata Steel in the UK. However, it is not the location of the integrated steelworks, which is in Port Talbot. The installations GB 1263 and GB 330 are both located in the Teesside steelmaking and industrial complex. The entire site was initially owned by Tata Steel and emissions were reported under GB 330. When the business was split in 2010, the downstream processing remained under this ID and the integrated steelworks began reporting under GB 1263.
Source: EC n.d., EUROFER (2020).

Table 32 shows the emissions of the integrated steelworks in the UK. The table shows the fluctuating emissions of the decommissioned Teesside plant. It should be noted that the Teesside integrated steelworks reported emissions under ID 330 before the sales to SSI and the disintegration of the downstream hot rolling plant. After the sales, the Teesside Beams Mill reports under ID GB 330 and the integrated steelworks under ID GB 1263. As the Teesside Beams Mill is not part of an integrated steelworks and does not use its waste gases for energy supply, we correct the calculated emissions attributed to the BF-BOF route accordingly.

Table 32: United Kingdom: Emissions of integrated sites for primary iron and steel production (BOF)

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
Integrated steelworks at Port Talbot					**6.2**	**7.3**	**7.7**	**6.5**
GB 325	24	BF-BOF	Tata Steel	Port Talbot (Rotherham)	6.1	7.3	7.6	6.4
GB 326	24	Processing	Tata Steel	Rotherham	0.02	0.02	0.1	0.04
Integrated steelworks at Scunthorpe					**6.0**	**5.9**	**5.7**	**4.5**
GB 321	22	BF-BOF	British Steel	Scunthorpe	6.0	5.9	5.7	4.5
Integrated steelworks at Teesside					**6.4**	**5.9**	**4.1**	**-**
GB 330	25	BF-BOF /processing	British Steel	Middlesbrough	6.4	1.2	0.1	0.1
GB 1263	24	BF-BOF	Sahaviriya Steel Industries UK Ltd	Teesside	0.0	0.0	4.1	0.0
Correction for disintegration at Teesside steelworks							-0.1	-0.1
Total of BF-BOF sites					**18.5**	**14.4**	**17.4**	**11.0**
Total iron and steel in the UK					**18.9**	**14.7**	**18.0**	**11.5**
Total production of crude steel (BF-BOF route in Mt)					**10.5**	**7.3**	**9.1**	**5.7**
Emission intensity of BF-BOF sites (t CO_2 per t crude steel)					1.76	1.97	1.93	1.94

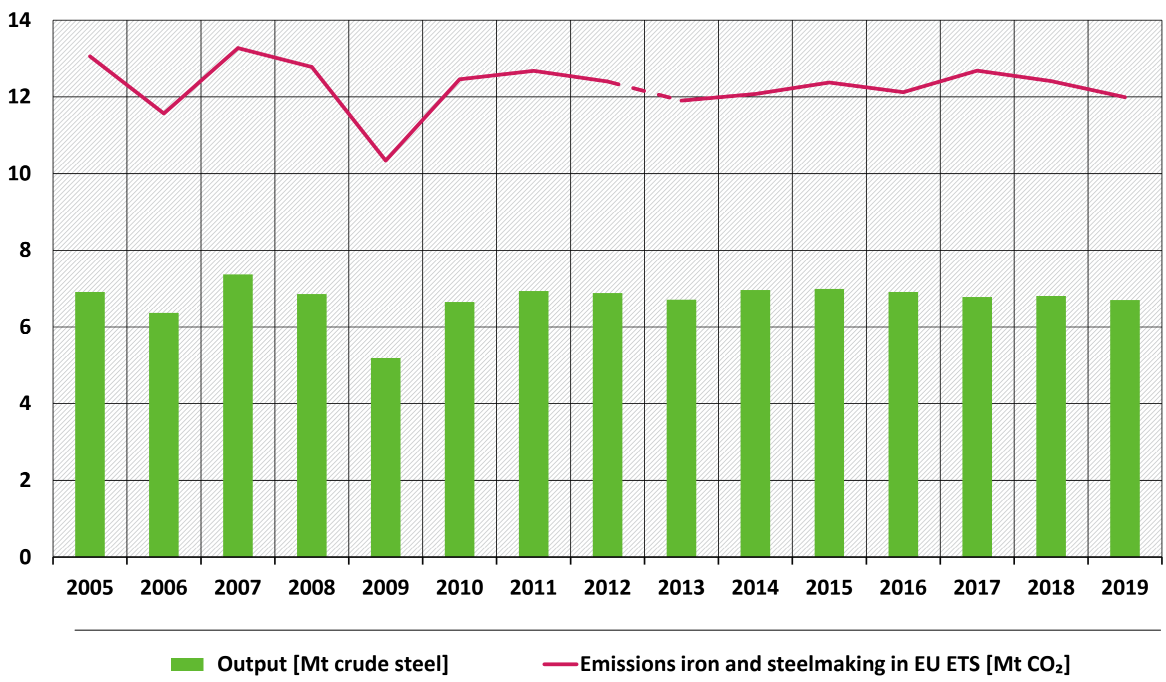
Source: EC n.d.,Worldsteel Association (2020)

9 Country fact sheet: Netherlands

9.1 Key messages

- The Netherlands has the 5th highest CO_2 emissions from iron and steelmaking in the EU ETS (12 Mt CO_2 in 2019, see Table 33) making up 6 % of total EU-28 emissions of the sector. The sector has a fluctuating share in total EU ETS emissions (13 – 16 % in 2005 - 2019) of the country, which is driven by changes in other sectors, most notably increasing coal-fired generation since 2013 and increasing co-firing of biomass since 2016.
- It is also the country with the 9th highest crude steel production in the EU-28, contributing about 4 %. Since 2005 iron and steel production has been very stable in the Netherlands. Except for 2009 the year of the financial crisis, it has been around 7 Mt crude steel per year. The emissions trend is dominated by production on the BF-BOF route which has high utilization rates and shows an emission intensity below the EU-28 average, with 1.79 t CO_2 per ton of crude steel.
- Production on the BF-BOF route comprises 98 % of total production since 2005. The last small EAF was closed by 2017; accordingly, the Netherlands is a significant exporter to EU and international scrap markets.
- The Netherlands hosts one integrated steelworks in Ijmuiden, close to Amsterdam. The site has two blast furnaces and a hot metal production capacity of 6.3 Mt per year.

Figure 54: The Netherlands: Key trends in CO_2 emissions and crude steel production, 2005 - 2019



Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: EC n.d.,Worldsteel Association (2020)

Table 33: The Netherlands: Key data on the iron and steelmaking sector in 2019

General information	2019	% change compared to 2013
Total CO_2 emissions in EU ETS in 2019 from iron and steelmaking[1] (share in total CO_2 emissions in EU ETS)	12 Mt CO_2 (14 %)	1 %
Total crude steel production in 2019 (share of EU-28)	6.7 Mt (4 %)	0 %
Total CO_2 emissions from BF-BOF sites[2] (total CO_2 emissions from EAF sites)	12 Mt CO_2 (0 Mt CO_2)	4 %
Crude steel production of BF-BOF sites (crude steel production from EAF sites)	7 Mt (0 Mt)	2 %
Estimated emission intensity of crude steel production from BF-BOF sites (relative to EU-28 average)	1.8 t CO_2/t crude steel (95 %)	0 %

Site-specific information of integrated sites for year 2019

Main EUTL-ID	Site name	Number of blast furnaces	Hot metal capacity Mt	CO_2 emissions Mt CO_2	% change in CO_2 emissions compared to 2013
NL 144	IJmuiden	2	6.3 Mt	12 Mt	6 %

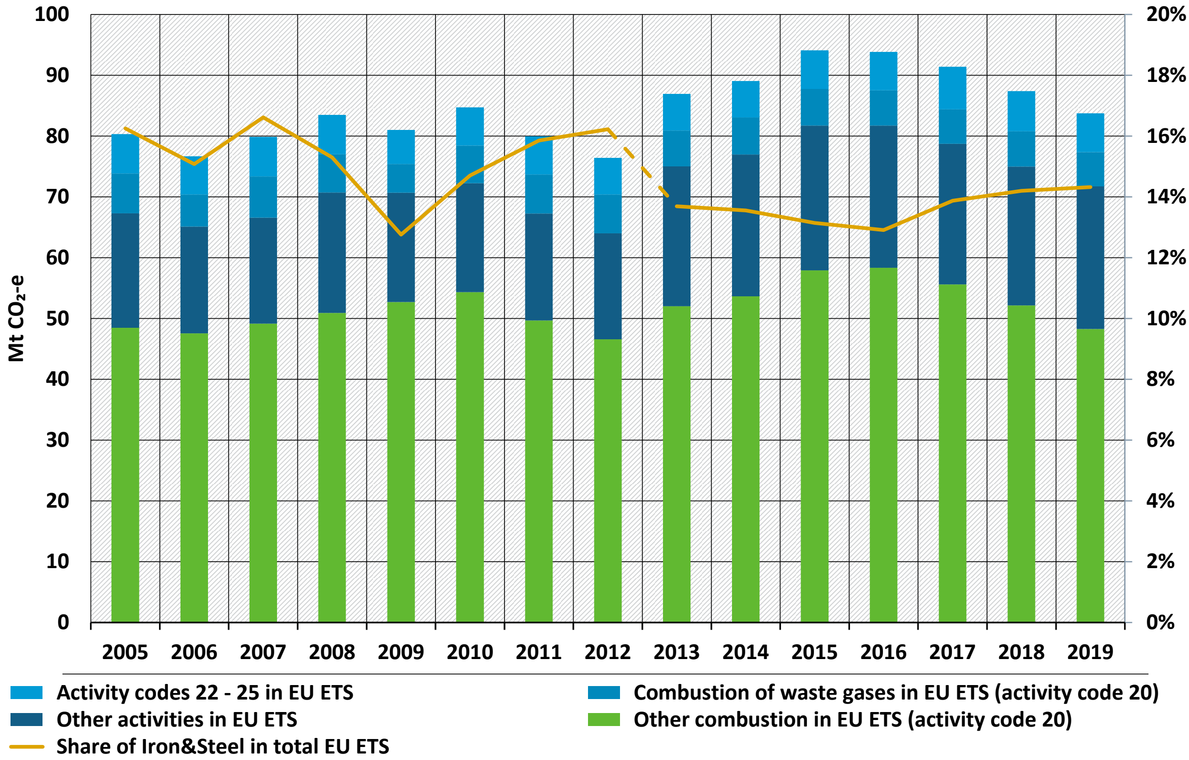
Notes:
[1] Activity codes 22 - 25; also including waste gas power plants from activity code 20.
[2] Installations belonging to one integrated site (including coking plants, sinter plants, blast furnaces, basic oxygen furnaces,coal and downstream processing plants and waste gas-fuelled power plants) were allocated manually. Emissions from waste gas power plants can also include co-firing with other fuels which adds uncertainty to the exact total emission levels. For a broad discussion of uncertainties see section 2.3.1. The respective sources are given in the details of the facility level description.
Source: own table based on EC n.d., EUROFER (2020), Worldsteel Association (2020)

9.2 Short description of the sector in the context of the country's economic and GHG pollution

Iron and steel production is not an important industrial sector in the Netherlands: it accounts for less than 1 % of the gross value added (GVA) of the entire manufacturing sector. As shown in Figure 72, the share of manufacturing GVA in total GVA in the Netherlands was stable between 2010 and 2017.[27] As also shown in Figure 72, employment in the steel sector saw a pronounced decline in the number of workers, from 23,000 workers in 2008 to 16,000 in 2017.

9.2.1 Emission trends

Figure 55: The Netherlands: Emission trends in stationary EU ETS



Note: Emissions from power plants that use waste gases from iron and steelmaking as fuel are attributed to the iron and steelmaking sector instead of the combustion sector.
Source: EC n.d..

The Dutch iron and steelmaking sector accounts for a share of about 14 % (2019) of stationary EU ETS emissions (Figure 55), equalling to 12 Mt of CO_2 emitted in 2019. The iron and steelmaking sector accounted for about 7 % of total Dutch emissions in 2018.

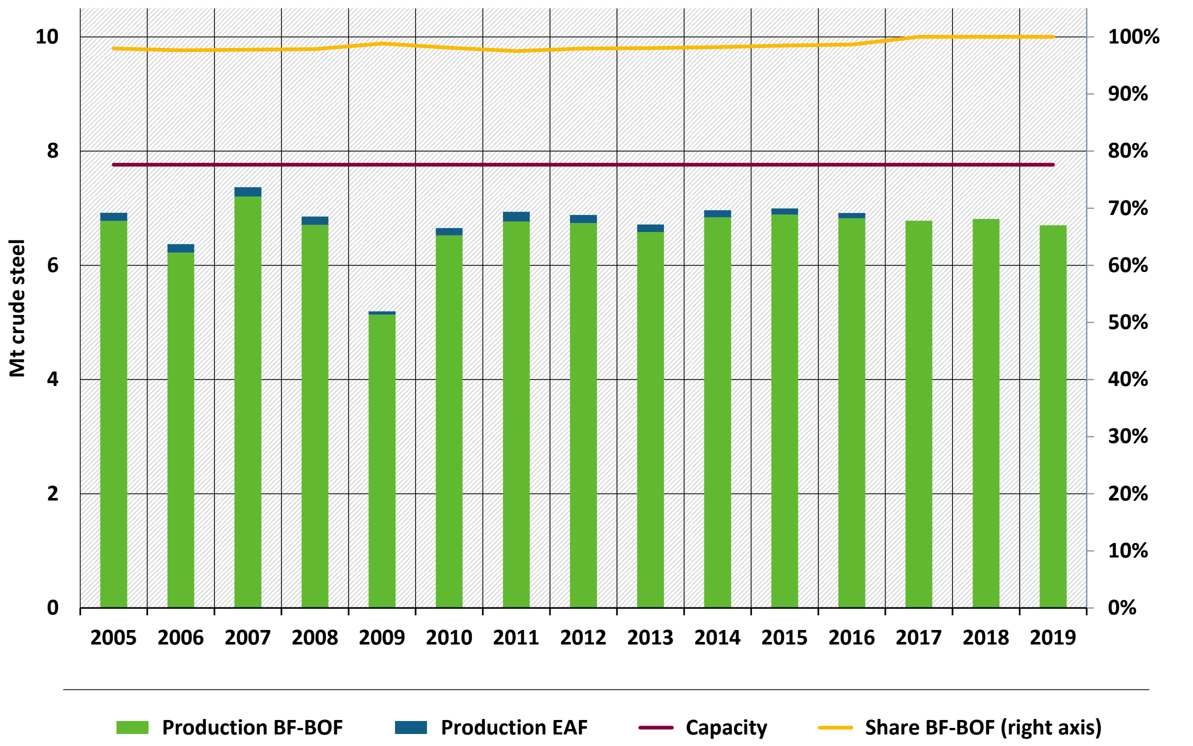
The decrease in the share of the iron and steelmaking sector compared to total stationary EU ETS emissions since 2013 and continuing until 2015 can be explained with a new built hard coal fired power plant (e.g. Maasvlakte 3), that increased emissions of stationary combustion installations. However, this trend peaked in 2015 - 2016 and is on a descendant slope, but still not reaching pre-2013 levels. Again, this trend is driven by the combustion sector, the emissions of which decreased due to biomass co-firing and increasing renewables shares; emission levels of 2005 and below were achieved. During the entire time period, emissions from the iron and

[27] There is no data available for prior years from the same sources. Note that data may include data gaps, e.g. due to confidentiality concerns due to the small number of businesses in the respective category.

steelmaking sector remained very stable at around 12 to 13 Mt CO_2 per year. They have been closely following the development in production on the BF-BOF route, which is the dominate route (98 % before 2017 and 100 % since then).

