Greenhouse Gas Emissions in 2022

Stationary Installations and Aviation Subject to Emissions Trading in Germany (2022 VET Report)

Umwelt Bundesamt

DEHSt
Deutsche Emissionshandelsstelle

Editorial Information

Publisher
German Emissions Trading Authority (DEHSt)
at the German Environment Agency
City Campus
Building 3, Gate 3 A
Buchholzweg 8
D-13627 Berlin
Phone: +49 (0) 30 89 03-50 50
Fax: +49 (0) 30 89 03-50 10
emissionstrading@dehst.de
Website: www.dehst.de/English

As of May 2023

Responsible editor: Section V 3.3

ISSN (hardcopy): 2567-8124
ISSN (online): 2570-0618

English by Nigel Pye, npservices4u@gmail.com

Cover image: Sebastian/Fotolia.com

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] These installations emitted around 354 million tonnes of carbon dioxide equivalents (CO_2eq), roughly the same level as in the previous year. By 2021, emissions had already returned to near pre-COVID 19 levels as a result of the economic recovery. In contrast, emissions trend in the EU ETS in 2022 was largely shaped by the Russian war of aggression in Ukraine and the associated turmoil in the energy markets: emissions from energy installations increased by 3 percent as a result of an increased fuel switch from natural gas to hard coal and lignite for power generation, while emissions from industrial installations fell by 6 percent against the previous year, driven by the economic situation.

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

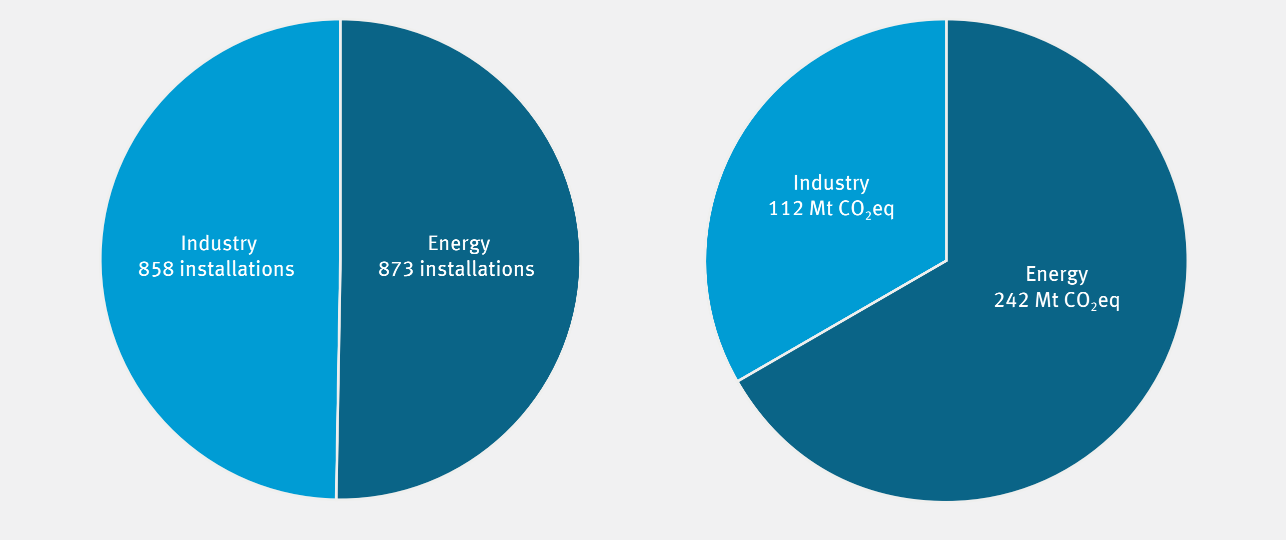


Figure 1: Distribution of emissions and installations subject to emissions trading in the energy sector (Activities 2 to 6 as per Annex 1 TEHG) and the industrial sector (Activities 1 and 7 to 29 as per Annex 1 TEHG) in Germany in 2022

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

1 In addition, 24 small emitters were required to report but were not subject to an emission allowance surrender obligation. These small emitters are not included in this report. For details, see Chapter 1.3.

Longer-term emissions trends

Figure 2 shows German EU ETS emissions since 2005, broken down to industrial and energy installations. The figure shows the reported emissions on an annual basis from 2018 onward, i.e. for the last five years, and the averages for each of the first (2005 to 2007), second (2008 to 2012), and third (2013 to 2020) trading periods. Emissions from installations that are no longer subject to emissions trading (n.l. ETS)[2] are also taken into account for the years up to the date of their decommissioning. These are predominantly emissions from energy installations that are no longer subject to emissions trading, which is why they have not been divided into the energy and industrial sectors. In addition, an estimated correction term (scope estimate) was added to emissions prior to 2013 in order to reflect the scope of emissions trading for previous trading periods at that time – thus 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 the figure.

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

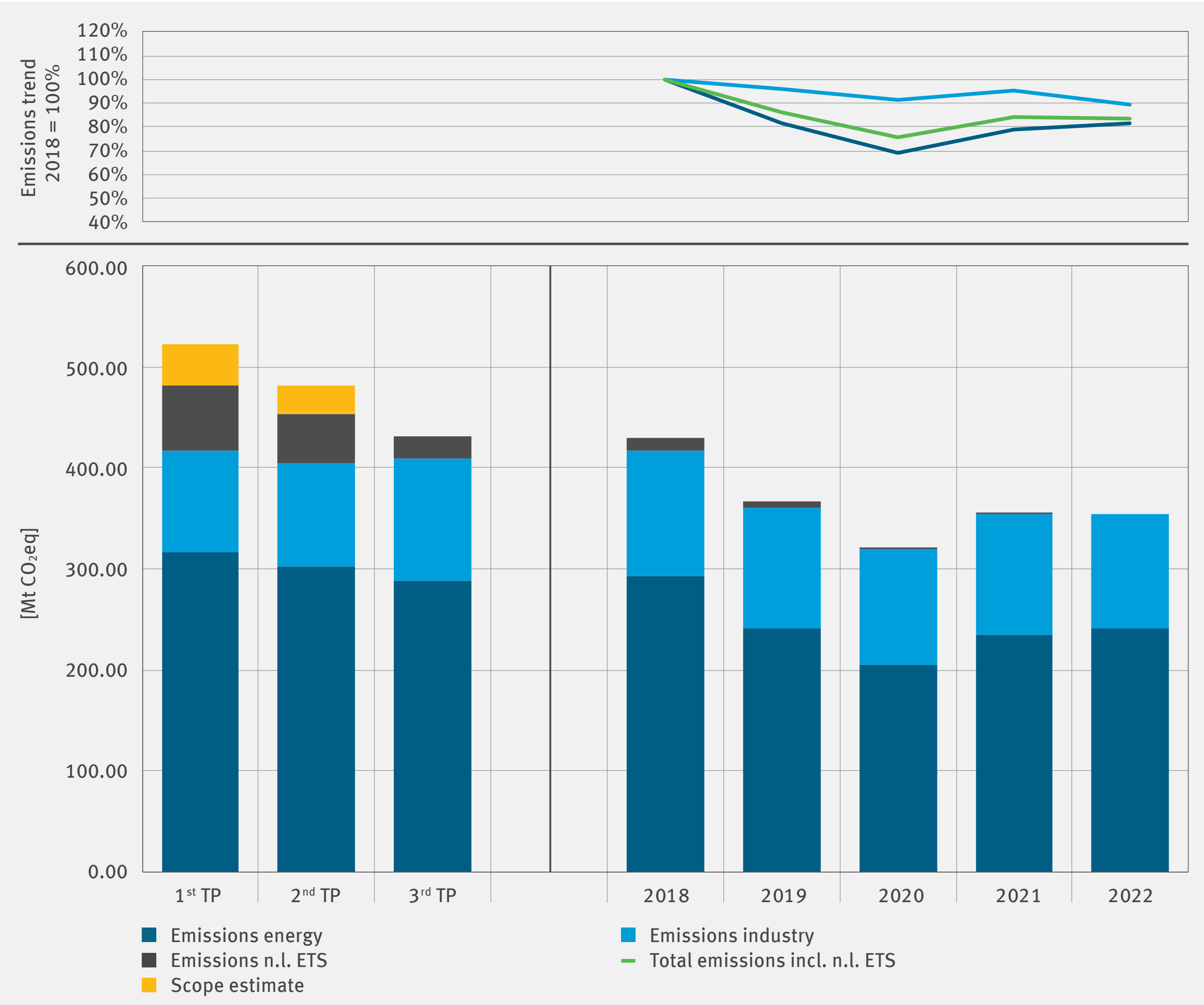


Figure 2: EU ETS emissions from the energy and industry sectors in Germany since 2005[3]

2 See explanations on 'Taking into account installations no longer subject to emissions trading (n.l. ETS)' in Chapter 1 Introduction.

3 Estimated emissions (scope estimate) from polymerisation plants that have been 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.

Emissions from **energy installations** have fallen steadily since the start of the third trading period in 2013. This is in particular due to the decline in electricity generation from lignite and hard coal. The main reasons for this are the growing importance of generating electricity from renewables, the step-by-step transfer of electricity generation capacities to the security reserve, the decommissioning of power plant units from 2016 and the significant increase in EUA prices from 2018. Carbon dioxide emissions have decreased by a total of 31 percent between 2018 and 2020, the final year of the third trading period. Contrary to the trend in the third trading period, the first year of the fourth trading period began with a 14 percent increase in emissions to 235 million tonnes of carbon dioxide. The reasons for this were an increased demand for electricity due to the economic recovery and rising emissions from the combustion of hard coal and lignite. This trend continued in 2022 due to the turmoil on the energy markets triggered by the Russian war of aggression in Ukraine: emissions from energy installations 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 installations therefore 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 rise in the price of natural gas in connection with a relatively tight supply, especially as a result of the Russian war of aggression in Ukraine. The price increase favoured the use of hard coal fired power plants over natural gas plants from an operational point of view. In addition, base-load capable nuclear power generation decreased due to power plant closures. Even a substantial increase in feed-in from renewables to a new high could not compensate for this trend. From the second half of 2022, hard coal fired power plants that had been shut down or earmarked for closure with a total capacity of around 5 gigawatts were reactivated from reserve to avert a gas emergency and prevent an electricity supply crisis.

Emissions from the **industry with high energy consumption** hardly changed in the 3rd trading period up to 2018 and were between roughly 123 and 126 million tonnes of carbon dioxide equivalents each. It was not until 2019 that they noticeably fell 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 the economic trend in the wake of the COVID 19 pandemic whereas in 2019, it had been significantly influenced by the global economic downturn which also affected production trends in Germany. In 2021, emissions increased by four percent year-on-year to 120 million tonnes of carbon dioxide equivalents. Emissions thus rose again after two years of declining emissions (due to economic causes), almost returning to pre-COVID 19 pandemic levels. In 2022, they fell again – to around 112 million tonnes of carbon dioxide equivalents, even below the 2020 emissions level, which was marked by the COVID 19 pandemic. The cause here, as for energy installations, was the impact of the Russian war of aggression in Ukraine. The associated uncertainties led to energy price increases, particularly of 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** up to 2020 was thus predominantly due to the decrease in emissions from energy installations.

Emissions from industrial installations in detail

Figure 3 shows the proportions of the total emissions from individual industrial sectors and their absolute emissions. The iron and steel industry accounts for the largest share of industrial emissions at around 30 percent, followed by refineries (21 percent), cement clinker production (17 percent) and the chemical industry (13 percent). The proportions of the iron and steel industry and cement clinker production remained unchanged compared to the previous year, while the proportion of refineries rose slightly (2021: 19 percent) and that of the chemical industry fell somewhat (2021: 14 percent). The remaining industrial emissions are distributed across four other sectors and sub-sectors: other mineral processing industries (seven percent), which includes glass and ceramics production, industrial and building lime (six percent), the paper and pulp industry (four percent) and non-ferrous metals industry (two percent). Other combustion plants that cannot be assigned to any of the aforementioned sectors generate only about half a percent of the total industrial emissions.

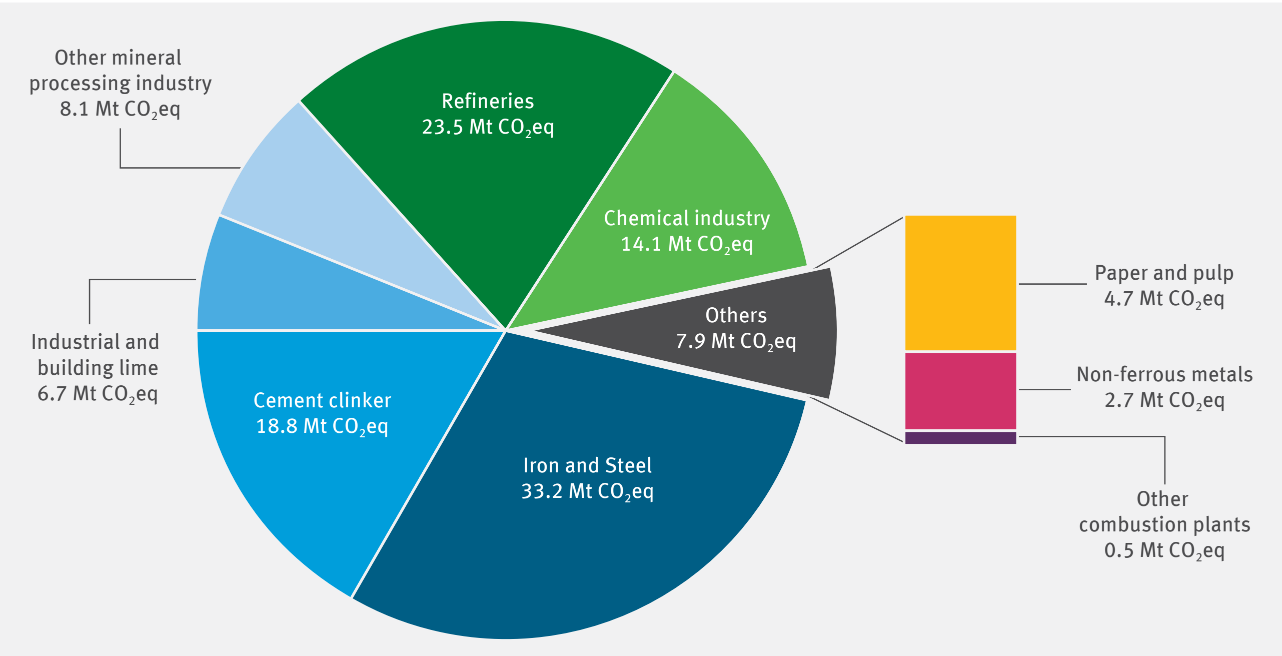


Figure 3: Distribution of emissions among individual industrial sectors in 2022 and absolute emissions

Figure 4 summarises the differentiated emission trends within selected industrial sectors compared to the previous year. In addition, the relative annual changes since 2018 are also shown. The five-year fluctuation between 2022 and 2018 is also shown.

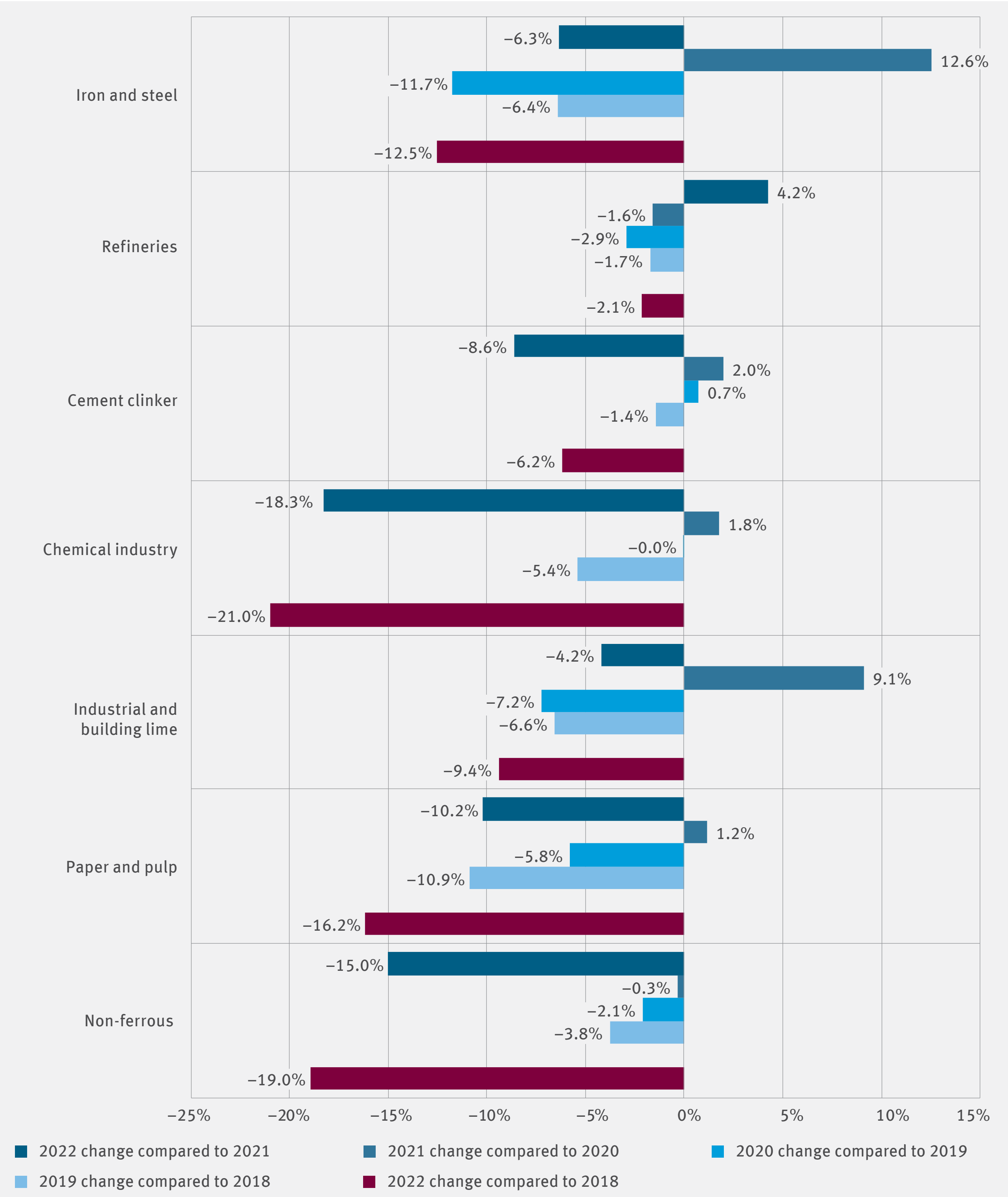


Figure 4: Annual changes in the industrial sectors' emissions since 2018 and total change since 2018

2022 emissions fell significantly in almost all sectors compared to the previous year. The decline in emissions from the non-ferrous metals and chemical industries at minus 15 and minus 18 percent respectively, even reached double digits. The decline in emission from the industrial and building lime sector, the iron and steel industry, cement clinker production and the paper and pulp industry were all between 4 and 10 percent.
In all the above sectors, the market reaction to the Russian war of aggression in Ukraine (including high energy prices and falling demand) affected production and therefore emissions: emissions fell in the wake of declining production in the majority of the industrial sectors. Only refinery emissions increased moderately by about 4 percent compared to 2021 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 across all sectors saw a decrease in emissions between the 2022 reporting year compared to 2018.

The largest emitters in the energy and industrial sectors

Table 1 shows the largest emitters among the energy installations in the current reporting year. The Boxberg III and Boxberg IV installations are combined into one power plant in Table 1. In total, these ten power plants and eleven installations contributed approximately 127 million tonnes of carbon dioxide equivalents accounting for slightly over a third (36 percent) of the emissions subject to emissions trading in the stationary sector. Moreover, they were responsible for just over half (53 percent) of the emissions from energy installations. In 2022, emissions from the ten largest power plants were around 15 million tonnes of carbon dioxide equivalents higher than the aggregate 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 and 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%
Kraftwerk Lippendorf (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 jointly owned power plant between LEAG (Lausitz Energy Power Plants AG) and EnBW (Energy Baden-Württemberg AG), each of which owns one unit.
** Mannheim Large Power Plant is a jointly owned power plant between the following companies: RWE Generation SE (40%), EnBW (32%) and MVV RHE GmbH (28%).

The ten largest emitters among the industrial installations emit significantly less than the ten largest power plants at around 35 million tonnes of carbon dioxide equivalents from the iron and steel industry or refineries. These industrial installations contribute around ten percent of emissions subject to emissions trading in the stationary sector, while they account for 31 percent of emissions from all industrial installations.

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

Installation (operator)	2022 VET [kt CO_2eq]		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 den TOP 10

Allocation status

In the second year of the fourth trading period, verified emissions of 354 million tonnes of carbon dioxide equivalents from all installations in Germany subject to emissions trading again significantly exceeded the free allocation amount for that year. In 2022, about 126 million emission allowances were allocated free of charge to operators of 1,577 of Germany's 1,731 installations (as of 19/04/2023[4]). The average allocation coverage was thus 36 percent being on the level of the previous year. Taking into account transferred waste gases from iron, steel and coke production and heat imports in the allocation amounts, the allocation shifts proportionately between the sectors. This adjustment reduced the allocation coverage in 2022 in the industrial sectors from 102 to 87 percent, while the allocation in the energy sector increased from 5 to 12 percent, as Table 3 illustrates.

4 See explanations in Chapter 1.2.

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

Sector	Activity	Number of install-ations	2022 allocation amount [1000 EUA]	2022 VET [kt CO_2eq	2022 allocation deviation from 2022 VET [kt CO_2eq]	2022 alloca-tion cover-age*	Adjusted 2022 allocation amount** [1000 EUA]	Adjusted 2022 allocation coverage**
Energie	Energy installations	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 industry	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 com-bustion plants	50	577	499	78	115.7%	577	115.7%
		858	**114,391**	**112,202**	**2,190**	**102.0%**	**97,368**	**86.8%**
Total		**1,731**	**126,076**	**353,953**	**−227,877**	**35.6%**	**126,076**	**35.6%**

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

Germany and Europe

The emissions from all installations participating in the EU ETS in 2022 (27 EU Member States plus Iceland, Liechtenstein and Norway) declined slightly. According to European Commission data, emissions decreased by 1.1 percent in 2022 and amounted to 1.32 billion tonnes of carbon dioxide equivalents.

Emissions in Germany decreased less sharply in the first trading period and the second half of the third trading period than in the other EU ETS Member States. The emissions trend in German installations then followed the Europe-wide trend for the following years: since the beginning of the third trading period, emissions in Germany actually fell somewhat more sharply (minus 26 percent) than in the EU ETS Member 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 periods was in part reduced in recent years. This was primarily achieved through reductions in the auction volumes: in the 2014 – 2016 period due to backloading, and from 2019 through the Market Stability Reserve (MSR). If the number of emission allowances in circulation exceeds the threshold of 833 million emission allowances, then the volume of EUAs earmarked for auctioning is reduced by 24 percent of the number in circulation in the following twelve months and transferred to the MSR. The European Commission determines an official value of the amount in circulation each year called TNAC (Total Number of Allowances in Circulation) as an indicator of the surplus. At the end of 2022, the TNAC was 1.13 billion emission allowances according to the European Commission[5]. Despite the extensive auction volume cuts and increased emissions, the value remains well above the upper MSR threshold at which auction volume cuts 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 deleted 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.[6]

Aviation

For 2022, a total of 72 aircraft operators subject to emissions trading administered by Germany reported emissions of 7.2 million tonnes of carbon dioxide. This represents an increase of around 55 percent in emissions compared to the previous year. The average allocation coverage in 2022 was around 45 percent, well below the 2021 figure of 71 percent. This is due to further increases in emissions driven by the recovery of the aviation sector after the sharp decline in air transport in 2020 due to the COVID 19 pandemic. However, the emission level before the COVID 19 pandemic has not yet been reached again.

Outlook

In 2022, the EU ETS entered its second year of the fourth trading period marked by a modified allocation regime compared to the third trading period and a more significant reduction in the emissions cap coming into effect. With the 'Fit for 55' package, further adjustments have now been decided for the EU ETS, which will be implemented step by step within the fourth trading period.

5 COM 2022b
6 COM 2023b

This broad legislative package, first presented by the European Commission in the summer of 2021 as part of the European Green Deal, is designed to implement the increase in the EU's greenhouse gas reduction target for 2030 to at least 55 percent compared to 1990. The legislative adjustments affecting the EU ETS were adopted in the spring of 2023 and the corresponding legal acts were published in the Official Journal of the European Union in May 2023. The amendment to the EU Emissions Trading Directive (EHRL) significantly raises the ambition level in the EU ETS and expands the scope of the EHRL Directive to additional sectors. In detail:[7]

- The abatement within the EU ETS will be increased from 43 percent to 62 percent by 2030 compared to 2005. To achieve this, the linear reduction factor (LRF) is to be raised from the current 2.2 percent to 4.3 percent from 2024 and to 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 adjusted in some technical aspects: the decisive factor being a doubling of the reduction rate from 12 to 24 percent of the total number of allowances in circulation (TNAC) which will be maintained until 2030 and thus will not end in 2023 as currently envisaged.
- In addition, the European solidarity and support instruments will be significantly expanded and adjusted to cushion the economic challenges of the increased ambition level and the social consequences of the new EU ETS 2 (see below in the text). The Member States must also refinance 100 percent of their auction revenues in climate protection issues and their active accompanying measures in the future.
- 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. The first pilot sectors will be subject to mandatory reporting from October 2023 and also to mandatory surrender of CBAM certificates from 2026. This is intended to impose the same CO_2 price on certain basic materials and products with high energy consumption imported into the EU from abroad as being within the EU. In return, free allocation for these products, the previous measure for carbon leakage protection, is to be gradually scaled back and ended by 2034.
- Maritime transport will be gradually integrated into the existing EU ETS 1 from 2024.
- In addition, the rules for aviation, which have been included in the EU ETS from 2012, will be adjusted in view of the implementation of CORSIA and the ambition level will be raised as well.
- A separate EU ETS 2 will be gradually created for fuels, including those from the transport and building sectors from 2024 onwards (the reporting obligation commencing in 2024 to 2026 and the full upstream ETS with a surrender obligation from 2028 at the latest). 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 into it in the future. Since 2021, the nETS has regulated the emissions from diesel, petrol, heating oil, natural gas and biomass. The aim is to avoid double burdens by nEHS and EU ETS. National emission allowances amounting to about 306 million tonnes of carbon dioxide were surrendered for 2021, the first reporting year.[8] The scope of the nEHS was expanded to include coal in 2023 and it will be extended to include waste in 2024.

The other 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 in Ukraine on 24/02/2022. The resulting increases in energy prices, shortages of raw materials and declines in demand shaped the emissions trend in 2022 and will continue to have an influence on the development of energy and climate policy in Germany and Europe for the foreseeable future.

7 A more detailed analysis of the proposals is shown in the Fact Sheets published on the German Environment Agency's Website in summer 2023.
8 See DEHSt 2022c

Content

List of Tables

List of Figures

Abbreviations

AA	Allocation amount
AGEB	Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen)
AR	Activity rate
BNetzA	Federal Network Agency (Bundesnetzagentur)
BImSchG	Federal Exposure Control Act (Bundes-Immissionsschutzgesetz)
BMWK	Federal Ministry for Economic Affairs and Climate Action
BV Kalk	Association of the German Lime Industry (Bundesverband der Deutschen Kalkindustrie e. V.)
CBAM	Carbon Border Adjustment Mechanism
CER	Certified Emission Reductions (from CDM projects)
CHP	Combined heat and power
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
CS	Clean spread
DEHSt	German Emissions Trading Authority at the German Environment Agency
DRI	Direct reduced iron
EA	Emission allowance
EAF	Electric arc furnace
EEA	European Economic Area (the same as EU30)
EEX	European Energy Exchange
EHRL	Emissions Trading Directive (Emissionshandels-Richtlinie)
EM	Emissions
ER	Emissions report
ERU	Emission Reduction Units (from JI projects)
EU27	As of 2021: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden
EU30+	EU ETS countries since 2021: EU27 plus Iceland, Liechtenstein and Norway, and some installations in Northern Ireland
EU ETS	European Emissions Trading Scheme: it has included EU27, Iceland, Liechtenstein, Norway and some power generation installations in Northern Ireland since 2021
EUA	EU Emission Allowances
EUAA	EU Aviation Allowances
FGD	Flue gas desulphurisation plant
GW	Gigawatt
HC	Hard coal
ICAO	International Civil Aviation Organisation
ICE	Intercontinental Exchange
kt	Kilotonne or one thousand tonnes
LF	Linear factor

MSR	Market Stability Reserve
Mt	Million tonnes
MW	Megawatt
NER	New Entrant Reserve
NG	Natural gas
N_2O	Dinitrogen monoxide, nitrous oxide
n. l. ETS	No longer subject to emissions trading
PFC	Perfluorocarbons
RegR	EU Registry Regulation
RTI	Rated thermal input
TEHG	German Greenhouse Gas Emission Allowance Trading Act (Treibhausgas-Emissionshandelsgesetz)
TNAC	Total Number of Allowances in Circulation (amount in circulation determined by the European Commission)
TWh	Terawatt-hour
UK	United Kingdom
VCI	German Chemical Industry Association (Verband der Chemischen Industrie)
VDP	German Pulp and Paper Association (Verband Deutscher Papierfabriken e. V.)
VDZ	German Cement Works Association (Verein Deutscher Zementwerke)
VE	Verified Emissions
VET	Verified Emissions Table (table of VEs entered into the EU Registry)
VET Report	For an explanation of how to use this short name of the report, see below
WSA	World Steel Association
WSB	Growth, Structural Change and Employment Commission (Wachstum, Strukturwandel und Beschäftigung)
WV Metalle	Metal Industry Association (Wirtschaftsvereinigung Metalle e. V.)
WV Stahl	German Steel Federation (Wirtschaftsvereinigung Stahl)
WVZ	Sugar Economic Association (Wirtschaftliche Vereinigung Zucker e. V.)
ZuV 2020	Allocation Ordinance (Zuteilungsverordnung) 2013 to 2020

VET Report: why is VET the short name for this report?

The VET Report's analyses are mainly based on the previous year's verified emissions in the form as recorded in the Union Registry. The verifiers enter this data in the registry annually by 31 March. In the first and second trading periods, the verified emissions were still reported to the European Commission by transferring the Verified Emissions Table (VET) from the national registry. The term VET report has prevailed and been retained due to the original data source i. e. the Verified Emissions Table. Another reason for this short name is the need to be able to distinguish between emission reporting in emissions trading and emissions reporting for the national greenhouse gas inventory, for which the short name of national emission reporting has already been introduced.

1 Introduction

Chapter 1 describes the data underlying the evaluations in the 2022 VET Report. Chapter 2 addresses the emissions from stationary installations subject to emissions trading according to sectors. Section 2.9 addresses the cross-sectoral allocation status of stationary installations in Germany and presents an excursus on the adjusted allocation rules for the fourth trading period of the European Emissions Trading Scheme. Section 2.10 describes the trend in emissions from the stationary sectors subject to emissions trading in the EU. Chapter 3 looks beyond Germany at EU ETS emissions in Europe, the carbon market surplus and EUA price trends. Chapter 4 describes emissions subject to emissions trading in the aviation sector administered by Germany. The appendix contains additional information organised in summary tables.

The figures presented in the tables are rounded while the calculations used exact values so infrequent discrepancies may occur in the representation of the totals.

1.1 Relationship between VET Emissions, Annual Emissions and Number of Installations since 2005

The operators must submit their electronic emissions report, in which the monitoring and calculation of emission volumes is recorded, to the German Emissions Trading Authority (DEHSt) at the German Environment Agency before 31/03 of the year following the reporting year at the latest. The data in the emissions report must be verified by independent accredited verifiers who must also enter the aggregated emission data by 31/03 in the European Union Registry. The operator then needs to surrender the same number of emission allowances equal to the emissions volume of the previous year by 30/04. Subsequently the emission reports will be checked by DEHSt. If it detects deficiencies or errors in the reported emissions, DEHSt may correct figures, factors or emission volumes. Table 4 shows the sums of VET entries and the annual emissions for 2005 to 2022. The first registry entry at the cut-off date of 31/03 in one of the years following the reporting year is considered a VET entry. Figures that result from the emissions report – possibly with subsequent changes to the data up to the cut-off date – are referred to as annual emissions. The figures showing the 2022 annual emissions will be available for the first time in the autumn of 2023 after DEHSt has reviewed the emission reports, but they may vary due to new information and necessary corrections. The number of reports gives the unchecked number of VET entries regardless of the currently existing emissions trading obligation of the installations because closed or decommissioned installations are still subject to reporting and are obliged to make a VET entry, therefore the operator must surrender the appropriate allowances for the year of closure or decommissioning.

Table 4: VET entries and annual emissions of the verified reports and the respective number of installations

Year	Initial report by 31/03 of the subsequent year		Verified reports, as of 28/02/2023	
	Number of reports	VET [kt CO_2eq]	Number of installations	Annual emissions [kt CO_2eq]
2005	1,815	473,681	1,830	474,990
2006	1,824	477,382	1,777	478,068
2007	1,882	487,050	1,744	487,166
2008	1,660	472,599	1,672	472,593
2009	1,651	428,198	1,658	428,295
2010	1,628	453,883	1,642	454,865
2011	1,631	450,267	1,649	450,351
2012	1,629	452,586	1,622	452,596
2013	1,929	480,937	1,922	481,011
2014	1,905	461,173	1,904	461,249
2015	1,889	455,528	1,885	455,616
2016	1,863	452,873	1,858	452,806
2017	1,833	437,647	1,831	437,607
2018	1,870	422,294	1,867	422,841
2019	1,851	362,955	1,848	363,316
2020	1,817	320,275	1,816	320,715
2021	1,732	355,082	1,756	355,209
2022	1,731	353,953		

As of 02/05/2023

The significant increase in emissions between 2012 and 2013 can be traced back to the expansion of the EU ETS's scope at the beginning of the third trading period. For example, installations for non-ferrous metal processing and aluminium, adipic acid, nitric acid and ammonia production started participating in emissions trading from 2013.

1.2 Data Sources and Methods

Scope correction before 2013 (Scope correction or estimated emissions before 2013)

The emissions trend figures show an estimate of emissions prior to 2013 to correct the scope over the individual trading periods (scope estimation). In addition, the scope correction estimate used in the 2013 – 2020 allocation report has been improved since the 2017 VET report. This now also includes a scope adjustment from the first to the second trading period.

This adjustment was determined based on the emission data from the allocation applications and from the 2020 data acquisition. The difference between historical emissions and data from the allocation application or 2020 data acquisition was determined for installations where new partial activities had been added. The scope estimate has for years been determined by linear interpolation where data is not available (especially for 2011 and 2012). However, the estimated scope up to 2013 also takes into account the emissions from the polymerisation plants, which have been subject to emissions trading from 2018, amounting to an average of about 75,000 tonnes of carbon dioxide equivalents per year. For the 2013 – 2017 period, no scope correction was taken into account for these installations.

Taking into account installations no longer subject to emissions trading (n. l. ETS)

In previous VET reports (up to and including 2016), the chapters concerning sector emissions trends have only shown the trend for installations subject to emissions trading in the respective reporting year. Starting with the 2017 VET report, the figures on emissions trends take into account the emissions from installations no longer subject to emissions trading (n. l. ETS installations) within the sectors as well as in the total for the years up to the date of their decommissioning. This enables us to show the actual emissions trend in European emissions trading in Germany since 2005 and not just the installations subject to emissions trading in the respective reporting year. Installations no longer subject to emissions trading include decommissioned installations and installations that still exist but are no longer subject to emissions trading because they fall below the 20 megawatt (MW) rated thermal input (RTI) limit as an energy installation.

The tables in Sections 2.1 to 2.8 list the installations no longer subject to emissions trading but were still subject to them in the year prior to the reporting year in order to fully reflect the change in emissions compared to the previous year.

Free allocation in 2022

Free allocation approved for 2021 and 2022 by the European Commission prior to 19/04/2023 is the basis for the allocation status assessment, i. e. comparison of emissions and free allocation. Currently, not all necessary allocation changes that are relevant for 2021 and 2022 have been approved. That is, the presentation of the allocation status does not include any allocation changes made after 19/04/2023. In particular, the allocation data reports that had to be submitted by 30/04/2023 are not taken into account in the 2022 VET report which will lead to adjustments to the free allocation for 2022.

The allocation amount approved by the European Commission is included in the National Allocation Table[9] (NAT), which specifies the free basic allocation for 1,555 existing installations and corrections and adjustments of this basic allocation for individual installations as approved by the European Commission by 19/04/2023. There are some allocation adjustments based on the annual allocation data reports (including production data), allocation corrections for existing installations due to mergers, installation separations, allocation waivers, shutdowns, lawsuits and appeals. 1,577 installations of those considered in the 2022 VET report received free allocations for 2022 totalling around 126 million allowances as of 19/04/2023.

9 See DEHSt 2013b

Estimated allocation for adjustment of the allocation coverage[10]

The method for determining the estimated allocation for the transfer of waste gases from iron, steel and coke production is described in Section 2.4.

The estimated allocation for heat imports in the paper industry and the chemical industry in the third trading period was determined based on heat import data from the allocation procedure[11]. For this purpose, only heat imports from energy installations and importing installations that were subject to emissions trading in the respective reporting year were considered. For the fourth trading period, the imported heat quantities are taken into account based on the data from the annual allocation data reports (ADR), but with a one-year delay. This means for the current reporting year: heat quantities stated in the 2021 ADR are used for 2021 and allocation application data are used for 2022. In addition, the valid heat benchmarks were used for the estimation.

Emissions and production trends

For some sectors or activities, the emission trend is compared with the trend in production. For this purpose, activity rates (AR) of the respective (product) benchmarks collected by DEHSt were used. The activity rates up to and including 2019 were collected in the annual operation notifications; the activity rates from 2020 onwards are now reported by the operators in the annual allocation data reports. The submission deadline for the 2022 allocation data report was 30/04/2023, so the data was not included in the 2022 VET report. These different data sources may therefore be the cause of a break in the time series of activity rates between 2019 and 2020.

The production volume reported in the emission report and calculated from the material flows has been used for cement clinker, industrial and building lime instead of activity rates.

The activity rates have been supplemented by external data as far as possible, for instance by production data from the respective industrial associations. The relative changes in activity rates and production volumes between 2018 and 2022 compared to 2018 (2018 = 100%) and the corresponding emissions (also as relative changes compared to 2018) have been shown.

It should be noted that the production volumes are usually determined using different methods, especially when comparing activity rates and external data. For example, the requirements of uniform EU allocation rules must be observed when determining activity rates. These, of course, do not apply to the acquisition of data from associations. In addition, there may be differences in the total population considered since not all companies organised into an association necessarily operate installations subject to emissions trading and vice versa. Also, data on activity rates only stems from those installations that are currently subject to emissions trading and have received a basic allocation as existing installations or new market entrants.

External data sources are generally expected to take account of the historical data of all installations in a sector or association. In contrast to activity rates, they also include data on installations which were decommissioned before 2020 or which were never subject to emissions trading due to small capacities.

EU data

The evaluation at the EU level was primarily based on the allocation and emission data processed by the European Environment Agency (EEA) (see EEA 2023). This refers to both Section 2.10 and Section 3.

For 2022 these will be supplemented by a notification on the European Commission's website of 24/04/2023 (see COM 2023a). Information on auction volumes has been provided by the European Energy Exchange (EEX) and Intercontinental Exchange (ICE).

The evaluations in the Sector Chapters are based on a summary of the installations by activities in the EU Union Registry (see Table 37, Chapter 7).

10 See also glossary entry on adjusted allocation coverage.

11 See also DEHSt 2014a, Chapter 7.8.

Data status

The status of the data used as the basis for the tables and figures in the VET Report is generally 02/05/2023 unless a different date is specified or is derived from external sources, which is then indicated in each case.

1.3 Special Features with Regard to the Fourth Trading Period

2021 was the first year of the fourth trading period of the European Emission's Trading Scheme. With this in mind, the 2021 VET Report includes several aspects worth mentioning, which are presented below.

Free allocation

An excursus on the allocation rules of the fourth trading period can be found in the text box at the beginning of Section 2.9.

Zero-emission installations

Zero-emission installations, where licensing law excludes the fact that they have emission sources as per Section 4(3)(4) TEHG, also called zero-emission installations, no longer fall within the scope of the TEHG in the fourth trading period.[12] Those were relevant in the third trading period, in particular in the chemical industry (19 installations) and in the paper and pulp industry (7 installations). This means that there was a total of 26 installations that are no longer subject to emissions trading from 2021 onwards.

Small emitters

Small emitters according to Section 27 TEHG have only been obliged to report their emissions since the beginning of the fourth trading period. However, they do not have to surrender emission allowances, nor are they allowed to apply for a free allocation. This means that they also do not need to make a VET entry in the register but only submit an emissions report. 24 small emitters were required to report in 2022. They were distributed across both the energy and industrial sectors within the EU ETS (industrial sectors: refineries, iron and steel industry, mineral processing industry, paper and pulp industry, chemical industry) and in total reported about 140,000 tonnes of carbon dioxide equivalents up to the data cut-off date 02/05/2023.

Main activity of the installations

When the transition from the third to the fourth trading period occurred, a review of the assignment of the main activity of the installations subject to emissions trading, needed for evaluating the VET report, was undertaken. Some adjustments have been made especially in the field of energy installations (Activities 2 to 6) or other incineration plants and also in the industrial sectors. The assignment of activities has also been adopted for previous years in order to correctly reflect the emissions trend. However, this means that neither the installation inventory nor the emissions of the individual sectors can be directly compared to previously published data.

12 Basis: Judgment of the European Court of Justice of 28/02/2018, Case C-577/16. See also DEHSt 2021c, Section 4.5 'Installations without emissions'

2 Evaluation by Sectors – Activities 1 to 29 as per Annex 1 TEHG

2.1 Energy Installations

873 energy installations (installations according to points 2 to 6 Annex 1 of the TEHG) were subject to emissions trading in 2022.[13]

Emissions from these energy installations increased by more than 6 million tonnes of carbon dioxide compared to the previous year (plus 3 percent). A large increase in emissions compared to 2020 was already recorded in the previous year (plus 14 percent). In 2022, emissions amounted to around 242 million tonnes (compare Table 5).

The majority, i. e. 98 percent, of the emissions from energy installations can be attributed to large combustion plants, i. e. power plants, combined heat and power plants and heat plants with a rated thermal input (RTI) exceeding 50 megawatts (Activity 2 as per Annex 1 TEHG), see also the Figure 5.

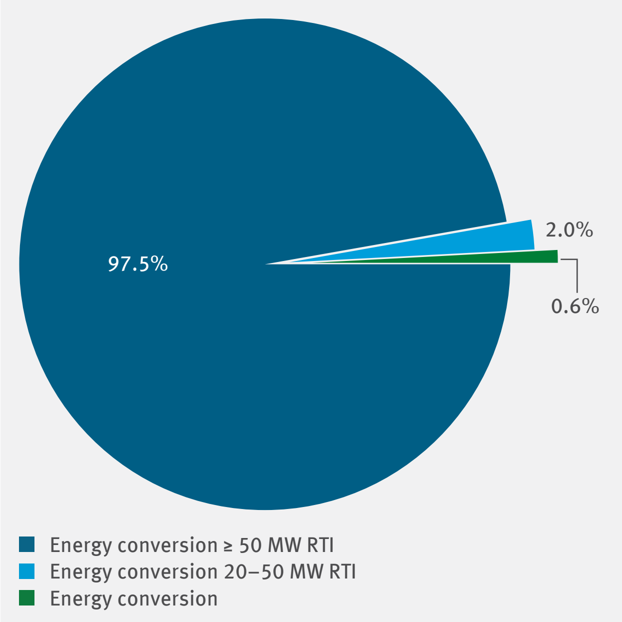


Figure 5: Proportions of 2022 emissions from energy installations (Activities 2 to 6)

Table 5: Energy installations (Activities 2 to 6), number of installations, 2021 emissions, 2022 free allocation, 2022 VET entries and allocation coverage

No.	Activity	Number of installations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
2	Energy conversion >= 50 MW RTI	445	228,630	235,634	9,921	4.2%
3	Energy conversion 20–50 MW RTI	359	5,102	4,695	1,486	31.6%
4	Energy conversion 20–50 MW RTI, other fuels	13	64	63	87	137.6%
5	Prime movers (engines)	3	43	86	9	10.9%
6	Prime movers (turbines)	53	823	1,274	182	14.3%
	n. l. ETS	*9**	*682*	–	–	–
Total		**873**	**235,345**	**241,752**	**11,685**	**4.8%**

As of 02/05/2023
* n. l. ETS not included in total number of installations

13 The sector also includes five small emitters. Details on small emitters in the fourth trading period of the EU ETS are described in Chapter 1 'Introduction'.

Overall, emissions from all large combustion plants have increased by about 3 percent compared to 2021. This reflects the fact that electricity generation from hard coal and lignite has strongly increased and thus compensated for the decline in electricity generation from natural gas.

On the other hand, energy installations with an RTI between 20 and 50 megawatts (Activities 3 and 4 as per Annex 1 TEHG) experienced a reduction in emissions (minus eight percent). In contrast to large combustion plants, Activity 3 and 4 installations include many natural gas fired heat and power plants and district heating boilers so that the emissions also depend on weather-related heat demand. The use of natural gas as a fuel in power plants and CHP plants for electricity/heat supply decreased overall in 2022. Measured by degree-day figures, 2022 was on average consistently warmer than 2021, apart from September and December, and also significantly warmer than the long-term average.[14]

Although the roughly 400 installations amount to a similar order of magnitude as in Activity 2, the emissions from Activity 3 and 4 installations were significantly less than those from large combustion plants in 2022. This was less than 5 million tonnes of carbon dioxide, i. e. only about two percent of the amount emitted by combustion plants in total.

Only slightly less than 0.6 percent of the total emissions from energy installations can be attributed to prime mover engines and turbines (Activities 5 and 6 as per Annex 1 TEHG). The emissions from these installations, which are mainly used for the transport, storage and processing of natural gas, increased significantly by around 57 percent compared to the previous year. The operation of these installations depends heavily on the conditions in the natural gas network, which, in 2022 in particular, differed considerably from the conditions in previous years. Compressor stations for the long-distance transport of natural gas in the eastern part of Germany were only utilised to a fraction of their historical values due to the significant drop in natural gas deliveries from Russia, especially in the second half of the year, while compressors in the north-western part of Germany, which especially transported gas from the Netherlands, Belgium and Norway to Germany, emitted many times more than in previous years. Despite the lower gas consumption in Germany in 2022 and lower transport volumes (imports and exports) compared to 2021, the expenditure for transporting the natural gas increased massively and resulted in the approximately 57 percent higher emissions.

In 2022, around 12 million emission allowances were allocated free of charge for heat generation in energy installations. They cover five percent of the obligation to surrender for emissions from these installations (see Table 5). In 2021, the allocation coverage was also about five percent with a free allocation of about 12 million emission allowances.

While the ratio of free allocation to emissions from large combustion plants was about four percent (see Table 5), the significance of heat production for energy installations with an RTI between 20 and 50 megawatts (Activity 8) in terms of the allocation status is recognisable. Allocation coverage compared to large combustion plants was greater by a factor of eight and was equal to about 32 percent of their emissions. Activity 4 installations, in which biomass and fuels with biogenic components are used, have an even higher allocation coverage of 138 percent. Prime movers (engines and turbines) have mainly received a free allocation via the fuel benchmark for production by mechanical work.[15] The ratio of free allocation to emissions from prime movers was on average around 14 percent.

14 AGEB 2023a

15 Compare DEHSt 2014a, Chapter 'Energy installations'

The following must be taken into account in order to fully understand the allocation situation of energy installations: the free allocation for energy recovery of waste gases from iron, steel and coke production is made to the producers of the waste gases from iron, steel and coke production, while part of the allocation for heat generation is made to heat consumers (compare Chapters 2.4, 2.7 and 2.8). An estimated 15 million emission allowances allocated free of charge could be assigned to the transfer of waste gases from iron, steel and coke production from industrial to energy installations in 2022 and about 2 million emission allowances could be assigned to the export of heat from energy to industrial installations. Assuming that these allocation amounts were offset between the operators in the industrial and energy sectors, this results in an adjusted allocation of about 12 percent compared to about 5 percent without adjustment for the above estimated allocation amounts (compare Table 6 and Figure 6). Despite the significant effect of the adjustment, it is clear that no free allocation is made for 88 percent of the energy installations' emissions.

Table 6: Energy installations (Activities 2 to 6), number of installations, allocation amounts, 2022 VET entries and adjusted allocation coverage

Sector	Number of installations	2022 adjusted allocation amount [1000 EUA]	2022 VET [kt CO_2eq]	2022 allocation deviation from 2022 VET [kt CO_2eq]	Adjusted allocation coverage
Energy installations	873	28,708	241,752	−213,044	11.9%

As of 02/05/2023

Trends over the past years

Figure 6 below shows the emissions trend for energy installations since the beginning of emissions trading. For the first, second and third trading periods, the average emissions and allocation quantities are shown as columns in each case; for the period from 2018, annual emissions and allocation quantities as well as the relative emissions trend are shown. Installations no longer subject to emissions trading (n. l. ETS) are also taken into account.

Average emissions in the second trading period of the EU ETS (including n. l. ETS) decreased by around seven percent compared to the first trading period. Emissions fell steadily during the third trading period: between 2018 and 2020 alone, the last year of the third trading period, carbon dioxide emissions fell by a total of 31 percent and were only just above the 200 million tonne mark. The fourth trading period began with an increase in emissions, contrary to the trend in the third trading period. By 2022, emissions from energy suppliers had increased to 242 million tonnes of carbon dioxide equivalents, approximately 18 percent compared to 2020. Increasing emissions from the combustion of hard coal and lignite were instrumental in this increase. However, carbon dioxide emissions were still 19 percent lower than in 2018.

While energy installations had received around 50 percent of the total free allocation for the product 'electricity' in the second trading period for installations subject to emissions trading – i. e. an average of around 200 million emission allowances per year – the free allocation for electricity generation was replaced by auctioning from the third trading period in 2013. In addition, the free allocation for energy recovery from waste gases from iron, steel and coke production was made to the producers of the waste gases and part of the allocation for heat generation was made to heat consumers (cf. comments on Table 6).

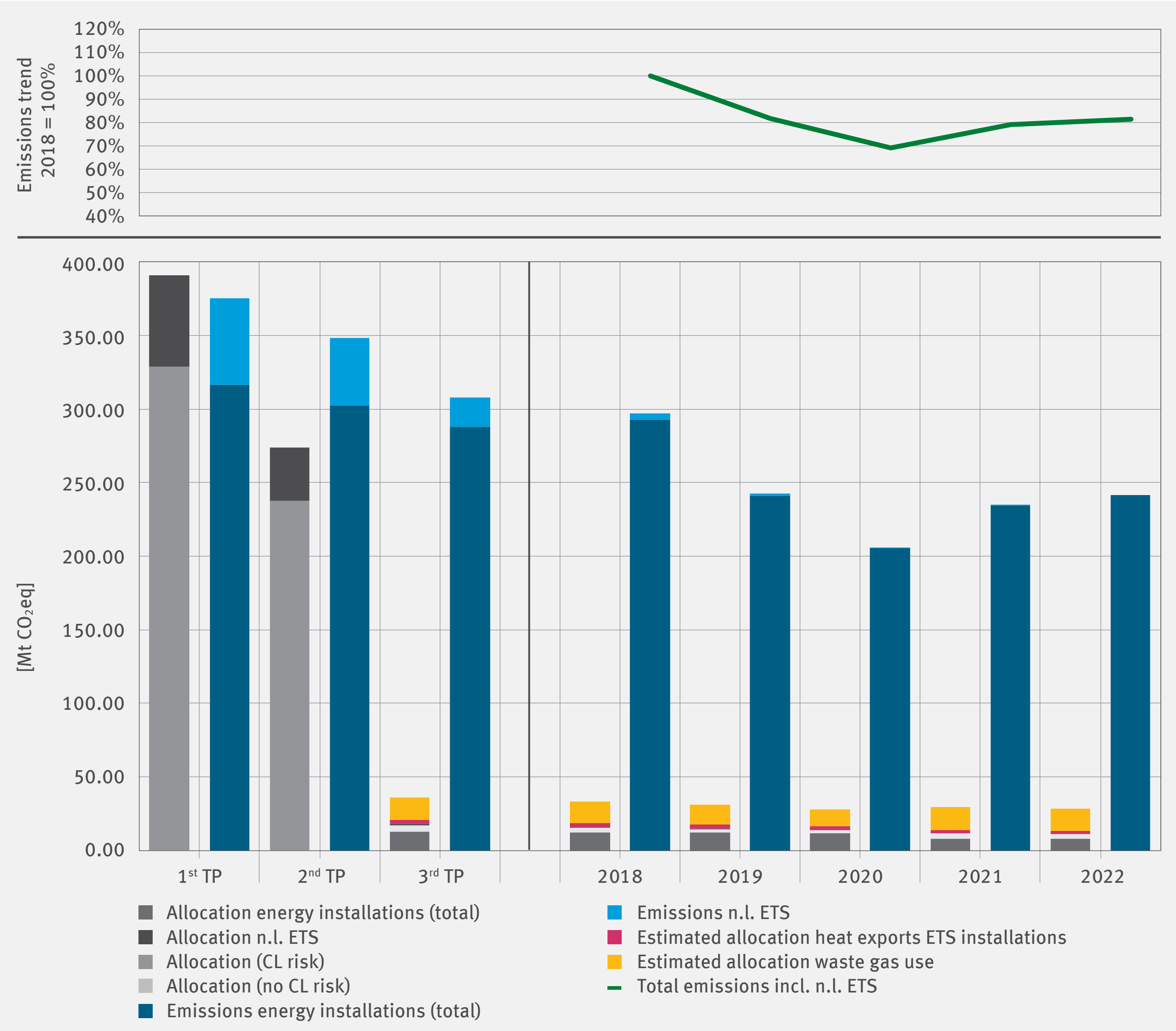


Figure 6: Energy installations (Activities 2 to 6), emissions and free allocation trend in Germany up to 2022[16]

16 As in the VET reports of the second trading period, the allocation amounts of this trading period are offset by taking into account the provisions of Section 11 of the 2012 Allocation Act (Zuteilungsgesetz). According to this regulation, in the second trading period producers of waste gases from iron, steel and coke production were legally obliged to forward emission allowances to the amount of their annual waste gases transfer to the utilising installations. Though it must be assumed that there are corresponding contractual agreements between producers and users also in the following trading periods, the third and fourth trading period allocation rules do not contain any obligation comparable to Section 11 of the 2012 Allocation Act.

