Greenhouse Gas Emissions in 2021

Stationary Installations and Aviation Subject to Emissions Trading in Germany (2021 VET Report)

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Summary

Energy and Industrial Sectors in Germany

2021 was the first year of the fourth trading period of the European Emissions Trading Scheme (EU ETS). This year, 1,732 stationary installations in Germany were covered by the EU ETS as being subject to reporting and surrender.[1] These installations emitted around 355 million tonnes of carbon dioxide equivalents (CO_2eq), an increase of 11 percent compared to 2020. This is only around 8 million tonnes less than 2019 levels before the COVID 19 pandemic. This included a 14 percent increase in emissions from energy installations and a five percent increase in emissions from industrial installations compared to the previous year. Following the economic slump in 2020 due to the Corona pandemic, the economic recovery was a major factor in this development last year.

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

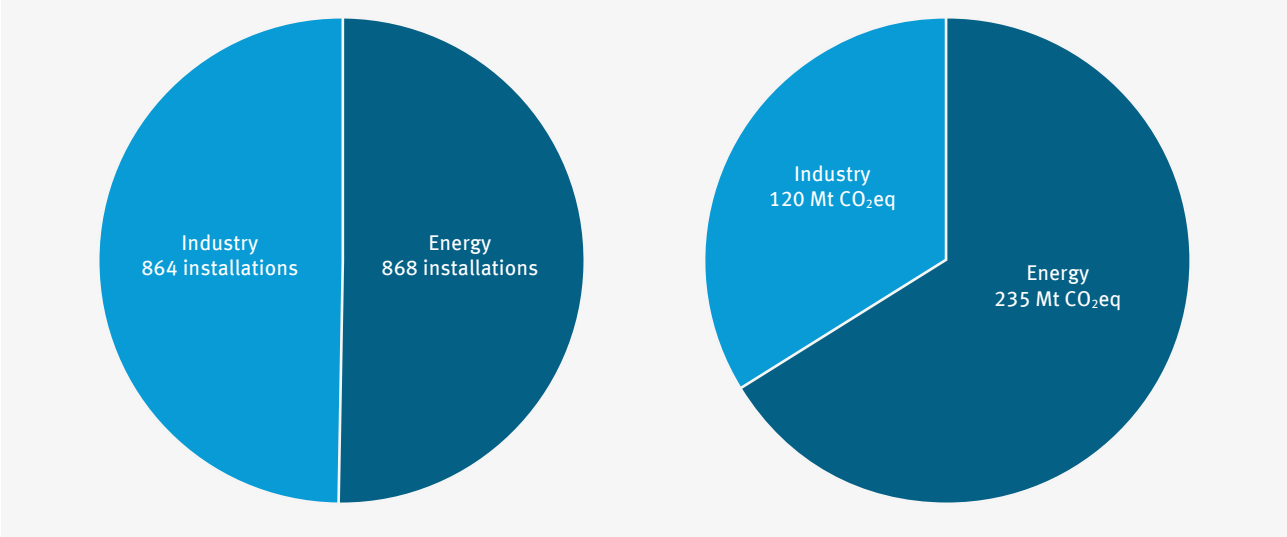

Figure 1: Distribution of emissions and installations subject to emissions trading in the energy sector (Activities 2 to 6 as per Annex 1 TEHG) and the industrial sector (Activities 1 and 7 to 29 as per Annex 1 TEHG) in Germany in 2021

While the number of installations is divided about half and half between the industrial and the 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 for each year from 2017 onward 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, 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. This 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.

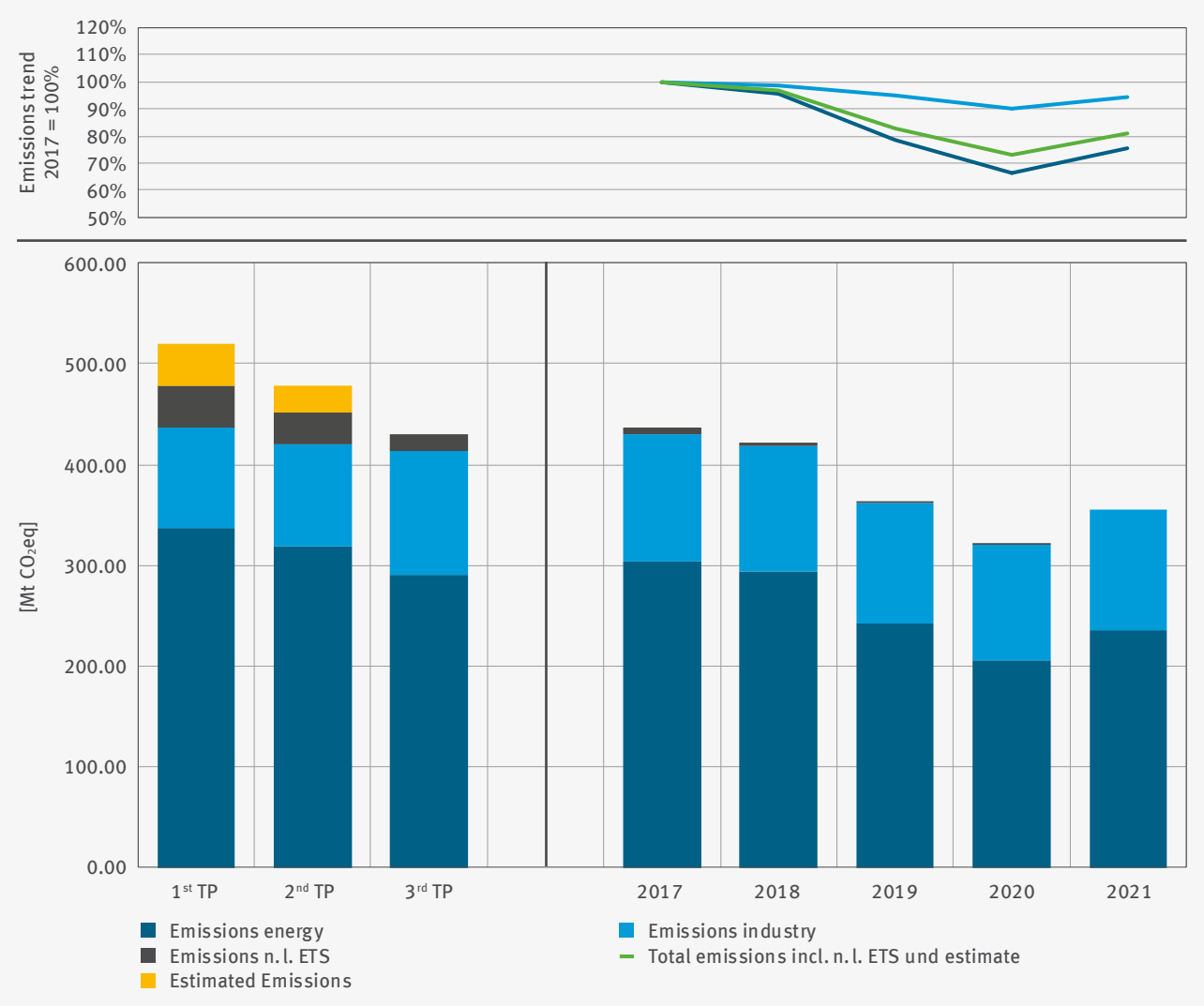

Figure 2: EU ETS emissions from the energy and industry sectors in Germany up to 2021[3]

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

3 Estimated emissions 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.

Since the start of the third trading period in 2013, emissions from energy installations have fallen steadily. Between 2017 and 2020, the last year of the third trading period, carbon dioxide emissions fell by a total of 34 percent. 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 transfer of electricity generation capacities to the security reserve and the decommissioning of power plant units from 2016 and the significant increase in EUA prices from 2018. Contrary to the trend of the third trading period, the first year of the EU ETS's fourth trading period began with a 14 percent increase in emissions to 235 million tonnes of carbon dioxide. The reasons for this were increased demand for electricity due to the economic recovery and rising emissions from the combustion of hard coal and lignite. The latter was due to significantly lower feed-in from wind power plants and the disproportionate rise in the price of natural gas, which made the use of hard coal and lignite-fired power plants economically more favourable than natural gas plants. In 2021, lignite was again the most important energy source in electricity generation having a share of around 19 percent. In 2020, and for the first time, onshore wind power was the most important one. Hard coal-fired power plants' share also recorded an increase in 2021. All the more noteworthy is the relatively high number of power plants being decommissioned and transfers to the grid reserve with a total capacity of 7 gigawatts in 2021 (including around 1 gigawatt of lignite and around 6 gigawatts of hard coal).

Emissions from the industry with high energy consumption hardly changed 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 it was significantly influenced by the global economic downturn in 2019, which also affected production trends in Germany. In 2021, emissions increased by five percent year-on-year to 120 million tonnes of carbon dioxide equivalents. Emissions thus rose again after two years of emissions declines (latter due to economic causes), almost returning to pre-COVID 19 pandemic levels.

The decrease in total German EU ETS emissions up to 2020 was thus predominantly due to the decrease in emissions from energy installations. However, a proportional effect by the EUA price in the EU ETS on the emission trend can only be observed in terms of emissions from energy installations from 2019 onwards. In both 2019 and 2020, the economic efficiency of natural gas power plants compared to coal-fired power plants improved, partly due to the increased EUA prices so that they increasingly displaced generation from coal-fired power plants. This trend did not continue in 2021 due to the increase in natural gas prices.

Emissions from Industrial Installations in Detail

Figure 3 shows the distribution of the total emissions from individual industrial sectors and their emissions. The iron and steel industry accounts for the largest share of industrial emissions at around 30 percent, followed by refineries (19 percent), cement clinker production (17 percent) and the chemical industry (14 percent). Due to the emissions trend, the iron and steel industry's share increased compared to the previous year (2020: 28 percent), while the shares of the other three sectors decreased slightly (2020: refineries 20 percent, cement clinker production 18 percent, chemical industry 15 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 (three 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.

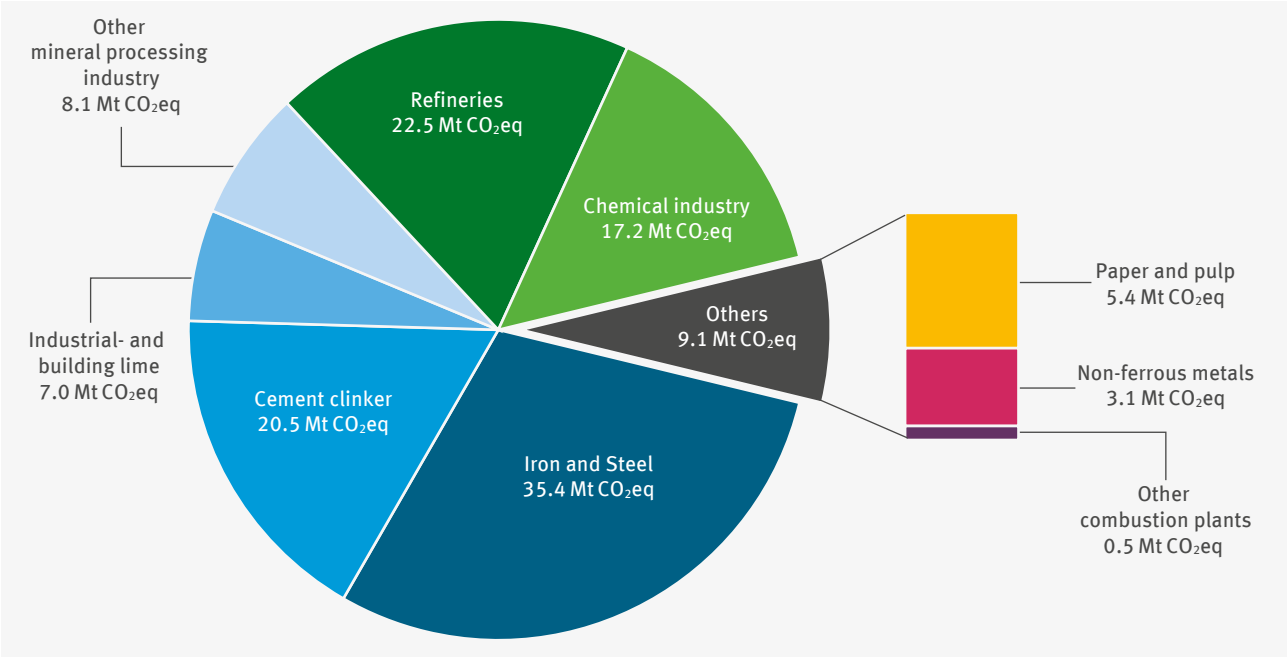

Figure 3: Distribution of emissions among individual industrial sectors in 2021

Figure 4 summarises the different trends of emissions in selected industrial sectors compared to the previous year. In addition, the relative annual changes since 2017 are also shown. The five-year comparison change in 2021 compared with 2017 is also shown.

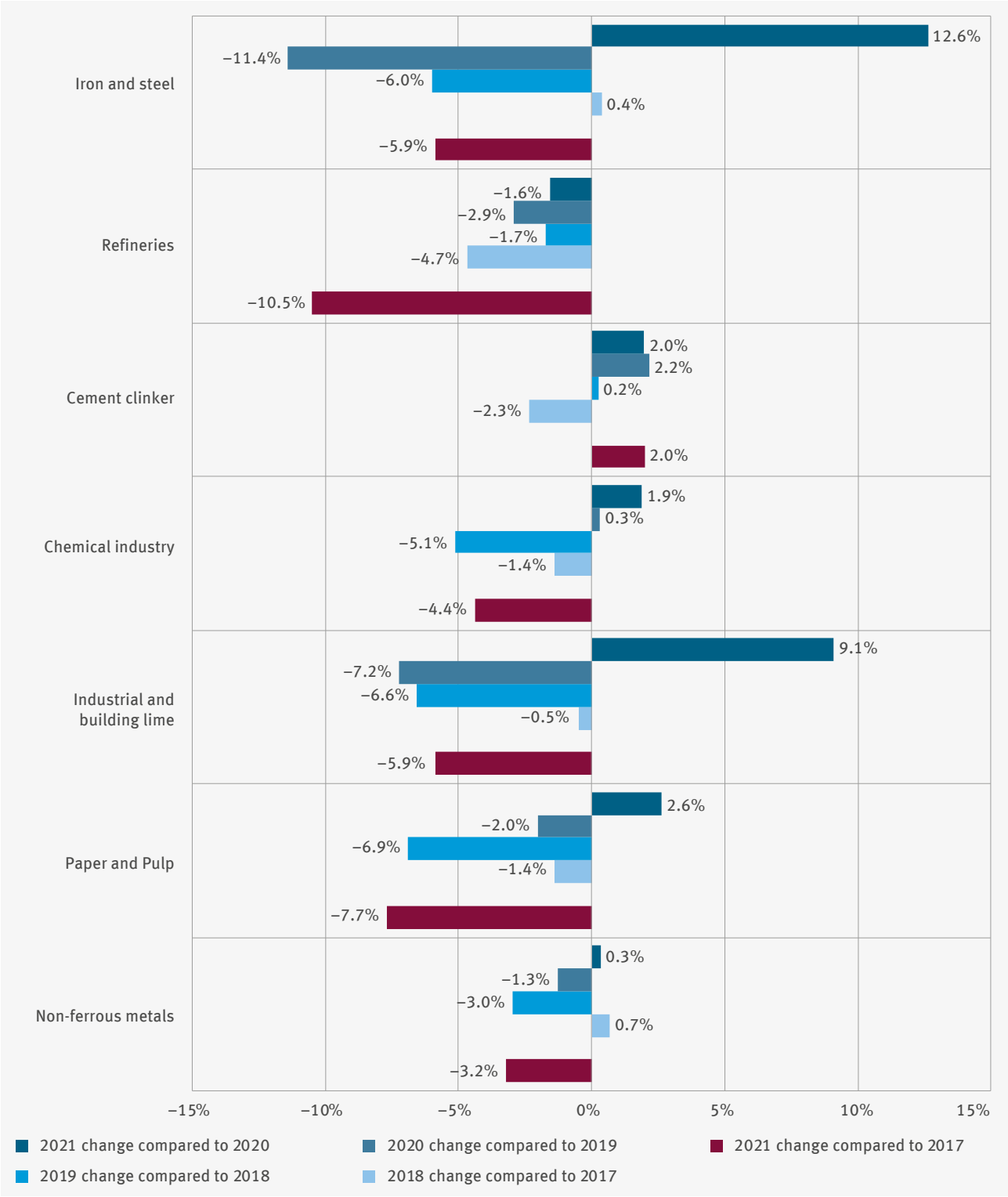

Figure 4: Annual changes in the industrial sectors' emissions since 2017 and total change since 2017

2021 emissions increased significantly year-on-year in two sectors: in the iron and steel industry and in the industrial and building lime sector. In the chemical industry, cement clinker production and the paper and pulp industry emissions increased slightly by values between 1.5 and 2.4 percent. In contrast, emissions from refineries fell slightly by 1.6 percent. Emissions from the non-ferrous metals industry remained about the same. Looking at the change in 2021 emissions compared to 2017, a decrease in emissions can be seen in all of these industries except cement clinker.

The Largest Installations in the Energy and Industrial Sectors

Table 1 shows the largest emitters among the energy installations. The Boxberg III and Boxberg IV installations are combined into one power plant in Table 1. In total, these ten power plants or eleven installations at about 120 million tonnes of carbon dioxide equivalents cause a third (34 percent) of the emissions subject to emissions trading in the stationary sector and about half (51 percent) of the emissions from energy installations. Emissions from the ten largest power plants in 2021 were on par with emissions from all German industrial installations combined, after their 2020 emissions were about twelve percent below the emissions from industrial installations.

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

Installation (operator)	2021 VET [kt CO_2eq]	Change against 2020	
Neurath Power Plant (RWE Power AG)	22,076	▲	18%
Niederaußem Power Plant (RWE Power AG))	16,105	▲	36%
Boxberg III and IV Power Plant (Lausitz Energie Kraftwerke AG)	15,534	▲	1%
Jänschwalde Power Plant (Lausitz Energie Kraftwerke) AG)	15,184	▲	11%
Weisweiler Power Plant (RWE Power AG)	14,490	▲	26%
Schwarze Pumpe Power Plant (Lausitz Energie Kraftwerke AG)	11,834	▲	15%
Lippendorf Power Plant (Lausitz Energie Kraftwerke AG)*	11,051	▲	34%
Mannheim Large Power Plant (GKM) (Grosskraftwerk Mannheim AG)**	5,004	▲	20%
Schkopau Power Plant (Saale Energie GmbH)	*4,409*	▲	*48%*
Rheinhafen Steam Power Plant, Karlsruhe (EnBW Energie Baden-Württemberg AG)	*4,157*	▲	*95%*
Total	**119,844**	▲	**21%**

As of 02/05/2022
* Lippendorf Power Plant is a joint power plant owned by LEAG (Lausitz Energy Power Plants AG) and EnBW (Energy Baden-Württemberg AG), each of which owns a unit.
** Mannheim Large Power Plant is a joint power plant of the following companies: RWE Generation SE (40%), EnBW (32%) and MVV RHE GmbH (28%).
Italics = new installation / power plant in the TOP 10

The ten largest emitters among the industrial installations all belong to the iron and steel industry or are refineries. At around 36 million tonnes of carbon dioxide equivalents they emit significantly less than the ten largest power plants. Their share of emissions subject to emissions trading in the stationary sector is around ten percent, while they account for 30 percent of emissions from industrial installations.

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

Installation (operator)	2021 VET [kt CO_2eq]	Change against 2020	
Duisburg Integrated Steelworks (thyssenkrupp Steel Europe AG)	7,837	▲	15%
Duisburg-Huckingen Plant, Glocke (HKM Hüttenwerke Krupp Mannesmann GmbH)	4,894	▲	24%
Dillingen Plant, Amalgamated Installation (ROGESA Roheisengesellschaft Saar mbH)	4,284	▲	19%
Salzgitter Plant, Glocke (Salzgitter Flachstahl GmbH)	3,736	●	0%
PCK Refinery, Glocke (PCK Raffinerie GmbH)	3,480	▼	–1%
Ruhr Oel GmbH – Scholven Plant (Ruhr Oel GmbH)	3,010	▲	8%
Oberrhein Mineral Oil Refinery, Plant 1 and Plant 2 (Mineralölraffinerie Oberrhein GmbH & Co. KG)	2,477	▼	–6%
Bremen Plant, Amalgamated Installation (ArcelorMittal Bremen GmbH)	2,267	▼	–3%
Duisburg-Schwelgern Coking Plant (thyssenkrupp Steel Europe AG)	1,897	▼	–6%
Wesseling Plant (Shell Deutschland GmbH Shell Energy and Chemicals Park Rheinland)	*1,782*	▼	*–5%*
Total	**35,664**	▲	**7%**

As of 02/05/2022
Italics = new installation / power plant in the TOP 10

Allocation Status

In the first year of the fourth trading period, verified emissions of 355 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 2021, about 124 million emission allowances were allocated free of charge to operators of 1,570 of Germany's 1,735 installations. The average allocation coverage was thus 35 percent being considerably below the level of the previous year (2020: 43 percent). On the one hand, this is due to the increase in emissions compared to the previous year. On the other hand, the amount of free allocation decreased significantly (2020: 136 million emission allowances) although no cross-sectoral correction factor was used in 2021 as was the case in the third trading period. However, various aspects of the allocation rules adjusted to the fourth trading period (above all reducing the product and fallback benchmarks) had the effect of reducing the amount of free allocation.[4] The allocation coverage taking into account transfers of waste gases from iron, steel and coke production and heat imports in the allocation amounts changes proportionally between the sectors. This adjustment reduces the 2021 allocation coverage in the industrial sectors from 94 to 79 percent, while the energy sector's allocation increases from 5 to 13 percent as illustrated in Table 3.

4 Further details can be found in the industry chapters 2.1 to 2.8 and, in summary, in Chapter 2.9.

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

Sector	Activity	No. of instal-lations	2021 allocation amount [1000 EUA]	2021 VET [kt CO_2eq]	2021 allocation deviation from VET 2021 [kt CO_2eq]	2021 alloca-tion cove-rage*	Adjusted 2021 allocation amount** [1000 EUA]	Adjusted 2021 allocation coverage**
Energy	Energy installation	868	11,858	235,222	−223,363	5.0%	29,809	12.7%
		868	**11,858**	**235,222**	**−223,363**	**5.0%**	**29,809**	**12.7%**
Industry	Refineries	22	15,729	22,514	−6,784	69.9%	15,729	69.9%
	Iron and steel	120	45,422	35,428	9,994	128.2%	29,580	83.5%
	Non-ferrous metals	39	2,443	3,135	−692	77.9%	2,443	77.9%
	Industrial and building lime	39	4,425	6,958	−2,533	63.6%	4,425	63.6%
	Cement clinker	35	17,337	20,532	−3,195	84.4%	17,337	84.4%
	Other mineral processing industry	223	5,513	8,128	−2,615	67.8%	5,513	67.8%
	Paper and pulp	138	4,942	5,383	−441	91.8%	3,910	72.6%
	Chemical industry	198	16,191	17,249	−1,058	93.9%	15,113	87.6%
	Other combustion plants	50	581	534	47	108.8%	581	108.8%
		864	**112,582**	**119,861**	**−7,278**	**93.9%**	**94,632**	**79.0%**
Total		**1,732**	**124,441**	**355,082**	**−230,642**	**35.0%**	**124,441**	**35.0%**

As of 02/05/2022
* 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 2021 (27 EU Member States and Iceland, Liechtenstein, Norway) also increased to a smaller extent than Germany. According to European Commission data, emissions increased by 7.3 percent in 2021 and amounted to 1.31 billion tonnes of carbon dioxide equivalents. As a result of the economy picking up in the second pandemic year, electricity consumption returned to 2019 levels and industrial production also increased significantly again.

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, the EUA amounts earmarked for auctioning are 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 2021, the TNAC was 1.45 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 and is also higher than the emissions of installations covered by the EU ETS. The current value of the TNAC decides the size of the auction volume cut by the MSR in the period from 01/09/2022 to 31/08/2023. In this period, a total of around 347 million fewer emission allowances than planned will be auctioned and transferred to the MSR.

Aviation

For 2021, a total of 67 of the aircraft operators subject to emissions trading administered by Germany reported emissions of 4.6 million tonnes of carbon dioxide. This means that emissions increased by around 20 percent compared to the previous year. The average equipment level in 2021 was around 72 percent, which is significantly lower than the figure for 2020 of 92 percent. This is due to the increased emissions caused by the recovery of the aviation sector after the sharp decline in transport performance in 2020 due to the COVID 19 pandemic.

Outlook

2021 was the first year of the fourth trading period of the EU ETS, from which a changed allocation regime and a more sharply declining cap will now come into effect. It was characterised by a recovery of the overall economic situation and thus an increase in emissions following the sharp drop in emissions in 2020 due to the COVID 19 pandemic.

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In the summer of 2021, the European Commission also presented a broad legislative package as part of the European Green Deal to implement an increase in the EU greenhouse gas reduction target for 2030 to at least 55 percent compared to 1990. This package called **'Fit for 55'** also contains proposals for adjusting the EU ETS and thus new framework conditions for the fourth trading period launched this year:[6]

- It is planned to reduce emissions in the EU ETS by 61 percent by 2030 compared to 2005. To achieve this, the linear reduction factor (LRF) is to be increased from the current 2.2 percent to 4.2 percent. In addition, the **cap** is to be lowered once in the year after the amended emissions trading directive comes into force so that a linear reduction is achieved between 2021 and 2030.
- In addition, the **Market Stability Reserve** will also be strengthened and adjusted: a doubling of the reduction rate from 12 to 24 percent of the number in circulation (TNAC) will be maintained up to 2030 and will thus not end in 2023 as currently planned. A smoothing mechanism will also be introduced to prevent threshold effects.
- In the future, Member States are to use 100 percent of their **revenues from auctioned** emission allowances for climate protection measures or social compensation measures, instead of the current 50 percent. There are also plans to increase the two funds financed by the EU ETS, the Modernisation Fund and the Innovation Fund, and to expand their scope of support.
- To protect against carbon leakage, i. e. the relocation of industrial production, investments and associated emissions abroad, a **Carbon Border Adjustment Mechanism** (CBAM) is to be gradually introduced. This is intended to impose the same CO_2 price on certain energy-intensive basic materials and products imported into the EU from abroad as 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.
- It is planned to gradually extend the scope of the EU ETS to include **maritime transpor**t. Emissions from journeys within the European Economic Area (EEA) – i. e. EU, Norway, Iceland and Liechtenstein – and emissions at a berth should be fully covered. Emissions from journeys arriving in or departing from the EU from abroad should be covered at 50 percent.
- For **aviation**, the ambition level is to be increased via adjustments to the cap as well as to the free allocation. CORSIA will also be implemented as part of the EU Emissions Trading Directive.

The Commission's proposals for adjusting the legal framework in the EU ETS are currently still being negotiated by the European Council and the European Parliament and have therefore not yet been adopted.

In addition, **national fuel emissions trading** started in Germany in 2021. The relevant emissions recorded will be reported for the first time in 2022.

In particular, the **war of aggression against Ukraine** launched by Russia on 24/02/2022 will have a lasting impact on further energy and climate policy trends. In order to ensure energy security for Germany, both for private households and industry, dependence on Russian fuels should be ended. This seems possible in the foreseeable future through alternative suppliers, the determined acceleration of the expansion of renewable energies, improvements in energy efficiency and energy-saving measures in general. In the short term, high war-related natural gas prices could mean that more coal-fired power plants, especially lignite-fired power plants, would again be used to generate energy. This would result in higher emissions from energy installations. On the other hand, the effect of high energy prices on industrial production and thus emissions from industrial installations would tend to be dampening. Overall, it can be assumed that economic development in Germany and the EU will be significantly influenced and shaped by this situation. The requirement to meet emission reduction targets by 2030 for the EU as well as nationally in accordance with the Climate Protection Act remains unchanged.

6 For a more detailed analysis of the proposals, see the fact sheets published by UBA: www.umweltbundesamt.de/en/topics/eu-commission-proposes-comprehensive-reform-of

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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)
BMWi	Federal Ministry for Economic Affairs and Energy
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
CL	Carbon leakage
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
EA	Emission allowance
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
EEA	European Economic Area (the same as EU30)
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 2021 VET Report. Chapter 2 addresses the emissions from stationary installations subject to emissions trading according to sectors. Section 2.9 of Chapter 2 addresses the cross-sectoral allocation status of stationary installations in Germany. Section 2.9 of this year's report contains an excursus on the adjusted allocation rules for the fourth trading period of the European Emissions Trading Scheme. In addition, Section 2.10 of Chapter 2 contains a review of the trend in emissions from the stationary sectors subject to emissions trading in the EU during the third trading period. Chapter 3 looks beyond Germany at EUA price trends, EU ETS emissions in Europe and the carbon market surplus. 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 2021. 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 2021 annual emissions will be available for the first time in the autumn of 2022 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 28/02/2022	
	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		

As of 02/05/2022

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 (Estimated Emissions before 2013)

An estimate of emissions prior to 2013 to correct the scope over the individual trading periods (scope estimation) has been shown in the emissions trend figures. In addition, the estimate of the scope correction 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. For installations where new partial activities were added, the difference between historical emissions and data from the allocation application or 2020 data acquisition was determined. The scope estimate has been determined by linear interpolation for years 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 considered 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 on the emissions trend of the sectors 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 e. g. 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 before the reporting year in order to fully reflect the change in emissions compared to the previous year.

Free Allocation in 2021

Free allocation as reported for 2021 to the European Commission prior to 28/02/2022, is the basis for the allocation status assessment, i. e. comparison of emissions and free allocations. At this time not all allocation changes that are relevant for 2021 are necessarily approved. That is, the representation of the allocation status does not include any potential allocation corrections made after 28/02/2022.

The allocation amount approved by the European Commission is included in the National Allocation Table[7] (NAT), which specifies the free basic allocation for 1,555 existing installations and corrections of this basic allocation for individual installations as approved by the European Commission by 28/02/2022. 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. 1,570 installations of those considered in the 2021 VET report received free allocations for 2021 totalling around 124 million allowances as of 28/02/2022.

7 Cf. DEHSt 2013b

Estimated Allocation for Adjustment of the Allocation Coverage[8]

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 for the third trading period was determined based on heat import data from the allocation procedure[9]. 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 mean value of the data on heat imports from the allocation applications was used for this year's VET report.[10] In addition, the respective valid heat benchmarks were used for the estimation.

Emissions and Production Trends

For some sectors or activities, the emission trend is compared with the production trend. 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 information about the operational status; the activity rates from 2020 onwards are now reported by the operators in the annual allocation data reports. The submission deadline for the annual allocation data report is 31 March, but this was extended to 30 April for 2021, so the data was not included in the 2021 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 2017 and 2021 compared to 2017 (2017 = 100%) and the corresponding emissions (also as relative changes compared to 2017) 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 incumbent 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.

8 See also glossary entry on adjusted allocation coverage.

9 See also DEHSt 2014a, Chapter 7.8

10 Heat import data is also available in the annual allocation data reports of the fourth trading period. This cannot be used for this year's VET report due to the extended submission deadline of 30/04/2022.

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 2021a). This refers to both Section 2.10 and Section 3.

For 2021 these will be supplemented by a notification on the website of the European Commission of 25/04/2022 (see COM 2022a). 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 38, Chapter 7).

Data Status

The status of the data used as the basis for the tables and figures in the VET Report is generally 02/05/2022 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 Emissions 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 they have emission sources as per Section 4(3)(4) TEHG, no longer fall within the scope of the TEHG in the fourth trading period.[11] 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 for this reason.

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 2021. 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 150,000 tonnes of carbon dioxide equivalents up to the data cut-off date 02/05/2022.

Main Activity of the Installations

On the occasion of the transition from the third to the fourth trading period, the assignment of the main activity of the installations subject to emissions trading, needed for evaluating the VET report, was reviewed. 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 with previously published data.

11 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

868 energy installations[12] (installations according to points 2 to 6 Annex 1 of the TEHG) were subject to emissions trading in 2021.

The emissions from these energy installations increased by 29 million tonnes of carbon dioxide (plus 14 percent), a significant gain compared to the previous year. However, a strong reduction in emissions was recorded a year earlier (minus 15 percent). In 2021, emissions amounted to around 235 million tonnes (see Table 5).

The majority, i. e. 97 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.

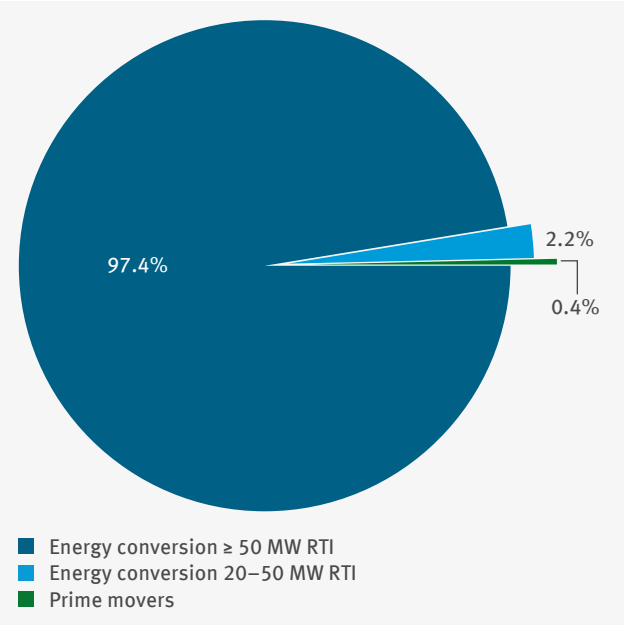


Figure 5: Shares of 2021 emissions from energy installations (Activities 2 to 6)

Table 5: Energy installations (Activities 2 to 6), number of installations, 2020 emissions, 2021 free allocation, 2021 VET entries and allocation coverage

No.	Activity	No. of installations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
2	Energy conversion >= 50 MW RTI	439	200,274	229,172	10,076	4.4%
3	Energy conversion 20 – 50 MW RTI	361	4,764	5,120	1,455	28.4%
4	Energy conversion 20 – 50 MW RTI, other fuels	12	67	64	90	140.0%
5	Prime movers (engines)	3	42	43	8	18.8%
6	Prime movers (turbines)	53	791	823	229	27.8%
	n. l. ETS	*26**	*27*	–	–	–
Total		**868**	**205,965**	**235,222**	**11,858**	**5.0%**

As of 02/05/2022
* n. l. ETS not included in total number of installations

Overall, emissions from all large combustion plants have increased by more than 14 percent compared to 2020. This reflects the fact that electricity generation from lignite and hard coal in particular, has strongly increased.

12 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'.

On the other hand, the increase in emissions from energy installations with an RTI between 20 and 50 megawatts (Activities 3 and 4 as per Annex 1 TEHG) was lower (plus seven 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 combined heat and power plants for electricity supply decreased overall in 2021, but more natural gas was used for heat generation at district heating utilities. 2021 was on average noticeably colder than 2020, especially in the first half of the year, and also colder than the long-term average measured by the number of degree days.[13]

Although the about 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 2021. This was about 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 0.4 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). Emissions from these installations, which are used to transport, store and process natural gas, again increased by around four percent compared to the previous year. The operation of these installations depends on the conditions in the natural gas network. Overall, natural gas consumption in Germany increased by around five percent last year.[14]

In 2021, 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 2020, the allocation coverage was still about nine percent with a free allocation of about 18 million emission allowances.

This strong decline in free allocation and allocation coverage is due to the allocation rules of the fourth trading period:

1. Emission-intensive fuels are used in the form of lignite and hard coal, especially in large combustion plants. However, a heat benchmark is used for all heat-based allocations for the fourth trading period which was derived in accordance with the Emissions Trading Directive and took into account combined heat and power (CHP) and also biogenic fuels, and is 24 percent lower than the emissions benchmark for the third trading period. This explains a significant part of the sudden drop in allocation coverage compared to the situation in 2020.
2. Only the linear reduction factor is applied to the allocation for products that are not classified as at risk of carbon leakage in the first allocation period of the fourth trading period (2021 to 2025). It is fixed at 30 percent and thus maintains the value achieved at the end of the third trading period. However, the allocation of products considered at risk of carbon leakage was fundamentally revised with the transition from the third to the fourth trading period with the result that numerous products are no longer considered at risk of carbon leakage in the fourth trading period. The heat volumes supplied by energy installations for these products are now subject to a carbon leakage factor (CL factor) of 30 percent rather than 100 percent. This also contributes to the sudden drop in allocation coverage.

The increase in emissions compared to 2020 also led to a reduction in allocation coverage.

13 AGEB 2022a
14 AGEB 2022a

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 seven and was equal to about 28 percent of their emissions. Activity 4 installations, in which biomass and fuels with biogenic components are used, have an even higher allocation coverage of 140 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 27 percent.

The following must be considered 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 16 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 2021 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 a somewhat higher adjusted allocation coverage of around 13 percent (compare Table 6 and Figure 6).

Table 6: Energy installations (Activities 2 to 6), number of installations, allocation amounts, 2021 VET entries and adjusted allocation coverage

Sector	No. of installations	2021 adjusted allocation amount [1000 EUA]	2021 VET [kt CO_2eq]	2021 allocation deviation from 2021 VET [kt CO_2eq]	Adjusted allocation coverage
Energy installations	868	29,809	235,222	–205,413	12.7%

As of 02/05/2022

Trends in the Past Years

Figure 6 below shows the emissions trend of energy installations since the beginning of emissions trading. For the first, second and trading periods, the average emissions and allocation quantities are shown as columns in each case; for the period from 2017, 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 here.

Average emissions in the second trading period (including n. l. ETS) decreased by around seven percent compared to the first trading period. Emissions fell steadily during the third trading period: carbon dioxide emissions decreased by a total of 34 percent between 2017 and 2020, the final year of the third trading period, and were just above the 200 million tonne mark. 2021 emissions from energy supply increased by 14 percent to 235 million tonnes of carbon dioxide equivalents. Thus, contrary to the trend in the third trading period, the first year of the fourth trading period of the EU ETS began with an increase in emissions. The key factors in this rise were mainly from the combustion of hard coal and lignite, along with higher demand for electricity due to the economic recovery.

15 Cf. DEHSt 2014a, Chapter 'Energy installations'.

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). The above-mentioned decrease in free allocation is difficult to see in Figure 6 due to scaling.

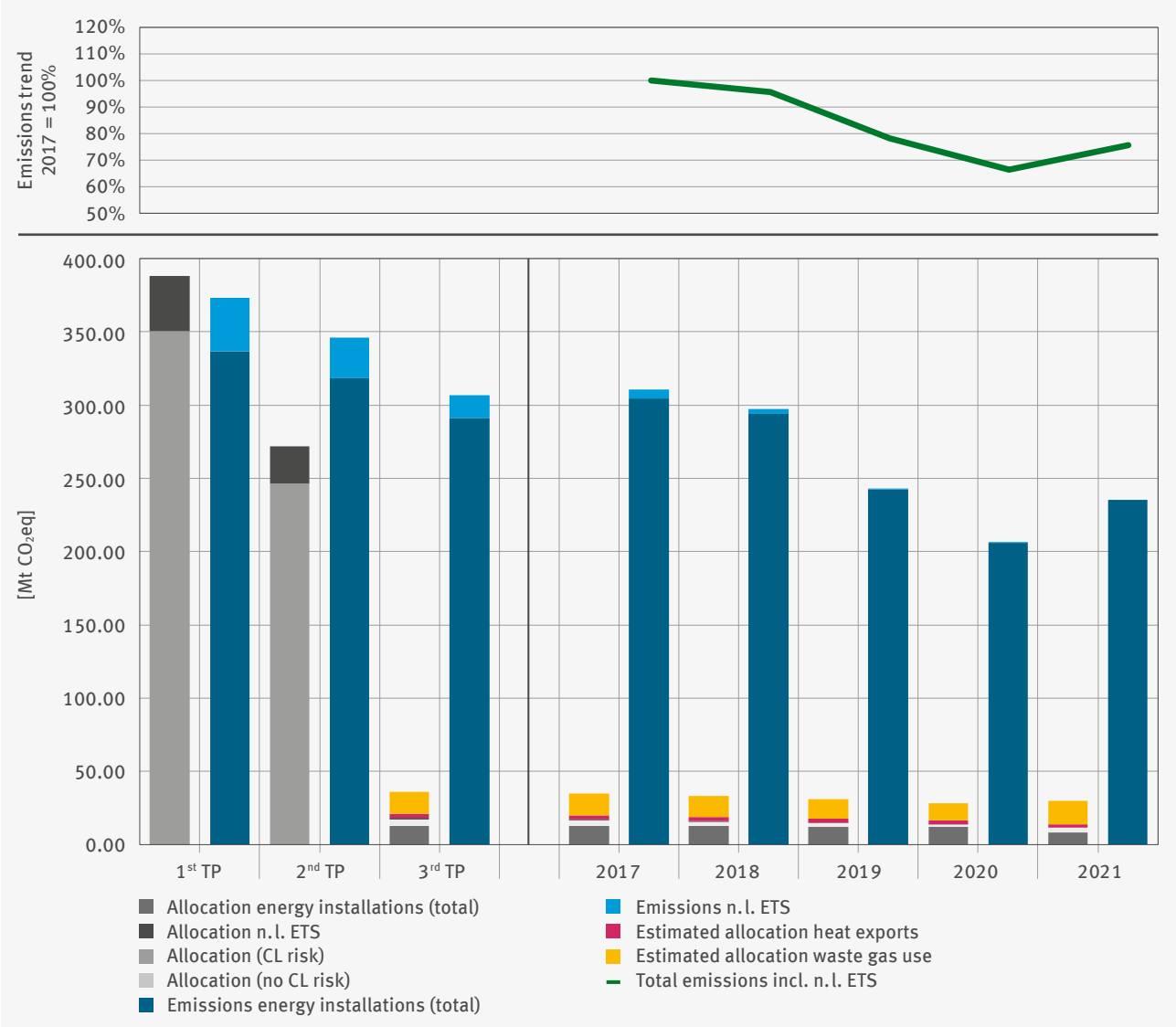


Figure 6: Energy installations (Activities 2 to 6), emissions and free allocation trend in Germany up to 2021[16]

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. 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.

