Greenhouse Gas Emissions in 2020

Stationary installations and aviation subject to emissions trading in Germany (2020 VET report)

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Executive Summary

Energy and Industry Sector in Germany

2020 is the last year of the third trading period of the European Emissions Trading Scheme (EU ETS). This year, 1,817 stationary installations were covered by the EU ETS in Germany. The installations emitted around 320 million tonnes of carbon dioxide equivalents (CO_2eq), which represents a decrease of 12 percent compared to 2019. At the end of the third trading period, emissions from German installations approached the 300 million tonnes of carbon dioxide equivalents mark for the first time since the start of the EU ETS in 2005. This more or less continues the emissions trend of the previous year. In 2019, the decrease was 14 percent. Emissions from energy installations fell by 15 percent and emissions from industrial installations by five percent compared to the previous year. The economic impact of the COVID 19 pandemic, which began in spring 2020, had a discernible influence on the emissions situation in 2020 presented in this report. However, an exact determination requires further analyses, which cannot be provided within the scope of this report.

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

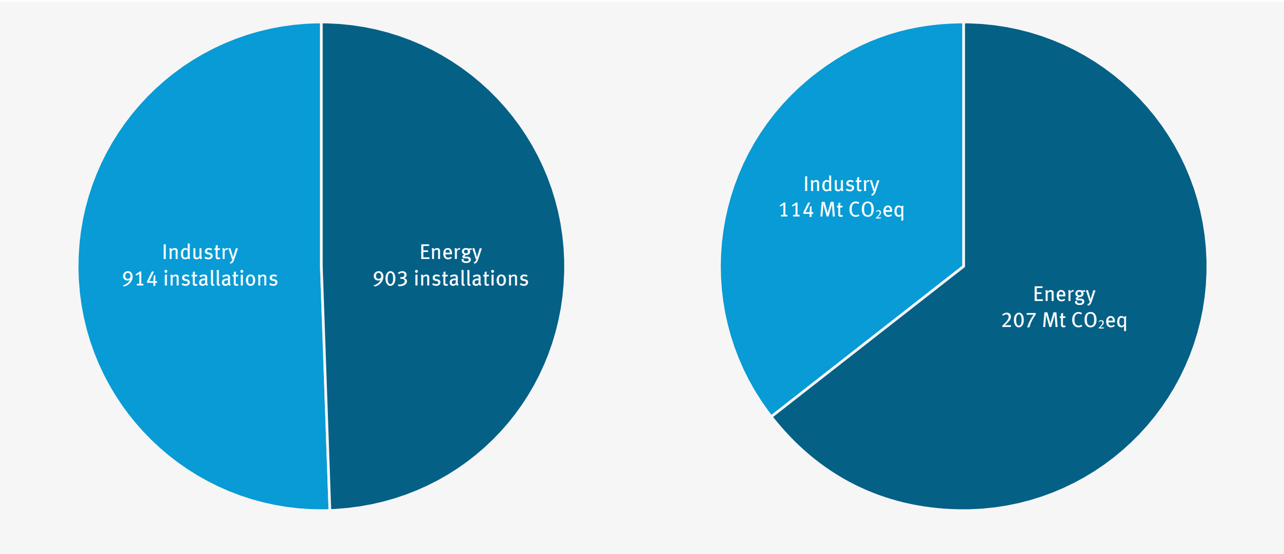

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Figure 1: Distribution of emissions and installations subject to emissions trading in the energy sector (Activities 2 to 6 as per Annex 1 TEHG) and the industrial sector (Activities 1 and 7 to 29 as per Annex 1 TEHG) in Germany in 2020

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: nearly two thirds of emissions from Germany's stationary installations subject to emissions trading is generated by energy installations and one third from industrial installations.

Emissions trends in the third trading period

Figure 2 shows the German EU ETS emissions since 2005, broken down to industrial and energy installations. The figure shows the reported emissions for the individual years from 2013 onwards, but only the average of the first (2005 to 2007) and second (2008 to 2012) trading period for 2005 to 2012. The average for the third trading period (2013 to 2020) is also shown in addition to the figures for the individual years. Emissions from installations that are no longer subject to emissions trading (n. l. ETS)[1] 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.