9.2.2 Trends in production, capacity and trade

Figure 56: Dutch iron and steel industry: Trends in production and capacity



Source: Worldsteel Association (2020), OECD 2020 Steelmaking Capacity Database.

The Netherlands ranks 9th on the EU market when considering the production of iron and steel; it accounts for 4 % of EU's production. As shown in Figure 56, production levels have been relatively stable in the last 15 years, except during the economic crisis; it reached approx. 7 Mt of crude steel yearly and a utilization rate of about 88 %. Compared to other Central and Western-European countries, the Netherlands is the only one to have 100 % production on the BF-BOF route, with the existing small EAF closed by 2017.

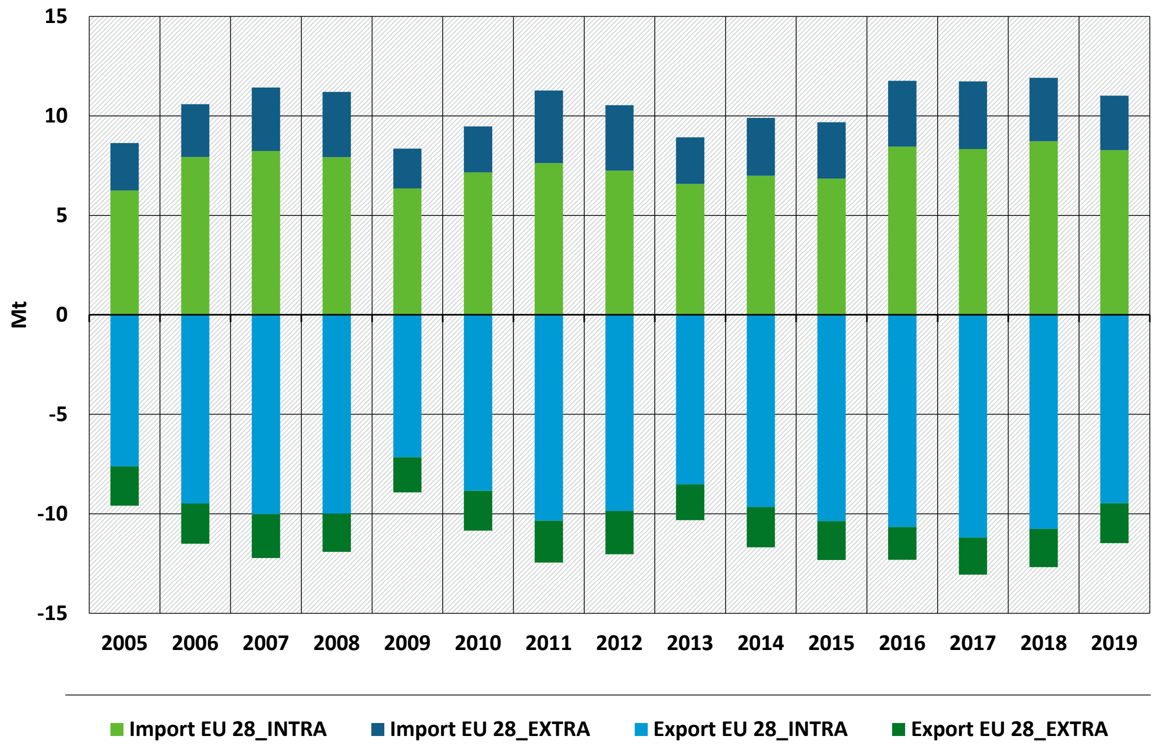
Iron and steelmaking on the EAF route partly depends on the availability of steel scrap. It is an internationally traded commodity but also a resource that is domestically available in all EU-28 countries. Figure 80 in the Appendix shows the domestic steel scrap quantity and the scrap import and export balance. The majority of the domestic steel scrap is exported to the EU and internationally (about 2.6 Mt and 2.4 Mt of scrap annually, with fluctuations of about 1 Mt respectively). Domestic steel scrap volumes in the Netherlands amounted to approx. 4 - 5 Mt, annually. Domestic consumption declined slightly from 2015 to 2017.

The Dutch trade balance in basic and semi-finished iron and steel products seems to closely follow the general economic trends (see Figure 57). 2009 and 2013 respectively depict lower points both in exports and imports, while 2007, 2011 and 2016 - 2018 saw higher trade volumes.

For intra-EU trade in 2019, Dutch trade balance was positive, with 14 % more exports than imports to EU Member States. In reverse, the extra-EU trade is negative. Imports from outside the EU comprised 25 % of all Dutch imports, and extra-EU exports 17 % of total exports.

Among the most important countries for imports to the Netherlands are Germany and Belgium, which together account for 43 %. Equally important are these two countries when considering exports from the Netherlands, which total 43 % of exports. The first non-European importer of Dutch basic and semi-finished iron and steel products is the US, which accounts for 5 % of Dutch exports.

Figure 57: Dutch trade balance: imports and exports of basic and semi-finished iron and steel products to/from the Netherlands

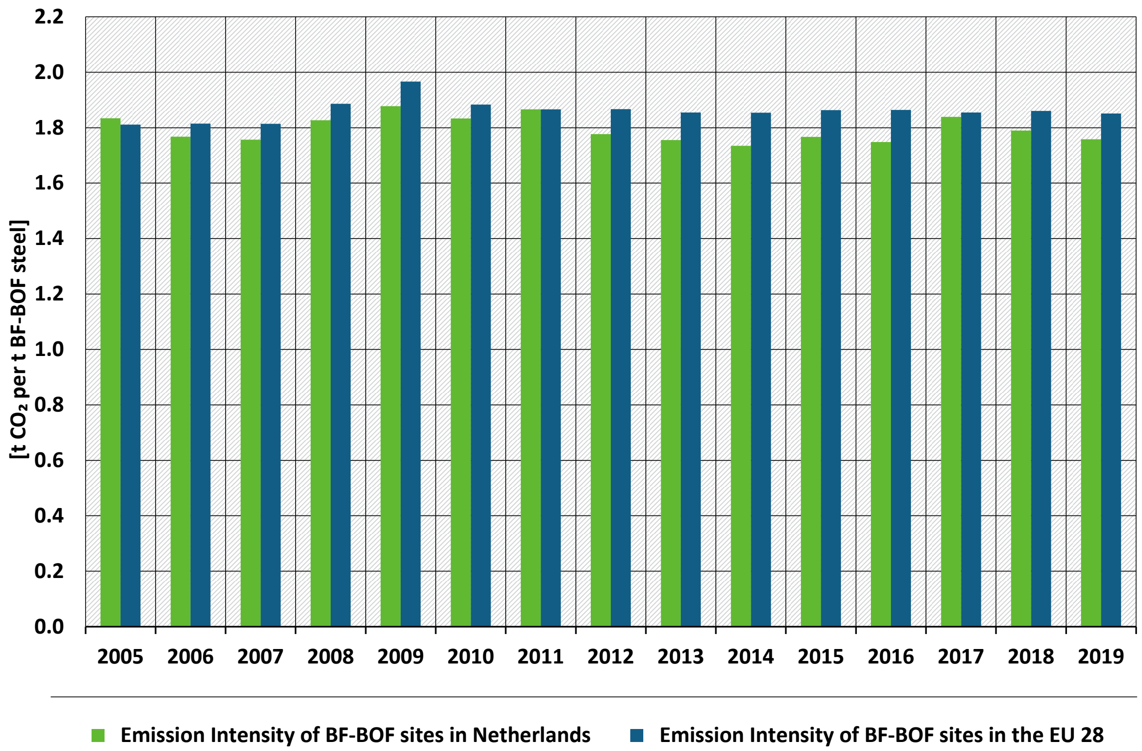


Source: Eurostat (2020b).

9.2.3 Trends in emission intensity on the BF-BOF route

The emission intensity is derived in a bottom-up calculation by dividing the total emissions related to integrated BF-BOF sites (including emissions from coking plants, sintering plants, blast furnaces, basic oxygen furnaces and waste gas power plants) by the total production of steel in BOFs.

Figure 58: Dutch BF-BOF route: Development of specific emission indicators

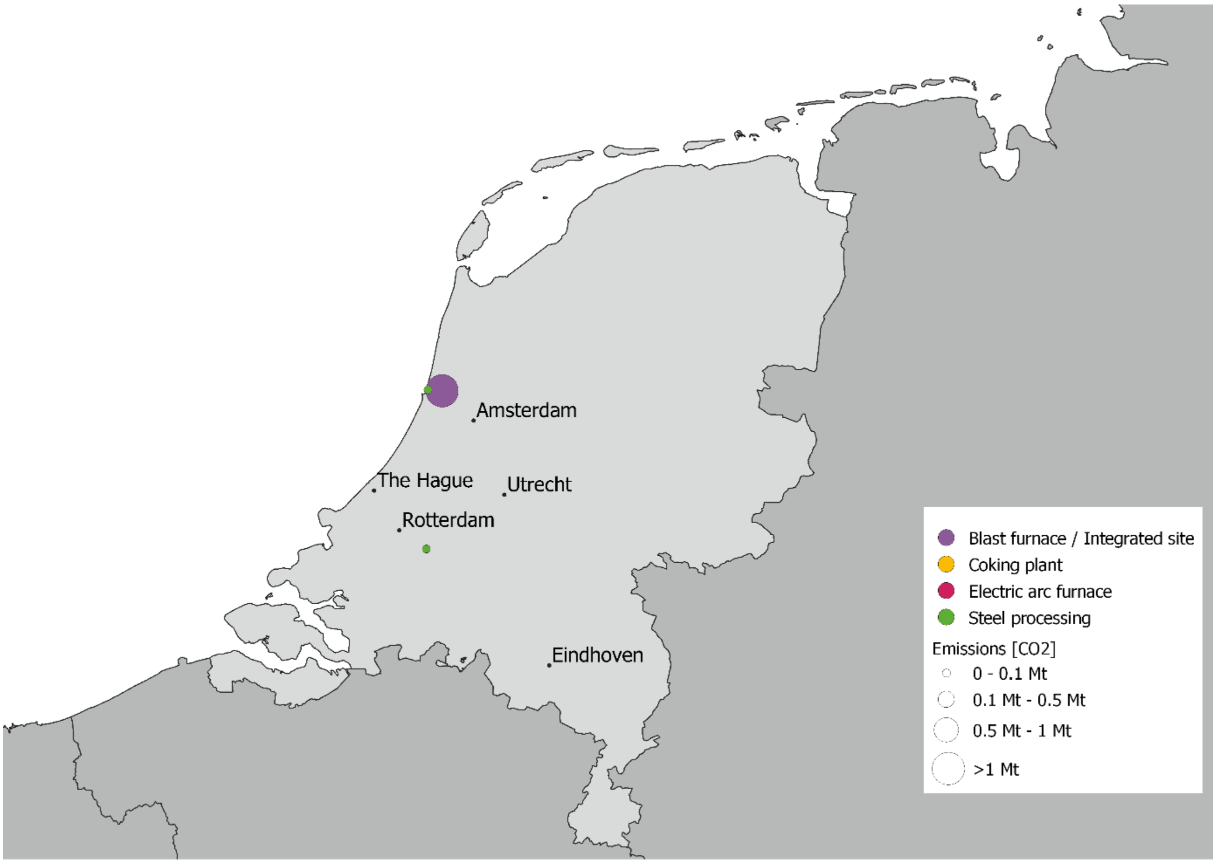


Note: Emission values also include emissions from power plants that use waste gases from iron and steelmaking as fuel.
Source: Data for the Netherlands based on based on Table 35; data for EU-28 based on Table 4.

Specific emission intensity of crude steel production in the Netherlands closely follows the respective EU-28 average. Starting in 2009, specific emissions began to decline below EU-28 average but with deviations below 5 %. In 2019, emission intensity of steel production on the BF-BOF route was 1.76 t CO_2 per ton of crude steel, while the EU-28 average was at 1.85 t CO_2. In 2005, emission intensities were at 1.83 t CO_2 and 1.82 t CO_2 per ton of crude steel, respectively. This (lack of) development is in line with the low fluctuations in the levels of production, high utilization rates and with no significant modernizations in recent years.

9.3 Facility level description

Figure 59: Netherlands: Location map of major CO_2 emission sources from the iron and steelmaking sector verified emissions in 2019



Note:
[1] The illustration is based on emissions reporting under the EU ETS. While the EU ETS has activity codes specifying the main activity of an installation, the codes are not a fully reliable indicator in terms of the installation's function in the steelmaking process. The practice of grouping different facilities under one installation ID and the allocation of emissions between different installations at one integrated site diverge for different sites. Detailed information on the functions and facilities present at individual site is given in this section, below.
[2] Waste gas power plants listed as separate installations in the EU ETS are not displayed here but in Figure 10 (lower-left panel), due to overlap with blast furnace / integrated sites.
Source: Own illustration based on EC n.d..

Figure 59 shows the location of sites listed under the EUTL activity codes 22 - 25. The map indicates the location of the facility and the facility purpose and differentiates between EAF sites, BF-BOF sites and coking plants, and other types of facilities (e.g., rolling mills and foundries) involved in the iron and steel making process. It also ranks the facility emissions into bins: below 0.1 Mt CO_2, 0.1 Mt CO_2 to 0.5 Mt CO_2, 0.5 Mt CO_2 to 1 Mt CO_2 and facilities emitting more than 1 Mt CO_2 per year.

