Greenhouse Gas Emissions in 2022 – Executive Summary

Stationary installations and aviation subject to emissions trading Germany (2022 VET report)

Umwelt Bundesamt

DEHSt
Deutsche Emissionshandelsstelle

Editorial information

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Summary

Energy and industrial sectors in Germany

In 2022, the second year of the fourth trading period of the European Emissions Trading Scheme (EU ETS), 1,731 stationary installations in Germany were covered by the EU ETS as being subject to reporting and surrender.[1] The installations emitted around 354 million tonnes of carbon dioxide equivalents (CO_2-eq), which is roughly the same level as in the previous year. By 2021, as a result of the economic recovery, emissions had almost returned to pre-COVID 19 pandemic levels. In contrast, the development of emissions in the EU ETS in 2022 was significantly influenced by the Russian war of aggression on Ukraine and the associated distortions on the energy markets: Emissions from energy installations increased by 3 percent as a result of the increased fuel switch from natural gas to hard coal and lignite in electricity generation, while emissions from industrial installations fell by 6 percent year-on-year, driven by the economic situation.

Figure 1 provides an overview of the distribution of emissions and installations between the energy and industrial sectors.

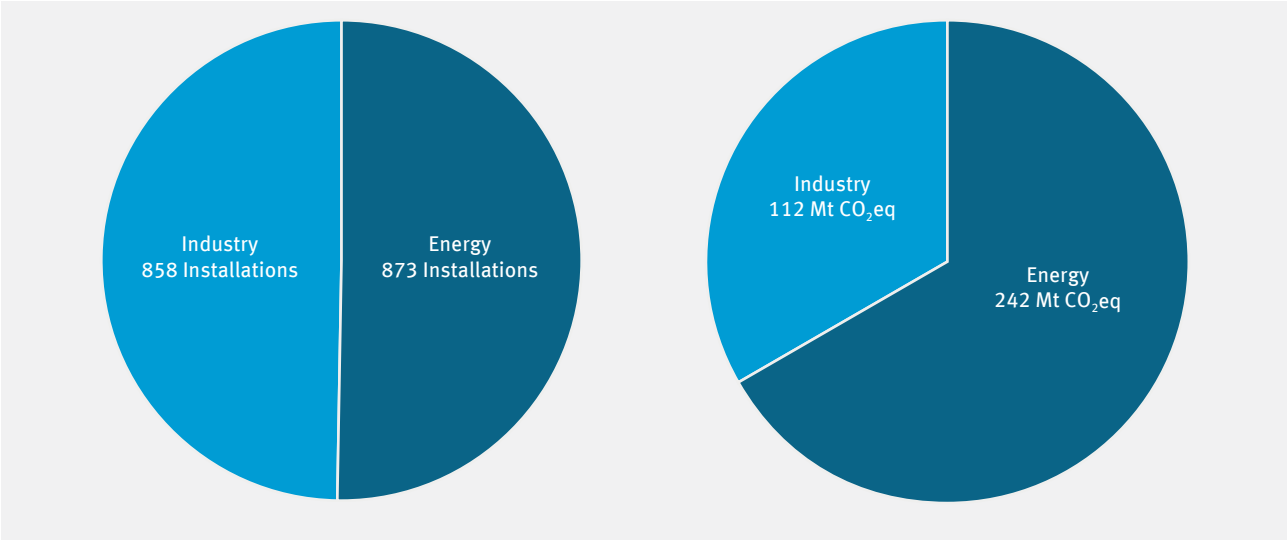

Figure 1: Allocation of emissions and installations subject to emissions trading to the energy sector (activities 2 to 6 according to Annex 1 of the Greenhouse Gas Emissions Trading Act, TEHG) and the industrial sector (activities 1 and 7 to 29 according to Annex 1 TEHG) in Germany 2022

While the number of installations is divided roughly equally between the industrial and energy sectors, energy installations dominate in terms of emissions: two thirds of the emissions from Germany's stationary installations subject to emissions trading is generated by energy installations, one third by industrial installations.

1 In addition, 24 small emitters were subject to reporting requirements, but were not subject to the obligation to surrender emission allowances. These small emitters are not included in this report.