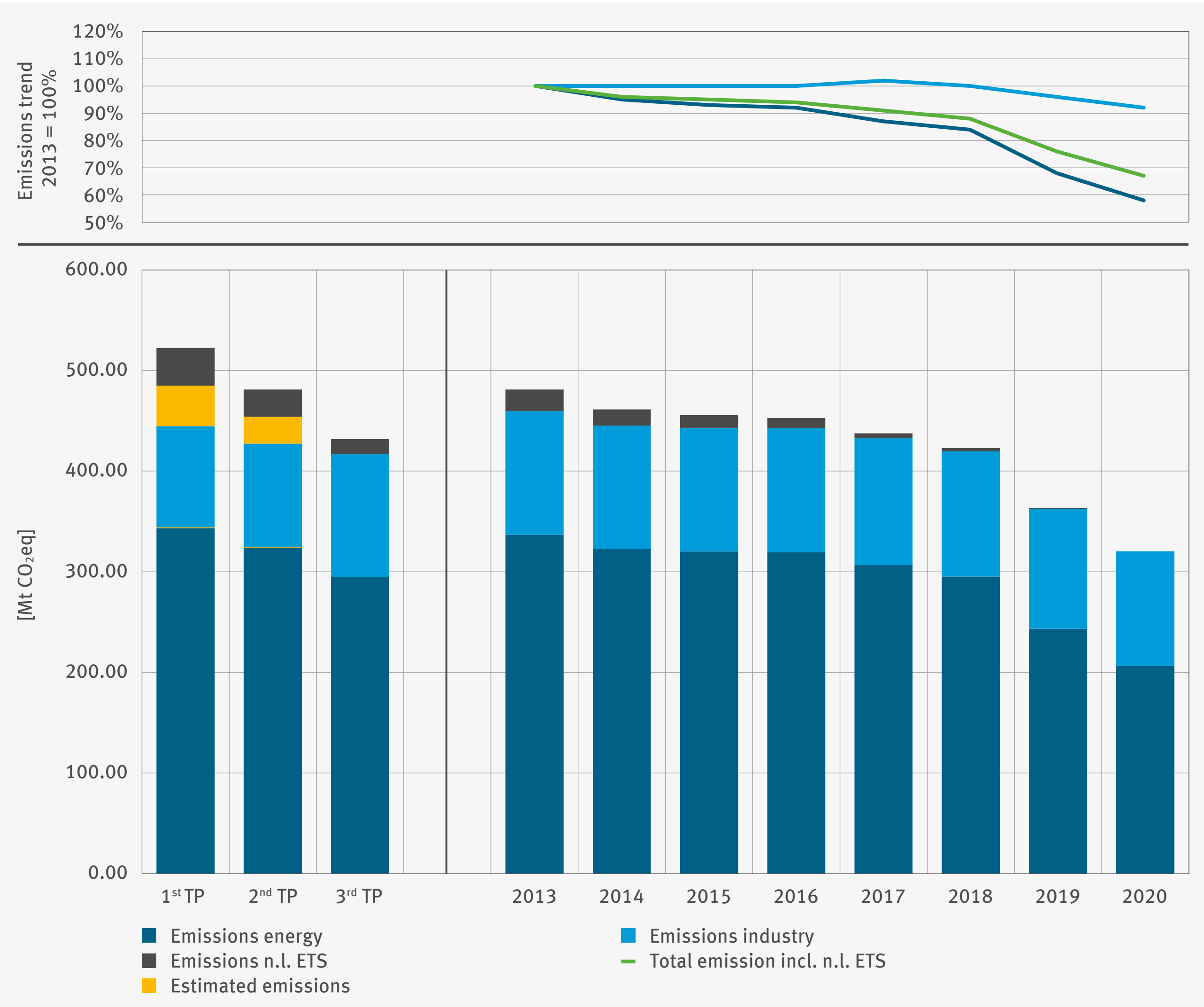

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Figure 2: EU ETS emissions from the energy and industry sectors in Germany since 2005[2]

1 Cf. Explanation for 'Taking into account installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1 Introduction

2 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.

Compared to the previous year, emissions from energy installations in 2020 dropped by around 15 percent to 207 million tonnes of carbon dioxide. This is a continuation of the downward trend of the previous year, albeit slightly weakened (2019: minus 18 percent). The reason is the continued significant decline in lignite and hard coal emissions. Hard coal emissions decreased by 21 percent, lignite emissions by 18 percent in 2020.

The main reasons for the decrease in hard coal emissions were another significant increase in the feed-in of electricity from wind power / photovoltaic installations and a continued displacement by natural gas power stations. Power plant closures, however, played a subordinate role in 2020, unlike in 2019, as the first round of tenders for the closure of hard coal capacities only started in September 2020 and will therefore only have an impact on electricity generation in 2021. The economic efficiency of hard-coal-fired plants deteriorated further compared to the previous year due to relatively low natural gas prices and continued high prices for emission allowances (EUA).

The economic efficiency of lignite-fired power plants also deteriorated further last year due to persistently high CO_2 prices and lower electricity market prices. With regard to lignite power plant closures or transfers of power plant units into security reserve did not play a prominent role in the emission trend in 2020.

Electricity production in Germany fell significantly in 2020 in the wake of the COVID 19 pandemic. Particularly noteworthy is the fact that lignite is no longer the most important energy source in electricity generation for the first time since 2006. With a share of around 18 percent, onshore wind power has moved to the top, lignite shares second place with natural gas (around 16 percent each), nuclear power follows with eleven percent and photovoltaics with nine percent. Hard coal now only has a market share of 7.5 percent.

Natural gas emissions rose by two percent compared to the previous year, but this had only a very minor impact in offsetting the decrease in hard coal and lignite emissions. The rising natural gas emissions are mainly due to the increasing fuel switch from coal to natural gas in power generation as described above.

Since the beginning of the third trading period in 2013, emissions from energy installations have dropped continuously and by around 42 percent. This is due in particular to the decrease in electricity generation from lignite and hard coal. The main reasons for this are the growing importance of electricity from renewable energies, the transfer of electricity generation capacities into security reserve and the decommissioning of power plant units from 2016, and the significantly increased EUA prices from 2018.

Emissions from the industry with high energy consumption hardly changed from 2013 to 2018 and were between roughly 123 and 126 million tonnes of carbon dioxide equivalents each. Only in 2019 did they fall below the 2013 level for the first time, at 119 million tonnes of carbon dioxide equivalents. In 2020, they then fell further to 113 million tonnes of carbon dioxide equivalents and thus to 92 percent of the 2013 emissions. The decrease in emissions compared to the previous year was five percent (2019: minus four percent). It 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 the previous year, which also affected production trends in Germany.

A 33 percent decrease in total German EU ETS emissions since 2013, i. e. to two-thirds of the 2013 level, is thus predominantly due to the decline 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.

Emissions from industrial installations in detail

Figure 3 shows the distribution of the total emissions from individual industrial sectors. The iron and steel industry accounts for the largest share of industrial emissions at around 28 percent, followed by refineries (20 percent), cement clinker production (18 percent) and the chemical industry (15 percent). Due to the emissions trend, the iron and steel industry's share fell slightly compared to the previous year (2019: 30 percent), while the shares of the other three sectors increased slightly (2019: refineries 19 percent, cement clinker production 17 percent, chemical industry 14 percent).

The remaining industrial emissions are distributed across four other sectors and sub-sectors: other mineral processing industries (seven percent), which includes glass and ceramics production, industrial and building lime (six percent), the paper and pulp industry (four percent) and non-ferrous metals industry (two percent). Other combustion plants that cannot be assigned to any of the aforementioned sectors generate only about half a percent of the total industrial emissions.