Table 34: The Netherlands: Overview of integrated sites for primary iron and steel production (BOF)

EUTL ID	EUTL activity code	Company	City	Hot metal capacity (Mt)	Finished steel capacity (Mt)	No. of furnaces
NL 144	24	Tata Steel Ijmuiden B.V.	Velsen	6.31	7.5	2

Source: EC n.d., EUROFER (2020).

Since the BF-BOF route dominates the development of emissions of the iron and steelmaking sector, the following section provides a detailed facility level description of installations on this route and their emission trends. The steps taken to match emissions to integrated steelworks and associated sources of uncertainty regarding the completeness and correct assignment are discussed in detail in section 2.3.

Table 35 gives an overview over the emissions of the integrated steelworks in Velsen. In the EUTL, the steelworks is recorded as a single installation plus an additional small unit that was added in the course of the extension of the scope of the EU ETS in 2013. Waste gases are burnt in two neighboring power plant units operated by Vattenfall.[28] Total emissions of the integrated site were 11.8 Mt CO_2 in 2019 and have usually fluctuated between about 12 and 13 Mt CO_2 since 2005, with a low point of 10.3 Mt CO_2 during the financial crisis in 2009. Since the Netherlands only hosts one site for primary iron and steel production, the emission intensity illustrated in section 0 is equal to the emission intensity of the steelworks in Velsen.

Table 35: The Netherlands: Emissions of installations related to the integrated site for primary iron and steel production (BOF)

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	2010	2015	2019
NL 144	24	BF-BOF	Tata Steel	Velsen	6.4	6.2	6.2	6.3
NL 204781	24	Other	Tata Steel	Velsen	-	-	0.1	0.1
NL 185	20	Power plant	Vattenfall	Velsen	2.2	2.2	2.0	1.8
NL 188	20	Power plant	Vattenfall	Velsen	4.4	4.0	4.1	3.9
Correction for non-waste gas use in power plant					**-0.6**	**-0.5**	**-0.2**	**-0.2**
Total of BF-BOF sites					**12.4**	**12.0**	**12.2**	**11.8**
Total iron and steel in the Netherlands					**12.5**	**12.0**	**12.2**	**11.8**
Total production of crude steel (BF-BOF route, in Mt)					**6.8**	**6.5**	**6.9**	**6.7**
Emission intensity of BF-BOF sites (t CO_2 per t crude steel)					1.83	1.83	1.77	1.76

Note:

[28] The power plants do not exclusively use waste gases from iron and steel production as fuel ((Vattenfall 2022)). If the share of natural gas used is significant, the emissions of the integrated steelworks may be overestimated. Therefore, we corrected for fuel input other than waste gases based on fuel input data available from the Large Combustion Plant Database ((EEA n.d.)) and assumptions on fuel emission factors.

[1] The Velsen power plant uses both waste gases and natural gas as fuel input. Based on data from the Large Combustion Plant Direct Database which reports fuel input for large installation we corrected total emissions substracting emissions attributed to the burning of natural gas.
Source: EC n.d., EEA n.d., Worldsteel Association (2020).

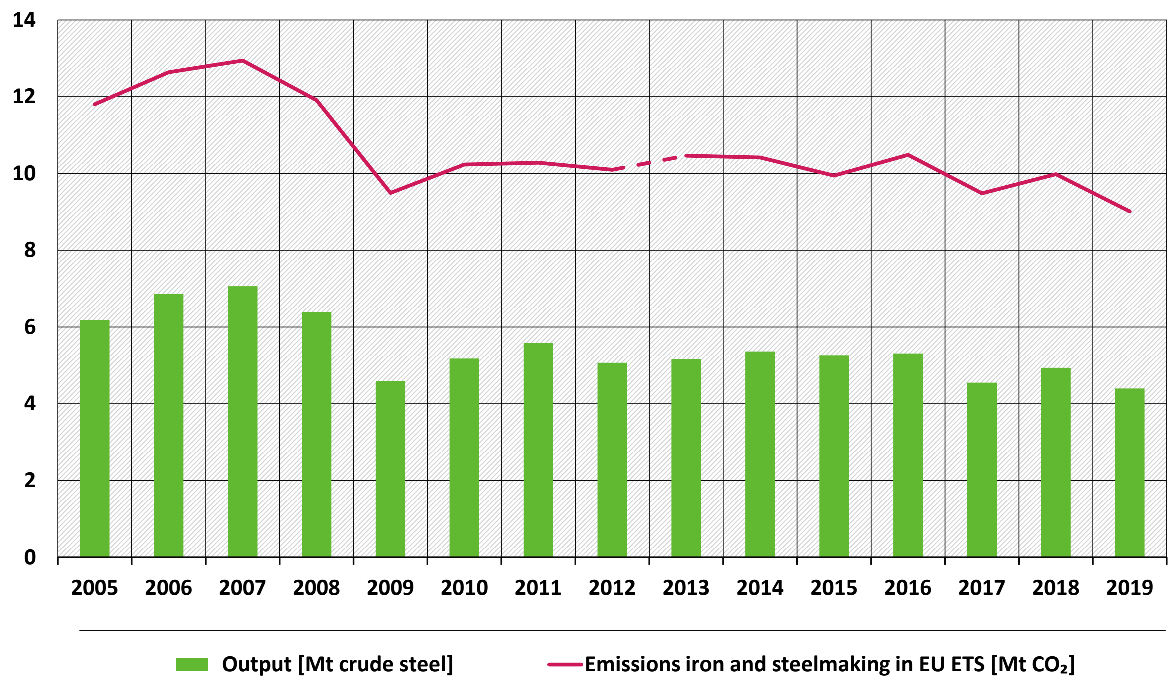
Other than the Tata Steel work in Velsen, there are no other active sites for primary or secondary iron and steel production located in the Netherlands and no installations are recorded under activity codes 22, 23 and 25. The only small EAF in Alblasserdam was closed by 2017. At this location FN Steel still operates a rolling mill and a wire processing unit (EUTL NL 204761).

10 Country fact sheet: The Czech Republic

10.1 Key messages

- The Czech Republic has the 10th highest CO_2 emissions from iron and steelmaking in the EU ETS (9 Mt CO_2 in 2019, see Table 36), comprising 5 % of total EU-28 emissions of the sector.
- In 2019, it had the 12th highest crude steel production in the EU-28 (4 Mt), contributing about 3 % of total production in the EU-28. The EAF share has been very low (5 %); still, more than 50 % of domestic scrap volumes were consumed domestically.
- The Czech Republic hosts two integrated steelworks, one in Ostrava now owned by Liberty Steel with a hot metal capacity of 3.2 Mt and one in Třinec owned by Třinecké železárny with a hot metal capacity of 2.1 Mt. Both steelworks are located in the far east of the country close to the Polish sites in Dabrowa Gornizca and Krakow.
- Production has decreased by about one third in the aftermath of the economic crisis in 2009. Restructuring and a corresponding decrease in emissions occurred at the Ostrava site while emissions were very stable at the Třinec site.
- By 2023, the Liberty Steel owed Ostrava site will be transformed from a pure BF-BOF site to a site with two hybrid furnaces of the same capacity that can accept high shares of steel scrap (the authors understand these as EAF furnaces). This will have a strong impact on the emission intensity of steel production and on electricity demand in the Czech Republic.

Figure 60: The Czech Republic: Key trends in CO_2 emissions and crude steel production, 2005 - 2019



Note: Emissions include activity codes 22 to 25 and identified blast furnace power plants, no scope correction was performed, therefore values from before 2013 and after are not comparable due to a difference in scope.
Source: EC n.d.,Worldsteel Association (2020)

Table 36: Key data on the iron and steelmaking sector in the Czech Republic in 2019

General information	**2019**	**% change compared to 2013**
Total CO_2 emissions in EU ETS in 2019 from iron and steelmaking[1] (share in total CO_2 emissions in EU ETS)	9 Mt CO_2 (14 %)	-14 %
Total crude steel production in 2019 (share of EU-28)	4.4 Mt (3 %)	-15 %
Total CO_2 emissions from BF-BOF sites[2] (total CO_2 emissions from EAF sites)	9 Mt CO_2 (0.1 Mt CO_2)	-12 %
Crude steel production of BF-BOF sites (crude steel production from EAF sites)	4 Mt (0.2 Mt)	-13 %
Estimated emission intensity of crude steel production from BF-BOF sites (relative to EU-28 average)	2.1 t CO_2/t crude steel (115 %)	1 %

Site-specific information of integrated sites for year 2019

Main EUTL-ID	**Site name**	**Number of blast furnaces**	**Hot metal capacity Mt**	**CO_2 emissions Mt CO_2**	**% change in CO_2 emissions compared to 2013**
CZ 73	Ostrava	3	3.2 Mt	4.6 Mt	-17 %
CZ 114	Třinec	2	2.1 Mt	4.2 Mt	-7 %

Notes:

[1] Activity codes 22-25; also including waste gas power plants from activity code 20.

[2] Installations belonging to one integrated site (including coking plants, sinter plants, blast furnaces, basic oxygen furnaces,coal and downstream processing plants and waste gas-fuelled power plants) were allocated manually. Emissions from waste gas power plants can also include co-firing with other fuels which adds uncertainty to the exact total emission levels. For a broad discussion of uncertainties see section 2.3.1. Respective sources are provided in the details of the facility level description.

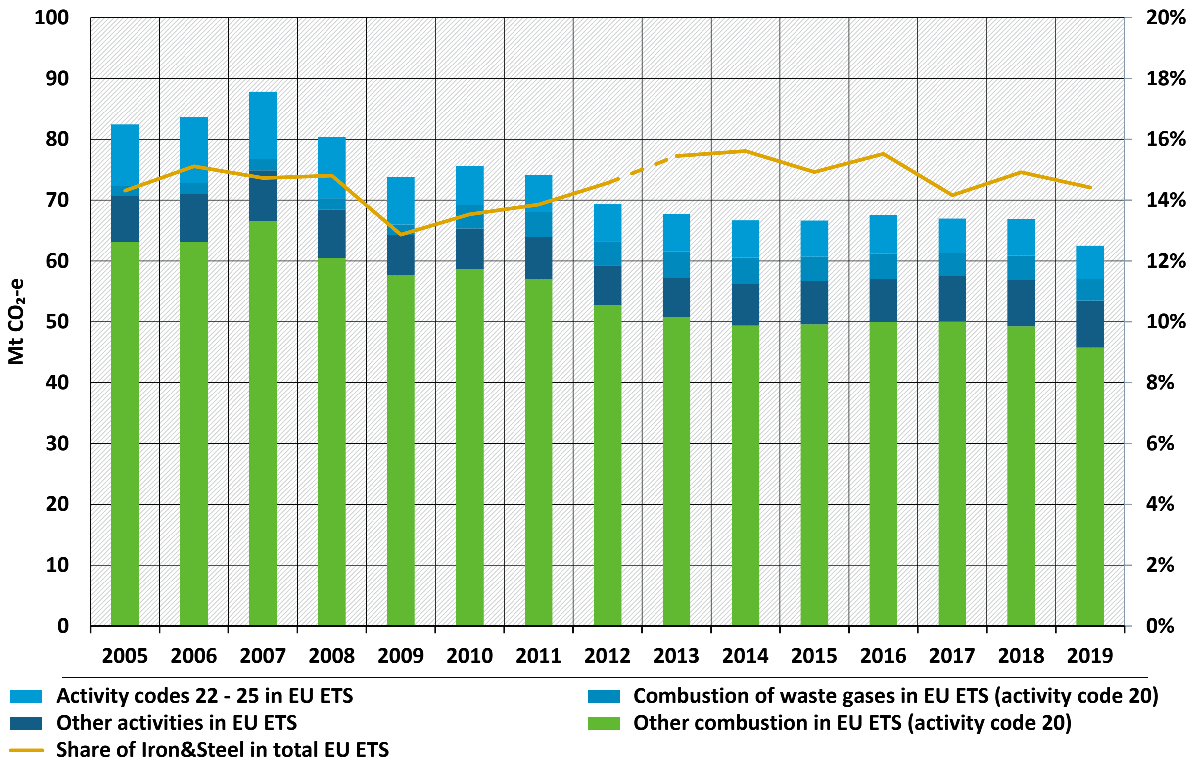
Source: Own table based on EC n.d., EUROFER (2020), Worldsteel Association (2020)

10.2 Short description of the sector in the context of the country's economic and GHG pollution

Iron and steel production has increased its importance as an industrial sector in the Czech Republic: in 2017, it accounted for 2 % of gross value added (GVA) of the entire manufacturing sector. As shown in Figure 73, the share of manufacturing GVA in total GVA in the Czech Repubilc has been stable between 2010 and 2017 at 23–27 %.[29] At the same time, the share of steel making GVA in manufacturing GVA has strongly increased from 0.9 % in 2010 to 2.6 % in 2015. In 2017, steel making accounted for 2.0 % of manufacturing GVA. As also shown in Figure 73, following the economic downturn, employment in the steel sector saw a decline from 22,000 workers in 2008 to 15,000 workers in 2013. Since then, the number of workers directly employed in the industry has increased again to 17,000 in 2017.

10.2.1 Emission trends

Figure 61: Czech Republic: Emission trends in stationary EU ETS



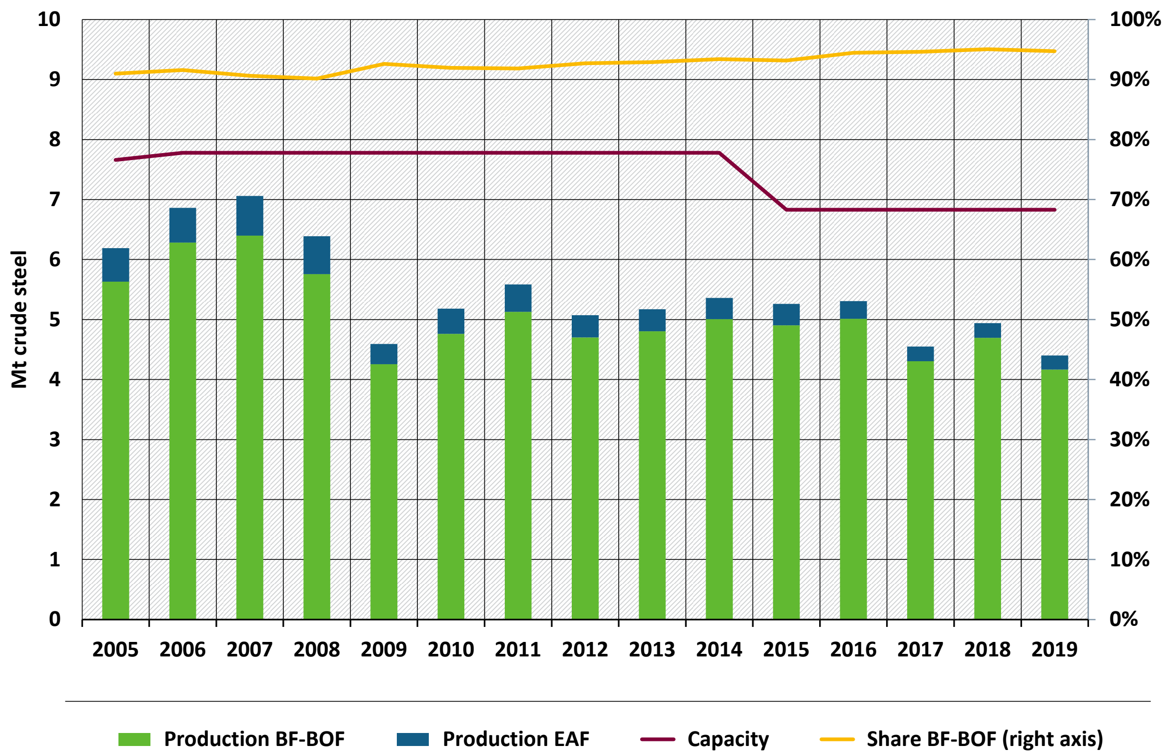
Note: Emissions from power plants that use waste gases from iron and steel making as fuel are attributed to the iron and steelmaking sector instead of the combustion sector.
Source: EC n.d..