Longer-term emissions trends

Figure 2 shows German EU ETS emissions since 2005, broken down into industrial and energy installations. From 2018 onwards - i.e. for the last five years - the figure shows the reported emissions on an annual basis; in addition, the averages of the first (2005 to 2007), second (2008 to 2012) and third (2013 to 2020) trading periods are shown in each case. The emissions of installations that are no longer subject to emissions trading (n.l. ETS) are also included for the years up to the date of their decommissioning.

These are predominantly emissions from energy plants that are no longer subject to emissions trading, which is why they have not been dividedinto the energy and industrial sectors. In addition, the emissions prior to 2013 were extended by an estimated correction term (scope estimate) in order to reflect the current scope of emissions trading for earlier trading periods as well - in this way, the emissions are comparable across the trading periods. This scope estimate mainly affects emissions from industrial installations, while the estimated additional emissions from energy installations are as low as to be barely visible in this figure.

A comparison of the average emissions from the first, second and third trading periods shows a clear decrease in emissions from German installations in the EU ETS - even without taking the scope estimate into account.

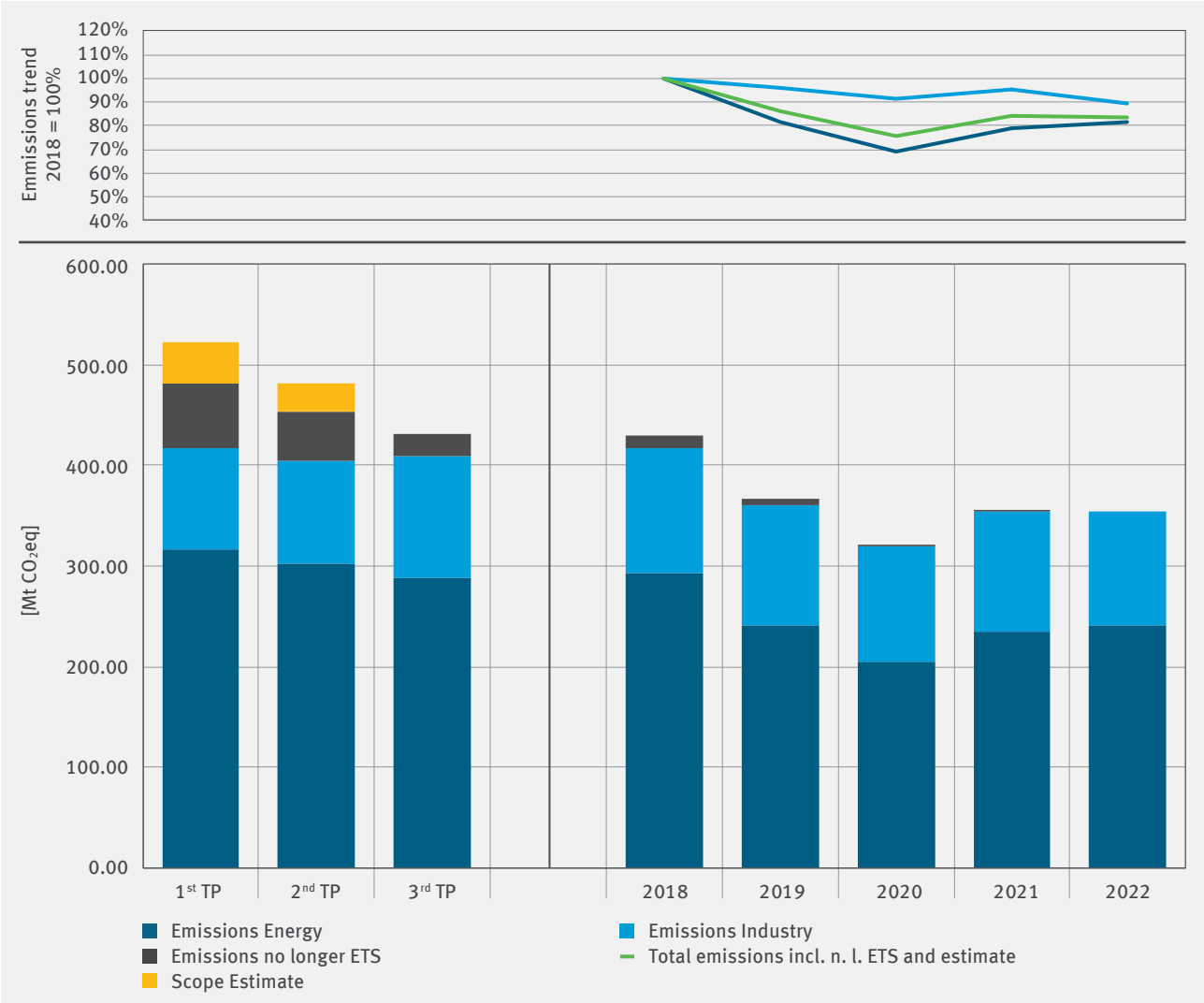

Figure 2: EU ETS emissions from the energy and industrial sectors since 2005 in Germany[2]