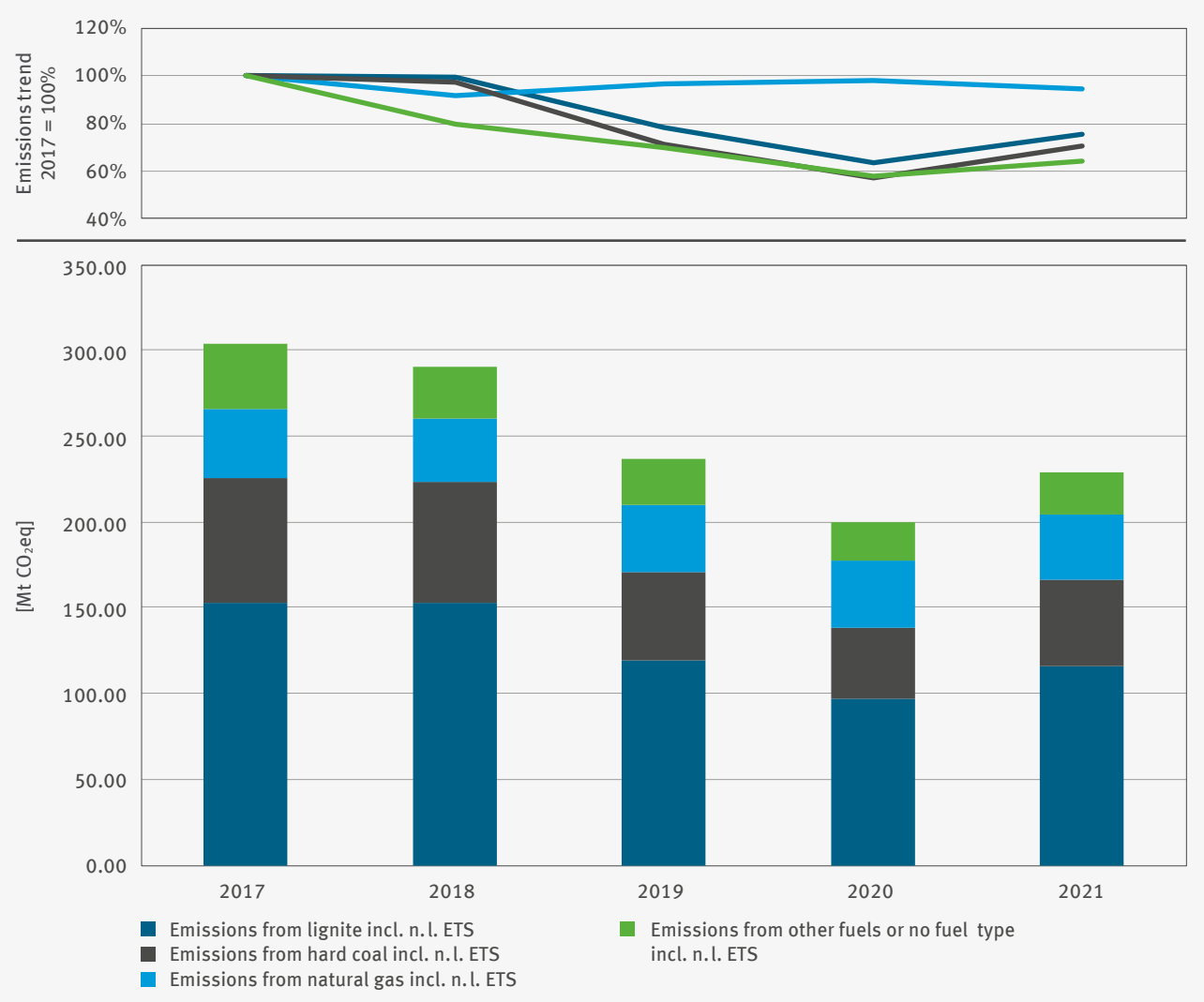


Figure 7: Energy installations (Activities 2 to 6), emissions trend from 2017 to 2021, according to fuel type

After emissions from lignite fell continuously during the third trading period and in 2020 reached their lowest level since the start of emissions trading in 2005, a strong increase was recorded last year. Emissions increased by around 19 percent compared to the previous year, almost reaching the 2019 level. A similar trend can also be observed for emissions from hard coal. During the third trading period, emissions declined for seven consecutive years, but last year saw an increase of around 23 percent compared to the same period the previous year. By contrast, emissions from natural gas-fired plants fell by around three percent. This is partly due to the increasing fuel switch from natural gas to coal in electricity production.

Compared to 2017, emissions from installations using lignite as their main fuel fell by around 25 percent. The decline in emissions from energy installations using hard coal as their main fuel was even greater at 30 percent. Emissions from natural gas installations were slightly below those in 2017. 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 shows the comparison of emissions trends for large combustion plants for gross electricity generation from fossil fuels in Germany broken down by lignite, hard coal and natural gas.

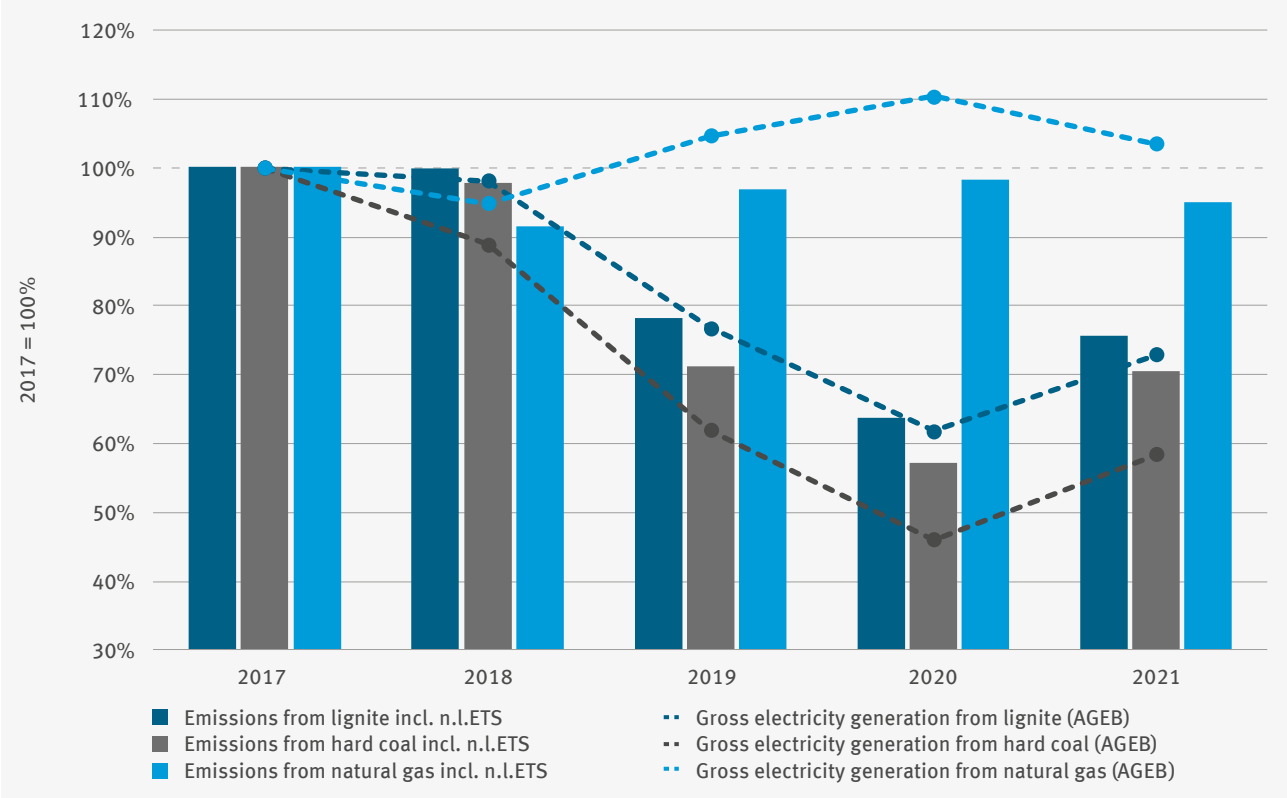


Figure 8: Large combustion plants (Activity 2), emissions and production trend from 2017 to 2021 compared to 2017

The figures of gross electricity generation and emissions from lignite and hard coal-fired installations (see Figure 8) shows first a clear downward trend in the third trading period (here from 2017 to 2020). At the same time, it is clear that – compared to 2017 – the decrease in gross electricity generation from hard coal-fired installations was greater than the decline in emissions from these installations. This means that the specific emissions of electricity generation from hard coal-fired installations did not decrease, but actually increased to a small extent, i. e. electricity was generated from hard coal at a lower efficiency. This is surprising since the decommissioning of old units in recent years was expected to increase efficiency, and this is also confirmed by studies by the German Environment Agency (UBA)[17] and others. That the figure does not show this may have various reasons. For one thing, combined heat and power generation (CHP) has not been included in the consideration. If the decrease in electricity generation from hard coal-fired CHP plants is not combined with a reduction in their heat generation to the same extent, it is not to be expected that emissions will decrease proportionally with electricity generation. On the other hand, a reduced workload for installations, especially due to more intensive operation in the partial load range, tends to lead to efficiency losses and increased specific emissions.

17 According to German Environment Agency (UBA) studies, an analysis of emissions (from power plants and CHP stations) to be exclusively assigned to electricity generation shows that the efficiency of coal-fired plants on the electricity side tends to increase when the 'Finnish emission assigning method' is applied to electricity and heat generation (cf. UBA 2020).

The opposite picture emerges for natural gas-fired installations: electricity generation from this group of installations has increased compared to 2017, while emissions are just below the 2017 level. This is mainly explained by the increased use of more efficient electricity generation, but the increasingly better capacity utilisation also plays a role. In 2021, electricity generation from natural gas decreased compared to the previous year and is only slightly above the level of 2017. However, emissions did not decrease analogously. This may be due to the fact that although natural gas was used less for electricity generation, it was used to a similar extent as previously for heat generation.

The trends in electricity generation and emissions from lignite-fired power plants were largely consistent in the period from 2017 to 2021.

Compared to 2017, the gross electricity generation of large combustion plants using hard coal fell by 41 percent from 93 terawatt-hours to 55 terawatt-hours.[18] In 2020, gross electricity generation from hard coal in Germany was 43 terawatt-hours, the lowest level in 65 years.[19] The main reasons for the renewed increase in electricity generation from hard coal and lignite were a significantly lower feed-in from wind power installations and a disproportionate increase in the price of natural gas, which economically favoured the use of hard coal installations over natural gas. All the more noteworthy was the high number of installation closures or transfers to the grid reserve with a capacity of around six gigawatts in 2021, which were carried out as part of the first two tendering rounds for the decommissioning of hard coal capacities.[20] These include the two units of the Moorburg installation, which only went into operation in 2015. Particularly in the second half of 2021, the economic efficiency of the hard coal-fired plants improved compared to the previous year due to the comparatively high prices for natural gas and electricity. Particularly in the last quarter of 2021, the calculated profit margins (clean dark spreads) reached new highs (see also Section 'Fuel Switch/Clean Spreads').

Since 2017, gross electricity generation by lignite-fired power plants has fallen by around 26 percent from 148 terawatt-hours to 110 terawatt-hours. In 2020, electricity production from lignite was at around 92 terawatt-hours, the lowest level for at least 40 years.[21] After an interruption in the previous year, lignite was the most important source of energy for electricity generation in 2021, with a share of around 19 percent. Next is natural gas and onshore wind power with a share of around 15 percent each, nuclear power (twelve percent) and hard coal (nine percent).[22] The economic efficiency of lignite-fired power plants also improved considerably in the second half of last year due to the disproportionate increase in natural gas and electricity market prices, while lignite production costs remained relatively stable. At the end of 2020, one unit of the Niederaussem installation (297 megawatts (MW)) was decommissioned in accordance with the Coal Phase-out Act.[23] At the end of 2021, a total of three more lignite units with a capacity of around one gigawatt also followed. Between October 2016 and October 2019, lignite units with an installed net capacity of around 2.7 gigawatts were placed on security reserve.[24] After four years on security reserve, the lignite units will be decommissioned permanently.

Since 2017, the gross electricity generation of natural gas power plants has increased by four percent from 86 terawatt-hours to 90 terawatt-hours.[25] However, compared to 2020, when electricity production in natural gas power plants reached a new high and overtook lignite for the first time, a decline was recorded for the reasons already mentioned above. The greater increase in gross electricity generation compared to emissions is an indication of improved average efficiency of the installations, also as a result of higher utilisation.

18 AGEB 2022b

19 Coal industry statistics 2022

20 AGEB 2022a

21 Coal industry statistics 2022

22 AGEB 2022b

23 In 2020, the German government passed a law to 'reduce and phase out coal-fired generation' [Coal Phase-out Act (KohleausstiegsG)]. The cabinet resolution 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).

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

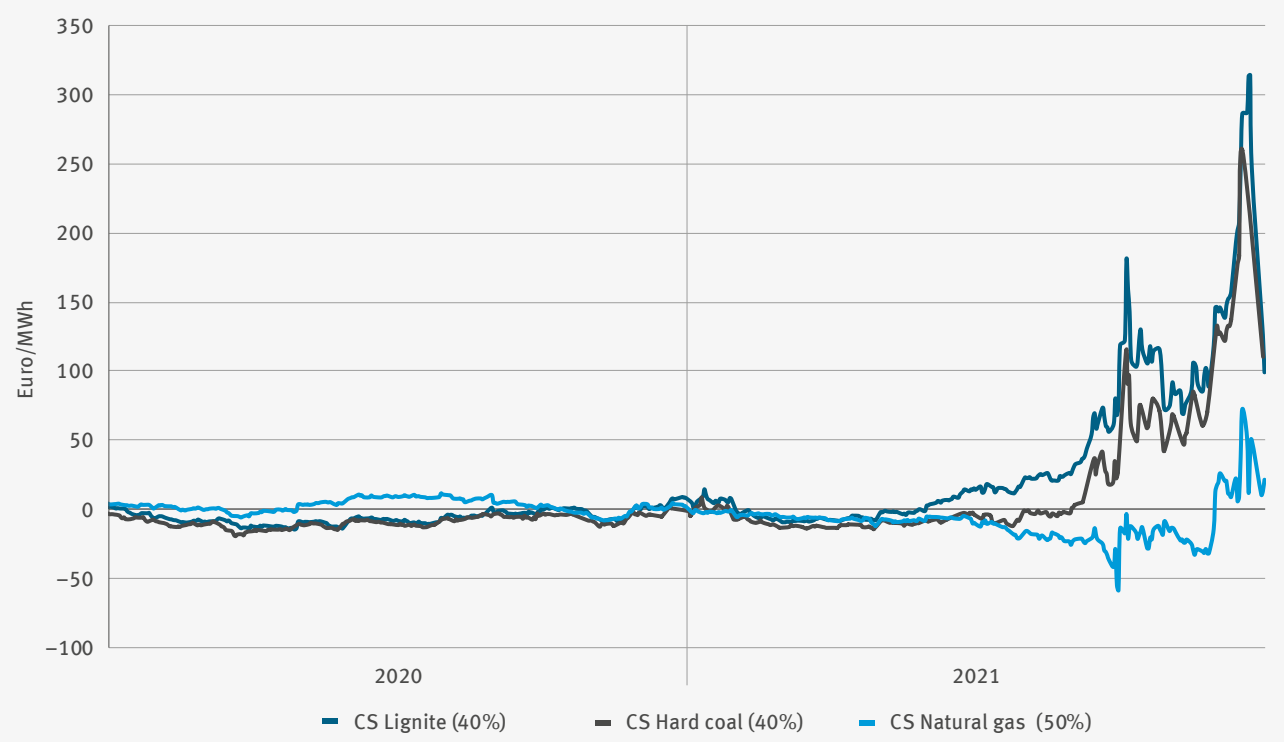
25 AGEB 2022b

Fuel Switch/Clean Spreads

The following figure shows the calculated contribution margins (clean spreads) for selected types of installations. The clean spreads are calculated as the balance of revenue per megawatt-hour (MWh) generated and the variable costs for fuel and emission allowances as well as operating costs. The actual contribution margins of the operators can deviate from this and depend partly on the respective hedging strategy[26] of the energy suppliers. Larger energy suppliers in particular hedge their electricity production several years in advance. Heat-controlled installations can also have a different cost structure.

The economic set up of lignite and hard coal power plants changed fundamentally, especially in the second half of 2021 compared to 2020. While the calculated contribution margins for lignite (clean lignite spreads) and hard coal (clean dark spreads) were still negative in some cases at the beginning of 2021, high triple-digit calculated profit margins were recorded in some cases in the second half of the year. Due to the rapid increase in natural gas prices on the world markets, gas-fired power plants were increasingly forced out of the market and at times determined the electricity price as price-setting marginal installations, which in turn reached new highs. In the case of lignite-fired power plants, the almost constant fuel costs for domestic lignite played an important role. The significant increase in electricity prices[27] was also able to more than compensate for the ever-increasing carbon dioxide prices.

The profitability of natural gas power plants compared to electricity generation from coal was almost consistently lower, at least on paper, especially in the second half of 2021 and within the framework of the assumptions made. It was also due to extremely high natural gas prices. However, it should be noted that larger energy suppliers in particular hedge the prices for fuels as well as carbon dioxide emission allowances several years in advance, so the current price trend is only reflected in the deployment order of the installations (merit order) with a certain time lag.



As of 13/04/2022
Source: Refinitiv Eikon, ICIS, DEHSt

Figure 9: Clean spreads for lignite, hard coal, natural gas in 2020 and 2021 (front month contracts in each case) with efficiency of 40 percent (coal) and 50 percent (natural gas)

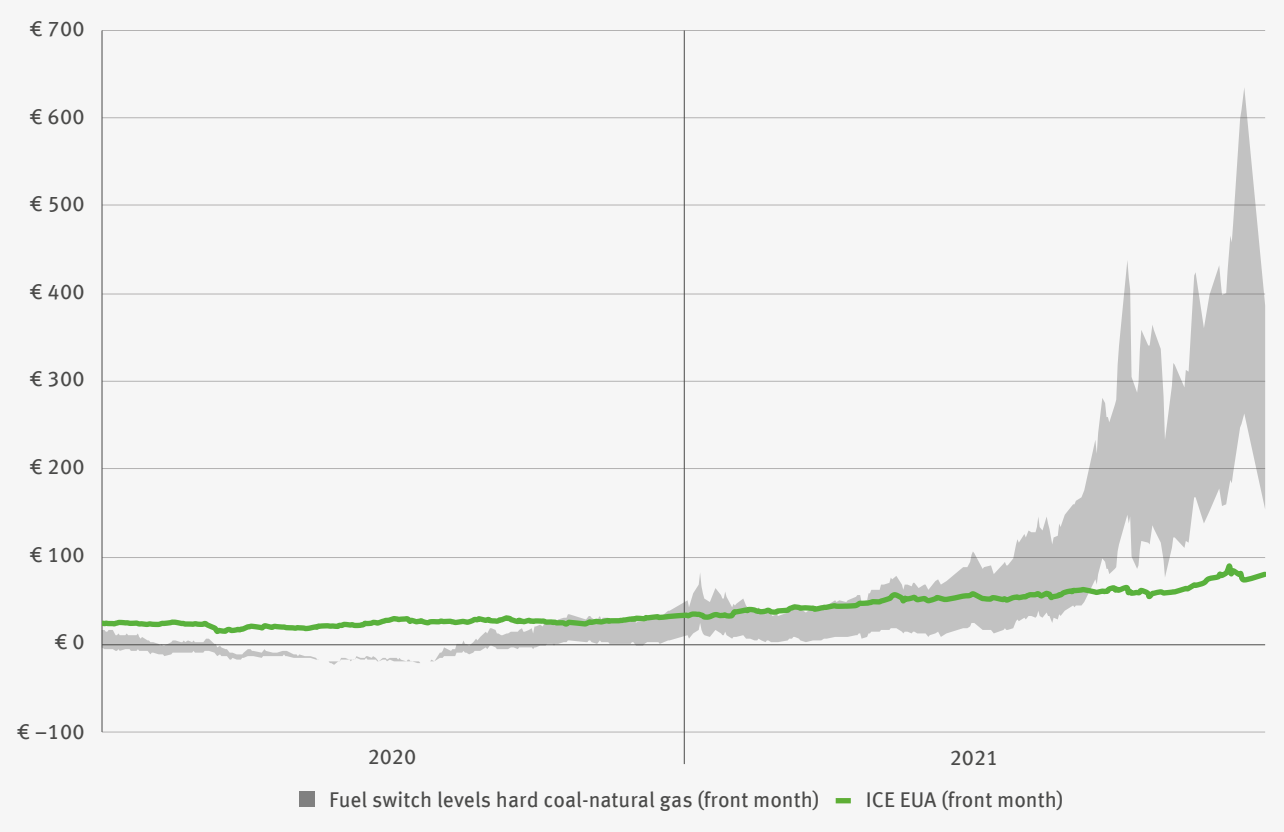
26 'Hedging strategy' refers to energy suppliers' hedging strategies with regard to fuel and carbon dioxide prices.

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

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 the 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 (especially in the second half of the year) led to significantly higher fuel switch levels overall last year, while negative fuel switch levels were still observed in some cases in 2020. In the course of the year, the price of natural gas (TTF front month[28]) rose at times by more than 800 percent compared to the beginning of the year and reached a new high of over €180 per megawatt-hour (MWh). In the same period, the price of hard coal (API2 front month[29]) rose by more than 300 percent at its peak. Accordingly, the calculated fuel switch range rose strongly in the second half of the year and the economic set up shifted in favour of hard coal. Figure 10 shows that at the beginning of the year, with EUA prices of around €30 to €50 and the resulting change in business cost factors, most hard coal power plants were displaced by efficient natural gas power plants, at least on paper. In the second half of the year however, the fuel switch levels had already reached high three-digit amounts, while the EUA price was significantly lower.

Rising natural gas prices also led to higher fuel switch levels between lignite and natural gas compared to the previous year, while production costs for lignite remained relatively constant.



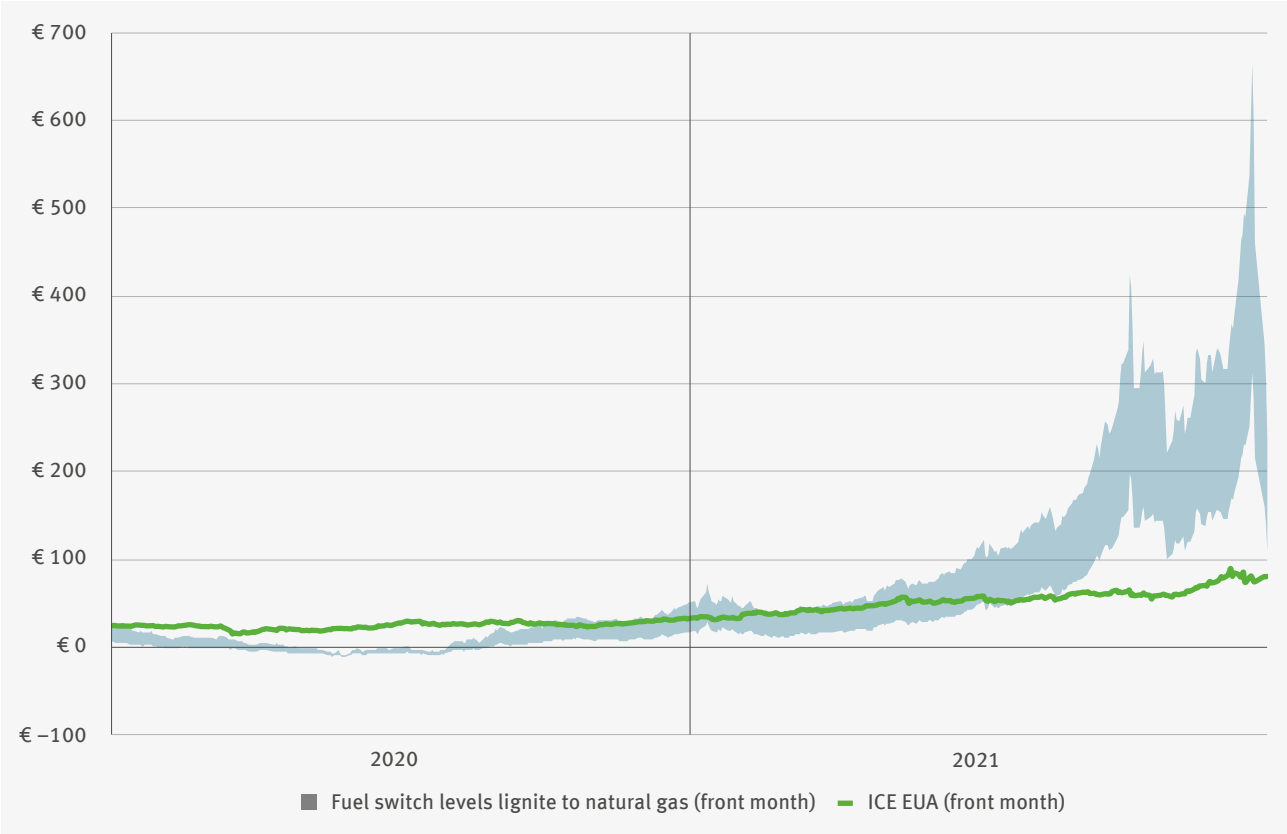
As of 13/04/2022
Source: Refinitiv Eikon, ICIS, DEHSt
* Range HC 35% – NG 60% to HC 45% – NG 50%; no volume-weighted representation of actually available capacities.

Figure 10: Fuel switch levels from hard coal to natural gas* and 2020 and 2021 EUA prices[30]

28 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 hubs for natural gas in Europe.

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

30 In addition to fuel prices, the fuel switch level also depends on the efficiency of the installations 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 04/13/2022
Source: Refinitiv Eikon, ICIS, DEHSt
* Range LG32%-NG60% to LG43%-NG50%; no volume-weighted representation of the actual capacities available.

Figure 11: Fuel switch levels from lignite to natural gas* and EU price in 2020 and 2021

The emissions trends of the 'Combustion and Energy' Activity 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 (MW) 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 Activity 1 installations that are not assigned 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 summarises data on allocation and emissions for these installations. In total, the installations emitted around 0.5 million tonnes of carbon dioxide in 2021. The allocation coverage is around 109 percent of their emissions.

Table 7: Other combustion plants (Activity 1), number of installations, 2020 emissions, 2021 free allocation, 2021 VET entries, allocation coverage

No.	Activity	No. of instal-lations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
1	Combustion	50	536	534	581	108.8%
Total		**50**	**536**	**534**	**581**	**108.8%**

As of 02/05/2022

The following figure shows the emissions trends 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. 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 for the period since 2017. Installations no longer subject to emissions trading (n.l. ETS) are also taken into account.

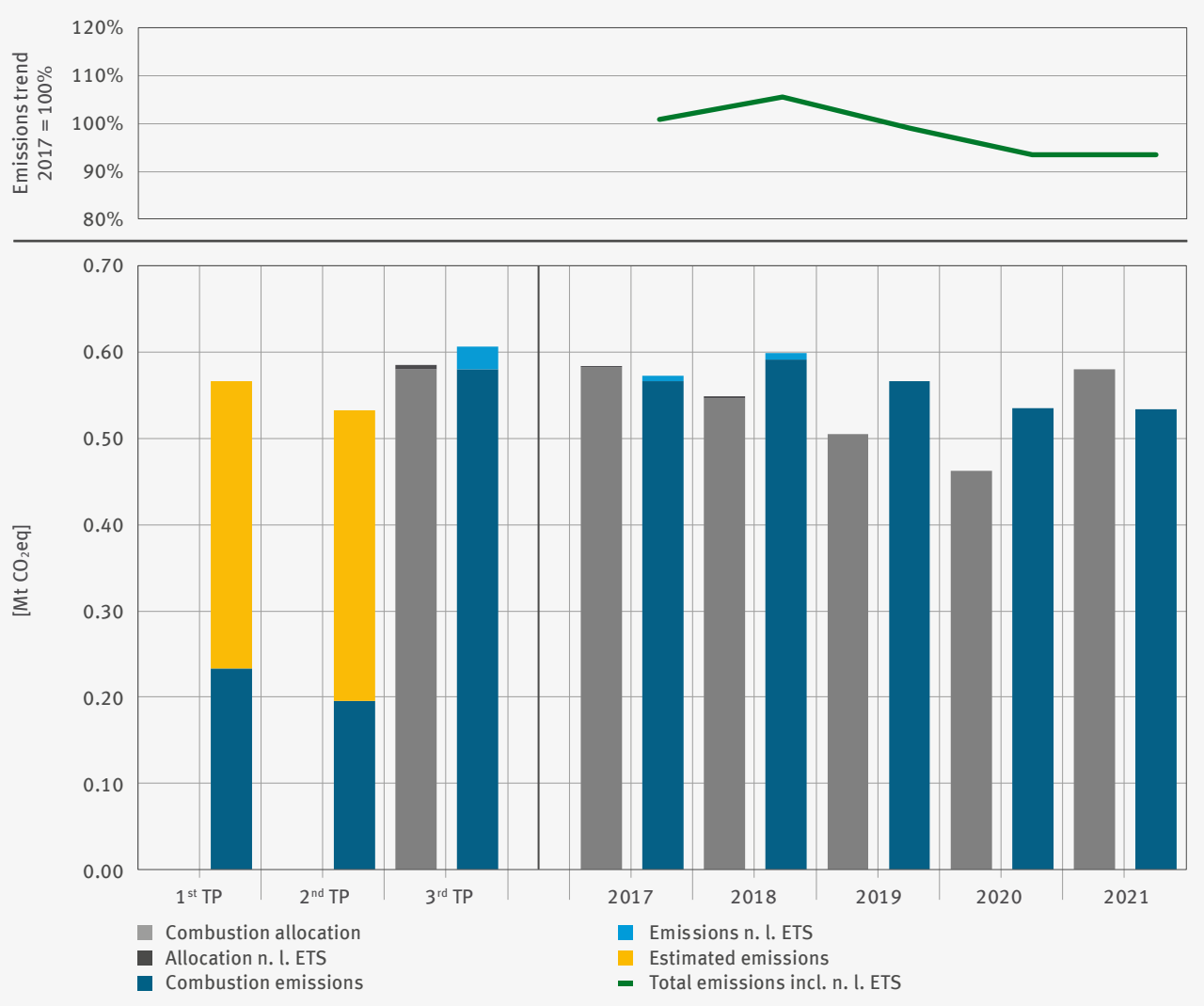


Figure 12: Other combustion plants (Activity 1), emissions trends and free allocation up to 2021

Overall, emissions have decreased by seven percent since 2017. Since this group of installations is very heterogeneous, no general statements can be derived from the emissions trends. It is clear that the free allocation in 2021 was significantly higher than in 2020. This was not due to the discontinuation of the cross-sectoral correction factor compared to the third trading period, as Activity 1 installations only receive a free allocation based on the fallback benchmarks. The reduction of the fallback benchmarks during the transition from the third to the fourth trading period would have, in itself, exceeded the effect of the discontinuation of the cross-sectoral correction factor. The reason for the increase in free allocation is that, compared to the third trading period, Activity 1 installations increasingly receive a free allocation due to an increased carbon leakage risk.

2.3 Refineries

In the 2021 reporting year, 22 installations subject to emissions trading were refineries (Activity 7 Annex 1 TEHG).[31]

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. Pursuant 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 aforementioned regulation on the formation of an 'amalgamated installation'.

Total refinery emissions in 2021 were 22.5 million tonnes of carbon dioxide. Compared to 2020 with 22.9 million tonnes of carbon dioxide, emissions decreased to a small extent by around two percent (see Table 8).

Table 8: Refineries (Activity 7), number of installations, 2020 emissions, 2021 free allocation, 2021 VET entries, allocation coverage

No.	Activity	No. of installations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
7	Refineries	22	22,875	22,514	15,729	69.9%
Total		**22**	**22,875**	**22,514**	**15,729**	**69.9%**

As of 02/05/2022

In 2021, the refinery sector had a total calculated additional shortfall of around 6.8 million emission allowances with an allocation coverage of around 70 percent. In the previous year, the shortfall was 5.1 million emission allowances at an allocation coverage of 78 percent.

31 From 2021 onwards, an installation is considered a small emitter due to the low carbon dioxide emissions it has been emitting 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 the Past Years

Figure 13 shows the emissions trends of refineries 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 shown for the period since 2017. Installations no longer subject to emissions trading (n.l. ETS)[32] are also taken into account, as are the estimated emissions for the 2005 – 2012 period for those installations that only became subject to emissions trading from 2013[33].

In the first trading period, emissions averaged about 29 million tonnes of carbon dioxide, excluding estimated emissions; in the second trading period, emissions averaged about 27 million tonnes of carbon dioxide, seven percent lower than the average in 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 around 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 2017, emissions have fallen continuously by two to five percent compared to the previous year, with the number of installations remaining almost the same. 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 flowing waters in 2018 and the associated difficulties in the delivery of raw and auxiliary materials as well as in the removal of the products manufactured via waterways[34]. The pandemic-related adjustment of production in the refineries in the 2020 and 2021 reporting years also had an impact on the emissions trends in the industry.

The free allocation (see Figure 13) was on average higher than the sector's emissions in both the first and second trading period. This changed with the start of the third trading period. Refineries were affected by the discontinuation of free allocation for electricity generation because of their power plants. As a result, from 2013 onwards free allocation was significantly below the emissions of the refineries and, compared to other industrial sectors, led to a higher purchasing requirement.[35] The average purchasing requirement in the third trading period was around 22 percent.

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

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

33 The emissions for 2005 to 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.

34 See DEHSt 2020

35 For a comparison of the allocation coverage of the largest industrial sectors, see Section 2.9, Figure 40, page 122

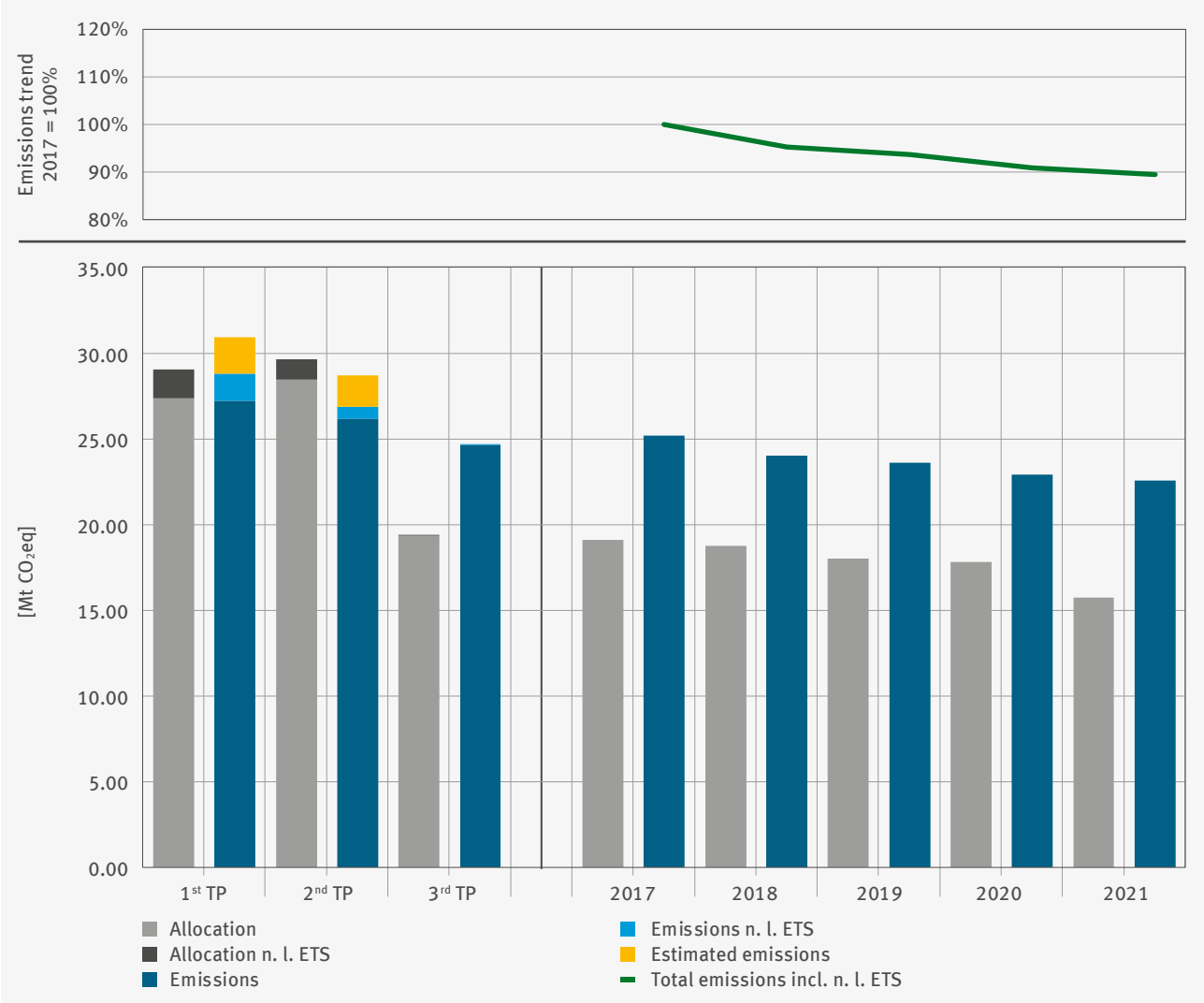


Figure 13: Refineries (Activity 7), emissions trends and free allocation up to 2021

Emissions and Production Trends

Figure 14 compares the emissions trends of the refineries with the German gross refinery output trends and the input of crude oil by the German refineries.

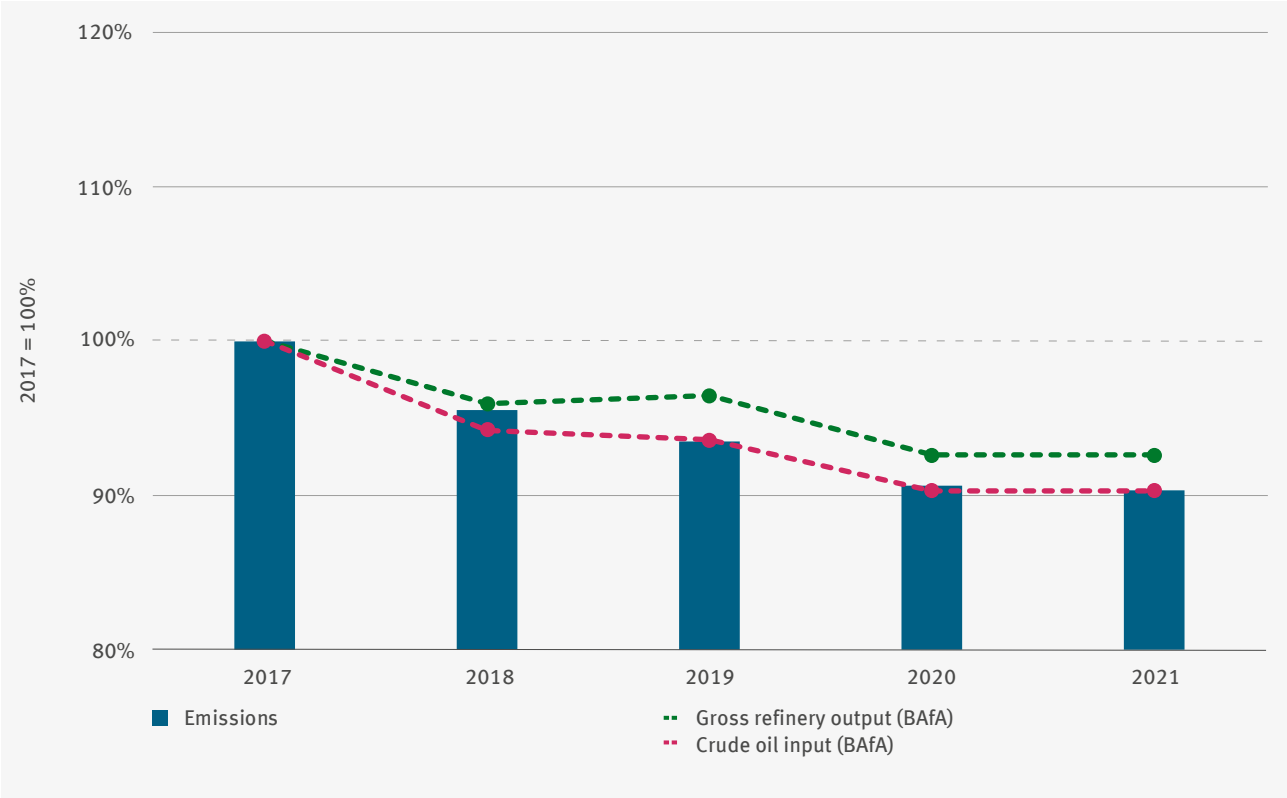


Figure 14: Refineries (Activity 7), emissions trends and 2017 – 2021 production in Germany in relation to 2017 respectively

Figure 14 shows that emissions, crude oil input and gross refinery output largely run parallel to each other. Overall, crude oil input and gross refinery output reflect the trend in emissions relatively well over the period under consideration. The decrease in emissions is likely to be predominantly due to the decline in crude oil input.

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

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 per TEHG[36], which means a total of 120 installations that are subject to emissions trading in Germany[37]. 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 approval regulation, 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.[38]

Figure 15 shows that steel production installations using the blast furnace route (oxygen steel) with a share of almost 84 percent dominate the emissions of the iron and steel industry in emissions trading in Germany. The blast furnace route accounts for about 68 percent of crude steel production.[39] In contrast, emissions from electric steel production, which accounts for 30 percent of total crude steel production in Germany, are comparatively low at about three percent.[40] Emissions from iron and steel processing (Activity 11) account for about 13 percent.

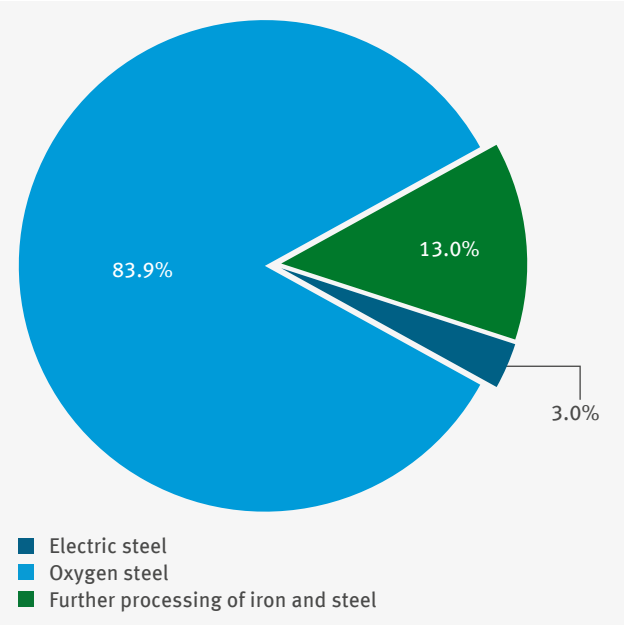


Figure 15: 2021 emissions distribution in the iron and steel industry (Activities 8 to 11 and 1)

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

37 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.

38 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.

39 See WV Stahl 2022

40 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.

Table 9 shows the emissions for 2020 and 2021, differentiated according to Activities 8 to 10, 11 and 1 in line with the explanation above. The emissions from Activities 8 to 10, at 30.9 million tonnes of carbon dioxide combined, were 13 percent higher in 2021 than the previous year's value of 27.5 million tonnes. Crude steel production increased at the same time by about twelve percent from 35.7 million tonnes to 40.1 million tonnes.[41] Emissions from the blast furnace route (including Activities 8 and 9) were about 29.6 million tonnes of carbon dioxide in 2021, i. e. about 3.4 million tonnes (13 percent) more than 26.2 million tonnes in the previous year. Emissions from the electric steel route increased by about 80,000 tonnes (eight percent) from about 989,000 tonnes of carbon dioxide to 1,068,000 tonnes. Emissions from the processing of ferrous metals (Activity 11) increased by about 0.5 million tonnes (twelve percent) to a current 4.6 million tonnes.

Table 9: Iron and steel industry (Activities 8 to 11 and 1), number of installations, 2020 emissions, 2021 free allocation, 2021 VET entries, allocation coverage

No.	Activity	No. of installations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
8, 9, 10	Pig iron and crude steel production*	35	27,508	30,914	42,443	137.3%
11	Ferrous metal processing	83	3,829	4,354	2,959	68.0%
1	Combustion	2	117	161	20	12.2%
	n. l. ETS	*3***	*19*	–	–	–
Total		**120**	**31,473**	**35,428**	**45,422**	**128.2%**

As of 02/05/2022
* Coking plants, metal ore processing, pig iron and steel production
** n. l. ETS not included in total number of installations

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 2021, the total emissions from transferred and energy-intensive used waste gases from iron, steel and coke production amounted to around 24.7 million tonnes of carbon dioxide (see Table 10), about 3.4 million tonnes more than in 2020.

Table 10: Transfer of waste gases from iron, steel and coke production in 2021 – 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]
3,919	1,174	19,346	98	127	24,664

As of 06/04/2022
* Emission volumes leaving installation boundaries but remaining within Activities 8 to 10.
** The total amount transferred is 165,149 tonnes of carbon dioxide equivalents, of which 38,114 tonnes are inherently carbon dioxide.