Emissions trend – broken down by main fuels

The following figure shows the emissions from energy installations broken down by fuels. For this purpose, the installations were assigned to the fuels lignite, hard coal and natural gas, according to the largest share of total energy consumption in each of the years 2018 to 2022. Installations that have no 'main fuel' assigned and installations that mainly use other fuels (e.g. heating oil and waste gases from iron, steel and coke production) are jointly illustrated.

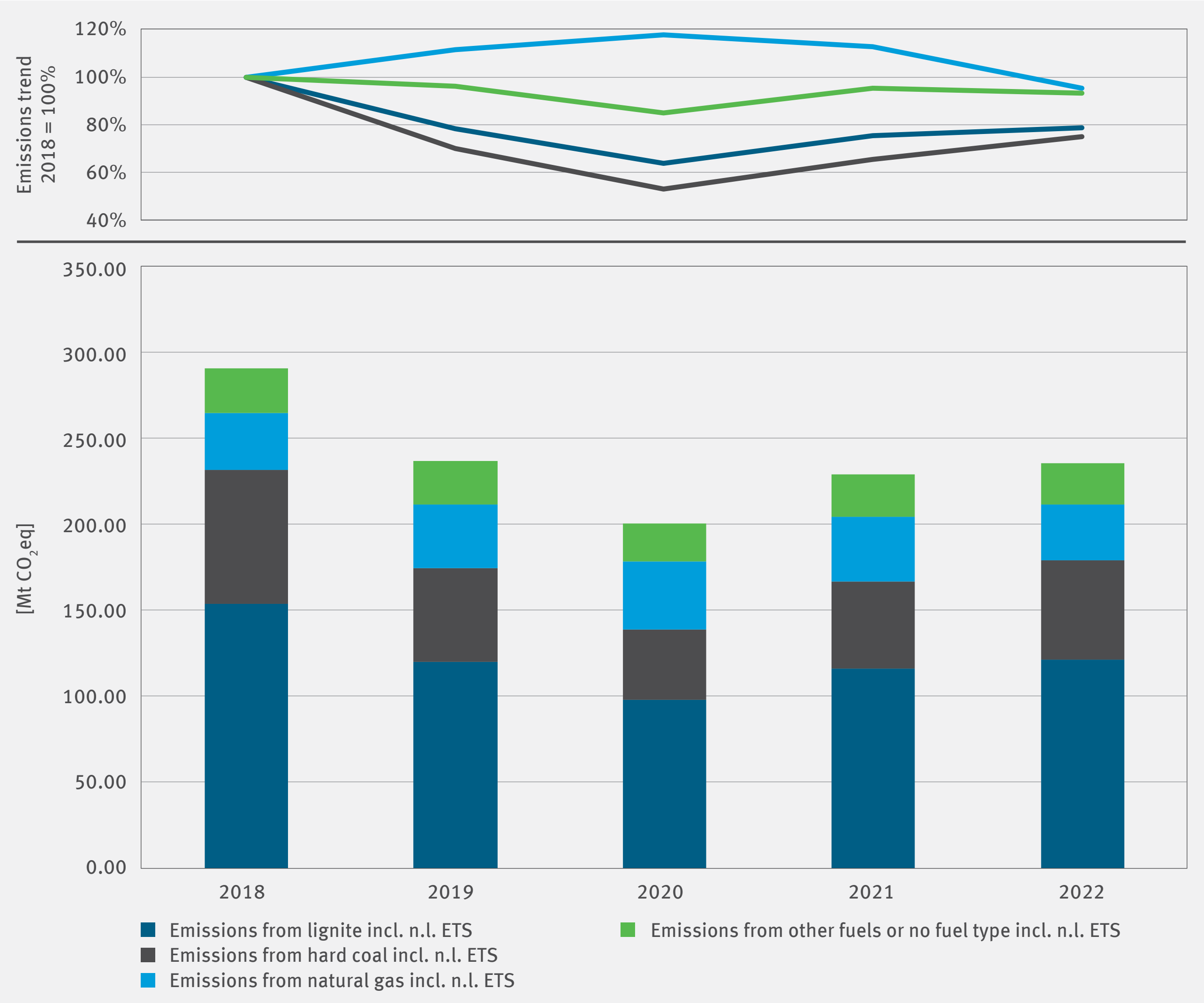


Figure 7: Energy installations (Activities 2 to 6), emissions trend from 2018 to 2022, according to fuel type[17]

After emissions from lignite fell continuously during the third trading period, reaching their lowest level in 2020 since the start of emissions trading in 2005, a strong overall increase was recorded in the following two years. Compared to the previous year, emissions in 2022 increased by around 5 percent, exceeding the 2019 level, the last year before the COVID 19 pandemic. A similar trend can be observed for emissions from hard coal. During the third trading period, emissions decreased for seven years in a row, but they have been steadily increasing since 2020. Last year, an increase of around 14 percent was observed compared to the same period in the previous year. On the other hand, natural gas fired installations have fallen by around 15 percent. This is mainly due to the increasing fuel switch from natural gas to coal for electricity production.

17 Note: In previous years, the presentation by main fuel was based on the main fuel in the respective reporting year. This meant that no changes in the main fuel at installations could be shown in the course of time. This was adjusted in the 2022 VET report, this is why the figure and figure description in the period 2018 to 2021 may differ from the previous year.

Compared to 2018, emissions from installations using lignite as their main fuel fell by around 21 percent. The decline in emissions from energy installations using hard coal as their main fuel was similarly high at 25 percent. Emissions from natural gas installations were five percent below those in 2018. Installations no longer subject to emissions trading were also included but they are not shown separately in the diagram.

Emissions and production trends

The following figure compares emissions trends for large combustion plants with the main fuels lignite, hard coal and natural gas[18] and the gross electricity generation from fossil fuels in Germany broken down by lignite, hard coal and natural gas.

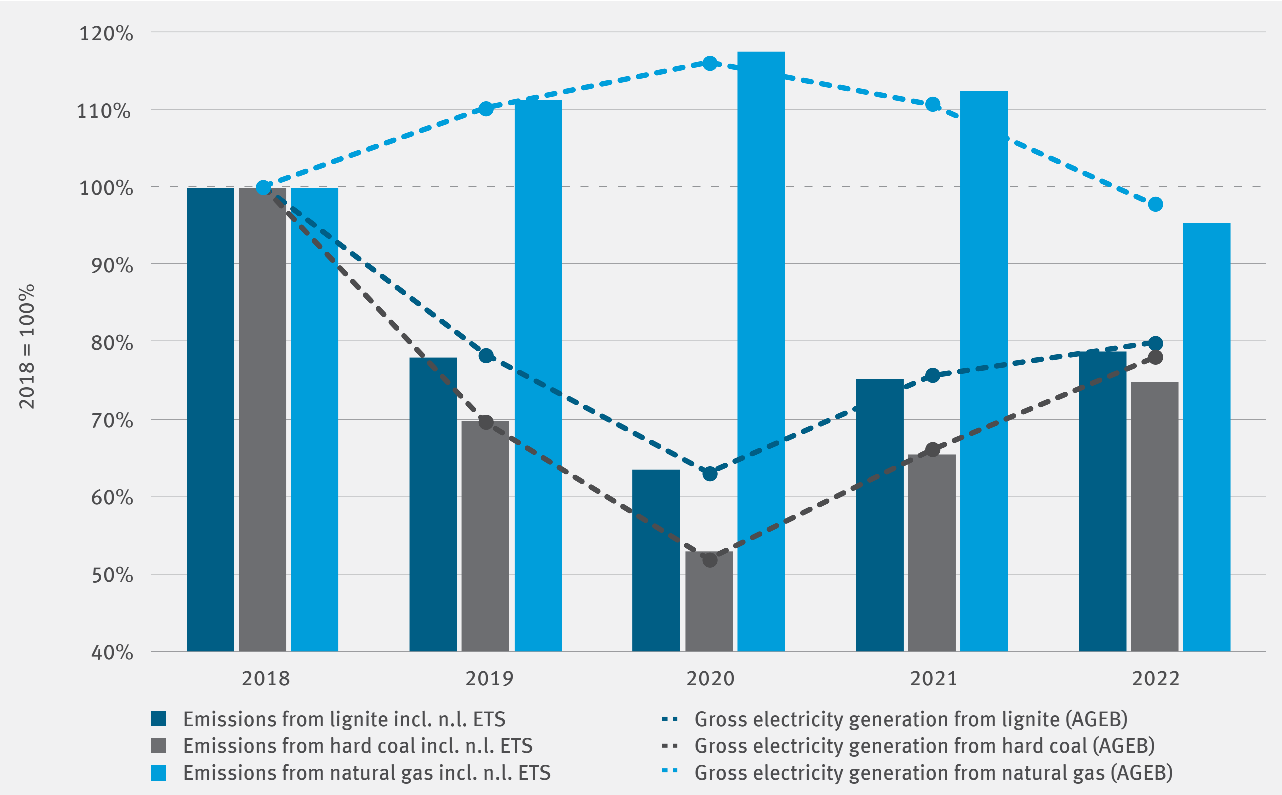


Figure 8: Large combustion plants (Activity 2), emissions and electricity generation trend from 2018 to 2022 compared to 2018[19]

The figures of gross electricity generation and emissions from lignite and hard coal-fired installations (cf. Figure 8) initially show a clear downward trend in the third trading period (here from 2018 to 2020). However, since 2020 an opposite trend can be observed.

The trend of electricity generation and emissions from lignite, hard coal and natural gas fired installations is largely in line within the period from 2018 to 2022.

18 The allocation of installations to a main fuel is carried out individually for each of the years from 2018 to 2022, i. e. depending on the installation constellation, an installation may use hard coal as its main fuel in one year but natural gas in the next year.

19 Note: In previous years, the presentation by main fuel was based on the main fuel in the respective reporting year. This meant that no changes in the main fuel at installations could be shown in the course of time. This was adjusted in the 2022 VET Report, this is why the figure and figure description in the period from 2018 to 2021 may differ from the previous year.

Compared to 2018, gross electricity generation from large combustion plants using hard coal fell by 22 percent from 83 terawatt-hours to 64 terawatt-hours in 2022.[20] In 2020, gross electricity generation from hard coal in Germany had in fact temporarily fallen to its lowest level in 65 years, at 43 terawatt-hours.[21] However, the past two years have again seen a significant increase in hard coal-fired electricity generation. A major cause of this increase for hard coal and lignite was the disproportionate rise in the price of natural gas in conjunction with a relatively tight supply on the European market in 2022, especially as a result of shifts in global natural gas trade flows following the Russian war of aggression in Ukraine. The price increase economically favoured the use of hard coal-fired power plants over natural gas plants. In addition, the generation of base-load electricity from nuclear power declined due to power plant closures. Even a substantial increase in feed-in from renewable energies to a new high could not compensate for this trend. 2021 was still characterised by a high number of power plant closures or transfers to the grid reserve with a capacity of around 6 gigawatts, which were carried out within the framework of the first two tendering rounds for the closure of hard coal capacities. This also included the two units of the modern Moorburg power plant, which only went into operation in 2015. In contrast, from the second half of 2022 onwards, hard coal-fired power plants that had already been shut down or were earmarked for decommissioning with a total capacity of around 5 gigawatts were taken out of reserve to avert a gas emergency and to prevent an electricity supply crisis.[22] [23]

Since 2018, gross electricity generation by lignite-fired power plants has fallen by around 20 percent from 146 terawatt-hours to 116 terawatt-hours. In 2020, electricity production from lignite fell to around 92 terawatt-hours, its lowest level in at least 40 years.[24] Since 2020, however, there has also been a significant increase in lignite-based electricity generation. Thus in 2022, as in the previous year, lignite was the most important energy source in electricity generation, with a proportion of around 20 percent. It was followed by onshore wind power with a proportion of around 17 percent, natural gas (14 percent), hard coal (eleven percent) and photovoltaics (ten percent). The proportion of nuclear energy fell by half to just six percent.[25] In the last quarter of 2021 and in April 2022, a total of six larger lignite units with a total capacity of around 1.8 gigawatts were decommissioned in accordance with the Coal Phase-out Act.[26] Between October 2016 and October 2019, lignite units with a net installed capacity of around 2.7 gigawatts were transferred to the security reserve.[27] After four years in the security reserve, the lignite units are to be decommissioned permanently. Due to the tense situation on the energy market, since October 2022 some lignite units have been transferred from the security reserve to the newly created supply reserve. A temporary opportunity for market participation applies to these power plants. Lignite units with a total capacity of around 1.9 gigawatts are affected by this measure.[28] [29]

Since 2018, the gross electricity generation of natural gas power plants has only fallen slightly from 82 terawatt-hours to 80 terawatt-hours.[30] However, compared to 2020, when electricity production in natural gas power plants reached a new peak of around 95 terawatt-hours and overtook lignite for the first time, a significant overall decrease was recorded for the reasons already mentioned above.

---

20 AGEB 2023b

21 Coal industry statistics 2022

22 AGEB 2023a

23 BNetzA 2023

24 Coal industry statistics 2022

25 AGEB 2023b

26 See the 'Act to Reduce and End Coal-fired Power Generation' (KohleausstiegsG) passed in 2020. The Act provides for a gradual reduction of installed electricity generation capacities for lignite and hard coal by 2038, combined with the possibility of bringing forward the Coal Phase-out to 2035. Further information on this topic can be found in the infobox 'Coal Phase-out in Germany' in the VET Report 2020 (Chapter 2.1). In addition, the Ministry of Economic Affairs, Industry, Climate Protection and Energy of the State of North Rhine-Westphalia agreed with the Federal Ministry of Economic Affairs and Climate Protection and RWE AG in 2022 on key points to bring forward the Coal Phase-out in North Rhine-Westphalia by eight years to 2030.

27 Power plants that are transferred to the security reserve will remain subject to emissions trading for the time being.

28 AGEB 2023b

29 BNetzA 2023

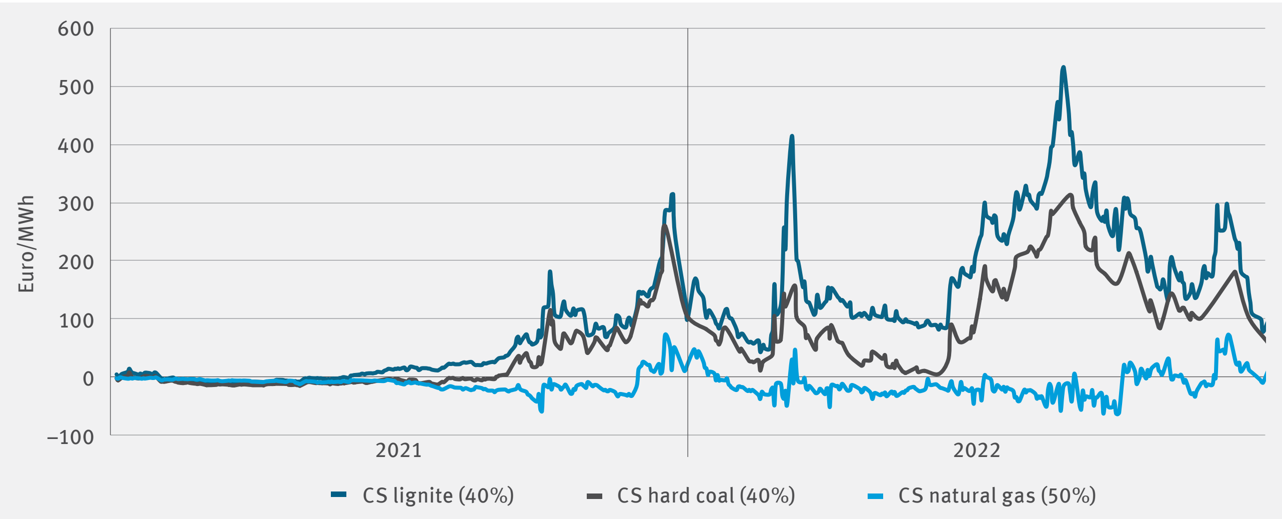
30 AGEB 2023b

Fuel switch/clean spreads

The following figure shows the **calculated** contribution margins (clean spreads) for selected types of power plants. The clean spreads are calculated as the balance of the revenues per megawatt-hour (MWh) generated and the variable costs for fuel and emission allowances as well as operating costs. The power plant operators' actual contribution margins can deviate greatly from this and depend partly on the respective hedging strategy[31] of the energy suppliers. Larger energy supply companies in particular hedge their electricity production several years in advance. Heat-controlled power plants can also have a deviating cost structure.

The economic set-up of lignite and hard coal-fired power plants has changed fundamentally since the second half of 2021. While at the beginning of 2021 the calculated contribution margins for lignite (clean lignite spreads) and hard coal (clean dark spreads) were still negative in some cases, since the second half of the year high triple-digit calculated contribution margins were recorded in some cases. This trend continued for the most part in 2022.[32] The additional increase in natural gas prices due to the relatively scarce supply volumes pushed gas-fired power plants further out of the market. Due to the outward shift in the merit order, they temporarily determined the electricity price as price-setting marginal power plants, which in turn reached new highs. In the case of lignite-fired power plants, the almost constant fuel costs for domestic lignite also played an important role. The significant rise in electricity prices[33] was also able to compensate for the ever higher carbon dioxide prices (see Chapter 3.3).

The profitability of natural gas power plants compared to electricity generation from coal has been almost consistently lower since the second half of 2021 and within the framework of the assumptions made, also due to extremely high natural gas prices, at least by calculation. However, it should be noted that larger energy supply companies in particular hedge the prices for fuels as well as carbon dioxide emission allowances several years in advance, so that the short-term price trend is only reflected in the deployment order of the power plants (merit order) with a certain delay.



As of 25/04/2023
Source: Refinitiv Eikon, ICIS, DEHSt

Figure 9: Clean spreads for lignite, hard coal, natural gas in 2021 and 2022 (front month contracts in each case) with an efficiency of 40 (coal) and 50 percent (natural gas) respectively

31 'Hedging strategy' refers to hedging strategies of energy suppliers with regard to fuel and carbon dioxide prices.

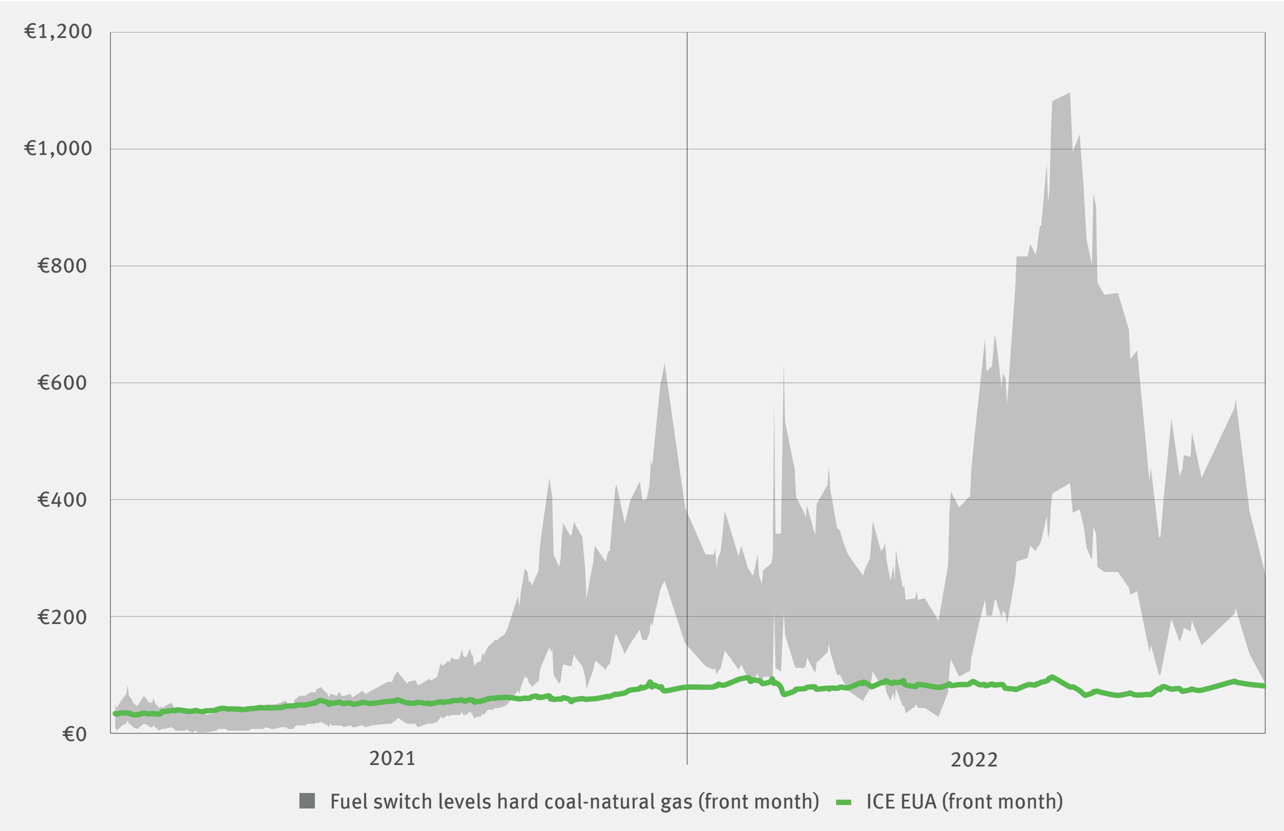
32 It should be noted that many energy suppliers sell their electricity on the futures market several years in advance and thus only profit from the sharp rise in electricity prices to a limited extent or with a time delay. In addition, in 2022 the Federal Government implemented a regulation on the 'windfall profit levy' on power plant operators. This means that power plant operators must transfer a certain proportion of their revenues on the electricity market to help finance the relief for households and businesses.

33 Electricity prices based on front month contracts: these are significantly more volatile than front year contracts, but better reflect current market developments.

In addition to the EUA price, the following figures also show a range of calculated 'fuel switch levels' for different power plant set-ups (hard coal/lignite to natural gas). The fuel switch indicates the calculated price level for EUA above which the clean spread for natural gas exceeds that for hard coal/lignite. The fuel switch level can thus be used as an indicator of the carbon dioxide price level at which the combustion of natural gas becomes more profitable than the use of hard coal/lignite.

The rise in natural gas prices relative to hard coal from mid-2021 onwards led to much higher fuel switch levels last year compared to previous years. Between mid-2021 and August 2022, the price of natural gas (TTF front month[34]) rose by around 800 percent and reached a new high of over €340 per megawatt-hour. In the same period, the price of hard coal (API2 front month[35]) increased by more than 300 percent at its peak. Accordingly, the calculated fuel switch bandwidth rose sharply in the second half of 2021 and the economic situation shifted in favour of hard coal. From Figure 10 it can be concluded that in 2022 the calculated fuel switch bandwidth was almost continuously above the EUA price level. Due to the existing gas emergency, a switch from coal to natural gas would hardly have been possible in most cases anyway. This circumstance is also reflected in the very high calculated fuel switch levels, which in some cases reached four-digit sums.

Rising natural gas prices also led to higher fuel switch levels between lignite and natural gas compared to the previous year, with relatively constant extraction costs for lignite, see Figure 11.



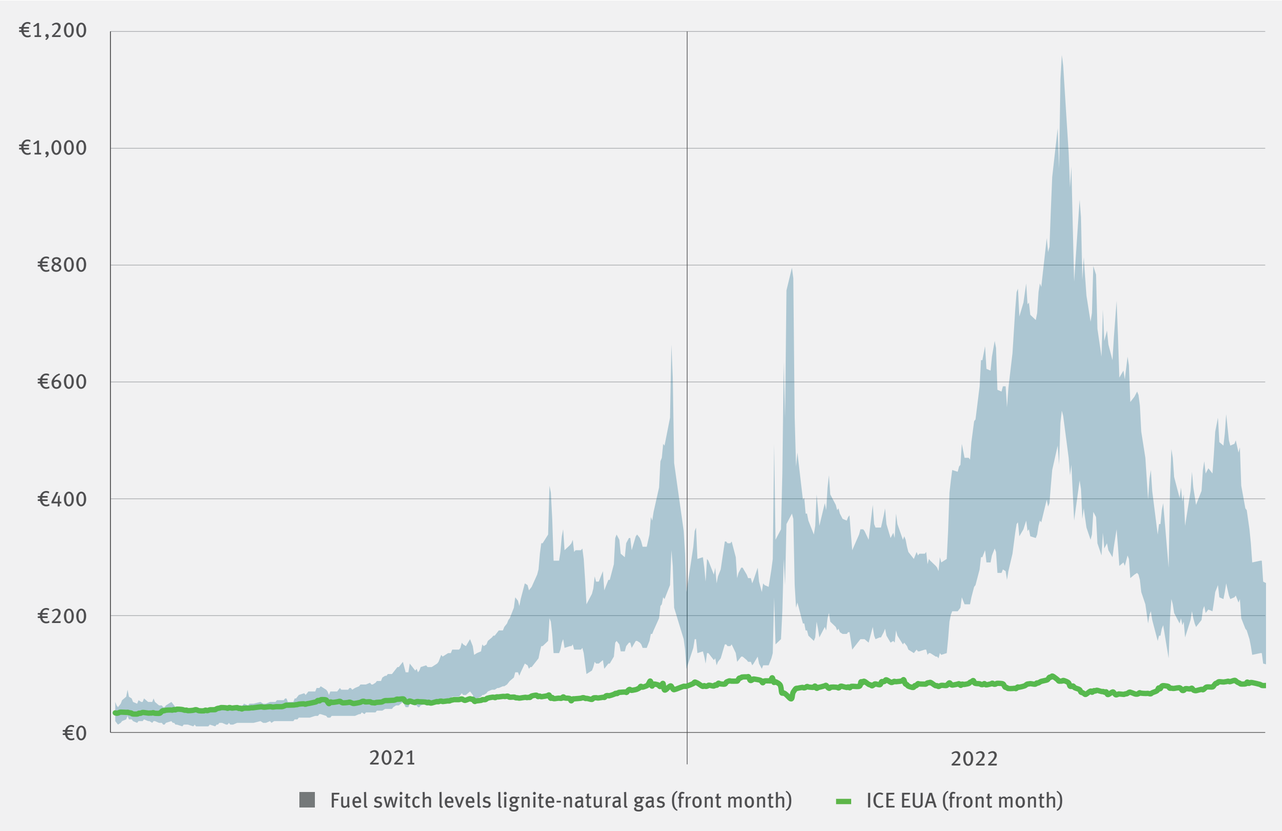
As of 25/04/2023
Source: Refinitiv Eikon, ICIS, DEHSt
* Range HC 35% – NG 60% to HC 45% – NG 50%; no volume-weighted representation of the actual capacities available.

Figure 10: Fuel switch levels from hard coal to natural gas* and EUA price 2021 and 2022[36]

34 Title Transfer Facility (TTF): central node for natural gas on the Dutch market. Due to its high trading volume, it is one of the most important trading points for natural gas in Europe.

35 API2: price index for hard coal with delivery within the ARA area (Amsterdam, Rotterdam, Antwerp).

36 In addition to fuel prices, the fuel switch level also depends on the efficiency of the power plants concerned. The range here is between hard coal-fired power plants with an efficiency of 35 percent compared to natural gas-fired power plants with an efficiency of 60 percent and hard coal-fired power plants with an efficiency of 45 percent compared to natural gas-fired power plants with an efficiency of 50 percent. The calculation was based on the comparatively volatile front month contracts (hard coal, natural gas).



As of 25/04/2023
Source: Refinitiv Eikon, ICIS, DEHSt
* Range BC 32% – NG 60% to BC 43% – NG 50%; no volume-weighted representation of the actual capacities available.

Figure 11: Fuel switch levels from lignite to natural gas* and EUA price 2021 and 2022

The emissions trend from the activity 'Combustion and energy' at EU level is described in Section 2.10.

2.2 Other Combustion

Approximately 80 installations with a rated thermal input of at least 20 megawatts have been subject to emissions trading since 2013 due to the broader definition of 'combustion' and are listed in Activity 1. This section only covers those 50 installations in Activity 1 that are not allocated to other industry sectors in this report. This group of installations mainly includes test benches for turbines or engines, but also process heaters and asphalt mixing plants.

The following table shows data on allocation and emissions for these installations. In total, they emitted around 0.5 million tonnes of carbon dioxide in 2022. The allocation coverage is around 116 percent of their emissions.

Table 7: Other combustion installations (Activity 1), number of installations, 2021 emissions, 2022 free allocation, 2022 VET entries, allocation coverage

No.	Activity	Number of instal-lations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
1	Combustion	50	535	499	577	115.7%
Total		**50**	**535**	**499**	**577**	**115.7%**

As of 02/05/2023

The following figure shows the trend in emissions since the beginning of emissions trading. Since the installations have only been participating in emissions trading since 2013, the data for 2005 to 2010 is the data reported by the operators in the allocation procedure. No emissions data is available for 2011 and 2012.
For the first, second and third trading periods, the average emissions and allocation amounts are shown as columns; for the period since 2018, annual emissions and allocation amounts as well as the relative emissions trends are shown. Installations no longer subject to emissions trading (n. l. ETS) are also taken into account.

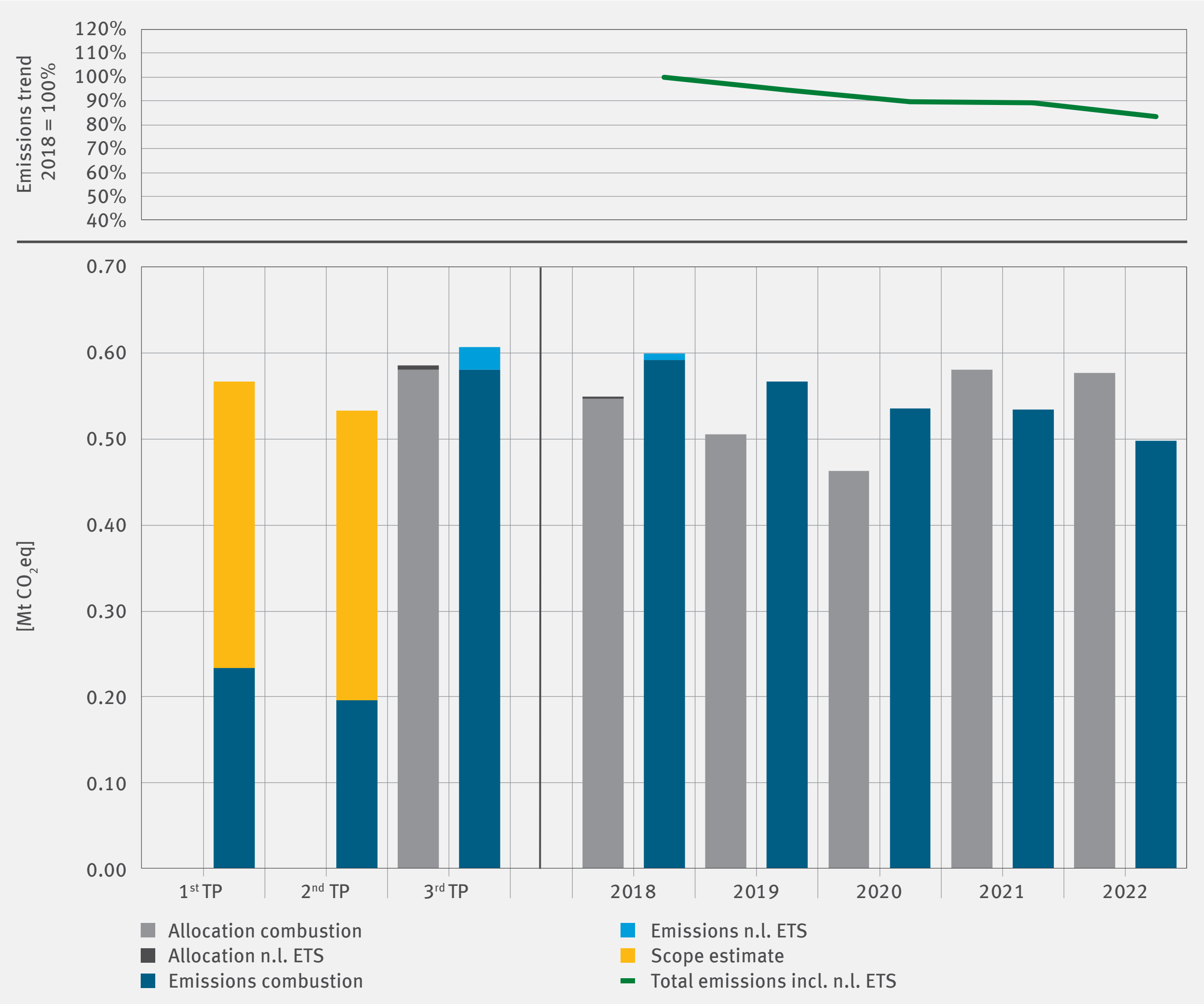


Figure 12: Other combustion plants (Activity 1), trend in emissions and free allocation up to 2022

Overall, emissions have decreased by 17 percent since 2018. As the composition of this group of installations is very heterogeneous, it is not possible to derive any overarching statements from the emissions trends.

2.3 Refineries

In the 2022 reporting year, 22 installations subject to emissions trading were refineries (Activity 7 as per Annex 1 TEHG).[37]

In this report, power plants are considered together with refineries if they are operated at the same site by the same operator in a technical network. According to Section 29(3) of the Allocation Ordinance (ZuV) 2020, they are then considered an ‘amalgamated installation’. In total, 14 of the 22 refineries subject to emissions trading include power plants. Of these, nine refineries are licensed together with one or more power plants, and five installations fall under the regulation mentioned above as the formation of an ‘amalgamated installation’.

Total refinery emissions in 2022 were 23.5 million tonnes of carbon dioxide. Compared to 2021 with 22.5 million tonnes of carbon dioxide, emissions increased by around four percent (see Table 8).

Table 8: Refineries (Activity 7), number of installations, 2021 emissions, 2022 free allocation, 2022 VET entries, allocation coverage

No.	Activity	Number of instal-lations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
7	Refineries	22	22,514	23,470	15,771	67.2%
Total		**22**	**22,514**	**23,470**	**15,771**	**67.2%**

As of 02/05/2023

In 2022, the refinery industry had a total calculated additional shortfall of around 7.7 million emission allowances with an allocation coverage of around 67 percent. In the previous year, the additional shortfall was 6.8 million emission allowances with an allocation coverage of around 70 percent.

37 From 2021, a facility is considered a small emitter due to the low carbon dioxide emissions it has had for years and is therefore no longer considered in this Chapter. Details on small emitters in the fourth trading period of the EU ETS are described in Chapter 1.3.

Trends in past years

Figure 13 shows the refineries' emissions trends since the start of emissions trading. For the first, second and third trading periods, the average emissions and allocation amounts are shown as columns; for the period since 2018, annual emissions and allocation amounts and the relative emissions trend are shown. Installations no longer subject to emissions trading (n. l. ETS)[38] are also taken into account as are the estimated emissions for the period 2005 to 2012 for the installation that only became subject to emissions trading in 2013[39].

In the first trading period, emissions averaged about 29 million tonnes of carbon dioxide, excluding estimated emissions (scope estimate); in the second trading period, they averaged about 27 million tonnes of carbon dioxide, seven percent below the average of the first trading period. From the second to the third trading period, emissions decreased again. At 25 million tonnes of carbon dioxide, the average emissions of the third trading period were about eight percent below the average emissions of the second trading period.

Overall, the refineries' emissions at the end of the third trading period were around 86 percent of the average emissions of the first trading period.

Since 2018 up to and including 2021, emissions have fallen continuously by two to five percent per year compared to the respective previous year, with the number of installations remaining almost unchanged. Possible causes for the decrease in emissions are production decline due to several extraordinary events in the past reporting years such as the low water levels of some watercourses in 2018 and the associated difficulties in the delivery of raw and auxiliary materials as well as in the removal of the products produced via waterways (see DEHSt2020b). The pandemic-related adjustment of production in refineries in 2020 and 2021 also had an impact on the emissions trend in the industry. In 2022, emissions were again close to the level of 2019 at around 23.5 million tonnes of carbon dioxide.

The free allocation (see Figure 13) was on average higher than the sector's emissions in both the first and second trading periods. This changed with the start of the third trading period. Refineries are affected by the discontinuation of free allocation for electricity generation because of their power plants. As of 2013, this led to the free allocation being significantly below the emissions of the refineries and, compared to other industrial sectors, to a higher shortfall.[40] The average shortfall in the third trading period was around 22 percent.

Also due to the cross-sectoral correction factor, the annual free allocation of refineries – as in all other industrial sectors – fell continuously in the third trading period. In 2021, the first year of the fourth trading period, the free allocation fell again compared to the previous year despite the discontinuation of the cross-sectoral correction factor. This can be explained by the reduction of the benchmark values for the allocation with the change from the third to the fourth trading period. In 2022, free allocation of around 15.7 million emission allowances was at the level of the previous year.

38 See explanation on 'Consideration of installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1 Introduction.

39 The emissions for 2005 to 2010 are data from the allocation procedure. No historical emissions are available for the years 2011 and 2012; the values for both years were estimated by linear interpolation.

40 For a comparison of the allocation coverage of the largest industrial sectors, see Section 2.9, Figure 40.

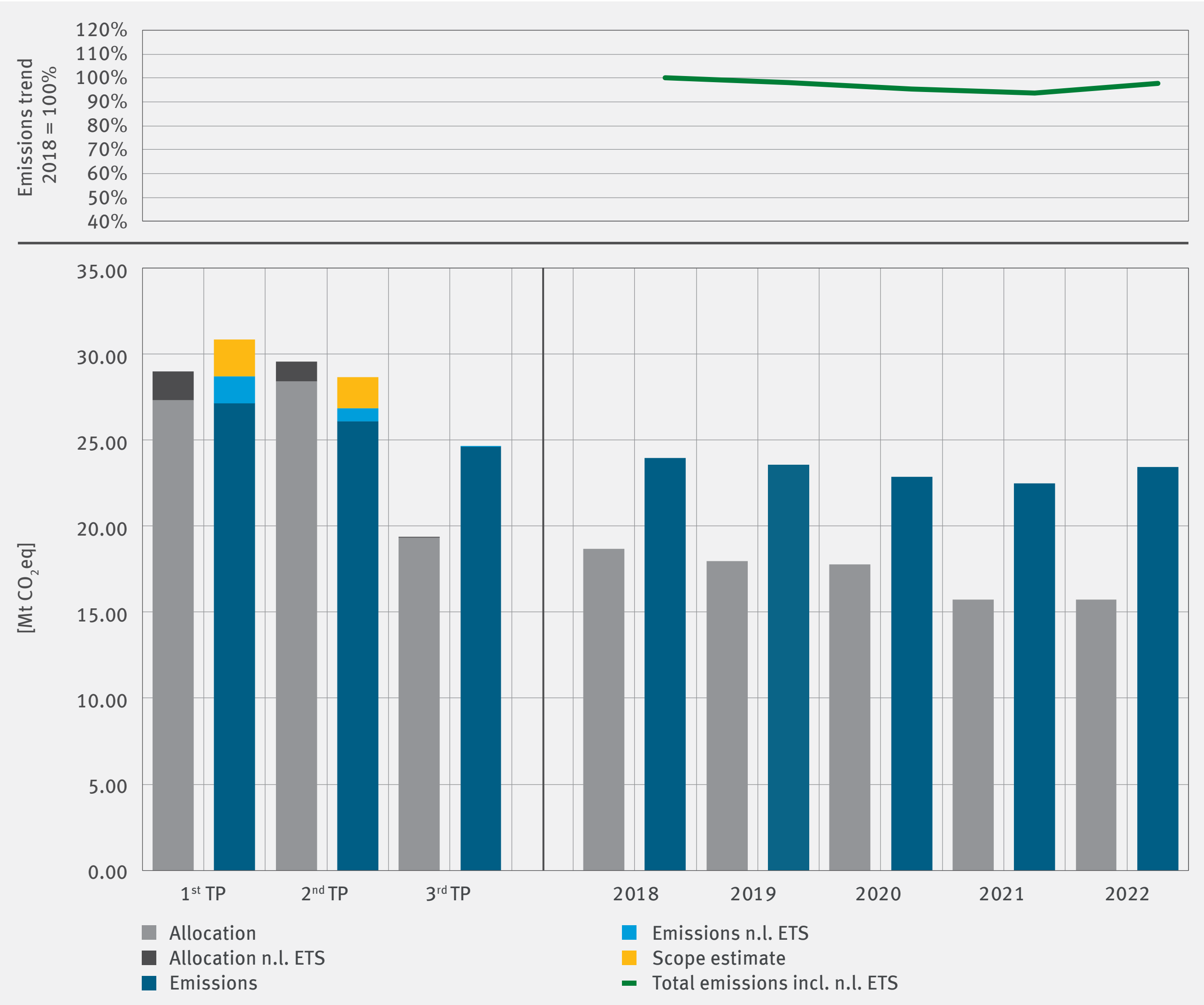


Figure 13: Refineries (Activity 7), trend in emissions and free allocation up to 2022

Emissions and production trends

Figure 14 compares the refineries' emissions trends with those of German gross refinery production and their crude oil input.

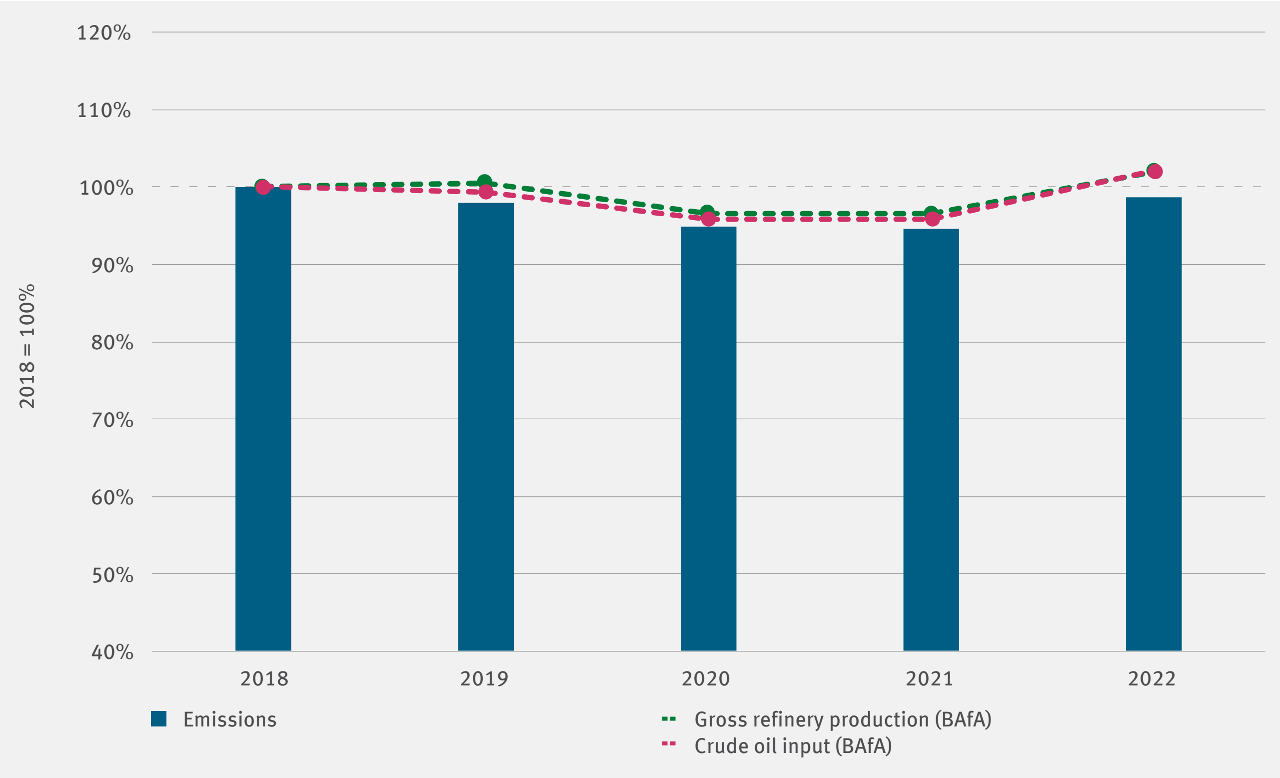


Figure 14: Refineries (Activity 7), trends in emissions and production 2018 to 2022 in Germany[41] each in relation to 2018

Figure 14 shows that emissions, crude oil input and gross refinery production largely run parallel to each other. Overall, crude oil input and gross refinery production reflect the trend in emissions relatively well in the period under consideration. The decrease in emissions up to 2021 is likely to be predominantly due to the decline in crude oil input. In 2022, gross refinery production and crude oil input were about two percent higher than in 2018, and compared to 2021, both values actually increased by about six percent. This trend could be attributed to the recovery of the travel industry[42] after the COVID 19 pandemic and the associated demand for fuels or it could be explained by the increased use of heating oil as a comparatively cheaper gas substitute[43].

The trend in refinery emissions at EU level is described in Section 2.10.

41 See BAfA 2023
42 See DRV 2023
43 See Tagesschau 2023

2.4 Iron and Steel Industry Including Coking Plants

The iron and steel industry includes Activities 8 to 11 and two Activity 1 installations as classified in the TEHG[44], which means a total of 120 installations that are subject to emissions trading in Germany[45]. An assessment of the iron and steel industry summarises Activities 8 (coke production), 9 (roasting and sintering of metal ores) and 10 (pig iron and steel production). The reason for this is that the installations are strongly interlinked and connected in terms of regulation approval, especially in the blast furnace route (production of oxygen steel). Thus, the installations partially include both the production of pig iron and steel as well as coking plants and sinter plants, which means that the emission data is not available in activity-specific form. This is predominantly due to the establishment of 'amalgamated installations' according to Section 24 of TEHG in conjunction with Section 15(2) 2030 EHV of 29/04/2019. In other cases, coking plants and sinter plants are recorded as separate installations in the EU ETS. A differentiated view according to Activities would therefore result in a distorted picture due to the different system boundaries.[46]

Figure 15 shows that steel production installations using the blast furnace route (oxygen steel) with a share of almost 85 percent, dominate the emissions from the iron and steel industry in emissions trading in Germany. X The blast furnace route accounts for about 70 percent of crude steel production.[47]
In contrast, emissions from electric steel production in electric arc furnaces (EAF) using steel scrap, which accounts for 30 percent of total crude steel production in Germany, are comparatively low at around three percent.[48] In addition to these two crude steel production routes, an installation for the production of sponge iron based on iron ore is also operated in Germany using the direct reduction process (DRI). Sponge iron can then be used in an electric arc furnace (EAF) instead of steel scrap to produce steel as well. Emissions from production amount to about 0.2 percent.[49] Emissions from iron and steel processing (Activity 11) account for about 12 percent.

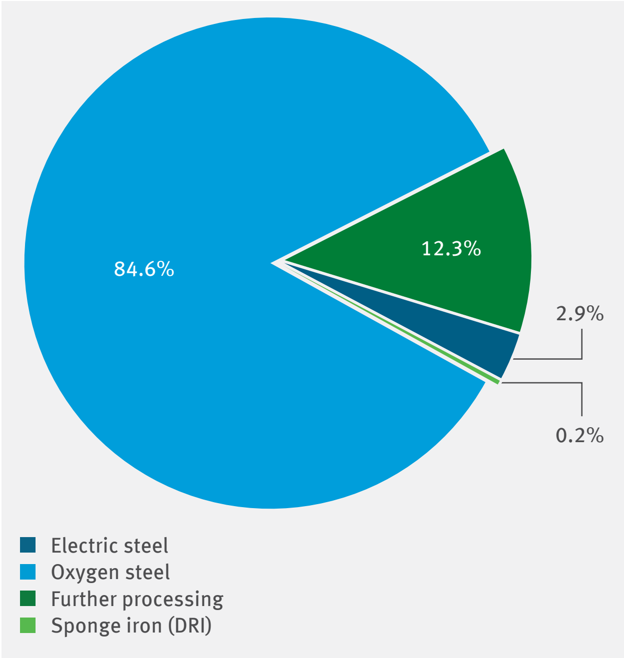


Figure 15: 2022 emissions distribution in the iron and steel industry (Activities 8 to 11 and 1)

44 These are two independently approved coal grinding and drying installations which carry out a pig iron production process step.

45 The sector also includes two small emitters (one each in Activity 10 and 11). Details on small emitters in the fourth trading period of the EU ETS are described in Chapter 1.3.

46 In addition, a small number of Activity 10 installations contain steps for further processing crude steel which would be assigned to Activity 11 'Ferrous metals processing' if they were operated as independent installations.

47 See WV Stahl 2023a

48 Only direct emissions are shown here. However, for both forms of crude steel production there are also indirect emissions resulting from electricity consumption. These are higher for electric steel production, yet even if these indirect emissions were included, the blast furnace route would clearly dominate emissions.

49 Here, only emissions from the production of sponge iron are shown separately, whereas emissions from the conversion to steel in the EAF are subsumed in the emissions from electric steel production.

Table 9 shows the emissions for 2021 and 2022, differentiated according to Activities 8 to 10, 11 and 1 in line with the explanation above. At 29.0 million tonnes of carbon dioxide combined, emissions from Activities 8 to 10, were 6 percent lower in 2022 than the previous year's figure of 30.9 million tonnes of carbon dioxide. At the same time, crude steel production decreased by about eight percent from 40.1 million tonnes to 36.8 million tonnes.[50] Emissions from the blast furnace route (including Activities 8 and 9) were about 28.0 million tonnes of carbon dioxide in 2022, about 1.6 million tonnes (five percent) less than previous year's 29.6 million tonnes. Emissions from the electric steel route decreased by about 122,000 tonnes (11 percent) from about 1,068,000 tonnes of carbon dioxide to 945,000 tonnes. Emissions from the processing of ferrous metals (Activity 11) decreased by about 0.3 million tonnes (seven percent) to a current 4.1 million tonnes.

Table 9: Iron and steel industry (Activities 8 to 11 and 1), number of installations, 2021 emissions, 2022 free allocation, 2022 VET entries, allocation coverage

No.	Activity	Number of instal-lations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
8, 9, 10	Pig iron and crude steel production*	35	30,911	29,025	43,561	150.1%
11	Ferrous metal processing	83	4,354	4,058	2,971	73.2%
1	Combustion	2	161	103	20	18.9%
Total		**120**	**35,426**	**33,186**	**46,551**	**140.3%**

As of 02/05/2023
* Coking plants, metal ore processing, pig iron and steel production

Transfer of waste gases from iron, steel and coke production

A characteristic feature of the iron and steel industry is the transfer of waste gases from iron, steel and coke production (blast furnace gas, converter gas and coke oven gas) for energy recovery. In 2022, the total emissions from transferred and energy-intensive used waste gases from iron, steel and coke production amounted to around 23.2 million tonnes of carbon dioxide (see Table 10), about 1.5 million tonnes less than in 2021.

Table 10: Transfer of waste gases from iron, steel and coke production in 2022 – produced within Activities 8 and 10

Transfer to [kt CO_2eq/a]					
Iron and steel production installations (Activities 8 – 10)*	Ferrous metal processing and combustion installations (Activities 11 and 1)	Energy installations	Refineries	Installations outside ETS**	Total [kt CO_2eq/a]
3,744	1,102	18,234	0	98	23,178

As of 14/04/2023
* Emission volumes leaving installation boundaries but remaining within Activities 8 to 10.
** The total amount transferred is 127.908 tonnes of carbon dioxide equivalents, of which 30.028 tonnes are inherently carbon dioxide.