2 Estimated emissions (scope estimate) from the polymerisation plants that will be subject to emissions trading from 2018 onwards, amounting to an average of 75,000 tonnes of carbon dioxide equivalents per year (2005 to 2017), are not shown.

Since the beginning of the third trading period in 2013, emissions from **energy installations** have dropped continously. This is due in particular to the decline in electricity generation from lignite and hard coal. The main reasons for this are the growing importance of electricity from renewables, the gradual transfer of electricity generation capacities to security reserve and the decommissioning of power plant units from 2016, and the significant increase in EUA prices from 2018. Between 2018 and 2020, the last year of the third trading period, carbon dioxide emissions have decreased by a total of 31 percent. The first year of the fourth trading period of the EU ETS began against the trend of the third trading period with an increase in emissions of 14 percent to 235 million tonnes of carbon dioxide. The reasons for this were an increased demand for electricity due to the economic recovery after the COVID 19 pandemic as well as increasing emissions from the combustion of hard coal and lignite. This development continued in 2022 due to the turmoil on the energy markets triggered by the Russian war of aggression on Ukraine: emissions from energy plants increased by around 3 percent in 2022 compared to 2021, as electricity generation from hard coal and lignite in particular increased noticeably, thus also compensating for the decline in electricity generation from natural gas. Emissions from energy plants thus returned to roughly the same level as in 2019.

A major cause of the increase in electricity generation from hard coal and lignite was the disproportionate increase in the price of natural gas in connection with a relatively tight supply, especially as a result of the Russian war of aggression on Ukraine. The price increase favoured the use of hard coal-fired power plants over natural gas plants from an economic point of view. In addition, base-load electricity generation from nuclear power declined due to power plant closures. Even a substantial increase in feed-in from renewable energies to a new peak could not compensate for this development. Starting in the second half of 2022, hard coal-fired power plants that had already been shut down or were scheduled for shutdown with a total capacity of around 5 gigawatts were reactivated from the reserve to avert a gas emergency and prevent an electricity supply crisis.

The **emissions of energy-intensive** industry hardly changed in the third trading period until 2018 and were between around 123 and 126 million tonnes of carbon dioxide equivalents in each case. It was not until 2019 that they fell noticeably for the first time, to 120 million tonnes of carbon dioxide equivalents. In 2020, they then fell further to 114.5 million tonnes of carbon dioxide equivalents. This decrease in emissions was mainly due to economic developments as a result of the COVID 19 pandemic, while in 2019 it was significantly influenced by the global economic downturn, which also affected production trends in Germany. In 2021, emissions increased by 4 percent year-on-year to 120 million tonnes of carbon dioxide equivalents. Thus, after two years of cyclical emission declines, emissions rose again and almost reached the level before the COVID 19 pandemic. In 2022, they fell again - to about 112 million tonnes of carbon dioxide equivalents and thus even below the emission level of 2020, which was marked by the COVID 19 pandemic. The cause here, as with energy plants, was the impact of the Russian war of aggression on Ukraine. The associated uncertainties led to energy price increases, especially for natural gas and electricity, cost increases, declines in demand and thus to lower production and emissions in most sectors.

The decrease in **total German EU ETS emissions** until 2020 is thus predominantly due to the decrease in emissions from energy plants.