41 See WV Stahl 2022

Transfers of waste gases from iron, steel and coke production within and between Activities 8 to 10 amounted to about 3.9 million tonnes of carbon dioxide emission equivalents[42], i. e. about 0.6 million tonnes more than in 2020. Transfers of waste gases from these installations to others for further steel processing (Activity 11) account for about 1.2 million tonnes of carbon dioxide compared to 0.8 million tonnes in 2020. Of the remaining waste gases from iron, steel and coke production, the majority went to energy installations: these waste gases correspond to about 19.3 million tonnes of carbon dioxide, compared to 16.8 million tonnes in the previous year.[43]

Allocation Status

It is not the nominal free allocation that is decisive in order to be 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[44]. 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 allocation to emissions of the respective year – i. e. 'Allocation coverage' (last column). This was 137 percent in nominal terms for Activities 8 to 10 in 2021 and is thus significantly below the 151 percent of the previous year. Due to the strong increase in emissions, the allocation coverage has fallen despite a slight increase in allocation quantities, due to the discontinuation of the cross-sectoral correction factor and a relatively small reduction in the relevant product benchmarks.

The calculated allocation coverage for activity 11 is 68 percent, which is a significant decrease compared to 2020, when the value was still around 100 percent. Here, too, the strong increase in emissions together with a drop in free allocation compared to the previous year is responsible for the lower allocation coverage. Since the majority of allocations for Activity 11 is made based on the 'fuel benchmark', it can be assumed that its reduction in the fourth trading period accounts significantly for the decline in the free allocation.

For Activities 8 to 10 it has to 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, which is calculated in comparison to emissions from using natural gas instead. The corresponding product benchmark also includes an 'inefficiency surcharge', which reflects the lower efficiency of waste gases 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. The volume of waste gases transferred to energy installations in 2021 corresponded to emissions of 19.3 million tonnes of carbon dioxide (see Section 'Transfer of waste gases from iron, steel and coke production' above).

The estimate of the number of transferred emission allowances therefore corresponds to the emission volume from the transferred waste gases from iron, steel and coke production produced additionally in comparison to natural gas, plus the 'inefficiency surcharge'.[45] Thus, the 2021 amount of emission allowances transferred to energy installations can be estimated at around 15.8 million emission allowances (compared to 11.3 million in the previous year). This results in an adjusted allocation amount of about 29.6 million emission allowances and an adjusted allocation coverage of 83.5 percent (see Table 11). This means that in 2021, the iron and steel industry arithmetically received 16 percent less allocation than it needs to surrender for the reported emissions.

42 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.

43 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.

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

45 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, 2021 VET entries and adjusted allocation coverage

Sector	No. of instal-lations	2021 adjusted allocation amount [1000 EUA]	2021 VET [kt CO_2eq]	2021 allocation deviation from 2021 VET [kt CO_2eq]	Adjusted allocation coverage
Iron and steel	120	29,580	35,428	–5,847	83.5%

As of 02/05/2022

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, in principle, this also applies to waste gases from iron, steel and coke production, according to the principle. A free allocation for electricity generation from waste gases from iron, steel and coke production is now only made to an extent that corresponds to the additional emissions that would arise compared to electricity generation from natural gas[46] (for which, as described, there is no free allocation).[47] 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.[48]

Trends in the Past Years

Figure 16 below shows the emissions trend of the entire sector since the start of the EU ETS. 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 2017. Installations no longer subject to emissions trading (n. l. ETS)[49] and emissions from installations that have only been subject to emissions trading from 2013[50] are estimated for 2005 to 2012 and then taken into account. 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 shares 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 emissions 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 2017 and 2020, emissions from the iron and steel industry fell significantly compared to the previous year, especially in 2020 due to the pandemic. On the other hand, between 2020 and 2021 emissions rose strongly again.

46 Also for heat generation, there is a natural gas based deduction in the allocation for iron and steel production; but at the same time users of these waste gases receive a direct free allocation for the heat generated, according to the heat benchmark.

47 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.

48 See DEHSt 2021a

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

50 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.

The allocation amounts also fell between 2017 and 2020. Their continuous decrease in the third trading period was primarily due to the annually fall in the cross-sectoral correction factor at a constant base period for determining the allocation (2005 to 2008). In 2020, this resulted in allocations even exceeding emissions due to the strong drop in emissions (even when deducting the assumed amounts for transfer of waste gases from iron, steel and coke production). In contrast, additional purchases of around 7 to 15 percent of emissions were required in the previous years.

From 2020 to 2021, as described above, emissions have once again increased significantly by about 13 percent. At the same time, the allocation amounts for the iron and steel sector as a whole remained almost constant. This nevertheless conceals relevant simultaneous changes in the course of the transition to the fourth trading period. For example, the product benchmark for 'liquid pig iron' i. e. 'hot metal' benchmark, for crude steel produced in the blast furnace route (oxygen steel), which has a key significance for the free allocation in the iron and steel industry, fell by only 3 percent compared to the third trading period. Sinter, on the other hand, fell by 7.9 percent and for coke it was 24 percent.[51] In parallel, the activity rates of the new allocation base period (2014 to 2018) have 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, in contrast, an allocation coverage very clearly below 100 percent can now be observed despite this discontinuation of the cross-sectoral correction factor due to the lower fallback benchmark values and the increased emissions (as described above under 'Allocation status').

51 See COM 2021

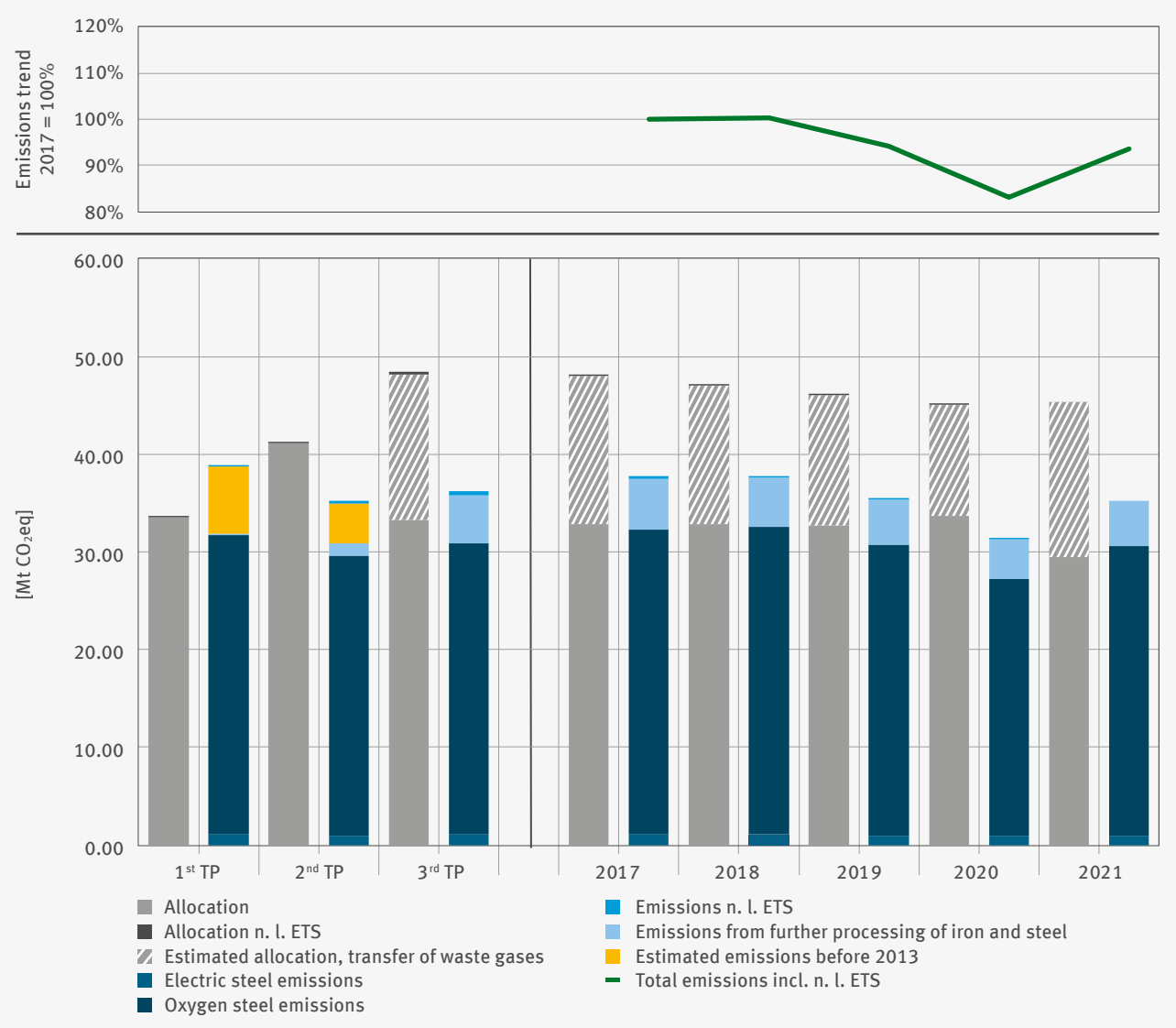


Figure 16: Iron and steel industry (Activities 8 to 11 and 1), emissions and free allocation trends up to 2021[52]

52 As in the VET reports of 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. Since the annually transferred waste gas amounts have been different, fluctuating allocation amounts apply in these years.

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 production volume trend for oxygen steel and electric steel each in relation to 2017. The activity rates of 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 (AR) of the products[53] supplemented by information from the German Steel Federation (WV Stahl 2020, 2021, 2022).[54]

After emissions from oxygen steel production (Figure 17) had increased slightly in 2018 compared to 2017, significant decreases were recorded in 2019 and especially in 2020 (2020: about 12 percent). In 2021, as mentioned above, they again increased by almost 13 percent compared to 2020.

Production of oxygen steel fell by around 20 percent from 2017 to 2020 i. e. slightly more strongly overall (16 percent) than emissions. In 2021, both characteristics increased again so that their ratio in 2021 corresponds closely to their ratio in 2019 – i. e. before the economic decline. This does not indicate a further divergence in the trend of the two characteristics.

Since a decline in production is usually associated with some decline in production efficiency, all other things being equal (the installations have a 'base load' of energy demand to some extent), it can be assumed that the slight 'divergence' of production volumes and emissions mentioned above is not least due to this.

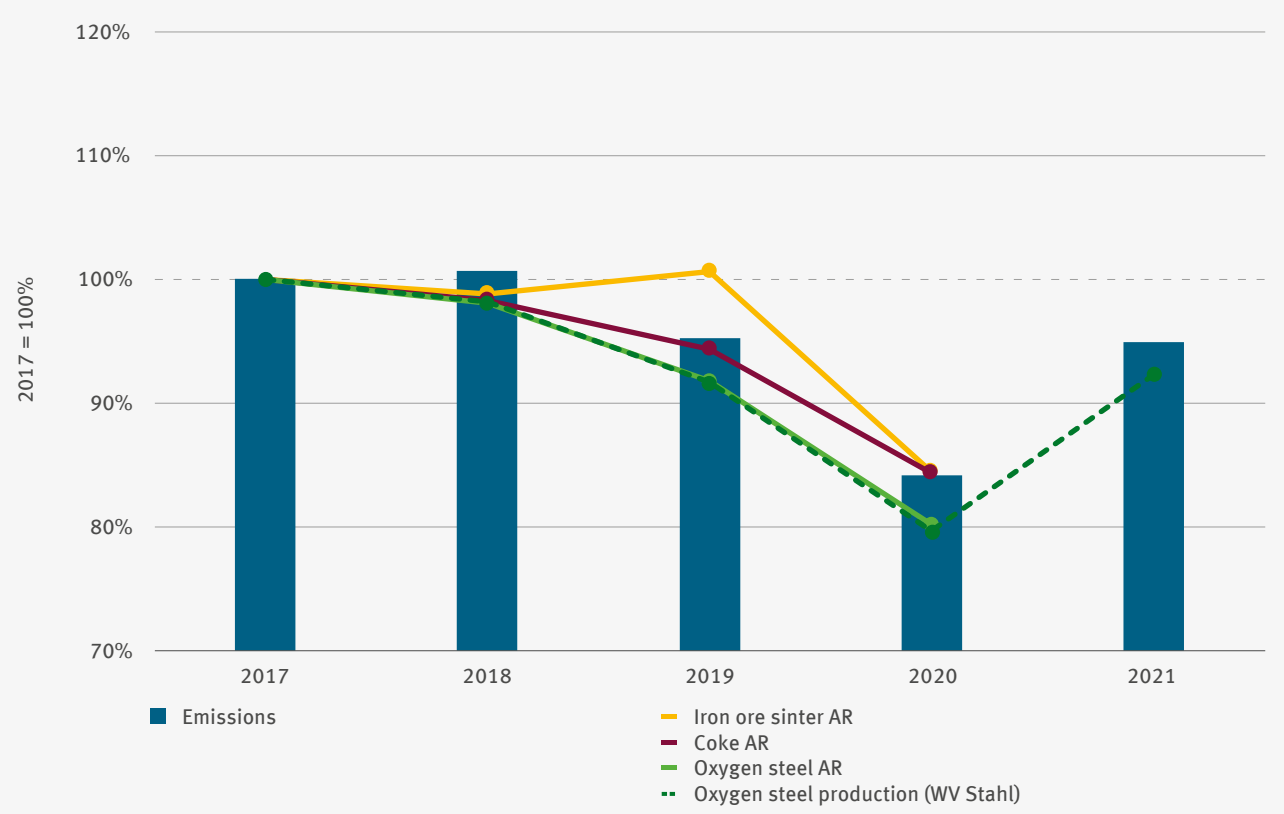


Figure 17: Oxygen steel production, 2017 to 2021 emissions and production trends in Germany, each in relation to 2017

53 Activity rates (AR) for the 'carbon steel' and 'high-alloy steel' product benchmarks are summarised for electric steel. It should be noted regarding s the activity rate for oxygen steel ('liquid pig iron' product benchmark) that due to the allocation rules, the AR data presented here refers to the amount of pig iron produced, that is, prior to processing into steel in the steel converter. In contrast, WV Stahl uses the crude steel amount. which 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.

54 WV Stahl 2020 for 2017 to 2019; WV Stahl 2021 for 2020; WV Stahl 2022 for 2021. Data from the sources checked for consistency for the overlapping years.

Figure 18 below for electric steel[55] shows both emissions and activity rates as well as association figures for electric steel production compared to 2017. The 2018 emissions are constant compared to 2017, decreased strongly in 2019 and slightly in 2020. With the exception of 2018, this general trend is consistent with the production trend: 2018 emissions did not decrease despite a decrease in production. In 2021, the ratio of emissions to production was again the same as in 2017.

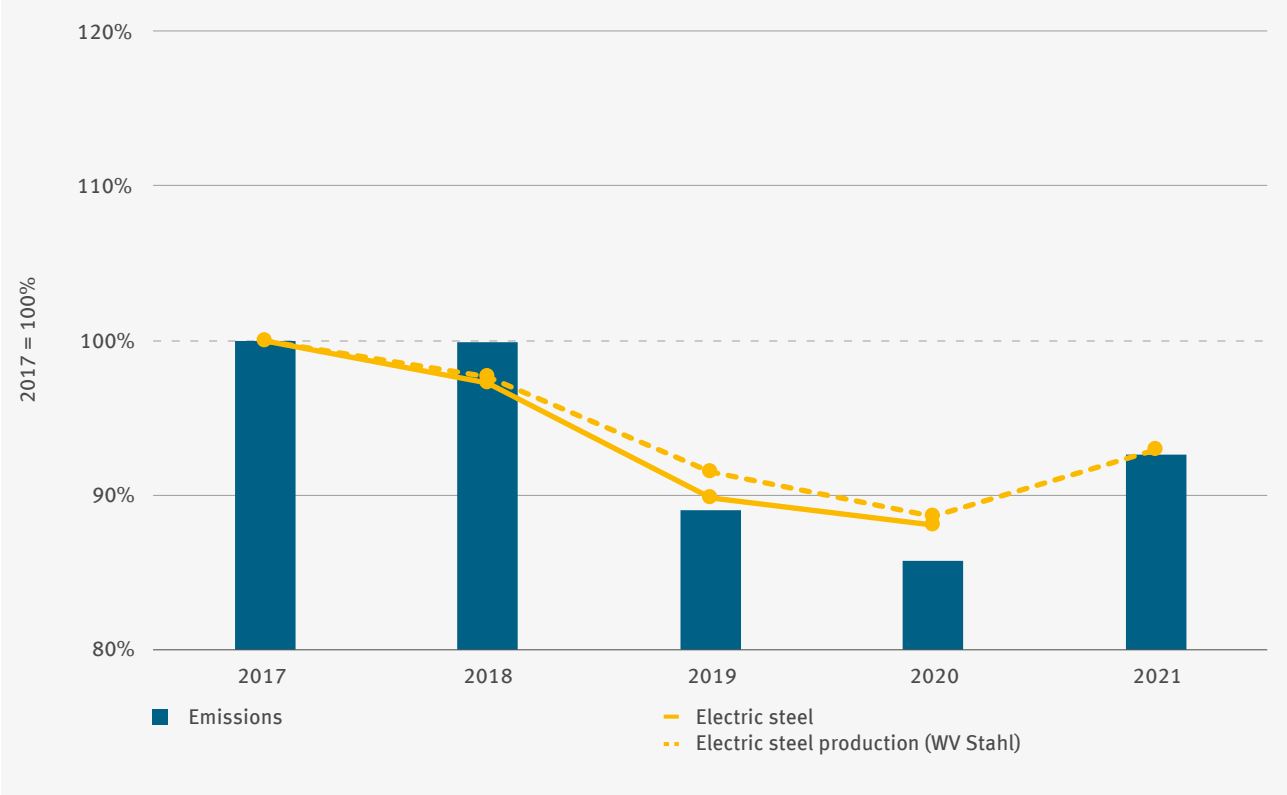


Figure 18: Electric steel production, 2017 to 2021 emissions and production trends in Germany, each in relation to 2017

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

55 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 2021 reporting year[56]. The installations in the non-ferrous metals industry subject to emissions trading emitted around 3.1 million tonnes of carbon dioxide equivalents in 2021. Emissions in 2021 were thus at the same level as in the previous year.

Figure 19 shows the 2021 shares 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 include two coating installations that further process aluminium strips and two installations that process aluminium hydroxide predominantly into alumina as a feedstock for primary aluminium production.

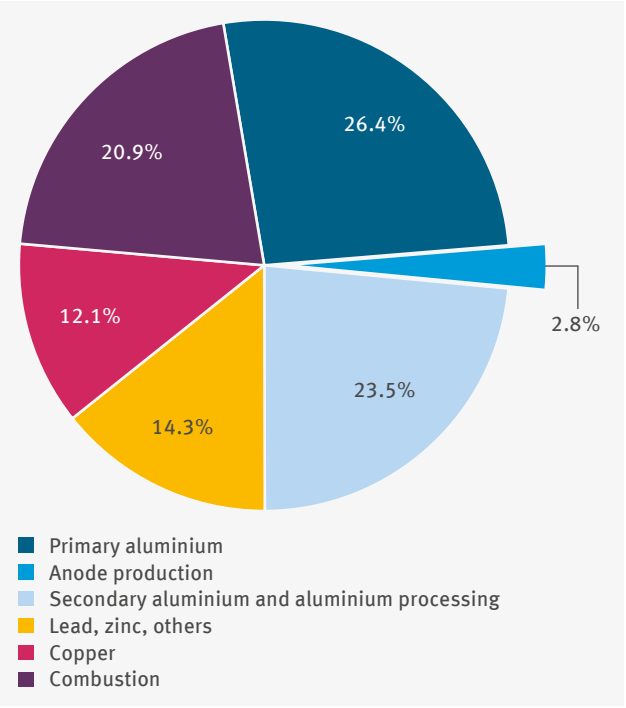


Figure 19: 2021 emission shares from non-ferrous metals industry (Activities 12, 13 and 1)

The electrolysis installations for primary aluminium production account for the largest share of emissions from the non-ferrous metals industry at about 26 percent. At around 24 percent, the installations for secondary aluminium production and aluminium processing are responsible for the second largest share of the sector's total emissions. The combustion plant's share is about 21 percent. Installations for the production or processing of lead, zinc or other non-ferrous metals account for 14 percent of the non-ferrous metal industry's emissions. The share of the installations for copper production and processing in the sector's emissions is somewhat smaller at around 12 percent. Emissions from anode production (Activity 12) only account for three percent.

56 Compared to last year's VET Report (cf. DEHSt 2021b), the non-ferrous metals industry partly includes other installations due to a change in the allocation of the main activity. For example, this applies to the four Activity 1 combustion plants. Therefore, the figures for the non-ferrous metals industry in this report are not comparable with those of last year.

Table 12 provides an overview of emissions and allocations for the non-ferrous metals industry in 2021.

Table 12: Non-ferrous metals industry (Activities 12, 13 and 1), number of installations, 2020 emissions, 2021 VET entries, 2021 free allowances and 2021 allocation coverage

No.	Activity	No. of instal-lations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
12	Primary aluminium production	7	963	915	874	95.5%
13	Non-ferrous metal processing	28	1,493	1,564	1,315	84.1%
1	Combustion	4	668	656	255	38.8%
	n. l. ETS	*1**	*21*	–	–	–
Total		**39**	**3,146**	**3,135**	**2,443**	**77.9%**

As of 02/05/2022
* n. l. ETS not included in total number of installations

The seven installations in Activity 12 (primary aluminium and anode production) emitted just under 1 million tonnes of carbon dioxide equivalents as in the previous year. They included three installations for anode production, which are 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 2021, these PFC emissions corresponded to almost 60,000 tonnes of carbon dioxide equivalents and their average share in the total emissions from the four electrolysis installations were about seven percent (2020: nine percent). Overall, the level of emissions from Activity 12 installations subject to emissions trading was five percent below the previous year's level.

The 28 installations in Activity 13 (production and processing of other non-ferrous metals such as copper, zinc or lead and secondary aluminium) emitted just below 1.6 million tonnes of carbon dioxide equivalents in 2021, five percent more than in 2020.

The installations for 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 2021 corresponded on average to about 96 percent of their annual emissions compared to 85 percent in 2020.[57] This increase in the allocation coverage cannot be explained solely by the decrease in emissions. The product benchmarks for 'primary aluminium' and 'prebaked anodes' were only slightly reduced[58] as part of the benchmark value adjustment for the fourth trading period which means that the discontinuation of the cross-sectoral correction factor fundamentally dominates the allocation level in the fourth trading period compared to the third trading period and led to a higher allocation in 2021 compared to 2020. The allocation for Activity 13 installations was slightly better than activity 12 installations on average across all installations in the third trading period, partly due to the fallback allocation. In 2020, the allocation coverage was still 94 percent, in 2021 it was only 84 percent. This could be due on the one hand to the increased emissions and on the other hand to the fallback benchmark values, which are significantly lower in the fourth trading period than in the third trading period[59] thus leading to a lower free allocation despite the discontinuation of the cross-sectoral correction factor already mentioned above.

Overall, the allocation coverage of the non-ferrous metals industry decreased from 84 percent in 2020 to 80 percent in 2021.

57 See DEHSt 2021b
58 The reduction is less than four percent each for both product benchmarks.
59 The reduction is 24 percent in each case for the fallback benchmarks.

Trends in the Past Years

Figure 20 shows the emissions of 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 and allocation amounts are shown as columns for the first, second and third trading periods[60]; annual emissions and allocation amounts and the relative emission trends are indicated for the period since 2017. Installations no longer subject to emissions trading (n.l. ETS)[61] and estimated 2005 – 2012 emissions from installations that have only been subject to emissions trading since 2013[62] are also taken into account.

The total emissions of the German non-ferrous metals industry in the EU ETS have decreased since 2017: in 2021, they were four percent below the 2017 level. Thereby the emissions from the different products/ materials had very different trends.

Emissions from copper production and processing installations fell by 10 percent below the 2017 level by 2019, after which they slightly increased by 7 percent and were still significantly below the 2017 level in 2021. The emissions trend is roughly mirrored by the production trend.[63]

In contrast, emissions from installations producing and processing lead, zinc or other non-ferrous metals rose between 2017 and 2019 to a level of 13 percent above the 2017 level, plateauing in 2020, and not falling until 2021, but remained seven percent above the baseline. The production figures of lead, zinc, tin and their alloys also decreased compared to 2020 according to the Metal Industry Association (WV Metalle).[64]

Emissions from primary aluminium production installations (electrolysis installations) and secondary aluminium production and aluminium processing installations recorded a slight increase in emissions between 2017 and 2018, after which they each fell below the 2017 level. In 2020, the first year of the COVID 19 pandemic, they moved in the opposite direction (slight increase in primary aluminium, strong drop in secondary aluminium), which was mainly related to the economic trend in that year. The pandemic-related decline in demand in the automobile industry and in mechanical engineering and, in particular, the slump in demand for secondary aluminium castings for the automobile industry played their part.[65] Emissions from electrolysis installations fell again in 2021 – to 10 percent below the 2017 level – while emissions from secondary aluminium production and aluminium processing plants rose again reaching the 2017 level. These developments can also be explained by the economic trend in 2021.[66]

60 Emissions data for the years prior to 2013 cannot be considered 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 (linear interpolation of the data between 2008 and 2013). This included, among others, the three anode production installations. No emissions data were available for the non-ferrous metals industry for 2011 and 2012.

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

62 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.

63 See WV Metalle 2022 and WV Metalle 2020

64 See WV Metalle 2022

65 See WV Metalle 2021 and DEHSt 2021b

66 See WV Metalle 2022

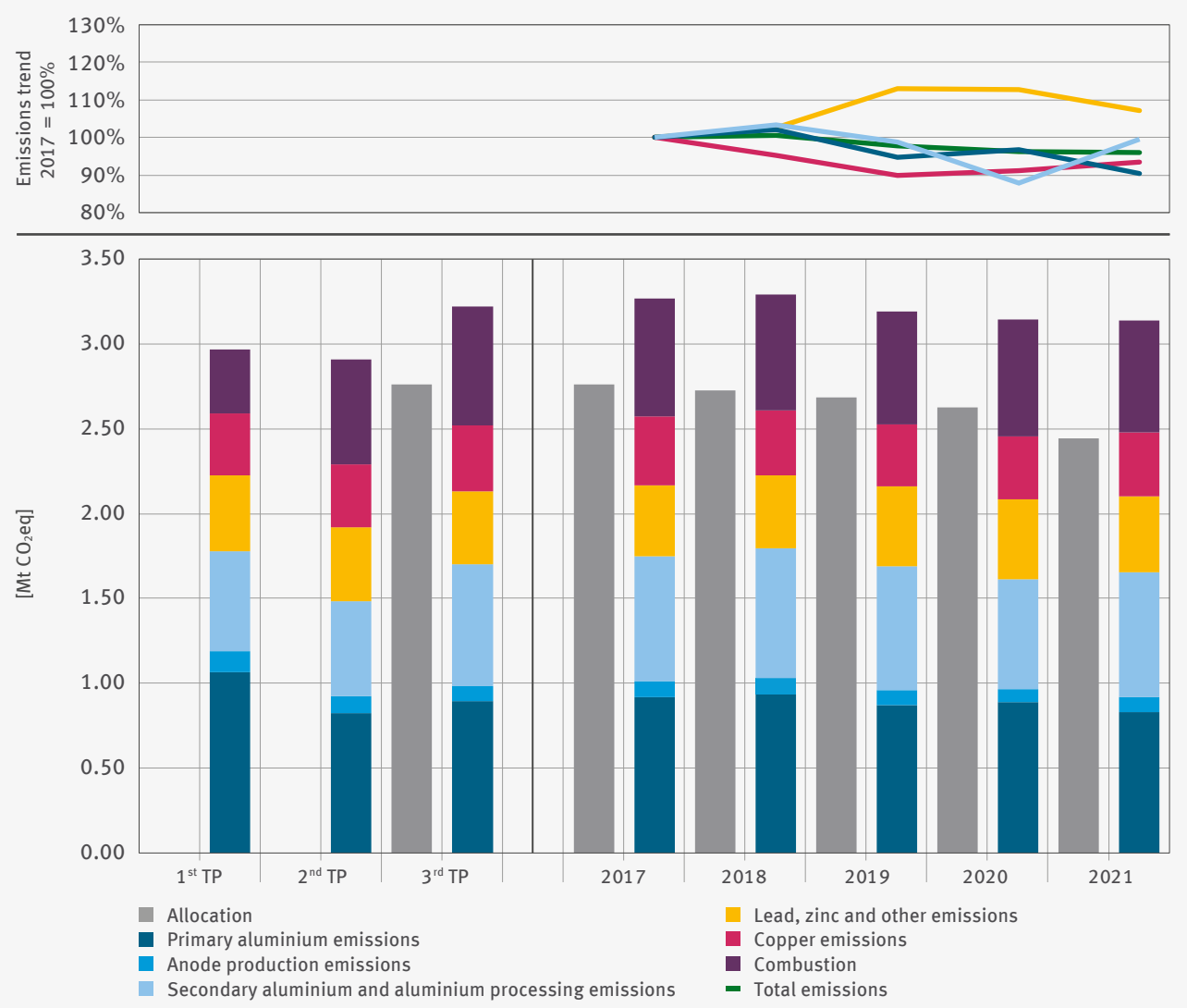


Figure 20: Non-ferrous metals industry (Activities 12, 13 and 1). Emissions and free allocation trends up to 2021[67]

Emissions and Production Trend

Figure 21 compares the emissions trend for electrolysis installations producing primary aluminium with the production data trend. These are based on the activity rates (AR) of the product benchmark 'primary aluminium'[68] and the primary aluminium production data by the Metal Industry Association (WV Metalle). The trend of the activity rate coincides well with the WV Metalle data.

67 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.

68 The 2021 activity rates will not be transmitted to DEHSt until April 2022 so that only the Metal Industry Association figure is indicated in the Figure for 2021. For details on the data basis for the activity rates, see Chapter 1.

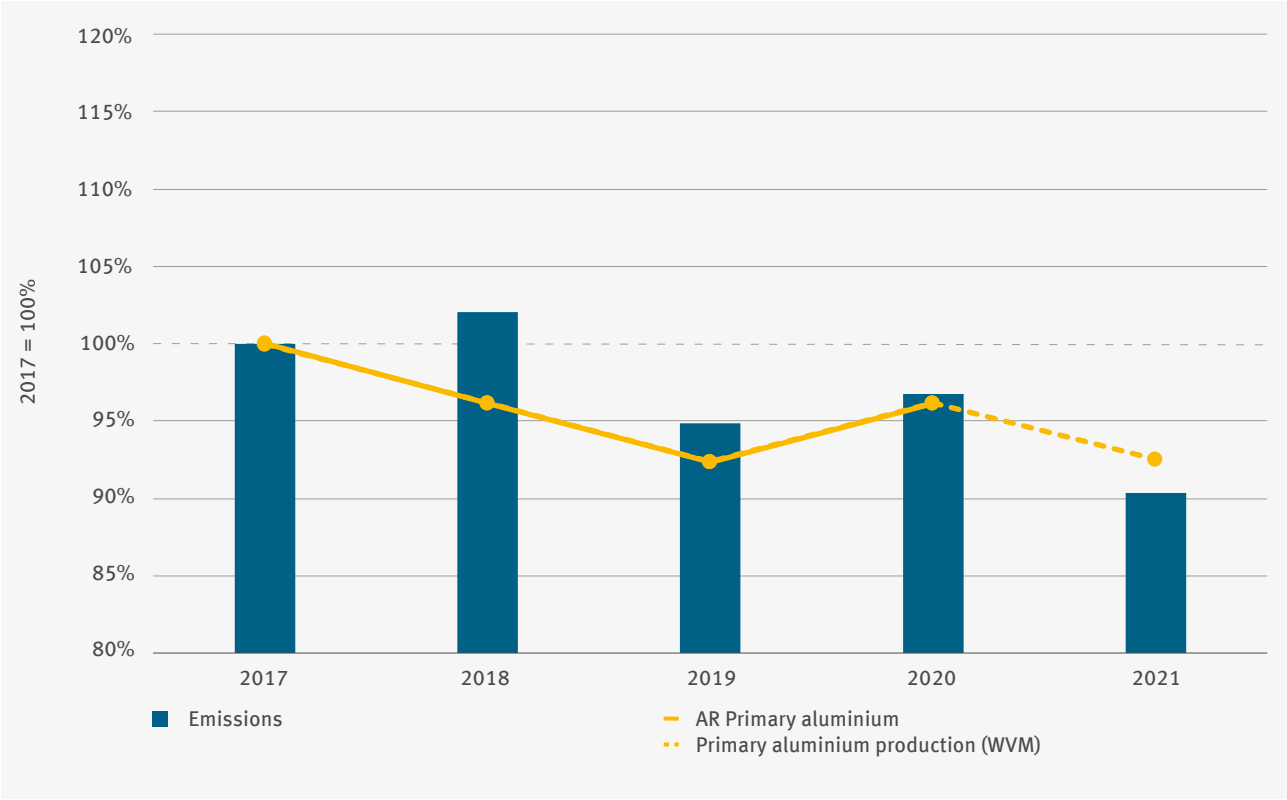


Figure 21: Electrolysis installations, 2017 – 2021 emissions and production trends in Germany in relation to 2017[69]

In 2018 a contrary trend in emissions and production was observed. Primary aluminium production fell by four percent. In contrast, emissions increased by about two percent. The installations had a lower workload in 2018 due to the decline in production, which may have been the reason behind the higher specific emissions.

From 2019, relative emission trends and production trends were again in good agreement compared to 2017. In 2021, emissions were 10 percent and production 7 percent below 2017 levels.

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

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

2.6 Mineral Processing Industry

Within the mineral processing industry, more than half (57.7 percent) of the total 35.6 million tonnes of carbon dioxide equivalents emitted in 2021 is attributable to the cement clinker production. The production of lime, gypsum and sugar which, in addition to industrial and building lime production installations, also includes the sugar industry and gypsum processing installations (for example power plant flue gas desulphurisation installations) accounts for a further 25.5 percent of emissions. Glass and mineral fibre production accounts for another 11.6 percent and ceramics installations for around 5.3 percent of emissions.

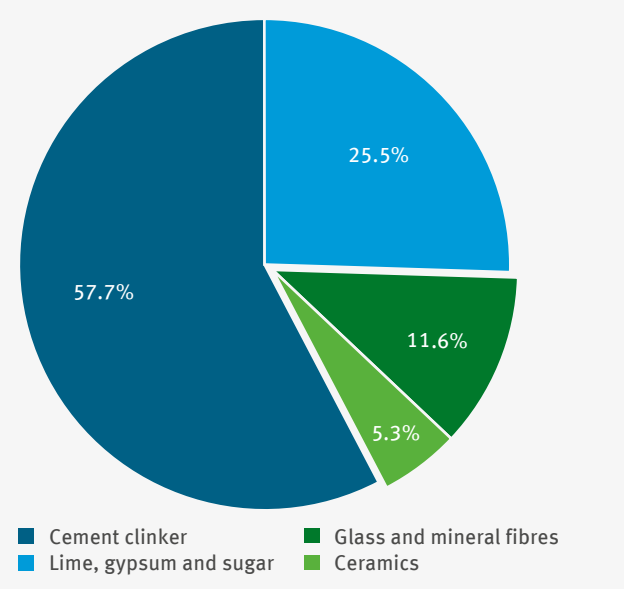


Figure 22: The mineral processing industry's shares in the 2021 emissions

2.6.1 Cement Clinker Production

The 34 installations that produce cement clinker and one installation that manufactures products from burnt oil shale are hereinafter referred to under the term 'cement industry'. One installation in North Rhine-Westphalia shut down and was no longer subject to emissions trading in 2021. The installations cover the entire German cement clinker production, the production threshold in the EU ETS is 500 tonnes per day (Activity 14(2), Annex 1 of TEHG) and this is exceeded by all installations throughout the industry in Germany.

In the building industry, the main sales market for the cement industry, construction activity slowed down despite high and even growing order backlogs, mainly due to supply bottlenecks for building materials[70]. The 2021 emissions from cement clinker production were nevertheless around two percent above the level of the previous year.

Table 13: Cement clinker production (Activity 14), number of installations, 2020 emissions, 2021 VET entries, 2021 free allocation and 2021 allocation coverage

No.	Activity	No. of installations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
14	Cement clinker production	35	20,134	20,532	17,337	84.4%
	n. l. ETS	*1**	*1*	–	–	–
Total		**35**	**20,134**	**20,532**	**17,337**	**84.4%**

As of 02/05/2022
* n. l. ETS not included in total number of installations

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In 2021, the free allocation for the cement clinker installations was around 3.2 million emission allowances below the emission volume subject to surrender obligation (see Table 13). This means that the shortfall has decreased somewhat compared to the previous year, although the product emission benchmark for cement clinker, which is crucial for the free allocation, was lowered from 0.766 to 0.693 tonnes of carbon dioxide equivalent per tonne of cement clinker in the first half of the fourth trading period. Since there is no cross-sectoral reduction in free allocation in the 2021 – 2025 period, the allocation coverage has increased somewhat and amounted to around 84.4 percent in 2021 (2020: 80.4 percent)

Trends in the Past Years

Figure 23 shows the emissions and free allocation trend of the cement clinker installations in the 2017 – 2021 period and additionally the averages of the three past trading periods (see columns '1st TP', '2nd TP' and '3rd TP' in the bottom 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 year compared to 2017. Installations no longer subject to emissions trading (n. l. ETS)[71] have also been taken into account.

After the emissions from clinker production were lower on average in the second trading period than in the first, in the third trading period they remained on average at the level of the second one[72]. This is presumably also due to the fact that the average annual clinker production in the second and third trading periods was somewhat lower than between 2005 and 2007[73].

In 2017, emissions peaked in the third trading period and have changed only slightly since then. The 2021 emissions of 20.5 million carbon dioxide equivalents were roughly at the same level as in 2017, i. e. eight percent higher than in 2013. This is in particular due to the increasing demand for cement, i. e. rising sales as a result of increasing construction investments during a period when the cement's clinker content has hardly changed.[74]

The free allocation, which had fallen continuously in the third trading period due to the cross-sectoral annual reduction, increased significantly at the beginning of the fourth trading period (plus 9 percent compared to 2020 without taking into account the installation no longer subject to emissions trading in 2021), in particular due to the discontinuation of the cross-sectoral reduction. This more than compensated for the reduction in the product benchmark[75] and the lower level of activity rate or clinker production for determining the free allocation[76].

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

72 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).

73 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. Source: VDZ 2022.

74 VDZ 2021, Tables A2, A3 and E3. The clinker content in cement decreased from 72 percent (2016) to 70 percent (2020) and was thus slightly below the average clinker share in the EU (27) of around 76 percent, cf. Cembureau (2022).

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

76 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.

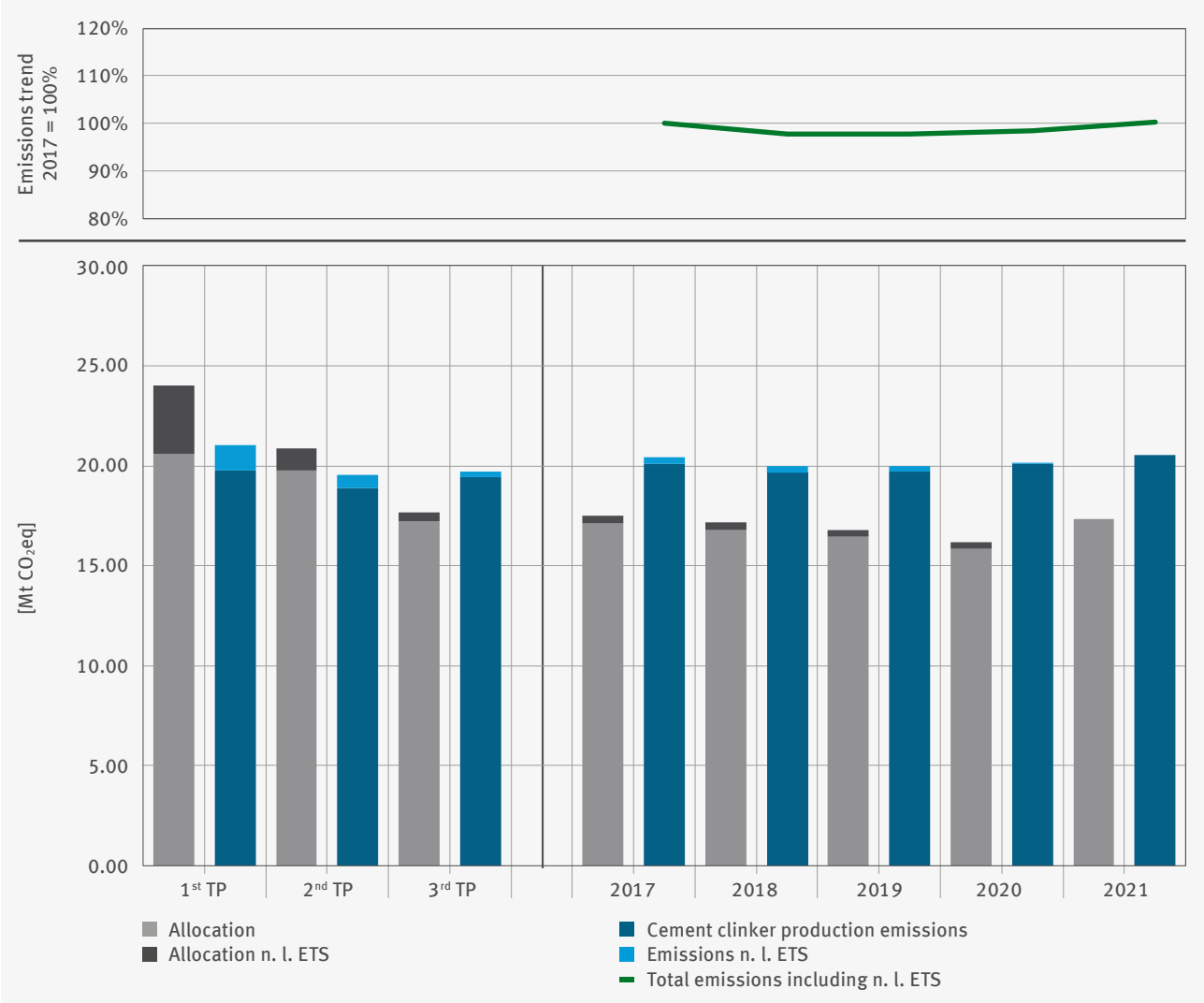


Figure 23: Cement clinker production (Activity 14), emissions and free allocation trends up to 2021

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 2017.[77] As in previous years, emissions and production development show an almost identical course. This means that the specific emissions of clinker production have not changed significantly over the past 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.

These are mainly secondary fuels and other residues (also called alternative fuels) such as industrial waste, used tyres and sewage sludge, some of which have significant biogenic carbon contents. The share of fossil fuels such as petroleum coke, lignite and hard coal has been decreasing since 2005.

The specific emission figure of the 33 grey cement clinker installations amounted to 0.793 tonnes of carbon dioxide per tonne of cement clinker in 2021, roughly the same as in the previous year.

77 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.