50 See WV Stahl 2023a

Transfers within and between Activities 8 to 10 (waste gases from iron, steel and coke production) amounted to about 3.7 million tonnes of carbon dioxide[51], a slight decrease in the 3.9 million tonnes reported in 2021. Additionally, transfers of waste gas from these facilities to further processing facilities (Activity 11) are accounted for around 1.1 million tonnes of carbon dioxide, down from 1.2 million tonnes in 2021. The majority of remaining waste gases from iron, steel and coke production, were transferred to energy plants: these waste gases correspond to around 18.2 million tonnes of carbon dioxide, compared to 19.3 million tonnes in the previous year.[52]

Allocation status

It is not the nominal free allocation that is decisive in being able to adequately assess the allocation situation of the iron and steel industry in the EU ETS, but the adjusted free allocation and the resulting allocation coverage as a ratio of free allocation to emissions[53]. The relationship between these parameters will be explained in detail for the iron and steel industry within this section.

Table 9 above not only shows the emissions but also the ratio of emissions to the allocation in the respective year – i. e. 'allocation coverage' (last column). In 2022, the nominal increase for Activities 8 to 10 was 150 percent, significantly surpassing the 137 percent recorded in the previous year. This notable rise is due primarily to the substantial decrease in emissions and to a slightly increased allocation quantity (compare Figure 16 below).[54]

For Activity 11, the calculated allocation coverage is 73 percent, which represents a moderate increase compared to 2021.

However, for Activities 8 to 10 it can be assumed that, following the transfer of waste gases from iron, steel and coke production, waste gas producing installations of the iron and steel industry will transfer emission allowances to waste gas utilising energy installations. The producers receive an allocation for the emissions from the utilisation of the waste gases for energy generation in comparison to natural gas which is the baseline fuel. The benchmark also includes an 'inefficiency surcharge', which reflects the lower efficiency of waste gases utilised for energy in the case of blast furnace gas compared to natural gas used for electricity or heat generation. The number of emission allowances transferred can be estimated based on the waste gas volumes actually transferred. In 2022, the emissions resulting from the volume of waste gases transferred to energy installations corresponded to 18.2 million tonnes of carbon dioxide (see Section 'Transfer of waste gases from iron, steel and coke production' above).

The estimated number of transferred emission allowances corresponds to the emission volume from the transferred waste gases from iron, steel and coke production produced when compared to natural gas along with the inclusion of the 'inefficiency surcharge'.[55] Thus, the 2022 amount of emission allowances transferred to energy installations can be estimated at around 14.9 million (compared to 15.8 million in the previous year). This results in an adjusted allocation amount of about 31.6 million allowances and an adjusted allocation coverage of 95.3 percent (see Table 11). This means that in 2022, the iron and steel industry arithmetically received five percent less allocation free of charge than it needed to surrender for the reported emissions.

51 Emission volumes leaving the installation boundaries but remaining within Activities 8 to 10. For different installation boundaries see the explanations on the amalgamated installations at the beginning of this chapter.

52 When waste gases are transferred to installations not subject to emissions trading, the waste gas producing installations must surrender emission allowances for the inherent carbon dioxide proportion of the waste gases, i. e. the volume of carbon dioxide that can no longer be used for energy purposes. This volume has already been subtracted from the total volume transferred (see Table 10) and is already included in the emissions of the waste gas producing installation. In the case of transfers to installations subject to emissions trading, the waste gas utilisation installations must surrender emission allowances corresponding to the total volume of carbon dioxide contained in the transferred waste gas.

53 See also explanations on both the allocation coverage and the adjusted allocation coverage in the glossary starting on page 187.

54 As of 19/04/2023, not all 2022 allocation adjustments had been finalised and approved by the European Commission. Based on the activity rates, allocation reductions of a relevant amount are still to be expected for iron and steel industry installations for 2022.

55 See DEHSt 2014a, Chapter 'Iron and steel industry'.

Table 11: Iron and steel industry (Activities 8 to 11 and 1), number of installations, allocation amounts, 2022 VET entries and adjusted allocation coverage

Sector	Number of installations	2022 adjusted allocation amount [1000 EUA]	2022 VET [kt CO_2eq]	2022 allocation deviation from 2022 VET [kt CO_2eq]	Adjusted allocation coverage
Eisen und Stahl	120	31,621	33,186	−1,565	95.3%

As of 02/05/2023

When assessing this allocation coverage in the iron and steel industry, it should also be borne in mind that a large proportion of waste gases from iron, steel and coke production is used to generate electricity. In accordance with the still valid basic principle of allocation in the third trading period, no free allocation is granted for electricity generation.

This means that an under-allocation of free emission allowances is inherent in the system for electricity generation and that this also applies to waste gases from iron, steel and coke production. Currently, a free allocation for electricity generation utilising waste gases from iron, steel and coke production is now only provided for the additional emissions that would arise when compared to electricity generation from natural gas[56] and for which there is no free allocation.[57] If the electricity generated is in turn used in iron or steel production, the operator can also apply for compensation for the additional costs arising from the assumed passing on of carbon dioxide costs via the electricity price.[58]

Trends in the past years

Figure 16 below shows the emissions trend of the entire sector since the start of emissions trading. The average emissions and allocation amounts are shown as columns for the first, second and third trading periods; annual emissions and allocation amounts and the relative emissions trends are indicated for the period from 2018. This also takes into account installations no longer subject to emissions trading (n. l. ETS)[59] and estimated emissions (scope estimate) from installations for the period 2005 to 2012 that will only be subject to emissions trading after 2013[60]. The estimated shares for the transfer of waste gases from iron, steel and coke production to energy installations contained in the allocation amounts are shown in hatched form (cf. detailed explanations in the sections above). These amounts are included in the allocation benchmarks and are thus allocated to steel producers. However, it is assumed that steel producers will pass on the proper amount of emission allowances to the operators of energy installations that are using waste gases from iron, steel and coke production.

The average emissions from the iron and steel industry in the second trading period were below the average in the first trading period due to the decrease in emissions caused by the financial and economic crisis. On average, emissions in the third trading period were again above those of the second trading period.

Between 2018 and 2020, emissions from the iron and steel industry fell significantly compared to the previous year, especially in 2020 due to the pandemic.

56 There is also a natural gas based deduction for heat generation in the allocation for iron and steel production, but users of waste gases from iron, steel and coke production and/or heat also receive a direct allocation for the heat generated according to the heat benchmark.

57 See DEHSt 2014a, Chapter 'Iron and steel industry'. There is a special feature of free allocation for waste gases, which results from Emissions Trading Directive provisions: if electricity is generated using residual gases, allowances should in exception be allocated free of charge in contrast to electricity generation from other fuels. These regulations are intended to ensure that the utilisation of the residual gases, which are often rich in emissions and are less efficient than conventional fuels, is not handicapped or prevented by emissions trading. This ensures that the only disadvantage of the inefficient use of residual gases compared to electricity or heat generation from natural gas is compensated for, but no further betterment in the use of residual gases occurs.

58 See DEHSt 2022b

59 See explanations on 'Consideration of installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1 Introduction.

60 The emissions for the 2005 – 2010 period represent data from the allocation procedure. No historical emissions are available for 2011 and 2012; the values for both years were estimated by linear interpolation.

The allocation amounts also declined between 2018 and 2020. This was in line with a continuous decrease in the third trading period of the cross-sectoral correction factor, whereas the reference period for determining the allocation on the level of each installation was based on a constant historical base period (2005 to 2008). In spite of this gradually reduced allocation, in 2020 a stronger decline in emissions compared to the decline in allocation resulted in allocations actually exceeding emissions (when deducting, as described above, the assumed amounts for transfer of waste gases from iron, steel and coke production). In contrast, in previous years, emissions exceeded allocations, so that additional purchases of around 7 to 15 percent of emissions were required.

From 2020 to 2021, emissions again increased significantly by about 12 percent and, as mentioned above, they fell by about 6 percent in 2022, being roughly 12 percent lower in 2022 compared to 2018.

While the allocation amounts in the iron and steel sector as a whole where relatively stable between 2020 and 2021, they were significantly higher in 2022 than in the previous year – by around 2 million allowances (adjusted figures, as described above). The relatively constant trend of allocation amounts between 2020 and 2021 nevertheless conceals simultaneous changes occurring during the transition to the fourth trading period. For example, the product benchmark for 'liquid pig iron' i. e. 'hot metal' benchmark used in crude steel production in the blast furnace route (oxygen steel), fell by only 3 percent compared to the third trading period. In contrast, sinter and coke saw more substantial reductions of 7.9 and 24 percent respectively. These changes hold crucial implications for the free allocation in the iron and steel industry.[61] In parallel, the activity rates of the new allocation base period (2014 to 2018) has a reducing effect on the allocations. On the other hand, no cross-sectoral correction factor will be applied from 2021 to 2025. In the field of further processing, the allocation coverage is very clearly below 100 percent. This is despite the above-mentioned discontinuation of the cross-sectoral correction factor, and can be attributed to the lower fallback benchmark values applicable to these processes, together with increased emissions (as described above under 'Allocation status').

The significant increase in the 2022 allocation for the iron and steel sector as a whole is mainly due to the allocation rules, which proportionally adjust the allocation quantities in the subsequent year if there is a significant change in production (by 15 percent compared to the base period or the last adjustment).[62] Furthermore, the considerable decrease in the notional allocation for the waste gases from iron, steel and coke production also plays a crucial role in the allocation increase.

61 See COM 2021

62 See Infobox on the allocation rules of the fourth trading period in the EU ETS in Section 2.9.

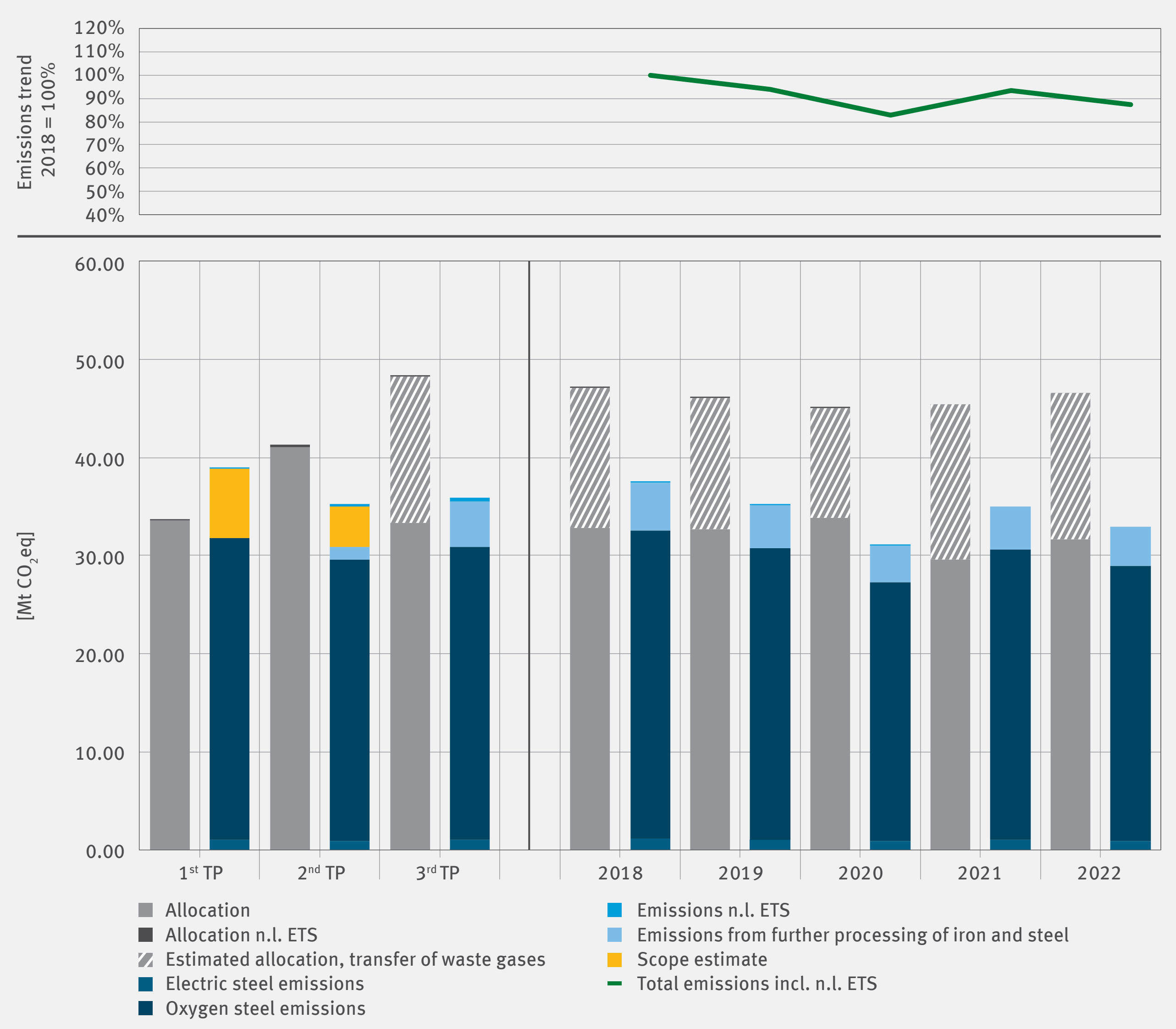


Figure 16: Iron and steel industry (Activities 8 to 11 and 1), emissions and free allocation trends up to 2022[63]

63 In the VET reports for the second trading period, the allocation amounts of this trading period are offset by considering the provisions of Section 11 of the 2012 Allocation Act. According to this regulation, producers of waste gases from iron, steel and coke production were legally obligated to transfer emission allowances in the amount of their annual waste gas transfers to the utilising installations in the second trading period. This waste gas transfer has already been subtracted in the illustrated allocation amounts.
While it must be assumed that there are similar contractual agreements between producers and users in the third and fourth trading period, the allocation rules for the third and fourth trading period do not contain any obligation comparable to Section 11 of the 2012 Allocation Act.

Emissions and production trend

Figure 17 and Figure 18 show the emission and trend in production volume for oxygen steel and electric steel, each in relation to 2018. The activity rates for coke and iron ore sinter are also shown separately for oxygen steel. Their emissions are also included in the emission timelines. The figures show the activity rates of the products[64] supplemented by information from the German Steel Federation (WV Stahl 2020, 2021, 2023a).[65]

As mentioned earlier, emissions from oxygen steel production (crude steel) play a dominant role in the overall emissions of the iron and steel industry in general. Consequently, their emissions trend largely coincides with the emissions trend of the iron and steel industry as a whole as previously described above. Thus, in 2019 and especially in 2020, significant decreases were recorded, followed by a rebound in 2021 to almost identical values as in 2019. In 2022, on the other hand, a significant decrease can be recorded in that the emissions in the reporting year were about 11 percent below the emissions in 2018.

From 2018 to 2022 production fell by around 13 percent, which is slightly surpassing the reduction in emissions (11 percent, see above). However, this does not necessarily indicate a significant divergence in the trend of these two parameters. Since a decrease in production is usually associated with a certain decline in production efficiency, assuming all other factors remain constant. Because the installations have a 'base load' of energy demand to a certain extent, it is reasonable to assume that the slight difference in the trend of production volumes and emissions, as mentioned above, is in part due to this fact.

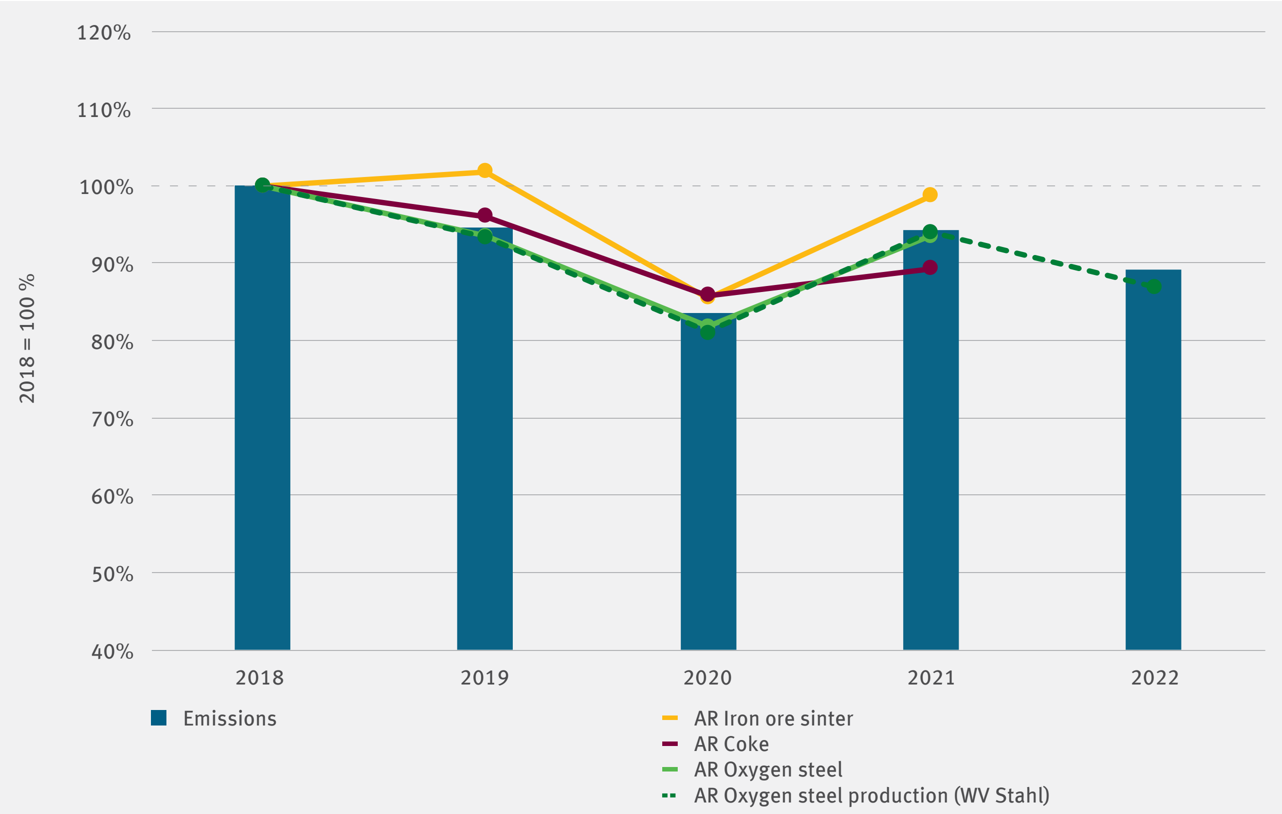


Figure 17: Oxygen steel production, 2018 to 2022 emissions and production trends in Germany, each in relation to 2018

64 Activity rates for the 'carbon steel' and 'high-alloy steel' product benchmarks are summarised for electric steel. It should be noted in connection with the activity rate for oxygen steel ('liquid pig iron' product benchmark) that due to the allocation rules, the data refers to the amount of pig iron produced, that is, prior to processing into steel in the steel converter. The crude steel amount is generally higher by about 10% (predominantly due to the addition of steel scrap in the converter). Since the figure shows the relative trend and since the amount of steel scrap added to the converter is approximately constant, there are no significant deviations.

65 WV Stahl 2020 for 2017 to 2019; WV Stahl 2021 for 2020; WV Stahl 2023a for 2021 (through back calculation) and 2022. Data from the sources checked for consistency for the overlapping years.

The following Figure 18 for electric steel[66] shows both the emissions and the activity rates and association figures on production for electric steel in relation to 2018. In contrast to oxygen steel, emissions fell quite sharply in 2019 compared to the previous year, while in 2020 they only fell marginally. After a strong increase in 2021, which also surpassed the 2019 emissions, in 2022 they fell to their lowest level ever: 18 percent below those in 2018. This general trend is consistent with the production trend in each case. The causes of the production decline, especially in the second half of 2022, are the Russian war of aggression against Ukraine, the energy crisis, inflation, and continued supply chain problems, according to a news report by WV Stahl (compare WV Stahl 2023b).

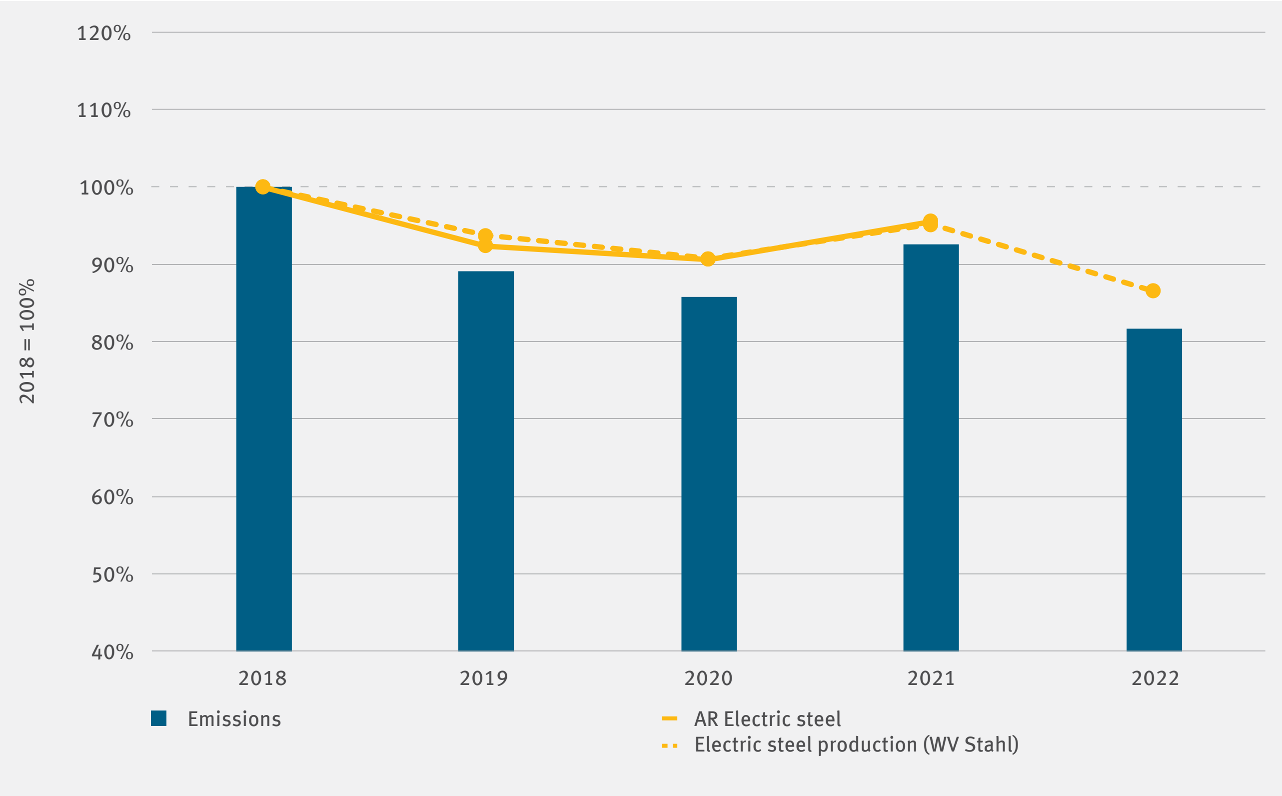


Figure 18: Electric steel production, 2018 – 2028 emissions and production trends in Germany, each in relation to 2018

The trend in emissions from the iron and steel industry at EU level is described in Section 2.10.

66 As mentioned above, the products with the EAF high-alloy and EAF carbon steel benchmarks are considered together.

2.5 Non-Ferrous Metals Industry

The German non-ferrous metals industry in European Emissions Trading included a total of 39 installations in Activities 12, 13 and 1 pursuant to Annex 1 TEHG in the 2022 reporting year. The installations in the non-ferrous metals industry subject to emissions trading emitted around 2.7 million tonnes of carbon dioxide equivalents in 2022. 2022 emissions were thus 15 percent lower than in the previous year due to high electricity and natural gas prices leading to production cutbacks, particularly in sub-sectors with high energy consumption.[67]

Figure 19 shows the 2022 proportions of emissions from the non-ferrous metals industry broken down into the installations' emissions according to their main products: primary aluminium and anode production (Activity 12), secondary aluminium and aluminium processing, production or processing of lead, zinc or other non-ferrous metal, production or processing of copper (Activity 13) and combustion (Activity 1). The four Activity 1 installations consist of two coating installations that further process aluminium sheet and two installations that process aluminium hydroxide predominantly into alumina as a feedstock for primary aluminium production.

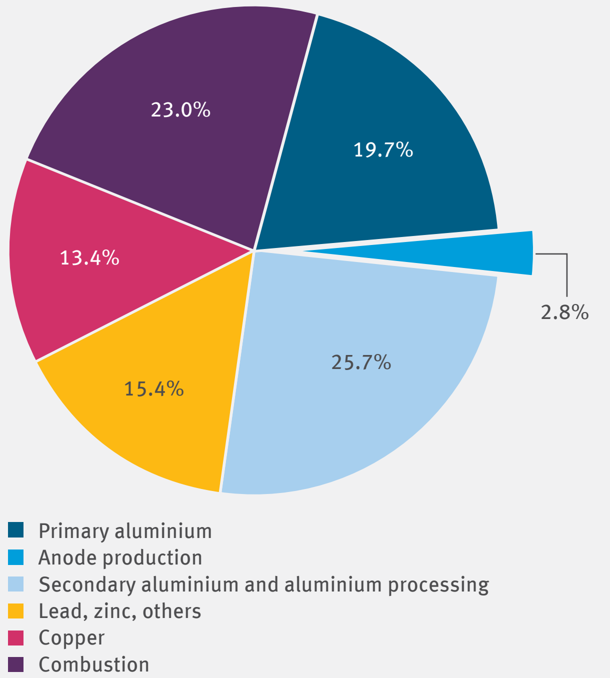


Figure 19: 2022 emission proportions from non-ferrous metals industry (Activities 12, 13 and 1)

There were changes compared to the preceding year. Unlike in the previous year, the electrolysis installations for the production of primary aluminium no longer account for the largest share of emissions in the non-ferrous metals industry at around 20 percent They are ranked third in terms of emissions, with secondary aluminium production and aluminium processing installations holding the largest share this year at 26 percent, followed by combustion plants, whose share of emissions of the non-ferrous metal industry amounts to about 23 percent. Installations for the production or processing of lead, zinc or other non-ferrous metals have a share of 15 percent in the emissions of the non-ferrous metals industry. The proportion of copper production and processing installations in the industry emissions is slightly smaller compared to the previous year, at around 13 percent. Emissions from anode production (Activity 12) have a share of only three percent.

Table 12 provides an overview of emissions and allocations for the non-ferrous metals industry in 2022.

Table 12: Non-ferrous metals industry (Activities 12, 13 and 1), number of installations, 2021 emissions, 2022 VET entries, 2022 free allowances and 2022 allocation coverage

No.	Activity	Number of installations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
12	Primary aluminium Production	7	915	600	874	145.5%
13	Non-ferrous metal processing	28	1,564	1,452	1,329	91.5%
1	Combustion	4	656	613	253	41.3%
Total		**39**	**3,135**	**2,665**	**2,456**	**92.2%**

As of 02/05/2023

67 See WV Metalle 2023.

The seven installations in Activity 12 (primary aluminium and anode production) emitted 600,000 tonnes of carbon dioxide equivalents – significantly less than in the previous year. They included three installations for anode production, which are then consumed in the production of primary aluminium. The four electrolysis installations for primary aluminium production also emitted PFC (perfluorocarbons) in addition to carbon dioxide. In 2022, these PFC emissions corresponded to almost 35,000 tonnes of carbon dioxide equivalents and their average proportion of the total emissions from the four electrolysis installations were about seven percent as in the previous year. Overall, the level of emissions subject to emissions trading for Activity 12 installations was about 34 percent below the level of the previous year, as production dropped sharply, in particular due to high electricity prices.[68]

The 28 installations in Activity 13 (production and processing of other non-ferrous metals such as copper, zinc or lead and secondary aluminium) emitted about 1.45 million tonnes of carbon dioxide equivalents in 2022, which was seven percent less than in 2021.

The installations involved in the production of primary aluminium and anode production receive a free allocation according to the product benchmarks 'aluminium' or 'prebaked anodes'. The free allocation for these installations for 2022 amounted to approximately 146 percent of their annual emissions compared to 96 percent in 2021.[69] This significant increase in the allocation coverage can be explained by the substantial drop in emissions resulting from the decline in production. For Activity 13 installations which receive only a fallback allocation, the allocation coverage in 2022 was about 92 percent, compared to 84 percent in 2021. Here too, for Activity 13, the increase in allocation coverage can be explained by the reduction in emissions due to the decrease in production.

Overall, the allocation coverage of the non-ferrous metals industry increased from 80 percent in 2021 to 92 percent in 2022.

Trends over the past years

Figure 20 shows the emissions from the non-ferrous metals industry broken down and presented according to the materials or products predominantly produced or processed since the start of emissions trading. The average emissions are shown as columns for the first, second and third trading periods; the average allocation amount is also shown for the third trading period.[70] Annual emissions and allocation amounts, and the relative emissions trend are shown for the period from 2018. Installations no longer subject to emissions trading (n. l. ETS)[71] have also been taken into account, and estimated emissions (scope estimate) from installations for the period from 2005 to 2012, which will only be subject to emissions trading from 2013 onwards[72].

The total emissions of the German non-ferrous metals industry in the EU ETS have decreased since 2018: between 2018 and 2021, they decreased between one and three percentage points per year, first due to a generally difficult economic situation[73], then due to the decline in demand or supply chain issues associated with the Covid 19 pandemic[74]. Between 2021 and 2022, emissions then fell significantly by 14 percentage points, so that in 2022 they were 19 percent below the 2018 level.[75] The emissions trends of the various products/materials were as follows:

68 See WV Metalle 2023.

69 See DEHSt 2022b.

70 Emissions data for the years prior to 2013 cannot be considered as being based on emissions reports because installations in the non-ferrous metals industry only became subject to emissions trading at the beginning of the third trading period. Instead, a comparable overview of the sector's emissions trend can be established using 2005 – 2010 emissions data from the third trading period allocation procedure. For five installations, 2009 and 2010 emissions were estimated using linear interpolation of the data between 2008 and 2013. This included the three anode production installations. No emissions data were available for the non-ferrous metals industry for 2011 and 2012.

71 See explanations on 'Consideration of installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1 Introduction.

72 The 2005 – 2010 emissions are data from the allocation procedure. No historical emissions are available for 2011 and 2012; the figures for both years were estimated by linear interpolation.

73 See WV Metalle 2019.

74 See WV Metalle 2021.

75 See WV Metalle 2023.

Emissions from copper production and processing installations fell to 4 percent below 2018 levels by 2020, after which they increased only slightly to 2 percent below 2018 levels in 2021, and then fell again to 8 percent below 2018 levels in 2022. The trend in emissions is roughly mirrored by the production trend.[76]

In contrast, emissions from installations producing and processing lead, zinc, or other non-ferrous metals rose to a level 10 percent above 2010 levels between 2018 and 2019, stagnated there in 2020, and fell to 4 percent below the 2018 baseline by 2022. Production figures according to the Metal Industry Association (WV Metalle) of lead, zinc, tin, and their alloys also declined compared to 2020 levels.[77]

Emissions from secondary aluminium production and aluminium processing installations decreased by a total of 15 percentage points between 2018 and 2020. In particular, the pandemic-related decline in demand from the automobile industry and mechanical engineering, and the slump in demand from the automobile industry for castings made from secondary aluminium, all played their part.[78] After an increase in 2021, emissions fell to 90 percent of 2018 emissions in 2022.[79]

Emissions from primary aluminium production installations (electrolysis installations) decreased by seven percentage points in 2019 compared to 2018, increased slightly by two percentage points in 2020, and then decreased, first by seven percentage points in 2021 followed by 32 percentage points in 2022 to a level of only 56 percent of 2018 emissions. These trends can also be explained by the economic trends in 2021 and 2022 as shown in more detail in the following section on emissions and production trends.

76 See WV Metalle 2020 and DESTATIS 2023c.
77 See WV Metalle 2023.
78 See WV Metalle 2020 and WV Metalle 2021.
79 See WV Metalle 2022.

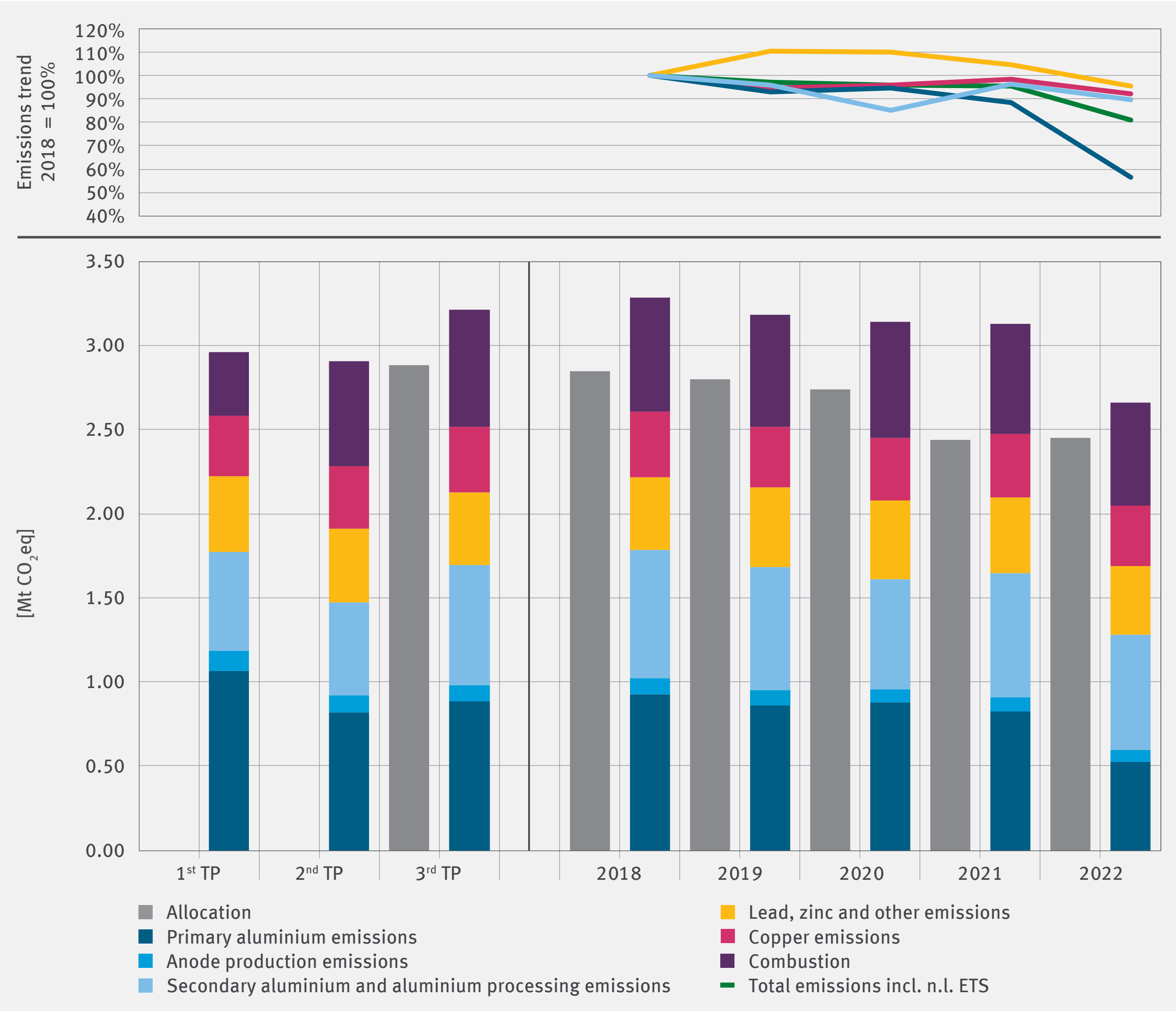


Figure 20: Non-ferrous metals industry (Activities 12 and 13). Emissions and free allocation trends up to 2022[80]

80 Two energy installations have been subject to emissions trading since 2005, which are operated at production sites for non-ferrous metals. Since the beginning of the third trading period, these installations are recorded together with the installation section that produces or processes non-ferrous metals. The Figure does not show the free allocation and emissions from these energy installations during the first and second trading periods.

Emissions and production trends

Figure 21 compares the emissions trend with the production trend data for the electrolysis installations for the production of primary aluminium. These are based on the activity rates (AR) of the 'primary aluminium' product benchmark[81] and the primary aluminium production data from the Metal Industry Association (WVMetalle). The activity trend rate corresponds well with that of the WVMetalle data.

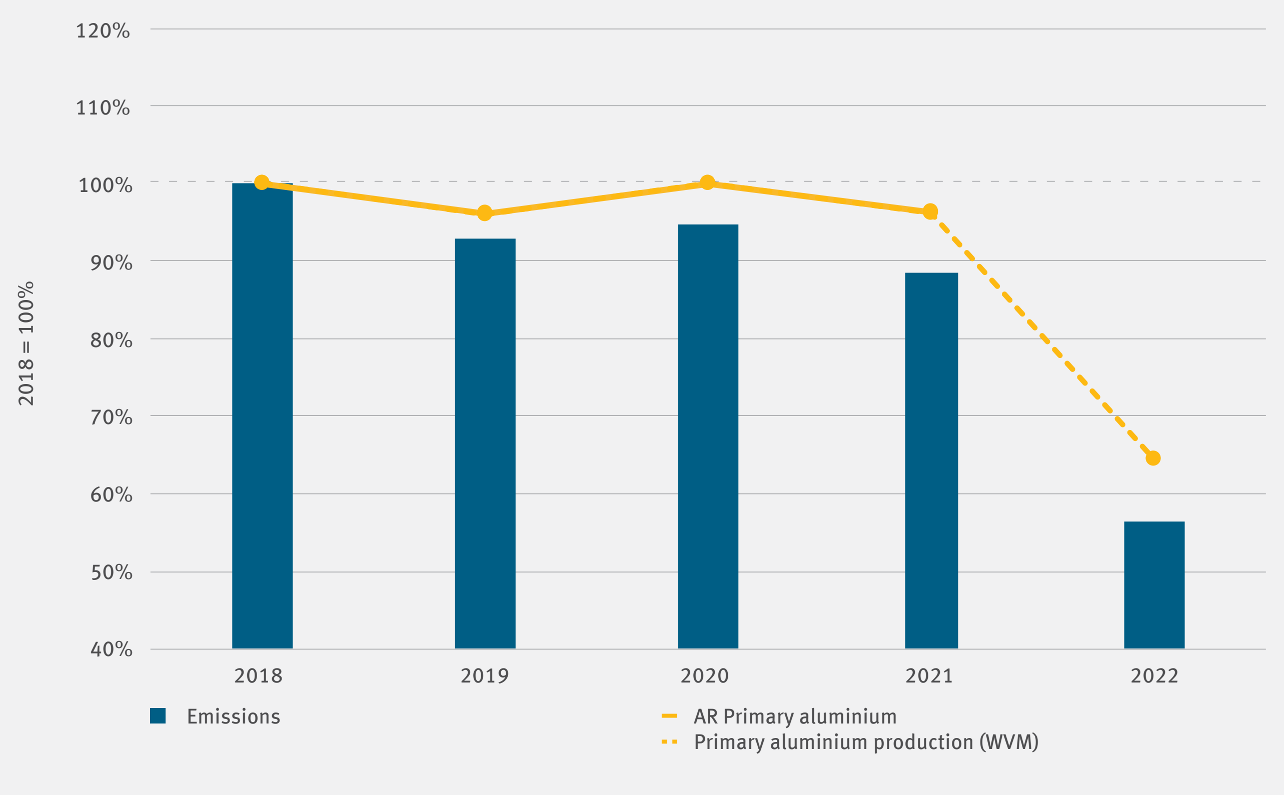


Figure 21: Electrolysis installations, 2018 – 2022 emissions and production trends in Germany in relation to 2018[82]

Over time, the relative trend of emissions and production correlate reasonably well. In 2019, both emissions and production decreased compared to 2018 due to the cooling economy. However, in 2020, primary aluminium production increased which led to higher emissions from primary aluminium production, despite the decrease in aluminium demand, which was met through lower secondary aluminium production.[83]

Moving on to 2021, emissions decreased by 12 percent and production four percent in comparison to 2018. This decline in primary aluminium production was attributed to the fact that aluminium demand, though roughly similar to 2020 levels, was chiefly met by secondary aluminium sources.[84] In the subsequent year, 2022, primary aluminium production and associated emissions fell once again, reaching only 65 percent and 56 percent of 2018 levels respectively. This was largely due to production curtailments driven by the surge in electricity prices.[85]

The trend in emissions from the non-ferrous metals industry at EU level is described in Section 2.10.

81 For 2022, the activity rates will only be transmitted to DEHSt in April 2023, so that only the Metal Industry Association data is included in the Figure for 2022. For details on the data basis of the activity rates, see Chapter 1.

82 Primary aluminium (WV Metalle): see WV Metalle 2021; Production figures for the production of aluminium from ore

83 See WV Metalle 2021.

84 See WV Metalle 2022.

85 See WV Metalle 2023.

2.6 Mineral Processing Industry

Within the mineral processing industry, more than half (55.9 percent) of the total 33.5 million tonnes of carbon dioxide equivalents emitted in 2022 can be attributed to cement clinker production. Following closely, emissions from lime, gypsum and sugar production including gypsum processing installations, like power plant flue gas desulphurisation installations, accounted for a further 26.7 percent of emissions. Additionally, the production of glass and mineral fibre accounts for another 12.2 percent of emissions while ceramics installations were responsible for 5.2 percent of the total emissions.

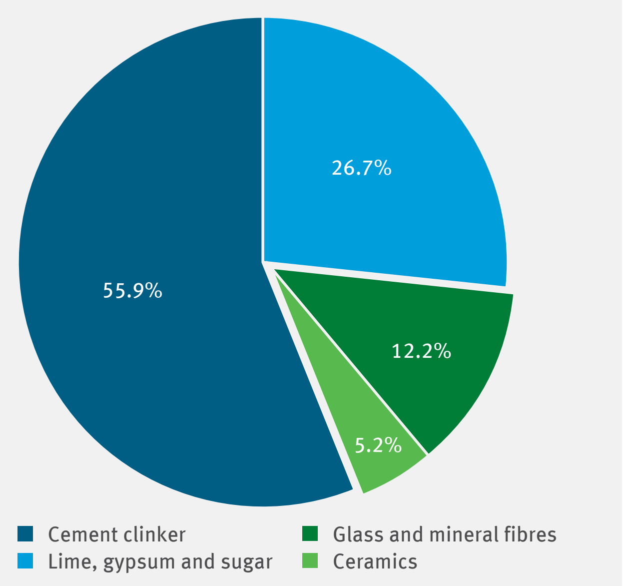


Figure 22: The mineral processing industry's shares in the 2022 emissions (Activities 1, 14 to 19)

2.6.1 Cement clinker production

The 34 installations that produce cement clinker and the single installation that manufactures products from burnt oil shale are hereinafter included under the term 'cement industry'. There were no changes in the number of installations in 2022. All of these installations cover the entire German cement industry, and throughout Germany exceed the EU ETS production threshold, which is 500 tonnes per day (Activity 14(2), Annex 1 of TEHG).

In 2022, emissions from cement clinker production showed a reduction of around nine percent below the previous year level.

Table 13: Cement clinker production (Activity 14), number of installations, 2021 emissions, 2022 VET entries, 2022 free allocation and 2021 allocation coverage

No.	Activity	Number of instal-lations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
14	Cement clinker production	35	20,532	18,763	17,550	93.5%
Total		**35**	**20,532**	**18,763**	**17,550**	**93.5%**

As of 02/05/2023

In 2022, the free allocation for the cement clinker installations was around 1.2 million emission allowances below the emission volume subject to a surrender obligation (see Table 13). This means that in 2022, the industry had an allocation coverage of around 94 percent. The shortfall was 3.2 million emission allowances with an allocation coverage of around 84 percent in the previous year.

This trend is primarily due to the industry's decreased emissions in 2022.

Trends over the past years

Figure 23 shows the emissions and free allocation trend for the cement industry over the 2018 to 2022 period and additionally the averages of the three past trading periods (see columns '1st TP', '2nd TP' and '3rd TP' in the lower part of the Figure).

The green line in the top part of the Figure shows the emissions trend of all installations subject to emissions trading in the respective years compared to 2018. Installations no longer subject to emissions trading (n. l. ETS)[86] have also been taken into account.

Following a decrease in the average emissions from clinker production during the second trading period compared to the first, emissions in the third trading period remained at a similar level to the second one[87]. This is presumably attributable to the fact that the average annual clinker production, both in the second and third trading periods, was somewhat lower than in the period between 2005 and 2007[88].

Between 2018 and 2021, there was a gradual but slight increase in emissions of around three percent. This rise was primarily due to a rising demand for cement, leading to increasing cement sales which in turn resulted from a surge in construction investments during this period. However, in 2022, emissions dropped to around 18.8 million tonnes of carbon dioxide equivalents which is around six percent lower than in 2018 due to the economic situation. In the construction industry, the main sales market for the cement industry, construction activity was slowed down mainly due to supply bottlenecks in building materials and a general price increase across all relevant sectors.[89]

During the third trading period, the free allocation, had been falling consistently due to the cross-sectoral annual reductions. However, at the beginning of the fourth trading period, the free allocation increased significantly primarily due to the discontinuation of the cross-sectoral reduction plus a seven percent increase from 2020 to 2021. This increase effectively compensated for the lowering of the product benchmark[90] at the beginning of the fourth trading period and the reduced activity rate of clinker production used for determining the free allocation[91].

86 See explanations on 'Taking into account installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1 Introduction.

87 Due to the transition from fixed emission factors to individually collected values, the reported emissions for the process-related emissions since 2013 have been slightly higher than they would have been if the fixed emission factor had been maintained (in the first trading period, an emission factor of 0.53 tonnes of carbon dioxide per tonne of cement clinker applied; in the second trading period, 0.525 tonnes of carbon dioxide per tonne of cement clinker).

88 Average annual production from 2005 to 2007: 25.4 million tonnes of cement clinker; 2008 to 2012: 24.2 million tonnes of cement clinker; 2013 to 2020: 24.0 million tonnes of cement clinker. See: VDZ 2015 and VDZ 2020 (Table 2).

89 See DESTATIS 2023a.

90 The product emission benchmark was adjusted from 0.766 to 0.693 tonnes of carbon dioxide equivalent per tonne of cement clinker.

91 The baseline period applied for most installations in the third trading period was 2005 to 2008, the baseline period for the first half of the fourth trading period was 2014 to 2018.

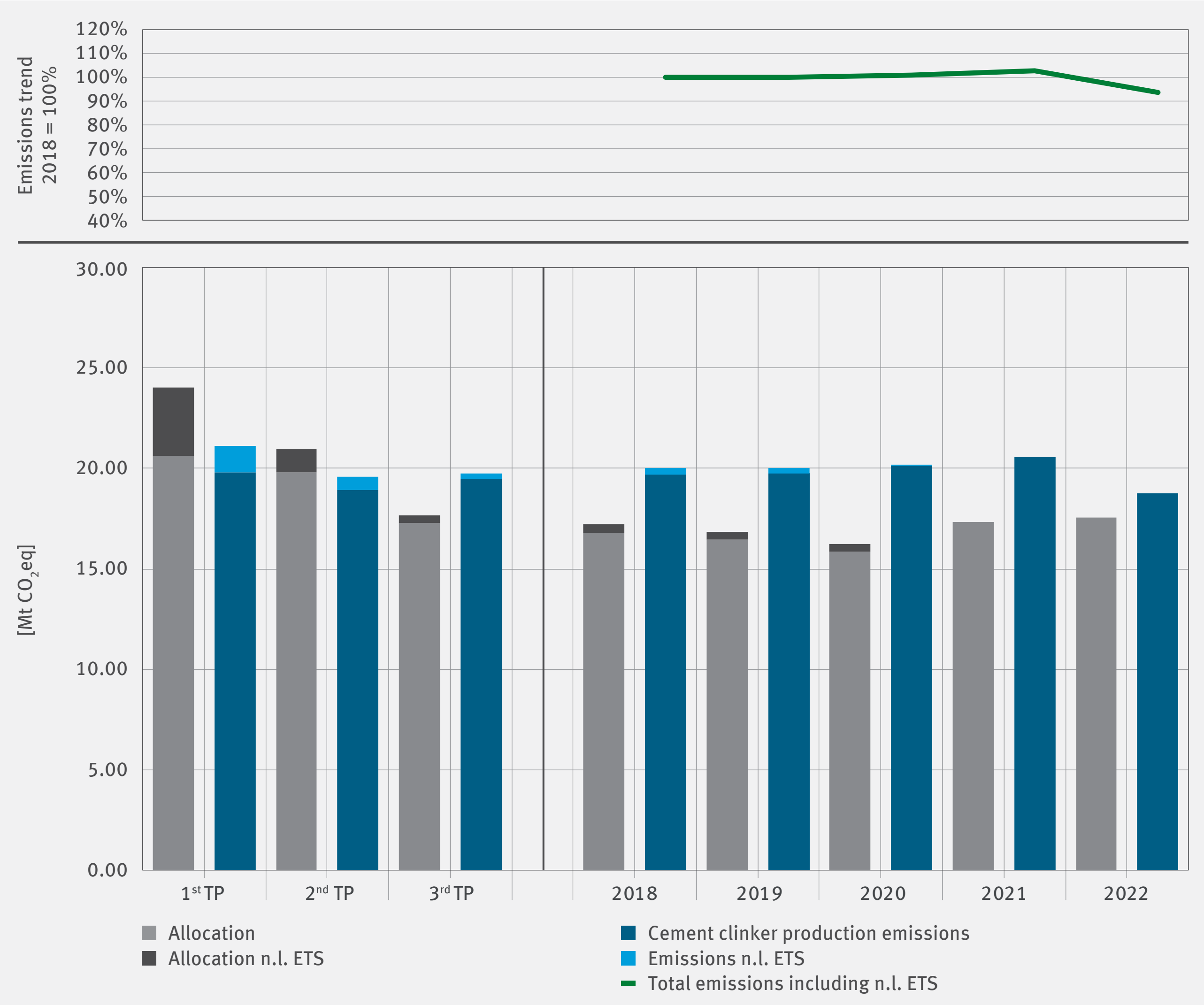


Figure 23: Cement clinker production (Activity 14), emissions and free allocation trend from 2005 to 2022

Emissions and production

The emissions from cement clinker production are primarily determined by the production trend. Figure 24 shows emissions and production (amount of clinker produced as reported in the emissions report), each in relation to 2018.[92] Between 2018 and 2021, emissions and production trend showed an almost identical course. This means that the specific emissions of clinker production have not changed significantly over these four years. This is also due to the high proportion of process-related emissions (about two thirds) from the deacidification of the limestone. Common carbon dioxide reduction measures (for example, increasing energy efficiency, using alternative fuels) have been applied for years, but have a limited reduction potential as they mostly only influence energy-related emissions. A wide variety of fuels have been used in clinker production, some of which have very different emission factors. The predominant source in this context are secondary fuels and other residues (also called alternative fuels). These include industrial waste, used tyres and sewage sludge, some of which can have significant biogenic carbon content. Conversely, the proportion of fossil fuels such as petroleum coke, lignite and hard coal has been gradually decreasing since 2013, albeit with occasional fluctuations.

92 The production data were evaluated based on of the reported material flows from the emission reports. The cement clinker production amounts also contain the amounts of dusts converted to cement clinker equivalents. The oil shale installation is not included in this evaluation. All installations subject to emissions trading in the respective year are indicated.

In 2022, the specific emission benchmark for the 33 grey cement clinker installations was 0.787 tonnes of carbon dioxide per tonne of cement clinker, which was slightly lower than in the previous year's benchmark of 0.793 tonnes of carbon dioxide per tonne of cement clinker. Interestingly, in relation to production, in 2022 the emissions from these installations decreased more strongly in 2022 compared to 2021 which is also primarily attributed to the reduced use of hard coal as a fuel.