Emissions from industrial installations in detail

Figure 3 shows the distribution of the total emissions from individual industrial sectors and their total emissions. The iron and steel industry accounts for the largest share of industrial emissions at about 30 percent, followed by refineries (21 percent), cement clinker production (17 percent) and the chemical industry (13 percent). The shares of the iron and steel industry and cement clinker production remained unchanged compared to the previous year, while the share of refineries increased slightly (2021: 19 percent) and that of the chemical industry decreased slightly (2021: 14 percent). The remaining industrial emissions are distributed among four other sectors and sub-sectors: other mineral processing industry (7 percent), which includes, for example, glass and ceramics production, industrial and construction lime (6 percent), pulp and paper industry (4 percent) and non-ferrous metals industry (2 percent). Other combustion plants, which cannot be assigned to any of the aforementioned sectors, generate only about half a percent of industrial emissions.

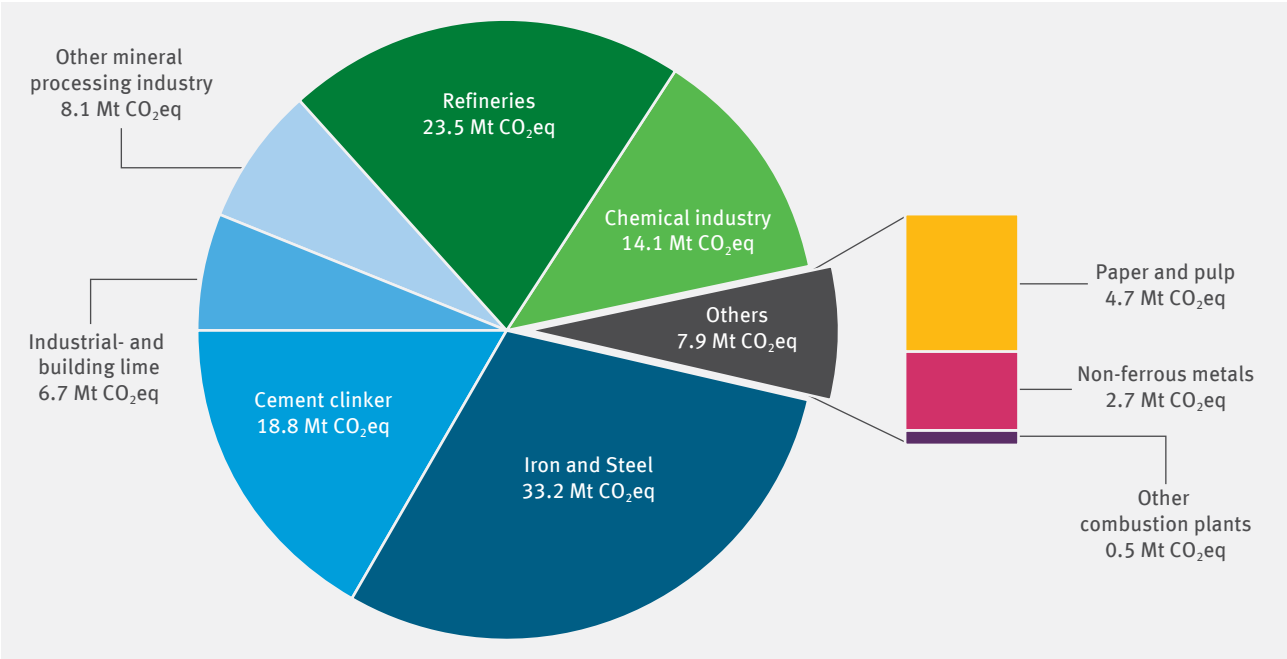

Figure 3: Shares of the individual industries in the emissions of the industrial sector in 2022 and total emissions

Figure 4 summarises the different trends of emissions in selected industrial sectors compared to the previous year. In addition, the relative annual changes since 2018 are also shown. In addition, the change in a five-year comparison in 2022 compared to 2018 is also shown.