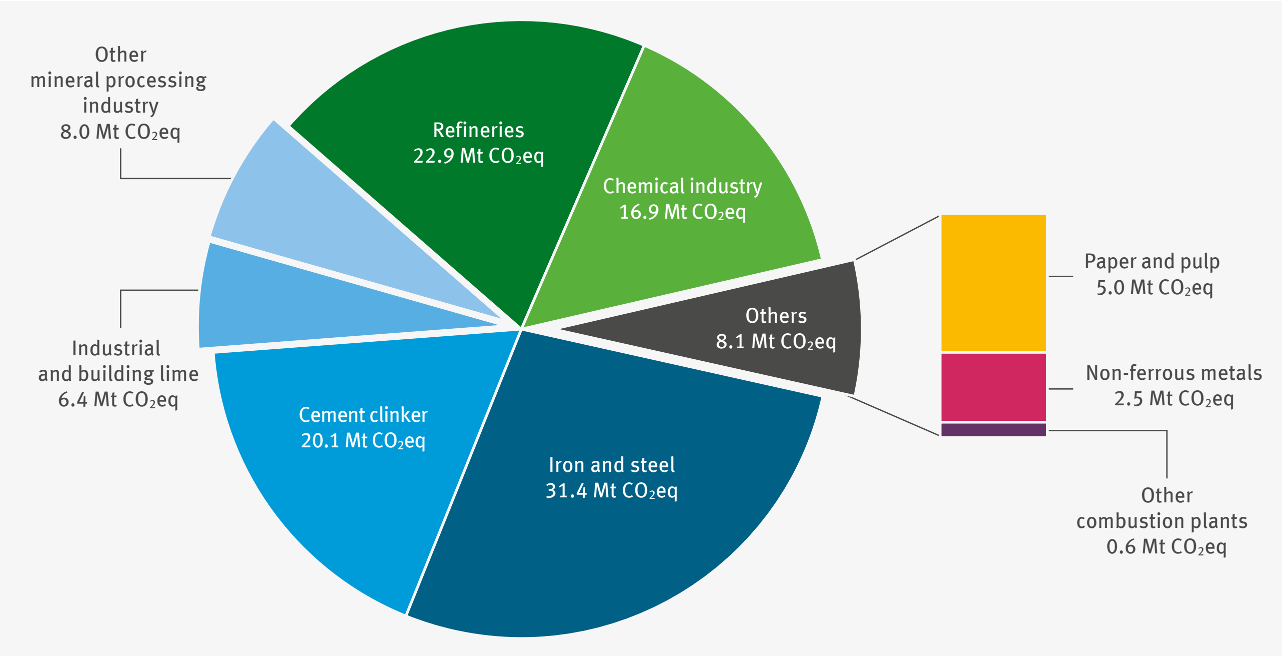

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Figure 3: Distribution of emissions among individual industrial sectors in 2020

Figure 4 summarises the different trends of emissions in selected industrial sectors compared to the previous year. In addition, the relative annual changes since 2013 are also shown.