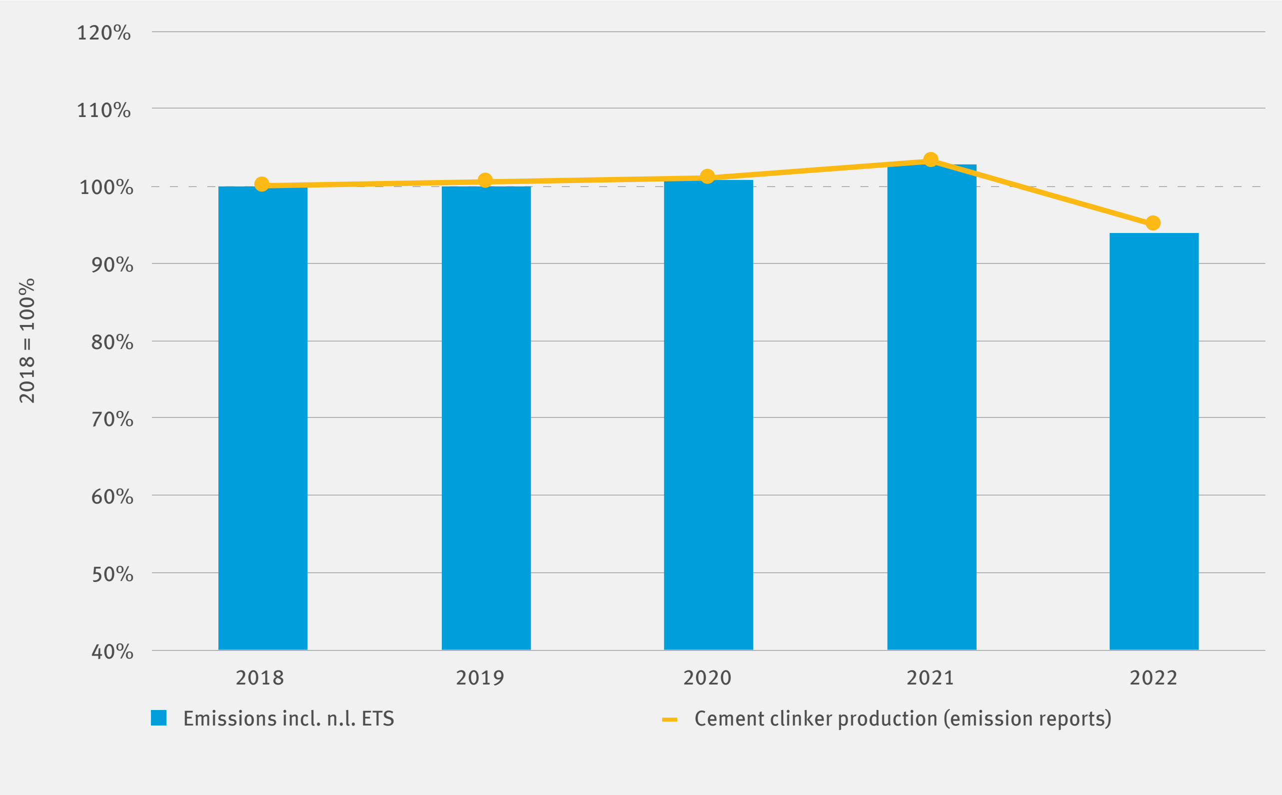


Figure 24: Cement clinker production (Activity 14), emissions and production trends in Germany in relation to 2018

The trend in emissions from cement clinker production at EU level is described in Section 2.10.

2.6.2 Lime, gypsum and sugar production

This section deals with emissions from Activities 15 'Lime production' and 19 'Gypsum production' from Annex 1, Part 2 TEHG. Together, these installations are responsible for 26.7 percent of emissions in the mineral processing industry (see Figure 22).

Activity 15 includes two different industries: industrial and building lime and sugar industry. In the 2022 reporting year, there were 38 installations subject to emissions trading that produced lime or dolime for the building, paper, chemical, iron and steel industries as well as environmental technology. These installations are collectively referred to in this section as the 'Industrial and building lime' category. Additionally, a limestone drying plant (combustion plant, Activity 1) is also assigned to this category. Within the mineral processing industry, emissions from the production of industrial and building lime accounts for 19.9 percent of total emissions (see Figure 25).

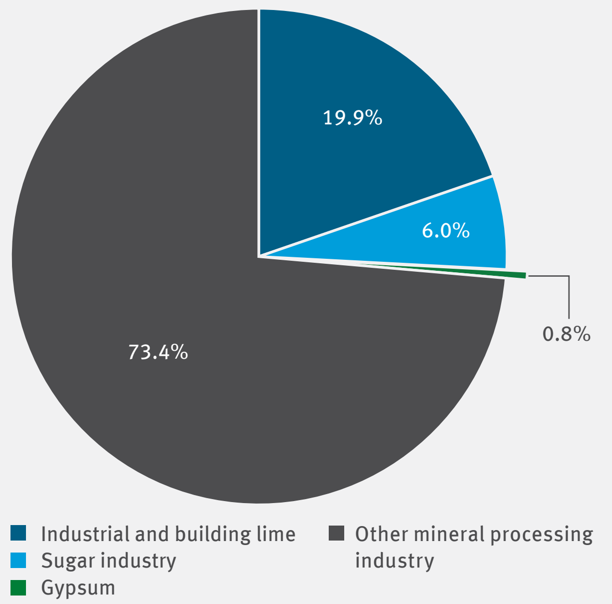


Figure 25: Proportions of lime, gypsum and sugar production (Activities 1, 15 and 19) in the 2022 emissions in the mineral processing industry

Activity 15 also includes 18 installations that use lime for sugar production and require heat and electricity in the manufacturing process.[93] The sugar industry also includes other sub-activities such as beet slice drying and caramelisation installations. In 2022, the sugar industry installations accounted for around six percent of the emissions within the mineral processing industry.

Activity 19 'Gypsum production' includes nine installations that mainly purchase and process flue gas desulphurisation (FGD) gypsum from large power plants with FGD plants. The emissions from this activity account for less than one percent of emissions from the mineral processing industry and are explained in the sections on 'Industrial and building lime production'.

Table 14: Lime, gypsum and sugar production (Activities 1, 15 and 19), number of installations, 2021 emissions, 2022 free allocation, 2022 VET entries, allocation coverage

No.	Activity	Number of installations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
15	Lime production	38	6,958	6,666	4,452	66.8%
	Sugar production	18	1,817	1,996	963	48.2%
		56	**8,775**	**8,663**	**5,415**	**62.5%**
19	Gypsum production	9	300	275	89	32.2%
		9	**300**	**275**	**89**	**32.2%**
1	Combustion	1	15	12	3	26.5%
		1	**15**	**12**	**3**	**26.5%**
	n. l. ETS	*1**	*0*	–	–	–
Total		**66**	**9,091**	**8,950**	**5,507**	**61.5%**

As of 02/05/2023
* n. l. ETS not included in the total number of installations

93 Since 2013, the sugar industry energy installations have also been included in the activity 'lime production', whereas in the second trading period, energy and lime installations were considered separately. In this section, the energy installations are retrospectively assigned to the lime production activity.

In 2022, emissions from the production of industrial and building lime were 6.7 million tonnes of carbon dioxide which is around four percent below the previous year's level. The allocation of free emission allowances was around 67 percent, resulting in a shortfall of 2.2 million emission allowances (see Table 14). In the previous year, the shortfall was 2.5 million emission allowances with an allocation coverage of around 64 percent.

The trend in shortfall is principally due to lower production and the resulting decrease of emissions in the industry.

In contrast, emissions from sugar installations in 2022 were 10 percent higher than in the previous year, totalling around 2 million tonnes of carbon dioxide. In 2022, operators had to purchase about 1 million additional emissions allowances which corresponds to an allocation coverage of 48 percent.

In 2022, emissions from gypsum plants decreased by around eight percent compared to the previous year. That year, gypsum plants received only 32 percent of the emission allowances free of charge, which they needed to cover their surrender obligation for the year. In contrast, the average allocation coverage for the third trading period was 106 percent. As for the fourth trading period, the industry was no longer considered to be at risk of carbon leakage, so installations received a significantly lower free allocation than in the previous trading period.

The limestone drying plant received an allocation for 2022 that corresponded to 26.5 percent of its emissions.

Trends in the past years – industrial and building lime and gypsum

Figure 26 shows the emission trends and free allocation for industrial and building lime production (dark blue) and gypsum (ochre yellow) since the start of emissions trading in 2005. The average emissions and allocation amounts are shown as columns for the first, second and third trading periods; annual emissions and allocation amounts, and the relative emissions trends are shown from 2018 onwards. Installations no longer subject to emissions trading (n. l. ETS)[94] and estimated emissions (scope estimate) from gypsum production installations for the period 2005 to 2012, which have only been subject to emissions trading from 2013 (yellow)[95] are also taken into account.

During the first trading period, the average emissions were around 8.4 million tonnes of carbon dioxide, which then fell by around eight percent to 7.7 million tonnes of carbon dioxide on average during the second trading period. From the second to the third trading period, emissions again decreased, with the average emissions during the third trading period reaching 7.2 million tonnes of carbon dioxide, about seven percent below the emissions of the second trading period.[96]

However, from 2013 onwards, the emissions have only been partially comparable to those from the second trading period. In the first and second trading periods these were calculated using fixed emission factors whereas the emission factors since 2013 are determined on an installation-specific basis. This change led to lower emissions on average unlike in the case of cement clinker producers (compare footnote 82, Section 2.6.1). In addition, the emissions from 2013 onwards were retroactively corrected for one installation following the implementation of the European Court of Justice ruling 'C-460/15-Schaefer Kalk' and are therefore also somewhat lower than in the previous trading periods.

Overall, the average emissions of industrial and building lime installations in the third trading period were around 86 percent of the first trading period's average emissions.

94 See explanations on 'Taking into account installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1 Introduction.

95 2005 – 2010 emissions are data from the allocation procedure. No historical emissions are available for 2011 and 2012; the figures for both years were estimated by linear interpolation.

96 The corrected lower emissions do not represent an emission reduction compared to the past but take into account the fact that in the case in question, carbon dioxide is stored (chemically bound) in the end product PCC (precipitated calcium carbonate). This carbon dioxide is not released into the atmosphere, so it is not considered an emission in terms of the ET Directive. Thus, there is no surrender obligation for the bound carbon dioxide in emissions trading. The retroactive correction for the years from 2013 to 2016 also results in minor deviations from the previous year's reports.

Production and emissions from industrial and building lime installations are primarily determined by the economic situation in the steel and building industries. Emissions from the industrial and building lime installations also behave in line with the iron and steel industry's production trend: they dropped by a total of 13 percent due to the economic situation between 2018 and 2020. 2021 and 2022 emissions also showed a downward trend analogous to the iron and steel industry (see Chapter 2.4), although their reduction was somewhat offset by increased lime purchase by coal-fired power plants[97] in 2022 in line with the trends in the iron and steel industry.

The nine gypsum-producing installations have only been in emissions trading since the beginning of the third trading period and did not receive any free allocation before 2013. Therefore, only estimates based on the allocation procedure data of the third trading period are available for the emissions. Emissions from gypsum-producing installations averaged around 270,000 tonnes of carbon dioxide in the third trading period. Since the installations were included in emissions trading, the emissions from gypsum installations showed a continuous and slightly increasing trend reaching 300,000 tonnes of carbon dioxide per year by 2022. In 2022, as in other industries, emissions fell due to reduced demand from the industry.

Figure 26 shows that the free allocation was higher than emissions both in the first and second trading periods. The proportion of free allocation in the emissions of industrial and building lime installations was over 100 percent in the first and second trading periods. The allocation status changed significantly at the start of the third trading period. The annual free allocation to the industrial and building lime and gypsum sectors – as to all other industrial sectors – fell continuously in the third trading period due to the cross-sectoral correction factor. A significant decrease in the free allocation compared to the previous year can be seen despite the discontinuation of the cross-sectoral correction factor in 2021, the first year of the EU ETS's fourth trading period.

Potential reasons are the benchmark reduction especially for quicklime, a lower activity rate of the relevant benchmarks due to the change of the baseline period and the discontinuation of the carbon leakage status for gypsum production. Compared to the previous year, the 2022 free allocation for industrial and building lime installations is at the same level.

97 See DESTATIS 2023b.

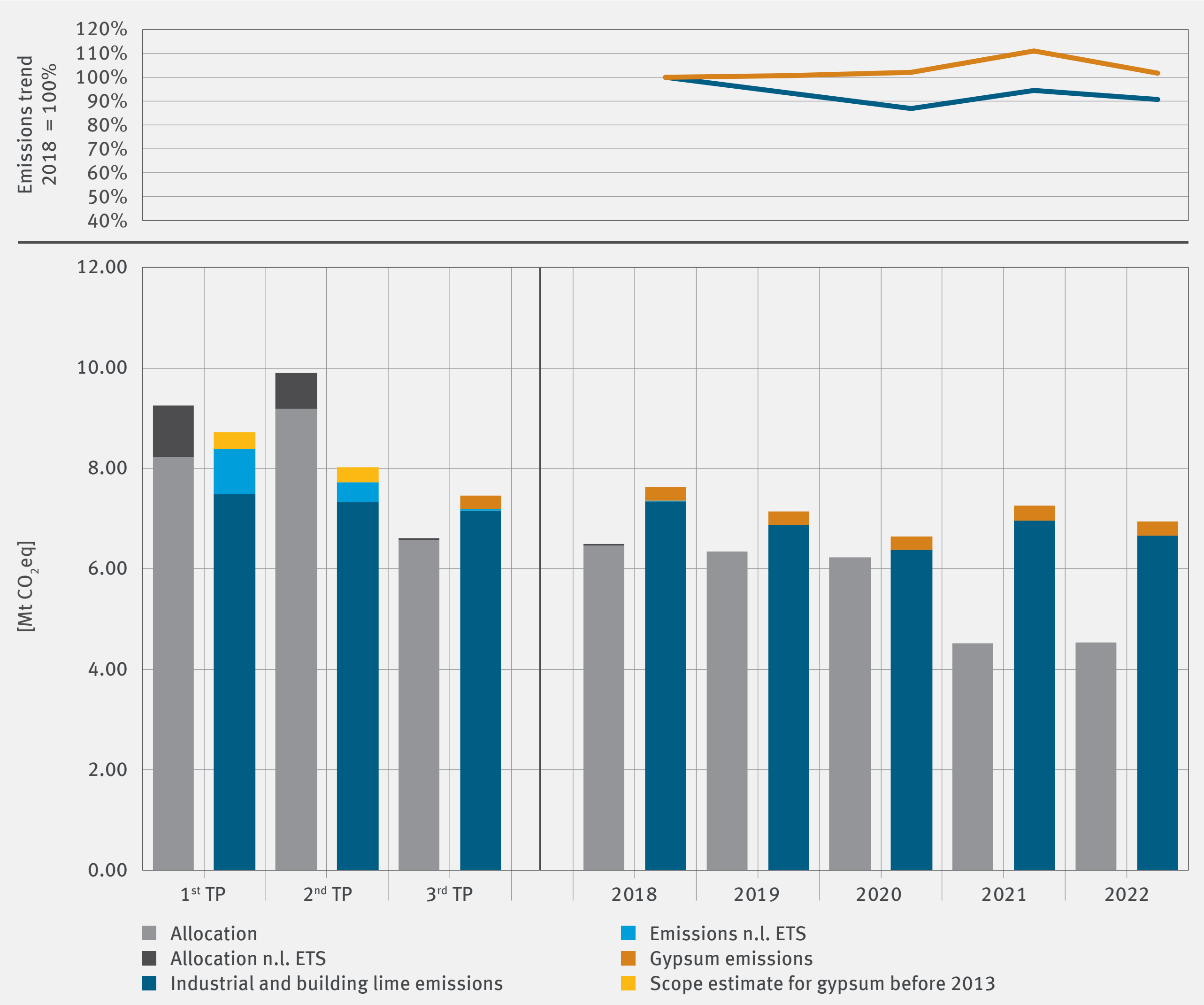


Figure 26: Industrial and building lime production (Activity 15)[98] and gypsum production (Activity 19), emissions and free allocation trends from 2005 to 2022

98 In this figure, only the industrial and building lime and gypsum activities are considered without the limestone drying installation (Combustion plant, Activity 1).

Emissions and production trends – industrial and building lime

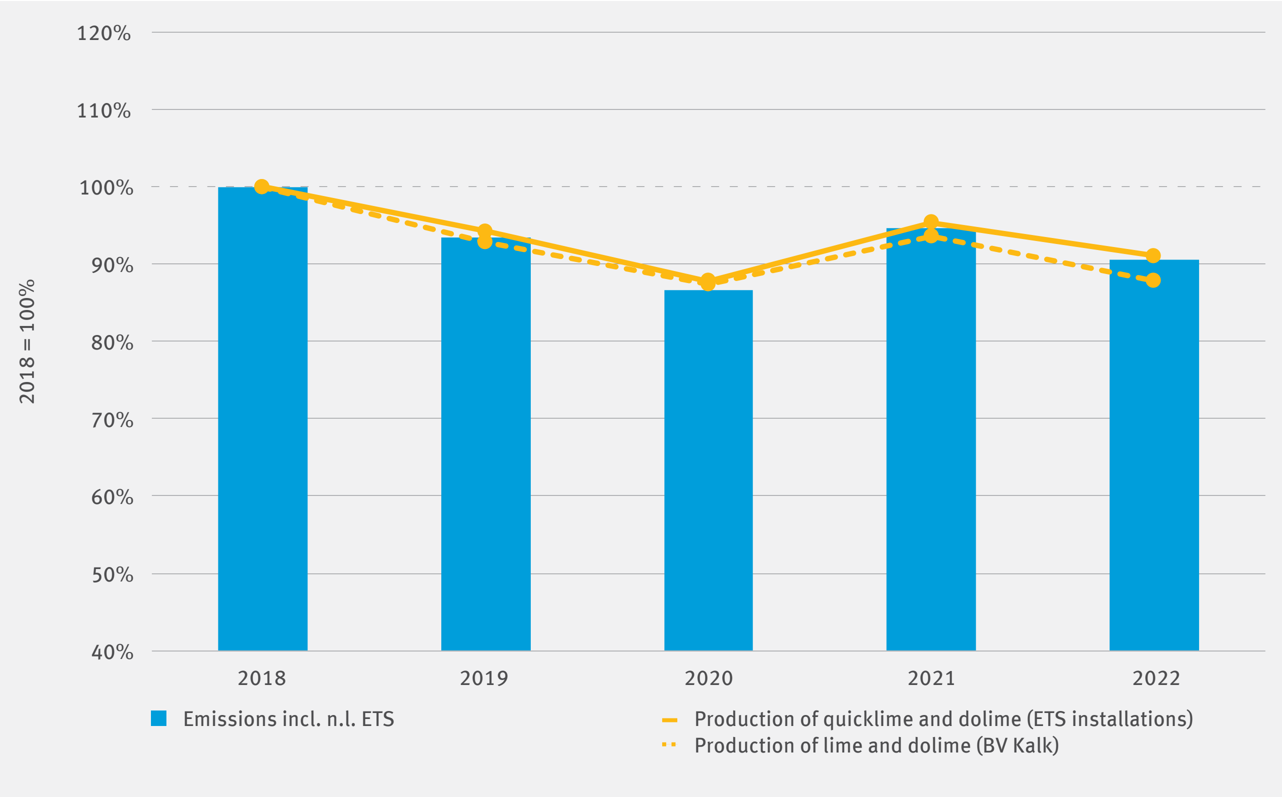


Figure 27: Industrial and building lime production (Activity 15), trends in emissions and production[99] in Germany each in relation to 2018

Figure 27 shows the trends in emissions and production in relation to 2018. The solid line represents the trend for all installations subject to emissions trading in the respective year (quicklime and dolime production). In contrast, the data from the Association of the German Lime Industry (dashed line) covers only the installations organised within the Association (lime and dolime). In 2018 to 2022 the emissions trend essentially reflects the trend in lime production. In 2019 to 2021, the specific emissions were relatively constant at 1.09 tonnes of carbon dioxide per tonne of quicklime or dolime. In 2022, the specific benchmark of the lime plants was 1.1 tonnes of carbon dioxide per tonne of quicklime or dolime, which is slightly above the level of previous years. Despite the use of more efficient kilns, this trend could also be due to the increased use of pulverised lignite as a fuel.

99 Sources of production data: German Lime Association (BV Kalk)

Trends in past years – sugar industry

Figure 28 shows the trend in emissions and free allocation in the sugar industry since the start of European Emissions Trading in 2005. The average emissions and allocation amounts are shown as columns for the first, second and third trading periods, and annual emissions and allocation amounts and the relative emissions trend for the period from 2018. The figure is supplemented by showing the installations that are currently no longer subject to emissions trading (n. l. ETS)[100] and the estimated emissions of installations that were only subject to emissions trading from 2013, for the period 2005 to 2012.[101]

The average total emissions of the sugar industry have increased from each trading period to the next. This increase was the greatest from the first to the second trading period, at 18 percent.

When looking at the emissions trend in the sugar industry: after emissions had increased slightly in the middle of the third trading period, a trend towards decreasing emissions can be seen from 2018 onwards. The overall decrease since 2018 amounts to 13 percent compared to 2021. In 2022, the industry's emissions increased by around ten percent compared to the previous year and are thus slightly below the level of emissions in 2018.

The change in the composition of fuels – less gas and more coal instead – is also influencing emissions in this sector. However, since the emissions of sugar plants are influenced not only by fuel use but also by the quality and quantity of the sugar beet harvest, emissions are also subject to annual fluctuations due to weather conditions. For a comparison of emissions and free allocation, the emissions in the respective applicable scope of the trading period must be considered, i. e. without the retrospectively estimated emissions (without the yellow column section). It can be seen that the free allocation of sugar installations, especially in the second trading period, was significantly higher than the emissions. In particular, due to the discontinuation of free allocation for electricity generation, sugar installations received on average about 37 percent fewer emission allowances for free in the third trading period than they needed to cover their emissions. Added to this in the third trading period was the cross-sectoral correction factor (which has a stronger effect every year).

With the start of the fourth trading period, free allocation to sugar installations has once again fallen significantly compared to 2020, although at least for the first allocation period 2021 to 2025 there will be no reduction in free allocation through a cross-sectoral correction factor. This is mainly due to the fact that installations in the sugar industry generally receive their free allocation via heat and fuel benchmarks and these fallback benchmark values were significantly reduced for the fourth trading period.

100 See explanation on 'Consideration of installations no longer subject to emissions trading (n. l. ETS)' in Section 1.2.

101 The emissions between 2005 and 2010 are data from the allocation procedure. No historical emissions are available for 2011 and 2012; the values for both years were estimated by linear interpolation.

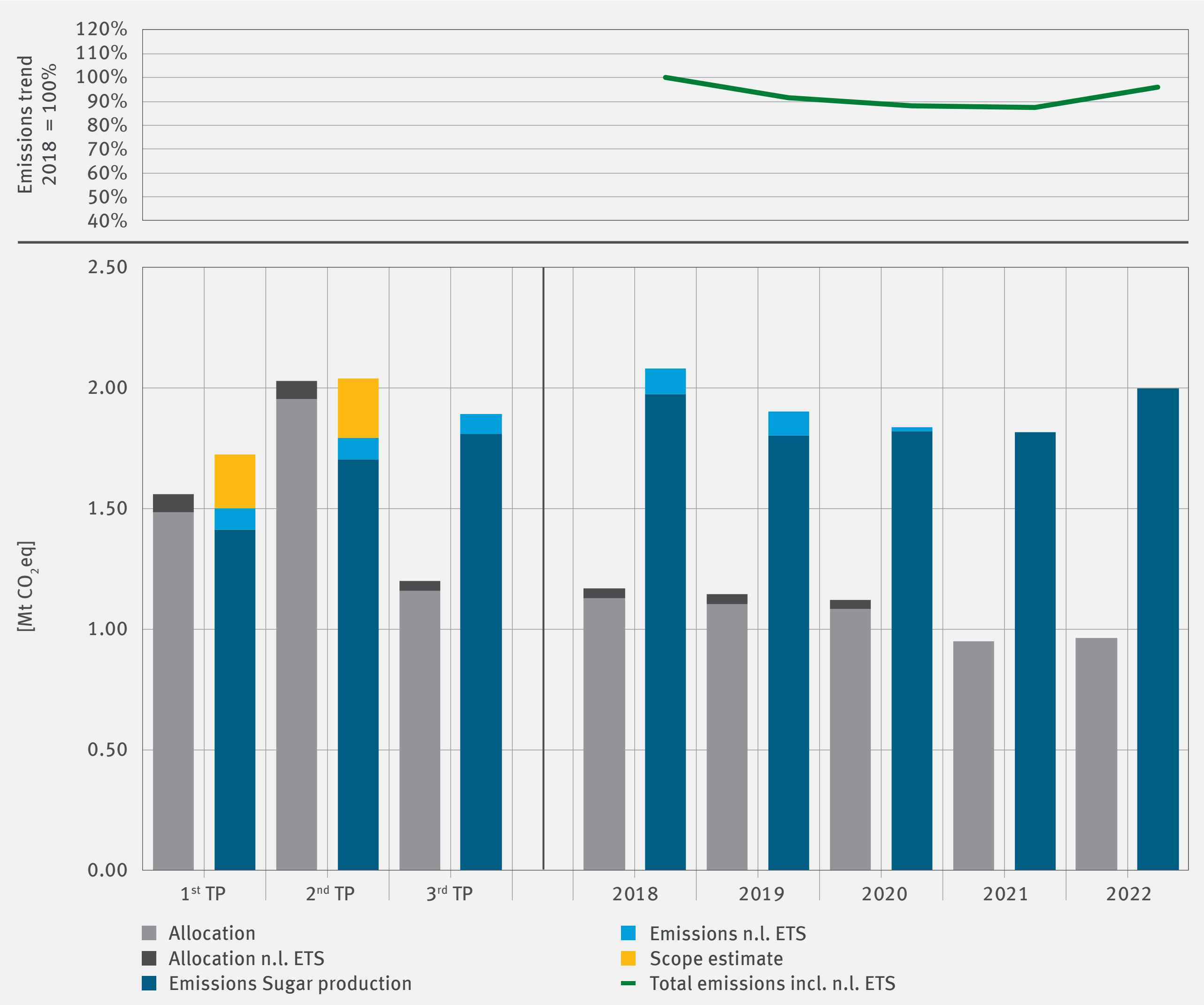


Figure 28: 2005 to 2022 trend in emissions and free allocation in the sugar industry (Activity 15)

The trend in the 'lime production' activity (not differentiated between industrial and building lime nor sugar lime) at EU level is described in Section 2.10.

2.6.3 Glass and mineral fibre production

This section includes Activities 16 (glass production) and 18 (mineral fibre production). These activities account for about 12.2 percent of the emissions of the mineral fibre processing industry. The emissions are predominantly generated in flat and hollow glass production (see Figure 29).

Overall, the emissions from installations for glass and mineral fibre production subject to emissions trading in 2022 are at the same level as in the previous year, at around 4.1 million tonnes of carbon dioxide. 76 installations were covered, 68 of which are glass manufacturing installations and 8 mineral fibre manufacturing installations, i. e. one more Activity 18 installation than in 2021.

Table 15 shows the emissions in 2022 compared to the previous year differentiated by economic sector.[102]

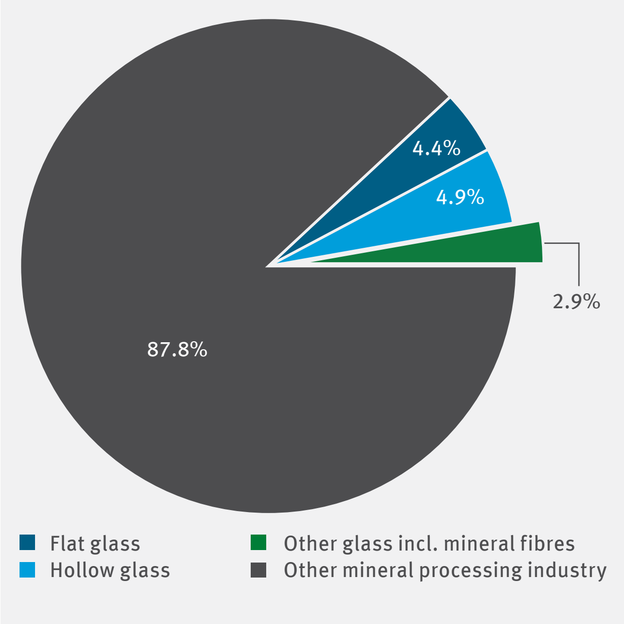


Figure 29: Shares of glass and mineral fibre production (Activities 16 and 18) in the 2022 emissions of the mineral processing industry

Emissions from hollow glass production were around 1.6 million tonnes of carbon dioxide in 2022, roughly the same level as the previous year.[103] Emissions from flat glass production have also not changed significantly compared to the previous year and remain at around 1.5 million tonnes of carbon dioxide.

Emissions from mineral fibre production are 400,000 tonnes of carbon dioxide, the same as in 2021.

102 The allocation is based on information provided by the operators.

103 Since the number of installations in the various economic sectors has changed somewhat compared to 2020, the emissions are not directly comparable with the values in the 2020 VET Report (see DEHSt 2021b).

Table 15: Glass and mineral fibre production (Activities 16 and 18), number of installations, 2021 emissions, 2022 free allocation, 2022 VET entries, allocation coverage

No.	Activity	Number of instal-lations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
16	Production of hollow glass	35	1,627	1,641	1,247	76.0%
	Production of glass fibre and goods thereof	8	203	190	119	62.9%
	Production, finishing and processing of flat glass	14	1,514	1,489	1,176	79.0%
	Production, finishing and processing of other glass including technical glassware	11	378	371	295	79.4%
		68	**3,722**	**3,691**	**2,837**	**76.9%**
18	Production of glass fibre and goods thereof	1	7	6	3	47.4%
	Production of other non-metallic mineral products n.e.c.	7	387	394	278	70.6%
		8	**395**	**400**	**281**	**70.3%**
Total		**76**	**4,117**	**4,091**	**3,119**	**76.2%**

As of 02/05/2023
* n. l. ETS not included in total number of installations

The aggregated shortfall of all installations was 973,000 emission allowances, of which Activity 16 (glass production) alone accounts for 853,000 emission allowances. The allocation coverage of all installations for glass and mineral fibre production was around 76 percent in 2022. In the previous year, the shortfall totalled 1.1 million emission allowances with an allocation coverage of around 74 percent.

Trends in past years

Figure 30 shows the trend in emissions and free allocation in glass and mineral fibre production since the start of the EU ETS in 2005. For the first, second and third trading periods, the average emissions and allocation amounts are shown as columns in each case; for the period since 2018, annual emissions and allocation amounts as well as the relative emissions trends are shown. The figure is supplemented by showing the installations currently no longer subject to emissions trading (n. l. ETS)[104] plus the estimated emissions of the installations only subject to emissions trading from 2008, for the period 2005 to 2007[105].

104 See explanation on 'Consideration of installations no longer subject to emissions trading (n. l. ETS)' in Section 1.2.

105 Emissions 2005 to 2007 are data from the allocation procedure.

In the sector as a whole, only minor changes in emissions can be observed when looking at the past three trading periods. Since the introduction of the European Emissions Trading Scheme in 2005, the entire sector's emissions have been just over four million tonnes of carbon dioxide, with slight annual fluctuations. Looking at the period from 2018 onwards, emissions fell by a total of just under six percent in 2019 and 2020 compared to 2018. This was due to economic factors, and by 2021 emissions had risen again by around three percent. In 2022, they were at a level of 97 percent of 2018.

Emissions from hollow glass production have remained relatively constant at around 1.6 million tonnes of carbon dioxide annually since 2018.

The production and emissions of flat glass manufacturing installations are largely determined by the economic situation of the automobile and construction industries. In line with the trend in these industrial sectors, emissions are subject to cyclical fluctuations – from 2018 to 2020, emissions fell by around eight percent; in 2021, they returned to the 2018 level and subsequently fell again by a good two percent.

The emissions trend of installations for the production of other glass including mineral fibre is subject to the greatest relative fluctuations within the sector. This category includes emissions from the 'Production, refining and processing of other glass including technical glassware', 'Production of other non-metallic mineral products n.e.c.' and 'Production of glass fibre and goods thereof'. Between 2018 and 2020, emissions fell by eleven percent and then rose again by eight percent by 2022.

Overall, it can be seen that the individual economic sectors within this sector were affected to varying degrees by the impact of the COVID 19 pandemic in 2020 and 2021.

For comparison with free allocation, only emissions of the respective applicable scope may be considered (without the yellow column sections). As in other sectors, the allocation situation in the glass industry changed significantly due to the cross-sectoral correction factor in the third trading period, so the installations had an annual shortfall that increased from year to year: the allocation coverage has decreased from around 85 percent in 2013 to around 78 percent in 2020.

In 2021, free allocation decreased again compared to the previous year which can be explained by the reduction in the benchmark values for the allocation in connection with the change from the third to the fourth trading period. Further, the reduced level of benchmark emission values is not fully compensated for by the discontinuation of the cross-sectoral correction factor. Compared to 2021, the allocation coverage increased from 74 to 76 percent in 2022, but this is primarily due to the decreased emissions of the sector.

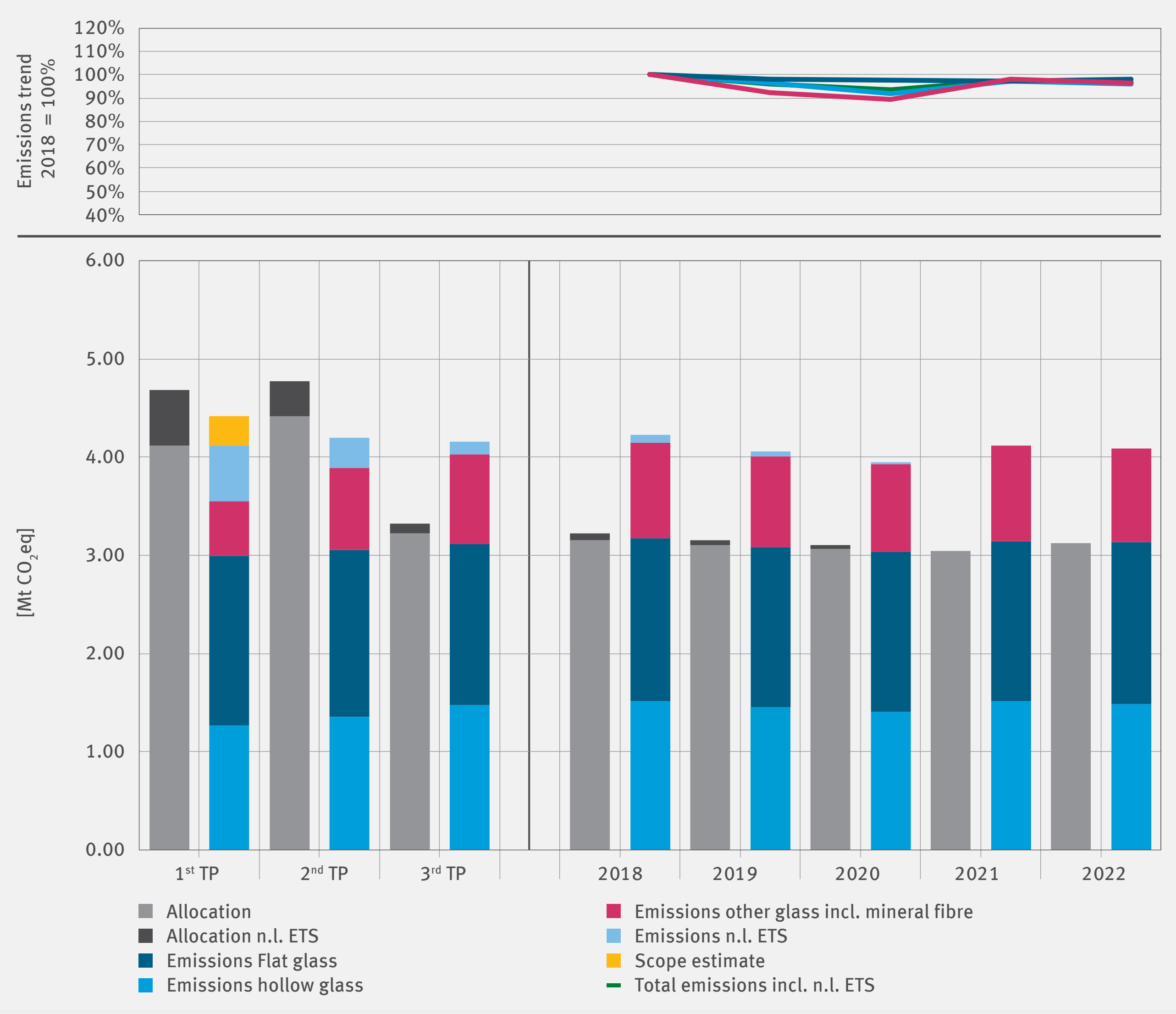


Figure 30: Glass and mineral fibre production (Activities 16 and 18), trend in emissions and free allocation up to 2022

2.6.4 Ceramics production

Compared to other sectors subject to emissions trading, the ceramics industry consists of numerous installations with a broad product range and comparatively low emissions. In 2022, the sector comprised 118 installations.[106] One installation is no longer subject to emissions trading.

These installations caused about 5.2 percent of the mineral processing industry's emissions (see Figure 22).

The emissions of the ceramic plants subject to emissions trading in 2022 have decreased by around 126,000 tonnes of carbon dioxide or seven percent compared to the previous year.

Table 16: Ceramics production (Activity 17), number of installations, 2021 emissions, 2022 free allocation, 2022 VET entries, allocation coverage

No.	Activity	Number of installations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
17	Ceramics production	118	1,814	1,688	1,432	84.8%
	n. l. ETS	*1**	*0*	–	–	–
Total		**118**	**1,814**	**1,688**	**1,432**	**84.8%**

As of 02/05/2023
* n. l. ETS not included in total number of installations

The average allocation coverage of the ceramic plants was almost 85 percent in 2022. In the previous year, the shortfall was 394,000 emission allowances with an allocation coverage of 78 percent. This trend is primarily due to lower emissions in the sector.

However, around 20 percent of installations receive more free emission allowances than are needed for surrender.

Trend in past years

Figure 31 shows the trend in emissions and free allocation in the ceramics industry since the start of emissions trading in 2005. The average emissions and allocation amounts are shown as columns for the first, second and third trading periods, and annual emissions and allocation amounts and the relative emissions trend for the period since 2018. The Figure is supplemented by showing the installations currently no longer subject to emissions trading (n. l. ETS)[107] and the estimated emissions from the installations only subject to emissions trading from 2013, for the period 2005 to 2012[108].

During the transition between the trading periods, there were changes in the scope of the EU ETS that affected the number of installations. Therefore, the emissions and allocation amounts of the different trading periods are only comparable to a limited extent.

Between 2018 and 2020, emissions from ceramics installations decreased and in 2020 were around 91 percent of 2018 emissions. In 2021, they increased by four percent before decreasing again. In 2022, emissions were twelve percent less than in 2018.

106 Nine installations are considered small emitters from 2021 due to the low carbon dioxide emissions for years and are therefore no longer considered in this Chapter. Details on small emitters in the fourth trading period of the EU ETS are described in Section 1.3.

107 See explanation on 'Consideration of installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1 Introduction.

108 2005 to 2010 emissions are data from the allocation procedure. No historical emissions are available for 2011 and 2012; the values for both years were estimated by linear interpolation.

For comparison with free allocation, only the emissions of the respective applicable scope may be considered (without the yellow column sections). In the first and second trading periods, ceramics installations received more free allocations than they would have needed for their surrender obligations. The allocation coverage was 122 percent for the first trading period and 142 percent for the second. As in other sectors, the allocation situation of the ceramics industry changed significantly at the start of the third trading period, so the installations had an overall shortfall. Allocation coverage had dropped to an average of around 89 percent in the third trading period. In the transition from the third to the fourth trading period, the allocation coverage fell further to 78 percent. This was due to increased emissions and a decrease in free allocation in comparison to the third trading period in 2021. Free allocation has decreased primarily because many installations in the ceramics industry receive the largest proportion of their free allocation through fallback allocation elements and the underlying fallback benchmark values were significantly reduced in comparison to the third trading period. The discontinuation of the cross-sectoral correction factor is thus not reflected in an increase in free allocation.

Due to the impact of production decline on increased energy prices and the associated reduction in emissions within the sector, the average allocation coverage of ceramics plants increased to almost 85 percent in 2022.

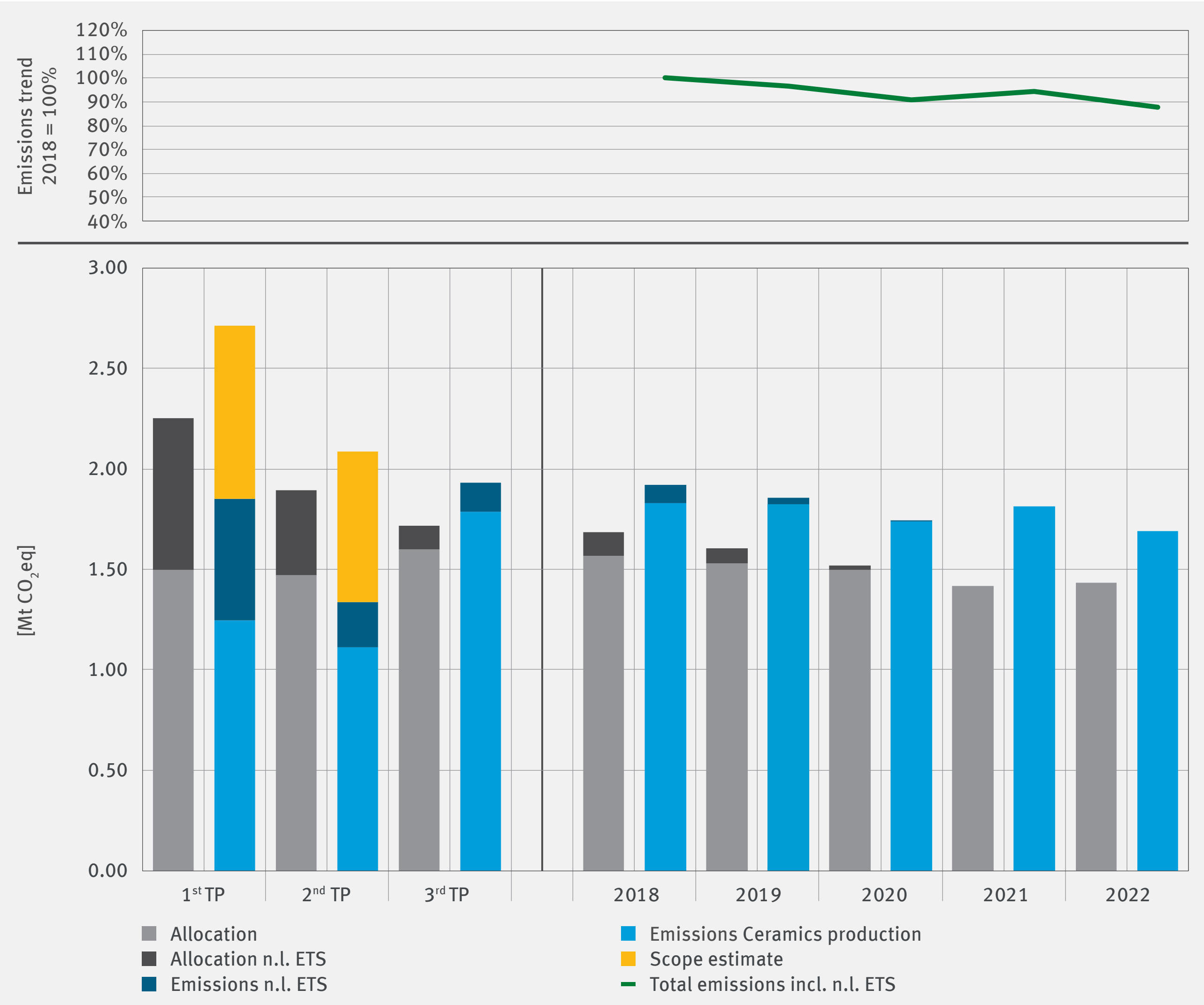


Figure 31: Ceramics production (Activity 17), trend in emissions and free allocation up to 2022

2.7 Paper and Pulp Industry

This sector includes the production of pulp and paper, cardboard or paperboard (Activities 20 and 21 as per Annex 1 TEHG).

The number of paper and pulp installations fell from 138 in 2021 to 134 in 2022.[109] Four installations were allocated to pulp production and 130 to paper production. Emissions from all installations in the pulp and paper industry amounted to about 4.7 million tonnes of carbon dioxide in 2022, representing a 10 percent reduction over the previous year's level. Figure 32 shows that paper production contributes almost 97 percent of the emissions while pulp production accounts for about 3 percent.

In the 2022 reporting year, emissions subject to surrender in activity 21, pulp production, increased by about 11 percent from 146,000 tonnes of carbon dioxide in 2021 (see Table 17). In activity 20, paper production, emissions decreased by 479,000 tonnes of carbon dioxide (a good nine percent) to just under 4.6 million tonnes of carbon dioxide. According to association data, paper production fell by 6.5 percent in the same period.[110]

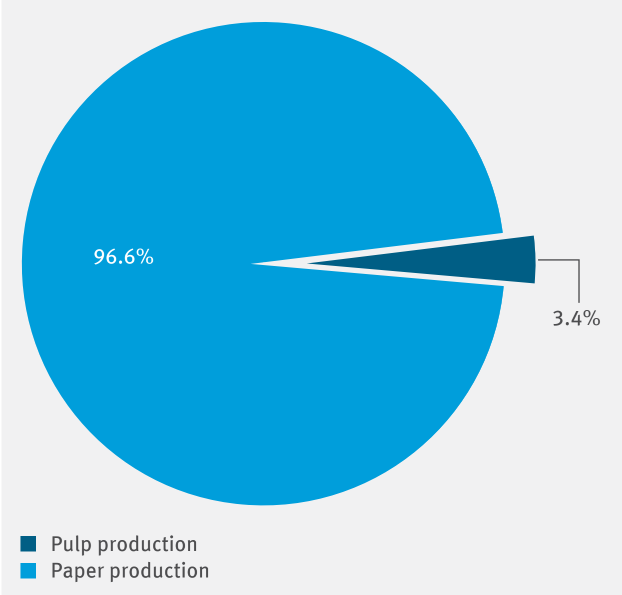


Figure 32: 2022 emission proportions of the paper and pulp industry (Activities 20 and 21)

The operators of the 130 installations in the paper production activity received almost 4.8 million emission allowances for 2022, which is about 216,000 allowances more than they would need to surrender according to the 2022 VET values (4.6 million, see Table 17). This means that for the first time, there was a shift from a slight overall shortfall in the previous year to a slight surplus allocation for this activity in the 2022 reporting year. Compared to the previous year, this is primarily related to the significantly lower emissions, which fell more sharply than the overall lower free allocation for installations in the paper industry during the fourth trading period, due to the benchmark adjustments. Overall, the installations in the pulp industry face a considerable shortfall with an allocation coverage of approximately 40 percent of the 2022 emissions.

Table 17: Paper and pulp industry (Activities 20 and 21), number of installations, 2021 emissions, 2022 free allocation, 2022 VET entries, allocation coverage

No.	Activity	Number of installations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
20	Pulp production	4	146	162	64	39.8%
21	Paper production	130	5,050	4,572	4,788	104.7%
	n. l. ETS	*5**	*74*	–	–	–
Total		**134**	**5,270**	**4,733**	**4,852**	**102.5%**

As of 02/05/2023
* n. l. ETS not included in the total number of installations

109 The sector also includes two small emitters. Details on small emitters in the fourth trading period of the EU ETS are described in Chapter 1.3
110 See THE PAPER INDUSTRY (DIE PAPIERINDUSTRIE) (2023), Press release of 01/03/2023.

However, if the allocation is adjusted to the estimated allocation amount for heat imports[111], the picture changes regarding allocation coverage (Table 18). Overall, the share of the allocation attributable to heat imports from energy installations subject to emissions trading can be estimated at about 1 million emission allowances (see Figure 33, hatched area).[112] Without this share, the allocation coverage for paper production (Activity 21) and pulp production (Activity 20) could drop to around 73 percent (adjusted allocation coverage).

Table 18: Paper and pulp industry (Activities 20 and 21), number of installations, allocation amounts, 2022 VET entries and 2021 adjusted allocation coverage

Sector	Number of installations	2022 adjusted allocation amount [1000 EUA]	2022 VET [kt CO_2eq]	2022 deviation allocation from 2022 VET [kt CO_2eq]	Adjusted allocation coverage
Paper and pulp	134	3,827	4,733	−907	80.8%

As of 02/05/2023

Trends in past years

Figure 33 shows the emissions and free allocation trends in the paper and pulp industry since the start of emissions trading. The average emissions and allocation amounts are shown as columns for the first, second and third trading periods. Additionally it shows annual emissions and allocation amounts as well as the relative emissions trends for the period from 2018. Installations no longer subject to emissions trading (n. l. ETS)[113] are also taken into account. The estimated shares for heat imports from energy installations included in the allocation amounts are shown in the hatched area (see detailed explanations in the section above).

The average paper and pulp industry emissions have decreased from one to the next trading period.

Between 2018 and 2020, emissions from the pulp and paper industry also fell at a relatively constant rate before a slight increase in emissions was recorded in 2021. In the 2022 reporting year, however, this trend did not continue and emissions fell once again. This decrease is mainly due to lower emissions in the paper sector. While emissions in this sector fell by about 12 percent from 5.2 million tonnes of carbon dioxide in 2018 to just under 4.5 million tonnes in 2022, the emissions trend in the pulp industry shows a relatively constant level over the same period. However, due to the limited number of installations (four) combined with comparatively low emissions in this activity, there is no significant impact on the trend in total emissions from the pulp and paper industry. Alongside the increase in energy efficiency in production, the reducing trend from 2018 can be mainly attributed to the decreasing trend in production levels (see Figure 34). In the 2022 reporting year, the generaleasing of the markets in the wake of the COVID 19 pandemic is therefore likely to have played a significant role in the decline in emissions.

Despite the currently tense market environment, natural gas remains by far the most dominant energy source for production in the paper and pulp industry. In recent years, the use of lignite and hard coal has been significantly reduced, mainly in favour of this lower-emission energy source. Overall, the use of natural gas has had a significant impact on emissions in the industry.

111 Many installations in these activities import heat from energy installations subject to emissions trading and receive a free allocation for this, while the emissions occur at the heat-generating installation. It can be assumed that part of this free allocation is passed on to the heat-generating installation.

112 For details on determining the estimated value, see Chapter 1.2.

113 See explanation on 'Taking into account installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1.2.

With regard to free allocation, Figure 33 shows the aggregated representation of the trading periods and in particular illustrates the effects adjustment of the allocation rules had in the paper and pulp industry from the third trading period onwards, compared to the first two trading periods of the EU ETS. The new regulations on cross-boundary heat flows are important in this case since they stipulate that producing installations that import heat from other installations subject to emissions trading also receive a free allocation for this heat. For this reason, and to accurately estimate the actual relevant allocation amounts in the paper and pulp industry from the third trading period onwards, it is important to take into account the heat imports from energy installations. This is taken into account accordingly via the adjusted allocation coverage and is indicated by the hatched area in the figure.

Since the start of the fourth trading period in 2021, there has been a significant decrease in free allocation in the paper sector of the industry. This is mainly due to the greatest possible reduction in the product benchmarks within this sector for the 2021 – 2025 allocation period. This exceeded the positive effect of the discontinuation of the cross-sectoral correction factor. Furthermore, there was a slight decline in heat imports eligible for allocation from other installations subject to emissions trading. Overall, emissions from the activity fell appreciably more strongly than the free allocation and the heat imports eligible for allocation in the reporting year, so that a slight surplus allocation can be roughly recorded in 2022.

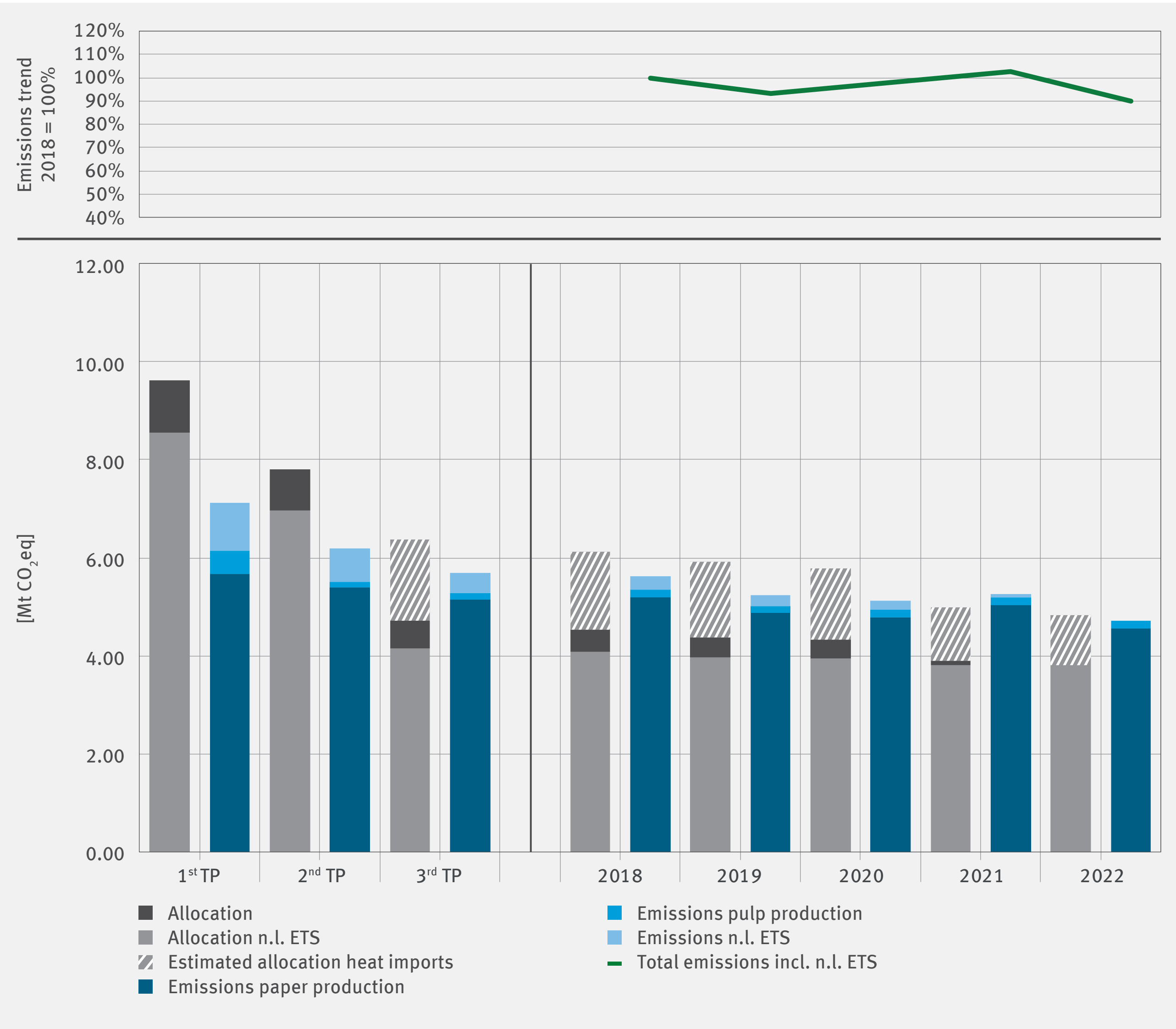


Figure 33: Paper and pulp industry (Activities 20 and 21), free allocation and emissions trends up to 2022

Figure 34 shows the emissions trends in the paper industry alongside the trends in production data. To achieve this, the activity rates of the product benchmarks for 'fine paper' and 'newsprint' were combined into graphic papers. Similarly, the activity rates of the product benchmarks for 'cardboard' and 'testliner and fluting' were combined into packaging. The activity rates of the product benchmark for 'tissue paper' (German term: Hygienepapier) are also shown. The activity rates are compared to the corresponding data of the association 'THE PAPER INDUSTRY' (DIE PAPIERINDUSTRIE) up to 2020. For 2022, only the association's production data are available.