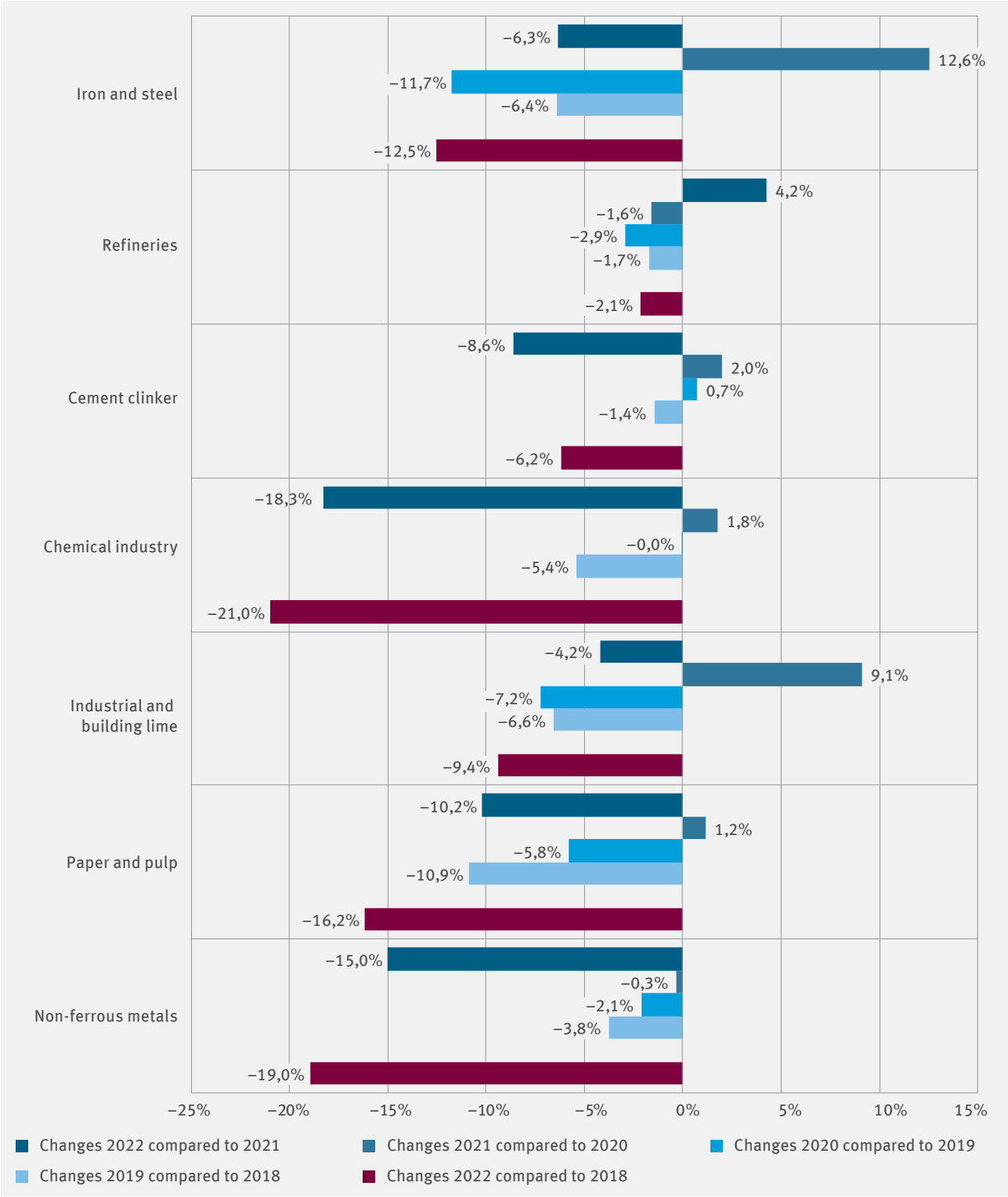

Figure 4: Annual changes in emissions in the industrial sectors since 2018 and overall change since 2018

In 2022, emissions fell significantly in almost all sectors compared to the previous year. The emission decreases of the non-ferrous metals industry and the chemical industry were even in the double-digit range, at minus 15 and minus 18 percent, respectively. The emission reductions of the industrial and building lime sector, the iron and steel industry, cement clinker production and the paper and pulp industry were between 4 and 10 percent. In all of the above-mentioned sectors, the reaction of the markets (including high energy prices and falling demand) to the Russian war of aggression on Ukraine had an impact on production and thus on emissions: In the course of the mostly declining production in the industrial sectors, emissions fell. Only emissions from refineries increased moderately compared to 2021, by about 4 percent, due in part to increased demand for fuels as the travel industry recovered from the removal of restrictions following the COVID 19 pandemic. Looking at the change in emissions in the reporting year 2022 compared to 2018, a decrease in emissions can be seen in all sectors.