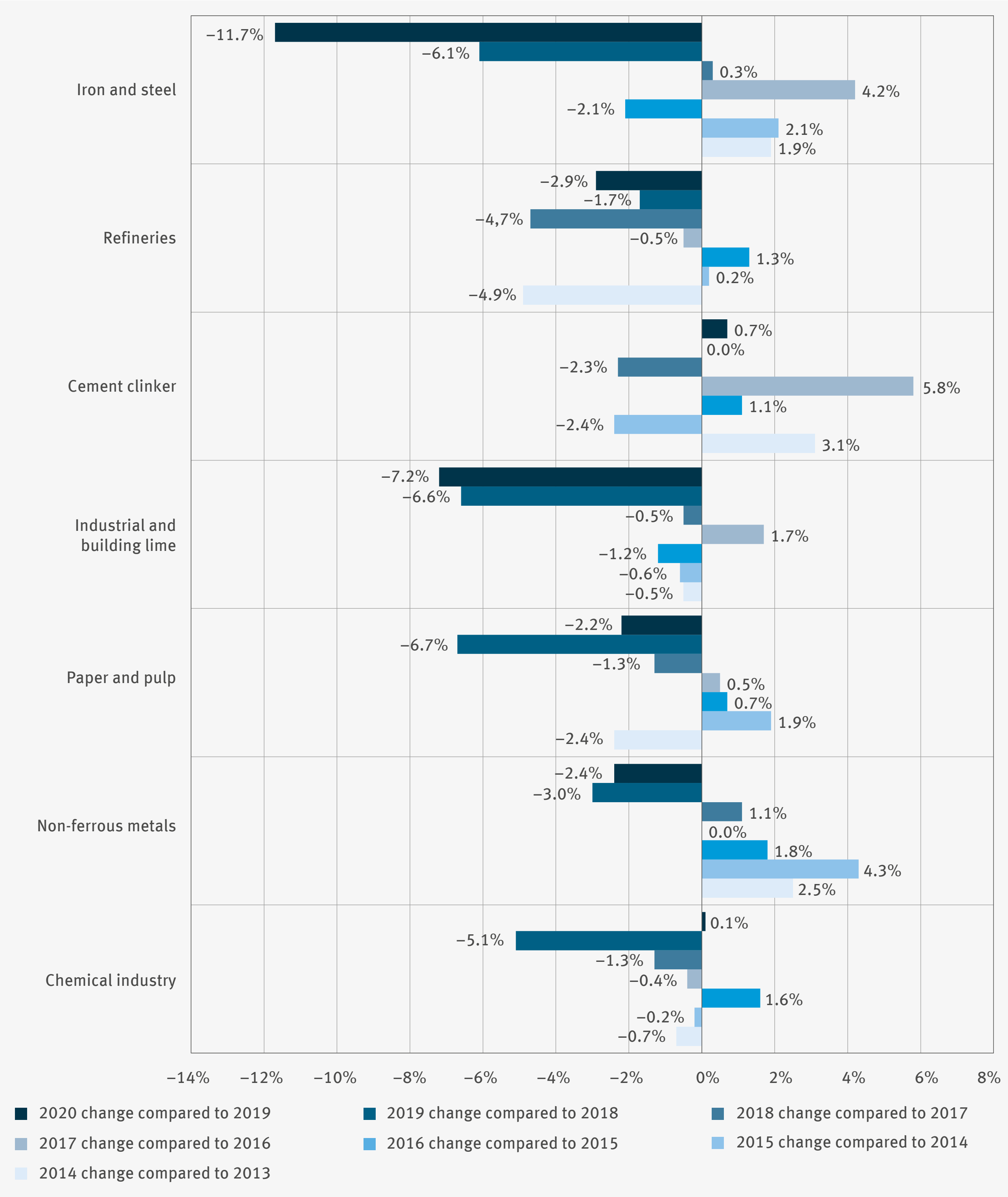

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Figure 4: Annual emission changes in the industrial sectors since 2013

In 2020, emissions fell in almost all sectors, sometimes considerably, compared to the previous year, they only remained roughly unchanged year-on-year in the cement clinker industry and the chemical industry. This also reflects the production trend in the individual sectors, with the cement clinker industry recording slight increases in production as the construction sector was not affected by the COVID 19 pandemic.

Since the beginning of the third trading period, the sectors have also developed quite differently, but depending on their economic situation.

Emissions from the iron and steel industry increased slightly from 2013 to 2018, with the exception of 2016, but fell back to almost the 2013 level in 2019 and significantly below it in the 2020 reporting year due to the economic situation. The emissions trend was also influenced by the fact that coke imports were increasingly replaced by domestic production. Other factors for emission fluctuations in the iron and steel industry can be further changes in the fuel mix, for example the mutual substitution of natural gas and more emission-intensive hard coal. Another reason could be changes in the quality of raw materials (ores used).

Emissions from refineries fell overall between 2013, the start of the third trading period, and 2020. Since 2017, emissions have decreased continuously compared to the respective previous year. Potential causes for this trend were several extraordinary events in 2018 and 2019 and the pandemic-related adjustment of production in refinery installations in the reporting year. For example, demand for aircraft fuel fell sharply in 2020. In contrast, the demand for heating oil rose considerably due to the significantly lower price level, which somewhat mitigated the production decline at the German refineries.

Since the beginning of the third trading period in 2013 and especially between 2015 and 2017, emissions from the cement clinker industry increased significantly, reaching their highest level since 2008 in 2017. Since 2018, emissions have remained relatively constant and they are primarily determined by the production trend. The cement industry was less affected by the pandemic containment restrictions than other industries. Construction sites continued to operate and construction investments, a key sales market for the cement industry, even increased.

From 2013 to 2018, emissions from the production of industrial and building lime did not change. Production and emissions from industrial and building lime installations are primarily determined by the economic situation of the steel and construction industries. In line with the decline in production in the iron and steel sector since 2018, emissions from industrial and building lime plants have also fallen.

Overall, emissions from the paper and pulp industry remained relatively constant since the beginning of the third trading period. However, in the last two years of the third trading period there was a significant decrease in emissions. Reasons for the trend since 2013 were, in addition to an increasing energy efficiency in production, essentially also the production trend: the COVID 19 pandemic intensified the trend towards the decrease in production of graphic paper and the increase in the production of packaging products in 2020.

In the first years of the third trading period, emissions from the non-ferrous metals industry rose steadily, but decreased again in 2019 and 2020 due to the economic situation and in 2020 in particular, due to reduced demand from the automobile industry.

Total emissions from the chemical industry remained at about the same level in the first years of the third trading period, only dropping significantly from 2018 onwards. Emissions in 2020 did not change compared to 2019. There were different pandemic-related developments in the chemical industry (decrease in demand for polymers from the automobile industry, higher demand for cleaning agents and disinfectants, etc.), which were not directly reflected in the emissions trend, as their production is associated with low direct emissions.

The largest emitters 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 100 million tonnes of carbon dioxide equivalents cause just under a third (31 percent) of the emissions subject to emissions trading in the stationary sector and about just under half (48 percent) of the emissions from energy installations. While the ten largest power plants had actually emitted more carbon dioxide equivalents in total in 2019 than all German industrial installations combined, they were about twelve percent below the emissions of industrial installations in 2020.

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

Installation (operator)	2020 VET [kt CO_2eq]	Change against 2019
Neurath Power Plant (RWE Power AG)	18,671	▼ −17%
Boxberg III and IV Power Plant (Lausitz Energie Kraftwerke AG)	15,385	▼ −18%
Jänschwalde Power Plant (Lausitz Energie Kraftwerke AG)	13,650	▼ −23%
Niederaußem Power Plant (RWE Power AG)	11,878	▼ −36%
Weisweiler Power Plant (RWE Power AG)	11,474	▼ −14%
Schwarze Pumpe Power Plant (Lausitz Energie Kraftwerke AG)	10,286	▼ −2%
Lippendorf Power Plant (Lausitz Energie Kraftwerke AG)*	8,273	▼ −8%
Mannheim Large Power Plant (GKM) (Grosskraftwerk Mannheim AG)**	4,179	▼ −15%
Scholven Power Plant (Uniper Kraftwerke GmbH)	3,448	▼ −15%
Hallendorf Power Plant (Salzgitter Flachstahl GmbH)	*3,124*	▼ *−10%*
Total	**100,368**	▼ **−18%**

As of 03/05/2021
* 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

At around 33 million tonnes of carbon dioxide equivalents, the ten largest emitters among the industrial installations emit significantly less than the ten largest power plants and come exclusively from the iron and steel industry or are refineries. Their share of emissions subject to emissions trading in the stationary sector is around ten percent, while they account for 29 percent of emissions from industrial installations.