In accordance with the association's production data up to 2020, a clear and accelerating decline in the activity rate for graphic papers can be seen compared to the respective previous year. However, according to the association's data, after a significant slump in 2020 there was a recovery in 2021. In 2021, the renewed increase in demand after the lockdown phase of the COVID 19 pandemic is likely to have played a role as a reason for the increase in production: The reopening of sales outlets and renewed demand from retailers for printed advertising have been identified as significant drivers for the trend reversal.[114] However, this increase did not continue in the 2022 reporting year. The Association's data again show a clear decline in production of graphic papers.

For tissue paper, a relatively constant trend at a similar level can be seen in the 2017 – 2020 period, both in the production data and in the activity rate. In 2021, a slight decline in the association's production data was visible. After an increase in demand and production of tissue paper in the wake of the increased hoarding of toilet tissue, especially at the beginning of the COVID 19 pandemic in 2020, the demand level returned to normal in 2021 and remained at a similarly constant level in the reporting year.

According to the association's production data, the upward trend in production of packaging products, already seen in the previous years, continued up to 2021. However, a noticeable decline in production can be observed for the 2022 reporting year. The growth trend in packaging products, which saw the largest increase in a comparison of product groups since 2017, has therefore not continued. The overriding reasons contributing to the production decline in the paper industry[115] was the increased costs for energy and raw materials, along with a reduced demand due to customers' previous inventory build-up.

Overall, there is no complete comparability of the association's activity rates and production data as not all installations participate in emissions trading. This could be a potential explanation for the discrepancies between the different levels of the Association's production data and activity rates.

114 See THE PAPER INDUSTRY (DIE PAPIERINDUSTRIE) (2022), Press release of 01/03/2022.
115 See THE PAPER INDUSTRY (DIE PAPIERINDUSTRIE) (2023), Press release of 01/03/2023.

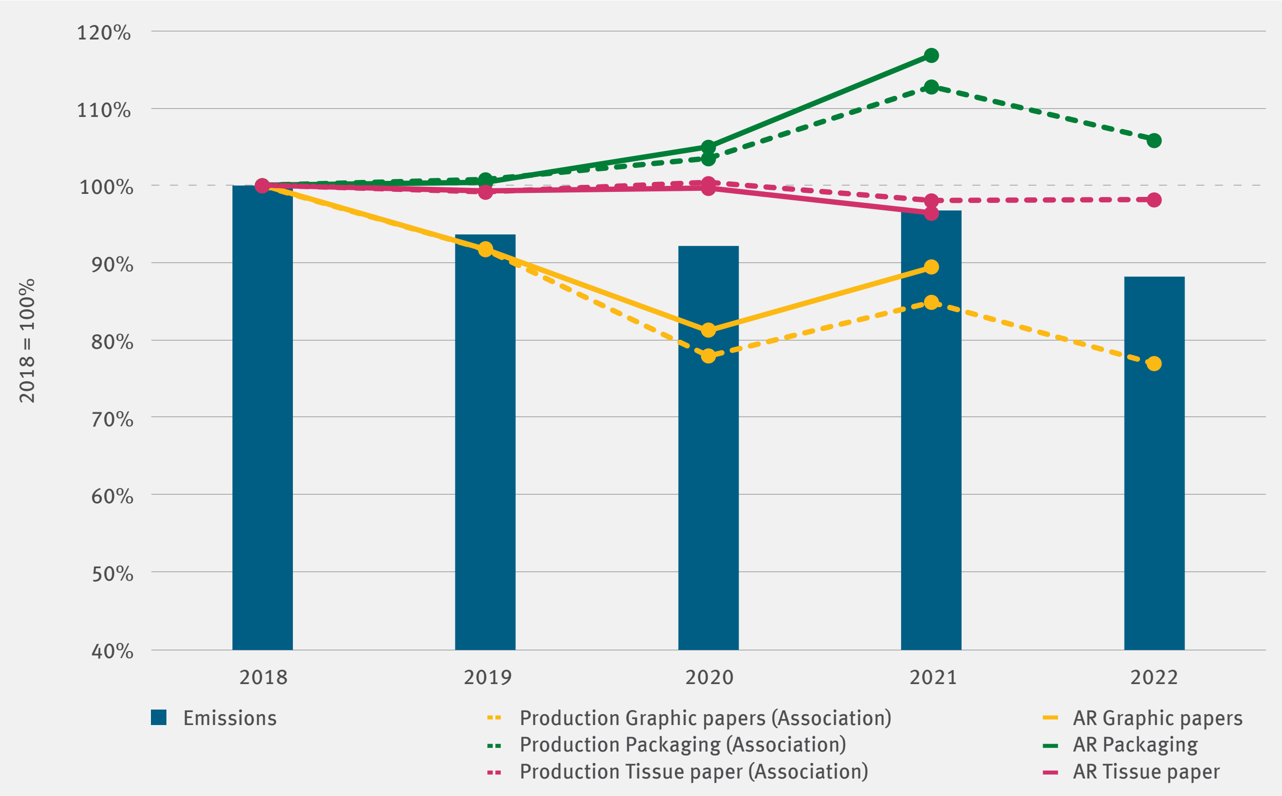


Figure 34: Paper production (Activity 21), 2018–2022 emissions and production trends in Germany compared to 2018

Figure 35 shows the 2022 production proportions of the above paper production sectors such as Packaging, Graphic papers and Tissue paper measured using the Association's production data (in 1,000 tonnes). Packaging production accounts for about 63 percent which is the largest proportion. Graphic papers account for slightly less than 30 percent and tissue papers account for somewhat more than seven percent.

The trend of the Activity 'Paper production' at EU level is described in Chapter 2.10.

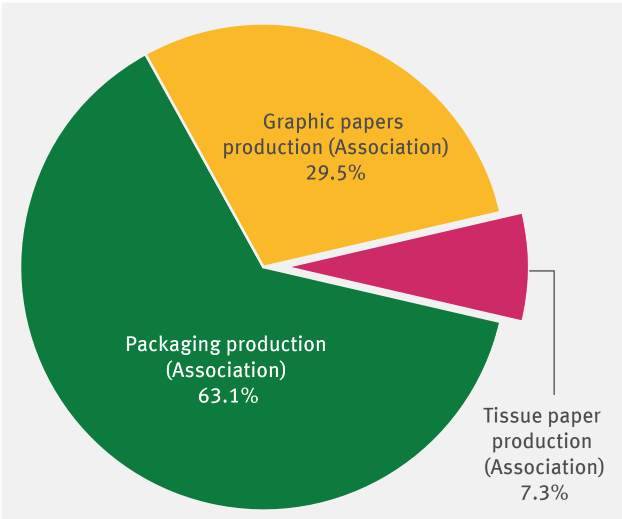


Figure 35: Significance of the production of graphic paper, tissue paper and packaging paper for the paper industry subject to emissions trading, proportions of the Association's 2022 production data

2.8 Chemical Industry

The chemical industry comprises Activities 22 to 29 as per Annex 1 TEHG, which for the most part were included in emissions trading for the first time at the start of the third trading period. Also assigned to the sector are some installations that do not belong to any chemical activity subject to emissions trading but which fall under Activity 1 in Annex 1 TEHG because of their rated thermal input of a minimum of 20 megawatts, for example, installations for the production of titanium dioxide, sulphuric acid or other inorganic chemistry products. Installations generating electricity and heat for the chemical industry, however, are assigned to energy installations provided they are approved independently in terms of pollution control and are therefore not discussed in this chapter. In 2022, the second year of the fourth trading period, the chemical industry comprised 197 installations[116]. The number of installations remained more or less the same compared to the previous year. Emissions from the chemical industry in 2022 amounted to around 14.1 million tonnes of carbon dioxide equivalents, i. e. 18.3 percent less than in the previous year.

Figure 36 shows the chemical industry's emissions breakdown in percentages of activities covered. They are clearly dominated by the production of bulk organic chemicals (Activity 27) at about 49 percent, followed by ammonia production (Activity 26) at about 22 percent. The production of hydrogen and synthesis gas (Activity 28) and combustion (Activity 1)[117] fell into the next largest categories with ten and eight percent respectively. Other activities make up the smallest share with around four percent each.

In contrast to the previous year, there was a decrease in emissions for all activities in the 2022 reporting year (see Table 19).

The two activities with the highest emissions are Activity 27 (production of bulk organic chemicals) and Activity 26 (ammonia production). There was a decrease of 1.17 million tonnes of carbon dioxide (minus 14.4 percent) within Activity 27 and a decrease of 1.49 million tonnes of carbon dioxide (minus 32.2 percent) within Activity 26 compared to the previous year.

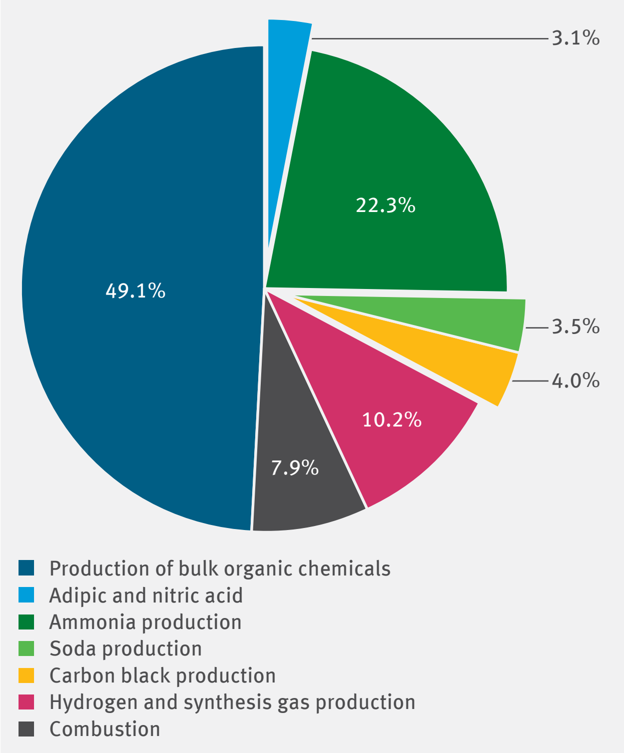


Figure 36: Proportions of 2022 emissions from the chemical industry (Activities 22 to 29 and 1)

Activity 26 (ammonia production) also had the largest total emission reduction this year, ahead of Activity 27 (production of bulk organic chemicals). The combined activities 23, 24 (adipic and nitric acid) follow at a greater distance with a decrease of 77,000 tonnes of carbon dioxide (minus 14.9 percent). Part of this decrease can be attributed to the fact that the conversion of nitrous oxide emissions into carbon dioxide equivalents has been carried out with a smaller conversion factor (GWP) since the beginning of the third trading period.[118]

116 The sector also includes five small emitters. Details on small emitters in the fourth trading period of the EU ETS are described in Chapter 1.3.

117 In the past years, Activity 1 (combustion) was grouped together with Activity 25 (production of glyoxal and glyoxylic acid) under Others; this year's report does not consider installations with Activity 25 in the chemical industry.

118 The global warming potential (GWP) equivalence factor for nitrous oxide is 265 in the fourth trading period compared to 298 in the third trading period.

Table 19: Chemical industry (Activities 22 to 29 and 1), number of installations, 2021 emissions, 2022 free allocations, 2022 VET entries and allocation coverage

No.	Activity	Number of installations	2021 emissions [kt CO_2eq]	2022 VET [kt CO_2eq]	2022 allocation amount [1000 EUA]	2022 allocation coverage
22	Carbon black production	4	582	568	414	72.9%
23, 24	Adipic and nitric acid	11	514	438	1,246	284.7%
26	Ammonia production	5	4,627	3,138	3,861	123.0%
27	Production of bulk organic chemicals	133	8,084	6,919	7,882	113.9%
28	Hydrogen and synthesis gas production	15	1,637	1,439	1,122	78.0%
29	Soda production	6	525	487	1,040	213.6%
1	Combustion	23	1,279	1,110	973	87.7%
	n. l. ETS	*1**	*0*	–	–	–
Total		**197**	**17,248**	**14,098**	**16,538**	**117.3%**

As of 02/05/2023

* n. l. ETS not included in the total number of installations

Activities 23 and 24 include eleven installations that produce adipic or nitric acid and are subject to emissions trading both in terms of their carbon dioxide and nitrous oxide (dinitrogen monoxide, N_2O) emissions. In 2022 the nitrous oxide emissions amounted to around 355,000 tonnes of carbon dioxide equivalents and on average accounted for 76.6 percent of the total emissions from these installations.

Allocation status

In the third trading period, the chemical industry installations were on average adequately equipped with free emission allowances compared to other industrial sectors. However, at the start of the fourth trading period in 2021, the allocation coverage was 94.3 percent. In 2022, the installations in the chemical industry were allocated 16.5 million emission allowances (see Table 19). This allocation amount, at 17.3 percent, is significantly higher than the total amount of allowances needed for surrender.

As in the third trading period, the largest relative surplus allocation with free emission allowances could be observed in the adipic and nitric acid production installations (284.7 percent). This can be explained by the fact that nitrous oxide (dinitrogen monoxide) emission abatement techniques have in the meantime been implemented and further developed in these installations. The outcome being that their specific emissions are significantly lower than the specific product benchmarks for adipic acid and nitric acid which is an allocation standard throughout the EU.

A surplus allocation compared to their emissions has also been given to soda production installations (213.6 percent or 553.000 emission allowances). The high allocation for soda can be explained by methodological shortcomings[119] in the definition and calculation of the derivation of the product benchmark for soda.

119 The benchmark includes emissions that are not directly released and for which there is no surrender obligation.

Conversely, the carbon black, ammonia and hydrogen or synthesis gas producing installations did not receive sufficient free allocations to fully offset their emissions in previous years. This situation was further exacerbated in the fourth trading period where there was a total shortfall of around 317,000 emission allowances (22.0 percent) for the operators of hydrogen and synthesis gas installations and about 154,000 emission allowances (27.1 percent) for the producers of industrial carbon black.

Table 20: Chemical industry (Activities 22 to 29 and 1), number of installations, 2022 VET entries, allocation amounts and adjusted allocation coverage

Sector	Number of instal-lations	2022 adjusted allocation amount [1000 EUA]	2022 VET [kt CO_2eq]	2022 allocation deviation from 2022 VET [kt CO_2 eq]	Adjusted allocation coverage
Chemical industry	197	15,471	14,098	1,372	109.7%

As of 02/05/2023

While the chemical industry installations in the third trading period, even after adjustments in the free allocation for an estimated allocation for imported heat were, on average, still relatively well-equipped with free emission allowances compared to other industries. However, a clear deficit became apparent in the first year of the fourth trading period. In the second year of the fourth trading period, there were corresponding reductions in emissions and thus a significant increase in allocation coverage due to a decline in production in large parts of the chemical industry.

After deducting the estimated allocation amount resulting from heat imports from other installations subject to emissions trading, which amounted to about 1 million emission allowances[120], the allocation coverage in the chemical industry fell from 117.3 percent to 109.7 percent (adjusted allocation coverage). In comparison, the adjusted allocation coverage in the previous year was only 87.6 percent.

Trends in the past years

Figure 37 shows the emissions and free allocation trends in the chemical industry since the start of emissions trading. The average emissions and allocation amounts are indicated as columns for the first, second and third trading periods. The annual emissions and allocation amounts, and the relative emissions trends are shown from 2018 onwards. Installations no longer subject to emissions trading (n. l. ETS)[121] have also been taken into account. The estimated proportions for heat imports from energy installations included in the allocation amounts are shown as hatched (cf. detailed explanations in the section above). The majority of installations have only been reporting their emissions since the third trading period, so the figures for the first and second trading periods are mostly estimated.[122]

120 For details on determining the estimated value, see Section 1.2.

121 See explanations on 'Taking into account installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1 Introduction.

122 2005 – 2010 emissions are data from the allocation procedure. No historical emissions are available for 2011 and 2012; the figures for both years were estimated by linear interpolation.

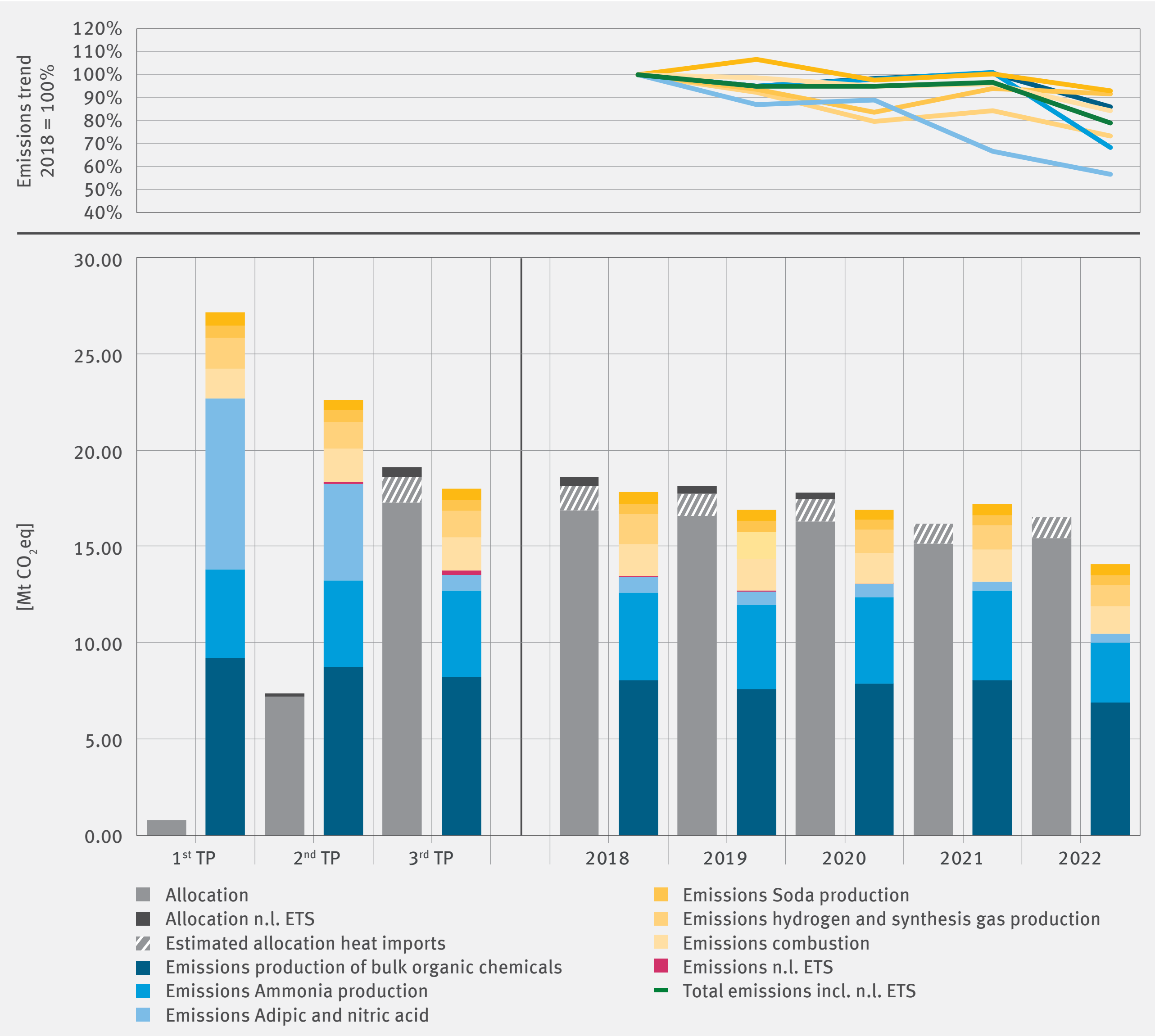


Figure 37: Chemical industry (Activities 22 to 29 and 1), emissions and free allocation trends in Germany from 2005 to 2022[123]

There were changes in the scope of the EU ETS in each case during the transition between the trading periods, which had an impact on existing installations. Therefore, the emissions and allocation amounts of the various trading periods are only comparable to a limited extent.

Apart from the crisis-related decrease in emissions in 2022, it can be seen that the chemical industry has largely constant emissions over the respective activities over time.

123 N. l. ETS: The figure retroactively takes into account installations no longer subject to emissions trading in order to show the actual emissions trend in European emissions trading in Germany since 2005 and to not just show the emissions trend of installations subject to emissions trading in the respective reporting year (see also Chapter 1 Introduction).

The only significant exception is adipic and nitric acid production: the decrease in emissions in the first and second trading periods largely resulted from the installation of abatement technologies, which enabled nitrous oxide emissions to be reduced at a relatively low cost. Substantial emission reductions were achieved even before the start of the emissions trading obligation through voluntary commitments by industry, immission control requirements and above all implementing Joint Implementation projects in Germany. Emissions from this activity have fallen by 25 percent since the beginning of the third trading period. This has also been one of the significant factors for the decrease in emissions in the entire chemical industry during the third trading period. Emissions from adipic and nitric acid production decreased visibly between 2020 and 2022, the second year of the fourth trading period. The changed GWP factor is responsible for the decline between 2020 and 2021, as mentioned previously, and the general economic downturn is responsible for the decline between 2021 and 2022.

Looking at the trend in total emissions from the chemical industry over the last five years, the emissions trend since 2018 has been roughly constant over time. It is not until 2022 that there is a clearly perceptible decline in emissions from the chemical industry.

Basically, the global COVID 19 pandemic in 2020 first led to a slump in demand for the chemical industry both at home and abroad. The polymers sector, which is strongly linked to the automobile industry, was particularly affected. At the same time, there were also positive trends in demand, especially in the areas of disinfectants and cleaning agents, medicines and soaps.[124] However, this pandemic effect was not directly reflected in the emissions as the affected areas of the chemical industry hardly have any direct emissions.

Although production increased in almost all product areas in 2021 despite the COVID 19 pandemic and supply chain difficulties but rising raw material and energy prices and a shortage of intermediate products weakened growth.[125]

In the 2022 reporting year, supply chains and logistics slowly began to recover from the consequences of the shortages caused by the COVID 19 pandemic.[126]

At the same time, the Russian war of aggression in Ukraine led to distortions on the international markets, which on the one hand led to a significant increase in energy and raw material prices and on the other hand, due to the general uncertainty about the future trend, also affected the demand for products of the chemical industry.[127] Thus, production was no longer economically viable in some cases due to the high gas prices, especially in ammonia production, but also in the production of other bulk organic chemicals, so that production was reduced and in some cases stopped altogether.[128]

This led to a significant decrease in emissions. The almost unchanged or slightly increased allocation amount in the reporting year also explains the increased allocation coverage in the chemical industry in 2022.

124 VCI 2020
125 VCI 2021
126 VCI 2022a
127 VCI 2022b
128 See Agrarheute (2022)

The Figure also shows the increase in allocation from the first to the second and from the second to the third trading period according to the respective expanded scope of the chemical industry within emissions trading. It can be seen how the free allocation steadily decreases due to the cross-sectoral correction factor over the period from 2018 to 2020 while emissions remain relatively constant. Particularly noteworthy is the transition to the fourth trading period where, for the first time since the beginning of the third trading period, there is no longer a surplus allocation in the chemical industry. This is mainly due to the reduction of the benchmarks and in particular to the very strong reduction of the heat benchmark which accounts for a large share of free allocations in the chemical industry. The increase in the 2022 allocation is due to the positive production trend after 2020, which will only take effect with a time lag.

Emissions and production trend

Figure 38 and Figure 39 below show the emissions from the production of bulk organic chemicals (Activity 27) and ammonia production (Activity 26). These have the highest emissions within the chemical industry. In addition, the activity rates from the annual production reports under the allocation procedure and the corresponding data of the German Chemical Industry Association (VCI).

Activity 27 in Figure 38 is the activity rate for the 'steam cracking' product benchmark, as this product benchmark makes up a large part of the total allocation in the production of bulk organic chemicals activity. In addition to the activity rate, the VCI data was included in the illustration comprising an index for bulk organic chemicals and an index for ethylene and propylene being the key products arising from steam cracking.[129]

The graph clearly shows that between 2018 and 2022 there was a downward trend in both emissions and production from 2018 to 2019 and a subsequent recovery from 2019 to 2021. The production trend indices follow the emissions trend, nonetheless with a rather different slope, but are moving together again for 2021.

The ethylene and propylene production index increases somewhat steeper than the activity rate of the 'steam cracking' product benchmark. Both only represent sub-sectors of bulk organic chemicals production, which is why the emission trend is similar but not identical. The deviating slope of the curves between the emissions and the VCI production index of bulk organic chemicals can be explained by the fact that, on the one hand, the VCI index only includes a selection of typical products such as benzene, ethylene and propylene while on the other hand, not all products are affected to the same extent by factors such as a possible decline in demand or production restrictions.

The decreasing emissions can partly be explained by a decline in demand from home and abroad.[130] At the same time, occasional effects such as the overhaul of steam crackers comes into play, which can take several weeks and months and thus have a strong impact on the activity's emission trend. In 2019, emissions from the Böhlen cracker decreased by 372,000 tonnes compared to 2018, partly due to an overhaul. The cracker then reached more than 90 percent of the 2018 emission level in 2020. In 2021, despite the impact of the COVID 19 pandemic, emissions returned to 2018 levels, only to plummet sharply in 2022 as a result of Russia's war of aggression in Ukraine and associated market uncertainties, as well as significantly higher raw material and fuel prices.

129 The index for bulk organic chemicals consists of all production data for organic chemicals published by the VCI in the publication 'Chemistry in Figures' (VCI 2013, VCI 2022), the index for ethylene and propylene only from these products. Data gaps for some products were interpolated. Xylene is not included in the index due to data gaps.

130 VCI 2019

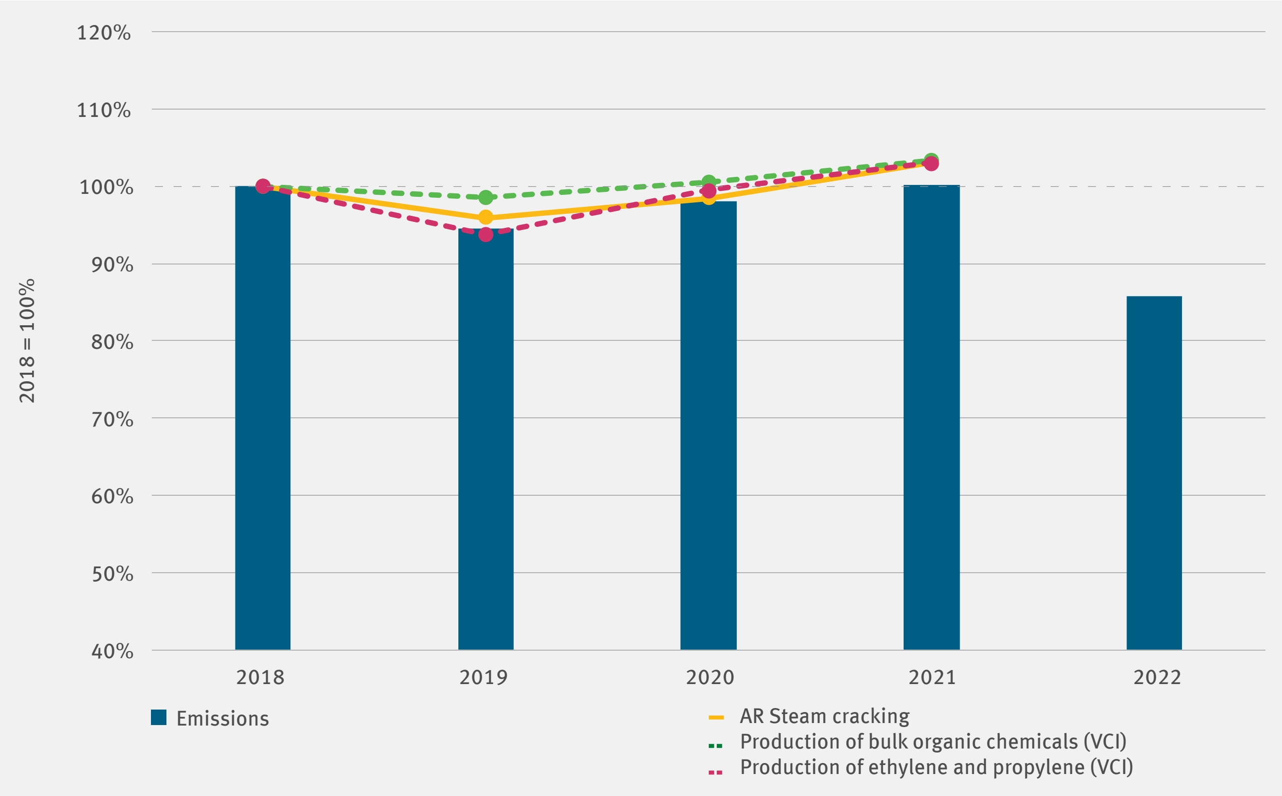


Figure 38: Production of bulk organic chemicals (Activity 27), 2018 – 2022 emissions and production trends in Germany, each in relation to 2018[131]

131 VCI 2013, VCI 2022. The Association's production data are regularly only available with a one-year delay, and the 2021 activity rates are exceptionally only available from June and not already from January of the following year. See explanations in Chapter 1 (Introduction).

The emissions trend for ammonia production (see Figure 39) essentially corresponds to the trend of the activity rate and the association's data. However, the association's data for ammonia production from 2018 onwards run at a lower level compared to the emissions and activity rate. An ammonia-producing installation is included in the Refineries activity because it is authorised as a refinery pursuant to Section 4 TEHG. From 2020 to 2021, there is an opposite trend in the VCI production data. In the 2022 reporting year, there is a significant drop in emissions, as in all areas of the chemical industry.[132]

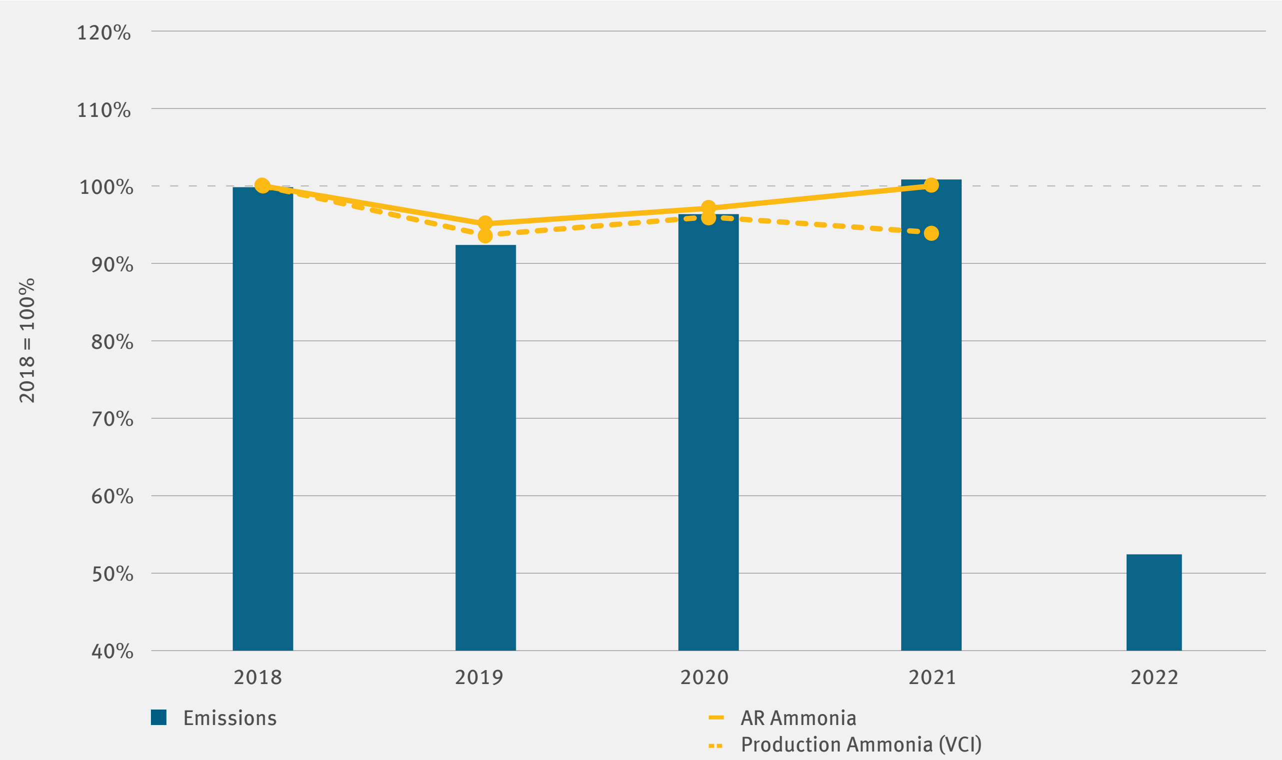


Figure 39: Ammonia production (Activity 26), 2018 – 2022 emissions and production trends in Germany, each in relation to 2018

132 VCI 2013, VCI 2021b

2.9 Overview of the Allocation Status in Germany

Allocation rules in the fourth trading period

Note: The following explanations do not yet include the adjustments to the EHRL resulting from the 'Fit for 55' package. These will be implemented gradually from 2024 and therefore do not yet apply to the current reporting year.

The amendment of the EHRL 2018[133] has created the basis for the harmonised Union-wide allocation rules for the 2021 – 2030 trading period. Auctioning will continue to be the basic allocation principle in the future. Also, rules established from the third trading period will be retained, for example free allocation based on the uniform EU benchmarks and considering a potential carbon leakage risk. This will continue to apply in principle while implementing the 'Fit for 55' package. The major differences between the two trading periods are summarised in the following table:

Table 21: Major differences in the allocation rules in the fourth trading period compared to the third trading period (Status before 'Fit for 55')

3rd trading period	4th trading period (status before 'Fit for 55')
8-year trading period	**10-year** trading period
Linear reduction factor: **1.74%** per year	Linear reduction factor: **2.2%** per year
Allocation is determined at the start of the trading period.	Allocation takes place in **two allocation periods** for five years each (2021 to 2025 and 2026 to 2030). It will be determined at the start of the respective allocation period.
Uniform benchmarks apply for the entire trading period	Benchmarks will be updated for each allocation period.
Free allocation decreases from 80% of the calculated allocation in 2013 to 30% in 2020. Exception: ▸ No reduction for CL endangered sectors (100% of the calculated allocation is free of charge)	Free allocation decreases from 30% of calculated allocation in 2021 to 2026, after 2026 to 0% in 2030. Exceptions: ▸ No reduction for CL endangered sectors (100% of the calculated allocation is free of charge) ▸ Free allocation remains constant at 30% for district heating up to 2030
Allocation changes within the trading period: ▸ After a physical change due to a 'substantial capacity change' threshold: 10%, increase or decrease ▸ Irrespective of a physical change reduction due to a 'partial cessation of operations', threshold value: 50%	Allocation changes within the allocation period: ▸ Irrespective of a physical change exclusively due to the 'production changes', threshold value: 15%, increase or decrease
The number of emission allowances allocated free of charge to industrial installations (non-electricity producers) is limited to the historical emission share of the industrial installations ('industry cap'). A uniform cross-sectoral correction factor is applied to comply with the industry cap.	The number of emission allowances auctioned is set at 57% of the total number, but 3% of the total number can be used as a buffer for free allocation to prevent the application of a cross-sectoral correction factor.
The carbon leakage status is determined by carbon cost and/or trading intensity criteria. Changes in status are possible within the trading period.	The carbon leakage status is determined by the trading intensity multiplied by the emission intensity divided by the gross value added. No changes in status are envisaged within the trading period.

››

133 Directive (EU) 2018/410 of the European Council of 14/03/2018 amending Directive 2003/87/EC (EHRL), EUR-Lex – 32018L0410 – EN – EUR-Lex (europa.eu)

The structure of the allocation rules in the fourth trading period is specified in two EU-wide regulations:

- The EU Allocation Regulation (EU-ZuVO in particular contains the specifications for determining the free basic allocation.
- The EU Adjustment Regulation (EUA) regulates under what conditions can this basic allocation be adjusted, for example in the case of relevant production changes.[134]

The European Commission reduced all 54 benchmarks for the first allocation period (2021 – 2025) to take into account efficiency improvements achieved in the meantime. This was based on installation- and product-specific information from all Member States from 2016 and 2017, collected as part of the allocation procedure for existing installations. The average of the 10 percent most greenhouse gas efficient installations within the EU determined this update where the benchmarks for the third trading period were reduced by a minimum of three and a maximum of 24 percent[135].

As opposed to the third trading period, in the first allocation period it was not necessary for the basic allocation to industrial installations be reduced to secure the industry cap. This means that the cross-sectoral correction factor for the 2021 – 2025 period is one[136]. However, the basic allocation for electricity producers will continue to be reduced by the linear reduction factor.

In the fourth trading period, the free allocation is adjusted annually if current production has increased or decreased by more than 15 percent compared to historical values (from the basic allocation). This is based on the allocation data reports which must be submitted annually to DEHSt by 31 March[137].

In the second year of the fourth trading period, the verified emissions of all installations subject to emissions trading in Germany significantly exceeded the current year's free allocation amount of 354 million tonnes of carbon dioxide equivalents.[138] In 2022, a total of around 126.1 million emission allowances were allocated free of charge to operators of 1,577 of the 1,731 German installations (as of 19/04/2023[139]).

The free allocation thus covered an average of 35.6 percent of the verified emissions of all installations in Germany, which was at a similar level as the average allocation coverage for the previous year (35 percent). Both the emissions (minus 0.1 percent) and the allocation amount (plus 1.1 percent) are almost unchanged compared to the previous year. In 2021, i. e. the first year of the fourth trading period, the adjusted allocation rules (see text box above) were still noticeable in the trend of allocation coverage. These rules resulted in a significant decrease in the allocation amount for the first time in 2021.

Nevertheless, the differentiated allocation trend in the activities and sectors varies (see Sections below). In addition to the trend in relevant activity rates, a key factor is the correlation between the discontinuation of the cross-sectoral correction factor and the extent of the reduction in the corresponding benchmark for allocation.

Table 22 shows the allocation and emission status differentiated by Activities (1 to 29). A comparison of the individual activities clearly reflects the large differences between energy and industrial installations with regard to allocation rules.

134 The DEHSt website on free allocation provides a detailed overview of the regulations on free allocation in the fourth trading period: DEHSt – 2021 – 2030 allocation

135 Implementing Regulation (EU) 2021/447 sets out the benchmarks to be applied for the allocation period 2021 – 2025: https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32021R0447&rid=1.

136 The cross-sectoral correction factor was announced by the European Commission in its decision of 31/05/2021: Publications Office (europa.eu). The basic allocation shown in the National Allocation Table (NAT) reflects the final allocation amounts as approved by the European Commission – based on the allocation applications and applying the correction factors cf. Nationale Zuteilungstabelle für deutsche Bestandsanlagen im Zuteilungszeitraum 2021–2015 (National allocation table for German existing installations in the 2021-2015 allocation period) (dehst.de).

137 Detailed information on the annual adjustment of the allocation and on the allocation data reports is published at DEHSt – Zuteilungsdatenbericht (DEHSt – Allocation Data Report).

138 In Section 2.9, the existing installations of the 2021 reporting year are used throughout.

139 See Chapter 1.2 Data sources and methods – Free allocation 2022.

Table 22: 2022 allocation status by activities (non-adjusted allocation coverage)[140]

Industry	No.	Activity	Number of installations	2022 allocation amount [1000 EUA]	2022 VET [kt CO_2eq]	2022 allocation deviation from 2022 VET [kt CO_2eq]	2022 allocation coverage*	2021 allocation coverage*
Energy	2	Energy conversion >= 50 MW RTI	445	9,921	235,634	−225,713	4.2%	4.5%
	3	Energy conversion 20 – 50 MW RTI	359	1,486	4,695	−3,209	31.6%	29.0%
	4	Energy conversion 20–50 MW RTI, other fuels	13	87	63	24	137.6%	140.0%
	5	Prime movers (engines)	3	9	86	−76	10.9%	18.8%
	6	Prime movers (turbines)	53	182	1,274	−1,092	14.3%	28.5%
			873	**11,685**	**241,752**	**−230,067**	**4.8%**	**5.1%**
Industry	1	Combustion	80	1,826	2,337	−511	78.1%	70.2%
	7	Refineries	22	15,771	23,470	−7,699	67.2%	70.0%
	8, 9, 10	Production of pig iron and crude steel**	35	43,561	29,025	14,536	150.1%	137.3%
	8	Coking plants	4	1,436	3,770	−2,334	38.1%	38.2%
	9	Processing of metal ores	1	70	62	8	112.3%	95.9%
	10	Production of pig iron and steel	30	42,055	25,193	16,862	166.9%	150.9%
	11	Processing of ferrous metals	83	2,971	4,058	−1,087	73.2%	68.0%
	12	Production of primary aluminium	7	874	600	273	145.5%	95.5%
	13	Processing of non-ferrous metals	28	1,329	1,452	−123	91.5%	84.1%
	14	Production of cement clinker	35	17,550	18,763	−1,213	93.5%	84.4%
	15	Lime production	56	5,415	8,663	−3,248	62.5%	61.3%
	16	Glass production	68	2,837	3,691	−853	76.9%	74.7%
	17	Ceramics production	119	1,472	1,747	−275	84.3%	77.5%

140 Table 22 does not include an entry for Activity 25 (Production of glyoxal and glyoxylic acid) in this year's VET report as the only installation under this activity, as a small emitter, is no longer subject to the surrender obligation of emission allowances in 202 and thus does not have to make any VET entry. Details on small emitters in the fourth trading period of EU ETS are described in Chapter 1.3

Industry	No.	Activity	Number of instal-lations	2022 allocation amount [1000 EUA]	2022 VET [kt CO_2eq]	2022 allocation deviation from 2022 VET [kt CO_2eq]	2022 allo-cation cover-age*	2021 allo-cation cover-age*
Industry	18	Production of mineral fibres	8	281	400	–119	70.3%	67.2%
	19	Gypsum production	9	89	275	–187	32.2%	29.2%
	20	Pulp production	4	64	162	–97	39.8%	43.7%
	21	Paper production	130	4,788	4,572	216	104.7%	96.0%
	22	Carbon black production	4	414	568	–154	72.9%	70.4%
	23	Production of nitric acid	8	551	337	214	163.4%	139.0%
	24	Production of adipic acid	3	696	101	595	689.9%	651.9%
	26	Ammonia production	5	3,861	3,138	723	123.0%	83.2%
	27	Production of bulk organic chemicals	133	7,882	6,919	963	113.9%	93.2%
	28	Production of hydrogen and synthesis gas	15	1,122	1,439	–317	78.0%	65.6%
	29	Soda production	6	1,040	487	553	213.6%	197.6%
			858	**114,391**	**112,202**	**2,190**	**102.0%**	**94.1%**
Total			**1,731**	**126,076**	**353,953**	**–227,877**	**35.6%**	**35.2%**

As of 02/05/2023

* Without considering possible adjustments for the transfer of waste gases from iron, steel and coke production and for heat imports

** Coking plants, metal ores processing, production of pig iron and steel

In the 2022 reporting year the operators of the 858 installations with **industrial activities** received a total allocation of 114.4 million emission allowances. This compares to verified emissions totalling 112.2 million tonnes of carbon dioxide equivalents. Thus the allocation corresponded to 102 percent of the surrender obligation for these installations, a notable increase from 94.1 percent in 2021. This marked the second consecutive year where the allocation exceeded the 100 percent threshold, rebounding from the lowest value to date, which was recorded in 2021, since the start of the third trading period in 2013. Nevertheless, it's worth mentioning that the allocation coverage had already dipped below 100 percent in the 2017 – 2019 period.[141]

The adjusted allocation coverage[142] is once again significantly lower at 86.8 percent (2021: 79.1 percent) (see the following Sections with Table 23 and Table 24).

141 As of 19/04/2023, not all allocation adjustments had been finalised and approved by the European Commission for 2022. Based on the activity rates, allocation reductions of a relevant amount are still to be expected for installations in the iron and steel industry for 2022.

142 See explanations on the adjusted allocation coverage in the Glossary (Chapter 8).

The situation is different for the 873 **energy installations** (Activities 2 to 6). Since there has been no free allocation for power generation since the beginning of the third trading period. The ratio of allocation to verified emissions in 2022 was on average only 4.8 percent and thus approaching a similar level as in the previous year (2021: 5.1 percent). In total, energy installations received an allocation of 11.7 million emission allowances for heat generation in 2022, while verified emissions amounted to 241.8 million tonnes of carbon dioxide equivalents. While the emissions of these installations increased by almost 3 percent, allocation decreased by a comparable amount (3 percent) compared to the previous year.

Apart from the energy sector, **power generation in the industry sector** no longer received free allocations from 2013. This applies to refineries and the paper industry since (heat and) power stations are usually in operation in both sectors. Thus in 2022, refineries received an allocation that corresponded to only 67.2 percent of their verified emissions (2021 was 70 percent). The allocation coverage in the paper industry, however, does not indicate that part of the emissions that is attributable to power generation. These installations even showed a comparatively high surplus allocation of free emission allowances due to the allocation rules for cross-boundary heat flows (see Section 2.7). The installations in the paper industry exhibited a ratio of allocation to verified emissions of 104.7 percent (96 percent in 2021).

In the case of 30 pig iron and steel production installations (Activity 10), the nominal average allocation they received was noticeably higher (166.9 percent, 2021: 150.9 percent) compared to their actual emissions. This is substantiated by the allocation governing high-emission waste gases from iron, steel and coke production where some of these emissions are transferred to energy installations. The overall allocation coverage of the 120 installations from the entire iron and steel industry adjusted by the allocation amount for the transfer of waste gases from iron, steel and coke production is around 95.3 percent (cf. Section 2.4).

Allocation status taking into account waste gases from iron, steel and coke production and heat imports

The allocation that can be traced back to transferred waste gases from iron, steel and coke production and heat imports from other installations subject to emissions trading has a significant impact on the allocation coverage for the sectors concerned. In 2022, an estimated 14.9 million emission allowances were assigned to waste gas transfer from industrial installations to energy installations and around 2.1 million emission allowances assigned to heat imports transferred from energy installations to industrial installations.[143]

Assuming that these allocation amounts were settled between industry and energy sector operators, this industry sector exhibited a deficit of around 14.8 million emission allowances in 2022. Thus, the allocation coverage for the industrial sector would be 86.8 percent instead of the aforementioned 102 percent corresponding to a significant deficit for the entire sector.

The calculation refers to the iron and steel, paper and pulp and the chemical industry sectors (see Table 23). Conversely, under the assumptions made for the energy sector, the allocation coverage increased from 4.8 to 11.9 percent as a ratio of adjusted allocation to verified emissions for 2022. Table 23 summarises the allocation status adjusted by transferred waste gases from iron, steel and coke production and imported heat for 2022 at the sector level.

143 See explanations on the allocation estimate in Sections 2.1 'Energy installations', 2.4 'Iron and steel industry including coking plants', 2.7 'Paper and pulp' and 2.8 'Chemical industry'.

Table 23: Adjusted allocation coverage (taking into account waste gases from iron, steel and coke production and heat imports)

Industry	Sector	Number of instal-lations	2022 allocation amount [1000 EUA]	2022 VET [kt CO_2eq]	2022 allocation deviation from 2022 VET [kt CO_2eq]	2022 allo-cation cove-rage*	2022 adjusted allocation amount ** [1000 EUA]	2022 allo-cation cove-rage**
Energy	Energy instal-lations	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 build-ing 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 industry	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 com-bustion plants	50	577	499	78	115.7%	577	115.7%
		858	**114,391**	**112,202**	**2,190**	**102.0%**	**97,368**	**86.8%**
Total		**1,731**	**126,076**	**353,953**	**−227,877**	**35.6%**	**126,076**	**35,6%**

As of 02/05/2023
* Without considering possible offsets for the transfer of waste gases and for heat imports
** Considering possible offsets for the transfer of waste gases and for heat imports

Table 24 and Figure 40 show the trend of the adjusted allocation coverage over the course of the past five years, i. e. including the second half of the third trading period. In relation to 2013, the starting year of the third trading period, both energy and industrial installations on average tend to receive a declining free allocation. However, in the last two years of the third trading period (2020 and 2019), there was a slight increase in the average adjusted allocation coverage, both for energy and partly for industrial installations. In the second year of the fourth trading period, the average adjusted allocation coverage for energy installations decreased slightly, while the allocation coverage for industrial installations increased (see Table 24).

Table 24: Adjusted allocation coverage since 2018

Industry	2018 allocation coverage*	2019 allocation coverage*	2020 allocation coverage*	2021 allocation coverage*	2022 allocation coverage*
Energie	13,2 %	14,9 %	15,7 %	12,8 %	11,9 %
Industrie	84,7 %	86,5 %	90,0 %	79,1 %	86,8 %

As of 02/05/2023
* Considering possible offsets for the transfer of waste gases and for heat imports

Broken down to the level of industrial sectors, there is a partially significant increase in the average adjusted allocation coverage in all sectors except the refineries (see Figure 40). Here, the average adjusted allocation coverage fell slightly from 70 percent in 2021 to 67.2 percent in 2022. For the majority of industries, however, the trend in the reporting period was characterised by falling emissions with a simultaneous minor increase in allocation amounts[144]. The adjusted allocation coverage grew particularly strongly in the chemical industry (from 88 percent in 2021 to 109.7 percent in 2022) and in the iron and steel industry installations (from 83.5 percent in 2021 to 95.3 percent in 2022). The trends in the chemical industry and the iron and steel industry are largely due to emissions decline in the reporting year, with the decrease in emissions in the chemical industry being significantly greater. The main reason for the reduction in both sectors is a decline in production. In the iron and steel industry, in contrast to the chemical industry, an increase in the allocation amount in the reporting year was also relevant for the trend in the increased allocation coverage.

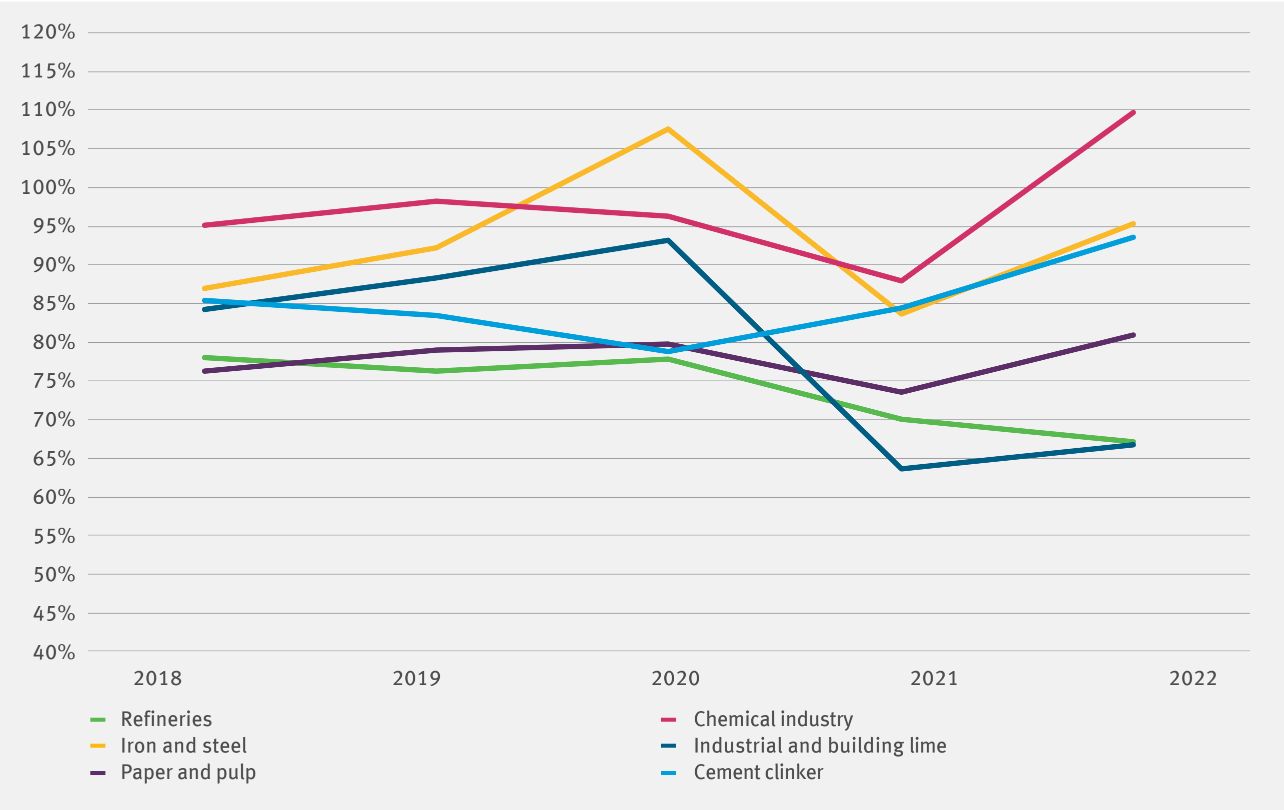


Figure 40: Adjusted allocation coverage trends for the largest emitters within the industrial sectors since 2018

144 Allocation status 19/04/2022, see also Section 1.2 Data sources and methods – Free allocation 2022

Allocation status in the overall period 2008 to 2022

For further consideration of the current allocation status, the corresponding values from previous years for the installations considered in this report are included in the following, in addition to the allocation surpluses (deficits) for 2022. This seems appropriate, as the emission allowances allocated from 2008 have been exchanged for emission allowances from the fourth trading period and can therefore continue to be used for surrender obligations in emissions trading (banking).