[29] There is no data available for prior years from the same sources.

The share of emissions in the iron and steelmaking sector compared to total EU ETS emissions of the Czech Republic is between 14 % and 15 %. The share in total emissions is about 8 %. Total emissions from the iron and steelmaking sector equal to 9 Mt CO_2 in 2019. This comprises a decrease of 14 % compared to 2013 and a 24 % decrease compared to 2005. The emissions trend is driven by the development in production on the BF-BOF route which made up 90 % and more of total production between 2005 and 2019. Production decreased by about one third in the aftermath of the economic crisis in 2009. Due to lower capacity utilization on the BF-BOF route, the emissions intensity has increased.

10.2.2 Trends in production, capacity and trade

Figure 62: Czech iron and steel industry: Trends in production and capacity



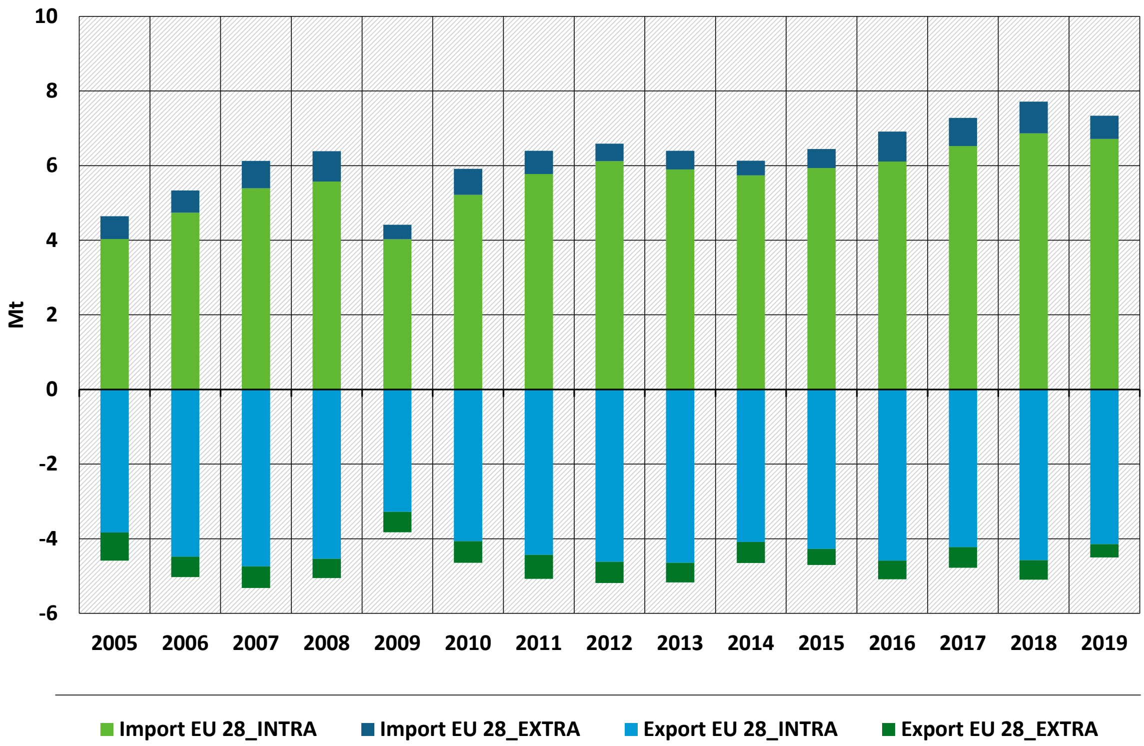
Source: Worldsteel Association (2020), OECD 2020 Steelmaking Capacity Database.

With a production of 4.4 Mt in 2019, the Czech Republic ranks 12th among the EU Member States. Before the economic crisis in 2009 production levels were considerably higher (about 6 Mt). However, the reduction in production capacity only took place six years after the 2009 economic crisis, which is likely due to the fact that capacity was mothballed and the capacity was adjusted with a delay. 2019 brought the lowest capacity utilization rate, with only 64 %. EAF facilities also make up only a small percentage of production, with a decrease from 10 % in 2008 to only 5 % percent since 2017. By 2023, the Ostrava site will be transformed from a pure BF-BOF site to a site with two hybrid furnaces of the same capacity that can accept high shares of steel scrap (the authors understand that these are EAF furnaces) (Liberty Steel 2020b). This will have strong implications on the emission intensity of steel production and on electricity demand in the Czech Republic.

Iron and steelmaking on the EAF route partly depends on the availability of steel scrap. It is an internationally traded commodity but also a resource that is domestically available in all EU-28 countries. Figure 81 in the Appendix shows the domestic steel scrap quantity and the scrap import and export balance. The majority of the domestic steel scrap is consumed domestically (about 2 Mt of scrap annually). Czech Republic has constantly been a net exporter of steel scrap since 2010. No data is available for prior years. The share of net-exports from domestic volumes reached about 36 % in 2017 but varied strongly, amounting to only 2 % in 2015.

While the export market of the Czech Republic has been relatively stagnant over the last two decades, imports, mostly intra-EU imports, have been rising steadily, with few exceptions, notably the economic crisis (see Figure 63). In 2019, Czech Republic's imports exceeded exports both inside and outside the EU. Almost 92 % of Czech imports came from the EU, roughly 6.7 Mt, while a quantity of about 4.5 Mt was exported, again around 92 % to other EU Member States. The most important countries regarding exports to and imports from the Czech Republic are its neighbours Germany, Poland and Slovakia, which account for 65 % and 56 % respectively.

Figure 63: Czech trade balance: imports and exports of basic and semi-finished iron and steel products to/from the Czech Republic

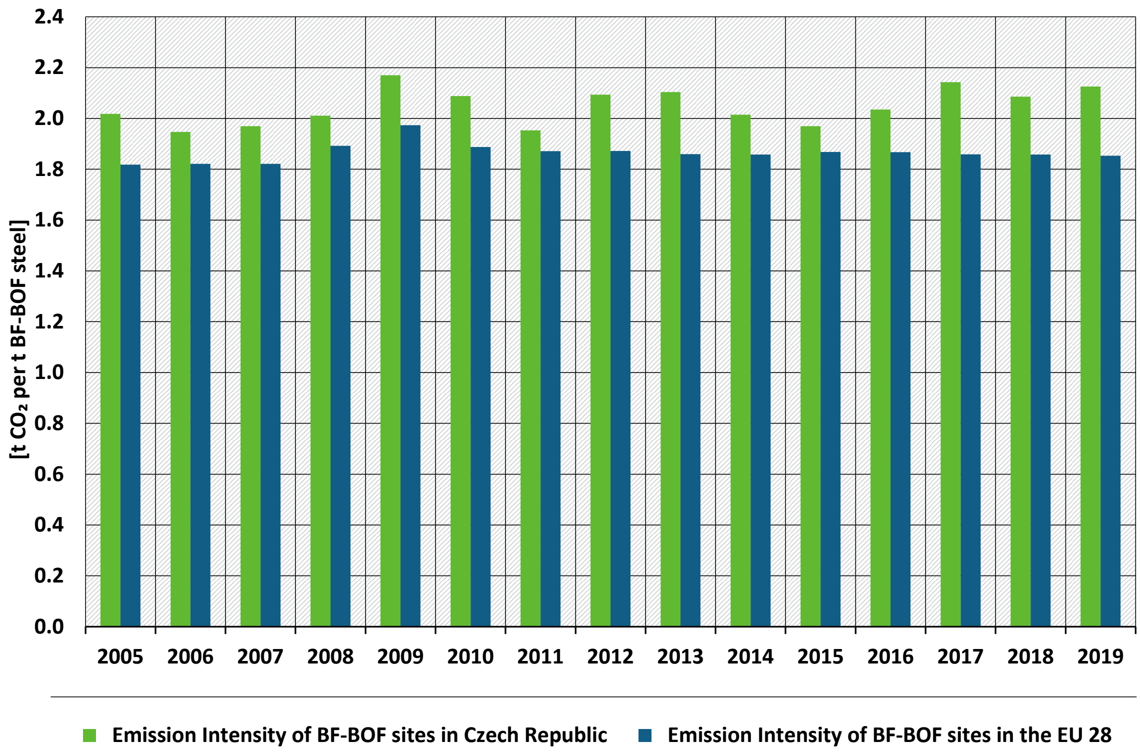


Source: Eurostat (2020b).

10.2.3 Trends in emission intensity on the BF-BOF route

The emission intensity is derived in a bottom-up calculation by dividing the total emissions related to integrated BF-BOF sites (including emissions from coking plants, sintering plants, blast furnaces, basic oxygen furnaces and waste gas power plants) by the total production of steel in BOFs.

Figure 64: Czech BF-BOF route: Development of specific emission indicators



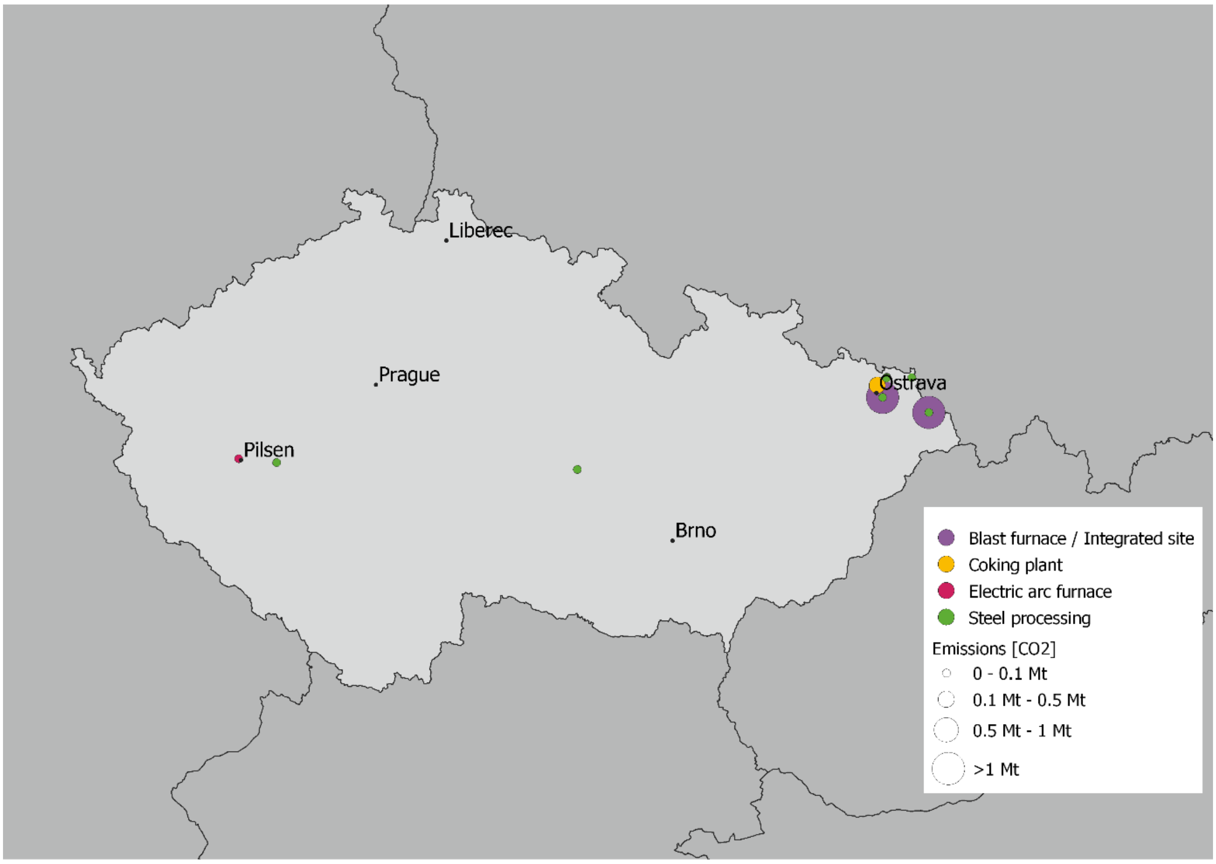
Note: Emission values also include emissions from power plants that use waste gases from iron and steelmaking as fuel.
Source: Data for the Czech Republic based on Table 4; data for EU-28 based on Table 4.

The comparison between the Czech-specific emission intensity of the BF-BOF route and the EU average shows that the Czech installations are consistently more emission-intensive. There is considerable variation in difference, but the last three years show a significantly more emitting industry. In 2017 and 2019, the emission intensity was almost 15 % higher than on average (2.13 t CO2 per ton of production in BF-BOF route compared to the average of 1.85 t CO_2). Just like the European average, emission intensity in the Czech Republic had also increased in the economic crisis in 2009. In both cases, the lower capacity utilization and hence less efficient use of the integrated infrastructure is the main driver of the increase in emission intensity. Additionally, waste gas power plants that are included in the integrated steelworks also have used significant amounts of coal for co-firing.[30] Due to a lack of data, emissions from co-firing could not be subtracted from total power plant emissions, hence leading to a potential overestimation of emissions associated with the BF-BOF route in the Czech Republic.

[30] Co-firing with coal occurs at both integrated sites, c.f. (Tameh-Tauron ArcelorMittal Energy Holding 2022b), and (Energetika Třinec 2022).