The largest emitters in the energy and industrial sectors

The largest emitters among the power plants in the current reporting year are shown in Table 1. The Boxberg III and Boxberg IV plants are combined into one power plant in Table 1. In total, these ten power plants and eleven plants respectively cause just over a third (36 percent) of the emissions subject to emissions trading in the stationary sector and slightly more than half (523 percent) of the emissions from energy installations, with around 127 million tonnes of carbon dioxide equivalents. In 2022, the emissions of the ten largest power plants were in total about 15 million tonnes of carbon dioxide equivalents higher than the aggregated emissions of all German industrial installations. In 2021 they were still on a par.

Table 1: The ten largest power plants (Activities 2 to 6) by emissions

Installation (operator)	2022 VET [kt CO_2eq]	Change against 2021	
Neurath Power Plant (RWE Power AG)	24,223	▲	10%
Boxberg III und IV Power Plant (Lausitz Energie Kraftwerke AG)	19,128	▲	23%
Niederaussem Power Plant (RWE Power AG)	16,996	▲	6%
Jänschwalde Power Plant (Lausitz Energie Kraftwerke AG)	15,313	▲	1%
Weisweiler Power Plant (RWE Power AG)	14,926	▲	3%
Lippendorf Power Plant (Lausitz Energie Kraftwerke AG)*	11,911	▲	8%
Schwarze Pumpe Power Plant (Lausitz Energie Kraftwerke AG)	9,571	▼	–19%
Mannheim Large Power Plant (GKM) (Grosskraftwerk Mannheim AG)**	5,972	▲	19%
Rheinhafen Steam Power Plant, Karlsruhe (EnBW Energie Baden-Württemberg AG)	4,764	▲	15%
Schkopau Power Plant (Saale Energie GmbH)	4,388	●	0%
Total	**127,191**	▲	**6%**

As of 02/05/2023
* Lippendorf Power Plant is a joint power plant owned by LEAG (Lausitz Energy Power Plants AG) and EnBW (Energy Baden-Württemberg AG), each of which owns a unit.
** Mannheim Large Power Plant is a joint power plant of the following companies: RWE Generation SE (40%), EnBW (32%) and MVV RHE GmbH (28%).

The ten largest emitters among the industrial facilities emit significantly less than the ten largest power plants, at around 35 million tonnes of carbon dioxide equivalents, and all belong to the iron and steel industry or are refineries. Their share of emissions subject to emissions trading in the stationary sector is about 10 percent, while they account for 31 percent of the emissions of all industrial facilities.

Table 2: The ten largest industrial installations (activities 1 and 7 to 29) by emissions

Installation (operator)	2022 VET [kt CO_2-eq]	Change against 2021	
Duisburg Integrated Steelworks (thyssenkrupp Steel Europe AG)	7,935	▲	1%
Duisburg-Huckingen Plant, Glocke (HKM Hüttenwerke Krupp Mannesmann GmbH)	4,205	▼	–14%
Dillingen Plant, Amalgamated Installation (ROGESA Roheisengesellschaft Saar mbH)	3,993	▼	–7%
Salzgitter Plant, Glocke (Salzgitter Flachstahl GmbH)	3,655	▼	–2%
PCK Refinery, Glocke (PCK Raffinerie GmbH)	3,601	▲	3%
Ruhr Oel GmbH – Scholven Plant (Ruhr Oel GmbH)	3,078	▲	2%
Oberrhein Mineral Oil Refinery, Plant 1 and Plant 2 (Mineralölraffinerie Oberrhein GmbH & Co. KG)	2,622	▲	6%
Bremen Plant, Amalgamated Installation (ArcelorMittal Bremen GmbH)	2,101	▼	–7%
Wesseling Plant (Shell Deutschland GmbH Shell Energy and Chemicals Park Rheinland)	1,998	▲	12%
Mineral Oil Refinery Leuna (TOTAL Raffinerie Mitteldeutschland GmbH)	*1,909*	▲	*19%*
Total	**35,097**	●	**–1%**

As of 02/05/2023
Italics = new installation / power plant in the TOP 10

Allocation status

In the second year of the fourth trading period, the verified emissions of all installations subject to emissions trading in Germany were again significantly higher than the free allocation amount for the current year, at 354 million tonnes of carbon dioxide equivalents. In 2022, a total of about 126 million emission allowances were allocated free of charge to operators of 1,577 of the total of 1,731 German installations (as of 19/04/2023). The average allocation rate was thus 36 percent, the same level as in the previous year. Taking into account transfers of waste gases and heat imports in the allocation amounts, there is a proportionate shift in the allocation between the sectors. As a result of this adjustment, the allocation coverage in the industrial sectors is reduced from 102 to 87 percent in 2022, while the allocation coverage in the energy sector increases from 5 to 12 percent, as Table 3 shows.