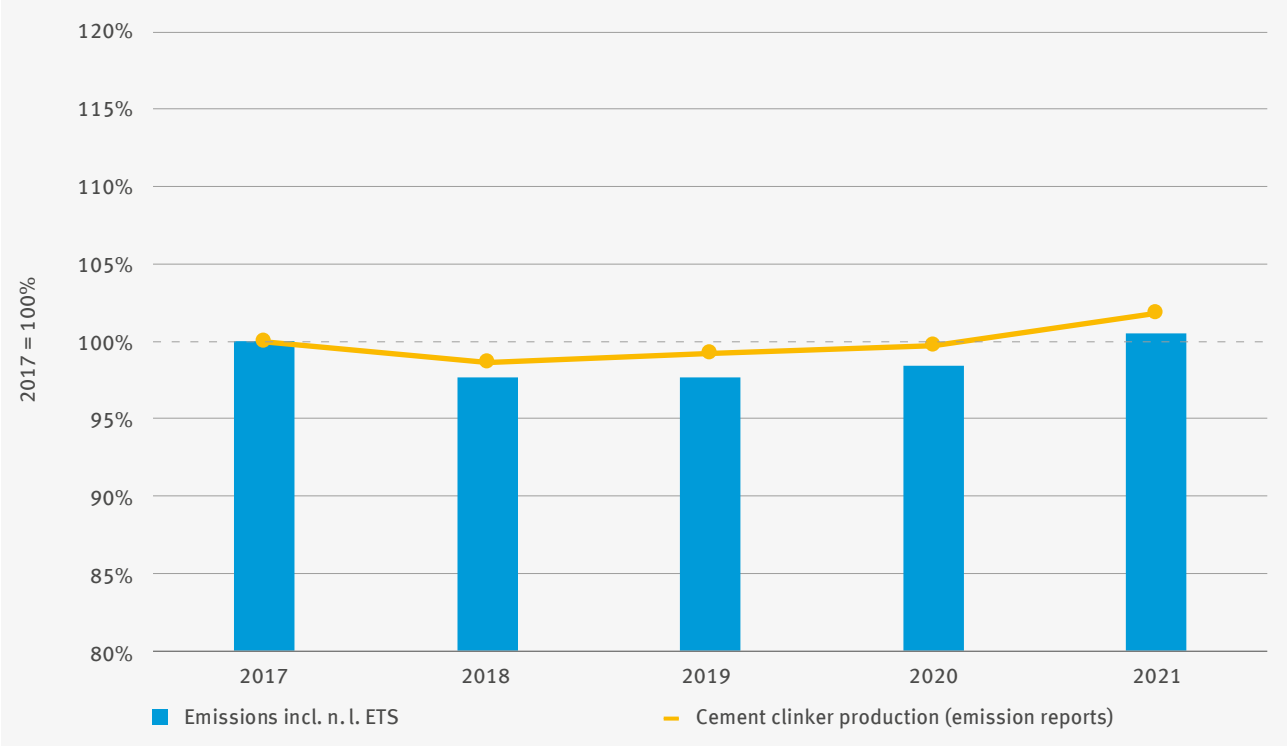


Figure 24: 2017 – 2021 cement clinker production (Activity 14), emissions and production trends in Germany in relation to 2017

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

2.6.2 Lime, Gypsum and Sugar Production

This section includes emissions from Activities 15 'Lime production' and 19 'Gypsum production' from Annex 1, Part 2 TEHG. Together, these installations account for 25.5 percent of emissions in the mineral processing industry (see Figure 22).

Activity 15 includes two different industrial sectors: industrial and building lime and the sugar industry. As in 2020, 39 of these installations produce lime or dolime for construction, paper, chemical, iron and steel and environmental industries and are referred to in this section as the 'industrial and building lime' category. A limestone drying plant (combustion plant, Activity 1) is also included in this category. Within the mineral processing industry 19.5 percent of the emissions are attributable to the production of industrial and building lime (see Figure 25).

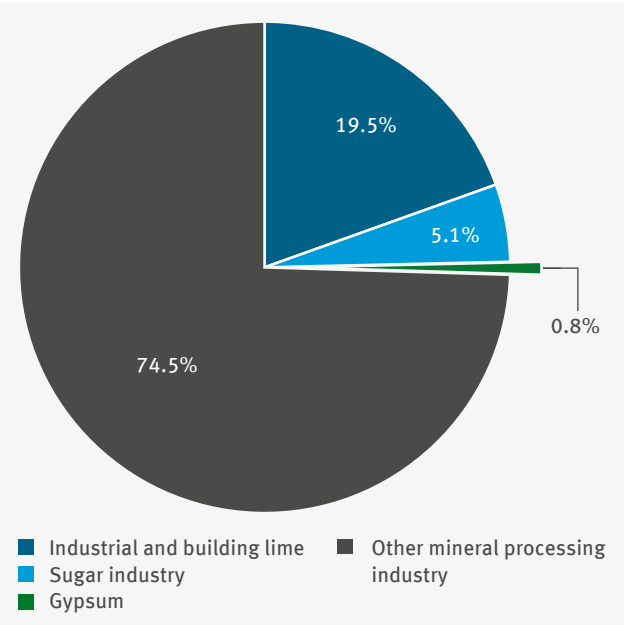


Figure 25: Shares of lime, gypsum and sugar production (Activities 1, 15 and 19) in the 2021 emissions in the mineral processing industry

Activity 15 also includes 18 installations that use lime for sugar production and require heat and electricity in the manufacturing process.[78] The sugar industry also includes other sub-activities such as beet slice drying and caramelisation installations. In 2021, the sugar industry installations accounted for around 5.1 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 the 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, 2020 emissions, 2021 free allocation, 2021 VET entries, allocation coverage

No.	Activity	No. of installations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
15	Lime production	39	6,378	6,958	4,425	63.6%
	Sugar production	18	1,819	1,817	950	52.3%
		57	**8,197**	**8,775**	**5,375**	**61.2%**
19	Gypsum production	9	276	300	88	29.2%
		9	**276**	**300**	**88**	**29.2%**
1	Combustion	1	13	15	3	21.7%
		1	**13**	**15**	**3**	**21.7%**
	n. l. ETS	*2**	*16*	–	–	–
Total		**67**	**8,502**	**9,091**	**5,466**	**60.1%**

As of 02/05/2022
* n. l. ETS not included in total number of installations

Emissions from the production of industrial and building lime in 2021 amounted to around 7 million tonnes of carbon dioxide which is around nine percent above the previous year's figure. The allocation of free emission allowances was around 64 percent (see Table 14), but the average allocation coverage in the third trading period was 88 percent. Possible reasons for this decrease in allocation coverage when switching from the third to the fourth trading period include the reduction in benchmark values for allocation, especially for quicklime, combined with a lower activity rate or production volume as the basis for free allocation[79] and the increase in emissions compared to the previous year.

In contrast, emissions from sugar plants remained almost unchanged from the previous year at around 1.8 million tonnes of carbon dioxide. In 2021, operators had to purchase around 867,000 additional emission allowances. This corresponds to 48 percent of their emissions in that year.

Emissions from gypsum plants increased by around nine percent compared to the previous year. In 2021, gypsum plants received only 29 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 is no longer considered to be at risk of carbon leakage, so installations received a significantly lower free allocation than in the previous trading period. This and the increased emissions lead to the lower allocation coverage.

The combustion plant (limestone drying) received an allocation for 2021 that corresponded to 21.7 percent of its emissions.

78 Since 2013, the sugar industry energy installations have also been included in the lime production activity, 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.

79 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.

Trends in the Past Years – Industrial and Building Lime and Gypsum

Figure 26 shows the emissions and free allocation trends for production of industrial and building lime (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, For the period from 2017, annual emissions and allocation amounts and the relative emissions trend are shown. Here, installations no longer subject to emissions trading (n.l. ETS)[80] are also taken into account as are estimated emissions from gypsum production installations for the 2005 – 2012 period, which have only been subject to emissions trading since 2013 (yellow)[81].

Average emissions for the first trading period were around 8.4 million tonnes of carbon dioxide and fell by around eight percent to 7.7 million tonnes of carbon dioxide on average for the second trading period. From the second to the third trading period, emissions again decreased and the average emissions of the third trading period were 7.2 million tonnes of carbon dioxide, about seven percent below the emissions of the second trading period.

However, the emissions from 2013 onwards have only been comparable to those from the second trading period to a limited extent, as these were calculated with fixed emission factors in the first and second trading periods whereas the emission factors since 2013 have to be determined on an installation-specific basis. The latter led to lower emissions on average unlike in the case of cement clinker producers (compare footnote 70, Section 2.6.1). In addition, the emissions from 2013 onwards were corrected retroactively 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.[82]

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.

The production and emissions of industrial and building lime installations are primarily determined by the economic situation of the steel and building industries. The emissions of the industrial and building lime installations also behave in line with the production trend of the iron and steel industry: Between the years 2018 and 2020, emissions fell by a total of 14 percent due to the economic situation. In 2021, emissions rose again by around nine percent, in line with the trend in the iron and steel industry (see Chapter 2.4).

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 data from the allocation procedure 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, emissions from gypsum installations have shown a continuous, slightly increasing trend and will amount to about 300,000 tonnes of carbon dioxide in 2021.

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

81 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.

82 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.

Figure 26 shows that the free allocation was higher than emissions both in the first and second trading periods. The share 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 with 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.

Possible reasons – as explained above – 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.

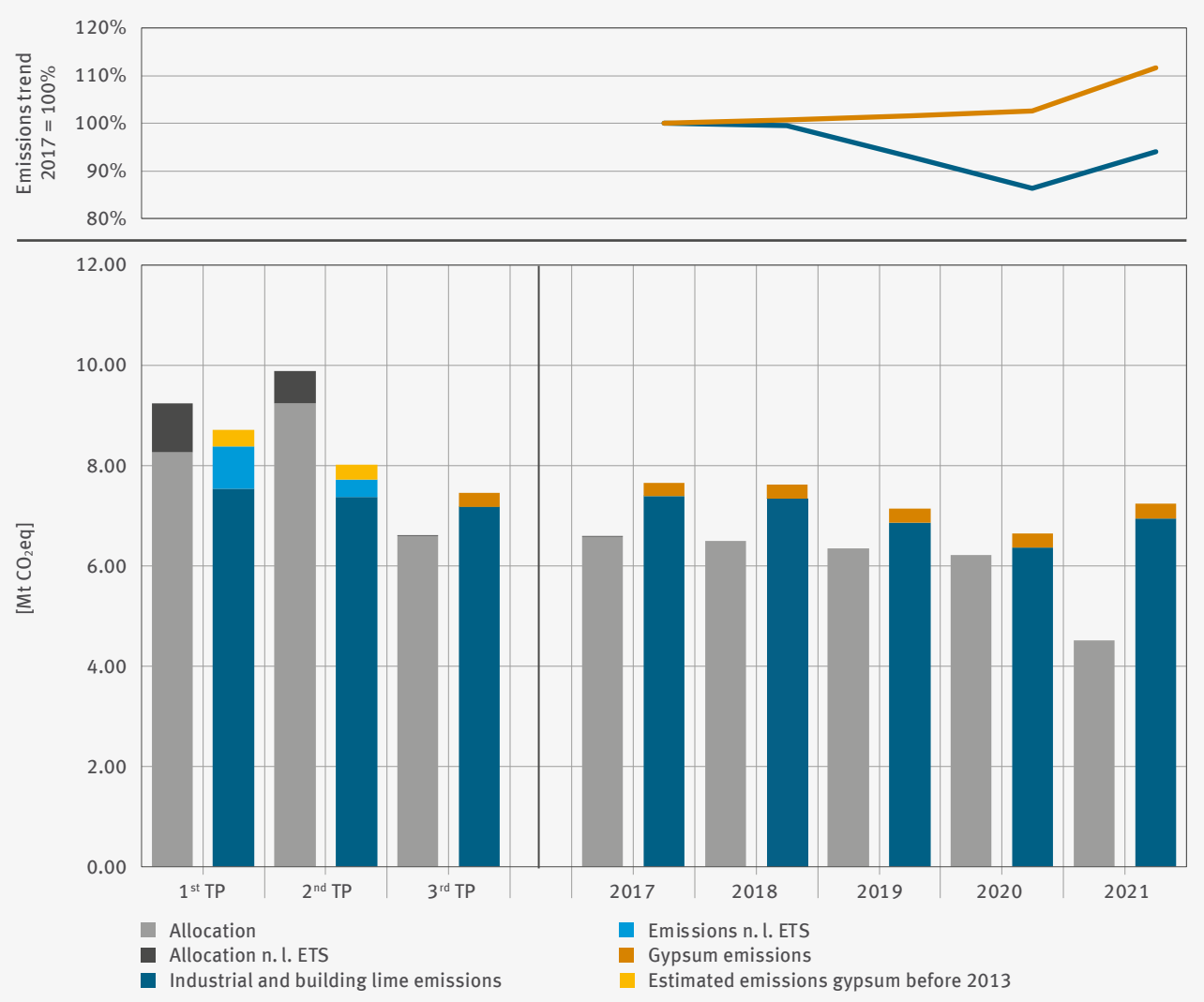


Figure 26: Industrial and building lime production (Activity 15)[83] and gypsum production (Activity 19), emissions and free allocation trends up to 2021

83 This Figure only covers the industrial and building lime and gypsum activities without the limestone drying installation (Combustion plant, Activity 1).

Emissions and Production trend – Industrial and Building Lime

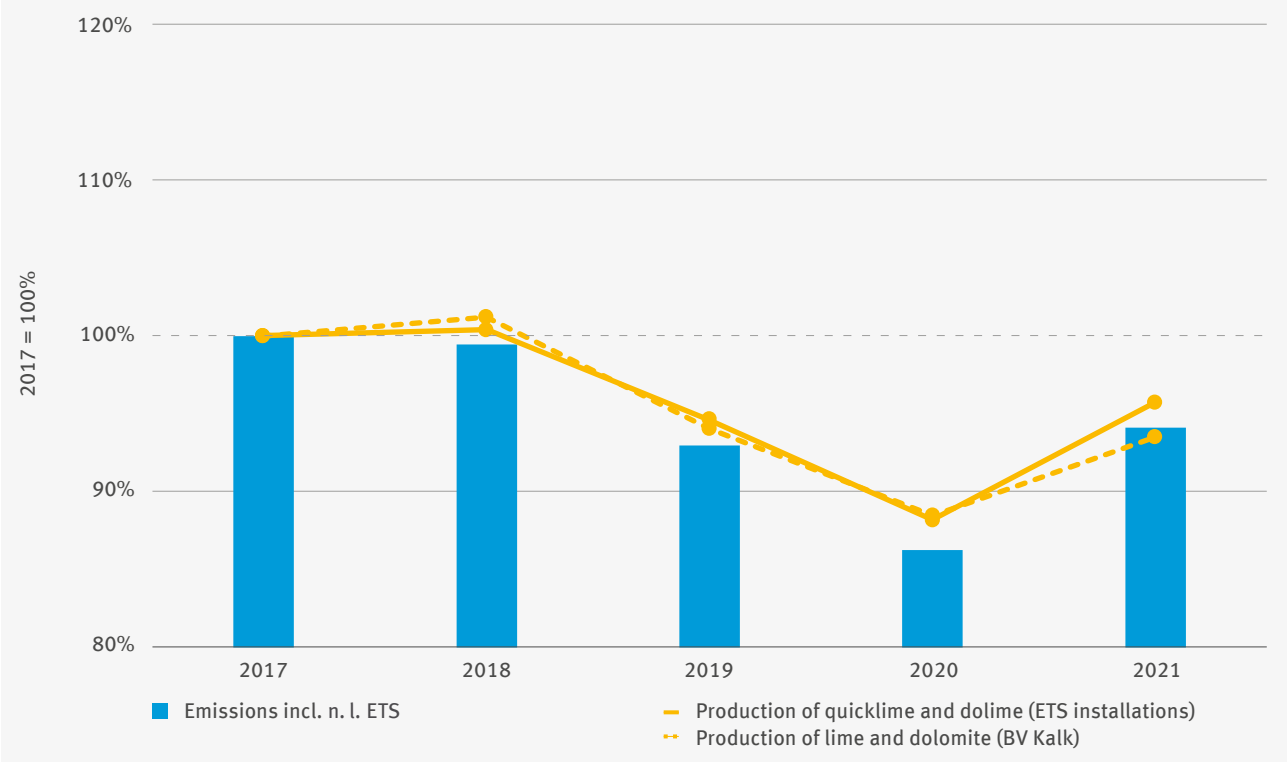


Figure 27: Industrial and building lime production (Activity 15), 2017 – 2021 emissions and production trends[84] in Germany in relation to 2017

Figure 27 shows the emissions and production trends in relation to 2017. The solid line shows the trend for all installations subject to emissions trading in the respective year (production of quicklime and dolime). In contrast, the data from the Association of the German Lime Industry (dashed line) only covers the lime and dolomite installations organised within the association. The emissions trend in the period 2017 to 2021 basically reflects the lime production trend. Despite the use of more efficient kilns, the specific emissions have remained largely unchanged in recent years because more pulverised lignite was used as a fuel. In 2021, the specific emissions from lime installations amounted to 1.09 tonnes of carbon dioxide per tonne of quicklime or dolime and was thus roughly at the same level as in previous years.

Trends in the Past Years – Sugar Industry

Figure 28 shows the emissions and free allocation trend 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 relative emissions trend are indicated for the period from 2017. The figure is supplemented by the presentation of installations currently no longer subject to emissions trading (n. l. ETS)[85] and the estimated emissions from installations subject to emissions trading only from 2013 for the period 2005 to 2012[86].

The average total emissions of the sugar industry have increased from each previous trading period to the next. This increase was the largest at just over 19 percent from the first to the second trading period.

Looking at the emissions trend in the sugar industry, after a slight increase in emissions in the middle of the third trading period, a trend of decreasing emissions can be seen from 2018 onwards. The decrease since 2018 has amounted to a total of 13 percent compared to 2021.

84 Sources for production data: Association of the German Lime Industry (BV Kalk)

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

86 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

In addition to fuel input, emissions from sugar installations are primarily influenced by the quality and quantity of the sugar beet harvest and are therefore subject to annual fluctuations due to weather conditions.

For a comparison of emissions and free allocation, the emissions must be considered within the scope of the respective trading period, i. e. without the emissions estimated retrospectively (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 37 percent fewer emission allowances free of charge on average in the third trading period than they needed to cover their emissions.

In addition, there was the (annually stronger) cross-sectoral correction factor in the third trading period.

With the start of the fourth trading period, the free allocation to sugar installations once again fell significantly compared to 2020, although there will be no reduction in the free allocation through a cross-sectoral correction factor at least for the first allocation period between 2021 and 2025. 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.

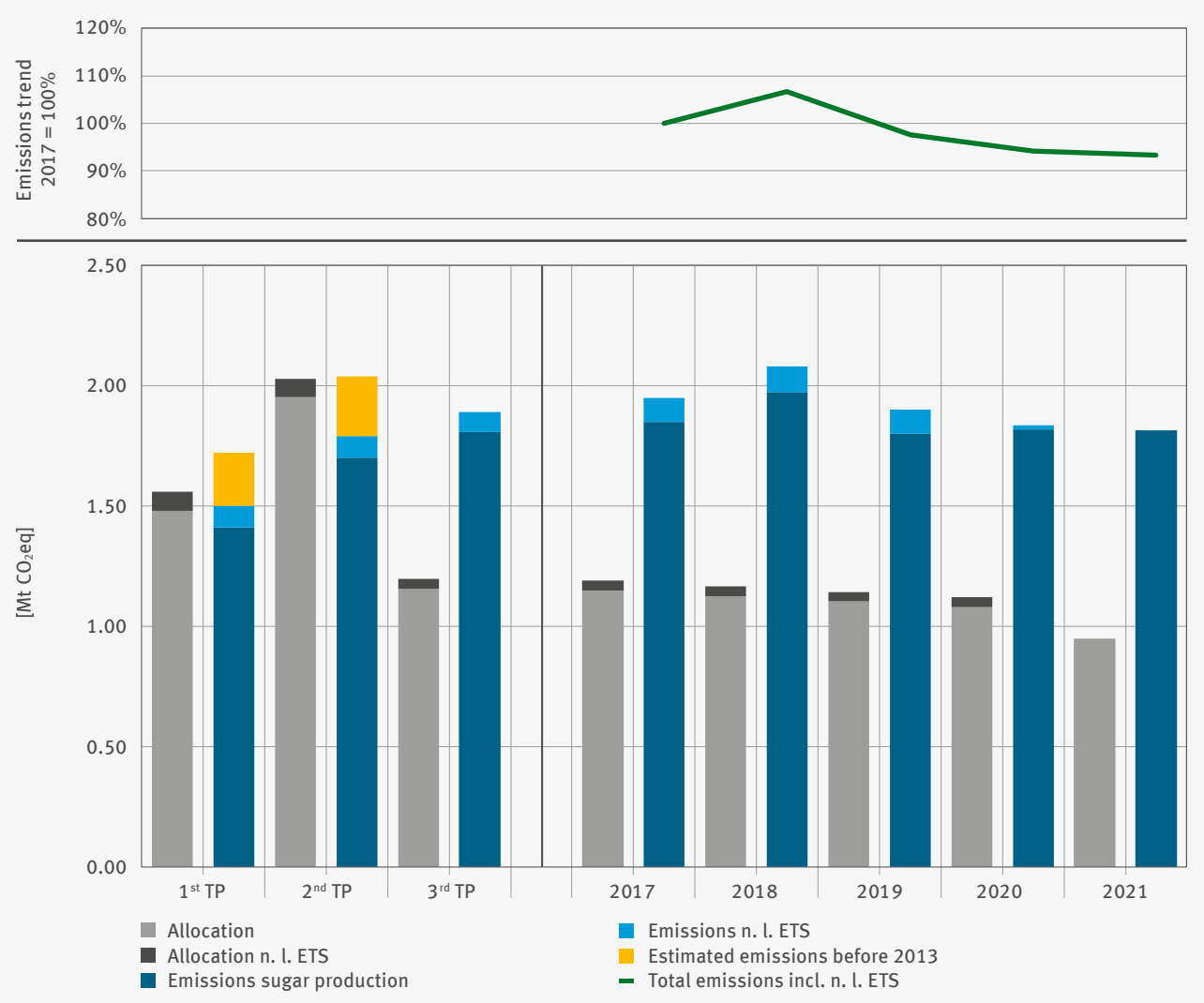


Figure 28: Emissions and free allocation trends in the sugar industry up to 2021 (Activity 15)

The trend of the 'Lime production' activity (not differentiated according to industrial and building lime or sugar lime) at EU level is described in Chapter 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 11.6 percent of the mineral processing industry emissions. The emissions are predominantly produced in the manufacture of flat and hollow glass (see Figure 29).

In total, the emissions from installations for glass and mineral fibre production subject to emissions trading in 2021 increased by around four percent to approximately 4.1 million tonnes of carbon dioxide compared to the previous year. A total of 75 installations were covered, of which 68 were glass production installations and seven mineral fibre production installations. One installation is no longer subject to the emissions trading obligation.

Table 15 shows the 2021 emissions broken down by economic sector compared to the previous year.[87]

Hollow glass production emissions were around 1.6 million tonnes of carbon dioxide in 2021, roughly the same level as the previous year.[88] Flat glass production emissions have increased by eight percent.

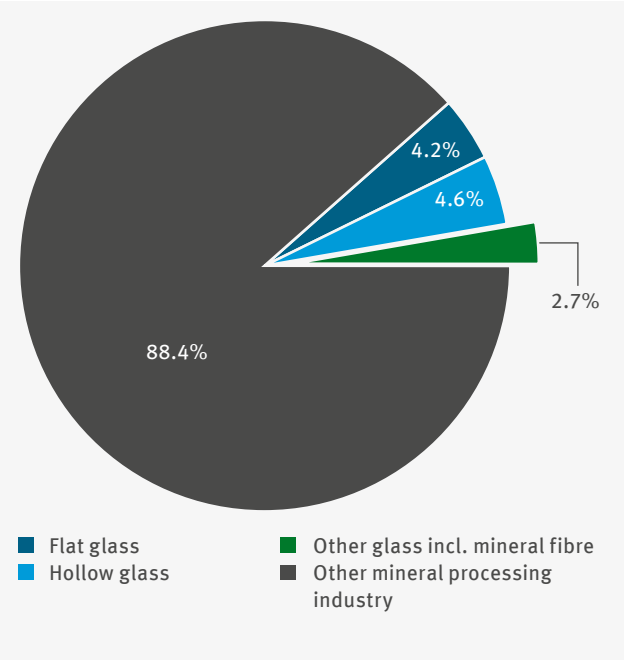


Figure 29: Allocation of shares for glass and mineral fibre production from the 2021 emissions in the mineral processing industry (Activities 16 and 18)

Mineral fibre production emissions increased by around 13 percent compared to the previous year. However, this is barely significant due to the low absolute level of emissions from the installations.

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

88 Since the number of installations in the various economic sectors has changed 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, 2020 emissions, 2021 free allocation, 2021 VET entries, allocation coverage

No.	Activity	No. of instal-lations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
16	Production of hollow glass	35	1,630	1,627	1,211	74.5%
	Production of glass fibre and goods thereof	8	188	203	115	56.5%
	Production, finishing and processing of flat glass	14	1,401	1,514	1,141	75.4%
	Production, finishing and processing of other glass including technical glassware	11	354	378	295	78.1%
		68	**3,573**	**3,722**	**2,762**	**74.2%**
18	Production of glass fibre and goods thereof	1	8	7	3	40.9%
	Production of other non-metallic mineral goods n.e.c.	6	342	387	262	67.7%
		7	**350**	**395**	**265**	**67.2%**
	n. l. ETS	*1**	*25*	–	–	–
Total		**75**	**3,949**	**4,117**	**3,027**	**73.5%**

As of 02/05/2022
* n. l. ETS not included in total number of installations

The aggregated shortfall of all installations was around 1.1 million emission allowances, of which Activity 16 (Glass production) alone accounts for 960,000 emission allowances. The allocation coverage of all installations for glass and mineral fibre production was around 74 percent in 2021.

Trends in the Past Years

Figure 30 shows the emissions and free allocation trends 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; for the period since 2017, annual emissions and allocation amounts and the relative emissions trends are shown. The figure includes a representation of installations that are currently no longer subject to emissions trading (n.l. ETS)[89] plus estimated emissions from the installations that were only subject to emissions trading from 2008, for the period 2005 to 2007.[90]

89 See explanations on 'Taking into account installations no longer subject to emissions trading (n. l. ETS)' in Section 1.2.

90 The 2005 – 2007 emissions are data from the allocation procedure.

In the sector as a whole, only minor changes in emissions can be seen when looking at the past three trading periods. Since the introduction of European Emissions Trading in 2005, the emissions of the entire sector have been just over four million tonnes of carbon dioxide with slight annual fluctuations. Only in 2019 and 2020 did emissions fall by a total of just under four percent compared to 2017. This was due to economic reasons and by 2021 emissions were back at the level of the starting year.

Emissions from hollow glass production have been relatively constant since 2017 at around 1.6 million tonnes of carbon dioxide annually.

The production and emissions of flat glass manufacturing installations are determined partly by the economic situation of the automobile and construction industries. In line with the trends of these industrial sectors, emissions increased in the middle of the trading period in 2018, and then decreased by a total of eight percent in the following two years. In 2021, they returned to the level of 2017.

The decrease in emissions from installations for the production of other glass including mineral fibres is subject to the greatest relative fluctuations within this sector. This category includes emissions from the 'Production, refining and processing of other glass including technical glassware', the 'Production of other non-metallic mineral products n.e.c.' and the 'Production of glass fibre and goods thereof'. In 2018, the increase in emissions was four percent compared to 2017, after which emissions fell by just over eleven percent up to 2020 and then increased again by nine percent in 2021.

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

In 2021, free allocation fell again compared to the previous year, which can be explained partly by the reduction in the benchmark values for allocation in connection with the change from the third to the fourth trading period. The reduced level of the benchmark values was not fully compensated for even by the discontinuation of the cross-sectoral correction factor.

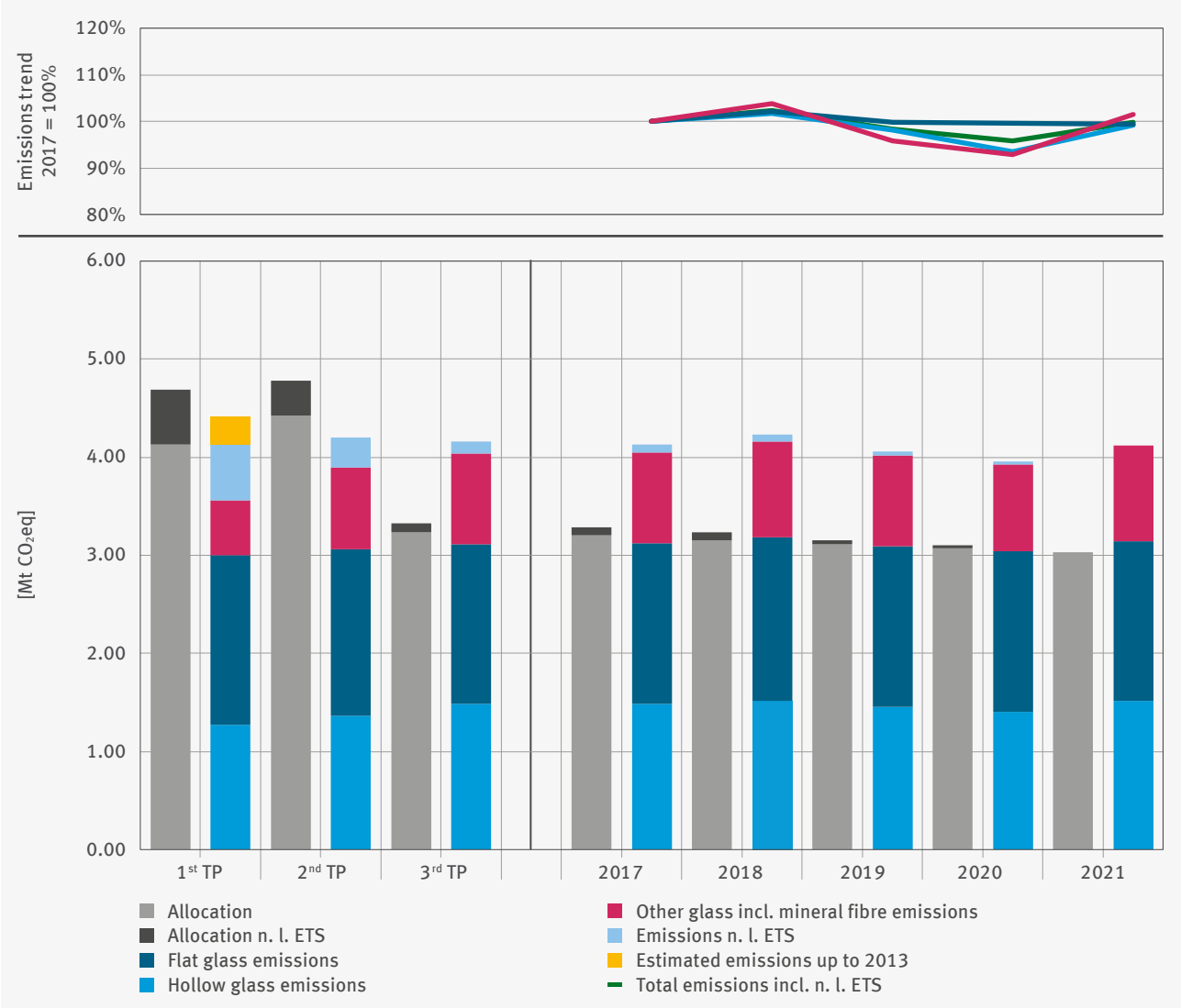


Figure 30: Glass and mineral fibre production (Activities 16 and 18), emissions and free allocation trends up to 2021

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. It comprises 119 installations.[91]

These installations caused about 5.3 percent of the emissions from the mineral processing industry (see Figure 22).

Emissions from ceramic installations subject to emissions trading in 2021 have increased by 70,000 tonnes of carbon dioxide or four percent compared to the previous year.

91 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 Chapter 1.3.

Table 16: Ceramics production (Activity 17), number of installations, 2020 emissions, 2021 free allocation, 2021 VET entries, allocation coverage

No.	Activity	No. of instal-lations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
17	Ceramics production	119	1,738	1,814	1,406	77.5%
	n. l. ETS	*12**	*5*	–	–	–
Total		**119**	**1,744**	**1,814**	**1,406**	**77.5%**

As of 02/05/2022
* n. l. ETS not included in total number of installations

The average allocation coverage for ceramic installations was almost 78 percent in 2021.

However, around 13 percent of the installations continue to be allocated more free emission allowances than they are required to surrender.

Trends in the Past Years

Figure 31 shows the emissions trends 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, plus annual emissions and allocation amounts and the relative emissions trend for the period since 2017. The Figure includes a representation of installations that are no longer subject to emissions trading (n. l. ETS)[92] and the estimated emissions for the period 2005 to 2012 of the installations that were only subject to emissions trading from 2013.[93]

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

However, from 2013 until the end of the third trading period, emissions from ceramic installations decreased steadily and in 2020 were around 88 percent of 2013 emissions or 91 percent of 2017 emissions. Compared to 2020, emissions increased again by four percent in 2021.

For the comparison with free allocation, only emissions in the respective eligible area should be considered (without the yellow sections of the column). In the first and second trading periods, the ceramic installations received more free allocations than they would have needed for their surrender obligations. The allocation coverage was 122 percent in the first trading period and 142 percent in the second trading period. As in the other industrial sectors, the allocation situation of the ceramics industry changed significantly at the start of the third trading period, hence the installations had an overall shortfall. The allocation coverage dropped to an average of around 89 percent in the third trading period.

With the transition from the third to the fourth trading period, the allocation coverage had further decreased – to 78 percent. This was due to increased emissions and a reduction in free allocation compared to the previous year. Free allocation has fallen primarily because many installations in the ceramics industry receive the largest share of their free allocation via fallback allocation elements and the underlying fallback benchmark values were significantly reduced compared to the third trading period. The discontinuation of the cross-sectoral correction factor is thus not reflected in an increase in the free allocation.

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

93 The 2005 – 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.

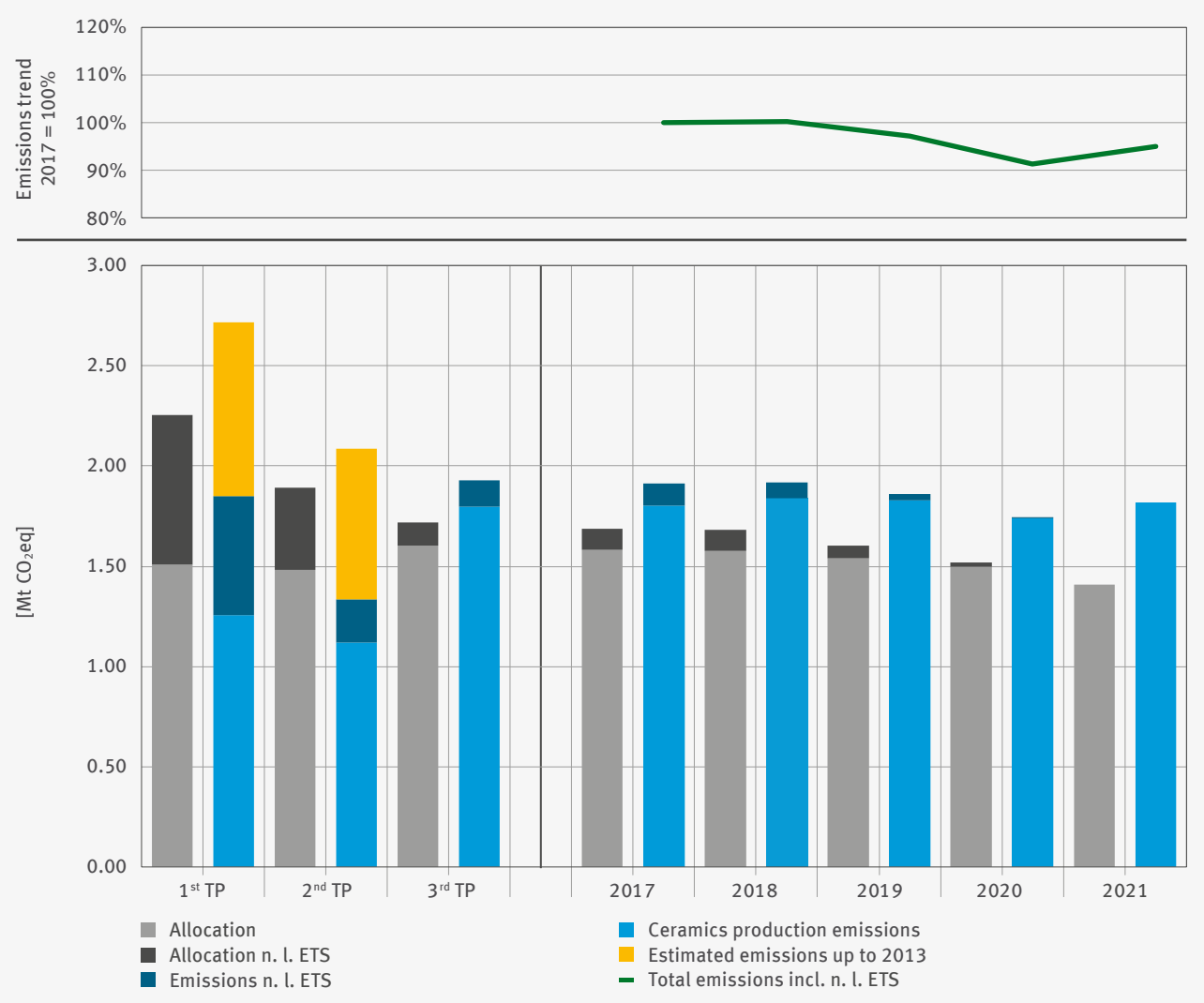


Figure 31: Production of ceramics (Activity 17), emissions and free allocation trends up to 2021

2.7 Paper and Pulp Industry

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

The number of installations fell from 146 in 2020 to 138 in 2021[94]. Five installations were assigned to pulp production, 133 to paper production.
The installations in the paper and pulp industry emitted about 5.4 million tonnes of carbon dioxide in 2021. Thus 2021 emissions were about 2.4 percent higher than in the previous year. As shown in Figure 32, paper production has a share of about 95 percent. Pulp production only accounts for just under five percent of the emissions.

For pulp production in 2020, the emissions subject to surrender of 259,000 tonnes of carbon dioxide remained unchanged for the 2021 reporting year (see Table 17). For paper production, emissions had increased by 137,000 tonnes of carbon dioxide (around 2.7 percent) to just under 5.1 million tonnes of carbon dioxide. According to the association's data, paper production increased by 8.3 percent in the same period.[95]

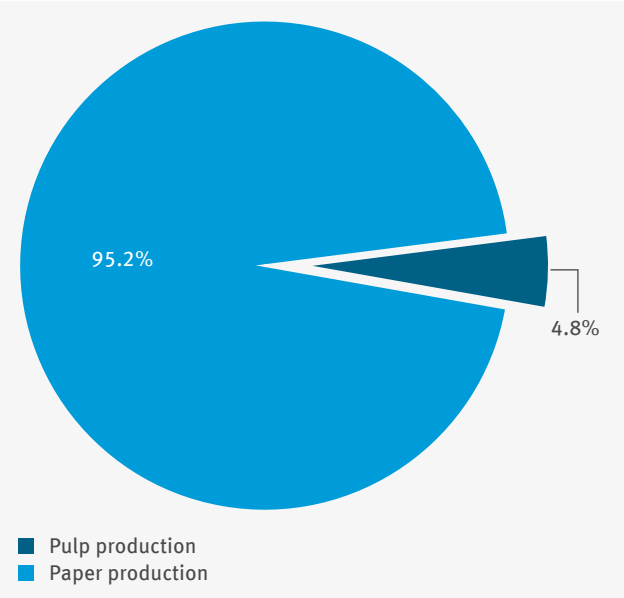


Figure 32: 2021 emission shares of the paper and pulp industry (Activities 20 and 21)

Operators of the 133 installations in the paper production sector of the industry received about 4.9 million emission allowances in 2021, which is about 260,000 allowances less than they would need to surrender according to the 2021 VET values (5.1 million, see Table 17). Compared to previous years, this resulted in a slight overall shortfall for this sector, for the first time. Compared to the previous year, this was attributable to both increased emissions and to reduced free allocation, partly due to the maximum possible reduction in the product benchmarks. The installations in the pulp sector of the industry overall had a considerable shortfall with an allocation coverage of around 30 percent of the emissions in 2021.

Table 17: Paper and pulp industry (Activities 20 and 21), number of installations, 2020 emissions, 2021 free allocation, 2021 VET entries, allocation coverage

No.	Activity	No. of instal-lations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
20	Pulp production	5	259	259	77	29.6%
21	Paper production	133	4,987	5,124	4,865	94.9%
	n. l. ETS	*8**	*0*	–	–	–
Total		**138**	**5,246**	**5,383**	**4,942**	**91.8%**

As of 02/05/2022
* n. l. ETS not included in total number of installations

94 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
95 See THE PAPER INDUSTRY (DIE PAPIERINDUSTRIE) (2022), Press release of 01/03/2022.

Adjusting the allocation for an estimated allocation amount for heat imports[96] also confirms the picture with regard to 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).[97] Without this share, the allocation coverage for paper production (Activity 21) and pulp production (Activity 20) could drop as low as around 73 percent (adjusted allocation coverage).

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

Sector	No. of instal-lations	2021 adjusted allocation amount [1000 EUA]	2021 VET [kt CO_2eq]	2021 allocation deviation from 2021 VET [kt CO_2eq]	Adjusted allocation coverage
Paper and Pulp	138	3,910	5,383	–1,473	72.6%

As of 02/05/2022

Trends in the Past Years

Figure 33 shows the emissions and free allocation trends of 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; annual emissions and allocation amounts and the relative emissions trends are shown for the period since 2017. Installations no longer subject to emissions trading (n.l. ETS)[98] 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 trading period to trading period.

Between 2017 and 2020, emissions from the paper and pulp industry also fell at a relatively constant rate, before a slight increase in emissions was recorded again in the 2021 reporting year. This rise was mainly due to increased emissions in the paper sector of the industry. While emissions in the paper sector fell by around eleven percent from 5.6 million tonnes of carbon dioxide in 2017 to just under 5 million tonnes in 2020, there was an increase in emissions of around 2.5 percent again in 2021. In comparison the emissions trends in the pulp sector was relatively constant over the same period, with no significant effect on the total emissions trends in the paper and pulp industry due to the limited number of installations (five) combined with comparatively low emissions in this sector. Reasons for the trend since 2017 were essentially the increase in energy efficiency in production and also the production trends (see Figure 42). In the 2021 reporting year, the easing of the markets in general and the revival of consumer demand in the second year of the COVID 19 pandemic, as well as newly created capacities in the packaging sector, were therefore likely to have played a significant role in the resurgence of emissions.

Natural gas is by far the most important energy source for paper and pulp industry production. The use of lignite and hard coal has been significantly reduced in recent years, 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.

96 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.

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

98 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, the aggregated representation of the trading periods in Figure 41 illustrates in particular the effects of adjustment of the allocation rules 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-installation heat flows are important in this case; they stipulate that the producing installations that import heat from other installations subject to emissions trading also receive free allocation for this heat. For this reason, it is important to take into account the heat imports from energy installations for estimating the actual relevant allocation amounts in the paper and pulp industry from the third trading period onwards; this is taken into account accordingly via the adjusted allocation coverage and indicated by the hatched area in the figure.

In 2021, the first year of the fourth trading period, there was 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 in this sector in the 2021 – 2025 allocation period, which exceeded the positive effect of the discontinuation of the cross-sectoral correction factor. Furthermore, the heat imports eligible for allocation from other installations subject to emissions trading decreased.