10.3 Facility level description

Figure 65: The Czech Republic: Location map of major CO_2 emission sources from the iron and steelmaking sector verified emissions in 2019



Note:
[1] The illustration is based on emissions reporting under the EU ETS. While the EU ETS has activity codes specifying the main activity of an installation, the codes are not a fully reliable indicator in terms of the installation's function in the steelmaking process. The practice of grouping different facilities under one installation ID and the allocation of emissions between different installations at one integrated site diverge for different sites. Detailed information on the functions and facilities present at individual site is given in this section, below.
[2] Waste gas power plants listed as separate installations in the EU ETS are not displayed here but in Figure 10 (lower-left panel), due to overlap with blast furnace / integrated sites.
Source: Own illustration based on EC n.d..

Figure 65 shows the location of sites listed under the EUTL activity codes 22 - 25. The map indicates the location of the facility and the facility purpose and differentiates between EAF sites, BF-BOF sites and coking plants, and other types of facilities (e.g. rolling mills and foundries) involved in the iron and steelmaking process. It also ranks the facility emissions into bins: below 0.1 Mt CO_2, 0.1 Mt CO_2 to 0.5 Mt CO_2, 0.5 Mt CO_2 to 1 Mt CO_2 and facilities emitting more than 1 Mt CO_2 per year.

Since the BF-BOF route dominates the development of emissions of the iron and steelmaking sector, the following section provides a detailed facility level description of installations on this route and their emission trends. The steps taken to match emissions to integrated steelworks and associated sources of uncertainty regarding the completeness and correct assignment are discussed in detail in section 2.3. The Czech Republic hosts two sites for primary iron and steel production in Třinec and Ostrava, which are located in the far east of the country close to the

Polish sites in Dabrowa Gornizca and Krakow. In terms of capacities, the sites in Třinec and Ostrava are relatively small steelworks with a hot metal capacity of 2.1 and 3.2 Mt hot metal per year, respectively.

Table 37: The Czech Republic: Overview of integrated sites for primary iron and steel production (BF-BOF)

EUTL ID	EUTL activity code	Plant Type	Company	City	Operating status	Hot metal capacity (Mt)	Finished steel capacity (Mt)	No. of furnaces
CZ 114	24	BF-BOF	Třinecké železárny	Třinec	Active	2.1	2.4	2
CZ 73	24	BF-BOF[1]	Liberty Ostrava	Ostrava	Active	3.2	3	3

Note:

[1] EUROFER report 3 BF only, but Liberty Steel report 4 tandem oxygen furnaces with an annual total curde steel capacity of 3 Mt (LIBERTY Steel Czech Republic 2020).

Source: EC n.d., EUROFER (2020).

Table 38 lists the emissions of the integrated sites in Třinec and Ostrava. The emissions of the site in Třinec are recorded under two EUTL installations, of which one is a waste gas power plant. The steelworks is operated by the local steel producer Třinecké železárny (Trinec Iron and Steelworks). Its emissions have been relatively stable since 2005, at 4.1 to 4.6 Mt CO_2 per year; even during the economic crisis, emissions did not drop as significantly as observable for other integrated steelworks in the EU ETS.

The larger integrated steelworks in Ostrava was acquired by Liberty Steel in 2019 and was previously owned by ArcelorMittal (Liberty steel group 2019). EUTL installations related to the integrated steelworks include a nearby coking plant operated by OKK Koksovny and a plant for tubular products by Liberty Steel. About one fifth of the hot metal is supplied to Vítkovice Steel for further processing (LIBERTY Steel Czech Republic 2022). Waste gases are used by a power plant operated on site by TAMEH since 2010. Total emissions of the site were considerably higher in the years before the financial crisis (8.1 Mt CO_2 in 2007) compared to the years since 2010, where emissions fluctuated between 4.6 Mt CO_2 (2019) and 5.8 Mt CO_2.

Table 38: Czech Republic: Emissions of installations related to integrated sites for primary iron and steel production (BF-BOF)

EUTL ID	EUTL activity code	Plant Type	Company	City	Emissions (Mt CO_2)			
					2005	**2010**	**2015**	**2019**
Integrated Steelworks Ostrava					**7.3**	**5.3**	**5.3**	**4.6**
CZ 62	22	Coking plant	OKK Koksovny	Ostrava	0.1	0.1	0.1	0.1
CZ 97	22	Coking plant	OKK Koksovny	Ostrava	0.1	0.1	0	0
CZ 73	24	BF-BOF	Liberty Ostrava	Ostrava	4.9	3.1	2.8	2.5
CZ 172	24	BF-BOF	Liberty Ostrava	Ostrava	1.9	0.0	0.0	0.0
CZ 52	24	BOF	Vítkovice Steel	Ostrava	0.3	0.2	0.1	0.1
CZ 410	25	Tubes	Liberty Ostrava	Ostrava	0.0	0.1	0.1	0.0
CZ 421	20	Power plant	TAMEH	Ostrava	0.0	1.8	2.2	1.9
Integrated Steelworks Třinec					**4.1**	**4.6**	**4.3**	**4.2**
CZ 114	24	BF-BOF	Třinecké železárny	Třinec	2.4	2.5	2.5	2.7
CZ 252	20	Power plant	Energetika Třinec	Třinec	1.7	2.1	1.8	1.6
Total of BF-BOF sites					**11.4**	**9.9**	**9.7**	**8.9**
Total iron and steel in the Czech Republic					**11.8**	**10.2**	**9.9**	**9.0**
Total production of crude steel (BF-BOF route, in Mt)					**5.6**	**4.8**	**4.9**	**4.2**
Emission intensity of BF-BOF sites (t CO_2 per t crude steel)					**1.94**	**2.03**	**1.94**	**2.13**

Source: EC n.d.,Worldsteel Association (2020)

In total, the two integrated steelworks accounted for about 98 % of total iron and steelmaking sector emissions in 2019 in the Czech Republic.

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A Appendix

A.1 Economic indicators

Note for all figures in Part A: Includes NACE codes 24.10, 24.20, 24.30, 24.51, 24.52

Source for all figures: (Eurostat 2020a), (Eurostat 2020c), Worldsteel Association (2020).

Figure 66: Germany: Share of iron and steelmaking in gross value added (GVA) of manufacturing, share of manufacturing GVA in total GVA and direct employment

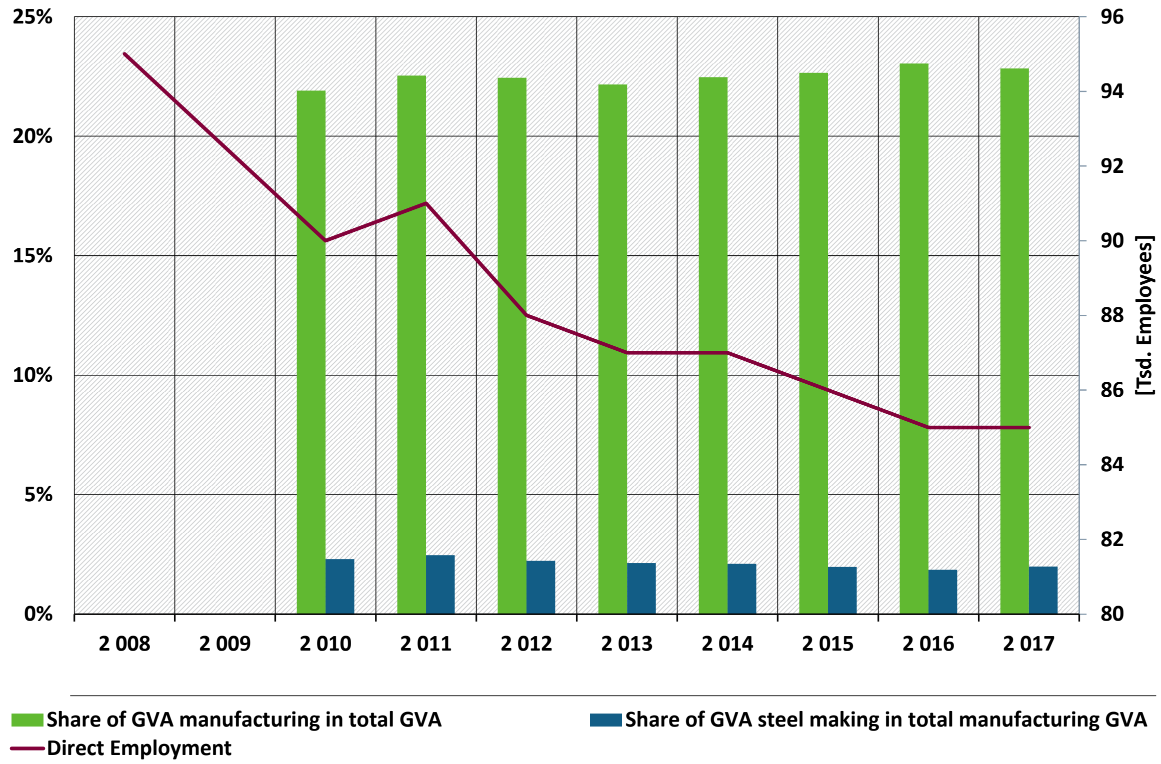


Figure 67: Italy: Share of iron and steelmaking in gross value added (GVA) of manufacturing, share of manufacturing GVA in total GVA and direct employment

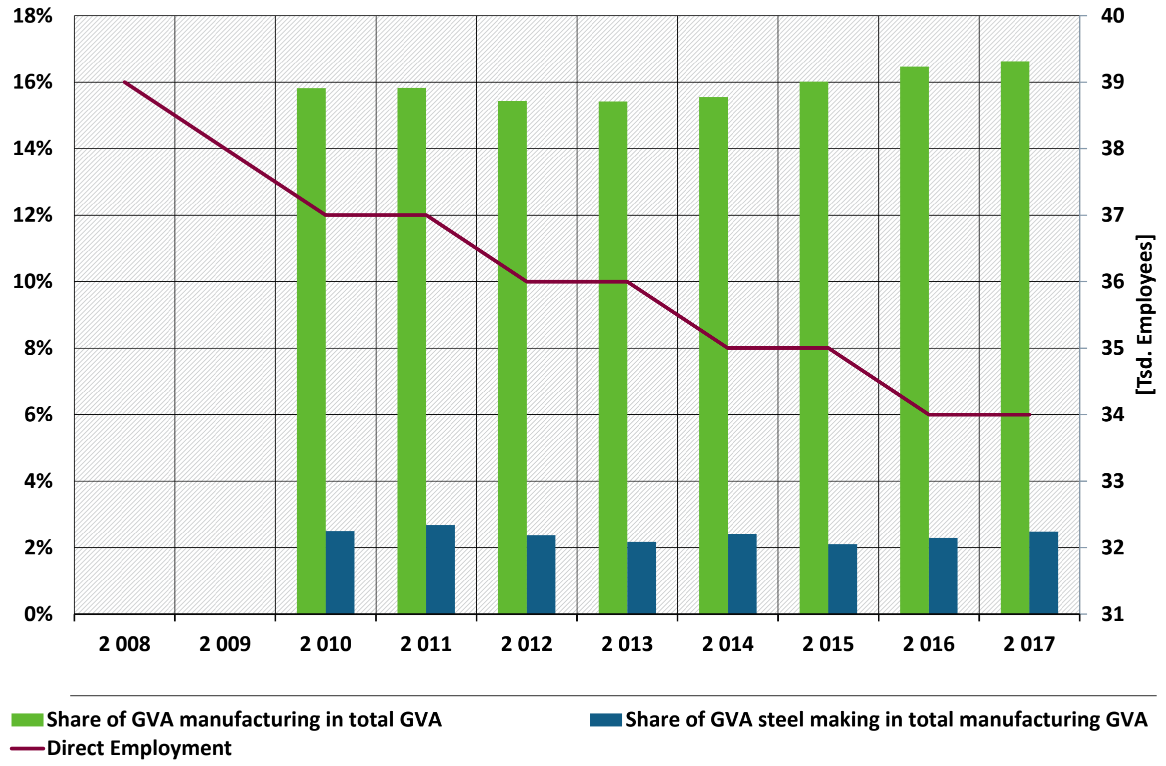


Figure 68: France: Share of iron and steelmaking in gross value added (GVA) of manufacturing, share of manufacturing GVA in total GVA and direct employment

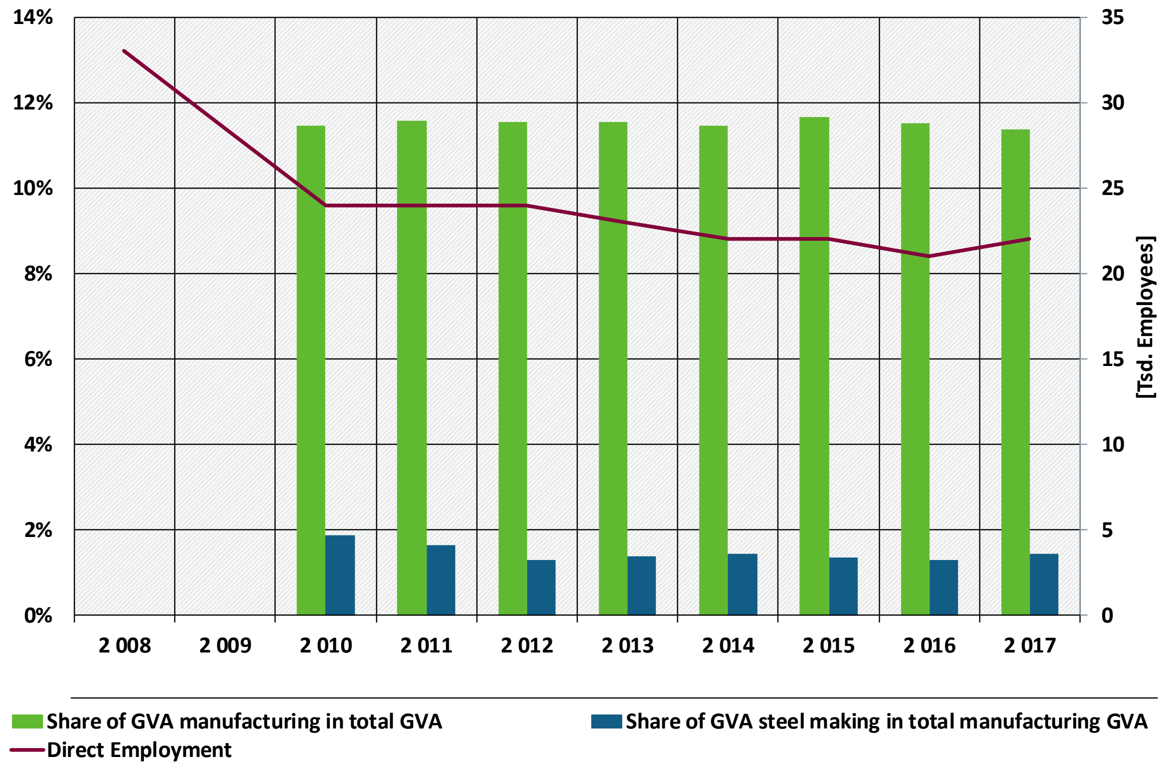


Figure 69: Poland: Share of iron and steelmaking in gross value added (GVA) of manufacturing, share of manufacturing GVA in total GVA and direct employment