The free allocation and verified emissions balance for industrial activities in the second trading period (2008 to 2012), was a cumulative surplus amounting to 96.8 million allowances.[145] Assuming that the allocations for transferred waste gases from iron, steel and coke production and imported heat amounts (143.2 million allowances for 2013 to 2020) are offset between industrial and energy sector operators, the aggregated allocation of the industrial sector for the completed third trading period was 113.6 million emission allowances below the cumulative emissions. This balance increased continuously in the final years of the third trading period and was, at least in mathematical terms, compensated by the surpluses accumulated in the second trading period up to 2019. This mathematical surplus had completely faded away by 2020. While emissions in the first year of the fourth trading period were 25 million tonnes above the allocation, they were again slightly below the allocation for the first time in the 2022 reporting year at 2.2 million tonnes[146]. For the industrial activities between 2008 and 2022 there was a total balance of minus 41.9 million emission allowances. Table 25 summarises the aggregated results at the sector level.

Table 25: Aggregated allocation status in the second, third and fourth trading periods

Industry/sector		Cumulative allocation surplus					
		Number of installations	2008–2012 adjusted* [M EUA]	2013–2020 adjusted** [M EUA]	2021 adjusted** [M EUA]	2022 adjusted** [M EUA]	2008–2022 total adjusted** [M EUA]
Energy	Energy installations	873	−319.7	−1,959.1	−204.7	−213.0	−2,483.5
		873	**−319.7**	**−1,959.1**	**−204.7**	**−213.0**	**−2,483.5**
Industry	Refineries	22	11.5	−42.1	−6.8	−7.7	−37.3
	Iron and steel	120	52.1	−20.6	−5.8	−1.6	25.7
	Non-ferrous metal	39	0.0	−2.3	−0.7	−0.2	−2.9
	Cement clinker	35	4.5	−17.3	−3.2	−1.2	−16.1
	Industrial and building lime	38	9.5	−7.0	−2.5	−2.2	0.0
	Other mineral processing industry	223	5.9	−13.1	−2.6	−2.5	−9.7
	Paper and pulp	134	7.4	−8.8	−1.4	−0.9	−2.8
	Chemical industry	197	5.1	−3.1	−2.1	1.4	−0.1
	Other combustion plants	50	0.8	0.6	0.0	0.1	1.4
		858	**96.8**	**−113.6**	**−25.0**	**2.2**	**−41.9**
Total		**1.731**	**−222.9**	**−2,072.7**	**−229.7**	**−210.9**	**−2,525.3**

As of 02/05/2023
* Incl. redistribution of emission allowances for onward transmission of waste gases as per Section 11 Allocation Act
** Considering possible adjustments for the transfer of waste gases and for heat imports

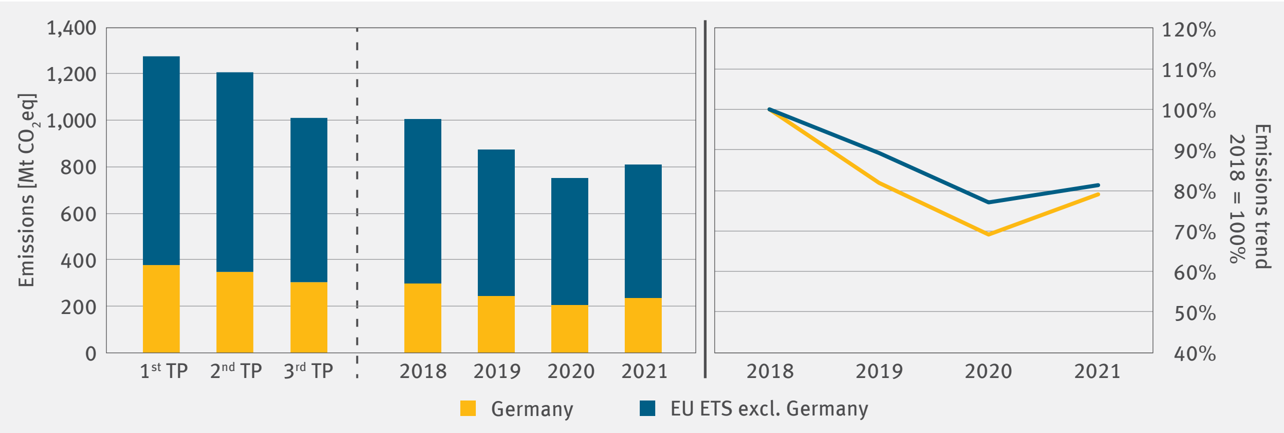
145 Including redistribution of emission allowances for transferred waste gases as per Section 11 Allocation Act 2012.
146 Status of allocation on 19/04/2022, see also Section 1.2 Data sources and methods – 2022 free allocation.

In contrast to the industrial sector, the balance of emissions and allocation for energy installations was already minus 319.7 million emission allowances in the second trading period. In addition to the level of the benchmarks set at the time and the proportionate reduction to safeguard the budget, this was also because in the second trading period in Germany free allocation for electricity generation had already been reduced in favour of auctioning emission allowances.[147] From the beginning of the third trading period, full auctioning has applied to electricity generation throughout Europe. As a result, the cumulative shortfall in the energy sector at the end of the third trading period increased by a further 1,959.1 million emission allowances, taking into account the balance from the second trading period and assuming the offsetting of free allocation for waste gases from iron, steel and coke production and heat imports between the industrial sectors and the energy sector. In 2022, the shortfall increased by an additional 204.7 million emission allowances, bringing the total balance from 2008 to minus 2,483.5 million emission allowances.

2.10 Emissions Trend of Individual Sectors in the EU

The following section provides an overview of the emissions trend in the sectors in Germany compared to other Member States[148]. The evaluation is based on a grouping of installations by activity in the EU Union Registry (see Table 37, Chapter 7) which may result in differences in the emission amounts per sector for Germany compared to Sections 2.1 to 2.8. As the complete, processed and quality-assured data for the previous year was only made available at EU level by the European Environment Agency (EEA) after the editorial deadline, only the period up to 2021 is shown.

2.10.1 Combustion and energy' Activity in the EU



Source: EEA (2023)

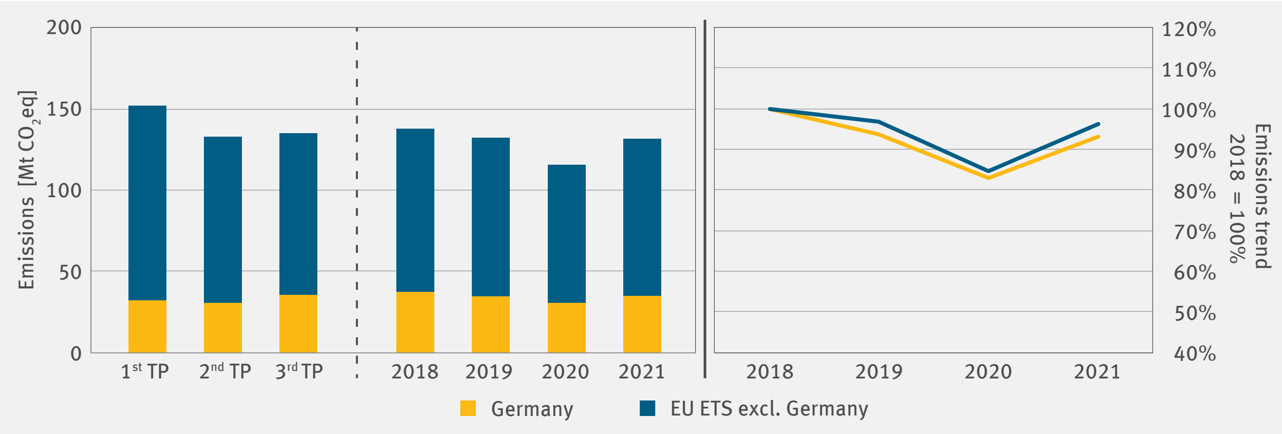
Figure 41: Trend in combustion and energy emissions (Registry Activity 20) in Germany and in the EU up to 2021

- Decline in combustion emissions across trading periods: between 2018 and 2020, initially continuously decreasing emissions from combustion plants both in Germany and in the rest of the EU ETS; increase in 2021 (2021: minus 19 percent compared to 2018 in the EU ETS).
- 2018 to 2020: emissions decline in Germany stronger than in the other Member States; 2021: stronger increase in emissions in Germany (2021: minus 21 percent compared to 2018 in Germany, minus 19 percent in the other Member States).
- Proportion of German installations in Activity 20 EU ETS-wide remained almost the same in 2021 as in 2018, at around 29 percent.

147 Free allocation for electricity generation was reduced by 38 million allowances annually in accordance with the provisions of Section 20 Allocation Act 2012 in favour of the disposal budget.

148 The European Environment Agency (EEA) publishes an annual report on the main trends in the EU ETS, see EEA 2021.

2.10.2 Iron and steel industry in the EU

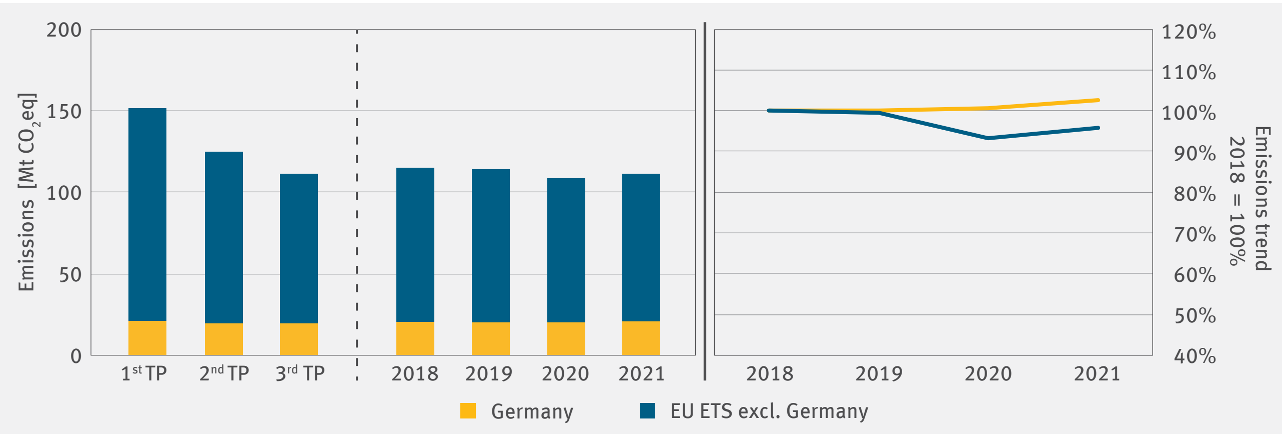


Source: EEA (2023)

Figure 42: Emissions trends for iron and steel production (Registry Activities 23 to 25) in Germany and the EU up to 2021 (excluding emissions from waste gases from iron, steel and coke production)

- Between 2018 and 2020, a significant decrease in emissions (2020 compared to 2018: minus 15 percent) at EU level; from 2020 onwards, a significant increase to around the level of 2019.
- Emissions in Germany largely stable in 2018 and 2019; marked decline in 2020 analogous to the trend at EU level, followed by a significant rebound in 2021.
- Germany's proportion of emissions from Activities 23 to 25 in the EU ETS at around 27 percent in 2021.

2.10.3 Cement clinker production in the EU

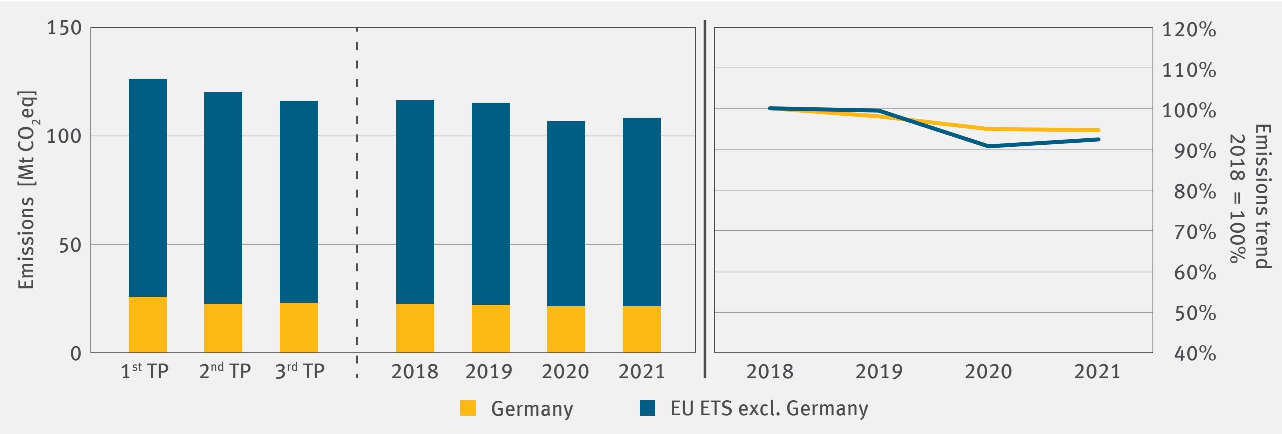


Source: EEA (2023)

Figure 43: Emissions trends for cement clinker production (Registry Activity 29) in Germany and the EU up to 2021

- Decrease in emissions for the entire sector in the EU across the trading periods; between 2018 and 2021 increase of cement clinker emissions in Germany by three percent, decrease in EU ETS cement clinker emissions in the same period by four percent.
- In the third trading period, partially fluctuating but overall increasing emissions from cement clinker production in the EU; between 2018 and 2021 different trends in Germany and the rest of the EU; slight increase in emissions in Germany compared with decrease in emissions from cement clinker production in the EU ETS.
- Proportion of emissions from German cement clinker production installations in the EU ETS (excluding UK) from 2018 between 17 and 19 percent.

2.10.4 Refineries in the EU

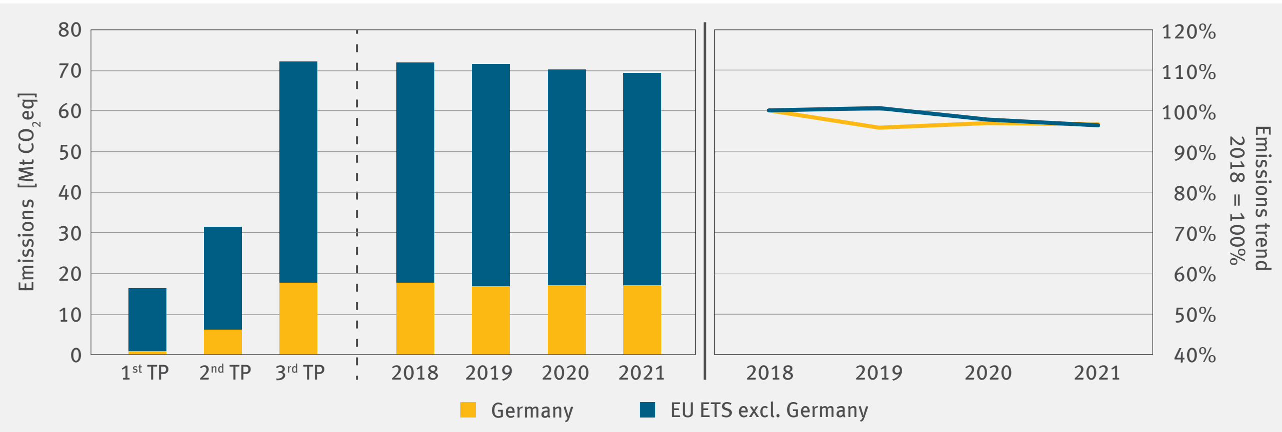


Source: EEA (2023)

Figure 44: Refinery emissions trends (Registry Activity 21) in Germany and the EU up to 2021[149]

- Decrease in emissions for the entire sector in the EU across trading periods; from 2018 to 2021 German emissions decreased by five percent; decrease in EU ETS refinery emissions by seven percent in the same period.
- Emissions trend of German refineries similar to that at EU level: from 2018 emissions decreased in both Germany and at EU level; from 2020 to 2021 little change in Germany, slight increase at EU level.
- German refineries account for around 20 percent of emissions from EU ETS refineries.

2.10.5 Chemical industry in the EU



Source: EEA (2023)

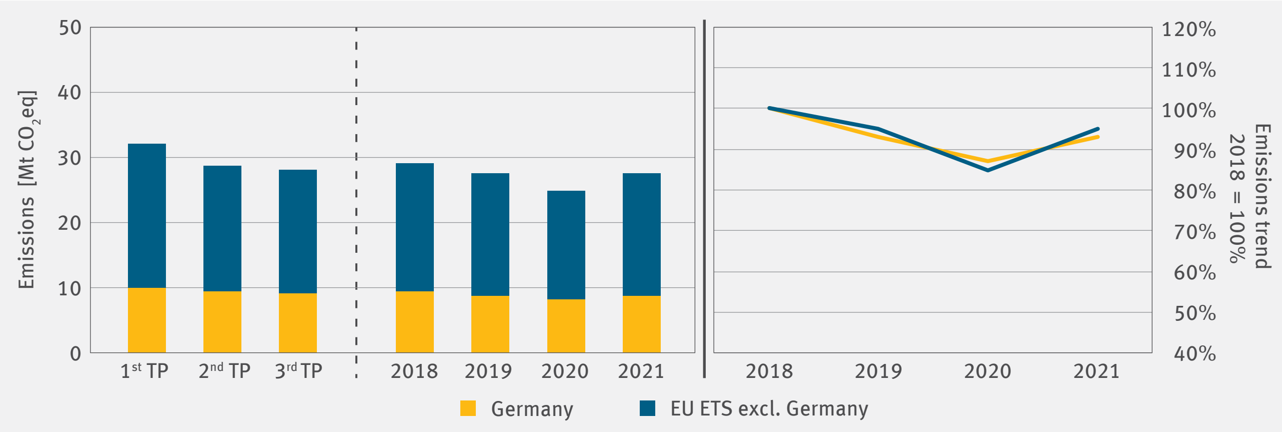
Figure 45: Chemical industry emissions trends (Registry Activities 37 to 44) in Germany and the EU up to 2021[150]

- Comparison between trading periods not effectively possible due to different scope
- Between 2018 and 2021 German emissions decrease of minus three percent, at EU level of minus four percent; emissions trend in Germany and the EU went partially in the opposite direction from 2018
- Germany's proportion of the chemical industry in the EU ETS (excluding UK) about 25 percent.

149 The mandatory rule for Germany's refineries from the third trading period onwards to form an amalgamated installation in accordance with Section 28(1) (4c) of the TEHG and Section 29(3) of the ZuV 2020 makes a comparison across trading periods but only to a limited extent.

150 The Figure shows that from one trading period to the next more and more chemical industry activities were included within the scope of emissions trading. See also Section 2.8.

2.10.6 'Lime production' Activity in the EU



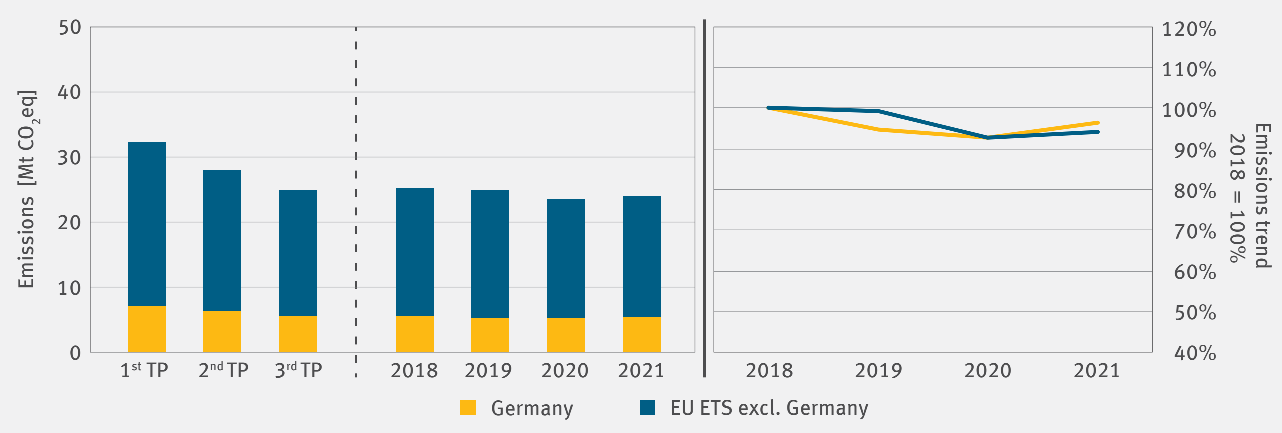
Source: EEA (2023)

Figure 46: Lime production emissions trends (Registry Activity 30) in Germany and in the EU up to 2021[151]

- Continuous decrease in total industry emissions in Germany and the EU across trading periods; 2018 to 2021 emissions decline of seven percent in Germany and five percent at EU level.
- Declining trend in the third trading period; in 2018 and 2020 slight decrease in emissions; compared to 2018, decrease in 2020 of 13 percent for Germany and 15 percent at EU level; from 2021, increase of seven and twelve percent respectively; emissions trend is strongly dependent on the economic trend in the iron and steel industry; total emissions trend in the sector in Germany analogous to EU ETS (excluding UK)
- Proportion of emissions from German lime installations in the EU ETS (excluding UK) constant at 32 percent from 2018.

151 Due to changes in the scope and in the allocation of installations to the 'Lime production' Activity, the values between the trading periods are only comparable to a limited extent.

2.10.7 Paper and pulp industry in the EU

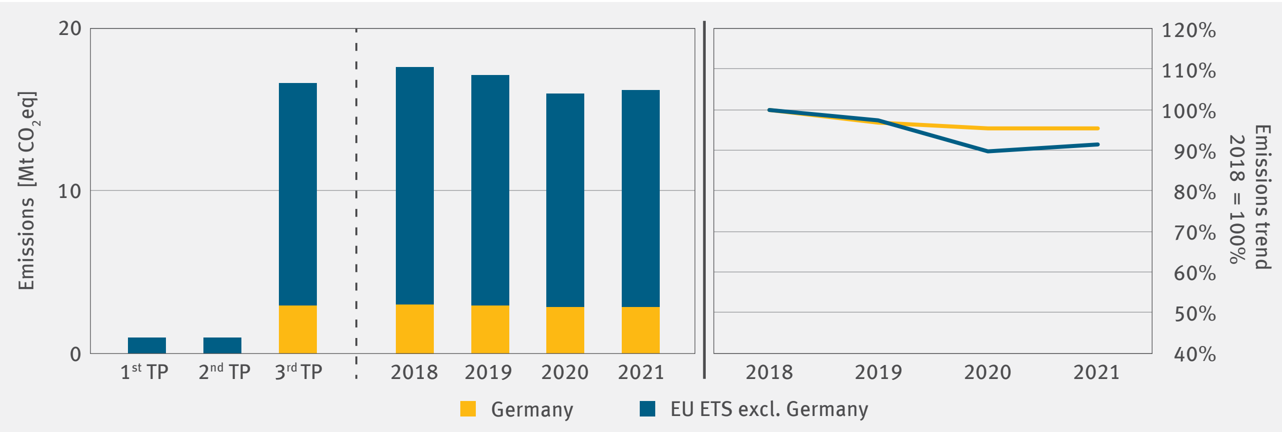


Source: EEA (2023)

Figure 47: Paper and pulp industry emissions trends (Registry Activities 35 and 36) in Germany and in the EU up to 2021

- Paper and pulp industry emissions (Registry Activities 35 and 36) have clearly decreased since the first trading period in both the EU and Germany by 27 and 25 percent respectively.
- Emissions trends between 2018 and 2020 show a decrease in emissions; decrease in Germany in this period was about four percent and at EU level about six percent; slight increase in emissions from 2021 as a result of the recovery after the COVID 19 pandemic.
- Share of emissions from the German paper and pulp industry in the EU ETS relatively constant over the entire period of the third trading period at about 22 percent.

2.10.8 Non-ferrous metals industry in the EU



Source: EEA (2023)

Figure 48: Emission trends in the non-ferrous metals industry (Registry Activities 26 to 28) in Germany and in the EU up to 2021

- Non-ferrous metals industry not subject to emissions trading until the start of the third trading period from 2013, in 2018 to 2020 decrease in emissions both in Germany and in the rest of the EU ETS, in 2021 slight increase in emissions.
- Stronger fall in emissions at EU level than in Germany up to 2020, increase from 2020 to 2021 by two percent at EU level, while German emissions remained almost unchanged.
- Share of emissions from the German non-ferrous metals industry in the EU ETS from 2018: 17 to 18 percent

3 Germany and Europe: Trends in Emissions, Surpluses and Prices

At the start of the fourth trading period and after the Brexit in 2021, 30 countries (EU27 plus Iceland, Liechtenstein and Norway) and some power generation plants in Northern Ireland participated in the European Emissions Trading Scheme. The data in this report is therefore not directly comparable with the data in previous reports before the start of the fourth trading period, which referred to 31 Member States.

After the sharp decline in emissions due to the pandemic in 2020 – partially made up for in 2021[152] – emissions from the approximately 9,000 ETS installations fell slightly in 2022 by around 1.1 percent compared to 2021 and, according to the European Commission, amounted to around 1.32 billion tonnes of carbon dioxide equivalents.[153] As in previous years, emissions from stationary installations, were significantly lower – by around 208 million tonnes of carbon dioxide equivalents (2021: 261 million tonnes) – than the maximum available output (nominal cap) of 1.529 billion emission allowances for the respective year.

However, the actual number of allowances issued in 2022 was significantly lower than the nominal cap. This is because the Market Stability Reserve (MSR) mechanism reduced the quantity of emission allowances (EUAs) to be auctioned in 2022 by around 369 million EUAs because the quantity of emission allowances in circulation (TNAC: Total Number of Allowances in Circulation) exceeded the upper threshold of the MSR of 833 million allowances in previous years (see Section 3.2). Despite this comprehensive reduction in auction volumes, in 2022 the TNAC decreased by 22 percent compared to the end of the previous year to around 1.13 billion emission allowances, according to the European Commission.[154] This corresponds to around 86 percent of the annual emissions from installations in the EU ETS.

3.1 Emissions Trends in the EU ETS Member States

According to the European Commission, emissions from installations participating in the EU ETS fell by 1.1 percent in 2022 compared to 2021, to 1.32 billion tonnes of carbon dioxide equivalents. After emissions from electricity generation in 2021 increased by around 8.3 percent compared to 2020 and those from industrial installations by around 5.2 percent, emissions from electricity generation rose by a further two percent in 2022 despite lower electricity demand, while emissions from industrial installations fell by around five percent[155]. Above all, sharply rising natural gas prices and the drought in large parts of Europe, which resulted in reduced generation from nuclear and hydropower, meant that the downward trend in electricity generation from coal, which had been ongoing since 2013 (with the exception of 2015) did not continue for the second year in a row. Thus, electricity generation from coal-fired power plants increased by around six percent in 2022 compared to 2021 and was around one percent lower than in 2019[156].

This means that the overall decrease in emissions from EU ETS installations across Europe was around 38 percent compared to the first year of emissions trading in 2005, while emissions from installations in Germany decreased to a slightly lesser extent, by 31 percent (see Figure 49). The first significant fall in emissions occurred in the second trading period; in the period between 2008 and 2012, emissions fell by twelve percent as a result of the economic and financial crisis. In the third trading period, emissions also fell significantly, particularly from 2018 to 2020 due to the ongoing decarbonisation of electricity generation – also driven by sharply increased prices in the EU ETS – and in 2020 also due to the pandemic, before a sharp rebound in 2021, which was slowed by a moderate decline in 2022.

152 To 4.4 percent below the 2019 emission level, see DEHSt 2022b.
153 Unless otherwise stated, the data cited in this section is based on the information provided by the European Commission on 24/05/2023 (COM 2023a).
154 COM 2023b
155 COM 2023a
156 Ember 2023

After emissions in Germany had fallen less sharply than in the other EU ETS Member States in the second and first half of the third trading period, the emissions trends in German installations in the following years followed the Europe-wide trend: overall, emissions in Germany since the start of the third trading period at 26 percent, have fallen even more sharply than in the EU ETS countries at 22 percent. This was mainly due to the significant reduction in emissions from German energy installations in 2019 and 2020.

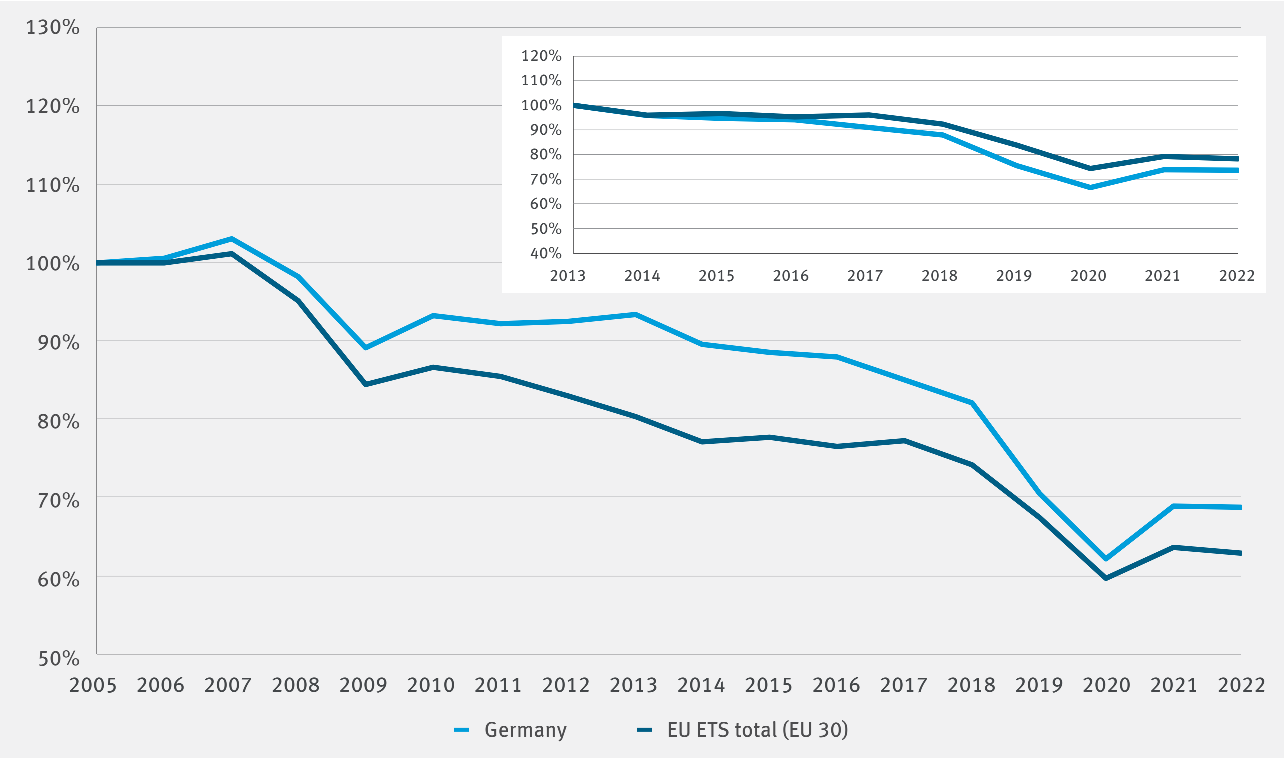


Figure 49: Emissions trends in Germany compared to stationary EU ETS emissions in all Member States (2005 emissions plus emissions estimate for extended scope of the third trading period = 100 percent)[157]

157 Source: EEA 2023

3.2 Demand and Supply in the Stationary Sector (EU-wide)

Figure 50 shows the supply of emission allowances available in the EU ETS in the respective year compared to the emissions (demand) in the same year. In addition to emission allowances allocated free of charge and auctioned emission allowances as well as surrendered or exchanged project credits, the nominal annual emission caps are also shown. From 2021, project credits can no longer be used in the EU ETS.

The large surplus of unused emission allowances from the second and the beginning of the third trading period was partially reduced in recent years. This was primarily achieved by reducing the auction volumes: from 2014 to 2016 through backloading, and from 2019 through the Market Stability Reserve (MSR). If the number of emission allowances in circulation exceeds the threshold of 833 million emission allowances, the EUA volumes earmarked for auctioning are reduced by 24 percent of the circulating volume over the next twelve months and transferred to the MSR. As an indicator of the surplus, the European Commission determines an official figure of the number in circulation each year, the TNAC (Total Number of Allowances in Circulation). This figure is decisive for the MSR auction volume reduction and corresponds to the difference between emission allowances issued (supply) and surrendered (demand) accumulated in the stationary sector since 2008, taking into account surrendered and exchanged project credits and voluntarily cancelled emission allowances.

According to the European Commission, the TNAC amounted to 1.13 billion emission allowances[158] at the end of 2022, around 22 percent lower than at the end of 2021. However, the figure was still well above the upper MSR threshold at which auction volume reductions take place. The current value of the TNAC is decisive for the auction volume reduction by the MSR in the period from 01/09/2023 to 31/08/2024. During this period, a total of around 272 million fewer emission allowances than planned will be auctioned and transferred to the MSR.[159]

In addition, allowances in the MSR were cancelled for the first time in accordance with Article 1(5a) of the MSR Regulation 2015/1814, thereby reducing the MSR stock of 3.0 billion allowances by 2.52 billion allowances, so that the remaining MSR stock now amounts to 486 million allowances.[160]

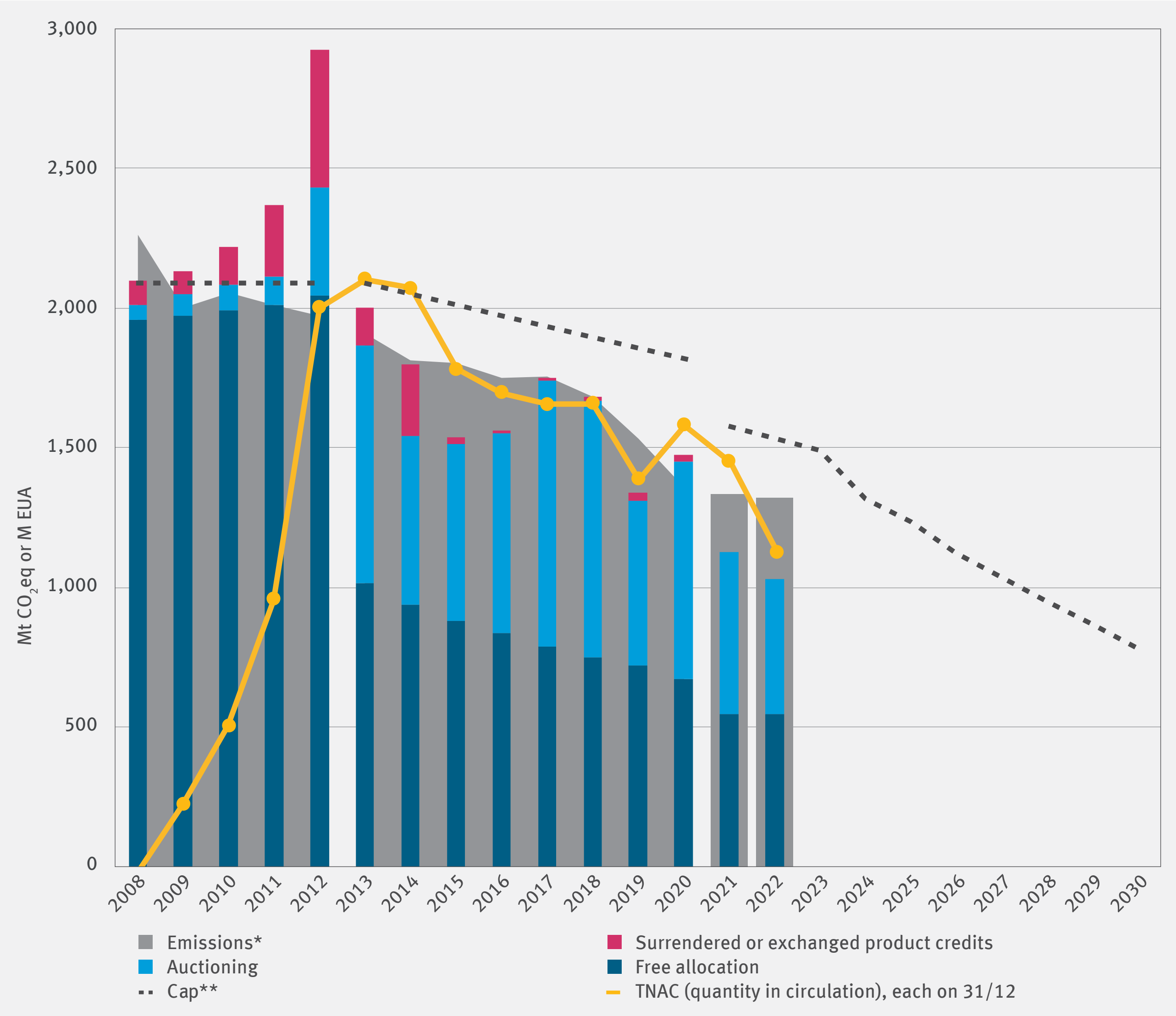
Supply and demand in aviation are **not** currently considered in the TNAC.[161] In 2022, aviation emissions were about 21 million EUAA above the allowances issued to the sector. With the exception of 2020, the sector had consistently appeared as a net buyer, reducing the actual surplus of the stationary sector available in the market. Between 2012 and 2022 the net demand of the aviation sector cumulatively amounted to around 163 million emission allowances (see Section 4.3).

158 COM 2023b

159 COM 2023b

160 COM 2023b

161 Also, any surpluses or deficits from trading with the Swiss Emissions Trading System, which has been linked to the EU ETS since 01/01/2020, are not taken into account in the calculation of the TNAC.



*Due to the change in the scope of the EU ETS between the second and third as well as the third and fourth trading periods, 2013 and 2021 emissions were not directly comparable with emissions in 2020 and earlier. Therefore, the depiction of emissions between 2021 and 2020 and 2013 and 2012 was interrupted.
**TP4: 2021 to 2023: annual reduction factor 2.2 percent, according to 'Fit for 55' decisions: 2024 and 2025: annual reduction factor 4.3 percent, from 2026 annual reduction factor 4.4 percent. In 2024 and 2026, the cap will also be reduced by an additional 117 million allowances.
Sources: EEA, EU KOM

Figure 50: Demand and supply in the overall system: comparison of emissions with available emission allowances and trend in the number in circulation from 2008 as determined by the European Commission[162]

The figure also shows the structural imbalance between cap and emissions, which grew steadily in the third trading period. On average, emissions between 2013 and 2020 were around 250 million tonnes of carbon dioxide equivalents below the annual cap. This did not change fundamentally in 2021 despite significantly increased emissions and the Brexit, although it did reduce somewhat in 2022: emissions were around 236 million tonnes of carbon dioxide equivalents lower than the cap in 2021, but only 208 million tonnes lower in 2022.

162 Sources: EEA 2023 and further EEX/ICE data and information published by the EU Commission regarding the auction volumes. The TNAC data is taken from the European Commission's Carbon Market Reports from 2012 to 2017 and the notifications on TNAC 2018 to 2023.

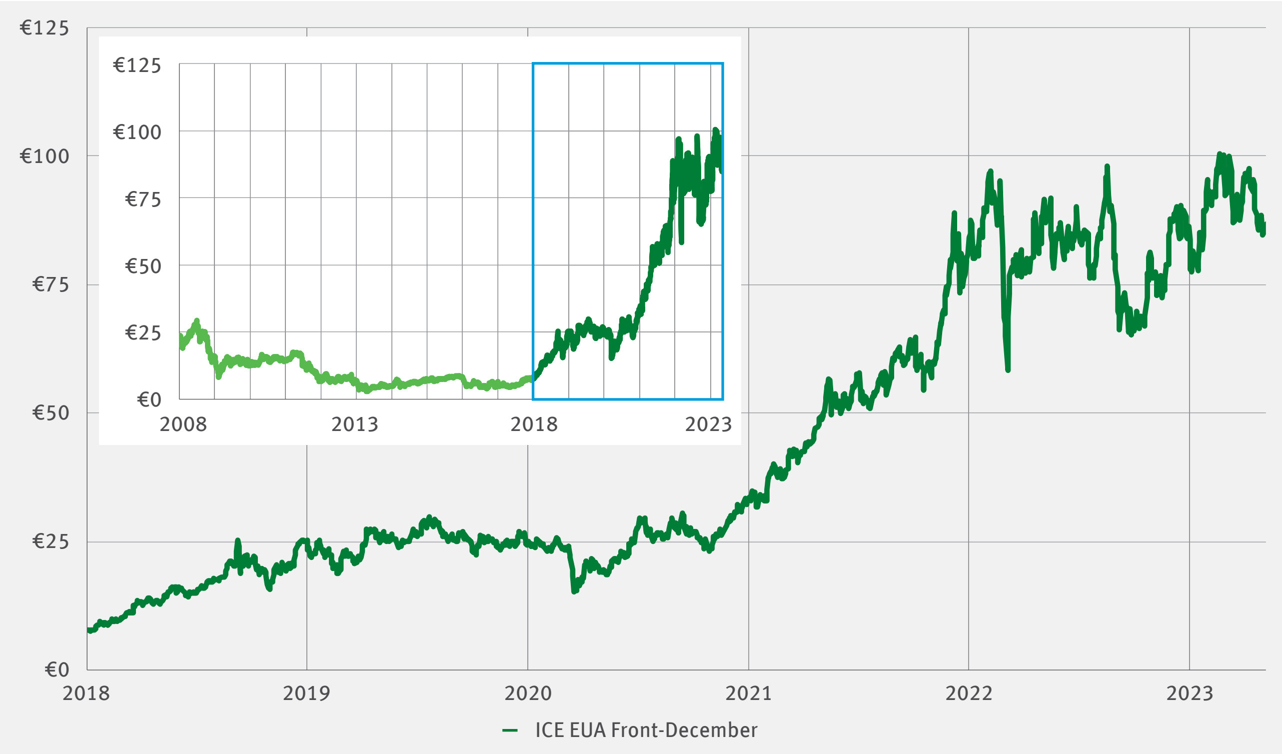
3.3 Price Trend for EUA

The price trend for EUA has been subject to strong fluctuation over the last few years. At the beginning of the second trading period, prices for EUA briefly reached a level of €25 to €30. By the beginning of 2009, prices initially fell to below €10, but stabilised at around €15 between 2009 and 2011. From mid-2011, the price then dropped continuously, driven by the growing surpluses on the carbon market. In April 2013, it finally reached its lowest level since the start of the second trading period, below three euros. By the end of 2015, the price had gradually stabilised again and climbed to a level of over eight euros. At the turn of the year 2015/2016, the price fell again to around five euros. Following a price fluctuation of between four and six euros, a steady upward trend began on the carbon market in May 2017. In 2018 this trend strengthened significantly with the political agreement on the amendment of the EU ETS Directive, as this reform also determined to significantly reduce the existing surpluses on the carbon market. A price level of over €15 had already been reached in the first half of 2018, and the €25 mark was then exceeded in September 2018. In the following months, the strong upward trend initially did not continue. The price trend was characterised by short-term upward and downward movements before reaching its highest level since 2006 at almost €30 in July 2019. The price of EUA had thus increased six-fold in two years. At the end of 2019, the price was trading at around the same level as at the beginning of the year, at around €25. As a result of severe turbulence on the international securities and energy markets caused by the COVID 19 pandemic, the price of EUA lost significant value in March 2020 and briefly fell to below €15. In the following months, however, the EUA price increased again significantly and was quoted at over €30 in December 2020. Overall, 2021 was characterised by a continuing stable upward trend. Between January and October, the EUA price initially rose steadily, from around €33 to €65. From November onwards, the upward movement accelerated and the EUA price reached a level of over €90 at the beginning of December.

Overall, the 2022 price trend was characterised by a lateral movement with high price volatility. Initially, the steady upward trend from the previous year continued and the EUA reference contract rose to a new high of over €98 by the beginning of February. This was followed by a significant downward correction, in particular due to exceptionally high price fluctuation on the international energy markets as a result of the global shifts in commodity trade flows following the Russian war of aggression on Ukraine. At the beginning of March, the EUA price briefly reached its lowest point for the year of €55. The EUA reference contract then recovered, reaching a new high of just under €100 by mid-August. In the subsequent consolidation phase, the EUA price initially moved towards the €65 mark and then upwards again. At the close of trading on 30th December 2022, the EUA reference contract was quoted at around €85, five percent above its value at the beginning of the year.

The price increase in the last quarter of 2022 initially continued in the current year. By the end of February 2023, the EUA price exceeded the €100 mark for the first time and reached its highest level since the start of the EU ETS in 2005. This was followed by a price consolidation, with the EUA price currently quoted at around €87 (as of 15/05/2023).

The price trend for EUA between January 2008 and April 2023 is shown in the following figure.



As of 10/05/2023
Sources: ICE, Refinitiv Eikon, DEHSt representation

Figure 51: Price trend for emission allowances (EUA) from 2008

In addition, the following table contains the average prices for EUAs for the completed second and third trading periods and for the current fourth trading period. In the second trading period, the relevant average price for an EUA was €13.62, in the third trading period €12.96. From the beginning of the fourth trading period, a significantly higher average price of over €70 has been recorded. In the 2022 calendar year, the average EUA price was €81.15.

Table 26: Average prices for emission allowances (EUA) in the second, third and fourth trading period

Time period	2nd trading period 03/2008 – 04/2013 [€]	3rd trading period 01/2013–04/2021 [€]	4th trading period 01/2021–04/2023 [€]	4th trading period 2022 reporting year [€]
Price EUA*	13.62	12.96	70.60	81.15

* VWAP ICE EUA front December
Sources: ICE, Refinitiv Eikon, DEHSt representation

3.4 Auction Volumes and Revenues

Since the start of the third trading period, auctioning has been the standard allocation method for stationary activities in European Emissions Trading throughout Europe. This means that significantly more emission allowances are allocated to trading participants through auctions than in previous trading periods. In principle, the Member States auction the part of the European emissions trading budget (EU cap stationary) that is not allocated free of charge to operators or tied up in the new installations reserve.

Allocation through auctions is in line with the polluter-pays principle and thus lays the foundation for the inclusion of climate costs in business decisions. Also, the income from the auctions opens up new scope for government support of climate protection measures. In Germany, from 2012 the auction revenues have flowed almost entirely into the Climate and Transformation Fund (KTF), formerly the Energy and Climate Fund (EKF).

The following table summarises the auctioning results since the beginning of the third trading period for Germany and the other EU Member States on an annual basis. In addition to emission allowances for stationary installations (EUA), aviation allowances (EUAA) are also shown. The auction volumes trend in the period from 2014 to 2016 was significantly influenced by the backloading decision. This provided for the planned EU-wide auction volumes to be reduced by around 900 million EUAs across the EU. In line with this decision, the German auction volumes were also reduced by around 174 million EUAs in the period in question. In addition, the Market Stability Reserve (MSR) has been in force since the beginning of 2019. In accordance with the MSR mechanism, the EUA volume to be auctioned was reduced EU-wide by more than 1.4 billion EUAs in the period from 2019 to 2022; the German auction volumes were reduced proportionately by more than 300 million EUAs in this period. In addition to adjustments to the auction volumes, the EUA price trend on the lead markets had a significant effect on the revenue trend in the individual years (see Section 3.3).

Table 27: Auction volumes and revenues for Germany and EU-wide from 2013

EUA				
Year	Germany		EU-wide	
	Auction volumes in Mt	Revenue in M€	Auction volumes in Mt	Revenues in M€
2013*	182.6	791.3	826.3	3,616.9
2014	127.1	750.0	528.4	3,115.1
2015	143.9	1.093.3	632.7	4,816.0
2016	160.8	845.7	715.3	3,761.6
2017	196.8	1.141.7	951.2	5,490.6
2018	172.2	2.565.3	915.8	14,090.3
2019	127.6	3.146.1	588.5	14,503.4
2020	107.4	2.641.8	778.5	19,017.2
2021	100.5	5.270.9	583.0	30,852.2
2022	84.2	6.772.4	482.4	38,468.6

* EU incl. NER amounts from the 2nd TP; 2012 early auctions not taken into account.
Sources: EEX, ICE, DEHSt calculation

EUAA				
Jahr	Germany		EU-wide	
	Auction volumes in Mt	Revenue in M€	Auction volumes in Mt	Revenues in M€
2013**	–	–		
2014	–	–	9.3	53.5
2015	2.2	16.9	16.4	117.3
2016	0.9	4.6	6.0	32.3
2017	0.7	5.1	4.7	34.1
2018	0.8	16.3	5.6	103.6
2019	0.8	17.9	5.5	137.5
2020	0.8	20.6	7.5	179.3
2021	0.6	35.3	3.8	206.6
2022	0.6	40.2	3.7	291.5

** 2012 German air traffic auction not taken into account
Sources: EEX, ICE, DEHSt calculation

4 Emissions in Aviation

4.1 The Legal Framework for Including Aviation in the EU ETS

In addition to stationary activities, aviation was included in the European Emissions Trading Scheme (EU ETS) from the beginning of 2012 so aircraft operators had to start surrendering emission certificates equal to their verified carbon dioxide emissions.

The duty to monitor and report on emissions has been in place since the beginning of 2010. In the field of aviation, the scope of the EU ETS initially included all flights that take off or land within the European Economic Area (EEA)[163]. In principle, all aircraft operators flying on these routes, including those whose registered office is outside the European Union (EU), are subject to emissions trading.

The Emissions Trading Directive provides for the delimitation of aviation emissions included in the EU ETS. The scope of the Directive was adjusted several times in previous years.

First, the scope for the 2012 reporting year was significantly restricted by the EU resolution 'stop-the-clock'. In that year, the EU relinquished the sanctioning of reporting violations and surrender obligations for flights subject to emissions trading that started or ended outside the EEA, Switzerland or Croatia. Thus, the reporting and surrendering obligation did not apply for a large number of flights to and from third-party countries in 2012.[164]

The scope was further limited between 2013 and 2016 which was then extended up to the end of 2023. This means that de facto operators are no longer subject to emissions trading for flights that start or end outside the EEA (reduced scope). In addition, non-commercial aircraft operators are exempt from emissions trading until the end of 2030 if their annual emissions based on the extended scope are lower than 1,000 tonnes of carbon dioxide.[165] [166]

In contrast to 2012, the restriction in the scope also applied to flights from the EEA to Switzerland or back until 2019. The linking agreement between the EU and Switzerland has applied from 01/01/2020[167]. Under this agreement, flights from the EEA to Switzerland are subject to the EU ETS, while flights from Switzerland to the EEA and within Switzerland are subject to the Swiss Emissions Trading Scheme (CH ETS). Starting from 01/01/2020, carbon dioxide emissions must be monitored and reported for all these flights. Flights subject to reporting requirements must also comply with the mandatory surrender of the corresponding number of allowances. The first-time surrender for the 2020 emissions was due by 30/04/2021.

The United Kingdom no longer participates in the EU ETS as of 01/01/2021 due to Brexit and the expiry of the transition period on 31/12/2020. However, flights to the UK will continue to be covered by the EU ETS due to the trade agreement between the EU and the UK[168]. Flights from the UK to the EEA and within the UK have now been covered by the UK Emissions Trading Scheme (UK ETS).

Since the linking agreement between the EU and Switzerland and Brexit, a distinction has been made between the extended full scope and the full scope.

163 In addition to the 27 former EU Member States, the European Economic Area (EEA) also included Norway, Iceland and Liechtenstein in 2012 and 2013. Since joining the EU in 2014, Croatia has also belonged to the EEA.