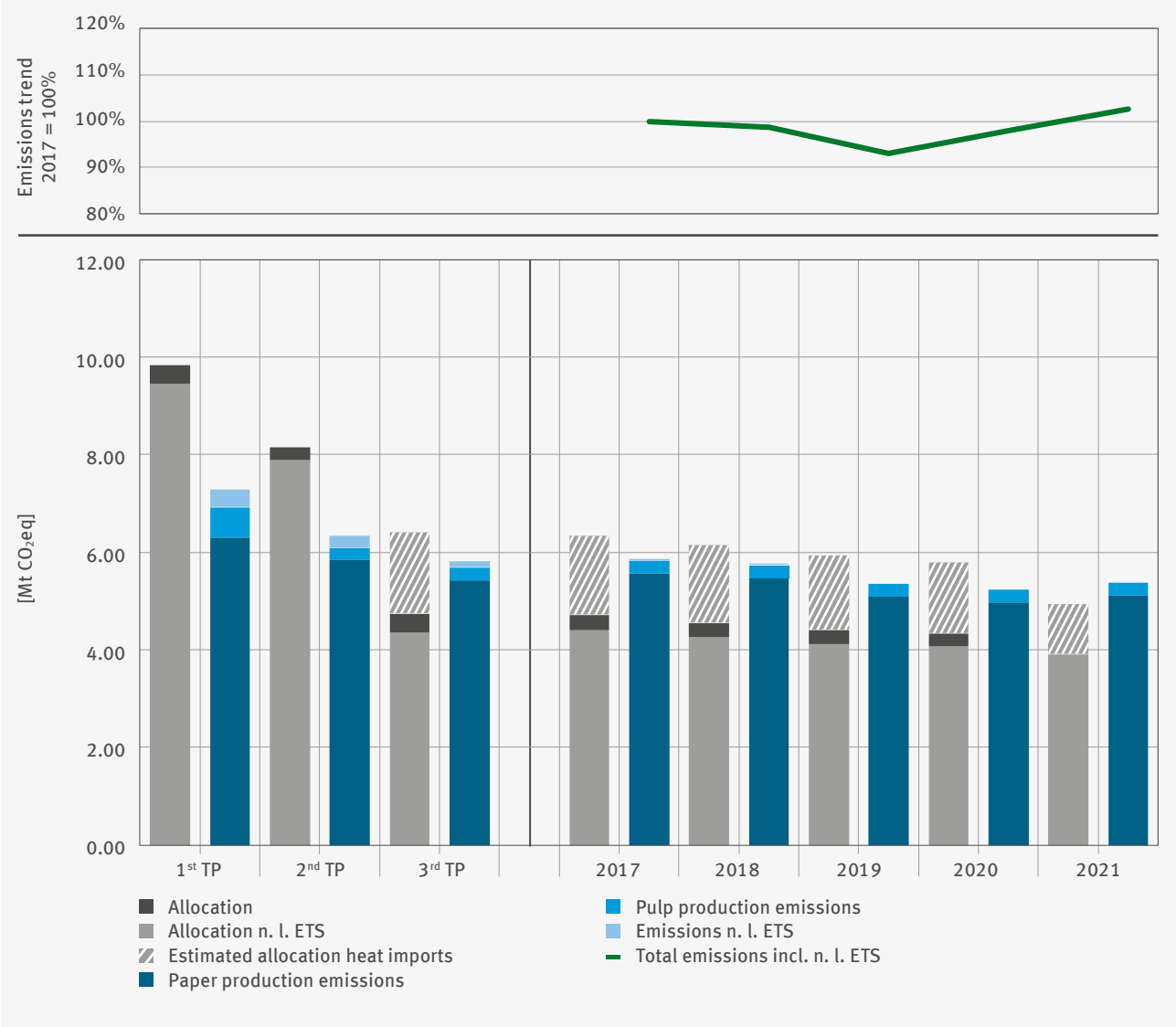


Figure 33: Paper and pulp industry (Activities 20 and 21), free allocation and emissions trends up to 2021

Figure 34 shows the emissions trends of the paper industry compared to the production data trends. For this purpose, the activity rates of the product benchmarks for 'fine paper' and 'newsprint' were combined into graphic papers. 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' are also shown. The activity rates are compared to the corresponding data of the association 'THE PAPER INDUSTRY' (DIE PAPIERINDUSTRIE) up to 2020. For 2021, 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 will be a recovery in 2021. After several years of decline, the production of graphic papers is showing a significant increase for the first time. In the 2021 reporting year, the renewed increase in demand after the lockdown phase of the COVID 19 pandemic is likely to be part of the cause for the increase in production: the reopening of sales outlets and the renewed demand from retailers for print advertising are the main drivers of the trend reversal.[99] 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. However, in the 2021 reporting year, a slight decline in the association's production data is visible. After increased demand and production of tissue paper in the wake of the increased hoarding of purchases, especially at the beginning of the COVID 19 pandemic in 2020, the level of demand returned to normal in the 2021 reporting year. According to the association's production data, the production increases already seen in the previous years for packaging products continued in 2021. The increased demand for packaging for food and e-commerce during the COVID 19 pandemic and the continuing trend of switching from plastic to paper packaging are likely to have had some impact.[100] In a comparison of the product groups, the strongest increase since 2017 can be seen in packaging products.

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.

99 See THE PAPER INDUSTRY (DIE PAPIERINDUSTRIE) (2022), Press release of 01/03/2022

100 See THE PAPER INDUSTRY (DIE PAPIERINDUSTRIE) (2022), Press release of 01/03/2022

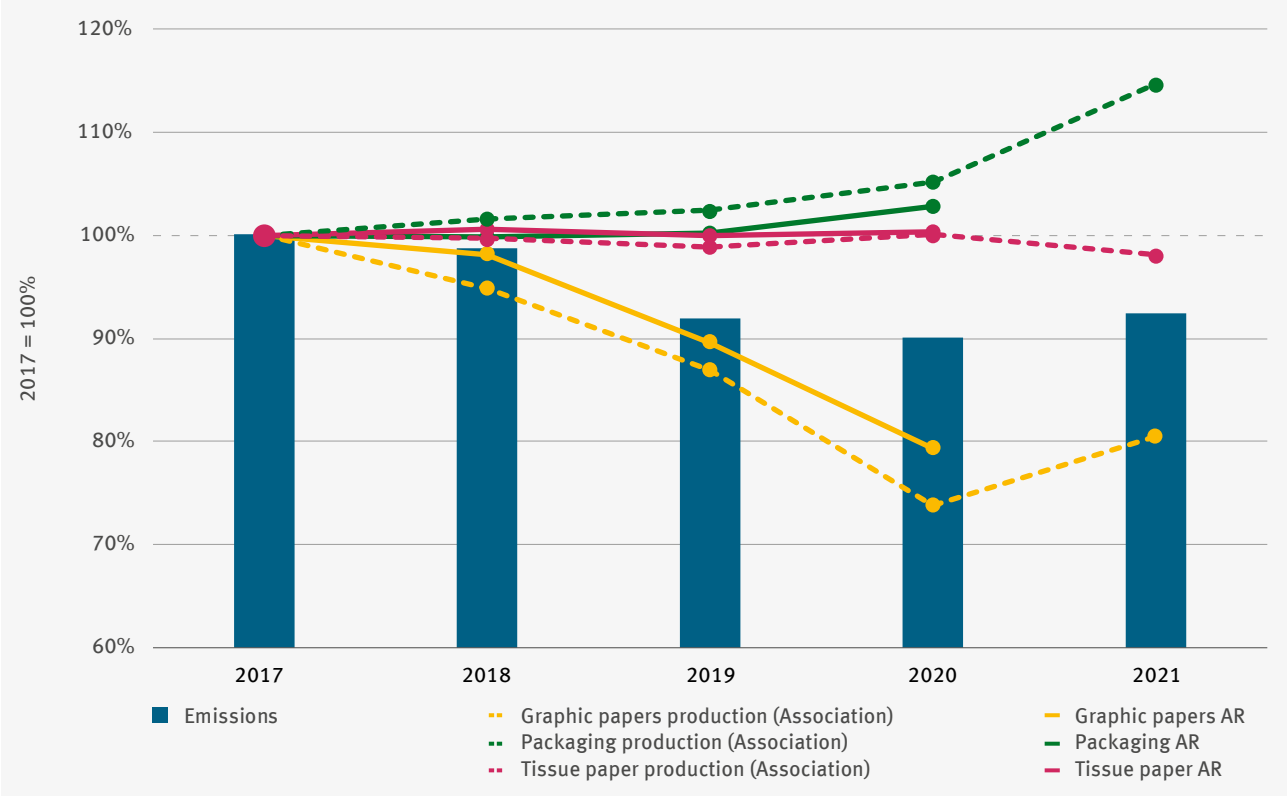


Figure 34: Paper production (Activity 21), 2017 to 2021 emissions and production trends in Germany compared to 2017

Figure 35 shows the 2021 production shares of the above paper production sectors such as packaging, graphic papers and tissue paper using the Association's production data. Packaging production accounts for about 63 percent which is the largest share. Graphic papers have a share of about 30 percent and tissue papers account for slightly less than seven percent.

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

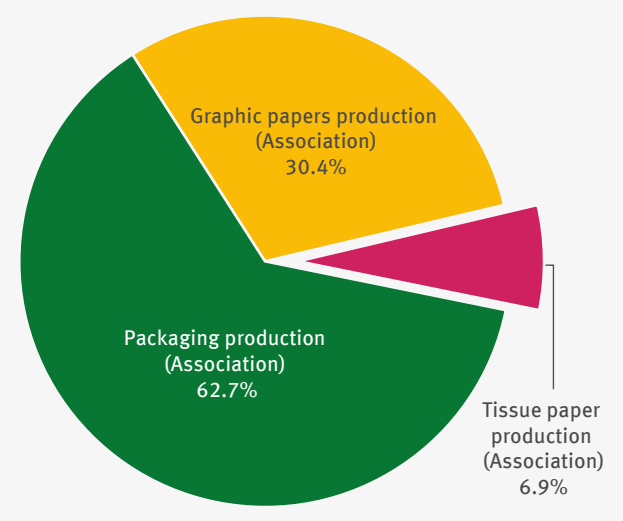


Figure 35: Significance of the production of graphic paper, tissue paper and packaging paper for the paper industry subject to emissions trading with shares of 2021 VDP production data

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 sector chapter. In 2021, at the start of the fourth trading period, the chemical industry comprised 198 installations[101]. The number of installations fell compared to the previous year and the surrender obligation was dropped for 19 installations with no emissions or zero-emission installations.[102] Emissions from the chemical industry in 2021 amounted to around 17.2 million tonnes of carbon dioxide equivalents, i. e. 1.9 percent more than in the previous year.

Figure 36 shows the percentage shares of the activities covered in the emissions of the chemical industry. They are clearly dominated by the production of bulk organic chemicals (Activity 27) at about 47 percent, followed by ammonia production (Activity 26) at almost 27 percent. The production of hydrogen and synthesis gas (Activity 28) and combustion (Activity 1)[103] fell into the next largest categories with ten and seven percent, respectively. Other activities make up the smallest share with around three percent each.

In detail, there is an increase in emissions for most activities. Only two activities showed a decrease (see Table 19).

The two activities with the highest emissions are Activity 27 (production of bulk organic chemicals) and Activity 26 (ammonia production). Compared to the previous year, there was an increase of 187,000 tonnes of carbon dioxide (up 2.4 percent) within Activity 27 and an increase of 139,000 tonnes of carbon dioxide (up 3.1 percent) within Activity 26.

Activity 27 (production of bulk organic chemicals) also had the largest absolute change in emissions, followed by the combined Activities 23, 24 (adipic and nitric acid) with a decrease of 172,000 tonnes of carbon dioxide (minus 25 percent). Part of this decrease is due to the fact that the conversion of nitrous oxide emissions into carbon dioxide equivalents has been carried out with a lower conversion factor (GWP) since the beginning of the third trading period.[104]

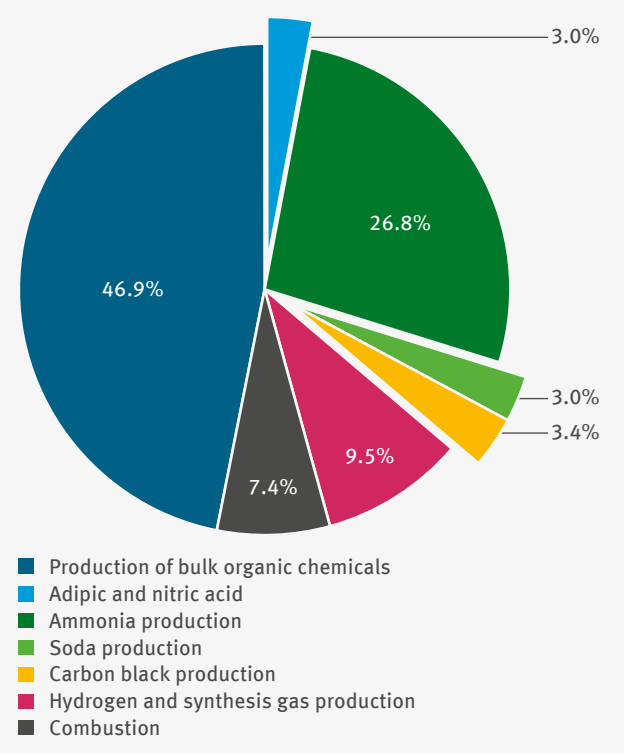


Figure 36: Shares of 2021 emissions from the chemical industry (Activities 22 to 29 and 1)

101 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.

102 Details on the discontinuation of the emissions trading obligation for zero-emission plants can be found in Chapter 1.3.

103 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.

104 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, 2020 emissions, 2021 free allocations, 2021 VET entries and allocation coverage

No.	Activity	No. of instal-lations	2020 emissions [kt CO_2eq]	2021 VET [kt CO_2eq]	2021 allocation amount [1000 EUA]	2021 allocation coverage
22	Carbon black production	4	518	582	378	64.8%
23, 24	Adipic and nitric acid	11	687	515	1,317	255.7%
26	Ammonia production	5	4,488	4,627	3,848	83.2%
27	Production of bulk organic chemicals	134	7,897	8,084	7,547	93.4%
28	Hydrogen and synthesis gas production	15	1,623	1,637	1,067	65.2%
29	Soda production	6	511	525	1,036	197.6%
1	Combustion	23	1,205	1,279	998	78.0%
	n. l. ETS	*24**	*0*	–	–	–
Total		**198**	**16,929**	**17,249**	**16,191**	**93.9%**

As of 02/05/2022
* n. l. ETS not included in 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 2021 the nitrous oxide emissions amounted to around 406,000 tonnes of carbon dioxide equivalents and accounted on average for 78.9 percent of the total emissions from these installations.

Allocation Status

Compared to other industrial sectors, the chemical industry's installations were, on average, adequately provided with free emission allowances in the third trading period. However, this has changed with the start of the fourth trading period.

In 2021, the first year of the fourth trading period, installations in the chemical industry were allocated 16.2 million emission allowances (see Table 19). For the first time, this allocation amount was 6 percent below the total amount of allowances required for surrender. Last year, the allocation coverage was still 106 percent.

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 (255.7 percent). This can be explained by the fact that N_2O emission abatement techniques have in the meantime been implemented and further developed in these installations so 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 (197.6 percent or 512,000 emission allowances). The high allocation for soda can be explained by methodological shortcomings[105] in the definition and calculation of the derivation of the product benchmark for soda.

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

In contrast, the free allocation to the carbon black, ammonia and hydrogen or synthesis gas producing installations was not sufficient to fully cover these installations' emissions in the past years. This situation has become even worse in the fourth trading period. Ammonia installation operators faced a shortfall of 780,000 emission allowances (16.8 percent) and carbon black producers had to handle a shortfall of 205,000 emission allowances (35.2 percent).

The shortfall for hydrogen and synthesis gas production increased considerably compared to that of the previous year (570,000 emission allowances or 34.8 percent).

Table 20: Chemical industry (Activities 22 to 29 and 1), number of installations, 2021 VET entries, allocation amounts and adjusted allocation coverage

Sector	No. of installations	2021 adjusted allocation amount [1000 EUA]	2021 VET [kt CO_2eq]	2021 allocation deviation from 2021 VET [kt CO_2eq]	Adjusted allocation coverage
Chemical industry	198	15,113	17,249	–2,136	87.6%

As of 02/05/2022

While the installations of the chemical industry were still relatively adequately equipped with free emission allowances on average compared to other sectors in the third trading period, a clear deficit became apparent at the beginning of the fourth trading period after adjustment of the free allocation by an estimated allocation for imported heat.

The chemical industry's adjusted allocation coverage would still be 87.6 percent, after subtracting the estimated allocation amount due to heat imports from other installations subject to emissions trading amounting to approx. one million emission allowances[106].

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 2017 onwards. Installations no longer subject to emissions trading (n.l. ETS)[107] have also been taken into account. The estimated shares 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.[108]

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

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

108 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.

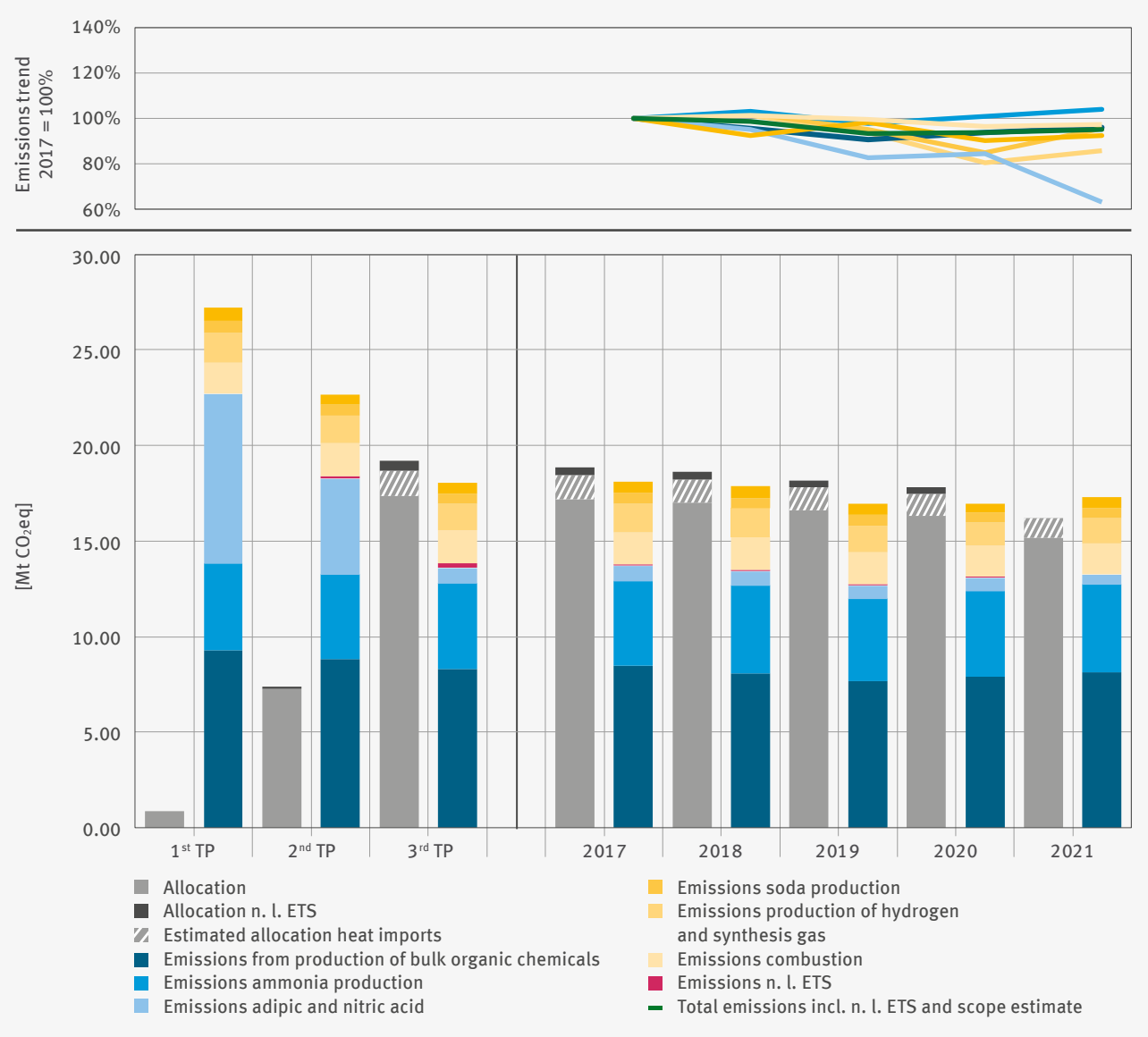


Figure 37: Chemical industry (Activities 22 to 29 and 1), emissions and free allocation trends up to 2021[109]

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.

It can be seen that the chemical industry shows largely constant emissions across the various activities over time.

109 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 2021, the first year of the fourth trading period – due to the change in the GWP factor, as mentioned earlier.

Looking at the trend in emissions of the activities over the last five years without adipic and nitric acid production, the trend has almost remained unchanged on average across the activities except for a slight decrease from 2019 to 2020.

Basically, the global COVID 19 pandemic in 2020 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.[110] However, this pandemic effect was not directly reflected in the emissions as the affected areas of the chemical industry hardly have any direct emissions.

In 2021, despite the COVID 19 pandemic and supply chain difficulties, production increased in almost all product areas. However, rising raw material and energy prices and a shortage of intermediate products weakened growth.[111]

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 course of time from 2017 to 2021 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 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.

Emissions and Production Trend

Figure 38 and Figure 39 below show the Activity 27 and 26 emissions which are the highest within the chemical industry. The corresponding activity rates from the annual production reports within the framework of the allocation procedure and the corresponding data of the German Chemical Industry Association (VCI) are also shown.

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.[112]

110 VCI 2020

111 VCI 2021

112 The index for bulk organic chemicals consists of all organic chemical production data published by the VCI in the publication ‘Chemie in Zahlen’ (‘Chemistry in figures’, VCI 2013, VCI 2021), while the index for ethylene and propylene comprises only these products. Data gaps for some products were interpolated. The 2018 and 2020 xylene figures and the 2020 propylene oxide figure were missing in the VCI publications. Accordingly, both products were not included in the index. Therefore, the 2018 index is not identical to the previous years.

The graph clearly shows between 2017 and 2021 there was a downward trend in both emissions and production from 2017 to 2019 and a subsequent recovery from 2019 to 2020. The production trend indices follow the emissions trend, but with a rather different slope.

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 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. 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.[113] At the same time, occasional effects such as the overhaul of crackers come into play, which can take several weeks and months and thus have a strong impact on the activity's emission trend. In 2019, partly due to an overhaul, emissions from the Böhlen cracker decreased by 372,000 tonnes compared to 2018. The cracker then reached more than 90 percent of the 2018 emission level in 2020.

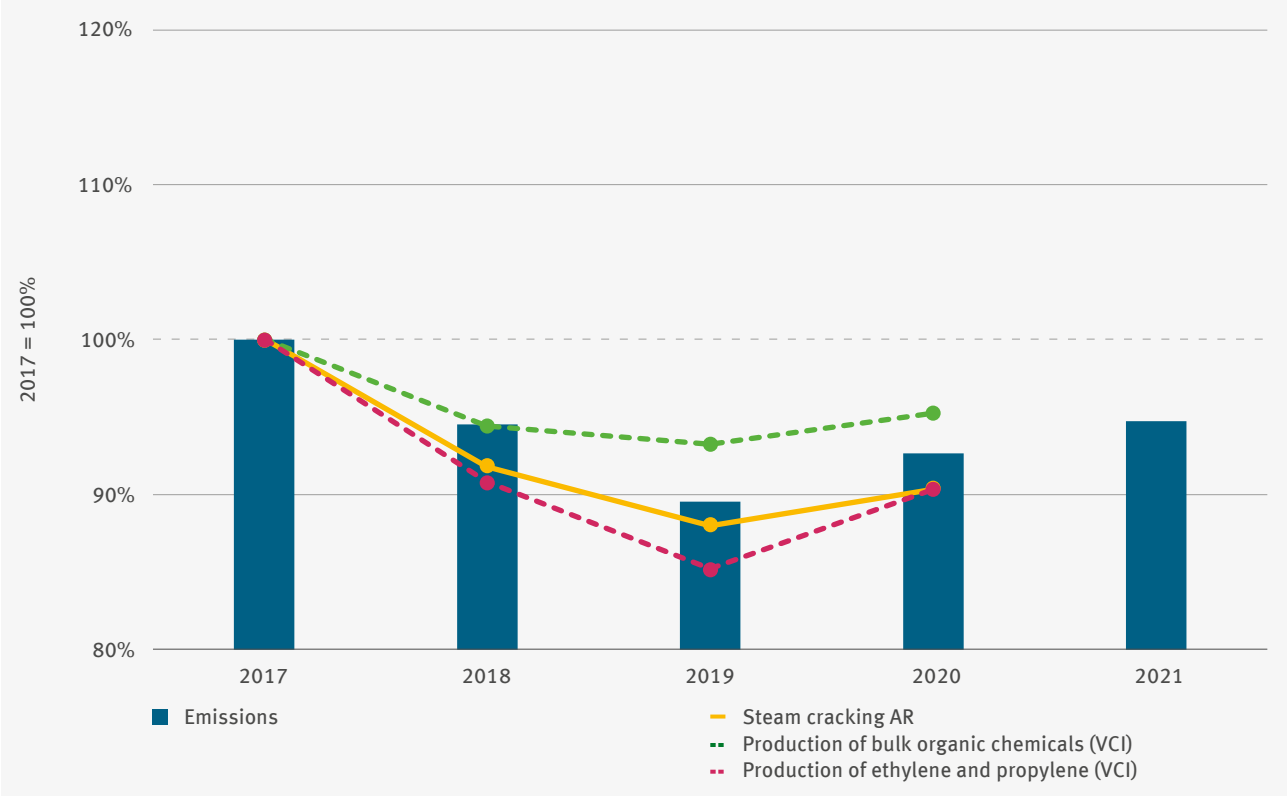


Figure 38: Production of bulk organic chemicals (Activity 27), 2017 to 2021 emissions and production trends in Germany, each in relation to 2017[114]

The emissions trend in ammonia production (see Figure39) 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.

113 VCI 2019

114 The association's production data are regularly only available with a one-year delay, and the 2020 activity rates are only exceptionally available from June and not from January of the following year. See explanations in Chapter 1 Introduction.

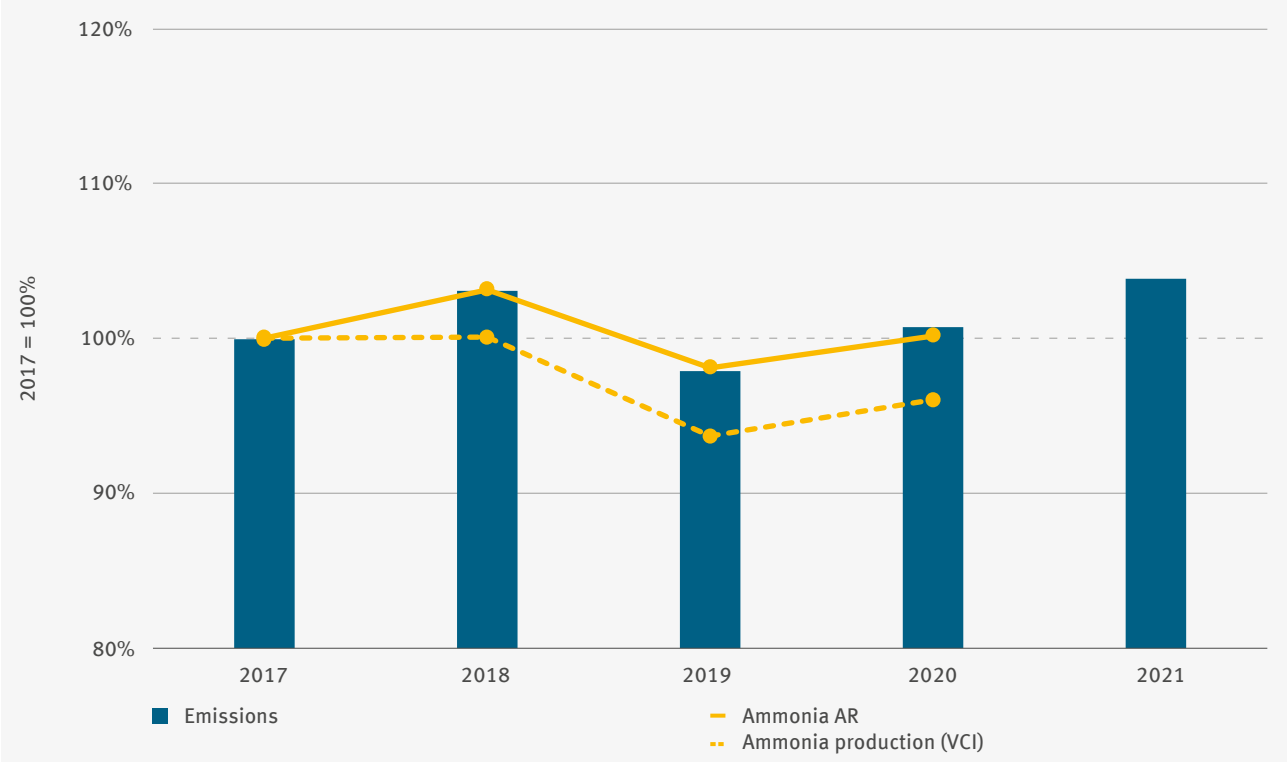


Figure 39: Ammonia production (Activity 26), 2017 to 2021 emissions and production trends in Germany, each in relation to 2017[115]

The trend of the chemical industry at EU level is described in Chapter 2.10.

115 VCI 2013, VCI 2019b

2.9 Overview of the Allocation Status in Germany

Allocation Rules in the Fourth Trading Period

The amendment of the EHRL[116] 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. However, the amendment also introduced changes.

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

3rd trading period	4th trading period
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 'production changes', threshold value: 15%, in-crease 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.

▸▸

116 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 in particular contains the specifications for determining the free basic allocation.
- The EU Adjustment Regulation regulates under which conditions, for example in the case of relevant production changes, this basic allocation is adjusted.[117]

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[118].

As opposed to the third trading period, it was not necessary in the first allocation period 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[119]. 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[120]. •

In the first 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[121] at 355.1 million tonnes of carbon dioxide equivalents. In 2021, a total of around 124.4 million emission allowances were allocated free of charge to operators of 1,570 of the 1,732 German installations.

The free allocation thus covered an average of 35 percent of the verified emissions from all installations in Germany (2020: 42.2 percent). This means that the average allocation coverage was around seven percentage points lower than in the previous year. Two effects come into play in this strong reduction. Firstly, emissions increased significantly (+10.8 percent) due to the economic recovery compared to the crisis year 2020 which was marked by a noticeable decrease in emissions due to the COVID 19 pandemic. Secondly, the 2021 allocation amount was decreased significantly by 7.9 percent compared to 2020. This decrease is the result of the adjusted allocation rules for the fourth trading period (see text box above). However, the allocation trend in the activities and sectors is differentiated (see sections below). In addition to the relevant activity rates' trend, a key factor is the respective relationship between the discontinuation of the cross-sectoral correction factor and the extent of the reduction in the corresponding benchmark for the allocation.

117 The DEHSt website on free allocation provides a detailed overview of the regulations on free allocation in the fourth trading period: DEHSt – Zuteilung 2021–2030; EU Allocation Regulation: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019R0331&from=EN; EU Adjustment Regulation: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019R1842&from=EN

118 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.

119 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).

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

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

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

Table 22: 2021 allocation status by activities (non-adjusted allocation coverage)[122]

Sector	No.	Activity	No. of instal-lations	2021 allocation amount [1000 EUA]	2021 VET [kt CO_2eq]	2021 allocation deviation from 2021 VET [kt CO_2eq]	2021 alloca-tion cover-age*	2020 alloca-tion cover-age*
Energy	2	Energy conversion >= 50 MW RTI	439	10,076	229,172	–219,095	4.4%	7.8%
	3	Energy conversion 20 – 50 MW RTI	361	1,455	5,120	–3,665	28.4%	48.2%
	4	Energy conversion 20–50 MW RTI, other fuels	12	90	64	26	140.0%	80.9%
	5	Prime movers (engines)	3	8	43	–35	18.8%	22.8%
	6	Prime movers (turbines)	53	229	823	–595	27.8%	45.8%
			868	**11,858**	**235,222**	**–223,363**	**5.0%**	**9.0%**
Industry	1	Combustion	80	1,856	2,644	–788	70.2%	84.6%
	7	Refineries	22	15,729	22,514	–6,784	69.9%	77.8%
	8, 9, 10	Production of pig iron and crude steel**	35	42,443	30,914	11,529	137.3%	150.1%
	8	Coking plants	4	1,414	3,699	–2,285	38.2%	47.5%
	9	Processing of metal ores	1	70	73	–3	95.9%	76.9%
	10	Production of pig iron and steel	30	40,959	27,142	13,817	150.9%	164.4%
	11	Processing of ferrous metals	83	2,959	4,354	–1,394	68.0%	98.4%
	12	Production of primary aluminium	7	874	915	–41	95.5%	85.2%
	13	Processing of non-ferrous metals	28	1,315	1,564	–249	84.1%	94.1%
	14	Production of cement clinker	35	17,337	20,532	–3,195	84.4%	78.7%
	15	Lime production	57	5,375	8,775	–3,400	61.2%	85.8%
	16	Glass production	68	2,762	3,722	–960	74.2%	78.1%
	17	Ceramics production	120	1,444	1,879	–434	76.9%	84.9%

122 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 is no longer subject to the surrender obligation of emission allowances as a small emitter in 2021 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.

Sector	No.	Activity	No. of instal-lations	2021 allocation amount [1000 EUA]	2021 VET [kt CO_2eq]	2021 allocation deviation from 2021 VET [kt CO_2eq]	2021 alloca-tion cover-age*	2020 alloca-tion cover-age*
Industry	18	Production of mineral fibres	7	265	395	–129	67.2%	77.9%
	19	Gypsum production	9	88	300	–213	29.2%	99.9%
	20	Pulp production	5	77	259	–182	29.6%	33.0%
	21	Paper production	133	4,865	5,124	–259	94.9%	109.1%
	22	Carbon black production	4	378	582	–205	64.8%	79.2%
	23	Production of nitric acid	8	552	397	154	138.8%	108.9%
	24	Production of adipic acid	3	765	118	648	650.9%	857.4%
	26	Ammonia production	5	3,848	4,627	–780	83.2%	77.6%
	27	Production of bulk organic chemicals	134	7,547	8,084	–537	93.4%	105.1%
	28	Production of hydrogen and synthesis gas	15	1,067	1,637	–570	65.2%	88.0%
	29	Soda production	6	1,036	525	512	197.6%	192.7%
			864	**112,582**	**119,861**	**–7,278**	**93.9%**	**101.9%**
Total			**1,732**	**124,441**	**355,082**	**–230,642**	**35.0%**	**42.2%**

As of 02/05/2022
* 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

The operators of the 864 installations with industrial activities received a total allocation of 112.6 million emission allowances for the 2021 reporting year. This compares with verified emissions totalling 119.9 million tonnes of carbon dioxide equivalents. The allocation thus corresponds to 93.9 percent of the surrender obligation of these installations (101.9 percent in 2020) and was therefore below the 100 percent mark. This is the lowest value since the start of the third trading period in 2013. The allocation coverage was already slightly below 100 percent in the 2017 – 2019 period before it rose above the 100 percent mark again in 2020 due to the strong drop in emissions due to the COVID 19 pandemic.

The adjusted allocation coverage[123] is once again significantly lower at 79 percent (2020: 89.9 percent) (cf. the following sections with Table 23 and Table 24).

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

The situation is different for the 868 energy installations (Activities 2 to 6). Due to the discontinuation of the free allocation for power generation in the third trading period, the 2021 ratio of allocation to verified emissions was only five percent on average thus once again significantly lower than in the previous year (2020: nine percent). Overall, in 2021 the energy installations received an allocation of 11.9 million emission allowances for heat generation while the verified emissions amounted to 235.2 million tonnes of carbon dioxide equivalents. While the emissions of these installations increased significantly by about 14.2 percent, the allocation decreased by about 35.7 percent compared to the previous year. The noticeable decrease in allocation can be attributed to the fact that the benchmark for the heat allocation was significantly lower compared to the third trading period and, in addition, a significant share of the allocation to energy installations is not subject to carbon leakage (cf. Chapter 2.1).

Apart from the energy sector, **power generation in industry** also no longer has received free allocations since 2013. This applies to refineries and to the paper industry since (heat and) power stations are usually in operation in both sectors. Thus in 2021, refineries received an allocation that corresponded to only 69.9 percent of their verified emissions (2020: 77.8 percent). The allocation coverage in the paper industry, however, does not indicate that part of the emissions 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 94.9 percent (109.1 percent in 2020).

30 pig iron and steel production installations (Activity 10), however nominally received on average a clearly higher allocation (150.9 percent, 2020: 164.4 percent) compared to their emissions. This is substantiated by the allocation rules for the high-emission waste gases from iron, steel and coke production but some of them 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 83.5 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 2021, an estimated 15.8 million emission allowances were assigned to waste gas transfer from industrial installations to energy installations and around 2.1 million emission allowances to heat imports from energy installations to industrial installations.[124]

Assuming that these allocation amounts were settled between industry and energy sector operators, the industry sector exhibited a deficit of around 25.2 million emission allowances in 2021. Thus, the allocation coverage for the industrial sector would be 79 percent instead of the aforementioned 93.9 percent corresponding to a significant deficit for the sector as a whole.

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 as a ratio of adjusted allocation to verified emissions for 2021 increased from five to 12.7 percent. Table 23 summarises the allocation status adjusted by transferred waste gases from iron, steel and coke production and imported heat for 2021 at the sector level.

124 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)

Sector	Industry	No. of instal-lations	2021 allocation amount [1000 EUA]	2021 VET [kt CO_2eq]	2021 allocation deviation from 2021 VET [kt CO_2eq]	2021 alloca-tion cove-rage*	2021 adjusted allocation amount** [1000 EUA]	2021 alloca-tion cove-rage**
Energy	Energy instal-lations	868	11,858	235,222	–223,363	5.0%	29,809	12.7%
		868	**11,858**	**235,222**	**–223,363**	**5.0%**	**29,809**	**12.7%**
Industry	Refineries	22	15,729	22,514	–6,784	69.9%	15,729	69.9%
	Iron and steel	120	45,422	35,428	9,994	128.2%	29,580	83.5%
	Non-ferrous metals	39	2,443	3,135	–692	77.9%	2,443	77.9%
	Industrial and building lime	39	4,425	6,958	–2,533	63.6%	4,425	63.6%
	Cement clinker	35	17,337	20,532	–3,195	84.4%	17,337	84.4%
	Other mineral processing industry	223	5,513	8,128	–2,615	67.8%	5,513	67.8%
	Paper and pulp	138	4,942	5,383	–441	91.8%	3,910	72.6%
	Chemical industry	198	16,191	17,249	–1,058	93.9%	15,113	87.6%
	Other combustion plants	50	581	534	47	108.8%	581	108.8%
		864	**112,582**	**119,861**	**–7,278**	**93.9%**	**94,632**	**79.0%**
Total		**1,732**	**124,441**	**355,082**	**–230,642**	**35.0%**	**124,441**	**35.0%**

As of 02/05/2022
* Without considering possible adjustments for the transfer of waste gases and for heat imports
** Considering possible adjustments 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 start year of the third trading period, both energy and industrial installations tend to receive a declining free allocation on average. 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 first year of the fourth trading period, the average adjusted allocation coverage now decreased significantly in both sectors (cf. Table 24).

Table 24: Adjusted allocation coverage since 2017

Sector	2017 allocation coverage*	2018 allocation coverage*	2019 allocation coverage*	2020 allocation coverage*	2021 allocation coverage*
Energy	13.6%	13.2%	14.9%	15.7%	12.7%
Industry	84.5%	84.6%	86.3%	89.8%	79.0%

As of 02/05/2022
* Considering possible adjustments for the transfer of waste gases and for heat imports

Broken down to the level of industrial sectors, there is a partly significant decline in the average adjusted allocation coverage in all sectors except the cement industry (see Figure 40). Here, the average adjusted allocation coverage grew from 78.7 percent in 2020 to 84.4 percent in 2021. In contrast to most other industrial sectors, the aggregated allocation of the cement industry did not decrease compared to the previous year, but was significantly higher than in 2020 at 9.4 percent. The discontinuation of the cross-sectoral correction factor more than compensated for the reduction in the benchmark for cement in this case. For the majority of sectors, however, the trend was characterised by increasing emissions and simultaneously decreasing allocation amounts.

The adjusted allocation coverage in the iron and steel industry (from 107.5 percent in 2020 to 83.5 percent in 2021) and in the industrial and building lime sector (from 93.2 percent in 2020 to 63.6 percent in 2021) fell particularly strongly. While the trend in the iron and steel industry is largely due to strong emissions growth as a result of the economic recovery after 2020, the crisis year, the allocation coverage in the industrial and building lime sector is shaped by the significant reduction in the relevant benchmarks for free allocation.

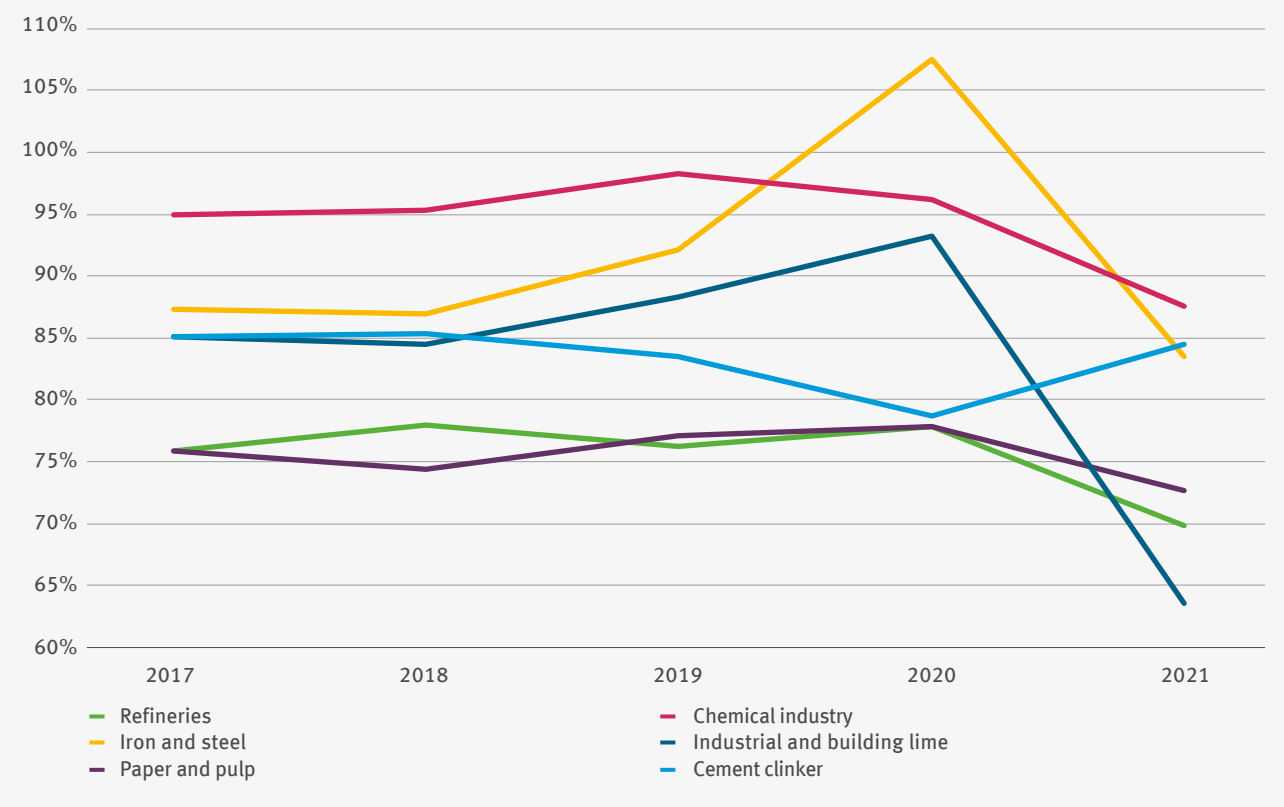


Figure 40: Adjusted allocation coverage trends for the largest emitters within the industrial sectors since 2017

Allocation Status in the Overall Period 2008 – 2021

For further consideration of the current allocation status, the following section includes not only the allocation surpluses (and deficits) for 2021 but also the corresponding figures from previous years for the installations considered in this report. This seems appropriate, as the emission allowances allocated since 2008 have been converted into emission allowances for the fourth trading period and could 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 98.5 million allowances[125]. Assuming that the allocations for transferred waste gases from iron, steel and coke production and imported heat (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 115.9 million emission allowances below the cumulative emissions. This balance increased continuously over the past years and was compensated, at least mathematically, by the surpluses accumulated in the second trading period until 2019. This mathematical surplus completely melted away in 2020. In the 2021 reporting year, the first year of the fourth trading period, emissions were 25.2 tonnes above the allocation. For industrial activities, the total balance for the 2008 – 2021 period is therefore minus 42.7 million emission allowances. Table 25 summarises the aggregated results differentiated at the sector level.