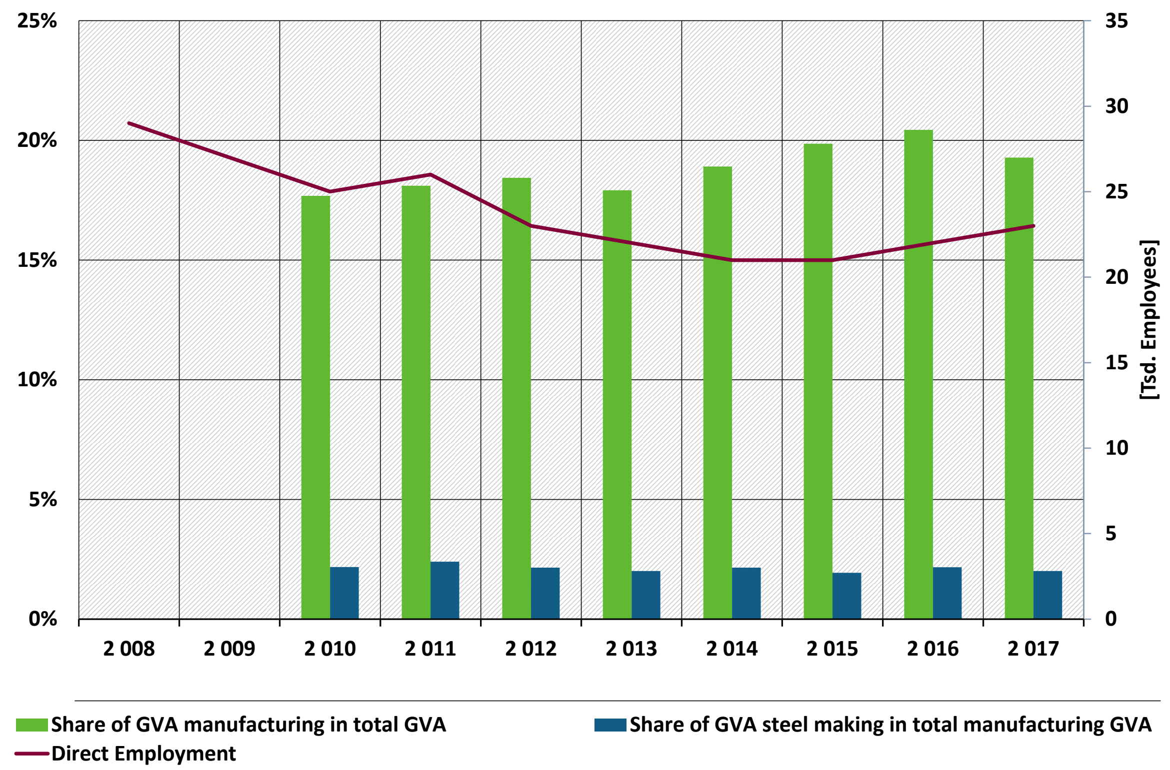


Figure 70: Austria: Share of iron and steelmaking in gross value added (GVA) of manufacturing, share of manufacturing GVA in total GVA and direct employment

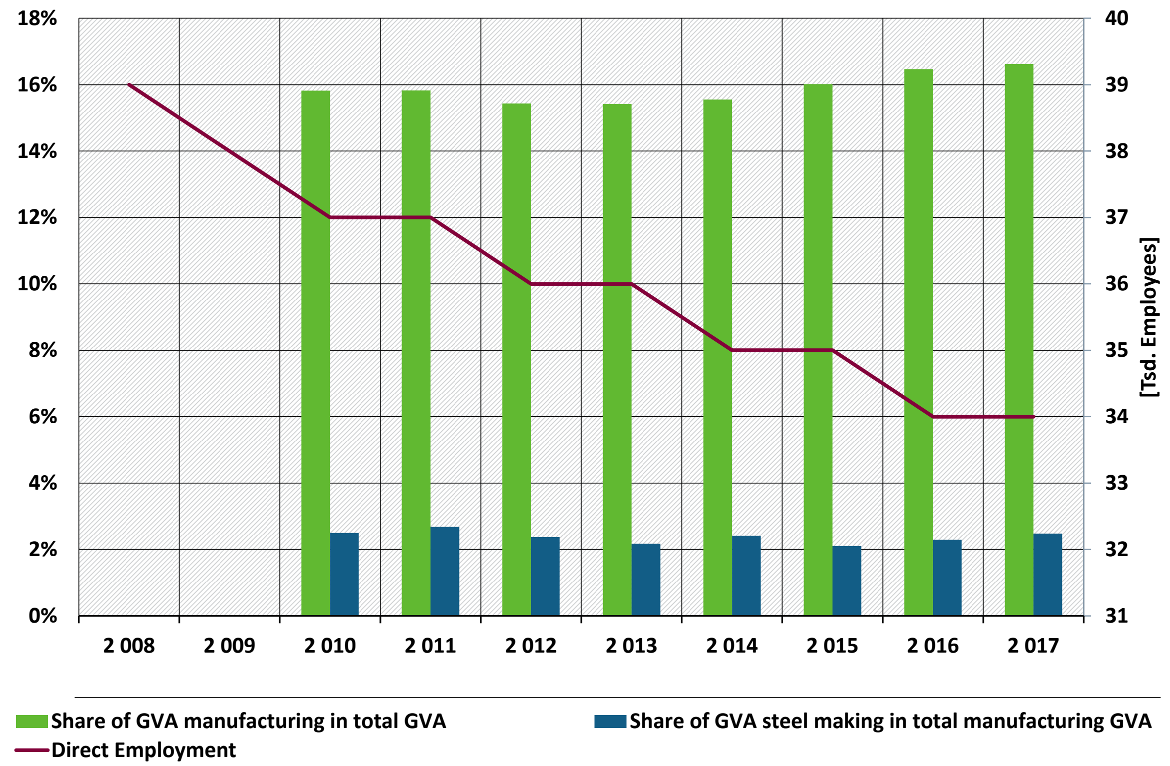


Figure 71: United Kingdom: Share of iron and steelmaking in gross value added (GVA) of manufacturing, share of manufacturing GVA in total GVA and direct employment

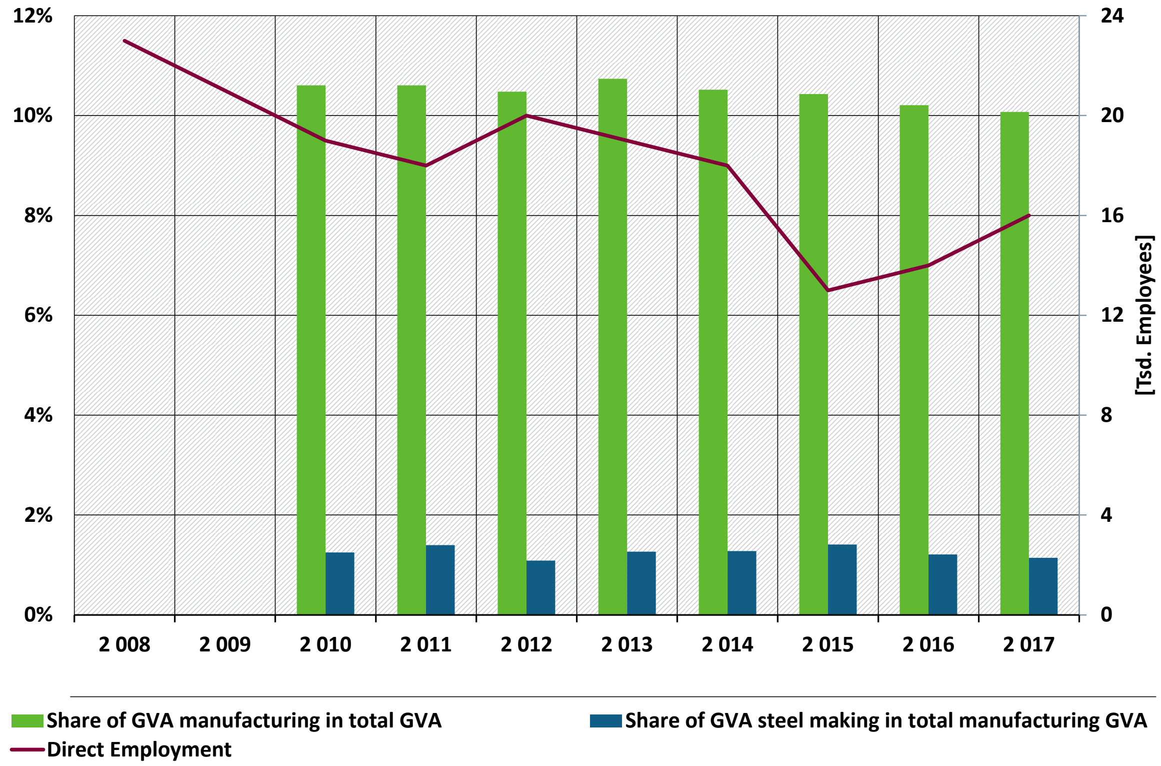


Figure 72: The Netherlands: Share of iron and steelmaking in gross value added (GVA) of manufacturing, share of manufacturing GVA in total GVA and direct employment

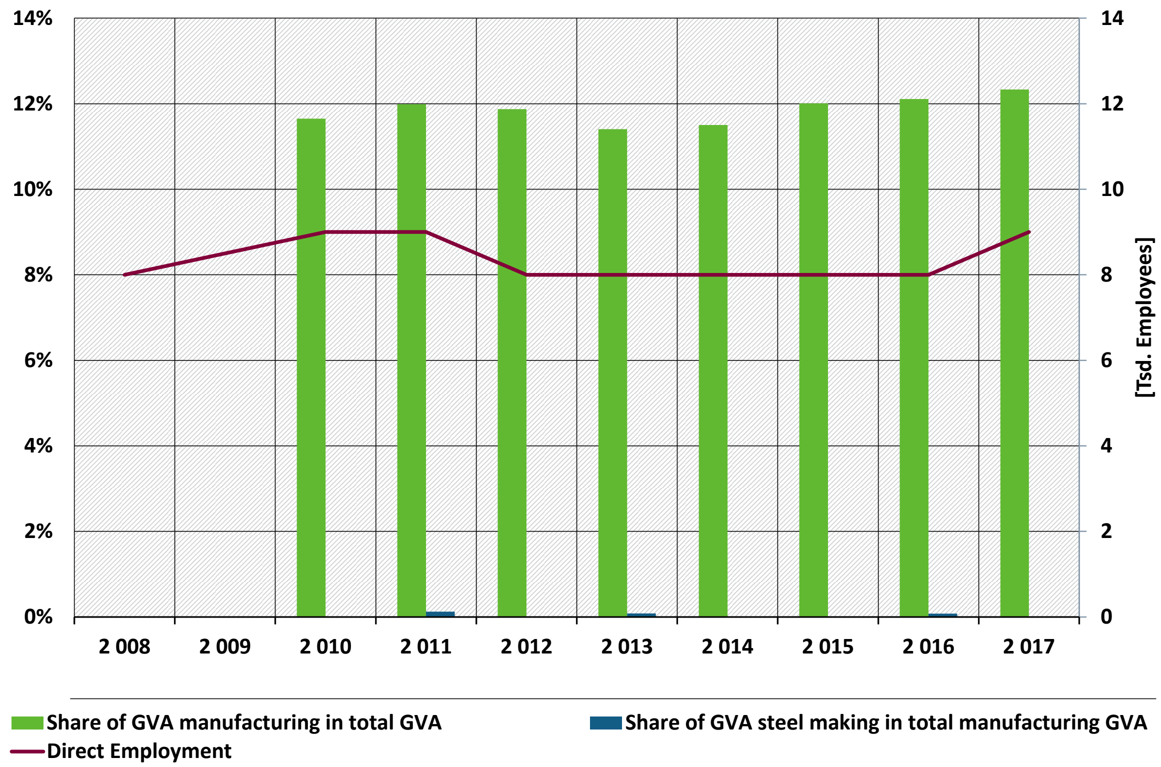
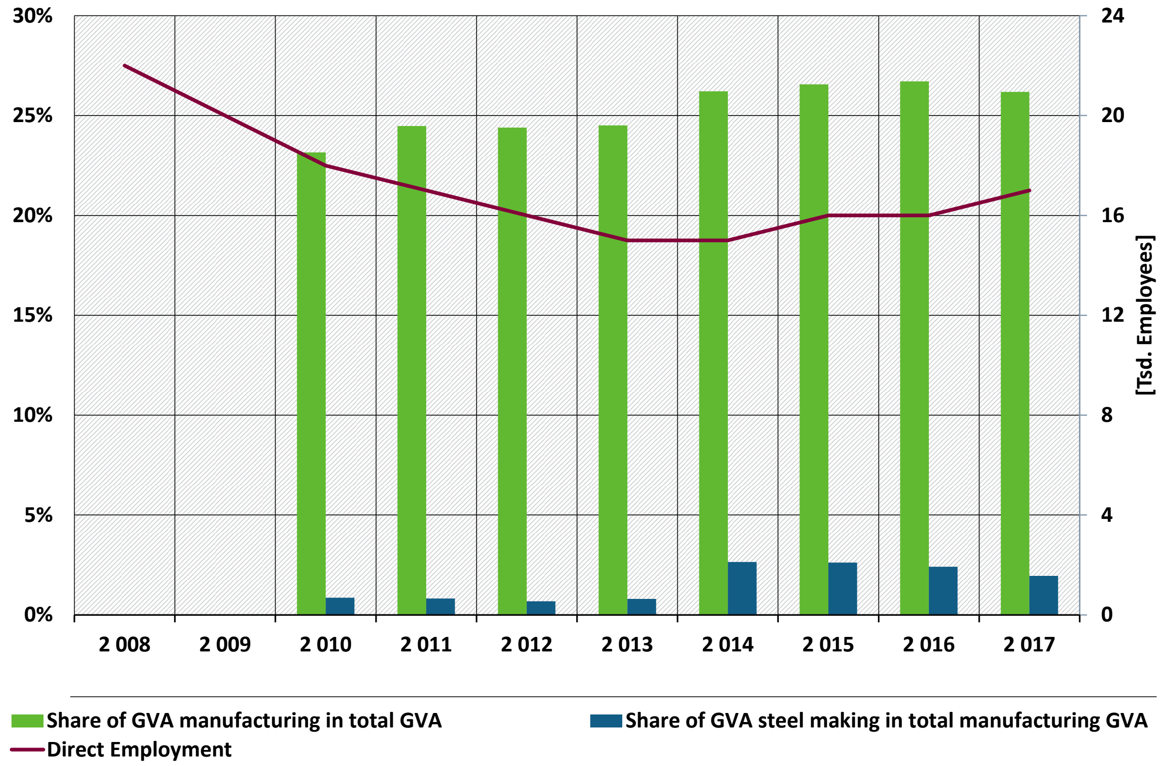


Figure 73: Czech Republic: Share of iron and steelmaking in gross value added (GVA) of manufacturing, share of manufacturing GVA in total GVA and direct employment



A.2 Details on the scrap balance

The source for all figures in Part C of the appendix: BIR (Bureau of International Recycling). The values for domestic scrap volumes are calculated as residuals by taking values on scrap consumption from BIR and subtracting imports and adding exports also reported by BIR. The source does not provide data on imports from outside of the EU on a country level. However, total imports to the EU only comprised around 3 Mt in 2017, compared to 20 Mt of extra-EU exports, hence the general trends and the magnitudes of the different figures reported below should be unaffected by this missing information. The large importers on the international scrap steel market, which comprised 56 Mt in 2017, are Turkey (21 Mt), India (5 Mt), and Korea Republic (6 Mt), USA (5 Mt), Pakistan (5 Mt) and Taiwan (3 Mt).