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

Installation (operator)	2020 VET [kt CO_2eq]	Changes against to 2019	
Duisburg Integrated Steelworks (thyssenkrupp Steel Europe AG)	6,835	▼	−13%
Duisburg-Huckingen Plant, Glocke (HKM Hüttenwerke Krupp Mannesmann GmbH)	3,952	▼	−23%
Salzgitter Plant, Glocke (Salzgitter Flachstahl GmbH)	3,736	▼	−9%
Dillingen Plant, Amalgamated Installation (ROGESA Roheisengesellschaft Saar mbH)	3,601	▼	−14%
PCK Refinery, Glocke (PCK Raffinerie GmbH)	3,516	▲	3%
Ruhr Oel GmbH –Scholven Plant (Ruhr Oel GmbH)	2,789	▼	−7%
Oberrhein Mineral Oil Refinery, Plant 1 and Plant 2 (Mineralölraffinerie Oberrhein GmbH & Co. KG)	2,629	▼	−1%
Bremen Plant, Amalgamated Installation (ArcelorMittal Bremen GmbH)	2,349	▲	8%
Duisburg-Schwelgern Coking Plant (thyssenkrupp Steel Europe AG)	2,015	▲	3%
Leuna Mineral Oil Refinery (TOTAL Raffinerie Mitteldeutschland GmbH)	*1,943*	▼	*−5%*
Total	**33,365**	▼	**−9%**

As of 03/05/2021
Italics = new installation / power plant in the TOP 10

Allocation status

In the last year of the third trading period, verified emissions of 320 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 2020, about 136 million emission allowances were allocated free of charge to operators of 1,601 of Germany's 1,817 installations. The average allocation coverage was thus 42.6 percent being above the level of the previous year (2019: 38.8 percent). This means that it increased for the second time in a row due to the renewed significant decrease in emissions. The allocation coverage changes proportionally between the sectors and takes into account transfers of waste gases from iron, steel and coke production and heat imports in the allocation amounts. As a result of this adjustment, allocation coverage in the industrial sectors decreased from 103.0 to 90.5 percent in 2020, while allocation coverage in the energy sector increased from 9.2 to 16.2 percent, as shown in Table 3.

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

Sector	Activity 3rd TP	No. of instal-lations	2020 allocation amount [1000 EUA]	2020 VET [kt CO_2-eq]	2020 allocation deviation from 2019 VET [kt CO_2eq]	2020 allocation coverage*	Adjusted 2020 allocation amount** [1000 EUA]	2020 adjusted allocation coverage**
Energy	Energy installtions	903	19,091	206,549	−187,458	9.2%	33,382	16.2%
		903	**19,091**	**206,549**	**−187,458**	**9.2%**	**33,382**	**16.2%**
Industry	Refineries	23	17,767	22,876	−5,108	77.7%	17,767	77.7%
	Iron and Steel	123	45,167	31,401	13,766	143.8%	33,898	108.0%
	Non-ferrous metals	38	2,267	2,513	−246	90.2%	2,267	90.2%
	Industrial- and build-ing lime	39	5,947	6,378	−431	93.2%	5,947	93.2%
	Cement clinker	36	16,190	20,133	−3,943	80.4%	16,190	80.4%
	Other mineral processing industry	246	6,085	7,951	−1,866	76.5%	6,085	76.5%
	Paper and pulp	146	5,711	5,001	710	114.2%	4,116	82.3%
	Chemical industry	226	17,657	16,922	735	104.3%	16,230	95.9%
	Other combus-tion plants	37	398	551	−154	72.1%	398	72.2%
		914	**117,190**	**113,726**	**3,464**	**103.0%**	**102,898**	**90.5%**
Total		**1,817**	**136,281**	**320,275**	**−183,994**	**42.6%**	**136,280**	**42.6%**

As of 03/05/2021
* 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 2020 (27 EU Member States and Great Britain, Iceland, Liechtenstein, Norway) also decreased to a similar extent as Germany. According to European Commission data, emissions fell by 11.2 percent in 2020 and amounted to 1.33 billion tonnes of carbon dioxide equivalents. As in Germany, the main reason for this trend was a decline in emissions from electricity generation (about 15 percent reduction), even though the emissions from industrial installations also showed a pandemic related seven percent decrease.

Emissions in Germany decreased less sharply in the first and 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 have actually fallen somewhat more sharply (minus 33 percent) than in the EU ETS Member States as a whole (minus 29 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 beginning of the third trading periods were in part reduced in recent years. This was primarily achieved through reductions in the auction volumes: in 2014 – 2016 due to backloading, and from 2019 through the Market Stability Reserve (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 2020, the TNAC amounted to almost 1.6 billion emission allowances, according to the European Commission, and thus increased significantly year-on-year for the first time since 2015 (plus 14 percent compared to the end of the previous year). The value also remains well above the upper MSR threshold at which auction volume cuts take place. Since emissions fell relatively sharply in 2020 as a result of the COVID 19 crisis and more was auctioned than in the previous year due to various special effects, the MSR mechanism could not prevent the surplus from rising again. The current value of the TNAC decides the size of the auction volume cut by the MSR in the period from 01/09/2021 to 31/08/2022. In this period, a total of around 379 million fewer emission allowances than planned will be auctioned and transferred to the MSR.

Aviation

For 2020, 48 aircraft operators subject to emissions trading administered by Germany reported emissions of 4 million tonnes of carbon dioxide. This means that emissions have decreased by around 58 percent compared to the previous year. This large decrease is due to the COVID 19 pandemic. The average allocation coverage in 2020 was around 92 percent, considerably above the 2019 figure of 39 percent and is due to the reduced emissions.