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

Industry/sector		Cumulative allocation surplus				
		No. of installations	2008–2012 adjusted* [M EUA]	2013–2020 adjusted** [M EUA]	2021 adjusted** [M EUA]	2008–2021 total adjusted** [M EUA]
Energy	Energy installations	868	–355.8	–1,986.1	–205.4	–2,547.3
		868	**–355.8**	**–1,986.1**	**–205.4**	**–2,547.3**
Industry	Refineries	22	11.5	–42.1	–6.8	–37.4
	Iron and steel	120	52.1	–20.6	–5.8	25.7
	Non-ferrous metals	39	0.0	–3.3	–0.7	–4.0
	Cement clinker	35	4.5	–17.3	–3.2	–16.1
	Industrial and building lime	39	9.5	–7.0	–2.5	0.0
	Other mineral processing industry	223	5.9	–13.1	–2.6	–9.8
	Paper and pulp	138	9.0	–10.4	–1.5	–2.9
	Chemical industry	198	5.1	–2.7	–2.1	0.2
	Other combustion plants	50	0.8	0.6	0.0	1.4
		864	**98.5**	**–115.9**	**–25.2**	**–42.7**
Total		**1,732**	**–257.3**	**–2,102.0**	**–230.6**	**–2,590.0**

As of 02/05/2022
* Incl. redistribution of emission allowances for transferred waste gases pursuant to Section 11 Allocation Act
** Considering possible adjustments for the transfer of waste gases and for heat imports

125 Including redistribution of emission allowances for transferred waste gases pursuant to Section 11 Allocation Act 2012

In contrast to the industrial sector, the energy installations already had a balance from emissions and allocations of 355.8 million emission allowances in the second trading period. This is also because in the second trading period in Germany, free allocation for electricity generation had already been reduced in favour of the auctioning of emission allowances in addition to the ambitious level of the benchmarks set at that time and the proportionate reduction to secure the budget.[126] Since the beginning of the third trading period, full auctioning has been in effect for electricity generation throughout Europe. Taking into account the balance from the second trading period and assuming that the free allocation for waste gases from iron, steel and coke production and heat imports has been offset between the industrial sectors and the energy sector, it can be seen that the energy sector's cumulative shortfalls at the end of the third trading period increased by another 1,986.1 million emission allowances. In 2021, the shortfall increased by an additional 205.4 million emission allowances, bringing the total balance since 2008 to minus 2,547.3 million emission allowances.

2.10 Emissions Trend of Individual Sectors in the EU – Review of the 3rd Trading Period

The last VET Report (2020 VET) had already described the overall trend in the third period in the individual sectors in Germany. Since complete, processed and quality-assured EU-level data for 2021 were published by the European Environment Agency only after the editorial deadline, they could not be taken into account when determining Germany's trend in relation to other Member States. This report now performs the sector-specific consideration of the developments between 2013 and 2020.

In the other Member States participating in the EU ETS, the emissions trend up to the end of the third trading period in the sectors covered differs significantly in part from the trend in Germany. In the stationary sector of the EU ETS, emissions are primarily determined by emissions from combustion plants, in particular emissions from electricity generation (2020: around 66 percent of stationary emissions). Their 2019 emissions were 24 percent lower and those in 2020 as much as 34 percent lower than in 2013 due to the COVID 19 pandemic (based on the EU30+[127]).

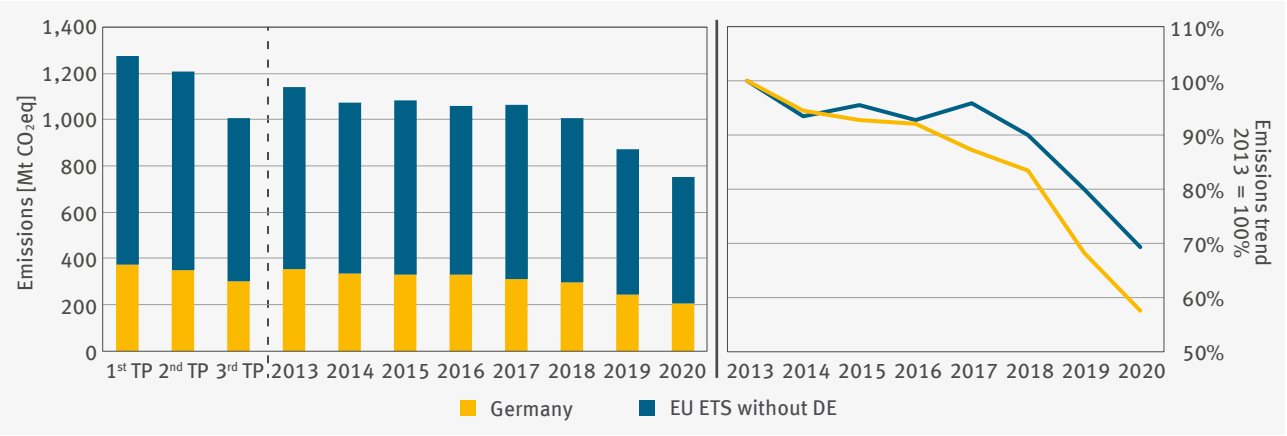
Although 2020 emissions from industrial installations were 7.8 percent lower than in 2013 due to pandemic-related production declines, they had remained largely stable in earlier years. In terms of industrial emissions, it is mainly the emissions from iron and steel production and cement clinker production that determine the trend (2020: around 9 percent of stationary emissions each). The following section therefore looks more closely at the trends in the three sectors mentioned and the Member States with the largest share of emissions in the third trading period in each case. This is followed by an overview of the trends in the other sectors in Germany that were not examined in depth in comparison to the other Member States[128]. This evaluation is based on a grouping of installations by activity in the EU Union Registry (cf. Table 38, Chapter 7), which may result in differences in the emissions amount per sector for Germany compared to Sections 2.1 to 2.8.

126 The 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.

127 EU30+ includes the countries participating in the EU ETS in 2021, i. e. the EU27 and Iceland, Liechtenstein, Norway, plus some installations in Northern Ireland

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

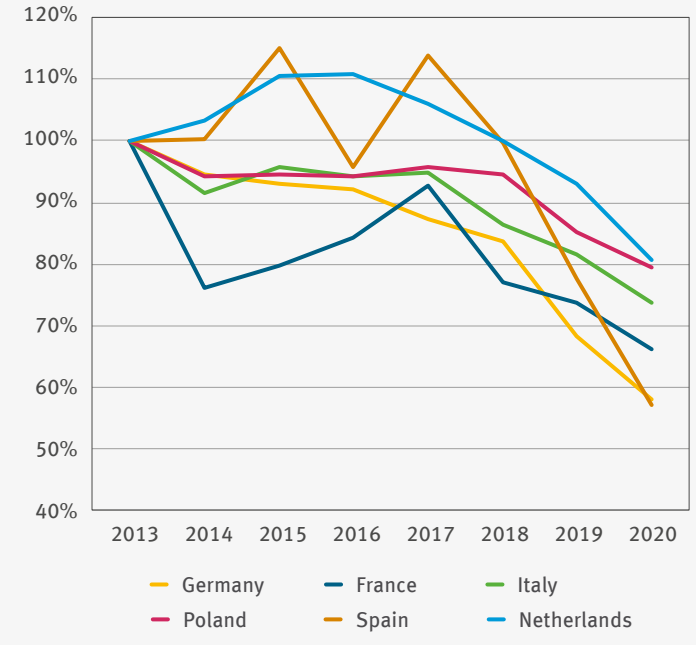
2.10.1 The 'Combustion and Energy' Activity in the EU



Source: EEA (2021a)

Figure 41: Trend in combustion and energy emissions (Registry Activity 20)

- Continuously decreasing emissions from combustion plants since 2013,
- Accelerated decrease from 2018 (2020: minus 34 percent compared to 2013),
- 2013 to 2016: Emissions decrease in EU similar to Germany,
- 2017 to 2020: Emissions decrease in Germany stronger than in the other Member States (2020: minus 42 percent compared to 2013 in Germany, minus 31 percent in the other Member States)
- Share of German installations in Activity 20 EU ETS-wide decreases from 31 percent (2013) to 28 percent (2020)



	Share of emissions Combustion	Share in electricity production
	(EU27, 2020)	
DE	28%	21%
PL	18%	6%
IT	10%	10%
NL	6%	5%
ES	5%	10%
FR	5%	19%

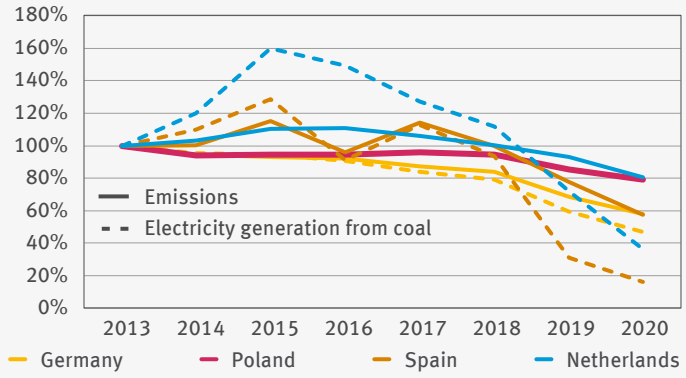
	Emission intensity of the electricity mix (g CO_2eq/kWh)	
	2013	2020
DE	489	311
PL	828	710
IT	273	213
NL	471	328
ES	270	156
FR	71	51
EU27	**322**	**231**

Source: EEA (2021a, c)[129], Ember (2022)

Figure 42: Emissions from combustion plants (Registry Activity 20) and electricity generation in the six Member States with the largest share of emissions

129 The German Environment Agency calculates the carbon dioxide intensity of the German electricity mix differently from the EEA and includes not only public but all electricity generation installations (2013: 572 g CO_2/kWh, 2020: 366 g CO_2/kWh). Icha (2021). For better comparability of the data, the EEA data are used here.

- 2013 to 2020: strong decrease in combustion plant emissions in all six Member States
- Strongest decline was in Germany (minus 42 percent) and Spain (minus 43 percent), smallest decline in the Netherlands (minus 19 percent) and Poland (minus 21 percent)
- France, Italy and Spain generate almost 40 percent of electricity in the EU27, but only 21 percent of emissions from combustion plants; the reason is the very low emission intensity especially in France due to the large use of nuclear power; emission intensity also in Italy and Spain significantly below the EU average (in Spain, however, fluctuating strongly depending on the availability of hydropower plants)
- Germany and Poland account for almost half of the emissions from combustion plants (EU27) but only about 27 percent of electricity generation; the reason is the continued high volume of lignite and hard coal used in electricity generation
- Improvement of emission intensity especially in Germany, Spain and the Netherlands
- Emission intensity in Poland still very high, slow improvement (reduction of emission intensity by minus 14 percent compared to minus 28 percent EU average in the 2013 – 2020 period)



	Share of electricity generation from coal in the country	Share of electricity generation from coal in EU27
	2020	
DE	24%	37%
PL	70%	30%
IT	5%	4%
NL	7%	2%
ES	2%	2%
FR	1%	1%

Source: EEA (2021a), Ember (2022)

Figure 43: Trends in emissions from combustion plants (Registry Activity 20) and electricity generation from lignite and hard coal in selected Member States

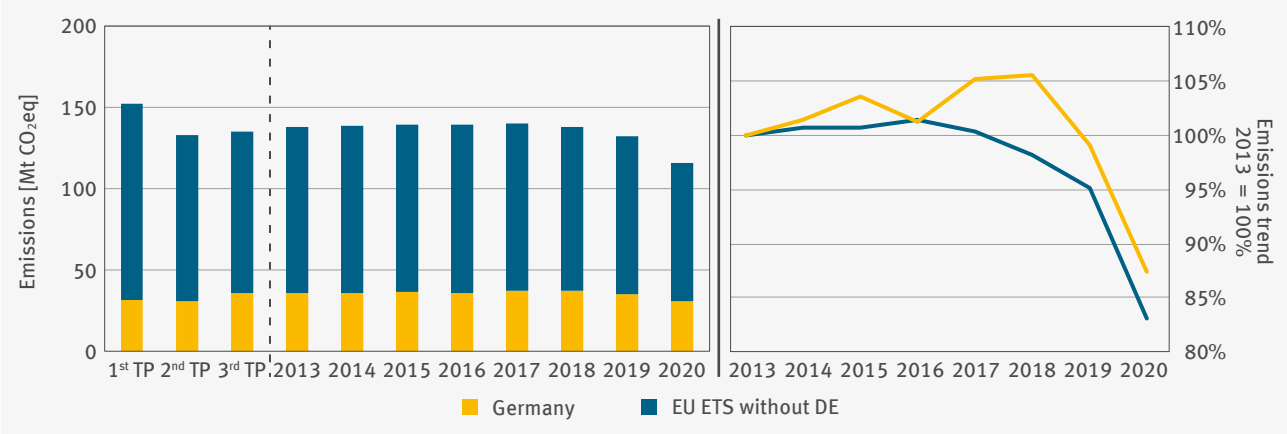
- In Member States with substantial shares of coal in the electricity generation mix (Germany and Poland), the trend in electricity generation from coal and emissions from combustion plants is largely the same.
- In Spain, the coal phase-out has been in full swing since 2019, with coal's share of electricity generation falling from around 15 percent (2013 to 2018) to 5 percent and 2 percent (2019/2020), respectively
- In 2019 and 2020: a significantly stronger decline in electricity production from coal than in emissions (Netherlands, Germany, Spain); reason: switch from coal to natural gas as an energy source due to low natural gas prices and high carbon dioxide prices[130]
- Special trend in the Netherlands: strong increase in electricity production from hard coal in 2015 due to the commissioning of three new coal-fired power plants with a total capacity of 3.5 GW[131] with a less strong increase in emissions. A possible reason for this is the high proportion of biomass co-firing in the Dutch coal power plants[132]. In the following years, closure of older coal-fired power plants in connection with the 'energy accord' and continuous decline in electricity generation from hard coal (2019 generation only 72 percent, in 2020 even only 36 percent of 2013 generation).

130 In all three countries, electricity generation from natural gas increased in parallel with the decreasing electricity generation from coal (Spain: +46%/+19%, the Netherlands: +27%/+33%, Germany: +34%/+36%, each in 2019/2020 compared to the respective previous year).

131 Wynn (2016).

132 The Amer coal-fired power plant burns 80 percent biomass, and the Maasvlakte power plant also uses biomass to a large extent according to RWE. https://benelux.rwe.com/en/locations/amer-power-plant; https://engineering.uniper.energy/sites/default/files/2021-03/18%20-%20Fifteen-Years-Of-Experience-With-Biomass-Fuels.pdf

2.10.2 The Iron and Steel Industry in the EU



Source: EEA (2021a)

Figure 44: Trend in emissions from iron and steel production (Registry Activities 23 to 25) (excluding emissions from waste gases from iron, steel and coke production)

- From 2013 to 2017 largely stable emissions from iron and steel production[133] in other Member States; in 2018 and 2019 and especially in 2020 significant decrease in emissions (in 2020 compared to 2013: minus 17 percent)
- In Germany, largely stable emissions up to and including 2019, slightly less pronounced decrease in 2020 (in 2020 compared to 2013: minus 13 percent)
- Germany's share in emissions from Activities 23 to 25 in the EU ETS excluding the UK largely constant at 26 to 27 percent

In 2020, seven Member States produced 75 percent of the EU27's crude steel and slightly less than 73 percent of the emissions covered by the EU ETS (see Table 26).

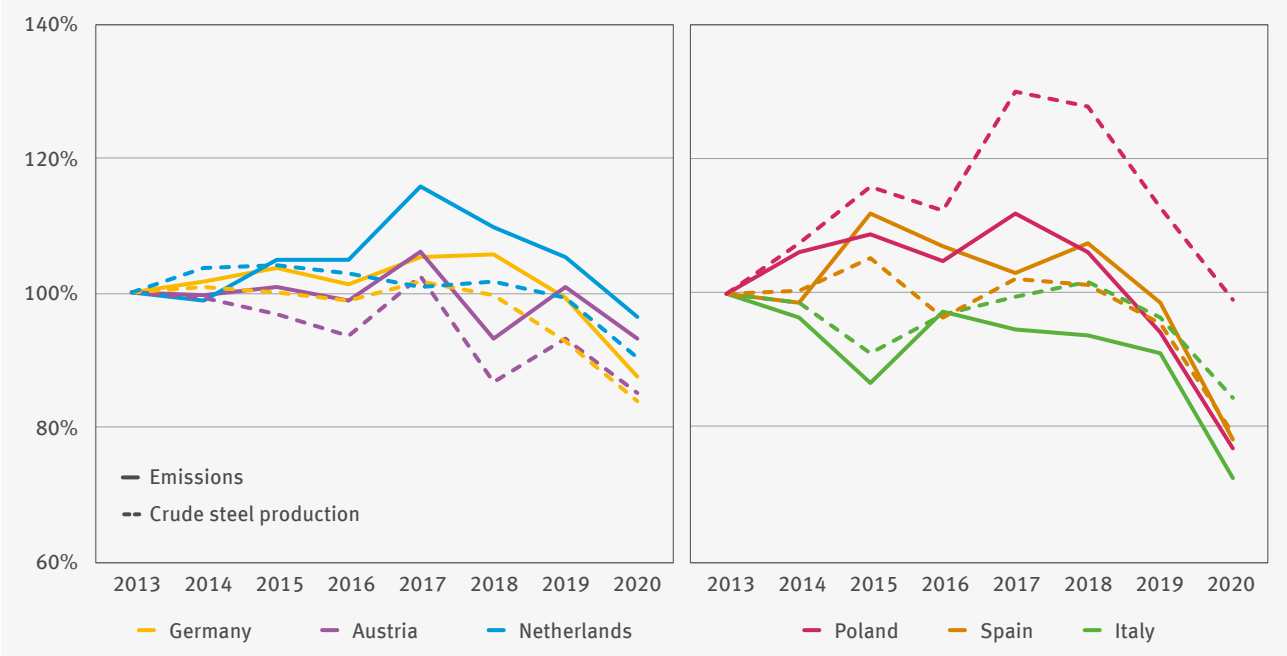
Table 26: Key figures of iron and steel production in selected Member States

Land	Share in emissions (EU27)		Share in crude steel production (EU27)	Share of generation from blast furnace route	
	2013	2020	2020	2013	2020
Germany	27%	28%	27%	68%	68%
France	14%	12%	9%	65%	68%
Austria	9%	10%	5%	92%	90%
Italy	9%	8%	15%	28%	15%
Poland	6%	5%	6%	55%	50%
Netherlands	4%	5%	5%	98%	100%
Spain	5%	5%	8%	31%	28%

Sources: EEA (2021a), WSA (2014, 2021), Eurofer (2022)

133 Emissions from the combustion of waste gases from iron, steel and coke production are not included if they are covered in Activity 20, which is the case in most Member States considered here.

- **There are large differences between Member States in the ratio of crude steel production to direct[134] emissions:** Spain, for example, produces almost as much crude steel as France, but emits less than half the emissions. Italy produces 15% of crude steel in the EU27 but only 8% of the emissions.
- **Main reason 1 for these differences is the different significance of the production routes:** crude steel production in a blast furnace is associated with substantially higher emissions (direct and total, i. e. direct and indirect) than in the electric arc process, which is based on the reuse of recycled scrap. In Italy, the blast furnace route accounts for only 15 percent, in Spain 28 percent, whereas in Austria and the Netherlands it accounts for 90 to 100 percent. In France and Germany, the blast furnace route accounts for about two-thirds of crude steel production, in Poland about half.
- **Main reason 2 for these differences is the attribution of emissions for the waste-gas-burning power plants:** the Netherlands produces almost as much crude steel as Austria, but the emissions recorded for the steel industry are almost twice as high in Austria. In Austria the power plants for the combustion of waste gases are recorded in Activity 24, whereas in the Netherlands and other Member States they are mostly recorded separately from the steel plants as combustion plants (Activity 20). As a result, the emissions from the iron and steel industry tend to be higher in Austria than in other Member States considered here, according to the delimitation in the EU ETS.[135]



Source: EEA (2021a), Eurofer (2022)

Figure 45: Iron and steel production emissions trends (Activities 23–25) compared to those in crude steel production in selected Member States

- Declining emissions (2013 to 2020) in all Member States considered in this chapter, especially in Italy (minus 28 percent), France (minus 28 percent, not shown), Poland (minus 23 percent) and Spain (minus 22 percent). In Italy, Poland and France, emissions were already lower in 2019 than in 2013; in Germany, Spain, the Netherlands and Austria, a substantial reduction in emissions only occurred in 2020 as a result of pandemic constraints.
- The decline in production had a major impact on emissions trends in the third trading period, especially in the countries with a larger share of the blast furnace route.

134 Direct emissions are the emissions that occur in the production process of an installation. Emissions from external installations, for example from electricity generation for the electricity consumed in the production process of a steel plant, are not taken into account.

135 Mendelevitch et al. (still unpublished). Also in France, at the Fos sur Mer site, the waste-gas-burning power plant is part of an integrated installation, but in the Dunkerque installation, as well as in the installations in Germany, the Netherlands, Poland, Spain and Italy, the power plants are included in Activity 20.

In **Austria, Germany and the Netherlands** (see Figure 45, left), emissions decreased less than production between 2013 and 2020. In Germany, this is due in particular to the replacement of previously imported coke from 2014 onwards (see Section 2.4). In the Netherlands, emissions increased significantly, especially between 2016 and 2018, while crude steel production remained largely the same. In **France** (not shown), crude steel production and emissions declined largely in parallel.

A different trend can be seen in countries with a higher share of electric steel production (see Source: EEA (2021a), Eurofer (2022) Figure 45, right): in **Italy**, emissions (minus 28 percent in the 2013 – 2020 period) decreased a lot more than crude steel production (minus 15 percent). This was due to an increasing share of production in the significantly lower emissions electric arc process. The share of electric steel production rose from 72 percent (2013) to around 85 percent (2020) of total crude steel production. However, this was not due to an expansion of the lower emissions electric steel route, but to the production cutback at the Ilva blast furnace steel plant in Taranto initiated after an environmental scandal[136].

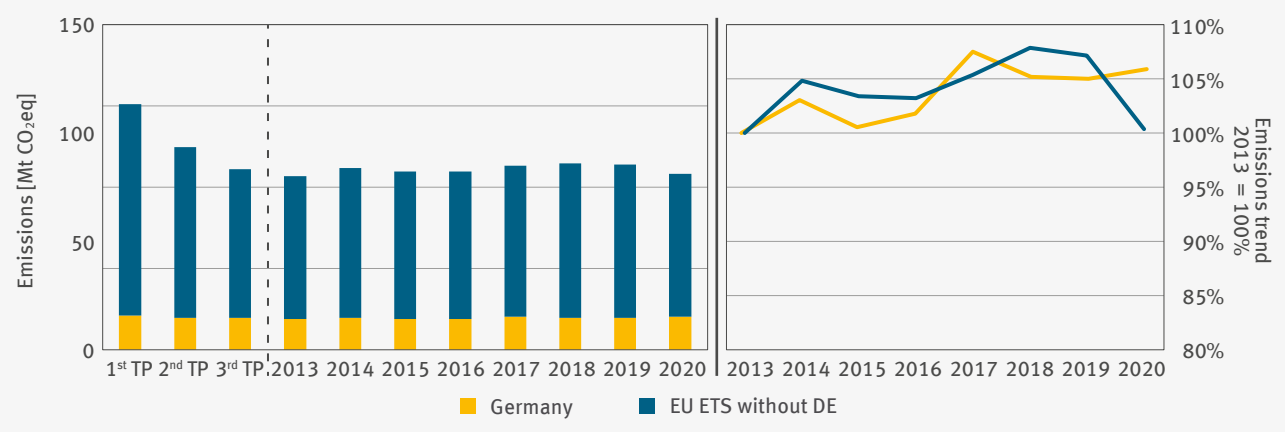
In **Poland**, crude steel production increased much more strongly than emissions, especially in 2017 and 2018. In this context, crude steel production in the electric steel route increased more strongly than in the blast furnace route. In 2019 and 2020, production in blast furnaces, especially in the Cracow blast furnace, decreased significantly; its final closure was announced at the end of 2020.[137] Electric steel production in 2020 was ten percent higher than in 2013 and accounted for 50 percent of total crude steel production. However, a large share of the electricity needed for electric steel production in Poland (72 percent in 2019) is produced from hard coal or lignite, so decreasing (direct) emissions from steel production are partly offset by higher emissions in electricity generation.

In **Spain**, emissions from steel production were twelve and seven percent higher than in 2013, especially in 2015, 2016 and 2018, respectively. In these years, crude steel production in the blast furnace route also increased more than production in the electric steel route. In 2019 and 2020, crude steel production in Spain decreased significantly to 96 and 79 percent of the 2013 level respectively, while the share of the electric steel route increased again to 69 percent (2019) and 73 percent (2020).

136 Vaglisindi, Grazia Maria, Gerstetter, Christiane (2015): In-depth analysis for the ENVI Committee; NZZ 15/04/2021, Italy: State makes industrial policy with steel in Taranto; Tagesspiegel 22/11/2019, ArcelorMittal gibt in Taranto auf: Stahlwerk Ilva – der sterbende Koloss in Süditalien. (ArcelorMittal gives up in Taranto: Ilva steel plant – the dying colossus in southern Italy)

137 Eurometal 09/10/2020: ArcelorMittal to permanently close Krakow furnace and steel plant in Poland

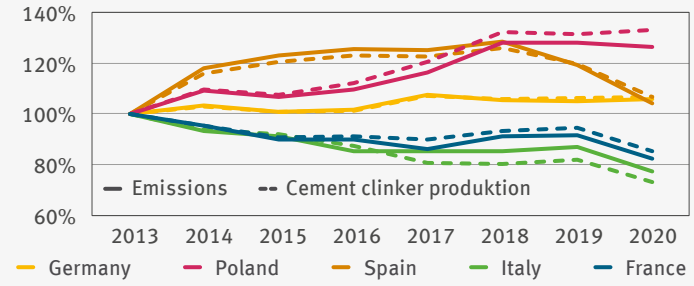
2.10.3 Cement Clinker Production in the EU



Source: EEA (2021a)

Figure 46: Emissions trends from cement clinker production (Registry Activity 29)

- 2013 to 2019 partly fluctuating, but overall increasing emissions from cement clinker production in Germany and other Member States.
- 2020 emissions declined in other Member States to around the 2013 level; emissions in Germany, however, increased slightly and remained at a higher level than in 2013 (2020: plus six percent compared to 2013)
- In Activity 29 in EU ETS emissions the share of German installations (excluding UK) largely constant since 2013 at between 17 and 19 percent



	Share of EU 30 emissions	
	2013	2020
DE	18%	19%
PL	8%	10%
IT	13%	10%
ES	11%	11%
FR	11%	9%

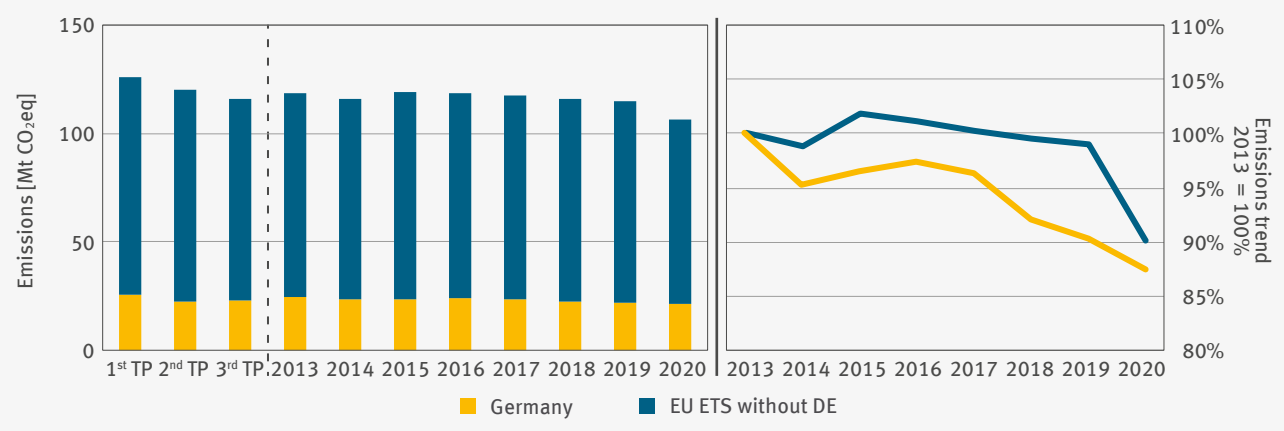
Source: EEA (2021), national sources (Germany: DEHSt, Spain: National Inventory Reports 2018–2021, Poland: Polskicement, Italy: Aitec/Federbeton, France: Infociments)

Figure 47: Trends and key figures on emissions and production of cement clinker (Registry Activity 29) in selected Member States

- 59 percent of emissions from clinker production in the EU ETS in 2020 are accounted for by the five countries Germany (19 percent), Spain (eleven percent), Poland and Italy (ten percent each) and France (nine percent)
- Significant decreases in emissions in Italy and France (minus 23 percent and minus 18 percent, respectively, compared to 2013 levels), therefore Italy and France have a decreasing share in EU emissions
- Significant increase in emissions in Spain (plus 28 percent 2013 to 2018, then decline; 2020: plus four percent compared to 2013 level) and Poland (plus 26 percent in the period 2013 to 2020), moderate increase in Germany (plus six percent)
- Emissions trends are primarily determined by production trends: in Poland, clinker production increased slightly more than emissions, indicating an improvement in emissions intensity. In Italy, production decreased more than emissions, indicating a worsening in emissions intensity. In the other Member States analysed here, the emissions and production trends are broadly similar.

2.10.4 Other Sectors in the EU

Refineries in the EU

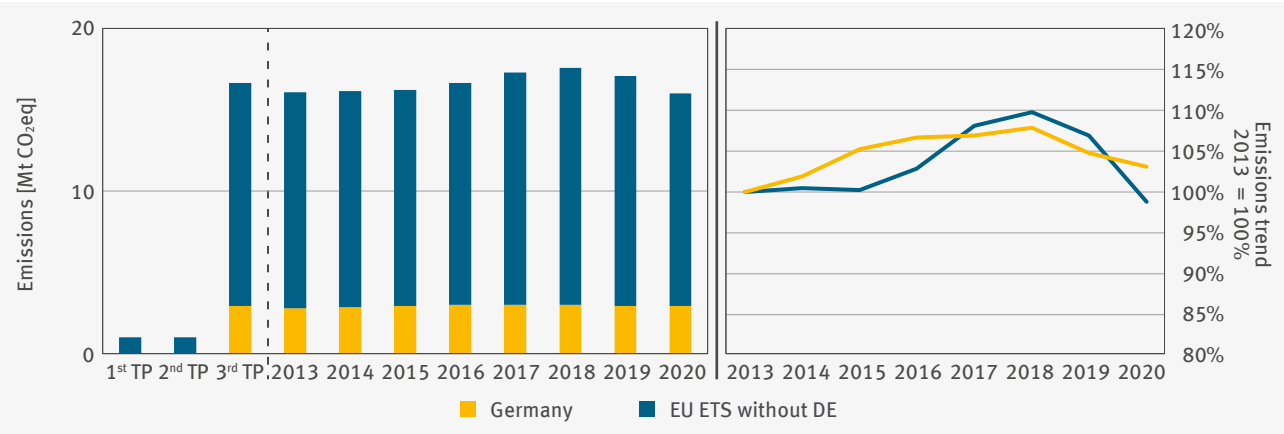


Source: EEA (2021a)

Figure 48: Refinery emissions trends (Registry Activity 21)[138]

- Emissions at EU level in 2015 showed an increase of around three percent compared to 2014, from 2016 onwards they fell continuously; emissions trends of German refineries were similar; both in Germany and at EU level, emissions fell significantly in 2020 due to the economic trends caused by the COVID 19 pandemic.
- Ten percent reduction in emissions from installations at EU level compared to 2013; for refineries in Germany, the decrease in emissions was 13 percent during the third trading period.
- Germany's share of emissions from refineries in the EU ETS (excluding UK) was around 20 percent in the third trading period

Non-ferrous metal industry in the EU



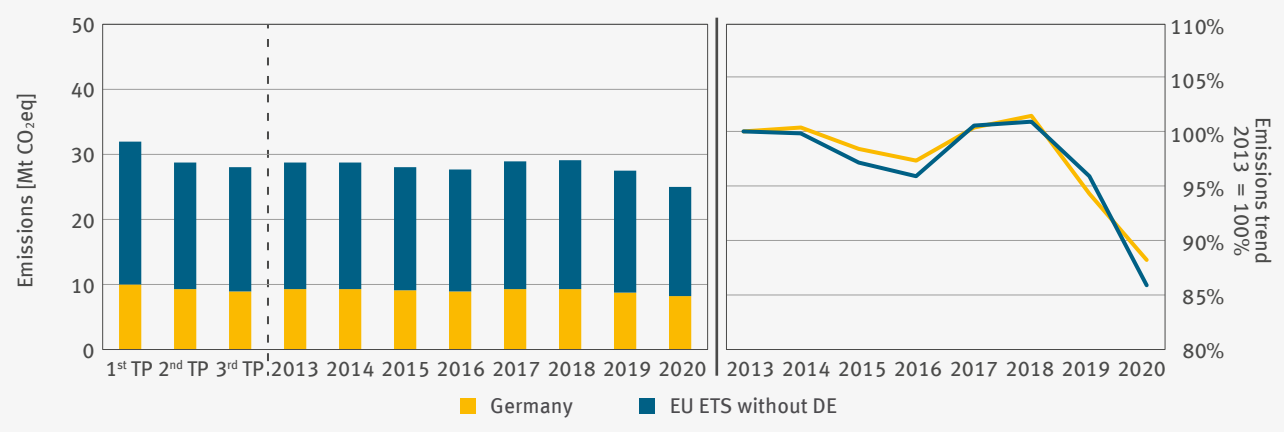
Source: EEA (2021a)

Figure 49: Emissions trends for the non-ferrous metals industry (Registry Activities 26 to 28)

- Increase in emissions both in Germany and in the rest of the EU ETS up to 2018, after which emissions decreased.
- Stronger increase in emissions at EU level than in Germany up to 2018 (ten percent and eight percent above 2013 levels, respectively), but also stronger decline to one percent below 2013 levels and three percent above 2013 levels, respectively, by 2020
- Germany's share of emissions from the non-ferrous metals industry in Registry Activities 26 to 28 in the EU ETS (excluding UK) in the third trading period: 17 to 18 percent

138 The mandatory rule for Germany's refineries from the third trading period onwards to form a uniform 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

‘Lime production’ Activity in the EU



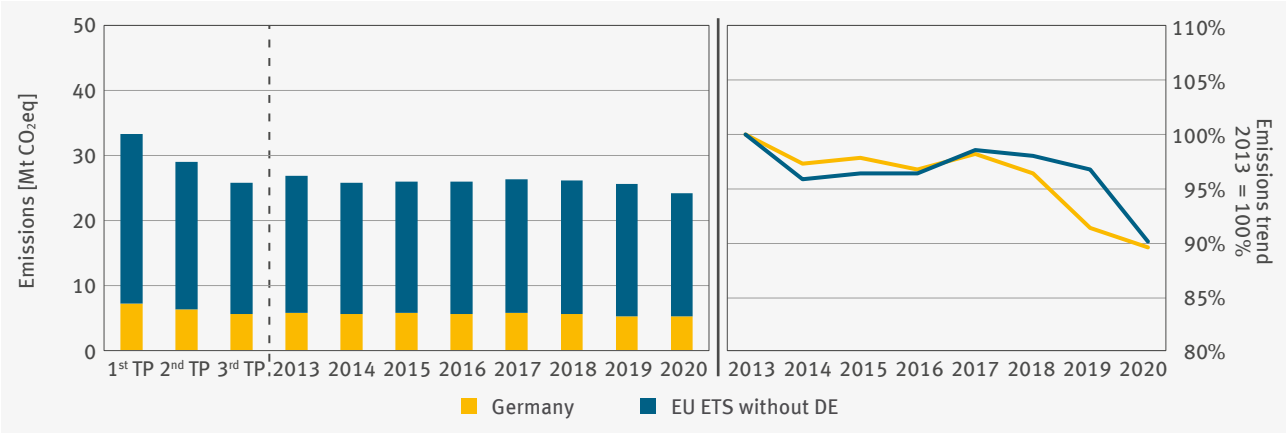
Source: EEA (2021a)

Figure 50: Lime production emissions trends (Registry Activity 30)[139]

- Constant decrease in sector total emissions in Germany and the EU across trading periods.
- Third trading period showed no clear trend; slight decrease in emissions in 2015 and 2016; compared to 2014, this decrease was around three percent for Germany and around four percent for the other ETS Member States in 2016; similar levels again in 2017 and 2018 as at the beginning of the trading period; a further decrease thereafter; emissions trends were highly dependent on the economic trend in the iron and steel sector.
- Emissions from installations at EU level decreased overall by around 14 percent compared to 2013; similar picture emerged for the emissions trends of German installations: decrease in emissions in Germany to twelve percent from the start of the third trading period
- Germany’s share of emissions from lime plants in the third trading period was around 32 percent from Registry Activity 30 in the EU ETS (excluding UK)

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

Paper and pulp industry in the EU

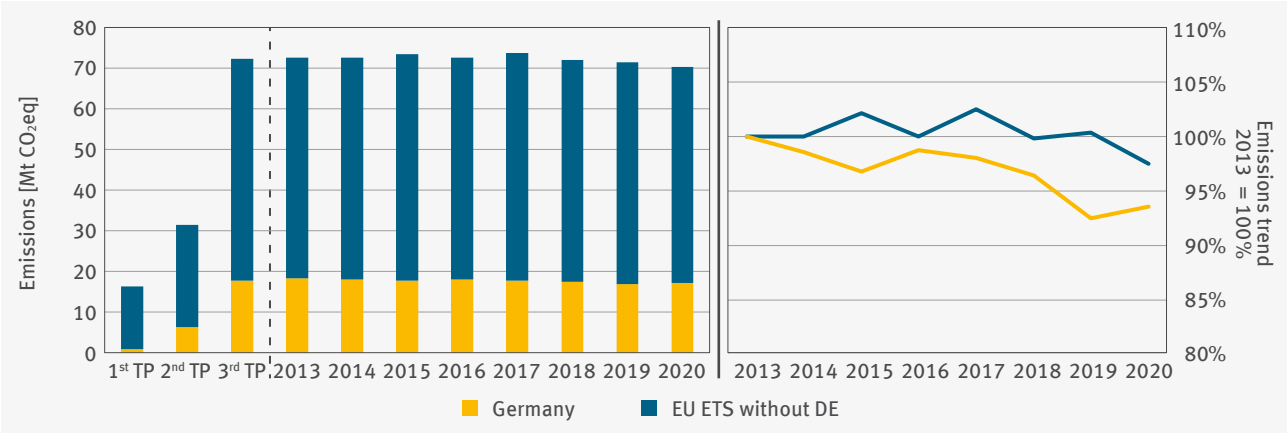


Source: EEA (2021a)

Figure 51: Paper and pulp industry emissions trends (Registry Activities 35 and 36)

- Paper and pulp industry emissions (Registry Activities 35 and 36) in both the EU and Germany in the third trading period clearly decreased by a total of ten percent each; strongest decline in both the EU and Germany was at the beginning and end of the trading period; emissions trends largely constant between 2015 and 2018
- Declining trend in emissions since 2018; in Germany in 2019 emissions declined by around five percent clearly stronger than at the EU level of around one percent; in 2020, however, stronger decline at EU level of around seven percent, in Germany the emissions level remained almost constant over the same period
- Germany's share of emissions from the paper and pulp industry in the Registry Activities 35 and 36 in the EU ETS excluding the UK was relatively constant over the entire period of the third trading period at around 22 percent

Chemical industry in the EU



Source: EEA (2021a)

Figure 52: Chemical industry emissions trends (Registry Activities 37 to 44)[140]

- Emissions decreased: in Germany minus six percent for the 2013 – 2020 period, at EU level minus 2.3 percent
- Emissions at EU level fluctuated by plus/minus two percent around their baseline during the third trading period; emissions trends in Germany and the EU ran in opposite directions during this period
- Germany's share of the chemical industry in the EU ETS (excluding UK) in the third trading period was around 25 percent

140 The figure shows that from one trading period to the next, more and more chemical industry activities have been included within the scope of emissions trading. See also Chapter 2.8.

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

With the start of the fourth trading period and the departure of the United Kingdom from the European Emissions Trading Scheme (EU ETS), 30 countries (EU27 plus Iceland, Liechtenstein and Norway) and some power generation plants in Northern Ireland participated in EU ETS. The data in this report are therefore not directly comparable with the data in previous reports, which referred to 31 Member States.

After the sharp decline in 2020 due to the pandemic, in 2021 emissions from the approximately 10,000 ETS installations increased again by about 7.3 percent compared to 2020, amounting to about 1.31 billion tonnes of carbon dioxide equivalents, according to the European Commission.[141] However, emissions remained about 4.4 percent below 2019 emissions. As in previous years, emissions from stationary installations were significantly lower – about 261 million tonnes of carbon dioxide equivalents – than the maximum amount of allowances to be issued for that year (nominal cap).

The actual amount of allowances issued in 2021 was still significantly lower than the nominal cap. This is because the Market Stability Reserve (MSR) mechanism reduced the number of emission allowances (EUAs) to be auctioned in 2021 by 323 million EUAs. This was because the number of emission allowances in circulation (TNAC: Total Number of Allowances in Circulation) exceeded the upper threshold in previous years (see Section 3.2). Due to the comprehensive reduction in auction volumes and the significant increase in emissions, the TNAC in 2021 declined by eight percent to around 1.45 billion emission allowances compared to the end of the previous year, according to the European Commission. However, the value was still around five percent above the 2019 level and is higher than the annual emissions of the installations.[142]

3.1 Emissions Trends in the EU ETS Member States

According to the European Commission, emissions from installations participating in the EU ETS increased by 7.3 percent to 1.31 billion tonnes of carbon dioxide equivalents in 2021 compared to 2020. This was approximately 4.4 percent lower than emissions in 2019. As a result of the economic recovery in the second pandemic year, electricity consumption returned to 2019 levels[143] and industrial production also increased significantly. Emissions from electricity generation increased by around 8.3 percent in 2021, while emissions from industrial installations increased by around 5.2 percent compared to 2020[144]. In addition to the higher demand for electricity, it was mainly the sharply rising natural gas prices in the second half of the year that halted the persistent downward trend in electricity generation from coal since 2013 (with the exception of 2015). Electricity generation from coal-fired power plants in 2021 increased by around 21 percent compared to 2020 and was only around four percent lower than in 2019.[145] According to European Commission data, overall emissions from electricity generation in 2021 were 7.3 percent lower than in the year before the pandemic. This was because the use of natural gas in electricity generation also remained below 2019 levels due to the strong growth in renewable energy. Emissions from industrial installations were around 1.9 percent below 2019 levels.[146]

The reduction 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 German installations fell by a slightly lesser extent, to 31 percent (see Figure 53). The first significant drop in emissions was in the second trading period, when emissions fell by 13 percent in the 2008 – 2012 period as a result of the economic and financial crisis. Emissions also fell significantly in the third trading period, particularly in the years 2018 to 2020 due to the ongoing decarbonisation of electricity generation and in 2020 due to the pandemic, before there was a sharp increase again in 2021.