Figure 74: Germany´s import/export balance on the international steel scrap market

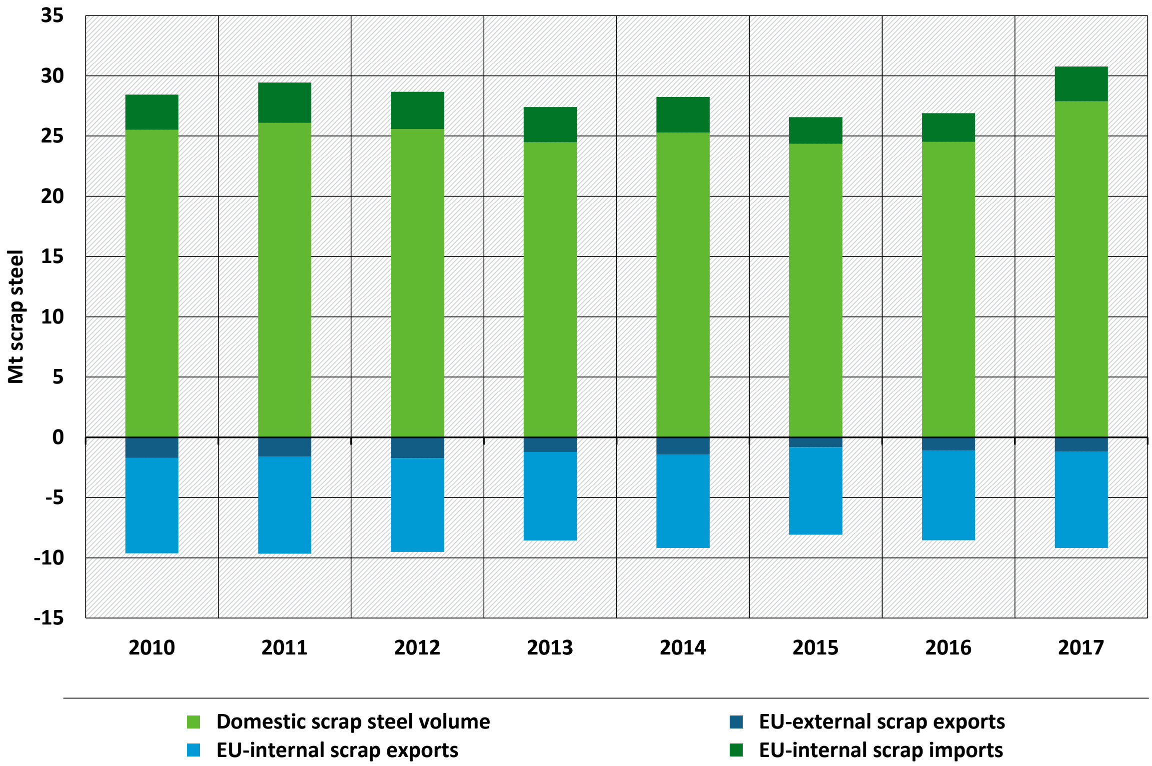


Figure 75: Italy´s import/export balance on the international steel scrap market

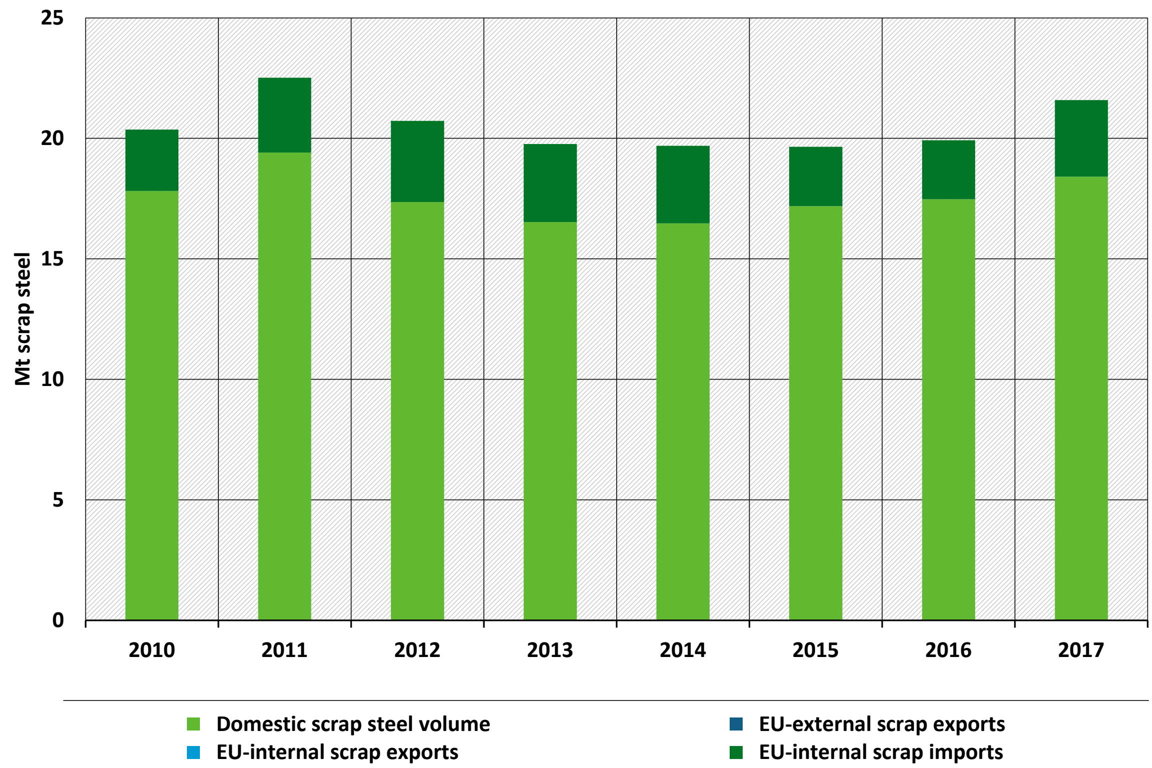


Figure 76: France´s import/export balance on the international steel scrap market

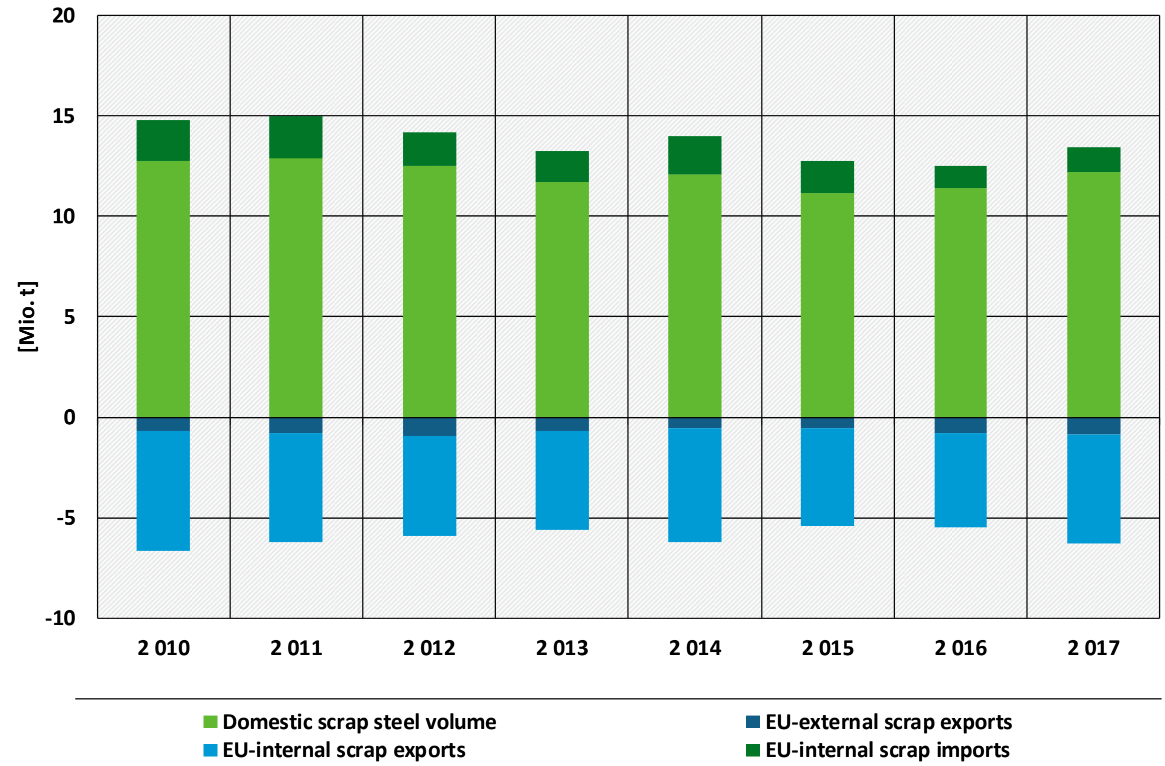


Figure 77: Poland´s import/export balance on the international steel scrap market

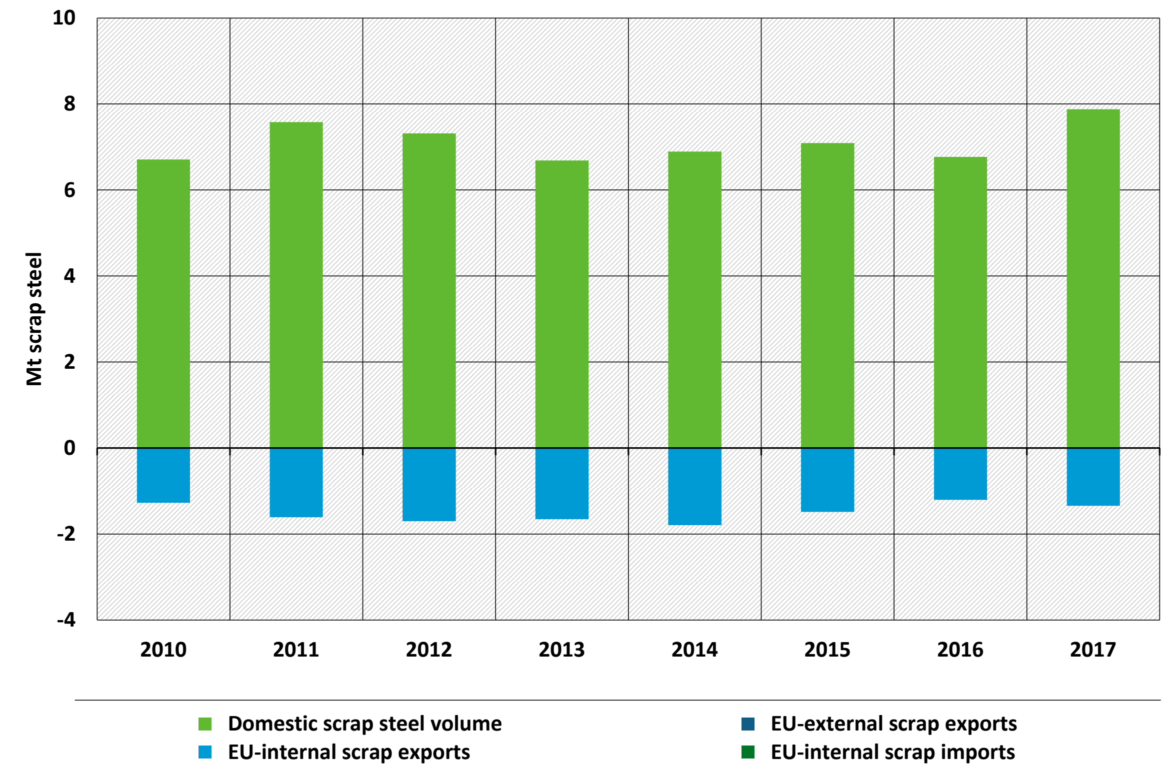


Figure 78: Austria´s import/export balance on the international steel scrap market