164 EU 2013. The restriction of the scope only applied to operators who also agreed to a reduced allocation.

165 EU 2014a

166 EU 2017a

167 EU 2017b

168 EU 2021

The extended full scope covers all flights that take off or land in the European Economic Area (the EEA includes the 27 EU Member States plus Norway, Iceland and Liechtenstein). The extended full scope is to be used for assessing of the emissions trading obligation of an aircraft operator.

The full scope does not include flights from Switzerland and the UK to the EEA as they are subject to the Swiss Emissions Trading Scheme and the UK Emissions Trading Scheme respectively. Apart from this, the full scope matches with the extended full scope. The full scope is to be used for the classification of an aircraft operator as a small emitter.[169] [170]

The first restriction of the scope (EU resolution 'stop-the-clock') reduced the scope of emissions subject to emissions trading administered by Germany to only about 30 percent of the extended full scope of emissions[171]. Another restriction from 2013 onwards yielded the current reduced scope which is about 16 percent of emissions in the extended full scope.[172]

Implementing these temporary scope adjustments, the EU set another positive signal for the establishment of a global instrument for reducing international aviation emissions at the International Civil Aviation Organisation (ICAO) level.

With the resolution[170] on the continuation of the reduced scope the 39th ICAO General Assembly's decision in the autumn of 2016 to introduce a global market-based measure to stabilise greenhouse emissions from international civil aviation and compensate for any excess emissions was taken into account. This has been achieved with the introduction of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) (see infobox at the end of Chapter 4).[173]

On 14/07/2021, the European Commission presented a series of legislative proposals (including measures for aviation) as part of the 'Fit for 55' package. These proposals shall align the energy and climate policy instruments with the new climate target of achieving an emissions reduction of at least 55 percent compared to 1990 by 2030. In December 2022, political agreements on all dossiers involved were reached in the trilogue between the EU Commission, the European Council and the European Parliament (EP). All relevant legal acts were published in the Official Journal of the European Union in May 2023.

169 The scope then referred to as 'full scope' (or initial full scope) corresponded to the current extended full scope in terms of definition (take-off or landing within the EEA) up to 31/12/2019. However, the initial full scope at that time was 'more extensive' than the current extended full scope since flights between third countries and the UK were included, which is no longer the case after Brexit. This should be taken into account especially when reading older texts.

170 Further information on the scope in aviation can be found in the Guideline for Aircraft Operators (cf. DEHSt 2022a) on page 13.

171 It should be noted that in 2012, aircraft operators were free to choose whether to report their emissions in accordance with the full scope or, on condition that they return the free allocation for the remaining flights, only emissions for flights within the EEA. Aircraft operators whose 2012 allocation exceeded their emissions in the full scope therefore generally reported the full scope.

172 These percentages are based on a comparison of aviation emissions subject to emissions trading in 2010, 2012 and 2013 for Germany. They only give an indication about the magnitude of the restrictions on the scope due to possible structural changes in aviation between the years.

173 ICAO 2016

4.2 The Part of Aviation Subject to Emissions Trading Administered by Germany

4.2.1 The administrative assignment of aircraft operators to Member States

The assignment of ETS emissions to an EU Member State is organised fundamentally differently in aviation than in stationary activities. Stationary installations use the 'territorial principle': the emissions from all stationary installations in Germany are assigned to Germany.

Regarding emissions from aviation however, each aircraft operator is assigned to an administering Member State. This aims to simplify the administration for operators and enforcement authorities. The assignment is determined by the European country that has granted the operating license. If the operator is a non-commercial operator or the operating license was issued outside the EU, the assignment will go to the EU Member State in which the aircraft operator causes the largest estimated share of emissions.

This system also differs significantly from the emission assignment in the national greenhouse gas inventory. In that inventory, a country is accredited with all aviation emissions (whether subject to emissions trading or not) from flights starting within its territory. Germany also administers flights within the EU ETS that do not start in Germany; the emissions of these flights are not included in the German greenhouse gas inventory. Furthermore, under the EU ETS, a part of the aviation emissions from flights starting in Germany are administered by other EU Member States. The emissions from these flights are in turn assigned to the German inventory.[174]

Due to the differences in assignments described above, it is not possible to draw any direct conclusions about the German aviation emissions included in the greenhouse gas inventory based on aviation emissions administered by Germany within the EU ETS. This circumstance must be taken into account when interpreting the following evaluations.

4.2.2 Emissions and free allocation in aviation administered by Germany

Germany is responsible for around 600 aircraft operators according to the list of administering Member States.

However, this assignment is purely administrative as not all operators carry out activities subject to emissions trading in each reporting year. The list also includes aircraft operators that have ceased operations or are subject to insolvency proceedings. In addition, the number of aircraft operators with activities subject to emissions trading is considerably reduced by the exemption of non-commercial small emitters with less than 1,000 tonnes of carbon dioxide per year.

In the course of the third trading period, Germany was responsible for about 500 aircraft operators. The UK's exit from the EU has further led to a redistribution of aircraft operators from third countries to EU administering Member States. As a result, the number of aircraft operators administered by Germany has increased by approximately 100.

Of the approximately 600 aircraft operators, 72 have reported the emissions for their flights subject to emissions trading in 2022. The total number of operators, 72, to be classified as subject to emissions trading has increased by about seven percent compared to the previous year (see Table 29).

Emissions from aircraft operators managed by Germany totalled around 7.2 million tonnes of carbon dioxide in 2022 meaning that they have increased by around 2.5 million tonnes of carbon dioxide or by somewhat less than 55 percent compared to the previous year. This very significant increase in emissions compared to the previous year is due to the recovery of the aviation sector from the effects of the COVID 19 pandemic. The emission level before the pandemic (in the 2013 – 2019 period) was around 9 million tonnes of carbon dioxide per year.

174 In addition, emissions included in the inventory are not fully covered by the scope of emissions trading. In principle, all aircraft flights with a maximum permissible take-off mass of less than 5,700 kilogrammes and flights by military, police, customs, non-EU governments, flights for research purposes, and sightseeing and training flights are not subject to emissions trading. Also excluded are emissions from aircraft operators depending on the number of flights flown and the emissions caused.

Table 28: Aviation (aircraft operators administered by Germany), overview of the 2013 – 2022 period

Year	Number of operators subject to ET	Allocation amount [1000 EUAA]	Emissions [kt CO_2eq]	Allocation coverage	Emissions trend compared to the previous year
2013	63	5,160	8,610	59.93%	
2014	67	5,149	8,861	58.11%	2.91%
2015	67	5,101	8,929	57.13%	0.77%
2016	67	5,100	9,274	55.00%	3.86%
2017	72	5,098	9,105	55.99%	−1.82%
2018	67	3,577	9,391	38.09%	3.14%
2019	63	3,534	9,014	39.21%	−4.02%
2020	45	3,544	3,856	91.91%	−57.22%
2021	67	3,331	4,688	71.04%	21.58%
2022	72	3,247	7,245	44.83%	54.52%

As of 02/05/2023

Irrespective of the increase in emissions, in 2022, the amount of free allocation for aviation (EUAA) of around 3.2 million emission allowances was marginally below the level of the previous year. Around 5.1 million EUAAs were still allocated annually between 2013 and 2017 (see Table 28). The Air Berlin insolvency was the reason for the large reduction in allocation volume since 2018. This carrier had received approx. 1.5 million EUAA per year between 2013 and 2017 then with the cessation of operations was discontinued for the entire remaining period up to 2022.

The difference between the aggregated emissions from the operators and the amount of EUAA allocated to them free of charge increased significantly in 2022 compared to 2021. On the one hand, this is due to the significant increase in emissions; on the other hand, the free allocation fell slightly, which is largely due to the linear reduction factor that was applied for the first time in 2021. The average allocation coverage[175] thus fell from around 71 percent in 2021 to around 45 percent in the 2022 reporting year (see Table 28).

In the 2022 reporting year, about 81 percent of the operators subject to emissions trading held a commercial status and about 19 percent a non-commercial status (2021: 85 percent commercial and 15 percent non-commercial operators). Similar to the previous year, the share of emissions from non-commercial operators subject to emissions trading is only 0.4 percent (see Table 29).

175 The allocation coverage refers to the average ratio of free allocation to emissions subject to surrender (see also Glossary).

Table 29: Aviation (aircraft operators administered by Germany), number of aircraft operators subject to emissions trading 2022, 2021 CO_2 emissions, 2022 allocation, 2022 CO_2 emissions and allocation coverage differentiated by commercial and non-commercial operators

Operator category	Number of operators subject to ET in 2022	2021 emissions [kt CO_2eq]	2022 emissions [kt CO_2eq]	Number of operators with allocation in 2022	2022 allocation amount [1000 EUAA]	Allocation coverage
Commercial	58	4,621	7,218	44	3,246	45.0%
Non-commercial	14	17	26	10	1	3.5%
2022 not subject to ET	*7**	*50*	–	–	–	–
Total	**72**	**4,688**	**7,245**	**54**	**3,247**	**44.8%**

As of 02/05/2023
* Not subject to ET, not included in total number of operators in 2022.

As in 2021, total emissions in 2022 were concentrated among a small group of aircraft operators: almost 90 percent of total emissions were caused by six commercial operators (see Figure 52). These six largest operators show increases in emissions of between four and 100 percent compared to 2021.

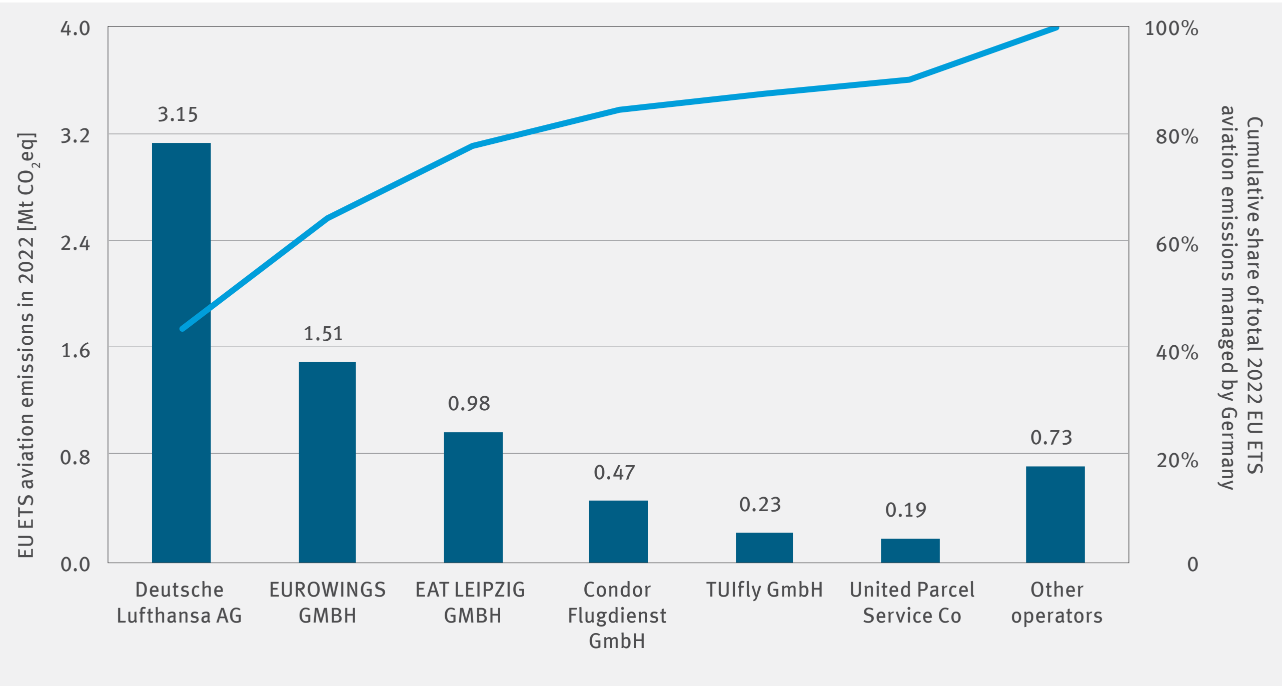


Figure 52: Aviation (aircraft operators administered by Germany) emissions of the six operators with the highest emissions in 2022 (columns, left-hand side axis) and their cumulative share of total aviation emissions under German administration (line, right-hand side axis)

The 2022 emissions are only approximately 80 percent of the average emission level in the 2013 – 2019 period (about 9 million tonnes of carbon dioxide per year). Overall, the emission levels reported in 2022 mark the third lowest since the introduction of the reduced scope in 2013. The severity of the emissions decline due to the COVID 19 pandemic can be seen in Figure 53. The strong recovery effect in the aviation sector, with emissions approaching levels recorded in 2019 – which was the last before the COVID 19 pandemic – is also clearly visible.

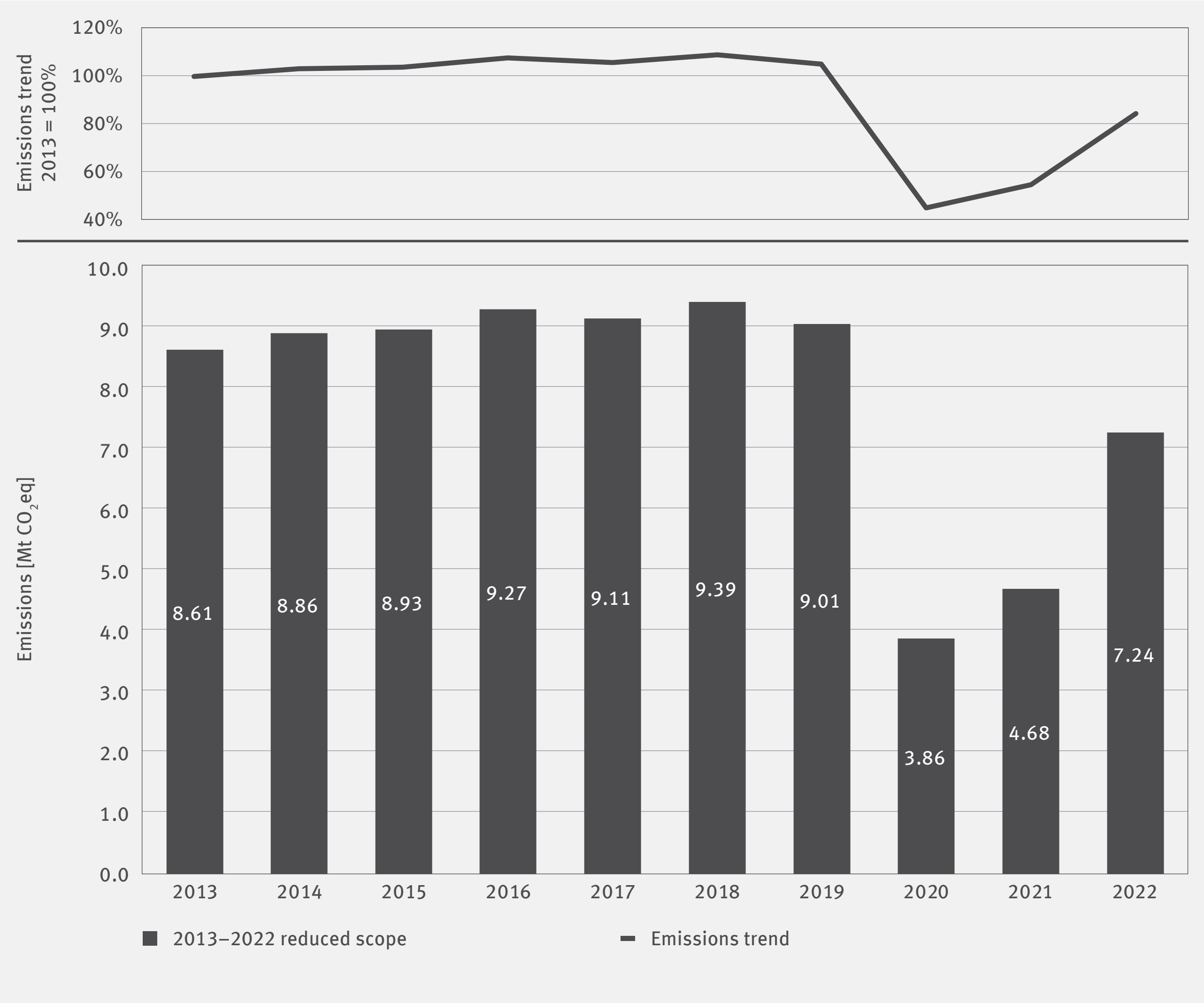


Figure 53: Aviation (aircraft operators administered by Germany), trend of aviation emissions in the reduced scope from 2013 to 2022[176]

4.3 Emissions and Emission Allowances Availability for Aviation at the European Level

The previous sections presented the allocation and emission trends for aircraft operators administered by Germany. The emissions of these aircraft operators accounted for around 15 percent of total 2022 European aviation emissions under the EU ETS.[177]

In 2022, the emissions from all aircraft operators subject to emissions trading under the EU ETS at around 49 million tonnes were about 77 percent above the previous year's level. Due to the increase in aviation emissions both in Germany and in the rest of the EU, a convergence to the emission level before the outbreak of the COVID 19 pandemic (approximately 61 million tonnes on average from 2013 to 2019) is approaching. Figure 54 puts the values of the second pandemic year 2021 and of the year 2022 into the context of the average emissions in the third trading period (approximately 56 million tonnes in the 2013 – 2020 period).

176 The emission shares that arose in connection with the linking agreement between the EU and Switzerland from 2020 (CH-ETS) and the trade agreement between the EU and the United Kingdom from 2021 (see Section 4.1) are not shown separately in the figure. This fact should be taken into account when interpreting the figure.

177 The proportion was about 16 percent in the two previous years, just over 16 percent at the start of the third trading period and is still at around 19 percent under stop-the-clock. There were no European total figures published for 2010 and 2011, meaning that no German share can be derived for this period.

As in the third trading period, 15 percent of the total amount of emission allowances to be allocated (EUAA) will be auctioned annually in the fourth trading period where the linear reduction factor of the EU ETS will also be applied to the aviation cap.[178]

The average annual total emissions of the third trading period noticeably exceeded the yearly average amount of EUAA allocated for free and auctioned (see Figure 54).[179] This trend continued in both 2021, the second year of the COVID 19 pandemic, and in the current 2022 reporting year, with total emissions surpassing the sum of freely allocated and auctioned EUAAs (coverage gap of around 0.3 million EUAA in 2021 and almost 21 million EUAAs in 2022). There was a shortfall of around 183 million EUAAs in total for the fulfilment of the surrender obligation in the 2012 – 2022 period. Aircraft operators can make up for this shortfall of allowances by purchasing EUAs from the stationary EU ETS[180] and, to a limited extent up to and including 2020, by using international project credits as these can also be used to fulfil their surrender obligation. Deducting international project credits from the coverage gap results in the demand from the aviation sector for EUAs from the stationary EU ETS.[181] This was around 163 million tonnes from the start of the surrender obligation in the aviation sector between 2012 and 2022. In the third trading period, the average annual aviation demand for EUAs was just under 18 million. While, in 2021, the second year of the COVID 19 pandemic, aviation demand for EUAs was still significantly below this average; in 2022, it amounted to just under 21 million, surpassing this average.

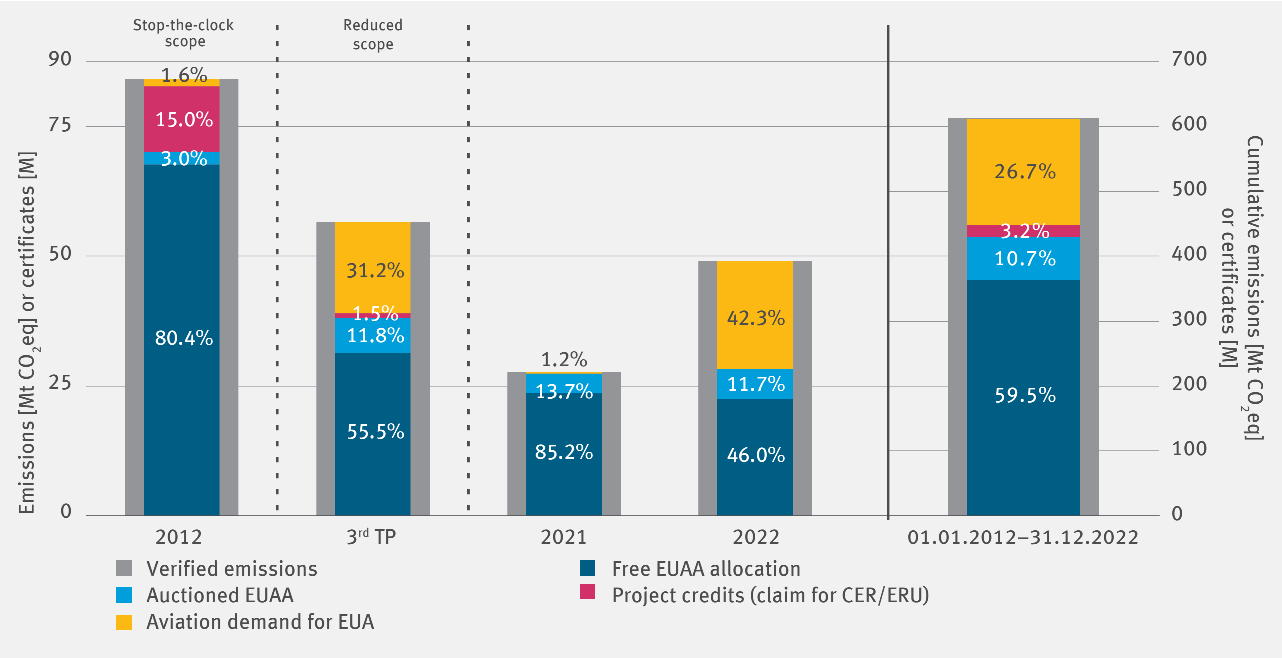


Figure 54: Aviation (aircraft operators administered by Germany), emissions, supply of usable emission allowances (EUAA, CER/ERU) and aviation demand for EUAs for aviation subject to emissions trading in Europe (left: 2012 to 2022 annual figures, right: cumulative)

178 For the calculation, see Articles 3c and 3e of the EHRL.

179 The special situation regarding free allocation in 2012 (optionally according to complete or stop-the-clock scope) requires attention in this case (also see Section 4.1). This option resulted in a lower relative deficit compared to the following years.

180 Operators of stationary installations, on the other hand, could not use EUAAs for surrender for emissions from the third trading period. For emissions from the fourth trading period onwards, EUAAs (referred to as aEUA in the German part of the Union Registry) can also be used by installation operators for surrender.

181 From 2021 onwards, aviation demand for EUA already corresponds to the coverage gap.

Legal framework for the inclusion of aviation in CORSIA

The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is a climate change mitigation measure adopted by the International Civil Aviation Organisation (ICAO) in 2016 to limit carbon emissions from international aviation to 2020 levels. To implement the CORSIA regulations adopted by ICAO in Annex 16, Volume IV, the delegated CORSIA Regulation[182] supplementing the Emissions Trading Directive entered into force in the EU on 20/10/2019. This regulation focuses on monitoring, reporting and verification of emissions from all international flights within the scope of CORSIA for aircraft operators based in the EU.

The regulations of CORSIA originally provided for the mean value of the 2019 and 2020 international aviation emissions (baseline) to calculate the amount of the offset obligation per aircraft operator. Due to the impact of the COVID 19 pandemic on international aviation, the 41st Assembly of ICAO in October 2022 followed the ICAO Council's proposal in June 2020 to set the baseline in the pilot phase (2021 to 2023) at the 2019 CO_2 emissions from international aviation, which essentially amounts to the emissions before the COVID 19 pandemic.

The ICAO's publication of October 2022 calculated the sectoral growth factor as zero since the CO_2 emissions of international aviation on routes affected by CORSIA offset obligations in 2021 (167,142,002 t CO_2) did not exceed those of 2019 (341,380,188 t CO_2). Thus, there was no obligation to offset for the 2021 reporting year. A sectoral growth factor of zero is also expected for 2022 (and maybe also for 2023).

With the aim of making CORSIA more ambitious, the 41st Assembly of ICAO also decided to permanently lower the baseline to 85 percent of the CO_2 emissions from international aviation in 2019 from 2024 and thus at the start of the first phase of CORSIA (2024 to 2026). Thus, operators will be obliged to offset part of their international emissions from 2024 at the latest.

Both in the pilot phase and in the first phase of CORSIA, states can decide whether to participate in CORSIA. Starting from 88 states in 2021, 119 states have now declared their voluntary participation as of April 2023. Both China and India are still not represented in the voluntary phases of CORSIA. CORSIA will be mandatory from 2027.

Emissions of aircraft operators administered by Germany under CORSIA

In accordance with the delegated CORSIA Regulation, DEHSt administers the emissions of aircraft operators based in Germany that cause more than 10,000 tonnes of carbon dioxide with aircrafts with a maximum take-off mass greater than 5.7 tonnes on all international flights within the extended full scope of the Emissions Trading Directive. To approximate the ICAO regulations, the delegated CORSIA Regulation provides the possibility of voluntary reporting of flights between third countries. As not all German aircraft operators followed this recommendation for the first time in the 2021 reporting year, it was possible to readjust by amending the National Emissions Trading Regulation 2030 (EHV 2030) at short notice and to ensure mandatory reporting of all flights between third countries for the 2022 reporting year.

In the 2022 reporting year, the 15 aircraft operators administered by DEHSt under CORSIA emitted 22.9 million tonnes of carbon dioxide on international flights (see Table 30). Emissions thus continued to be significantly influenced by the COVID 19 pandemic and did not reach the pre-crisis level of 2019.

182 The delegated Regulation (EU) 2019/1603 of the Commission supplementing Directive 2003/87/EC of the European Parliament and of the Council on measures adopted by the International Civil Aviation Organisation for the monitoring, reporting and verification of aviation emissions for the purposes of implementing a global market-based mechanism.

Table 30: 2019, 2020, 2021 and 2022 CO_2 emissions by German aircraft operators under CORSIA[183]

Aircraft operator	Int. CORSIA CO_2 emissions (t, EF 3.16)					
	2019	2020	2021		2022 (non-verified)	
	CORSIA CO_2 emissions [t]	CORSIA CO_2 emissions [t]	Total	With offsetting obligation	Total	With offsetting obligation
Condor Flugdienst GmbH	2,432,633	732,330	873,239	714,693	1,869,953	1,518,410
DC Aviation GmbH	11,464	Below *	13,801	10,603	16,297	14,311
Deutsche Lufthansa AG	18,083,555	5,276,782	6,442,518	5,058,357	11,404,802	8,771,138
Lufthansa Cargo AG	1,739,057	1,485,592	1,378,896	939,369	1,401,122	523,295
Aerologic GmbH	1,372,672	1,924,842	2,421,729	1,259,729	2,668,321	987,009
Air Hamburg Luftverkehrsgesellschaft mbH	86,834	98,766	134,946	90,516	192,325	172,364
Air X Charter (Germany) GmbH & Co. KG	13,371	Below *	Cessation of operations in 2021			
European Air Transport Leipzig GmbH	1,079,697	1,205,882	1,458,116	1,363,051	1,669,462	1,540,387
TUIfly GmbH	952,921	322,767	437,651	404,702	567,838	480,650
K5-Aviation GmbH	16,954	16,127	24,640	18,343	17,901	15,650
SunExpress Deutschland GmbH	299,156	55,516	Cessation of operations in 2021			
MHS Aviation GmbH	10,057	Below *	Below *		Below *	
Eurowings GmbH	2,851,542	779,176	904,400	874,021	1,812,940	1,754,746
SUNDAIR GmbH	96,141	63,823	104,741	69,069	185,762	133,026
EW Discover GmbH			159,055	135,036	1,082,563	929,007
CargoLogic Germany GmbH			26,431	21,494	Cessation of operations in 2022	
Aero West GmbH			11,529	10,444	12,717	12,344
Baden Aircraft Operations GmbH			Below *		Below *	
FAI rent-a-jet GmbH	Below *	Below *	15,531	9,109	16,816	10,411
VOLKSWAGEN AirService GmbH	Below *	Below *	Below *		11,668	10,156
Sum (t CO_2, EF 3.16)	**29,046,053**	**11,961,603**	**14,407,223**	**10,978,536**	**22,930,486**	**16,872,904**
No. of aircraft op.-s with ICAO data transfer	**14**	**11**	**15**		**15**	

As of 02/05/2023
* Below CORSIA threshold

183 Different emission factors apply for reporting under the EU ETS and CORSIA: 3.15 tonnes of carbon dioxide per tonne of fuel for the ETS, 3.16 tonnes of carbon dioxide per tonne of fuel for CORSIA. Technically, this was solved in such a way that in reports, the emissions are initially calculated uniformly with the emission factor of 3.15 tonnes of carbon dioxide per tonne of fuel for both reports (EU-ETS and CORSIA). The adjustment for CORSIA is made subsequently by DEHSt before the relevant data is transmitted to ICAO.

5 States (Länder)

Table 31: Overview of the 2021 verified emissions per state (Land), by activities

2021 emissions [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	28	0	22	114	0	80	3	8	569	1,263	404	0	0	0	128	27	2,645
2	Energy conversion >= 50 MW RTI	29,904	5,069	14,459	8,664	4,444	4,703	1,577	2,761	14,848	94,206	4,857	2,269	2,762	29,466	7,631	1,009	228,630
3	Energy conversion 20 – 50 MW RTI	127	158	578	768	114	291	216	49	785	1,055	355	105	132	74	205	90	5,102
4	Energy conversion 20 – 50 MW RTI, other fuels	0	0	12	4	0	0	0	0	0	18	5	0	0	0	0	24	64
5	Prime movers (engines)	0	0	0	15	0	0	0	0	28	0	0	0	0	0	0	0	43
6	Prime movers (turbines)	166	0	21	226	0	31	0	0	173	127	13	5	0	4	29	28	823
7	Refineries	3,480	0	2,477	2,981	0	0	961	0	1,234	7,255	0	2,096	0	0	2,030	0	22,514
8	Coking plants	0	0	0	0	0	0	0	0	0	2,637	0	0	1,060	0	0	0	3,698
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	73	0	0	0	0	0	0	73
10	Production of pig iron and steel	1,846	0	115	153	2,267	31	317	0	4,032	13,255	0	0	4,995	86	0	44	27,141
11	Processing of ferrous metals	283	0	184	58	569	380	49	0	449	1,298	122	0	679	128	94	59	4,354
12	Production of primary aluminium	0	0	0	0	0	0	242	0	0	672	0	0	0	0	0	0	915
13	Processing of non-ferrous metals	0	0	17	170	0	0	219	0	155	661	51	0	40	117	135	0	1,564
14	Production of cement clinker	1,257	0	3,621	4,005	0	325	0	0	1,157	5,400	908	1,053	0	0	1,736	1,071	20,532
15	Lime production	347	0	411	1,064	0	438	0	93	812	3,518	509	0	0	0	1,404	179	8,775
16	Glass production	138	0	85	725	0	4	0	25	359	1,026	272	33	0	240	563	253	3,722
17	Ceramics production	113	0	70	690	29	36	0	0	207	212	160	0	19	152	95	96	1,879

2021 emissions [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
18	Production of mineral fibres	0	0	42	126	0	0	0	0	7	68	0	0	0	101	51	0	395
19	Gypsum production	110	0	25	90	0	0	0	0	22	27	0	0	0	27	0	0	300
20	Pulp production	0	0	0	23	0	0	0	0	3	0	0	0	0	0	72	48	146
21	Paper production	79	0	705	711	0	331	0	4	896	1,165	453	90	0	358	242	17	5,050
22	Carbon black production	0	0	0	0	0	0	0	0	0	582	0	0	0	0	0	0	582
23	Nitric acid production	0	0	0	0	0	0	0	170	0	17	135	0	0	36	39	0	397
24	Adipic acid production	0	0	0	0	0	0	0	0	0	24	0	0	0	0	93	0	117
26	Ammonia production	0	0	0	0	0	0	0	0	0	557	1,549	0	0	0	2,521	0	4,627
27	Production of bulk organic chemicals	0	0	45	544	0	56	0	8	226	4,091	1,502	185	0	1,255	171	2	8,084
28	Production of hydrogen and synthesis gas	0	0	0	46	0	0	47	0	19	414	477	114	0	0	521	0	1,637
29	Soda production	0	0	0	0	0	0	0	0	0	136	67	0	0	0	322	0	525
Total		**37,877**	**5,228**	**22,888**	**21,176**	**7,423**	**6,706**	**3,631**	**3,118**	**25,981**	**139,759**	**11,838**	**5,949**	**9,686**	**32,044**	**18,082**	**2,948**	**354,334**

As of 02/05/2023

Table 32: Overview of the 2022 VET entries per state (Land), by activities

2022 VET [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	26	0	21	100	0	79	2	3	501	1,108	341	0	0	0	133	24	2,337
2	Energy conversion >= 50 MW RTI	27,825	4,727	16,124	7,735	4,762	5,638	1,510	2,307	13,729	98,427	4,243	2,328	3,793	33,899	7,704	884	235,634
3	Energy conversion 20 – 50 MW RTI	118	165	535	639	104	246	199	40	750	988	342	97	123	79	198	72	4,695
4	Energy conversion 20 – 50 MW RTI, other fuels	0	0	6	4	0	0	0	0	0	18	4	0	0	0	0	30	63
5	Prime movers (engines)	0	0	0	18	0	0	0	0	68	0	0	0	0	0	0	0	86
6	Prime movers (turbines)	6	0	30	227	0	186	0	0	328	276	72	4	0	4	39	101	1,274
7	Refineries	3,601	0	2,622	3,034	0	0	886	0	1,222	7,604	0	2,175	0	0	2,326	0	23,470
8	Coking plants	0	0	0	0	0	0	0	0	0	2,747	0	0	1,022	0	0	0	3,770
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	62	0	0	0	0	0	0	62
10	Production of pig iron and steel	1,429	0	102	124	2,101	26	124	0	3,911	12,597	0	0	4,657	75	0	46	25,193
11	Processing of ferrous metals	266	0	181	49	523	343	44	0	421	1,197	109	0	654	126	86	59	4,058
12	Production of primary aluminium	0	0	0	0	0	0	162	0	0	439	0	0	0	0	0	0	600
13	Processing of non-ferrous metals	0	0	16	157	0	0	203	0	149	619	51	0	8	125	125	0	1,452
14	Production of cement clinker	1,150	0	3,169	3,584	0	321	0	0	986	5,046	887	962	0	0	1,616	1,043	18,763
15	Lime production	320	0	395	1,046	0	436	0	101	832	3,455	475	0	0	0	1,438	165	8,663
16	Glass production	138	0	85	747	0	3	0	26	366	990	264	33	0	217	567	255	3,691
17	Ceramics production	102	0	68	673	27	30	0	0	195	182	142	0	8	146	79	97	1,747
18	Production of mineral fibres	0	0	46	128	0	0	0	0	6	70	0	0	0	91	52	7	400

No.	2022 VET [kt CO_2eq] Activity	State (Land) BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
19	Gypsum production	93	0	26	89	0	0	0	0	20	20	0	0	0	27	0	0	275
20	Pulp production	0	0	0	18	0	0	0	0	2	0	0	0	0	0	88	53	162
21	Paper production	44	0	621	736	0	313	0	5	865	990	399	80	0	271	231	16	4,572
22	Carbon black production	0	0	0	0	0	0	0	0	0	568	0	0	0	0	0	0	568
23	Nitric acid production	0	0	0	0	0	0	0	158	0	11	108	0	0	39	21	0	337
24	Adipic acid production	0	0	0	0	0	0	0	0	0	18	0	0	0	0	83	0	101
26	Ammonia production	0	0	0	0	0	0	0	0	0	353	1,048	0	0	0	1,737	0	3,138
27	Production of bulk organic chemicals	0	0	49	496	0	47	0	6	216	3,563	1,220	171	0	1,024	122	2	6,919
28	Production of hydrogen and synthesis gas	0	0	0	59	0	0	15	0	16	410	328	98	0	0	514	0	1,439
29	Soda production	0	0	0	0	0	0	0	0	0	136	42	0	0	0	309	0	487
Total		**35,116**	**4,891**	**24,095**	**19,663**	**7,517**	**7,669**	**3,145**	**2,646**	**24,583**	**141,894**	**10,074**	**5,948**	**10,264**	**36,124**	**17,471**	**2,853**	**353,953**

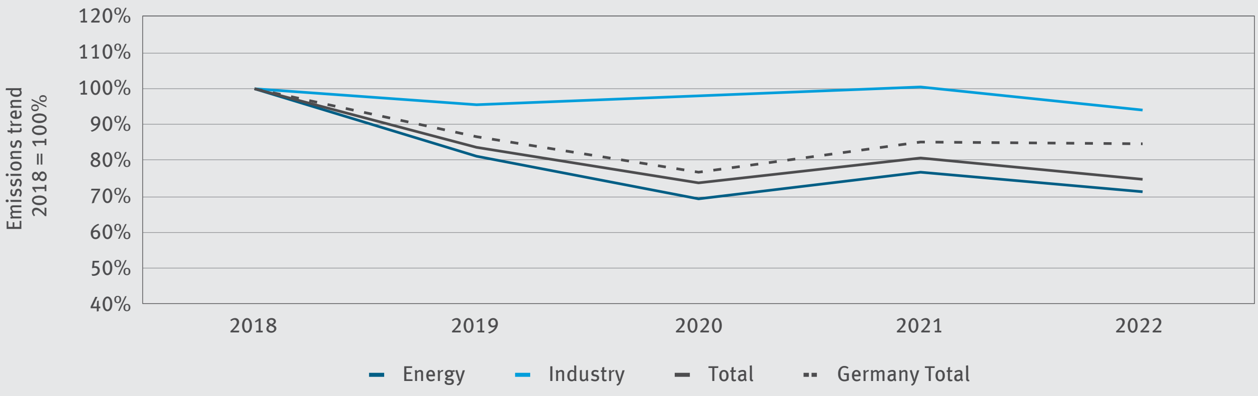
As of 02/05/2023

Table 33: Overview of the 2022 allocation amounts per state (Land), by activities

2022 allocation amount [1000 EUA]		State (Land)																
No.	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	146	0	5	83	0	85	0	1	244	791	305	0	0	0	138	27	1,826
2	Energy conversion >= 50 MW RTI	485	417	631	932	50	702	197	163	857	2,947	1,075	201	92	391	582	200	9,921
3	Energy conversion 20 – 50 MW RTI	24	22	159	175	23	89	76	12	275	357	100	22	43	12	61	37	1,486
4	Energy conversion 20 – 50 MW RTI, other fuels	0	0	34	14	0	0	0	0	0	13	3	0	0	0	20	3	87
5	Prime movers (engines)	0	0	0	2	0	0	0	0	7	0	0	0	0	0	0	0	9
6	Prime movers (turbines)	35	0	6	42	0	9	0	0	39	31	4	1	0	1	5	8	182
7	Refineries	1,736	0	1,801	2,317	0	0	737	0	786	4,844	0	1,623	0	0	1,928	0	15,771
8	Coking plants	0	0	0	0	0	0	0	0	0	1,185	0	0	251	0	0	0	1,436
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	70	0	0	0	0	0	0	70
10	Production of pig iron and steel	2,793	0	126	110	4,342	26	328	0	6,306	21,620	0	0	6,297	64	0	43	42,055
11	Processing of ferrous metals	210	0	141	43	290	251	36	0	381	998	100	0	319	92	64	46	2,971
12	Production of primary aluminium	0	0	0	0	0	0	225	0	0	648	0	0	0	0	0	0	874
13	Processing of non-ferrous metals	0	0	11	139	0	0	248	0	156	526	39	0	8	99	103	0	1,329
14	Production of cement clinker	1,163	0	3,252	3,531	0	273	0	0	1,015	4,383	686	899	0	0	1,489	859	17,550
15	Lime production	251	0	284	661	0	266	0	55	475	2,136	368	0	0	0	804	115	5,415
16	Glass production	97	0	73	579	0	3	0	10	249	745	180	30	0	180	481	210	2,837
17	Ceramics production	86	0	60	568	24	29	0	0	141	171	131	0	21	112	59	69	1,472
18	Production of mineral fibres	0	0	28	86	0	0	0	0	3	46	0	0	0	67	50	0	281
19	Gypsum production	33	0	5	25	0	0	0	0	4	10	0	0	0	11	0	0	89

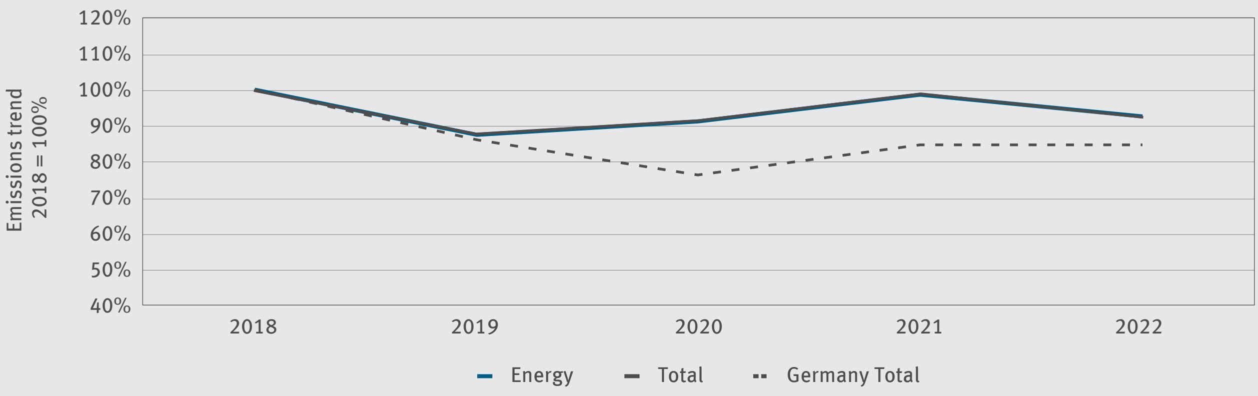
2022 allocation amount [1000 EUA]		State (Land)																
No.	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
20	Pulp production	0	0	0	6	0	0	0	0	2	0	0	0	0	0	40	16	64
21	Paper production	211	0	691	964	0	230	0	3	867	900	393	72	0	196	243	17	4,788
22	Carbon black production	0	0	0	0	0	0	0	0	0	414	0	0	0	0	0	0	414
23	Nitric acid production	0	0	0	0	0	0	0	237	0	133	136	0	0	12	32	0	551
24	Adipic acid production	0	0	0	0	0	0	0	0	0	198	275	0	0	0	223	0	696
26	Ammonia production	0	0	0	0	0	0	0	0	0	519	1,389	0	0	0	1,952	0	3,861
27	Production of bulk organic chemicals	0	0	15	424	0	81	0	4	285	4,090	1,820	147	0	855	159	1	7,882
28	Production of hydrogen and synthesis gas	0	0	0	33	0	0	35	0	3	281	371	70	0	0	328	0	1,122
29	Soda production	0	0	0	0	0	0	0	0	0	361	64	0	0	0	615	0	1,040
Total		**7,270**	**438**	**7,322**	**10,734**	**4,729**	**2,044**	**1,882**	**486**	**12,095**	**48,418**	**7,438**	**3,065**	**7,032**	**2,094**	**9,377**	**1,651**	**126,076**

As of 02/05/2023



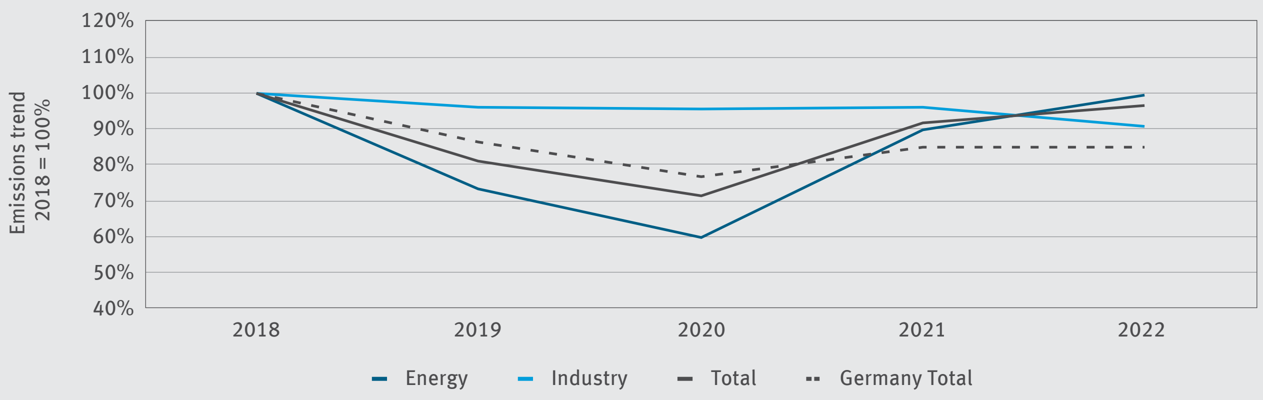
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	31	39,255,471	31,925,630	27,214,072	30,196,181	27,948,505
Industry	35	7,637,711	7,292,021	7,477,596	7,681,100	7,167,443
BB	**66**	**46,893,182**	**39,217,651**	**34,691,668**	**37,877,281**	**35,115,948**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 55: Emissions trends in Brandenburg since 2018



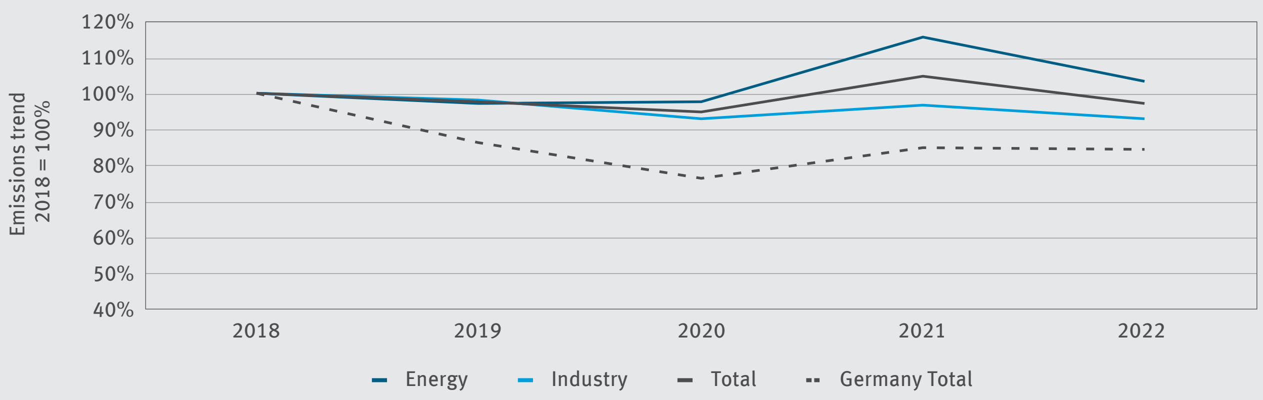
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	28	5,284,093	4,641,725	4,827,705	5,227,612	4,891,342
Industry						
BE	**28**	**5,284,093**	**4,641,725**	**4,827,705**	**5,227,612**	**4,891,342**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 56: Emissions trends in Berlin since 2018



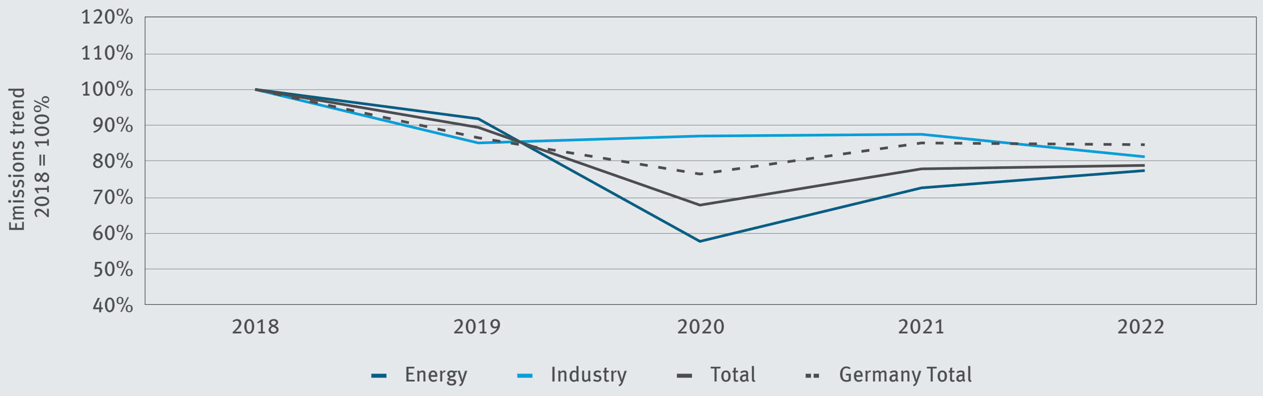
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	85	16,821,843	12,348,238	10,043,580	15,070,503	16,694,046
Industry	52	8,159,097	7,819,996	7,806,128	7,817,889	7,400,631
BW	**137**	**24,980,940**	**20,168,234**	**17,849,708**	**22,888,392**	**24,094,677**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 57: Emissions trends in Baden-Württemberg since 2018



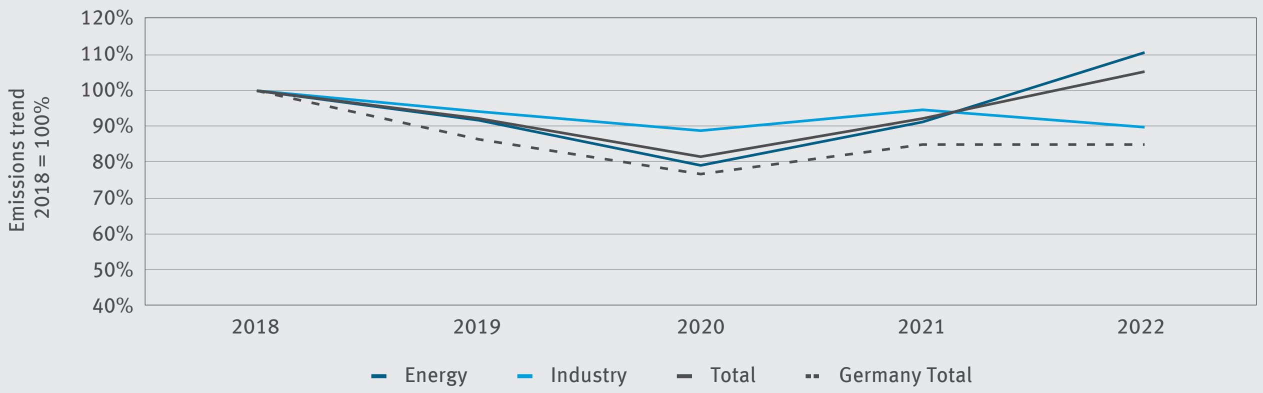
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	123	8,338,823	8,116,932	8,146,669	9,677,606	8,622,472
Industry	127	11,870,490	11,657,788	11,057,050	11,498,892	11,040,108
BY	**250**	**20,209,313**	**19,774,720**	**19,203,719**	**21,176,498**	**19,662,580**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 58: Emissions trends in Bavaria since 2018



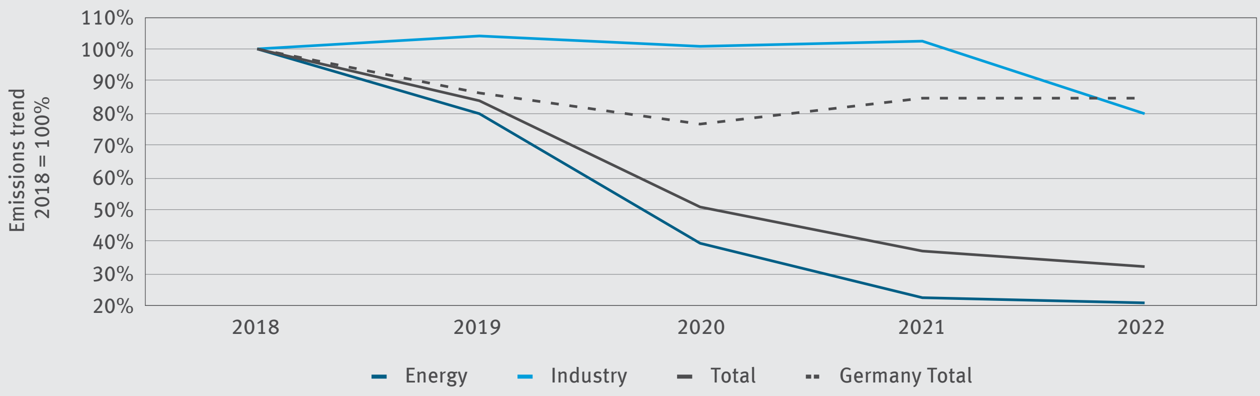
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	22	6,281,389	5,769,346	3,610,178	4,557,290	4,866,201
Industry	5	3,272,392	2,776,633	2,842,823	2,865,214	2,650,970
HB	**27**	**9,553,781**	**8,545,979**	**6,453,001**	**7,422,504**	**7,517,171**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 59: Emissions trends in Bremen since 2018