141 Unless otherwise stated, the data mentioned in this Section are based on the information provided by the European Commission on 25/04/2022 (COM 2022a).
142 COM 2022b (TNAC Communication of 12/05/2022).
143 DG Energy 2022
144 COM 2022a
145 DG Energy 2022
146 COM 2022a

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

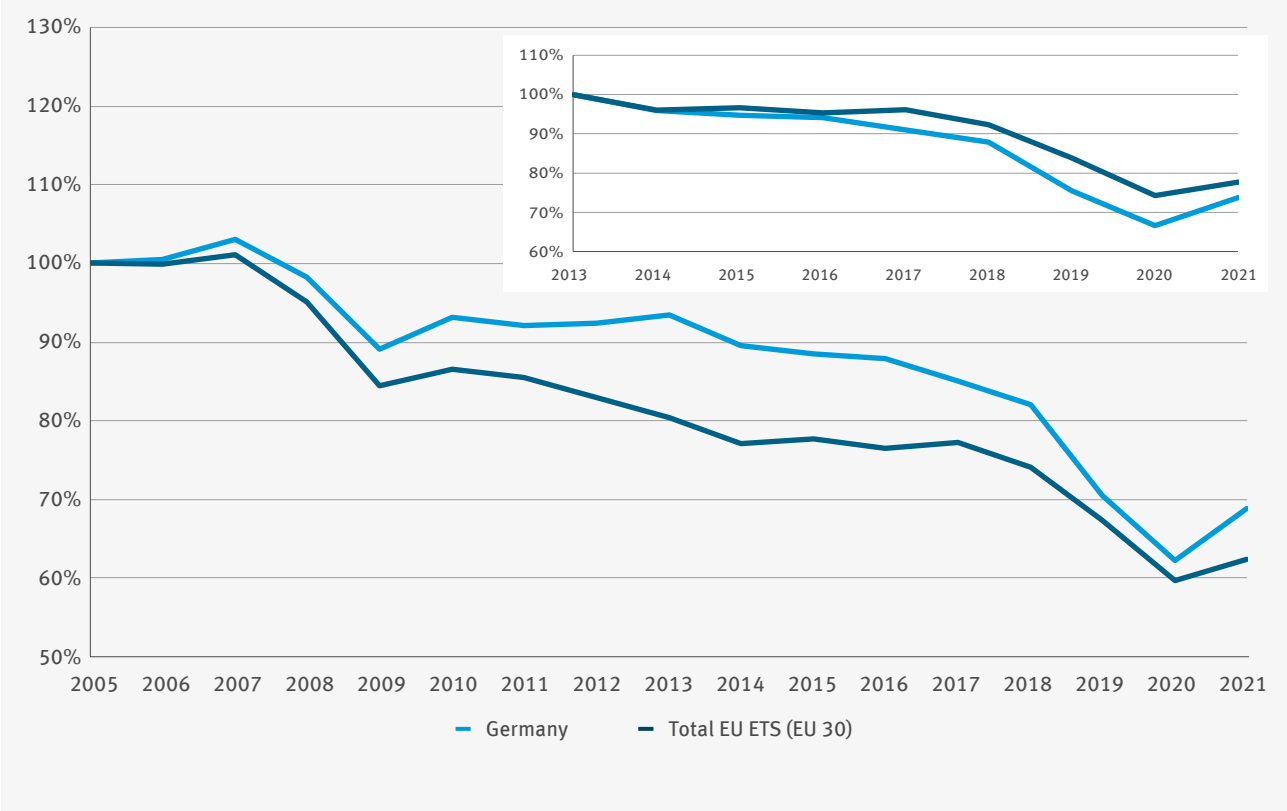


Figure 53: Emissions trends in Germany compared to stationary EU ETS emissions in all Member States (2005 emissions plus emissions estimate for extended scope of the third trading period = 100 percent)[147]

147 Preliminary figures for 2021. Sources: EEA 2022 for the years 2005 to 2020, COM 2022a for 2021.

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

Figure 54 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 shown. Since 2021, project credits can no longer be used in the EU ETS.

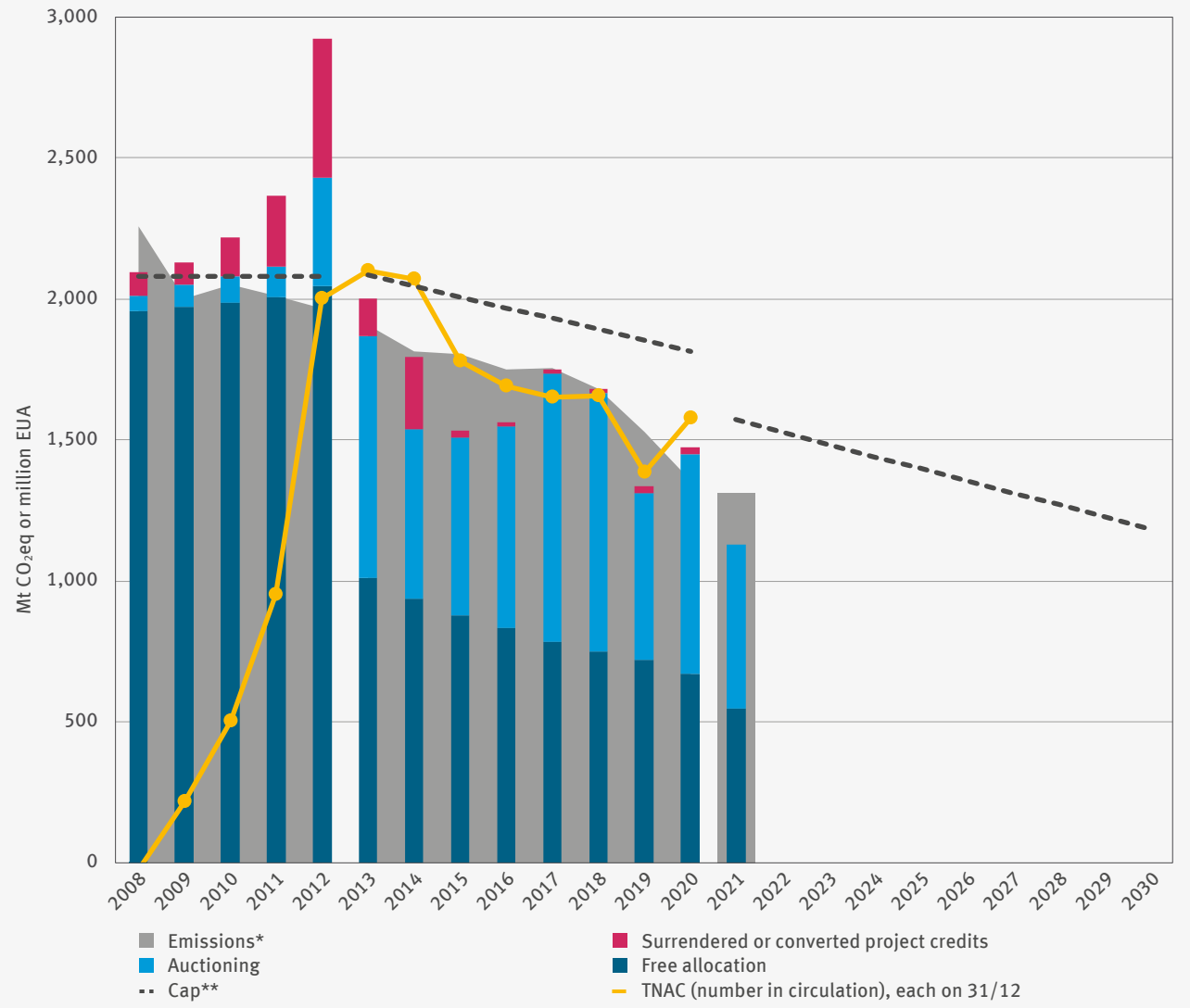
The large surplus of unused emission allowances from the second and the beginning of the third trading period has been partially reduced in recent years. This was primarily achieved by reducing the auction volumes: from 2014 to 2016 through backloading, from 2019 through the Market Stability Reserve (MSR). If the number of emission allowances in circulation exceeds the threshold of 833 million emission allowances, the EUA volumes earmarked for auctioning will be 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 for 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 those surrendered (demand) in the stationary sector i. e. accumulated since 2008, taking into account surrendered and exchanged project credits as well as voluntarily cancelled emission allowances.

According to the European Commission, at the end of 2021 the TNAC was 1.45 billion emission allowances[148], around eight percent lower than at the end of 2020, but still five percent higher than at the end of 2019. The value remains well above the upper MSR threshold at which auction volume reductions take place. The number of allowances in circulation is therefore also higher than the annual emissions of installations covered by the EU ETS. The current value of the TNAC is decisive for the auction volume reduction by the MSR in the period 1st September 2022 to 31st August 2023. During this period, a total of around 347 million fewer emission allowances than planned will be auctioned and transferred to the MSR.

Supply and demand in aviation are not currently considered in the TNAC.[149] In 2021, aviation emissions were just above the allowances issued for the sector. With the exception of 2020, the sector was consistently a net buyer, thereby reducing the actual surplus available in the market for the stationary sector. Between 2012 and 2021, aviation net demand amounted to around 143 million emission allowances (see Section 4.3).

148 COM 2022b

149 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 to 2021 emissions are not directly comparable with emissions in 2020 and earlier. Therefore, the there is a gap between the years 2021 and 2020 and 2013 and 2012.
** TP4: according to the current legal situation with an annual reduction factor of 2.2%
Sources: EEA, EU COM

Figure 54: Demand and supply in the overall system: comparison of emissions with available emission allowances and trends in the number of allowances in circulation since 2008 as determined by the European Commission[150]

The figure also shows the structural imbalance between cap and emissions, which grew steadily in the third trading period. On average, emissions in 2013 to 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 exit of the United Kingdom: 2021 emissions were around 261 million tonnes of carbon dioxide equivalents lower than the cap.

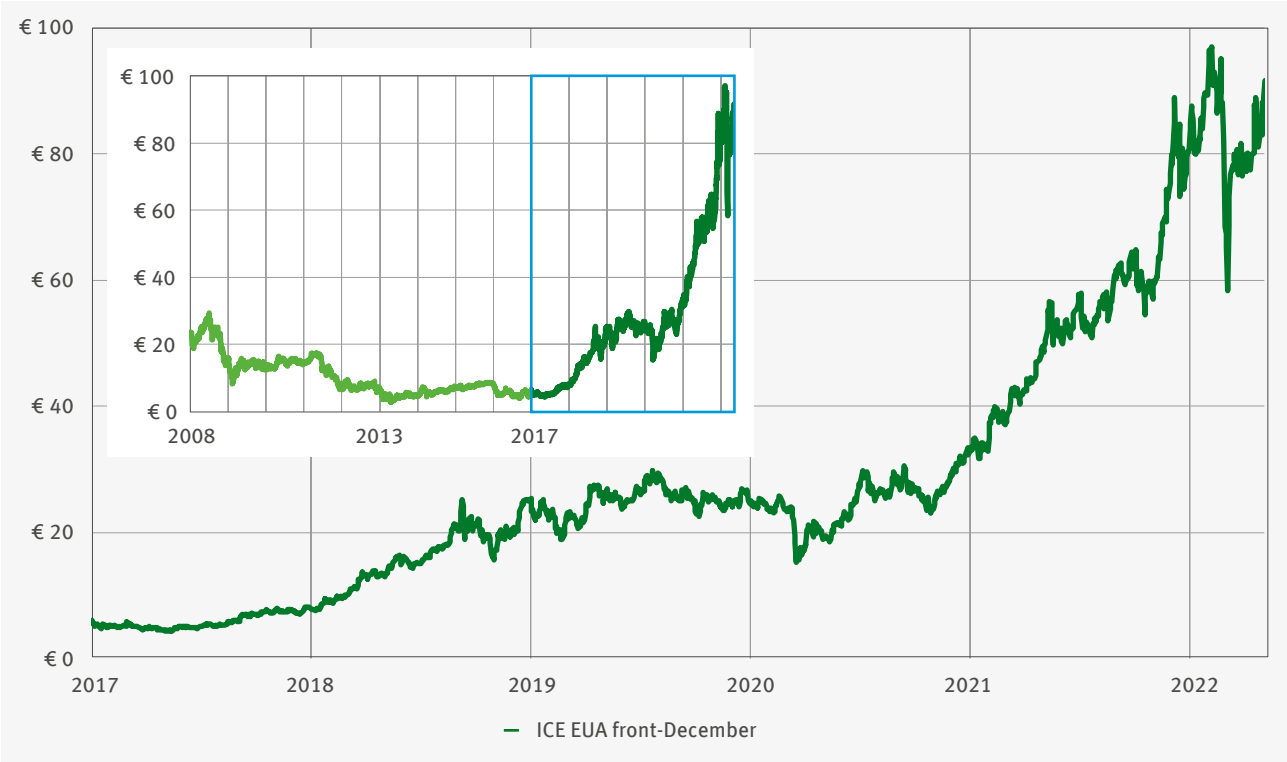
150 Sources: 2021 EEA for 2005 to 2020, COM 2022a and COM 2022b for 2021 and further EEX/ICE data and information published by the EU Commission regarding the auction volumes. The TNAC information is taken from the European Commission's Carbon Market Reports 2012 to 2017 and the notifications on the TNAC 2018 to 2022.

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 ten euros, 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; 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 did not initially continue. The price trend was characterised by short-term upward and downward movements before reaching the highest level since 2006 at almost €30 in July 2019. Thus the price of EUA had 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 price of EUA 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 EUA price reached a new high of over €90 at the beginning of December. This was followed by a consolidation phase and the EUA reference contract was quoted at around €80 at the close of trading on 31 December, almost 150 percent above the value at the beginning of the year. By February 2022, the EUA price had initially risen to over €98, the highest level since the start of the EU ETS in 2005. This was followed by a short-term downward correction, which was caused by turbulence on the international energy markets in response to the Russian war of aggression in Ukraine.The reference contract briefly fell below €60, but quickly recovered. Currently, the EUA price is quoted at around €90 (as of 13/05/2022).

The price trend for EUA from January 2008 to April 2022 is shown in the following figure.



Source: ICE, Refinitiv Eikon, DEHSt representation

Figure 55: 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 2021. In the second trading period the relevant average price for an EUA was therefore €13.62 and from January 2013 to April 2021 it was €12.96. In 2021, the average EUA price was €53.66.

Table 27: Average prices for emission allowances (EUA) and international project credits (CERs) in the second and third trading periods

Time period	2nd trading period 03/2008 – 04/2013 [€]	3rd trading period 01/2013 – 04/2021 [€]	4th trading period 2021 reporting year [€]
Price EUA*	13.62	12.96	53.66

* VWAP ICE EUA front-december
Source: ICE, Refinitiv Eikon, DEHSt calculation

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 the previous trading periods. In principle, the Member States auction that part of the European emissions trading budget (EU cap stationary) which is not allocated free of charge to operators or tied to the new installation 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 auctions opens up a new scope for government support of climate protection measures. In Germany, since 2012 the auction revenues have flowed almost entirely into the Energy and Climate Fund (EKF).

The following table summarises the auction results of the current 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. In accordance 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 by almost 800 million EUA across the EU in the period 2019 to 2020; the German auction volumes were reduced by around 85 million EUA in 2019 and 81 million EUA in 2020. In 2021, the first year of the fourth trading period, EU wide auction volumes were reduced by over 300 million EUAs and German auction volumes by around 80 million. 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 28: Auction volumes and revenues for Germany and EU wide since 2013

EUA				
Year	Germany		EU wide	
	Auction volumes in Mt	Revenues 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

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

EUAA				
Year	Germany		EU wide	
	Auction volumes in Mt	Revenues 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

** 2012 German aviation auction not taken into account
Source: 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)[151]. 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 three times in previous years.

First, the scope for the 2012 reporting year was significantly restricted by the 'stop-the-clock' EU resolution. 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. This waivered a large number of flights to and from third-party countries from the reporting and surrendering obligation in 2012.[152]

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 original scope are lower than 1,000 tonnes of carbon dioxide.[153, 154]

In contrast to 2012, the restriction of 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[155]. 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). For all these flights, carbon dioxide emissions have to be monitored and reported since 01/01/2020. For the flights subject to reporting, the surrender of the corresponding number of allowances is mandatory. This had to be done by 30/04/2021 for the first time for the 2020 emissions.

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[156]. 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.

The extended 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 scope is to be used for assessing of the emissions trading obligation of an aircraft operator.

151 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.

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

153 EU 2014a

154 EU 2017a

155 EU 2017b

156 EU 2021

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 basic scope of application corresponds to the extended scope of application. The full scope is to be used for the classification of an aircraft operator as a small emitter.[157, 158]

The first restriction of the scope ('stop-the-clock' EU resolution) reduced the scope of emissions subject to emissions trading administered by Germany to only about 30 percent of the extended scope of emissions[159]. Another restriction from 2013 onwards yielded the current reduced scope which is about 16 percent of the extended scope.[160]

With these temporary scope adjustments, the EU wanted to set another positive signal for ongoing negotiations at the International Civil Aviation Organisation (ICAO) level on a global instrument for reducing international aviation emissions.

The latest resolution153 about continuing the reduced scope implemented the 39th ICAO General Assembly decision of the autumn of 2016 to introduce a global market-based measure to stabilise greenhouse emissions from international civil aviation at the 2019/2020 level and to compensate for excess emissions. 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).[161]

The current scheme to reduce the scope of the EU ETS will be reviewed at the European level following an assessment of CORSIA's environmental effectiveness. On 14/07/2021, the European Commission presented a series of legislative proposals (including for aviation) as part of the 'Fit for 55' package, which are intended to align the energy and climate policy instruments with the new climate target of an emissions reduction of at least 55 percent compared to 1990 by 2030. The EU Commission's 'Fit for 55' package proposes that flights to countries outside the European Economic Area should again be covered by a market-based measure: EU emissions trading in aviation should be supplemented by rules in accordance with CORSIA.[162]

157 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 especially be taken into account when reading older texts.

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

159 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.

160 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.

161 ICAO 2016

162 A more detailed analysis of the proposal is contained in the factsheet 'Aviation in the EU ETS and CORSIA in the "Fit for 55" package' published by UBA: www.umweltbundesamt.de/en/topics/eu-commission-proposes-comprehensive-reform-of

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. Within the EU ETS, Germany also administers flights that do not start in Germany; their emissions are not contained 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.[163] Due to the differences in assignments described above, it is not possible to draw any direct conclusions about the German aviation emissions contained in the greenhouse gas inventory based on aviation emissions trading administered by Germany. This circumstance must be taken into account when interpreting the following evaluations.

4.2.2 Emissions and Free Allocation in Aviation Administered by Germany in 2021 and a 2013 – 2021 overview

Germany is responsible for around 6 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 competent for around 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, 67 have reported the emissions of their flights subject to emissions trading for the year 2021. The total number of operators, 67, to be classified as subject to emissions trading has increased by about 49 percent compared to the previous year, in which the lowest number since 2013 i. e., 45, operators to be classified as subject to emissions trading was recorded (see Table 29). The main reason for this increase is the takeover of the administrative activities of a further 17 operators due to Britain's exit from the EU.

Emissions from aircraft operators managed by Germany totalled around 4.6 million tonnes of carbon dioxide in 2021 meaning that they have increased by around 0.8 million tonnes of carbon dioxide or by somewhat less than 20 percent compared to the previous year. Around 0.121 million tonnes of carbon dioxide are attributable to the operators taken over by Germany due to Brexit.

163 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 29: Aviation (aircraft operators administered by Germany), overview 2013 – 2021

Year	No. 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	3,563	3,856	92.41%	–57.22%
2021	67	3,323	4,645	71.54%	20.47%

As of 02/05/2022

Irrespective of the increase in emissions, the amount of 2021 free allocation for aviation was around 3.3 million emission allowances (EUAA) i. e. just the same level as in the previous year. Around 5.1 million EUAAs were still allocated annually between 2013 and 2017 (see Table 29). 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 which was discontinued with the cessation of operations for the entire remaining period up to 2021.

The difference between the aggregated emissions from the operators and the amount of EUAA allocated to them free of charge increased significantly in 2021 compared to 2020. 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. The average allocation coverage[164] thus fell from around 92 percent in 2020 to around 72 percent in the 2021 reporting year (cf. Table 29).

In 2021, about 85 percent of the operators subject to emissions trading had a commercial status and about 15 percent a non-commercial status (2020: 84 percent commercial and 16 percent non-commercial operators). Similar to the previous year, the share of emissions caused by non-commercial operators subject to emissions trading is only 0.4 percent (see Table 30).

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

Table 30: Aviation (aircraft operators administered by Germany), number of aircraft operators subject to emissions trading, 2020 CO_2 emissions, 2021 allocation, 2021 CO_2 emissions and allocation coverage differentiated by commercial and non-commercial operators

Operator category	No. of operators subject to ET	2020 emissions [kt CO_2eq]	2021 emissions [kt CO_2eq]	No. of operators with allocation in 2021	2021 allocation amount [1000 EUAA]	Allocation coverage
Commercial	57	3,844	4,628	42	3,323	71.8%
Non-commercial	10	11	17	7	1	4.6%
2021 not subject to ET	*3**	*1*	–	–	–	–
Total	**67**	**3,856**	**4,645**	**49**	**3,323**	**71.5%**

As of 02/05/2022
* 2021 not subject to ET, not included in total number of operators.

There are also noticeable changes in the major emitters within the aviation sector subject to emissions trading compared to the previous year. As in 2020, total emissions in 2021 were concentrated on a small group of aircraft operators where almost 87 percent of the total emissions were caused by six commercial operators (see Figure 56).

On average, the operators subject to emissions trading under German administration in 2021 show increases in emissions compared to 2020. In particular, the four largest operators (see Figure 56) show increases in emissions between 13 and 110 percent. Only the emissions of cargo airlines (EAT Leipzig GmbH and United Parcel and Co) were about 5 percent below the 2020 level.

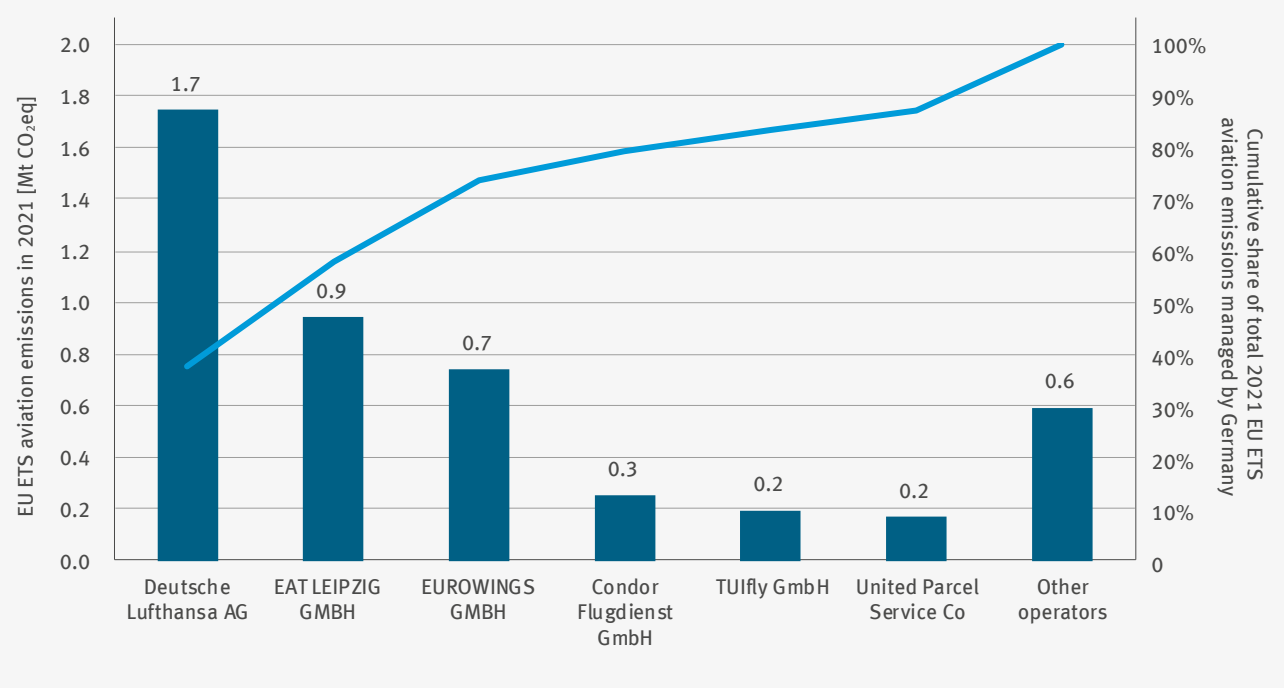


Figure 56: Aviation (aircraft operators administered by Germany) emissions of the six operators with the highest emissions in 2021 (columns, left-hand side axis) and their cumulative share of total aviation emissions under German management (line, right-hand side axis)

The 2021 emissions are only about half of the average emission level of the 2013 – 2019 period (about 9 million tonnes of carbon dioxide per year). Overall, the 2021 reporting year has by far the second lowest emission level since the introduction of the reduced scope in 2013. Figure 57 indicates how sizable the emissions drop has been due to the COVID 19 pandemic since 2020. The figure of 2021, the first year of the fourth trading period, significantly differs from the fairly continuous emission growth in the third trading period since 2013.

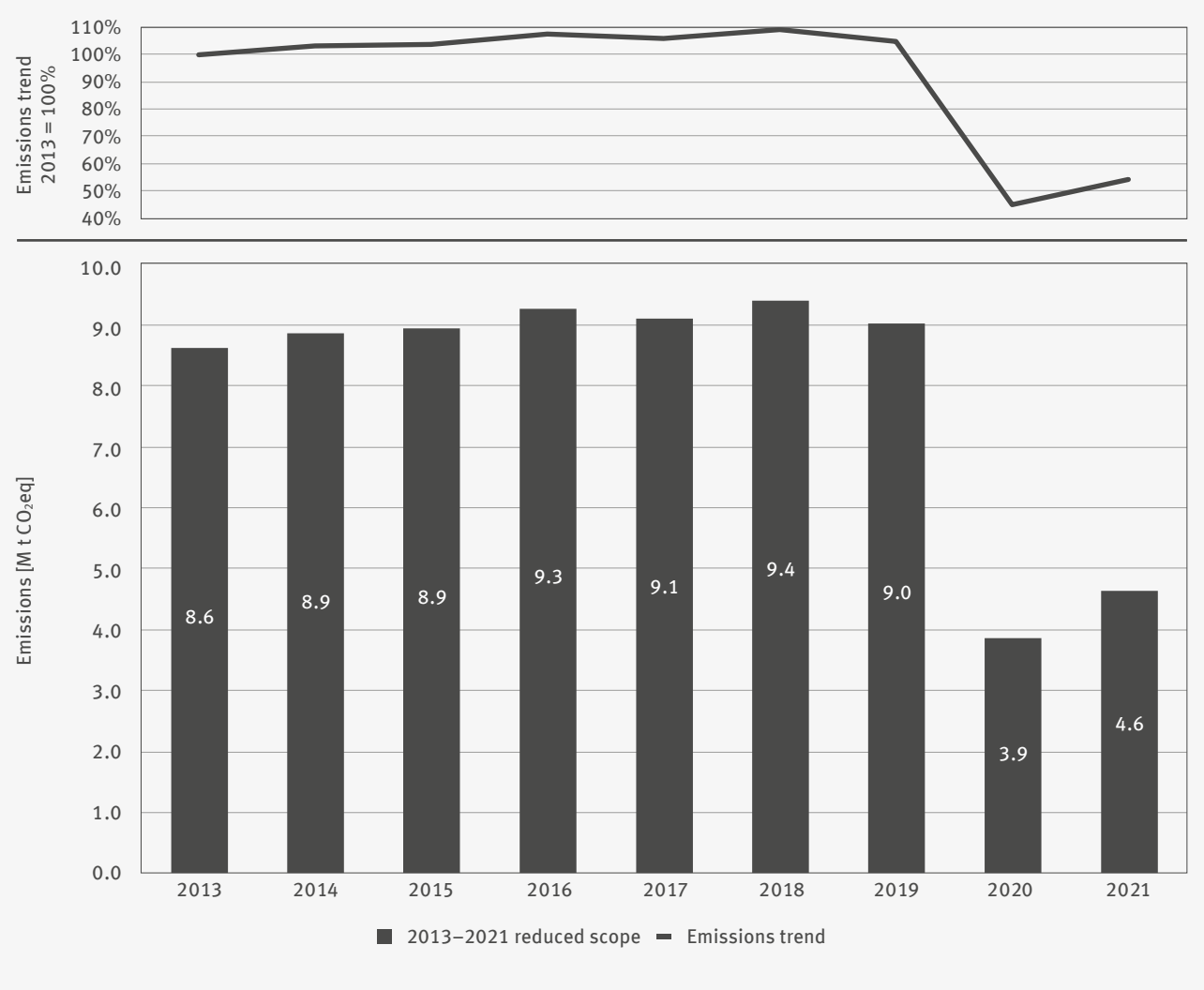


Figure 57: Aviation trend (aircraft operators administered by Germany) of emissions in the reduced scope from 2013 to 2021[165]

165 The chart indicates the 2014 and 2015 emissions as 8.9 million tonnes of carbon dioxide each, however columns have different heights. This is due to rounding after the decimal point. If they are rounded to the second digit after the decimal point, the figures are 8.86 million tonnes of carbon dioxide for 2014 and 8.93 million tonnes of carbon dioxide for 2015.

4.3 Emissions and Emission Allowances Availability for Aviation at the European Level in 2021

The previous sections presented the allocation and emission trends for aircraft operators administered by Germany. The emissions of these aircraft operators accounted for around 17 percent of total 2021 European aviation emissions under the EU ETS.[166]

The 2021 emissions of all aircraft operators subject to emissions trading in the EU ETS were slightly (about 8 percent) above the previous year's level at around 26.9 million tonnes. Despite the increase in aviation emissions in Germany and the EU, a recovery to the emission level before the outbreak of the COVID 19 pandemic (approx. 61 million tonnes on average in the 2013 – 2019 period) is still a long way off. The size of the drop in emissions due to the COVID 19 pandemic can be seen in Figure 58, where the values for the 2020 and 2021 pandemic years are placed in the context of the relatively continuous emissions growth in the 2013 – 2019 period.

Between 2013 and 2019, total emissions from aviation subject to emissions trading grew by an average of 4.1 percent per year from around 53 million tonnes of carbon dioxide to around 68 million in 2019.

The relatively continuous growth trend in emissions up to 2019 contrasted with an almost constant supply of EUAA since 2016, which includes both EUAA allocated free of charge and EUAA auctioned. In principle, the Emissions Trading Directive envisaged an almost constant allocation and auction volumes for the entire 2013 – 2020 period[167]. In the 2012 – 2015 period, however, there were delays in the planned auctions which resulted from the two legislative procedures which adapted the scope of the Emissions Trading Directive at EU level (see Section 4.1). In 2014 and 2015, considerably more EUAAs were auctioned than originally planned, as the auctions had been completely suspended in 2013. As was the case in the third trading period, 15 percent will be allocated annually through auctions in the fourth trading period and the linear reduction factor of the EU ETS will also be applied to the aviation cap.[168]

Irrespective of the auction features described above, total emissions in all years between 2012 and 2019 were significantly higher than the EUAA allocation and auction volumes[169]. The amount of newly issued EUAA exceeded emissions only in the 2020 reporting year. In the current reporting year, the total emissions are above the allocated and auctioned amount of EUAA (0.7 million EUAA). Despite the exceptional effect in 2020 and 2021, there was a shortfall of around 162 million EUAA in total for the fulfilment of the surrender obligation in the 2012 – 2021 period. Operators were able to offset the missing certificates by purchasing EUAA from the stationary EU ETS[170] and, to a limited extent up to and including 2020, by using international project credits as these could be used to fulfil their surrender obligation. The demand by aviation for EUAA from the stationary EU ETS is obtained by subtracting the international project credits from the coverage gap. This was around 143 million tonnes from the start of the surrender obligation in aviation in 2012 up to 2021, the first year of the fourth trading period (see Figure 58). Since the scheduled auction amounts were met in 2016, the annual aviation demand for EUAA increased continually from around 23 million to around 32 million in 2019. Only in 2020 did the supply of EUAA plus the project credits use quota exceed the level of emissions amounting to around eleven million tonnes.

166 The share was about 14 percent in the two previous years, just over 16 percent at the start of the third trading period and 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.

167 The total amount of EUAA allocated free of charge and auctioned is 97 percent of historical aviation emissions (average from 2004 to 2006) in 2012 and 95 percent of historical emissions multiplied by eight for each year of the third trading period (2013 to 2020).

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

169 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.

170 However, operators of stationary installations cannot rely on EUAAs.

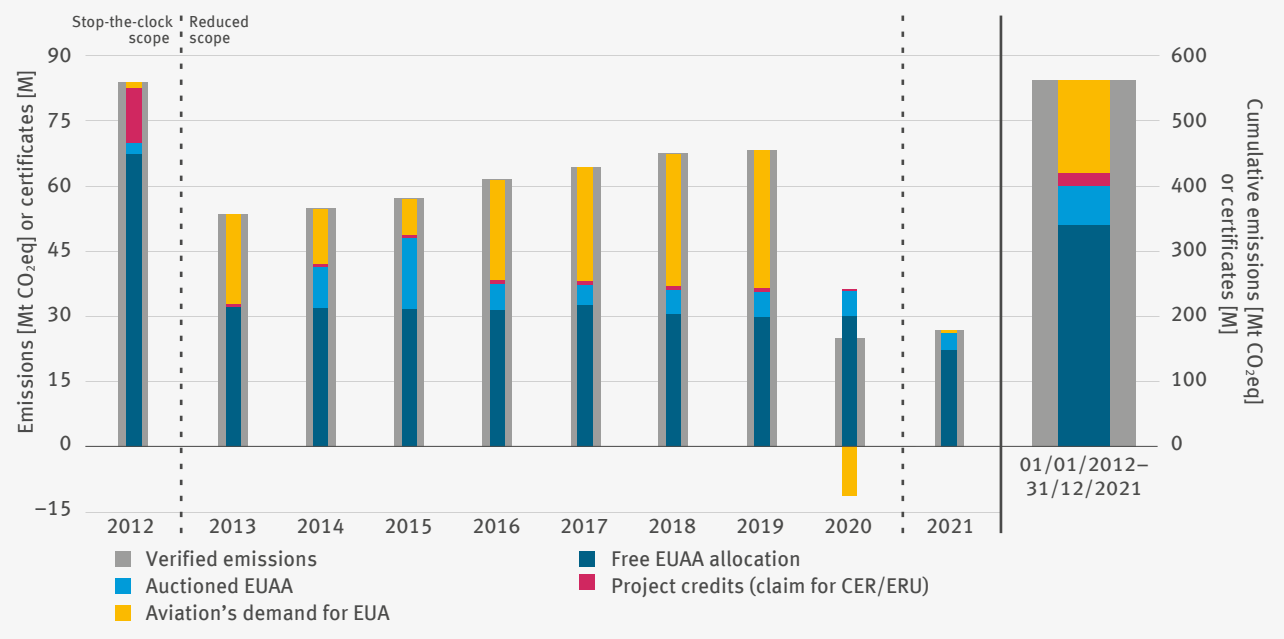


Figure 58: Aviation (aircraft operators administered by Germany), emissions, supply of usable emission allowances (EUAA, CER/ERU) and aviation demand for EUAs for aviation subject to emissions trading in Europe (left: 2012 to 2021 annual figures, right: cumulative)

Infobox: The 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 CORSIA Regulation[171] supplementing the Emissions Trading Directive entered into force in the EU on 20/10/2019. This regulation focuses on the monitoring, reporting and verification of emissions from all international flights within the scope of CORSIA for aircraft operators based in the EU.

The calculation of subsequent cancellation obligations is based on the average of the baseline emissions for 2019 and 2020, in accordance with ICAO Annex 16, Volume IV, Part II, Chapter 3, 3.2.1. The ICAO Council, in its decision of 30/06/2020, is seeking to amend the CORSIA baseline for the pilot phase (2021 – 2023) due to the impact of the COVID 19 pandemic on international air traffic. Depending on the assent of all 193 Contracting States at their 41st Assembly in autumn of 2022, the baseline year for the 2021 to 2023 period would thus be specified as 2019. Accordingly, due to the significant decline in traffic performance caused by the COVID 19 pandemic, aircraft operators would not be expected to have cancellation obligations in CORSIA in the coming years. The further handling of this situation is to be decided in the first CORSIA review in 2022, which will also be the subject of discussions at the 41st Assembly.

Emissions of Aircraft Operators Administered by Germany under CORSIA

In accordance with the CORSIA Regulation, DEHSt administers the emissions of aircraft operators based in Germany that cause more than 10,000 tonnes of carbon dioxide with aircraft with a maximum take-off mass greater than 5.7 t on all international flights within the expanded scope of the Emissions Trading Directive. To approximate the ICAO regulations, there is, among other things, the possibility of voluntary reporting of flights between third countries. Not all German aircraft operators followed this recommendation for the first time for the 2021 reporting year.

In the 2021 reporting year, the 15 aircraft operators managed by DEHSt under CORSIA emitted 14.4 million tonnes of carbon dioxide on international flights (see Table 31). Emissions thus continued to be significantly influenced by the COVID 19 pandemic and did not reach the pre-crisis level of 2019. Accordingly, the restriction of the CORSIA baseline to 2019 emissions only as envisaged by the ICAO Council (see above) is not expected to lead to a cancellation obligation, as 2021 emissions are lower than 2019 emissions. The reference point is the emissions on the routes between the 88 countries that have committed their national aircraft operators to cancel CORSIA project credits on these routes as part of the voluntary phase of CORSIA for 2021. For the year 2022, the number of countries to participate in the voluntary phase (up to 2026) has grown to 107.

►►

171 Commission Delegated Regulation (EU) 2019/1603 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 31: 2019, 2020 and 2021 CO_2 emissions by German aircraft operators under CORSIA[172]

	2019	2020	2021	
Operator	CORSIA CO_2 emissions [t]	CORSIA CO_2 emissions [t]	CORSIA CO_2 emissions [t] (non-verified)	CORSIA CO_2 emissions [t] on routes with a cancellation obligation (non-verified)
Condor Flugdienst GmbH	2,424,934	730,013	870,475	711,814
DC Aviation GmbH	11,428	below CORSIA thresold	14,086	10,732
Deutsche Lufthansa AG	18,026,329	5,260,083	6,422,429	4,921,280
Lufthansa Cargo AG	1,733,553	1,480,891	1,374,626	478,769
Aerologic GmbH	1,368,328	1,919,116	2,414,065	1,039,481
FAI RENT-A-JET	below CORSIA thresold	below CORSIA thresold	14,993	8,790
AEROWEST GMBH (HAN)	below CORSIA thresold	below CORSIA thresold	11,493	10,354
AIR HAMBURG	86,559	98,454	134,498	89,074
AIR X CHARTER (GERMANY) GMBH & CO, KG	13,329	below CORSIA thresold	below CORSIA thresold	below CORSIA thresold
EAT LEIPZIG GMBH	1,076,280	1,202,066	1,453,502	1,359,172
TUIfly GmbH	949,906	324,815	440,822	403,508
K5-AVIATION GMBH	16,900	16,134	24,562	17,809
MHS Aviation GmbH	10,025	below CORSIA thresold	below CORSIA thresold	below CORSIA thresold
EUROWINGS GMBH	2,842,518	795,010	931,608	871,255
SUNDAIR GMBH	95,837	63,653	104,429	68,870
CARGOLOGIC GERMANY	below CORSIA thresold	below CORSIA thresold	26,348	21,426
EW Discover GmbH	Start of operation in 2021	Start of operation in 2021	158,552	134,608
Total	**28,655,926**	**11,890,235**	**14,396,488**	**10,146,942**

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172 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 32: Overview of the 2020 verified emissions per state (Land), by activities

2020 emissions [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BY	HB	HE	HH	MV	NI	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	53	0	22	110	0	82	2	4	588	1,182	349	0	0	0	122	26	2,539
2	Energy conversion >= 50 MW RTI	26,935	4,681	9,400	7,344	3,502	4,037	2,981	1,594	13,285	82,865	4,930	2,154	2,240	26,327	7,084	915	200,274
3	Energy conversion 20 – 50 MW RTI	109	146	498	696	108	255	201	48	752	1,042	313	98	152	66	189	90	4,764
4	Energy conversion 20 – 50 MW RTI, other fuels	0	0	7	5	0	0	0	0	0	18	7	0	0	0	0	30	67
5	Prime movers (engines)	0	0	0	11	0	0	0	0	31	0	0	0	0	0	0	0	42
6	Prime movers (turbines)	170	0	29	155	0	47	0	0	162	145	19	2	0	4	13	44	791
7	Refineries	3,516	0	2,629	2,869	0	0	914	0	1,197	6,982	0	2,348	0	0	2,420	0	22,875
8	Coking plants	0	0	0	0	0	0	0	0	0	2,695	0	0	614	0	0	0	3,309
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	81	0	0	0	0	0	0	81
10	Production of pig iron and steel	1,647	0	116	132	2,349	25	340	0	4,005	11,249	0	0	4,138	74	0	42	24,118
11	Processing of ferrous metals	262	0	160	52	467	323	47	0	411	1,222	113	0	531	100	82	60	3,829
12	Production of primary aluminium	0	0	0	0	0	0	254	0	0	710	0	0	0	0	0	0	963
13	Processing of non-ferrous metals	0	0	13	159	0	0	208	0	161	639	43	0	40	110	119	0	1,493
14	Production of cement clinker	1,260	0	3,584	3,912	0	326	0	0	1,187	5,178	866	1,066	0	0	1,669	1,087	20,134
15	Lime production	336	0	391	952	0	425	0	91	772	3,250	475	0	0	0	1,329	176	8,197
16	Glass production	135	0	95	721	0	3	0	23	347	916	267	38	0	227	562	240	3,573

2020 emissions [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BY	HB	HE	HH	MV	NI	NW	RP	SH	SL	SN	ST	TH	Total
17	Ceramics production	97	0	66	673	27	23	0	0	201	214	151	0	21	147	98	85	1,803
18	Production of mineral fibres	0	0	48	94	0	0	0	0	8	53	0	0	0	98	49	0	350
19	Gypsum production	104	0	22	84	0	0	0	0	17	27	0	0	0	22	0	0	276
20	Pulp production	0	0	109	23	0	0	0	0	3	0	0	0	0	0	75	49	259
21	Paper production	67	0	747	685	0	334	0	4	826	1,241	490	84	0	326	163	19	4,987
22	Carbon black production	0	0	0	0	0	0	0	0	0	518	0	0	0	0	0	0	518
23	Nitric acid production	0	0	0	0	0	0	0	220	0	17	266	0	0	35	39	0	576
24	Adipic acid production	0	0	0	0	0	0	0	0	0	25	0	0	0	0	86	0	111
26	Ammonia production	0	0	0	0	0	0	0	0	0	573	1,536	0	0	0	2,379	0	4,488
27	Production of bulk organic chemicals	0	0	44	547	0	44	0	4	237	3,913	1,563	151	0	1,228	165	2	7,897
28	Production of hydrogen and synthesis gas	0	0	0	45	0	0	48	0	20	365	460	117	0	0	567	0	1,623
29	Soda production	0	0	0	0	0	0	0	0	0	105	71	0	0	0	335	0	511
Total		**34,692**	**4,828**	**17,981**	**19,268**	**6,453**	**5,923**	**4,996**	**1,988**	**24,208**	**125,224**	**11,919**	**6,058**	**7,736**	**28,762**	**17,548**	**2,865**	**320,449**

As of 02/05/2022

Table 33: Overview of the 2021 VET entries per state (Land), by activities

2021 VET [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BY	HB	HE	HH	MV	NI	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	28	0	22	113	0	80	3	8	569	1,263	404	0	0	0	128	27	2,644
2	Energy conversion >= 50 MW RTI	29,904	5,069	14,346	8,676	4,444	4,703	1,572	2,761	14,848	94,229	4,857	2,263	2,762	29,466	8,264	1,009	229,172
3	Energy conversion 20 – 50 MW RTI	127	158	578	774	114	291	218	49	784	1,064	355	105	132	77	205	90	5,120
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	2,639	0	0	1,060	0	0	0	3,699
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	45	27,142
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 VET [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BY	HB	HE	HH	MV	NI	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	113	23	0	0	0	0	3	0	0	0	0	0	72	48	259
21	Paper production	79	0	765	711	0	331	0	4	896	1,179	453	90	0	358	242	17	5,124
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	40	0	397
24	Adipic acid production	0	0	0	0	0	0	0	0	0	24	0	0	0	0	93	0	118
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**	**22,948**	**21,193**	**7,423**	**6,706**	**3,627**	**3,118**	**25,980**	**139,806**	**11,838**	**5,943**	**9,686**	**32,047**	**18,715**	**2,948**	**355,082**