Outlook

2020 was the last year of the third trading period of the EU ETS. It was significantly influenced by the COVID 19 pandemic so that emissions in the EU ETS again fell noticeably. However, this drop in emissions is not expected to be sustainable, especially among industrial installations, even though the pandemic will presumably continue to influence the overall economic situation beyond 2020. Other significant changes in perspective are the start of the fourth trading period in 2021 with a changed allocation regime and a more strongly declining cap, and the introduction of national fuel emissions trading in 2021. In summer 2021, the European Commission will also present a broad legislative package as part of the European Green Deal, which is to implement the increase of the 2030 EU greenhouse gas reduction target to at least 55 percent compared to 1990.

This package called "Fit for 55" will also include proposals to adjust the EU ETS and thus set new framework conditions for the fourth trading period that started this year.

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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.)
CER	Certified Emission Reductions (from CDM projects)
CHP	Combined heat and power
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
CS	Clean spread
DEHSt	German Emissions Trading Authority at the German Environment Agency (Deutsche Emissionshandelsstelle im Umweltbundesamt)
EA	Emission allowance
EEX	European Energy Exchange
EHRL	Emissions Trading Directive (Emissionshandels-Richtlinie)
ER	Emissions report
EmB	Emissionsbericht
ERU	Emission Reduction Units (Emissionsreduktionseinheiten aus JI-Projekten)
EU 25	Austria, Belgium, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Great Britain (EU exit as of 31/01/2020), Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden
EU 28	EU 25 (including Great Britain) plus Bulgaria, Croatia, Romania
EU 31	EU 28 (including Great Britain) and Iceland, Liechtenstein, Norway
EU ETS	European Emissions Trading Scheme
EUA	EU Emission Allowances
EUAA	EU Aviation Allowances
EWR	European Economic Area (the same as EU 31)
FGD	Flue gas desulphurisation plant
GW	Gigawatt
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)
WVMetalle	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 2020 VET Report. Chapter 2 addresses the emissions from stationary installations subject to emissions trading according to sectors. The last section of Chapter 2 addresses the cross-sectoral allocation status of stationary installations in Germany. 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.

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 2020. 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 2020 annual emissions will be available for the first time in the autumn of 2021 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 28/02/2021	
	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	481,003
2014	1,905	461,173	1,904	461,240
2015	1,889	455,528	1,885	455,602
2016	1,863	452,873	1,858	452,797
2017	1,833	437,647	1,830	437,594
2018	1,870	422,294	1,866	422,825
2019	1,851	362,955	1,847	363,310
2020	1,817	320,275		

As of 03/05/2021

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.

Scope correction before 2013 (Scope correction or 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 scope estimate does not take into account the emissions of the polymerisation plants, which are subject to emissions trading from 2018, amounting to an average of about 75,000 tonnes of carbon dioxide equivalents per year (2005 to 2017).

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 because they fall below the 20 Megawatt (MW) rated thermal input (RTI) limit as an energy installation.

Free allocation in 2020

Free allocation as approved for 2020 by the European Commission prior to 28/02/2021, is the basis for the assessment of the allocation status, i. e. comparison of emissions and free allocations. At this time not all allocation changes that are relevant for 2020 are necessarily approved. That is, the representation of the allocation status does not include any potential allocation corrections made after 28/02/2021.

The allocation amount approved by the European Commission is included in the National Allocation Table[3] (NAT), which specifies the free basic allocation for 1,763 incumbent installations and corrections of this basic allocation for individual installations as approved by the European Commission by 28/02/2021. There are some allocation changes resulting from (partial) shutdowns, changes in capacity, lawsuits and appeals or waivers of allocations. In addition, allocation amounts for new market entrants approved by the European Commission by 28/02/2021 are taken into account, i. e. for new installations or a capacity increase in incumbent installations which became operational from 01/07/2011. 1,601 installations of those considered in the 2020 VET report received free allocations for 2020 totalling around 136 million allowances as of 28/02/2021.

Emissions and production trends

Emissions and production trends for some sectors and activities have been compared. To do this, activity rates (AR) for the respective (product) benchmarks acquisitioned by the DEHSt during the allocation procedure for the third trading period and / or reported by the operators in the annual operational reports since 2012, have been used. Since no activity rates are available for 2011, that year's figure has been estimated by linear interpolation or is not shown in the relevant figures. Similarly, no activity rates are available for 2020 considered in this report as these will not be submitted until the annual activity level report in June 2021 (after the editorial deadline for the 2020 VET report).

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 2005 and 2020 compared to 2005 (2005 = 100%) and the corresponding emissions (also as relative changes compared to 2005) have been shown.

3 Cf. DEHSt 2013b

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.

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 2020). This refers to both Sector Chapters 2.1 to 2.8 and Section 3 'Germany and Europe: emissions trend, surplus and prices'.

For 2020, these are supplemented with excerpts (06/04/2021 and 05/05/2021) from the Union Registry published by the European Commission (COM 2021a and COM 2021b) and a notification on the European Commission's website on 15/04/2021 (COM 2021d). Information on auction volumes has been provided by the European Energy Exchange (EEX) and the 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), thereby differences may occur in the emission volumes per sector for Germany. The boundaries of activities as per TEHG are in line with those in the EU Union Registry in most sectors, in some cases however, such as the energy installations, this agreement is not fully given. EU registry activities have been used for EU comparisons in the respective Sector Chapters because the classification is somewhat different. The emissions between Germany, the EU 25 states (including the UK, which still participated in the EU ETS in 2020 but was no longer an EU member as of 01/02/2020) and the new post-2005 EU ETS entrants (Bulgaria, Croatia, Romania, Iceland, Liechtenstein, Norway) have been compared. The relative development of EU emissions (excluding Germany) refers to EU 25 (including the UK) and the new post-2005 EU ETS entrants.

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

2.1 Energy installations

903 energy installations (Activity 2 to 6 Annex 1 TEHG installations) were subject to emissions trading in 2020. Participation in emissions trading thus decreased by 34 installations compared to 2019.