Table 3: Adjusted equipment coverage (taking into account transfers of waste gases from iron, steel and coke production and heat imports)

Sector	Activity	No. of Installa-tions	2022 allocation amount [1000 EUA]	2022 VET [kt CO_2eq]	2022 allocation deviation from 2022 VET [kt CO_2eq]	2022 allocation coverage*	Adjusted 2022 allocation amount** [1000 EUA]	2022 adjusted allocation coverage**
Energy	Energy installtions	873	11,685	241,752	–230,067	4.8%	28,708	11.9%
		873	**11,685**	**241,752**	**–230,067**	**4.8%**	**28,708**	**11.9%**
Industry	Refineries	22	15,771	23,470	–7,699	67.2%	15,771	67.2%
	Iron and Steel	120	46,551	33,186	13,365	140.3%	31,621	95.3%
	Non-ferrous metals	39	2,456	2,665	–209	92.2%	2,456	92.2%
	Industrial and building lime	38	4,452	6,666	–2,214	66.8%	4,452	66.8%
	Cement clinker	35	17,550	18,763	–1,213	93.5%	17,550	93.5%
	Other mineral processing industries	223	5,645	8,122	–2,477	69.5%	5,645	69.5%
	Paper and pulp	134	4,852	4,733	119	102.5%	3,827	80.8%
	Chemical industry	197	16,538	14,098	2,440	117.3%	15,471	109.7%
	Other combustion installtions	50	577	499	78	115.7%	577	115.7%
		858	**114,391**	**112,202**	**2,190**	**102.0%**	**97,368**	**86.8%**
Gesamt		**1,731**	**126,076**	**353,953**	**–227,877**	**35.6%**	**126,076**	**35.6%**

As of 02/05/2023
* Without considering possible adjustments for transfers of waste gases and heat imports
** Considering possible adjustments for transfers of waste gases and heat imports

Germany and Europe

Emissions from all installations participating in the EU ETS in 2022 (27 EU Member States and Iceland, Liechtenstein, Norway) fell slightly: according to the European Commission, emissions fell by 1.1 percent in 2022 and amounted to around 1.32 billion tonnes of carbon dioxide equivalents.

After emissions in Germany had fallen less sharply than in the other EU ETS Member States in the second trading period and in the first half of the third trading period, the trend of emissions in German installations in the following years followed the Europe-wide trend: Overall, since the beginning of the third trading period, emissions in Germany have actually declined somewhat more (minus 26 percent) than in the EU ETS states as a whole (minus 22 percent). This is mainly due to the significant emission reductions of German energy installations in 2019 and 2020.

The large surplus of unused emission allowances from the second and the beginning of the third trading period could be partially reduced in recent years. This was primarily achieved through reductions in auction volumes: in the years 2014 to 2016 through so-called backloading, and since 2019 through the Market Stability Reserve (MSR). If the quantity of emission allowances in circulation exceeds the threshold of 833 million emission allowances, the EUA quantities earmarked for auctioning are reduced by 24 percent of the quantity in circulation in the following twelve months and transferred to the MSR. As an indicator of the surplus, the European Commission determines an official value of the quantity in circulation each year, the so-called TNAC (Total Number of Allowances in Circulation). According to the European Commission, the TNAC amounted to 1.13 billion emission allowances at the end of 2022. Despite the comprehensive auction volume cuts and the increased emissions, the value remains well above the upper MSR threshold above which auction volume reductions take place. The current value of the TNAC decides the size of the auction volume cut by the MSR in the period from 01/09/2023 to 31/08/2024. In this period, a total of around 272 million fewer emission allowances than planned will be auctioned and transferred to the MSR. In addition, allowances in the MSR were cancelled for the first time, reducing the MSR inventory of 3.0 billion allowances by 2.52 billion allowances, so that the remaining MSR inventory now amounts to 486 million allowances.