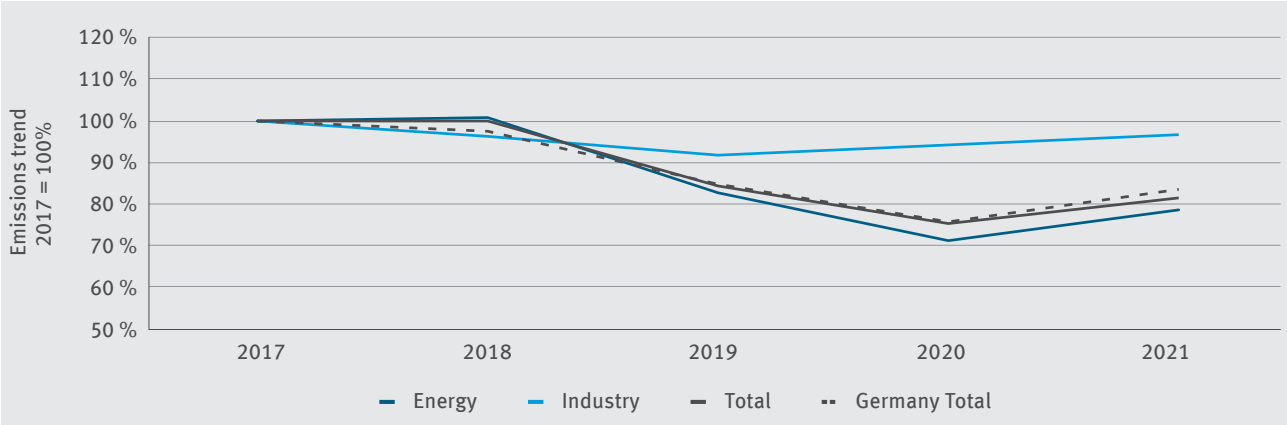
As of 02/05/2022

Table 34: Overview of the 2021 allocation amounts per state (Land), by activities

2021 allocation amount [1000 EUA]		State (Land)																
No.	Activity	BB	BE	BW	BY	HB	HE	HH	MV	NI	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	147	0	5	83	0	87	1	1	248	805	316	0	0	0	137	27	1,856
2	Energy conversion >= 50 MW RTI	548	426	517	975	51	660	201	164	924	3,066	1,080	186	93	384	597	205	10,076
3	Energy conversion 20 – 50 MW RTI	21	23	153	163	23	81	77	12	277	353	98	21	43	13	60	37	1,455
4	Energy conversion 20 – 50 MW RTI, other fuels	0	0	34	12	0	0	0	0	0	13	3	0	0	0	24	3	90
5	Prime movers (engines)	0	0	0	2	0	0	0	0	6	0	0	0	0	0	0	0	8
6	Prime movers (turbines)	51	0	9	42	0	18	0	0	41	40	6	1	0	1	3	18	229
7	Refineries	1,736	0	1,801	2,241	0	0	738	0	759	4,904	0	1,623	0	0	1,928	0	15,729
8	Coking plants	0	0	0	0	0	0	0	0	0	1,163	0	0	251	0	0	0	1,414
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	107	4,342	20	336	0	6,286	21,622	0	0	5,219	64	0	43	40,959
11	Processing of ferrous metals	210	0	139	41	290	258	36	0	386	1,007	100	0	312	81	54	46	2,959
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	12	142	0	0	248	0	159	510	39	0	9	99	98	0	1,315
14	Production of cement clinker	1,163	0	3,292	3,408	0	273	0	0	1,088	4,181	686	899	0	0	1,488	859	17,337
15	Lime production	251	0	266	646	0	260	0	55	466	2,158	368	0	0	0	789	115	5,375
16	Glass production	95	0	86	577	0	3	0	10	245	720	180	30	0	175	464	179	2,762
17	Ceramics production	85	0	60	558	24	20	0	0	140	167	126	0	21	111	62	69	1,444
18	Production of mineral fibres	0	0	28	70	0	0	0	0	3	46	0	0	0	67	50	0	265
19	Gypsum production	33	0	5	24	0	0	0	0	4	10	0	0	0	11	0	0	88

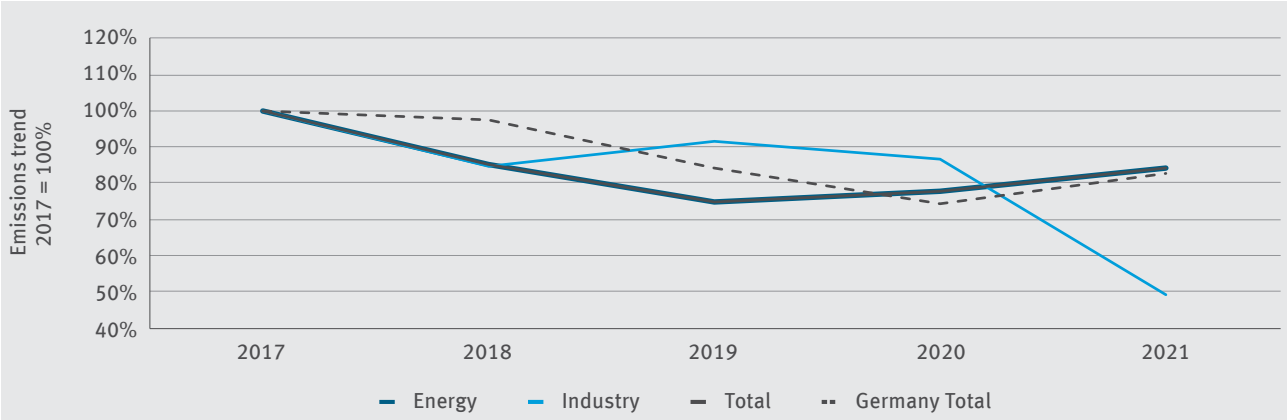
2021 allocation amount [1000 EUA]		State (Land)																
No.	Activity	BB	BE	BW	BY	HB	HE	HH	MV	NI	NW	RP	SH	SL	SN	ST	TH	Total
20	Pulp production	0	0	13	5	0	0	0	0	2	0	0	0	0	0	40	16	77
21	Paper production	239	0	749	988	0	230	0	4	930	924	392	77	0	195	120	17	4,865
22	Carbon black production	0	0	0	0	0	0	0	0	0	378	0	0	0	0	0	0	378
23	Nitric acid production	0	0	0	0	0	0	0	237	0	134	135	0	0	14	32	0	552
24	Adipic acid production	0	0	0	0	0	0	0	0	0	198	344	0	0	0	223	0	765
26	Ammonia production	0	0	0	0	0	0	0	0	0	519	1,390	0	0	0	1,939	0	3,848
27	Production of bulk organic chemicals	0	0	16	390	0	86	0	3	285	4,052	1,749	148	0	658	159	1	7,547
28	Production of hydrogen and synthesis gas	0	0	0	33	0	0	35	0	4	272	329	66	0	0	328	0	1,067
29	Soda production	0	0	0	0	0	0	0	0	0	361	64	0	0	0	611	0	1,036
Total		**7,373**	**449**	**7,312**	**10,509**	**4,730**	**1,996**	**1,896**	**486**	**12,253**	**48,321**	**7,404**	**3,051**	**5,948**	**1,874**	**9,204**	**1,636**	**124,441**

As of 02/05/2022



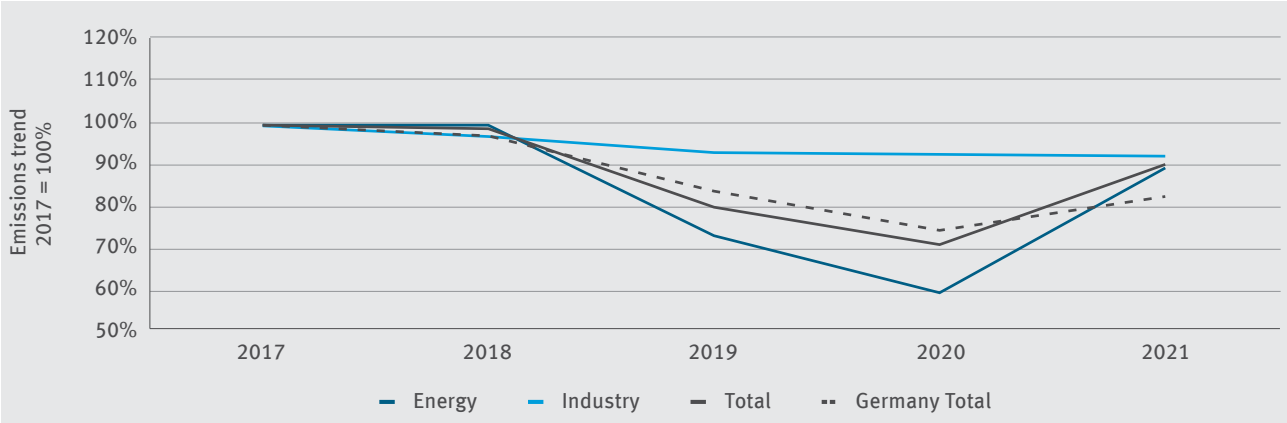
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	31	39,011,651	39,255,471	31,925,630	27,214,072	30,196,181
Industry	35	7,976,355	7,637,711	7,292,021	7,477,596	7,681,101
BB	**66**	**46,988,006**	**46,893,182**	**39,217,651**	**34,691,668**	**37,877,282**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 59: Emissions trends in Brandenburg since 2017



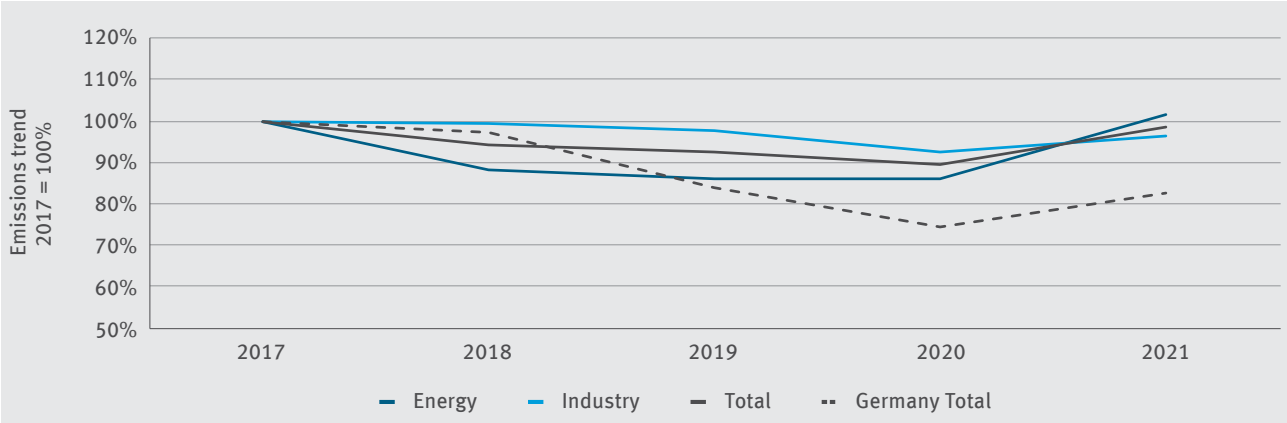
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	28	6,201,481	5,284,093	4,641,725	4,827,705	5,227,602
Industry	1	388	328	355	336	191
BE	**29**	**6,201,869**	**5,284,421**	**4,642,080**	**4,828,041**	**5,227,793**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 60: Emissions trends in Berlin since 2017



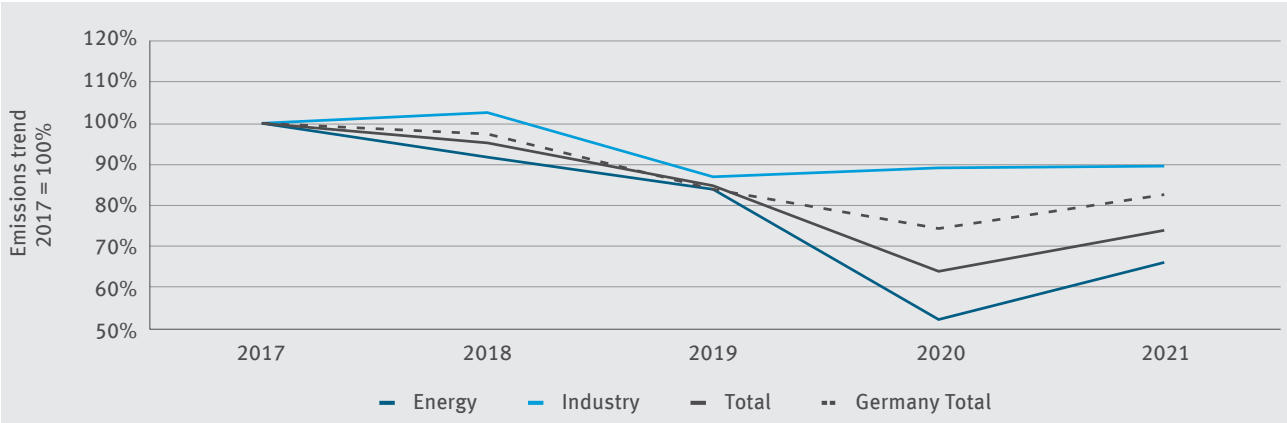
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	84	16,748,673	16,715,997	12,243,618	9,934,681	14,957,142
Industry	55	8,643,464	8,415,276	8,056,167	8,045,878	7,990,802
BW	**139**	**25,392,137**	**25,131,273**	**20,299,785**	**17,980,559**	**22,947,944**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 61: Emissions trends in Baden-Württemberg since 2017



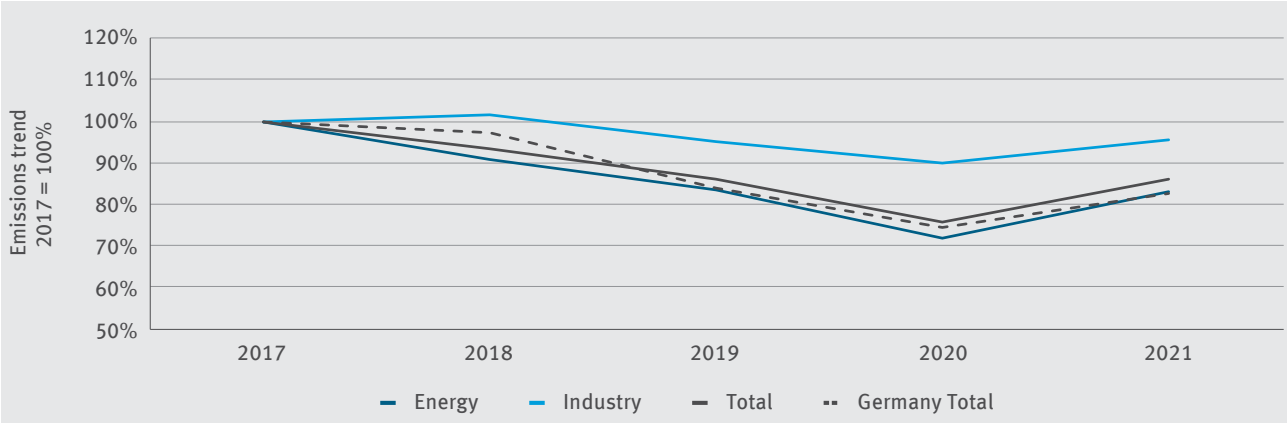
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	124	9,536,013	8,424,509	8,195,846	8,210,737	9,695,134
Industry	127	11,954,642	11,870,490	11,657,788	11,056,877	11,497,825
BY	**251**	**21,490,655**	**20,294,999**	**19,853,634**	**19,267,614**	**21,192,959**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 62: Emissions trends in Bavaria since 2017



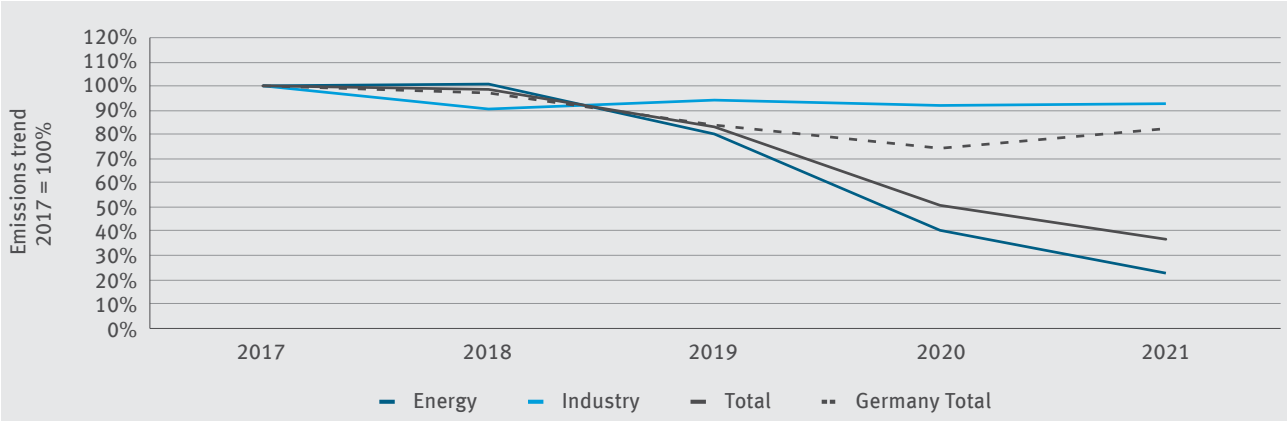
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	21	6,863,150	6,281,389	5,769,346	3,610,178	4,557,290
Industry	5	3,198,937	3,272,392	2,776,633	2,842,823	2,865,214
HB	**26**	**10,062,087**	**9,553,781**	**8,545,979**	**6,453,001**	**7,422,504**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 63: Emissions trends in Bremen since 2017



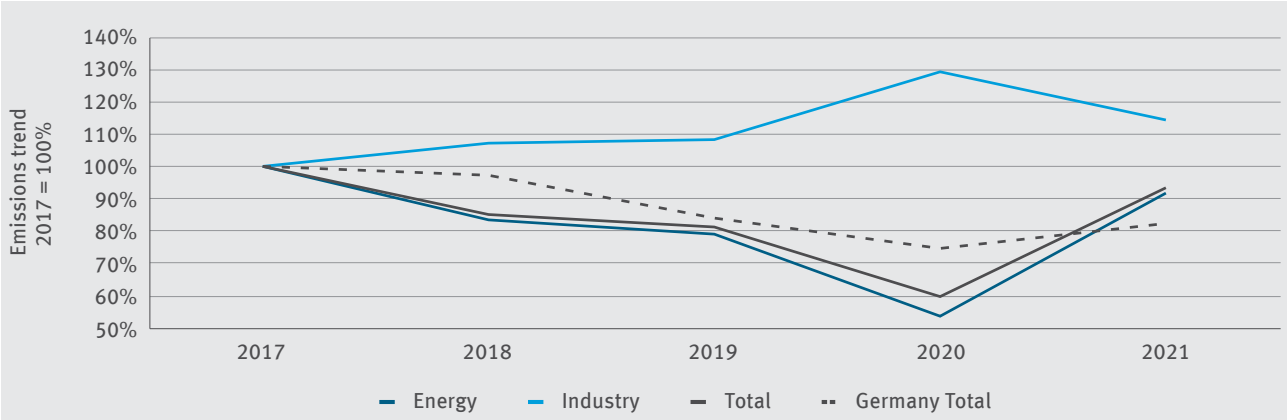
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	59	6,049,393	5,503,163	5,047,695	4,338,528	5,024,688
Industry	34	1,759,169	1,783,432	1,672,748	1,584,690	1,680,971
HE	**93**	**7,808,562**	**7,286,595**	**6,720,443**	**5,923,218**	**6,705,659**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 64: Emissions trends in Hesse since 2017



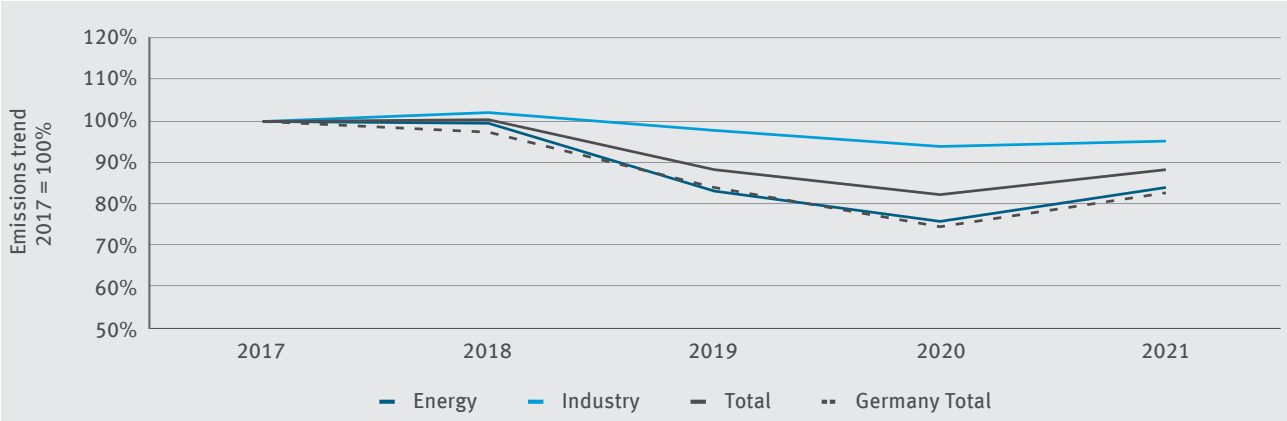
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	24	7,908,893	7,965,776	6,332,900	3,182,003	1,789,358
Industry	13	1,973,900	1,795,127	1,862,121	1,814,071	1,837,588
HH	**37**	**9,882,793**	**9,760,903**	**8,195,021**	**4,996,074**	**3,626,946**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 65: Emissions trends in Hamburg since 2017



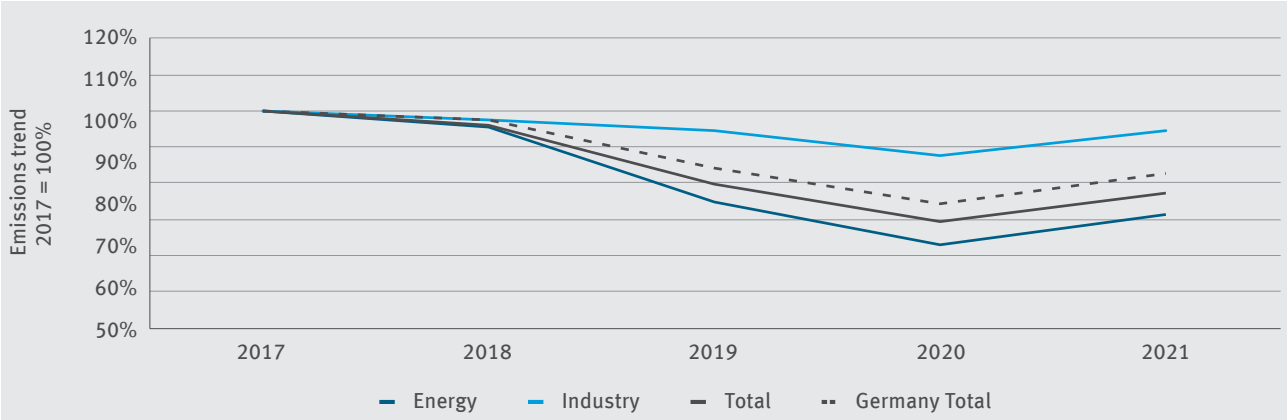
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	18	3,066,554	2,559,461	2,420,170	1,642,103	2,810,799
Industry	7	267,457	286,751	289,775	346,327	307,263
MV	**25**	**3,334,011**	**2,846,212**	**2,709,945**	**1,988,430**	**3,118,062**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 66: Emissions trends in Mecklenburg-Western Pomerania since 2017



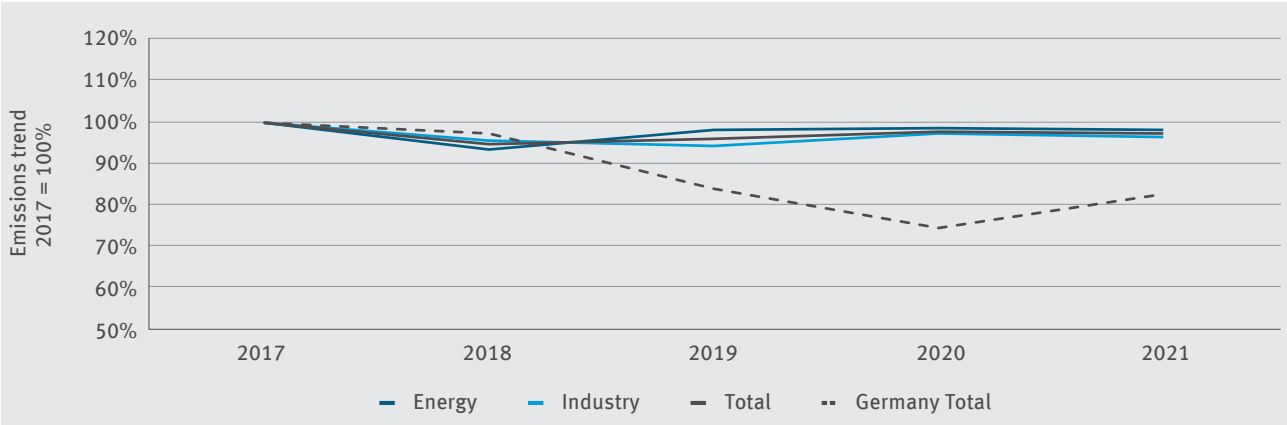
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	85	18,836,970	18,738,552	15,623,558	14,228,990	15,832,720
Industry	86	10,661,284	10,851,850	10,434,404	9,979,042	10,147,144
NI	**171**	**29,498,254**	**29,590,402**	**26,057,962**	**24,208,032**	**25,979,864**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 67: Emissions trends in Lower Saxony since 2017



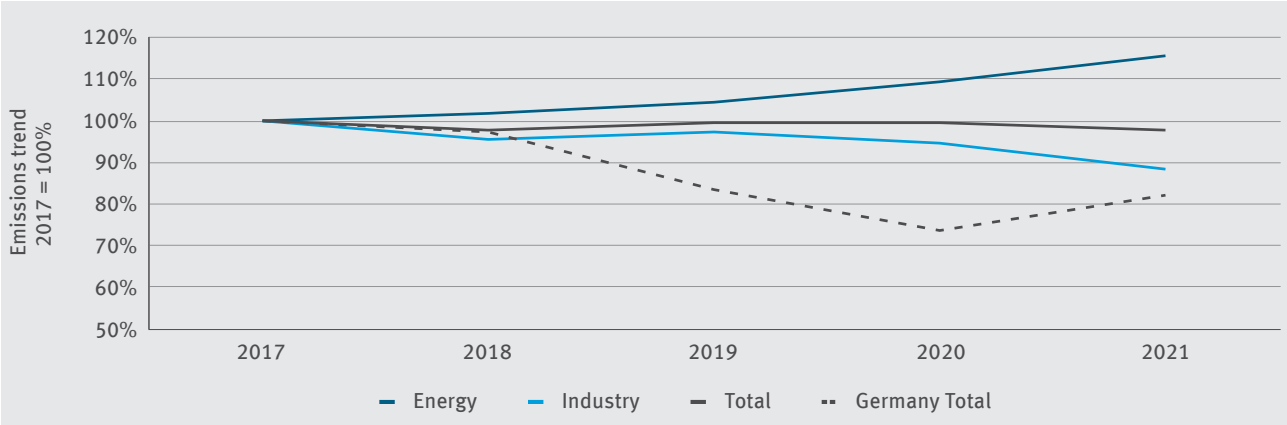
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	205	133,916,041	128,172,946	100,109,648	84,070,679	95,437,818
Industry	255	47,025,383	45,893,875	44,380,705	41,153,692	44,367,924
NW	**460**	**180,941,424**	**174,066,821**	**144,490,353**	**125,224,371**	**139,805,742**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 68: Emissions trends in North Rhine-Westphalia since 2017



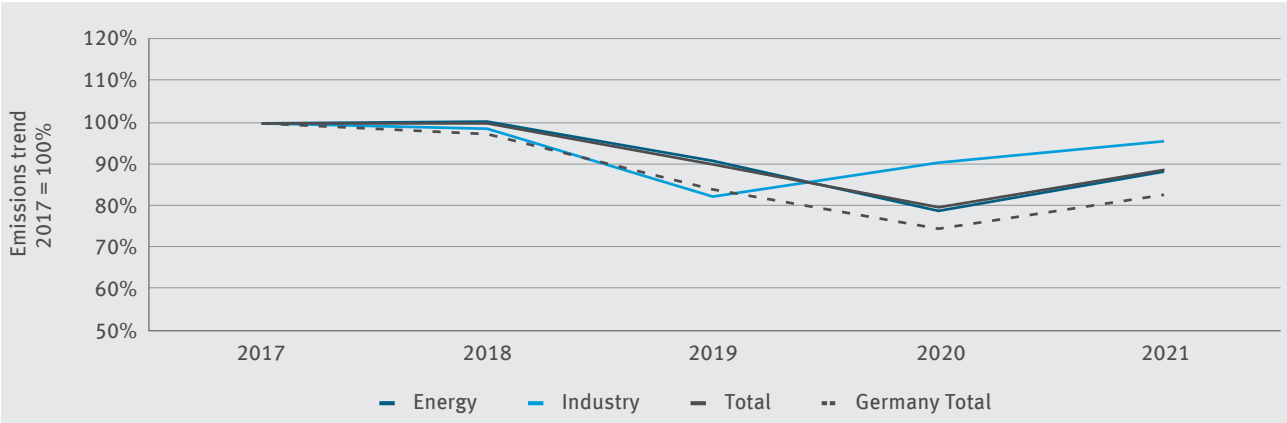
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	45	5,342,116	4,990,238	5,237,673	5,269,053	5,230,260
Industry	87	6,842,551	6,522,635	6,458,402	6,650,289	6,607,744
RP	**132**	**12,184,667**	**11,512,873**	**11,696,075**	**11,919,342**	**11,838,004**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 69: Emissions trends in Rhineland-Palatinate since 2017



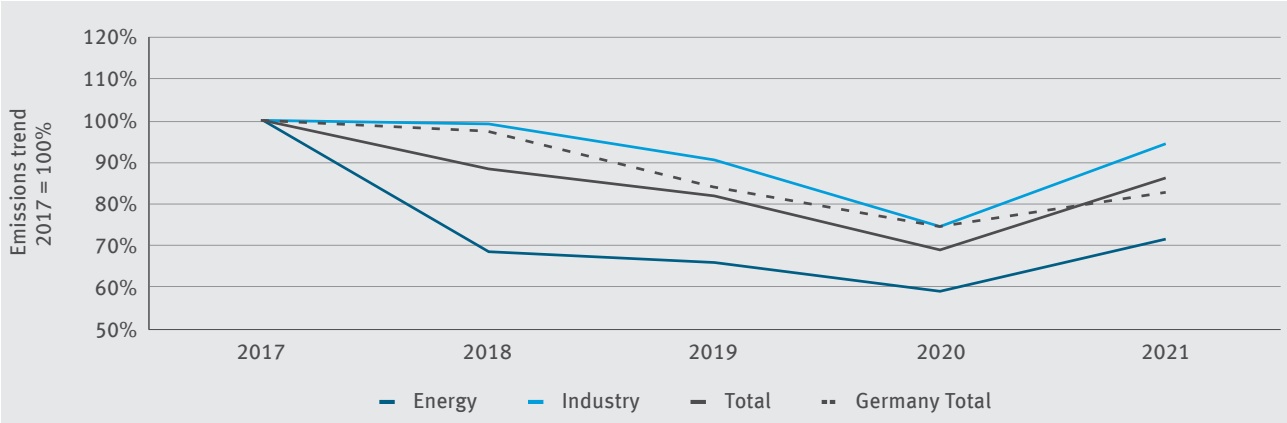
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	25	2,066,164	2,102,182	2,148,827	2,254,402	2,372,836
Industry	13	4,018,903	3,844,468	3,905,841	3,803,484	3,570,297
SH	**38**	**6,085,067**	**5,946,650**	**6,054,668**	**6,057,886**	**5,943,133**
DE	***1732***	***430,452,233***	***418,534,751***	***361,845,917***	***320,448,856***	***355,082,261***

Figure 70: Emissions trends in Schleswig-Holstein since 2017



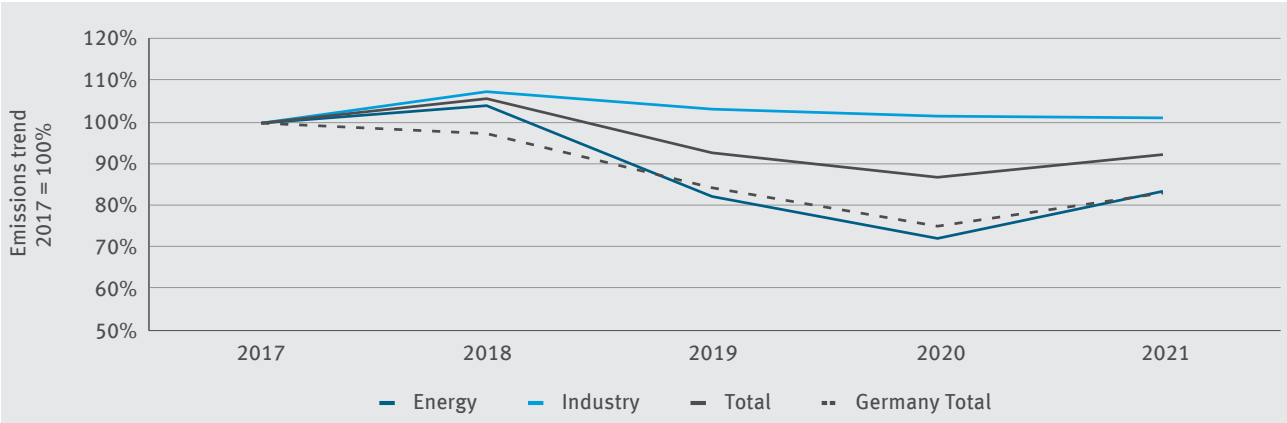
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	37	33,515,180	33,537,891	30,413,312	26,396,637	29,547,245
Industry	47	2,614,092	2,575,351	2,149,233	2,364,999	2,499,369
SN	**84**	**36,129,272**	**36,113,242**	**32,562,545**	**28,761,636**	**32,046,614**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 71: Emissions trends in Saxony since 2017



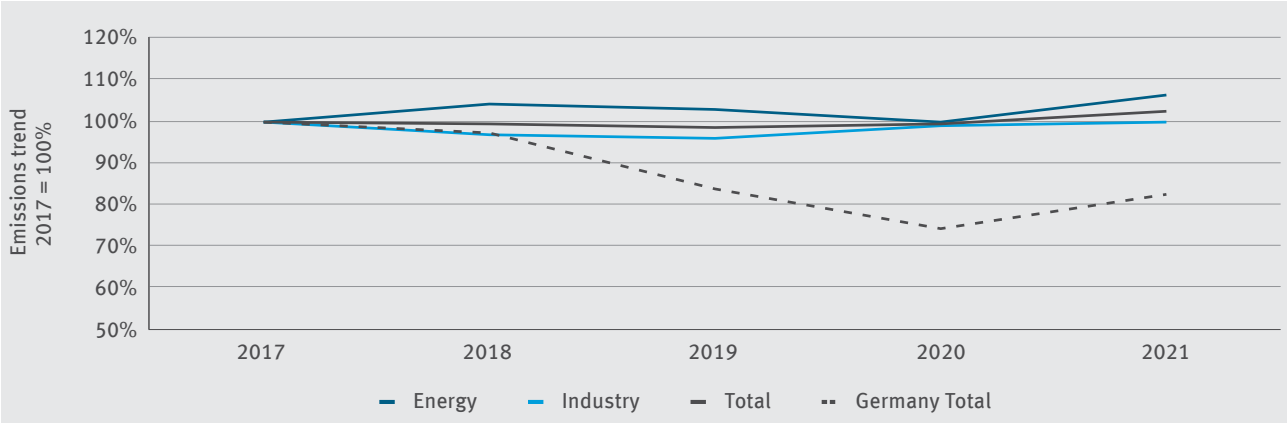
No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	21	4,056,536	2,770,715	2,666,529	2,391,996	2,893,355
Industry	16	7,200,241	7,136,685	6,511,365	5,344,245	6,792,682
SL	**37**	**11,256,777**	**9,907,400**	**9,177,894**	**7,736,241**	**9,686,037**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 72: Emissions trends in Saarland since 2017



No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	40	10,218,493	10,625,761	8,342,880	7,286,644	8,498,004
Industry	56	10,094,246	10,851,189	10,438,029	10,261,011	10,217,473
ST	**96**	**20,312,739**	**21,476,950**	**18,780,909**	**17,547,655**	**18,715,477**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 73: Emissions trends in Saxony-Anhalt since 2017



No, of installations subject to ET in 2021		2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	2020 emissions [t CO_2eq]	2021 VET [t CO_2eq]
Energy	21	1,082,408	1,125,910	1,114,977	1,079,254	1,151,119
Industry	27	1,801,505	1,743,137	1,725,996	1,785,834	1,797,122
TH	**48**	**2,883,913**	**2,869,047**	**2,840,973**	**2,865,088**	**2,948,241**
DE	***1,732***	***430,452,233***	***418,534,751***	***443,000,113***	***320,448,856***	***355,082,261***

Figure 74: Emissions trends in Thuringia since 2017

6 Main Fuels by Sectors

Table 35: 2017–2021 emissions from stationary installations in EU ETS using the main fuels natural gas, lignite and hard coal

Sector / Activity	Main fuel	2017 emissions [kt CO_2eq]	2018 emissions [kt CO_2eq]	2019 emissions [kt CO_2eq]	2020 emissions [kt CO_2eq]	2021 emissions [kt CO_2eq]
Energy installations	Lignite	153,636	153,427	119,941	97,806	115,988
	Hard coal	72,417	70,746	51,571	41,473	50,950
	Natural gas	45,530	42,178	44,216	44,322	43,354
Other combustion plants	Lignite	9	8	7	9	8
	Natural gas	345	360	348	329	335
Refineries	Lignite	463	465	474	478	430
	Natural gas	3,479	3,070	2,918	2,813	2,614
Iron and steel	Lignite	222	230	185	198	217
	Hard coal	23,141	22,970	21,829	19,319	21,567
	Natural gas	3,308	3,276	2,974	2,680	2,938
Non-ferrous metals	Lignite	231	228	221	222	230
	Hard coal	130	123	135	133	140
	Natural gas	1,535	1,565	1,542	1,491	1,565
Cement clinker	Lignite	922	825	768	906	855
	Hard coal	1,110	1,106	1,101	998	1,007
Industrial and building lime	Lignite	5,457	5,431	4,975	4,562	5,050
	Hard coal	762	771	772	761	768
	Natural gas	955	1,020	950	892	992
Other mineral processing industry	Lignite	560	561	498	528	515
	Hard coal	594	638	575	584	625
	Natural gas	6,782	7,015	6,829	6,641	6,937
Paper and pulp	Lignite	247	244	243	236	230
	Hard coal	610	587	526	450	469
	Natural gas	4,416	4,378	4,228	4,191	4,476
Chemical industry	Lignite	41	40	37	38	39
	Hard coal	488	455	480	440	458
	Natural gas	8,323	8,544	7,887	8,179	8,475
Sum		**335,715**	**330,262**	**276,230**	**240,680**	**271,231**
Complement: main fuel is not natural gas, hard coal or lignite		101,892	92,579	87,087	80,035	83,992
Total		**437,607**	**422,841**	**363,316**	**320,715**	**355,223**

As of 02/05/2022

The basis for determining the main fuel of an installation is the information provided by the operators in the annual emission reports at source stream level. 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 36: Number of stationary installations in 2017 – 2021 in EU ETS using the main fuels natural gas, lignite and hard coal

Sector / Activity	Main fuel	2017 installation	2018 installation	2019 installation	2020 installation	2021 installation
Energy installations	Lignite	20	20	20	20	20
	Hard coal	48	48	48	48	48
	Natural gas	615	626	634	638	640
Other combustion plants	Lignite	1	1	1	1	1
	Natural gas	21	22	22	23	24
Refineries	Lignite	1	1	1	1	1
	Natural gas	7	7	8	8	8
Iron and steel	Lignite	1	1	1	1	1
	Hard coal	23	23	23	23	23
	Natural gas	66	66	66	66	65
Non-ferrous metals	Lignite	1	1	1	1	1
	Hard coal	1	1	1	1	1
	Natural gas	26	26	26	26	26
Cement clinker	Lignite	2	2	2	2	2
	Hard coal	2	2	2	2	2
Industrial and building lime	Lignite	19	19	19	19	19
	Hard coal	7	7	7	7	7
	Natural gas	9	9	9	9	9
Other mineral processing industry	Lignite	5	5	5	5	5
	Hard coal	7	7	7	7	7
	Natural gas	208	210	210	210	202
Paper and pulp	Lignite	4	4	4	4	3
	Hard coal	3	3	3	3	3
	Natural gas	115	115	115	117	117
Chemical industry	Lignite	1	1	1	1	1
	Hard coal	3	3	3	3	3
	Natural gas	48	61	61	61	60
Sum		**1,264**	**1,291**	**1,300**	**1,307**	**1,299**
Complement: main fuel is not natural gas, hard coal or lignite		397	424	427	427	433
Total		**1,831**	**1,867**	**1,848**	**1,816**	**1,732**

As of 02/05/2022

The basis for determining the main fuel of an installation is the information provided by the operators in the annual emission reports at source stream level. 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 37: Activities (short description) according to Annex 1 TEHG and grouping in sectors and industries

TEHG No.	Activity	Industry	Sectors
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		

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Table 38: Activities (short description) according to Annex 1 TEHG and equivalent in Union Registry (Registry Activity)

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

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8 Emissions and Scope Estimates

Table 39: 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	332.8	98.1	35.9	5.5	39.9	512.2
2006 emissions	334.3	100.1	36.4	4.9	39.7	515.5
2007 emissions	340.5	103.0	36.2	4.7	43.6	528.1
2008 emissions	326.4	107.4	32.0	4.4	33.1	503.4
2009 emissions	302.8	94.7	25.8	2.8	30.5	456.7
2010 emissions	319.3	102.8	28.4	2.0	25.0	477.6
2011 emissions	317.6	104.4	24.8	1.7	24.2	472.6
2012 emissions	320.9	101.9	26.2	1.3	23.4	473.7
2013 emissions	330.4	123.0	24.1	1.8	0.1	479.4
2014 emissions	316.6	122.9	17.4	1.5	0.1	458.4
2015 emissions	315.2	123.1	13.5	1.3	0.1	453.3
2016 emissions	315.5	123.3	11.0	1.1	0.1	451.0
2017 emissions	304.4	126.0	6.1	0.9	0.1	437.6
2018 emissions	294.1	124.5	3.3	0.8	0.0	422.7
2019 emissions	242.2	119.6	0.7	0.7	0.0	363.2
2020 emissions	205.9	114.5	0.0	0.1	0.0	320.6
2021 emissions	235.2	119.9	0.0	0.0	0.0	355.1
No. of installations	868	864	520	322		

As of 02/05/2022

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 of the iron and steel industry and imported heat quantities of 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 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 is the fuel that has the largest share 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 of an installation for the reporting year does not correspond to the main fuel allocation based on the emission report of the year prior to the reporting year, as in the previous year's reports: the main fuel allocation for 2020 was determined for the first time for the 2020 VET report using the data from the emission reports of the 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 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, 2021, the linear factor was 0.8562. This will be reduced by 2.2 percent each year until it reaches 0.6582 in 2030.

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) to adjust 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 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 installations for the production and processing of non-ferrous metals and in the chemical industry were added. 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. Further details on the scope estimate can be found in Section 2.3 of the handbook ‘Data concepts in EU emissions trading’ (Graichen et al., 2021).

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