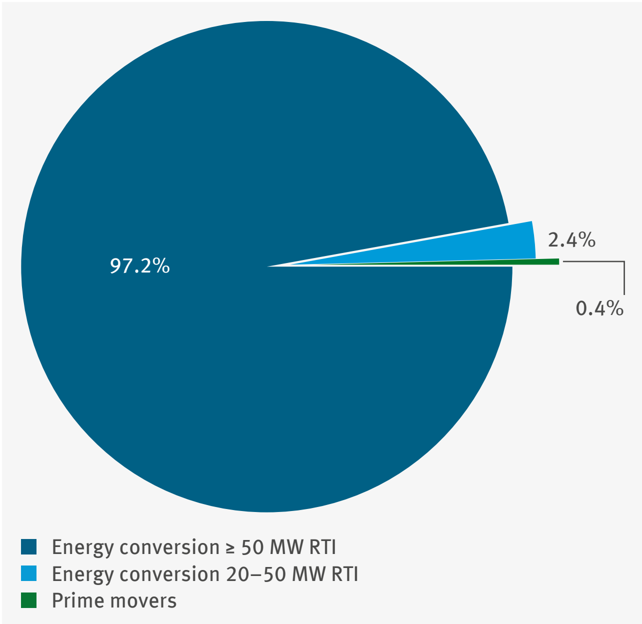
Compared to the previous year, emissions from these energy installations decreased significantly by more than 37 million tonnes of carbon dioxide (minus 15.3 percent), but the drop in emissions was not as steep as a year earlier (minus 18.2 percent) and the 2020 emissions were still around 207 million tonnes (see Table 5).

Emissions

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 MW (Activity 2 as per Annex 1 TEHG), see also the following Figure.

Overall, emissions from all large combustion plants have decreased by more than 15 percent. This reflects the fact that power generation from lignite and hard coal has strongly declined.

On the other hand, emission reduction from energy installations with an RTI between 20 and 50 MW (Activities 3 and 4 as per Annex 1 TEHG) was lower (minus two percent) compared to 2019. In contrast to large combustion plants, Activity 3 and 4 installations include many heat and power plants and district heating boilers so that the emissions also depend on weather-related heat demand. 2020 was on average slightly warmer than 2019 and significantly warmer than the long-term average measured by the number of degree days.[4]



As of 03/05/2021

Figure 5: Shares of 2020 emissions from energy installations (Activities 2 to 6)

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 2020. This was about 5 million tonnes of carbon dioxide, i. e. only 2.4 percent of the amount emitted by combustion plants in total.

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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 for the transport, storage and processing of natural gas, decreased significantly, by around 34 percent, compared to the previous year. This is also noticeable in view of the fact that emissions from this group of installations had increased in the previous years and decreased moderately in the previous year. Natural gas consumption in Germany fell by 2.4 percent last year, and Germany's natural gas imports (minus 1.7 percent) and domestic production (minus 15.6 percent) were also lower than in the previous year, leading to an overall decline in emissions from these installations.[5]

Table 5: Energy installations (Activities 2 to 6), number of installations, 2019 emissions, 2020 free allocation, 2020 VET entries and allocation coverage

No.	Activity	No. of instal-lations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
2	Energy conversion >= 50 MW RTI	469	236,912	200,678	16,171	8.1%
3	Energy conversion 20 – 50 MW RTI	365	5,013	4,895	2,470	50.5%
4	Energy conversion 20 – 50 MW RTI, other fuels	13	149	143	79	55.0%
5	Prime movers (engines)	3	38	42	10	22.8%
6	Prime movers (turbines)	53	1,225	791	362	45.8%
	N. I. ETS	*34**	*577*	–	–	–
Total		**903**	**243,914**	**206,549**	**19,091**	**9.2%**

As of 03/05/2021
* N. I. ETS not included in total number of installations.

Allocation status

While energy installations received around 50 percent of the total free allocation for installations subject to emission trading for the product 'electricity' in the second trading period – an average of around 200 million emission allowances per year – the free allocation for electricity generation was replaced by full auctioning in the third trading period (see Figure 6). Accordingly, only around 19 million emission allowances were allocated free of charge to energy installations for heat generation in 2020. These cover about nine percent of the obligation to surrender emission allowances from these installations (Table 5).

Apart from the lack of allocation for electricity generation in the third trading period, three other factors are responsible for the low allocation coverage in the energy installations:

1. In particular large lignite and hard coal burning combustion plants use high-emission fuels, while the allocation rules for heat generation assume the use of lower-emission natural gas.

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2. In addition, the free allocation for energy recovery of waste gases from iron, steel and coke production is given to the producers of the waste gases and a part of the allocation for heat generation is given to the heat consumers (cf. Chapters 2.4, 2.7 and 2.8). An estimated 11 million emission allowances allocated free of charge in 2020 could be assigned to the transfer of waste gases from iron, steel and coke production from industrial to energy installations, and an allocation of about 3 million emission allowances to the export of heat from energy to industrial installations. Assuming that these allocations were offset between the operators in the industrial sectors and the energy sector, this results in a slightly higher adjusted allocation coverage of around 16 percent (see Table 6 and Figure 6).
3. Apart from the decline in allocation due to the application of the budget securing factors (linear reduction factor and cross-sectoral correction factor), the allocation for products with no carbon leakage risk will continue to be gradually reduced. 80 percent of the benchmark value was still granted for allocations with no carbon leakage risk in the first year of the third trading period and this value was only 30 percent in 2020, the last year of the third trading period. While EU regulations assume free allocation to be almost entirely given to industrial installations with carbon leakage risk, about half of the free allocation to energy installations in 2013 was allocated to those with no carbon leakage risk. This share has decreased continuously and was only in the order of about 30 percent of the total allocation for energy installations in 2020.[6]