Aviation

For 2022, a total of 72 of the aircraft operators subject to emissions trading administered by Germany reported emissions amounting to 7.2 million tonnes of carbon dioxide. This represents an increase in emissions of around 55 per ent compared to the previous year. The average equipment level in 2022 was around 45 percent, which is significantly lower than the figure for 2021 of 71 percent. This is due to the further increase in emissions caused by the recovery of the aviation sector after the sharp decline in transport performance in 2020 due to the COVID 19 pandemic. However, the emission level before the COVID 19 pandemic has not yet been reached again.

Outlook

The year 2022 was the second year of the fourth trading period of the EU ETS, from which a changed allocation regime compared to the third trading period and a more sharply declining cap will come into effect. With the so-called “Fit for 55” package, further adjustments for the EU ETS have now been decided, which will be implemented step by step within the fourth trading period.

This broad legislative package, first presented by the European Commission in summer 2021 as part of the European Green Deal, is intended to implement the increase of the EU greenhouse gas reduction target for 2030 to at least 55 percent compared to 1990. The legislative amendments concerning the EU ETS were adopted in spring 2023 and the corresponding legal acts were published in the Official Journal of the European Union in May 2023. The amendment of the EU Emissions Trading Directive (EHRL) significantly raises the ambition level in the EU ETS and extends the scope of the EHRL to additional sectors. In detail:[3]

- The reduction performance in the EU ETS will be increased from 43 percent to 62 percent by 2030 compared to 2005. The linear reduction factor (LF) is to be raised from the current 2.2 percent to 4.3 percent from 2024 and 4.4 percent from 2028. In 2024 and 2026, the cap will also be lowered by an additional 117 million allowances.
- In addition, the Market Stability Reserve (MSR) will also be strengthened and adapted in some technical aspects: The decisive factor is that the doubled reduction rate from 12 to 24 percent of the quantity in circulation (TNAC) is maintained until 2030 and thus does not end in 2023 as currently envisaged.
- Furthermore, the European solidarity and support instruments will be significantly expanded and adapted, which are intended to cushion the economic challenges of the increased ambition level as well as the social consequences of the new EU ETS 2 (see below in the text). In future, the member states must also refinance 100 percent of their auction proceeds in climate protection issues and their active flanking measures.
- To protect against carbon leakage – i.e. the relocation of industrial production, investments and associated emissions abroad – an EU Carbon Border Adjustment Mechanism (CBAM) is to be gradually introduced. From October 2023, the first pilot sectors will be subject to a reporting obligation, and from 2026 also to an obligation to surrender CBAM allowances. This means that certain energy-intensive raw materials and products imported into the EU from abroad will be subject to the same CO_2 price as in the EU. In return, the free allocation for these products as a previous measure for carbon leakage protection is to be gradually reduced and ended by 2034.
- From 2024, maritime transport will be gradually integrated into the existing EU ETS 1.
- In addition, the rules for aviation, which has already been included in the EU ETS since 2012, will be adjusted in view of the implementation of CORSIA and the ambition level will be raised there as well. For fuels, including those from the transport and buildings sectors, a separate EU ETS 2 will be gradually created from 2024 onwards (2024 to 2026 reporting obligation only, from 2028 at the latest full upstream ETS with levy obligation). The reduction performance in the EU ETS 2 is to be 43 percent by 2030 compared to 2005.

Due to the introduction of the EU ETS 2, the national emissions trading system (nEHS) will be transferred to it in the future. Since 2021, the nEHS has regulated the emissions of diesel, petrol, heating oil, natural gas and biomass. The aim is to avoid double burdens from the nEHS and the EU ETS. For the first reporting year 2021, national emission allowances amounting to about 306 million tonnes of carbon dioxide were surrendered in 2022.[4] In 2023, the scope of the nEHS was extended to include coals, and in 2024 it will be extended to include waste.

The economic and political environment must also be kept in mind: The recovery of the overall economic situation in 2021 after the strong emission declines in 2020 due to the COVID 19 pandemic was abruptly ended by the consequences of the Russian war of aggression on Ukraine on 24 February 2022. The resulting increases in energy prices, shortages of raw materials and declines in demand shaped the development of emissions in 2022 and will continue to have an impact on the development of energy and climate policy in Germany and Europe for the foreseeable future.

3 A more detailed analysis of the proposals is contained in the fact sheets published by UBA on the Federal Environment Agency website in summer 2023.

4 See DEHSt News (only in german).

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