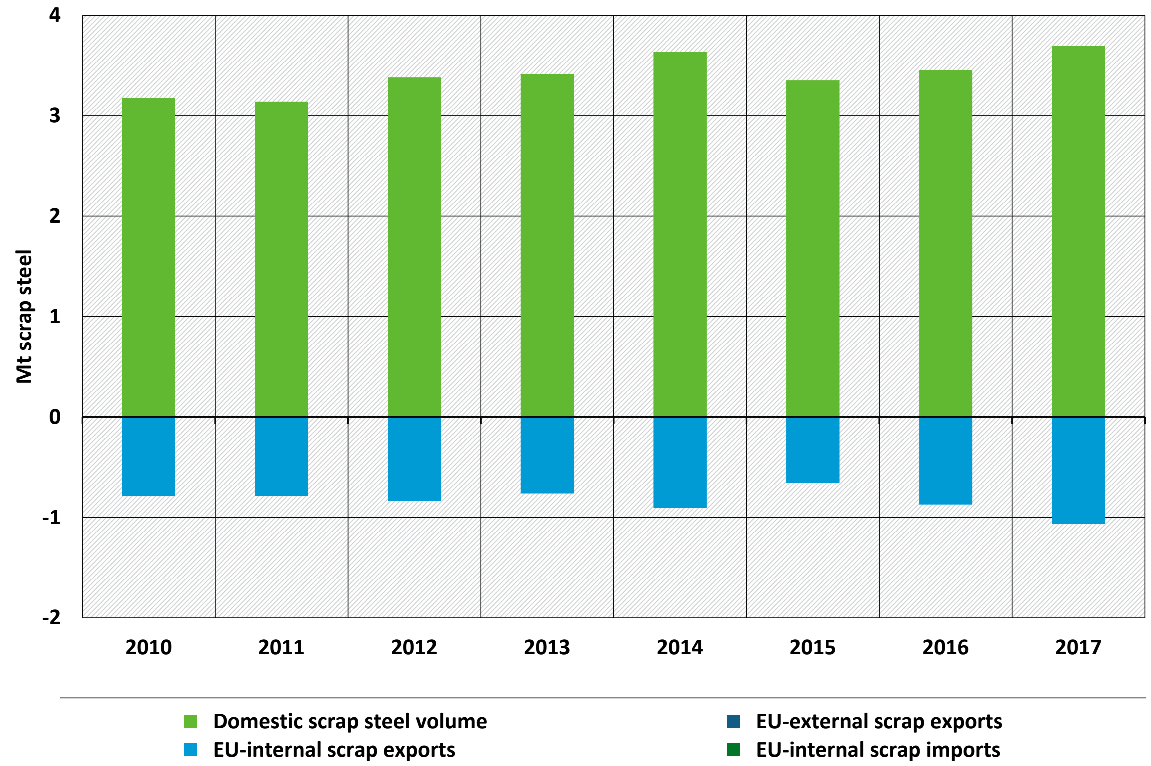


Figure 79: British import/export balance on the international steel scrap market

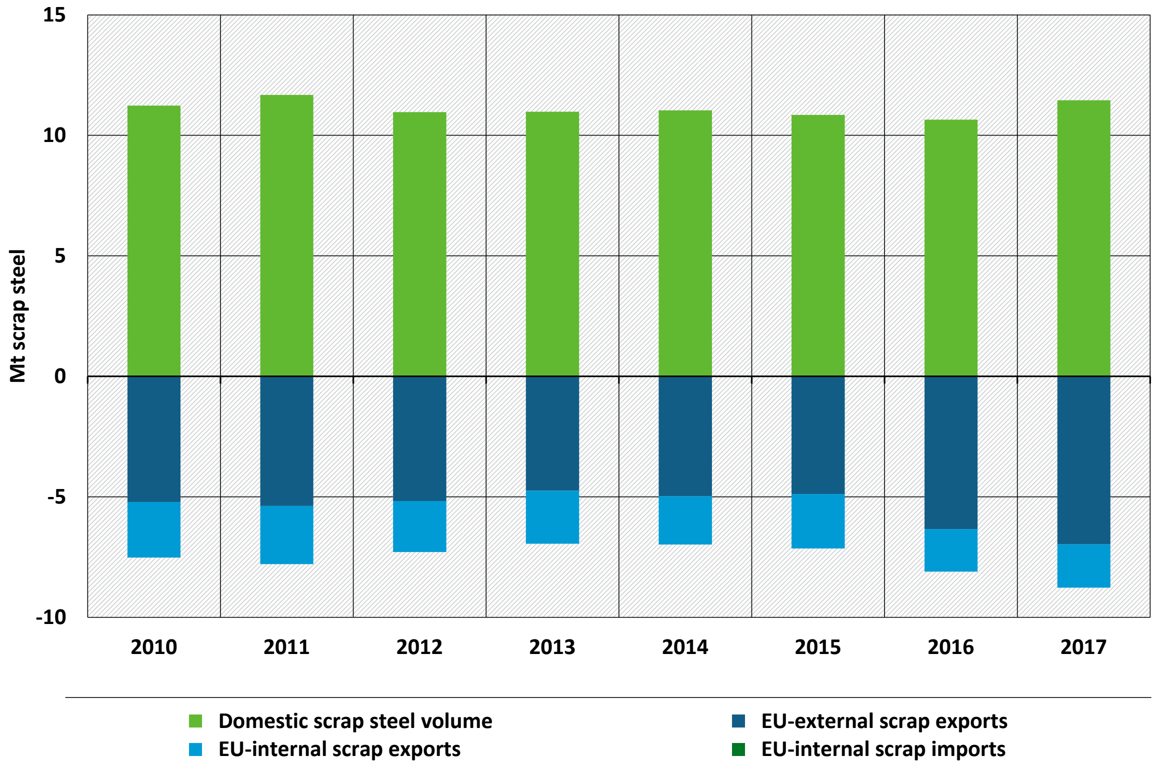


Figure 80: Dutch import/export balance on the international steel scrap market

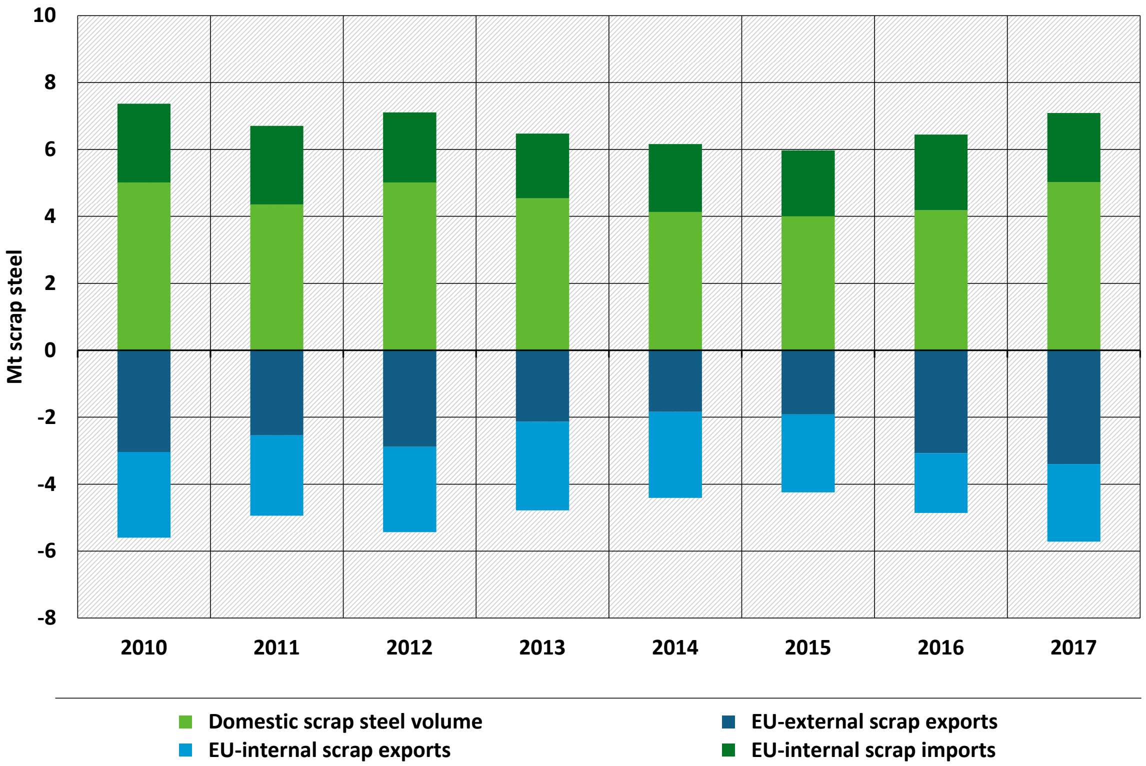
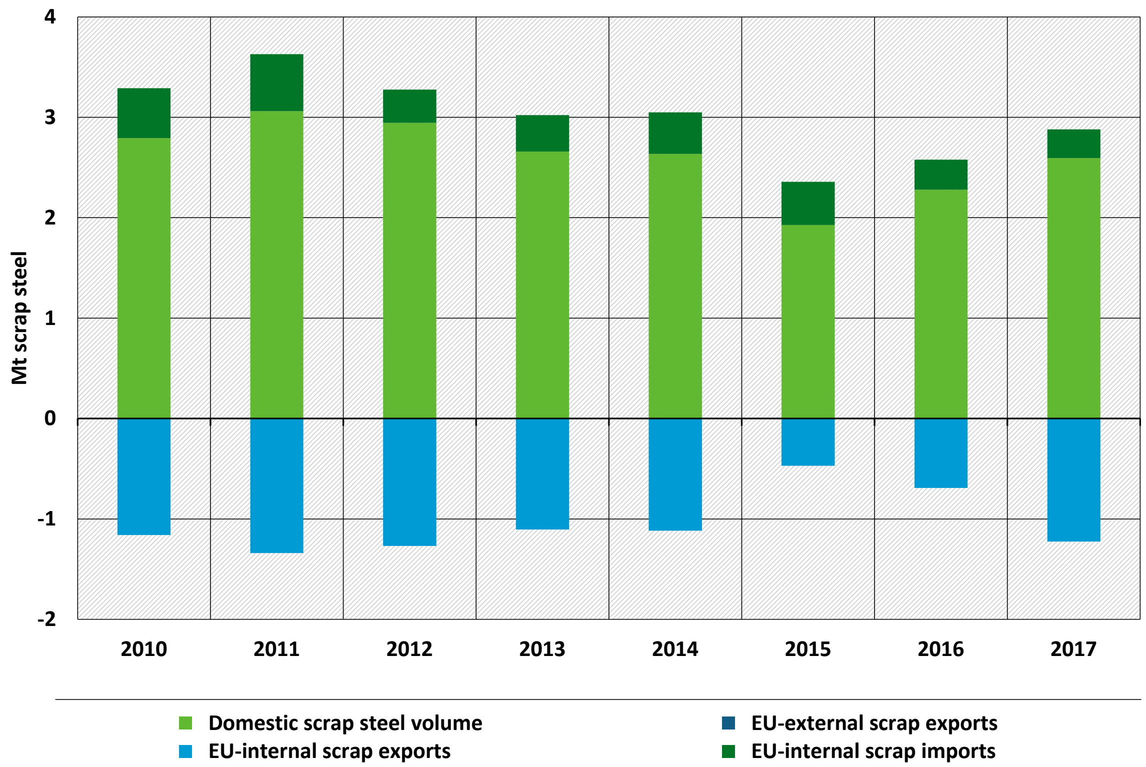


Figure 81: Czech import/export balance on the international steel scrap market



A.3 Waste gas installations

Integrated steelworks produce so-called waste gases, which stem from processes in the coke oven (coke oven gas), the blast furnace (blast furnace gas) and the basic oxygen furnace (oxygen furnace gas). These waste gases are in some cases burned in combustion installations reporting their emissions under activity code 20 in the EU ETS. These waste gas combustion installations were identified through individual research based on common addresses with blast furnaces as well as installation and company names by the authors. A list of the installations identified is included in Table 39.

However, the identified installations may also burn other fuels such as natural gas or coal. This leads to uncertainties regarding the exact emissions of the iron and steelmaking sector (also see section 2.3.1 for further details).

Table 39: Identified waste gas power plants reporting under activity code 20

EUTL-ID	Installation	Emissions 2019 (Mt CO_2)[1]
AT 12	Energiepark Donawitz	0.0
AT 15	Voestalpine Kraftwerk Linz	0.0
AT 231	Voestalpine Stahl Linz sonstige Anlagen	0.0
BE 112	ArcelorMittal Liège Upstream Energie Ougrée	0.0
BE 113	ArcelorMittal Liège Upstream Energie Seraing	0.0
BE 286	Carsid Autoproduction Charleroi Rectif	0.0
BE 74	Electrabel - Centrale Rodenhuize	0.2
BE 750	Electrabel - Knippegroen	5.1
CZ 252	ENERGETIKA TŘINEC - Teplárny a Tepelná zařízení	1.6
CZ 421	TAMEH Czech	1.9
DE 1086	Kesselstation der DH	0.1
DE 1132	Kraftwerk Hallendorf	3.5
DE 1228	Block 4 Bremen	2.5
DE 1230	Block 3 Bremen	0.0
DE 1320	Kraftwerk zur Stromerzeugung	0.4
DE 1329	Dampfkesselanlage SAG	0.0
DE 1386	Dampfheizkraftwerk VEO	1.9
DE 1411	Heizkraftwerk ThyssenKrupp Stahl AG Duisburg Hamb.	2.0
DE 1415	Dampfkesselanlage Duisburg Hamborn	2.3
DE 1486	Kraftwerk Huckingen	2.7
DE 1850	Kraftwerk Hamborn Block 5	3.1
DE 4112	Kesselanlage Kokerei Prosper III	0.0

DE 4137	Gichtgaskraftwerk Dillingen/Saar	1.1
ES 201	EDP España. S.A. - Aboño 1[2]	4.9 (2.7)
FR 988	ETF - CENTRALE DK6[2]	4.6 (3.9)
HU 63	ISD POWER Kft. Erőmű	1.4
IT 511	ArcelorMittal Italy Energy srl	4.4
NL 185	Vattenfall Power IJmond[2]	1.8 (5.4)
NL 188	Vattenfall Power Velsen[2]	3.9
PL 31	Zakład Wytwarzania Nowa (TAMEH)	3.3
PL 457	TAMEH Elektrociepłownia w Krakowie	1.1
PL 928	Walcownia Rur	0.0
RO 111	SC ELECTROCENTRALE GALATI SA	0.0
SE 178	Luleå KVV	1.4
SK 208904	Ferroenergy s.r.o.	2.5
Total		57.8
Total (including correction)		54.5

Notes:

[1] Emissions are displayed as reported in the EUTL. However, emissions coming from waste gases burned in the respective power plant might be lower due to the co-firing of other fuels. The LCPD database provides information on the fuel inputs for large combustion units in the EU. In combination with assumptions on the emission factors of the fuel (0.202 tCO_2 per MWh LHV for natural gas; 0.338 tCO_2 per MWh for coal in Spain) and information on CO_2 emissions from EUTL co-firing of other fuels in waste gas-fired power plants can be identified and emissions can be corrected to account for waste gas emissions only. However, due to the lack of matching IDs, different definitions and scopes of installation, and low quality of reporting, the information cannot be broadly used but needs to be compiled and checked for plausibility, individually.

[2] It was possible to correct emissions from other fuel use for France, the Netherlands and Spain. For other countries the attempt did not provide reliable results. We detail the correction factors in the respective country fact sheets.

Source: (EC n.d.), (EEA n.d.).