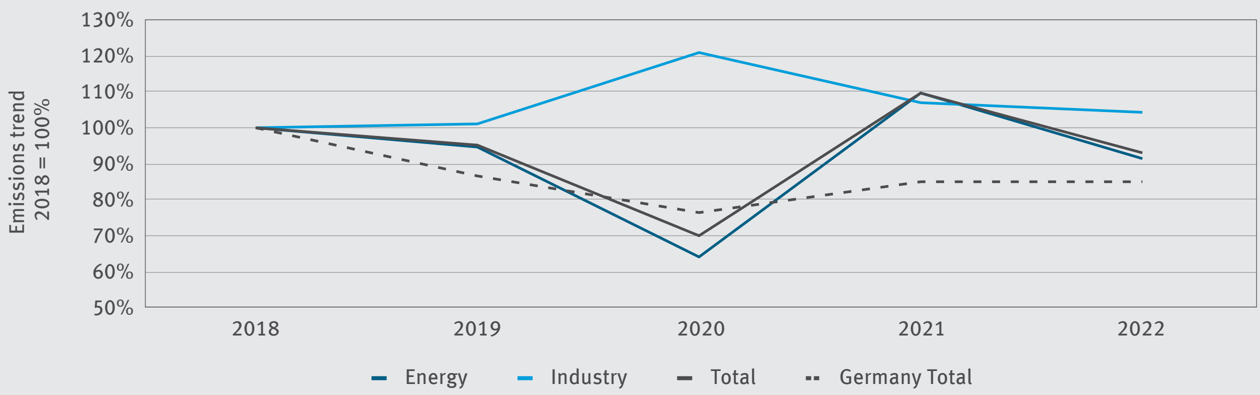
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	60	5,503,163	5,047,695	4,338,528	5,024,688	6,070,156
Industry	34	1,783,432	1,672,748	1,584,690	1,680,971	1,598,933
HE	**94**	**7,286,595**	**6,720,443**	**5,923,218**	**6,705,659**	**7,669,089**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 60: Emissions trends in Hesse since 2018



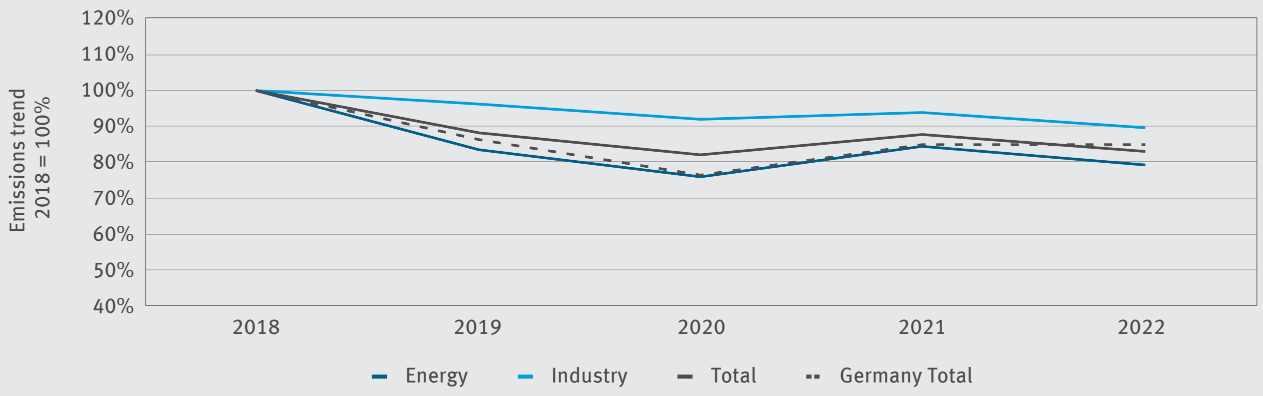
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	24	7,965,776	6,332,900	3,182,003	1,793,067	1,709,053
Industry	13	1,795,127	1,862,121	1,814,071	1,837,588	1,436,431
HH	**37**	**9,760,903**	**8,195,021**	**4,996,074**	**3,630,655**	**3,145,484**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 61: Emissions trends in Hamburg since 2018



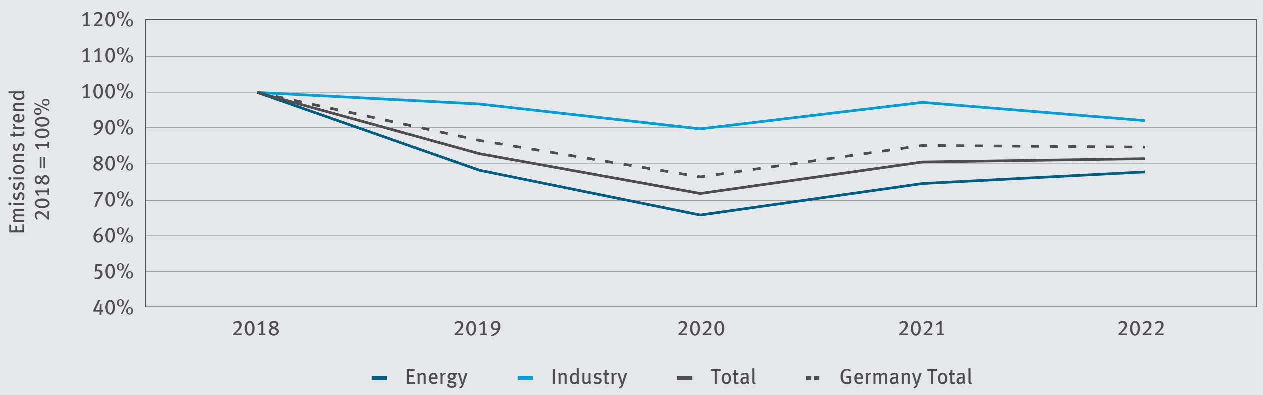
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	18	2,559,461	2,420,170	1,642,103	2,810,799	2,346,910
Industry	7	286,751	289,775	346,362	307,263	299,119
MW	**25**	**2,846,212**	**2,709,945**	**1,988,465**	**3,118,062**	**2,646,029**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 62: Emissions trends in Mecklenburg-Western Pomerania since 2018



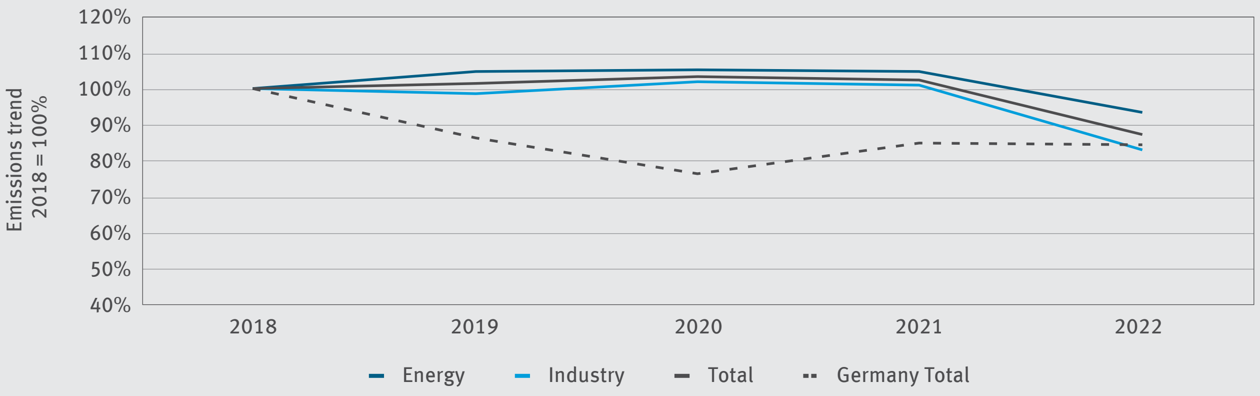
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	85	18,736,895	15,622,024	14,226,700	15,834,113	14,875,768
Industry	84	10,836,098	10,436,975	9,978,992	10,147,380	9,707,141
NI	**169**	**29,572,993**	**26,058,999**	**24,205,692**	**25,981,493**	**24,582,909**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 63: Emissions trends in Lower Saxony since 2018



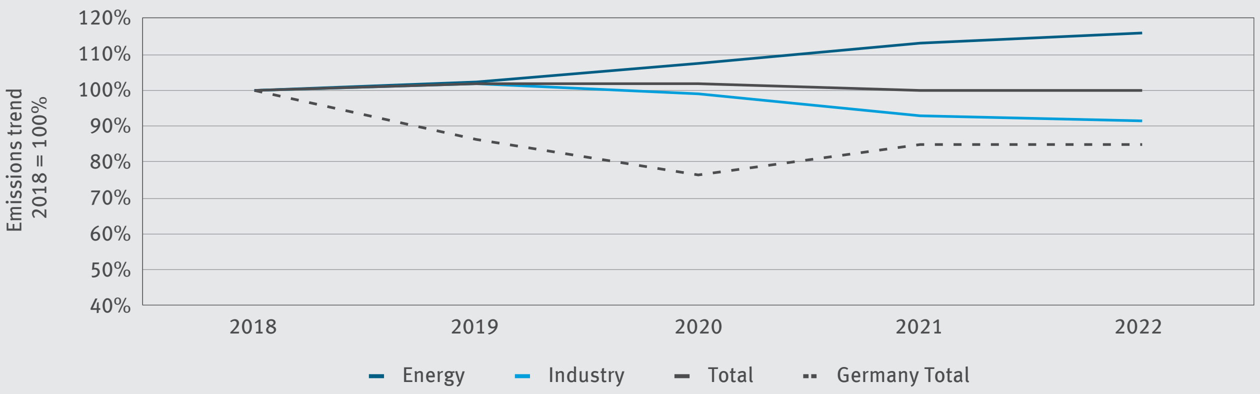
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	206	128,130,308	100,063,259	84,024,673	95,406,834	99,709,719
Industry	254	45,768,764	44,293,427	41,094,167	44,352,099	42,184,724
NW	**460**	**173,899,072**	**144,356,686**	**125,118,840**	**139,758,933**	**141,894,443**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 64: Emissions trends in North Rhine-Westphalia since 2018



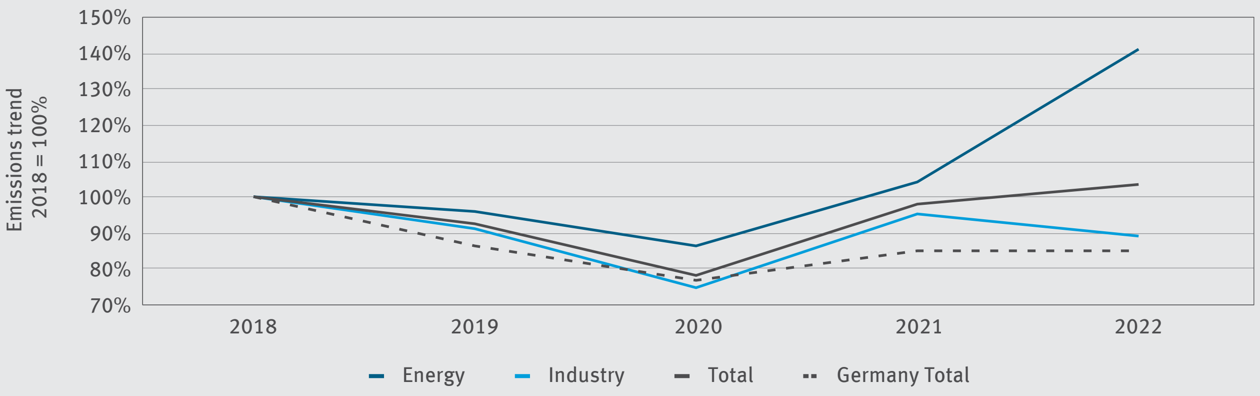
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	46	4,990,238	5,237,673	5,269,053	5,230,260	4,660,656
Industry	86	6,521,690	6,458,402	6,650,289	6,607,680	5,412,861
RP	**132**	**11,511,928**	**11,696,075**	**11,919,342**	**11,837,940**	**10,073,517**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 65: Emissions trends in Rhineland-Palatinate since 2018



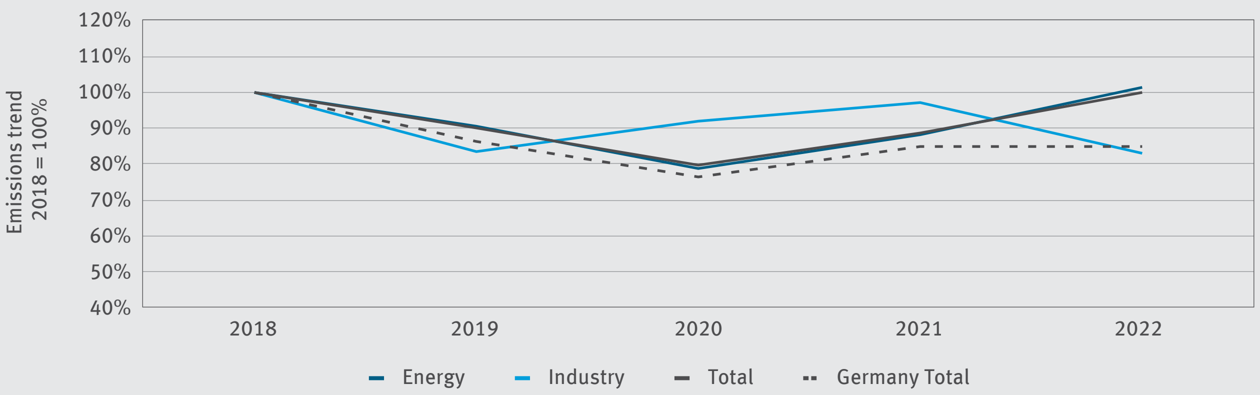
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	24	2,100,114	2,146,906	2,252,432	2,379,001	2,429,092
Industry	13	3,844,468	3,905,841	3,803,484	3,570,416	3,519,207
SH	**37**	**5,944,582**	**6,052,747**	**6,055,916**	**5,949,417**	**5,948,299**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 66: Emissions trends in Schleswig-Holstein since 2018



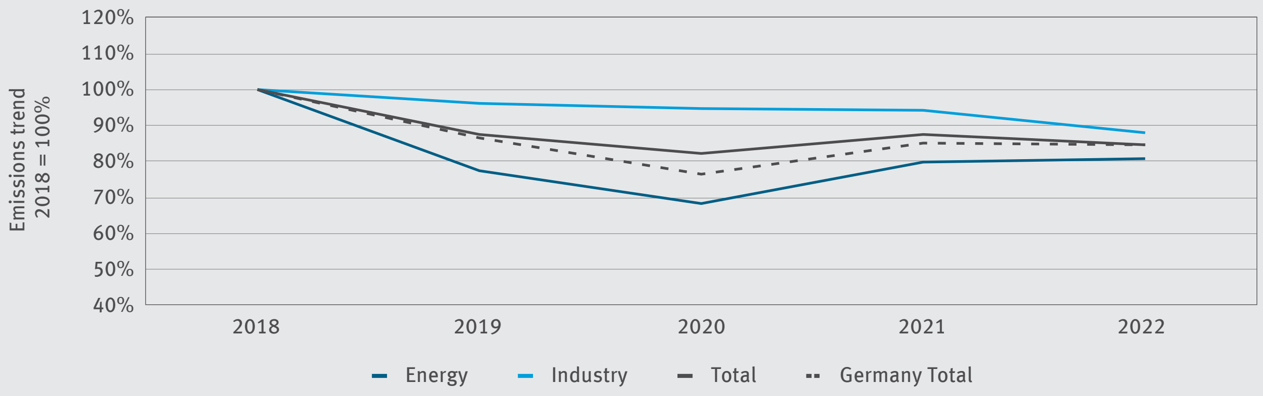
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	21	2,770,715	2,666,529	2,391,996	2,893,355	3,915,253
Industry	16	7,136,685	6,511,365	5,344,245	6,792,701	6,349,041
SL	**37**	**9,907,400**	**9,177,894**	**7,736,241**	**9,686,056**	**10,264,294**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 67: Emissions trends in Saarland since 2018



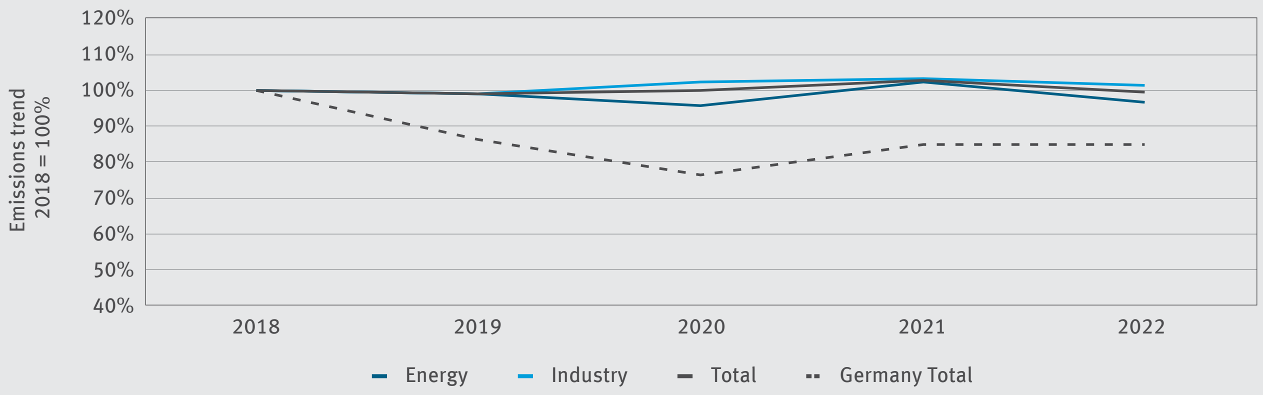
Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	39	33,537,891	30,413,312	26,396,637	29,544,262	33,982,675
Industry	47	2,575,351	2,149,233	2,364,999	2,499,369	2,141,112
SN	**86**	**36,113,242**	**32,562,545**	**28,761,636**	**32,043,631**	**36,123,787**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 68: Emissions trends in Saxony since 2018



Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	39	9,848,414	7,619,929	6,729,555	7,865,707	7,942,356
Industry	56	10,851,189	10,438,029	10,261,011	10,216,680	9,528,154
ST	**95**	**20,699,603**	**18,057,958**	**16,990,566**	**18,082,387**	**17,470,510**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 69: Emissions trends in Saxony-Anhalt since 2018



Number of installations subject to ET in 2022		2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 emissions [t CO_2eq]	2022 VET [t CO_2eq]
Energy	22	1,125,910	1,114,977	1,079,254	1,151,119	1,087,357
Industry	29	1,743,137	1,725,996	1,785,834	1,796,714	1,765,771
TH	**51**	**2,869,047**	**2,840,973**	**2,865,088**	**2,947,833**	**2,853,128**
DE	***1,731***	***417,332,886***	***360,777,595***	***319,586,879***	***354,334,353***	***353,953,207***

Figure 70: Emissions trends in Thuringia since 2018

6 Main Fuels by Sectors

Table 34: 2018 – 2022 emissions from stationary installations in EU ETS using the main fuels natural gas, lignite and hard coal

Sector / activity	Main fuel	2018 emissions [kt CO_2eq]	2019 emissions [kt CO_2eq]	2020 emissions [kt CO_2eq]	2021 emissions [kt CO_2eq]	2022 emissions [kt CO_2eq]
Energy installations	Lignite	153,951	120,195	97,806	115,988	121,293
	Hard coal	77,798	54,377	41,278	50,961	58,310
	Natural gas	39,635	43,282	44,731	43,389	37,508
Other combustion plants	Lignite	15	7	9	8	5
	Natural gas	343	334	329	336	367
Refineries	Lignite	465	474	478	430	417
	Natural gas	1,534	1,631	1,663	2,614	2,372
Iron and steel	Lignite	230	185	198	217	208
	Hard coal	31,770	30,072	26,558	29,638	8,254
	Natural gas	3,868	3,353	2,983	3,142	7,285
Non-ferrous metals	Lignite	228	221	222	230	225
	Hard coal	123	135	133	140	0
	Natural gas	1,592	1,568	1,512	1,565	1,696
Cement clinker	Lignite	2,433	1,484	2,622	855	817
	Hard coal	868	775	382	1,007	583
Industrial and building lime	Lignite	5,551	4,781	4,106	5,050	4,719
	Hard coal	772	772	1,028	768	1,007
	Natural gas	899	1,144	1,081	992	747
Other mineral processing industry	Lignite	794	658	706	515	611
	Hard coal	672	613	584	625	644
	Natural gas	6,819	6,726	6,451	6,937	6,454
Paper and pulp	Lignite	536	634	459	230	125
	Hard coal	712	526	450	469	436
	Natural gas	4,003	3,837	3,969	4,363	3,891
Chemical industry	Lignite	127	37	38	39	106
	Hard coal	455	480	440	322	445
	Natural gas	7,579	7,669	7,541	8,591	6,775
Sum		**343,774**	**285,972**	**247,755**	**279,420**	**265,301**
Complement: main fuel is not natural gas, hard coal or lignite		79,072	77,349	72,959	75,790	88,652
Total		**422,846**	**363,321**	**320,714**	**355,209**	**353,953**

As of 02/05/2023

The basis for determining the main fuel of an installation is the information provided by the operators in the annual emission reports at the source stream level. From 2022 onwards, additional information from the emission reports, which confirm the actual use as fuel, will be used to determine the main fuel. All fuels are counted as fuel unless the operator indicates whether a fuel was actually used as a fuel or, for example, as a reducing agent in the installation.

Table 35: Number of stationary installations in 2018 – 2022 in EU ETS using the main fuels natural gas, lignite and hard coal

Sector / Activity	Main fuel	2018 installation	2019 installation	2020 installation	2021 installation	2022 installation
Energy installations	Lignite	23	21	20	20	18
	Hard coal	60	54	50	48	46
	Natural gas	674	675	659	651	619
Other combustion plants	Lignite	2	1	1	1	1
	Natural gas	21	21	22	24	24
Refineries	Lignite	1	1	1	1	1
	Natural gas	5	6	6	8	6
Iron and steel	Lignite	1	1	1	1	1
	Hard coal	31	31	31	27	10
	Natural gas	75	72	72	71	86
Non-ferrous metals	Lignite	1	1	1	1	1
	Hard coal	1	1	1	1	0
	Natural gas	28	28	27	26	31
Cement clinker	Lignite	5	4	4	2	2
	Hard coal	2	2	1	2	2
Industrial and building lime	Lignite	21	19	18	19	19
	Hard coal	7	8	9	8	8
	Natural gas	7	9	9	9	7
Other mineral processing industry	Lignite	6	6	7	5	5
	Hard coal	8	8	7	8	8
	Natural gas	230	222	220	212	200
Paper and pulp	Lignite	5	6	5	4	2
	Hard coal	4	3	3	3	3
	Natural gas	111	111	114	117	110
Chemical industry	Lignite	2	1	1	1	2
	Hard coal	3	3	3	2	3
	Natural gas	67	72	68	64	86
Sum		**1,401**	**1,387**	**1,361**	**1,336**	**1,301**
Complement: main fuel is not natural gas, hard coal or lignite		466	460	454	420	430
Total		**1,867**	**1,847**	**1,815**	**1,756**	**1,731**

As of 02/05/2023

The basis for determining the main fuel of an installation is the information provided by the operators in the annual emission reports at the foundation stream level. From 2022 onwards, additional information from the emission reports, which confirm the actual use as fuel, will be used to determine the main fuel. All fuels are counted as fuel unless the operator indicates whether a fuel was actually used as a fuel or, for example, as a reducing agent in the installation.

7 Industries, Sectors and Activities in the EU ETS

Table 36: Activities (short description) according to Annex 1 TEHG and grouping in sectors and industries

TEHG-No.	Activity	Sectors	Industry
2	Energy conversion ≥ 50 MW RTI	Energy installations	Energy
3	Energy conversion 20–50 MW RTI		
4	Energy conversion 20–50 MW RTI, other fuels		
5	Prime movers (engines)		
6	Prime movers (turbines)		
1	Combustion	Other combustion plants, iron and steel, non-ferrous metals, mineral processing industry, chemical industry	Industry
7	Refineries	Refineries	
8	Coking plants	Iron and steel	
9	Processing of metal ores		
10	Production of pig iron and steel		
11	Processing of ferrous metals		
12	Production of primary aluminium	Non-ferrous metals	
13	Processing of non-ferrous metals		
14	Production of cement clinker	Mineral processing industry	
15	Lime production		
16	Glass production		
17	Ceramics production		
18	Mineral fibres production		
19	Gypsum production		
20	Pulp production	Paper and pulp	
21	Paper production		
22	Carbon black production	Chemical industry	
23	Nitric acid production		
24	Adipic acid production		
25	Production of glyoxal and glyoxylic acid		
26	Ammonia production		
27	Production of bulk organic chemicals		
28	Production of hydrogen and synthesis gas		
29	Soda production		

As of 02/05/2023

Table 37: Activities (short description) according to Annex 1 TEHG and grouping in sectors and industries

TEHG No.	TEHG Activity	RegR-No.	RegR activity
2	Energy conversion ≥ 50 MW RTI	20	Combustion and energy
3	Energy conversion 20–50 MW RTI		
4	Energy conversion 20–50 MW RTI, other fuels		
5	Prime movers (engines)		
6	Prime movers (turbines)		
1	Combustion		
7	Refineries	21	Refineries
8	Coking plants	22	Coking plants
9	Processing of metal ores	23	Processing of metal ores
10	Production of pig iron and steel	24	Production of pig iron and steel
11	Processing of ferrous metals	25	Processing of ferrous metals
12	Production of primary aluminium	26	Production of primary aluminium
13	Processing of non-ferrous metals	27	Production of secondary aluminium
		28	Production and processing of non-ferrous metals
14	Production of cement clinker	29	Production of cement clinker
15	Lime production	30	Lime production
16	Glass production	31	Glass production
17	Ceramics production	32	Ceramics production
18	Production of mineral fibres	33	Production of mineral fibres
19	Gypsum production	34	Gypsum production
20	Pulp production	35	Pulp production
21	Paper production	36	Paper production
22	Carbon black production	37	Carbon black production
23	Nitric acid production	38	Nitric acid production
24	Adipic acid production	39	Adipic acid production
25	Production of glyoxal and glyoxylic acid	40	Production of glyoxal and glyoxylic acid
26	Ammonia production	41	Ammonia production
27	Production of bulk organic chemicals	42	Production of bulk organic chemicals
28	Production of hydrogen and synthesis gas	43	Production of hydrogen and synthesis gas
29	Soda production	44	Soda production

As of 02/05/2023

8 Emissions and Scope Estimates

Table 38: German EU ETS emissions and scope estimates in the stationary sector since 2005

	Energy emissions [Mt CO_2eq]	Industry emissions [Mt CO_2eq]	N. l. ETS energy emissions [Mt CO_2eq]	N. l. ETS industry emissions [Mt CO_2eq]	Estimated emissions [Mt CO_2eq]	Total [Mt CO_2eq]
2005 emissions	314.3	97.3	57.1	6.2	39.9	514.8
2006 emissions	314.2	99.2	58.9	5.6	39.7	517.7
2007 emissions	319.9	102.2	59.5	5.4	43.6	530.7
2008 emissions	306.9	106.7	53.9	5.0	33.1	505.6
2009 emissions	285.2	94.1	45.6	3.3	30.5	458.7
2010 emissions	304.1	102.2	45.9	2.5	25.0	479.8
2011 emissions	301.6	103.8	42.7	2.2	24.2	474.5
2012 emissions	311.0	101.3	38.4	1.7	23.4	475.9
2013 emissions	325.3	122.5	30.9	2.2	0.1	480.9
2014 emissions	311.2	122.4	25.6	1.9	0.1	461.2
2015 emissions	309.5	122.7	21.6	1.7	0.1	455.6
2016 emissions	310.3	122.8	18.1	1.5	0.1	452.8
2017 emissions	300.0	125.5	10.6	1.3	0.1	437.6
2018 emissions	293.3	124.1	4.2	1.1	0.0	422.7
2019 emissions	241.5	119.3	1.5	0.9	0.0	363.2
2020 emissions	205.4	114.2	0.7	0.3	0.0	320.6
2021 emissions	234.7	119.7	0.0	0.0	0.0	354.3
2022 emissions	241.8	112.2	0.0	0.0	0.0	354.0
Number of installations	873	858	529	331		

As of 02/05/2023

9 Glossary

Allocation coverage

The ratio of free allocation to emissions. An allocation coverage of 100 percent or more means that no emission allowances need to be purchased to meet the annual surrender obligation. An allocation coverage below 100 percent means that the free allocation of one year is insufficient to meet the surrender obligation using emission allowances from the current allocation. In this case, emission allowances must be purchased or certificates from the second trading period must be used.

Adjusted allocation coverage

The ratio of free allocation to emissions, adjusted by the allocation for transferred waste gases from iron, steel and coke production in the iron and steel industry and imported heat quantities from the paper and chemical industry. Producers of waste gases from iron, steel and coke production and heat importers receive a free allocation for this purpose although emissions arise from waste gas users or heat producers. The adjusted allocation coverage is based on the assumption that producers of waste gases from iron, steel and coke production and heat importers transfer emission allowances to the installations that produce the emissions. The respective amounts are estimated for this report. The amounts are subtracted from the actual free allocation for industry sectors and added to energy installations. Further details on the adjusted allocation coverage can be found in Section 2.5 of the handbook 'Data concepts in EU emissions trading' (Graichen et al., 2021).

Clean Spread

The 'clean spreads' relate to fuel prices, the price of electricity, the price of emission allowances and variable operating costs with one another and thus allow conclusions to be drawn about contribution margins for a power plant (for natural gas power plants: clean spark spread, for hard coal power plants: clean dark spread, for lignite power plants: clean lignite spread).

CSCF

The abbreviation CSCF stands for cross-sectoral correction factor (see explanation below).

EU Allowances (EUA)

Emission certificates at a corporate level for emissions trading in Europe (EU Emissions Trading Scheme). Emission certificates are referred to as emission allowances (EAs). They have been tradable within the EU since 2005 and are issued to installations subject to emissions trading in the EU. One EUA legitimises the emission of one tonne of carbon dioxide or carbon dioxide equivalent (CO_2eq).

EU allowances (EUAs) and emission allowances (EAs) can be transferred in accordance with the European Emissions Trading Directive (EHRL) and the Greenhouse Gas Emissions Trading Act (§6(1) TEHG).
EUAs enable operators to comply with their annual obligation to surrender emission allowances.

Commercial aircraft operator

An aircraft operator that provides scheduled or non-scheduled air transport services to the public and carries passengers, cargo or mail in exchange for remuneration (Article 3 p, Emissions Trading Directive).

Main fuel

The main fuel in an installation refers to the fuel that makes up the highest proportion in the total energy of all fuel streams used in the installation. In contrast, until 2014, previous VET reports assigned an installation to a main fuel only if more than 80 percent of the energy consumption of an installation could be assigned to a fuel. The main fuel allocation for an installation for the reporting year does not correspond to the main fuel allocation based on the previous reporting year's emission report. For instance, the 2020 main fuel allocation was determined for the first time for the 2020 VET report using the data from the emission reports of the current reporting year.

Linear factor

The factor is applied to power producers and new market entrants for a linear reduction of the annual allocation amount. The linear factor was, until 2020, reduced by 1.74 percent each year from the baseline of 1 in 2013, meaning that the linear factor was 0.8244 in 2020. In the fourth trading period, the linear factor started at 0.8562 in 2021, and was planned to be reduced by 2.2 percent each year until reaching 0.6582 in 2030. However, with the modifications in the "fit-for-55 package", the annual reduction was raised to 4.3 percent from 2024 to 2027 and to 4.4 percent from 2028 onwards.

Installations no longer subject to emissions trading (n. l. ETS)

Installations no longer subject to emissions trading include decommissioned installations and installations that continue to exist but are no longer subject to emissions trading because as energy installations, they fall below the 20 megawatt RTI limit.

Reduced scope of EU ETS in aviation

Valid from 01/01/2013 to 31/12/2023. Compared to the full scope, operators are effectively no longer subject to emissions trading for emissions from flights that take off or land outside the European Economic Area. Further exceptions are described in Section 4.1.

Cross-sectoral correction factor

Correction factor (cross-sectoral correction factor – CSCF) adjusts the total amount of allowances allocated free of charge for non-power producers to the maximum amount of free allocation pursuant to Article 10a(5) of the EU Emissions Trading Directive (ETD) in the third trading period.

This factor was determined by the European Commission for each individual year of the third trading period (2013 to 2020) and applied uniformly across the EU for all industries (across sectors).

Scope correction or estimate before 2013 (scope estimate)

Estimated emissions before 2013 used to correct the scope over each trading period. In the transition from the second to the third trading period in particular, the scope of European Emissions Trading was extended and added to installations for the production and processing of non-ferrous metals and the chemical industry.
In the relevant figures in the report, this adjustment of timelines is referred to as a scope estimate in the legends. More detailed explanations can be found in the introductory chapter of the report.

10 Sources and Publications

AGEB 2023a Energy Balances Working Group, Energy consumption in Germany in 2022, as of March 2023, https://ag-energiebilanzen.de/wp-content/uploads/2023/01/AGEB_Jahresbericht2022_20230413-02_dt-1.pdf

AGEB 2022b Energy Balances Working Group, Electricity generation by energy sources from 1990 to 2021 Germany total, as of March 2022, https://ag-energiebilanzen.de/wp-content/uploads/2021/12/STRERZ_2021Febr2022_web.pdf

AGEB 2023b Energy Balances Working Group, Electricity generation by energy sources (electricity mix) from 1990 to 2021 Germany total, as of February 2023, https://ag-energiebilanzen.de/wp-content/uploads/2023/03/STRERZ22A11_Abg_0223.pdf

Agrarheute (2022) Press release, Deutscher Landwirtschaftsverlag GmbH (German Agricultural Publishing House), Fertiliser shortage – gas prices: Nitrogen fertiliser factories shut-down production, as of April 2022, www.agrarheute.com/management/agribusiness/gaspreise-stickstoff-duenger-fabriken-fahren-produktion-herunter-597108, accessed 16/05/2023

BAfA 2023 Federal Office for Economic Affairs and Export Control, 'Official Mineral Oil Data December 2022', www.bafa.de/SharedDocs/Downloads/DE/Energie/Mineraloel/moel_amtliche_daten_2022_12.xlsx, accessed 28/03/2023

Bauindustrie (2022) Main Association of the German Construction Industry: 2021 construction year closes on the plus side: more new jobs than expected, www.bauindustrie.de/fileadmin/bauindustrie.de/Media/Pressemitteilungen/12-22-Baukonjunktur2021.pdf, accessed 31/03/2022

BNetzA 2023 List of power plants, as of November 2022, www.bundesnetzagentur.de/EN/Areas/Energy/SecurityOfSupply/GeneratingCapacity/PowerPlantList/start.html

DEHSt 2009 German Emissions Trading Authority [ed.], '2008 carbon dioxide emissions from installations subject to emissions trading', Berlin, 15/05/2009, www.dehst.de/SharedDocs/downloads/DE/publikationen/VET-Bericht-2008.pdf

DEHSt 2010 German Emissions Trading Authority [ed.], '2009 carbon dioxide emissions from installations subject to emissions trading in Germany', Berlin, 15/05/2010, www.dehst.de/SharedDocs/downloads/DE/publikationen/VET-Bericht-2009.pdf

DEHSt 2011 German Emissions Trading Authority [ed.], '2010 carbon dioxide emissions from stationary installations subject to emissions trading in Germany', Berlin, 15/05/2011, www.dehst.de/SharedDocs/downloads/DE/publikationen/VET-Bericht-2010.pdf

DEHSt 2012a German Emissions Trading Authority [ed.], 'The allocation of emission allowances to aircraft operators for the 2012 and 2013 – 2020 trading periods', Berlin, 02/03/2012, www.dehst.de/SharedDocs/downloads/DE/luftverkehr/LV_Zuteilungsbericht.pdf

DEHSt 2012b German Emissions Trading Authority [ed.], '2011 carbon dioxide emissions from stationary installations subject to emissions trading and in aviation in Germany', Berlin, 15/05/2012, www.dehst.de/SharedDocs/downloads/DE/publikationen/VET-Bericht-2011.pdf

DEHSt 2013a German Emissions Trading Authority [ed.], '2012 carbon dioxide emissions from stationary installations subject to emissions trading and in aviation in Germany', Berlin, 15/05/2013, www.dehst.de/SharedDocs/downloads/DE/publikationen/VET-Bericht-2012.pdf

DEHSt 2013b National Allocation Table (NAT), as of 25/11/2013, www.dehst.de/EN/european-emissions-trading/installation-operators/allocation-2021-2030/allocation_2021-2030_node.html

DEHSt 2014a	German Emissions Trading Authority [ed.], '2013–2020 allocation – Results of the free allocation of emission allowances to existing installations for the 3rd Trading Period 2013 – 2020', Berlin, 22/04/2014, www.dehst.de/SharedDocs/downloads/DE/publikationen/Zuteilungsbericht.pdf
DEHSt 2014b	German Emissions Trading Authority [ed.], 'Greenhouse gas emissions from stationary installations subject to emissions trading and in aviation', Berlin, 15/05/2014, www.dehst.de/SharedDocs/downloads/EN/publications/2013_VET-Report.pdf
DEHSt 2015	German Emissions Trading Authority [ed.], '2014 greenhouse gas emissions: Stationary installations subject to emissions trading and aviation in Germany', Berlin, 21/05/2015, www.dehst.de/SharedDocs/downloads/EN/publications/2014_VET-Report.pdf
DEHSt 2016	German Emissions Trading Authority [ed.], '2015 greenhouse gas emissions: Stationary installations subject to emissions trading and aviation in Germany', 24/05/2016, www.dehst.de/SharedDocs/downloads/EN/publications/2015_VET-Report.pdf
DEHSt 2017	German Emissions Trading Authority [ed.], '2016 greenhouse gas emissions: Stationary installations subject to emissions trading and aviation in Germany', 01/06/2017, www.dehst.de/SharedDocs/downloads/EN/publications/2016_VET-Report.pdf
DEHSt 2018	German Emissions Trading Authority [ed.], '2017 greenhouse gas emissions: Stationary installations subject to emissions trading and aviation in Germany', 01/06/2018, www.dehst.de/SharedDocs/downloads/EN/publications/2017_VET-Report.pdf
DEHSt 2019	German Emissions Trading Authority [ed.], '2018 greenhouse gas emissions: Stationary installations subject to emissions trading and aviation in Germany', Berlin, 01/06/2019, www.dehst.de/SharedDocs/downloads/EN/publications/2018_VET-Report.pdf
DEHSt 2020a	German Emissions Trading Authority [ed.] 'Aid for indirect CO_2 costs of emissions trading (electricity price compensation) in Germany for 2018', Berlin, 25/03/2020, www.dehst.de/SharedDocs/downloads/EN/spk/Auswertungsbericht_2018_Englische_Version.pdf
DEHSt 2020b	German Emissions Trading Authority [ed.] '2019 greenhouse gas emissions: Stationary installations subject to emissions trading and aviation in Germany', Berlin, 28/05/2020, www.dehst.de/SharedDocs/downloads/EN/publications/2019_VET-Report.pdf
DEHSt 2021a	German Emissions Trading Authority [ed.] 'Aid for indirect CO_2 costs of emissions trading (electricity price compensation) in Germany for 2019', Berlin, 17/03/2021, www.dehst.de/SharedDocs/downloads/EN/spk/Auswertungsbericht_2019_Englische_Version.pdf
DEHSt 2021b	German Emissions Trading Authority [ed.] '2020 greenhouse gas emissions: Stationary installations subject to emissions trading and aviation in Germany', Berlin, 17/06/2021, www.dehst.de/SharedDocs/downloads/EN/publications/2020_VET-Report.pdf
DEHSt 2021 c	German Emissions Trading Authority [ed.] 'Guidelines on the creation of monitoring plans and emission reports for stationary installations – 4th trading period (2021 – 2030) of the European Emissions Trading Scheme', Berlin, October 2021, www.dehst.de/SharedDocs/ downloads/DE/stationaere_anlagen/2021-2030/Ueberwachungsplan-Emissionsbericht__Leitfaden.pdf
DEHSt 2022a	German Emissions Trading Authority [ed.] 'Guidelines for aircraft operators – creation of monitoring plans and emission reports in the 4th trading period'; Berlin, January 2023, www.dehst.de/SharedDocs/downloads/DE/luftverkehr/lv-leitfaden-monitoring-2023.pdf

DEHSt 2022b	German Emissions Trading Authority [ed.] ‘2020 greenhouse gas emissions: stationary installations and aviation subject to emissions trading in Germany’, Berlin, June 2022, www.dehst.de/SharedDocs/downloads/EN/publications/2021_VET-Report.pdf
DEHSt 2022c	German Emissions Trading Authority, News report of 24/10/2022: ‘National emissions trading – surrendered certificates for the 2021 starting year correspond to around 306.2 million tonnes of CO_2’, www.dehst.de/SharedDocs/news/DE/nEHS-abgegebene-zertifikate-2021.html; accessed 24/05/2023
DESTATIS 2023a	Federal Statistical Office (Destatis); Press Release No. N 006 of 1. February 2023; www.destatis.de/EN/Press/2023/02/PE23_N006_61.html; accessed 27/04/2023
DESTATIS 2023b	Federal Statistical Office (Destatis); Press Release No. 090 of 09/03/2023; www.destatis.de/EN/Press/2023/03/PE23_090_43312.html; accessed 27/04/2023
DESTATIS 2023b	Federal Statistical Office (Destatis); Table 42131-0004 Manufacturing output: Germany, years, goods index (9-digit), 2019 – 2022 period; www-genesis.destatis.de/genesis/online?operation=table&code=42131-0004&bypass=true&levelindex=0&levelid=1684357266289#abreadcrumb; accessed 17/05/2023
DG Energy 2022	Quarterly Report on European Electricity Markets, https://energy.ec.europa.eu/system/files/2022-04/Quarterly%20report%20on%20European%20electricity%20markets_Q4%202021.pdf, accessed 20/04/2022
DIE PAPIER-INDUSTRIE (2022)	THE PAPER INDUSTRY, Press Release of 01/03/2022, www.papierindustrie.de/presse/pressedetails?tx_news_pi1%5Baction%5D=detail&tx_news_pi1%5Bcontroller%5D=News&tx_news_pi1%5Bnews%5D=5207&cHash=5595bee80185518e61720d06afe5ebe3, accessed 27/04/2023
DRV 2023	German Travel Association, Press Release of 06/03/2023, www.drv.de/anzeigen/txnews/bilanz-touristikjahr-2022-reisebranche-im-aufwaertstrend-die-ausgaben-fuer-urlaub-haben-sich-verdop.html, accessed 27/04/2023.
EEA 2021	European Environment Agency. Trends and Projections in EU-ETS 2021, www.eionet.europa.eu/etcs/etc-cme/products/etc-cme-reports/etc-cme-report-9-2021-trends-and-projections-in-the-eu-ets-in-2021-the-eu-emissions-trading-system-in-numbers, accessed 07/04/2022
EEA 2023	European Environment Agency, European Union Emissions Trading System (EU-ETS) data from EUTL, Stand 02.2023, www.eea.europa.eu/data-and-maps/data/european-union-emissions-trading-scheme-17
EHRL	Directive 2003/87/EC of the European Parliament and of the Council of 13/10/2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, as last amended by Directive 2009/29/EC
Ember (2020)	EU Power Sector in 2020. Dataset European Power Sector in 2020, https://ember-climate.org/insights/research/eu-power-sector-2020, accessed 25/04/2022
Ember (2023)	EU electricity generation by source, https://ember-climate.org/topics/coal/, accessed: 28/04/2023
EU 2013	Resolution No. 377/2013/EU of the European Parliament and of the Council of 24/04/2013 providing for the transitional derogation from Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community

EU 2014a	Regulation (EU) No. 421/2014 of the European Parliament and of the Council of 16/04/2014 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community for the implementation of an international agreement on applying a single global market-based mechanism to international aviation emissions by 2020.
EU 2014b	Directive 2004/101/EC of the European Parliament and of the Council of 27/10/2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community in respect of the Kyoto Protocol's project mechanisms – Text with EEA relevance
EU 2017a	Regulation (EU) 2017/2392 of the European Parliament and of the Council of 13/12/2017 amending Directive 2003/87/EC to maintain the current restriction on its application to aviation activities and to prepare for the implementation of a global market-based mechanism from 2021.
EU 2017b	Agreement between the European Union and the Swiss Confederation linking their respective greenhouse gas emissions trading systems. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:22017A1207(01), accessed 25/04/2023
EU 2021	Trade agreement between the EU and the UK: https://commission.europa.eu/strategy-and-policy/relations-non-eu-countries/relations-united-kingdom/eu-uk-trade-and-cooperation-agreement_en, accessed 25/04/2023
Federbeton	Italian Cement Association. 2019 – 2020 annual reports, www.federbeton.it/Pubblicazioni, accessed: 23/03/2022
Graichen et al (2021)	Verena Graichen, Wolfram Jörß, Lukas Emele, Christian Nissen, UBA Climate Change 75/2021, Data concepts in EU emissions trading – Handbook, www.umweltbundesamt.de/publikationen/uba-eu-ets-handbuch
ICAO 2016	ICAO Resolution A39-3: www.icao.int/Meetings/a39/Pages/resolutions.aspx
Infociments	French Cement Association, 2017 – 2020 Annual Reports, www.infociments.fr/publications, accessed 23/03/2022
KohleaustiegsG	Act to reduce and cease coal-fired power generation and to amend other acts (Coal Phase-out Act); Federal Law Gazette I p. 1818; Coal Phase-out Act in the Federal Law Gazette of 13/08/2020; www.bmwi.de/Redaktion/DE/Gesetze/Wirtschaft/kohleausstiegsgesetz.html
COM 2021	'Update of Benchmark Values for the years 2021 – 2025 of phase 4 of the EU ETS', https://climate.ec.europa.eu/system/files/2021-10/policy_ets_allowances_bm_curve_factsheets_en.pdf, accessed 13/04/2022
COM 2023a	European Commission, Slight upturn in 2022 ETS emissions due to energy crisis and rebound in aviation – but declining trend maintained. Press release of the Commission of 24/04/2023, accessed 15/05/2023, https://climate.ec.europa.eu/news-your-voice/news/slight-upturn-2022-ets-emissions-due-energy-crisis-and-rebound-aviation-declining-trend-maintained-2023-04-24_en
COM 2023b	European Commission: Publication of the total number of allowances in circulation in 2022 for the purposes of the Market Stability Reserve under the EU Emissions Trading System established by Directive 2003/87/EC, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2023:172:FULL, accessed 15/05/2023
MWV2021a	Petroleum Industry Association, Press Release of 25/08/2020, www.mwv.de/presse/absatz-benzin-diesel-1-hj-2020-gesunken

MWV2021b	Petroleum Industry Association, Press Release of 03/08/2020, www.mwv.de/presse/benzin-und-diesel-ueberwinden-corona-krise/, accessed 15/04/2021
Statistik der Kohlenwirtschaft 2022	Statistics of the Coal Industry, Gross electricity generation in Germany, as of March 2022, https://kohlenstatistik.de/wp-content/uploads/2021/04/strak.xlsx
Tagesschau 2023	Norddeutscher Rundfunk, institution under public law, Analysis 'Lower Crude Oil Prices. Fill up the Heating Oil Tank Now?', www.tagesschau.de/wirtschaft/verbraucher/heizoel-kauf-oelpreis-gaspreis-verbraucher-101.html, accessed 23/03/2022
TEHG 2020	Greenhouse Gas Emissions Trading Act of 21/07/2011 (Federal Law Gazette I p. 1475), last amended by Article 2(45) and Article 4(28) of the Act of 07/08/2013 (Federal Law Gazette I p. 3154).
UBA 2022	Icha, Petra, Lauf, Dr Thomas Lauf, Kuhs, Gunter: 'Development of the specific greenhouse gas emissions of the German electricity mix in the 1990 – 2021 period', as of April 2022, www.umweltbundesamt.de/publikationen/entwicklung-der-spezifischen-kohlendioxid-8
VCI 2013	German Chemical Industry Association (VCI), Chemical industry in figures in 2013, www.vci.de/vci/downloads-vci/publikation/chiz-historisch/chemiewirtschaft-in-zahlen-2013.pdf, accessed 29/03/2017
VCI 2019	German Chemical Industry Association (VCI), Press information of 12/03/2020, VCI report on the economic situation of the industry in the 4th quarter of 2019, www.vci.de/vci/downloads-vci/quartalsberichte/2020-03-12-vci-quartalsbericht-04-2019.pdf, accessed 14/04/2020
VCI 2020	German Chemical Industry Association (VCI), Press Release of 08/09/2020, www.vci.de/presse/pressemitteilungen/ueberwindung-der-corona-folgen-braucht-zeit.jsp, accessed 16/04/2021
VCI 2022	German Chemical Industry Association (VCI), Chemical industry in figures in 2021, www.vci.de/vci/downloads-vci/publikation/chiz-historisch/chemiewirtschaft-in-zahlen-2022.pdf, accessed 06/03/2022
VCI 2022a	German Chemical Industry Association (VCI), Press information 15/12/2022 VCI member survey on the economic situation, www.vci.de/die-branche/aktuelle-wirtschaftliche-lage/vci-mitgliederbefragung-zur-wirtschaftlichen-lage.jsp, accessed 18/04/2023
VCI 2022b	German Chemical Industry Association (VCI), Press information of 15/12/2022, 2022 annual balance, www.vci.de/die-branche/aktuelle-wirtschaftliche-lage/dunkles-jahr-mit-trueben-aussichten-bilanz-der-chemisch-pharmazeutischen-industrie-2022.jsp, accessed 18/04/2023
VDZ 2015	German Cement Works Association, Cement industry overview in 2015, www.vdz-online.de/fileadmin/wissensportal/publikationen/zementindustrie/zementindustrie_ueberblick/VDZ_Zementindustrie_im_Ueberblick_2015.pdf, accessed 27/04/2023
VDZ 2022	German Cement Works Association, Environmental data of the German cement industry in 2020, www.vdz-online.de/wissensportal/publikationen/umweltdaten-der-deutschen-zementindustrie-2020, accessed 27/04/2023
WSA 2014	World Steel Association, World Steel in figures 2014, https://worldsteel.org/wp-content/uploads/2014-World-Steel-in-Figures.pdf, accessed: 07/04/2022
WSA 2020	World Steel Association, Steel Statistical Yearbook 2020 concise version, www.worldsteel.org/steel-by-topic/statistics/steel-statistical-yearbook.html

WSA 2021	World Steel Association, World Steel in figures 2021, https://worldsteel.org/wp-content/uploads/2021-World-Steel-in-Figures.pdf, accessed: 07/04/2022
WV Metalle 2019	Quarterly Report 11/2019, https://www.wvmetalle.de/index.php?eID=dump-Fi-le&t=f&f=120167&token=de4909a178c77aaf07f64d21ee2d73dc22266acd, accessed 21/04/2023
WV Metalle 2020	8/2020 Quarterly Report, www.wvmetalle.de/index.php?eID=dumpFile&t=f&f=169063&to-ken=c9789555115294f945d2f41555b678ece8505c4c, accessed 12/04/2022
WB Metalle 2021	11/2021 Quarterly Report, www.wvmetalle.de/index.php?eID=dump-File&t=f&f=249018&token=56bcf7f9738c8fd99152d0226f2d34ad11ef2e3b, accessed 21/04/2023
WV Metalle 2022	02/2022 Quarterly Report, www.wvmetalle.de/index.php?eID=dump-File&t=f&f=371048&token=11997292012a1379b121a4a46fc5173f9c7cb5b1, accessed 12/04/2022
WV Metalle 2023	02/2023 Quarterly Report, www.wvmetalle.de/index.php?eID=dump-File&t=f&f=443254&token=4b917cd72d7c046d307984e53a541f255e2a38e1, accessed 21/04/2023
WV Stahl 2020	2019/2020 Statistical Yearbook of the Steel Industry
WV Stahl 2021	Crude steel production in Germany: 2020 annual balance. Press Release of 22/01/2021, www.stahl-online.de/medieninformationen/rohstahlproduktion-in-deutschland-jahresbilanz-2020
WV Stahl 2023a	Crude steel production in Germany: 2022 annual balance. Press Release of 23/01/2023, www.stahl-online.de/medieninformationen/rohstahlproduktion-in-deutschland-im-jahr-2022
WV Stahl 2023b	Economic situation of the steel industry in Germany in January 2023 – in a challenging environment, www.stahl-online.de/startseite/stahl-in-deutschland/konjunkturinformationen, accessed: 24/04/2023
Wynn (2016)	Wynn, Gerard (2016): The Dutch Coal Mistake. How three brand-new power plants in the Netherlands are at risk already of becoming stranded assets. https://ieefa.org/ieefa-report-dutch-coal-mistake-shows-three-new-plants-netherlands-failing-live-expectations-risk-be-coming-climate-risk-stranded-assets, accessed 30/03/2022
ZuV 2020	Ordinance on the allocation of greenhouse gas emission allowances in the 2013–2020 trading period (2020 Allocation Ordinance – ZuV 2020) of 26/09/2011 (Federal Law Gazette I No. 49 p. 1921)

German Emissions Trading Authority (DEHSt) at the German Environment Agency
City Campus
Buidling 3, entrance 3A
Buchholzweg 8
D-13627 Berlin
www.dehst.de/English | emissionstrading@dehst.de