Table 6: Energy installations (Activities 2 to 6), number of installations, allocation amounts, 2020 VET entries and adjusted allocation coverage

Sector / activity	No. of installations	2020 adjusted allocation amount [1000 EUA]	2020 VET [kt CO_2eq]	2020 allocation deviation from 2020 VET [kt CO_2eq]	Adjusted allocation coverage
Energy installations	903	33,382	206,549	−173,167	16.2%

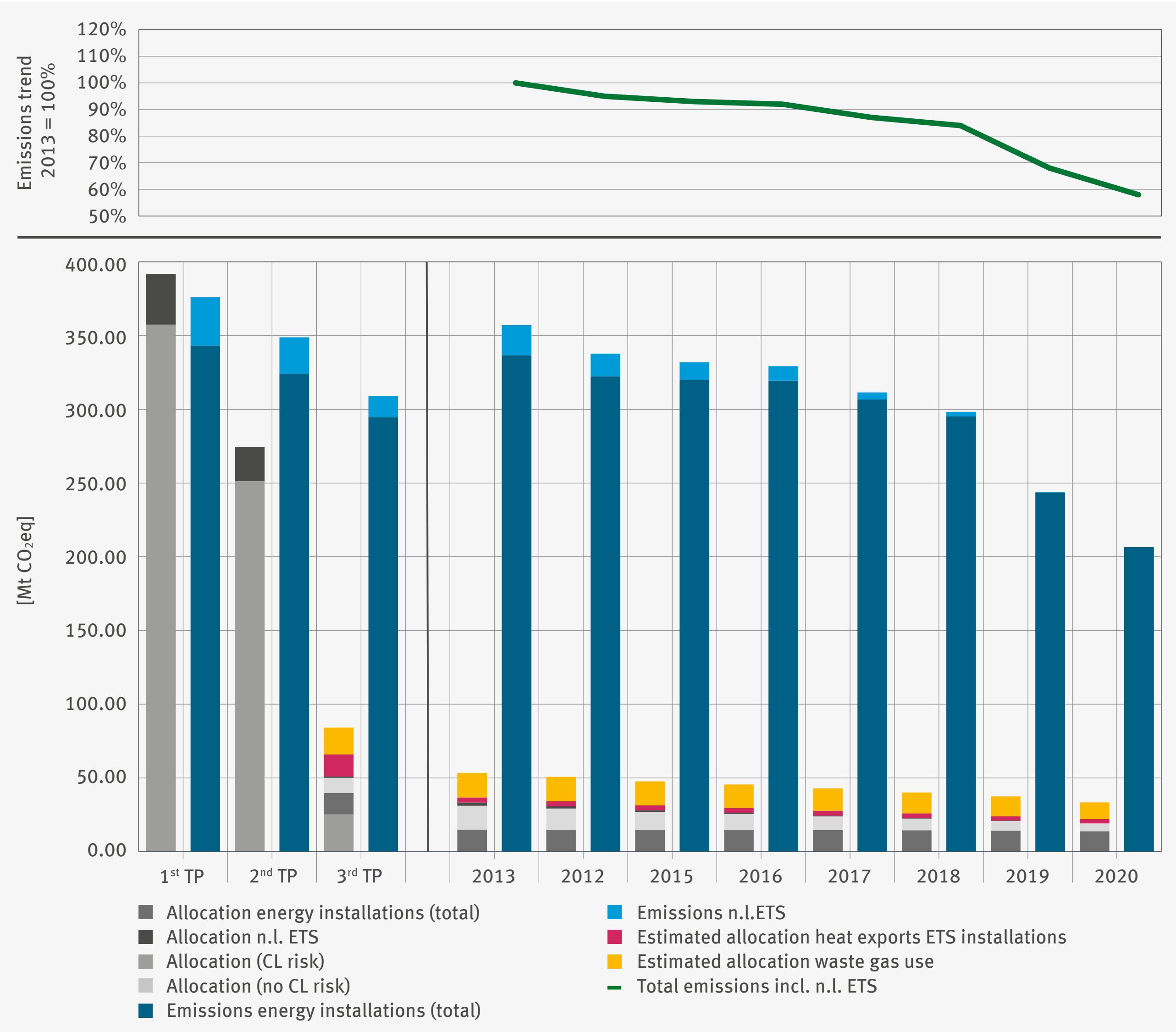
As of 03/05/2021

While the ratio of free allocation to emissions from large combustion plants was about eight percent (see Table 5), the significance of heat production for energy installations with an RTI between 20 and 50 MW (Activity 8) in terms of the allocation status is recognisable. Allocation coverage compared to large combustion plants was greater by a factor of six and was equal to about 51 percent of their emissions. Activity 4 installations, in which biomass and fuels with biogenic components are used, have an even higher allocation coverage of 55 percent. Prime movers (engines and turbines) have mainly received a free allocation via the fuel benchmark for producing mechanical work.[7] The ratio of free allocation to emissions from prime movers was on average around 45 percent.

Trends in the third trading period

The following figure shows the emissions trend of energy installations since the beginning of emissions trading. Installations no longer subject to emissions trading have also been taken into account. In the first trading period emissions increased steadily. Emissions decreased at the beginning of the second trading period in principle due to the influence of the financial and economic crisis, then rose again in the following years of the second trading period to between 337 and 342 million tonnes of carbon dioxide per year. In the first year of the third trading period, emissions reached nearly 357 million tonnes of carbon dioxide i. e. the 2008 level, but they decreased steadily after the beginning of the third trading period. In 2018, emissions were already below the 300 million tonne carbon dioxide mark. In 2019, the sharpest drop in emissions was recorded since the start of emissions trading in 2005, dropping below 250 million tonnes of carbon dioxide for the first time. Last year, the decline continued and CO_2 emissions were only just above the 200 million tonne mark.

6 DEHSt 2014a
7 See DEHSt 2014a, Chapter 'Energy installations'



As of 03/05/2021

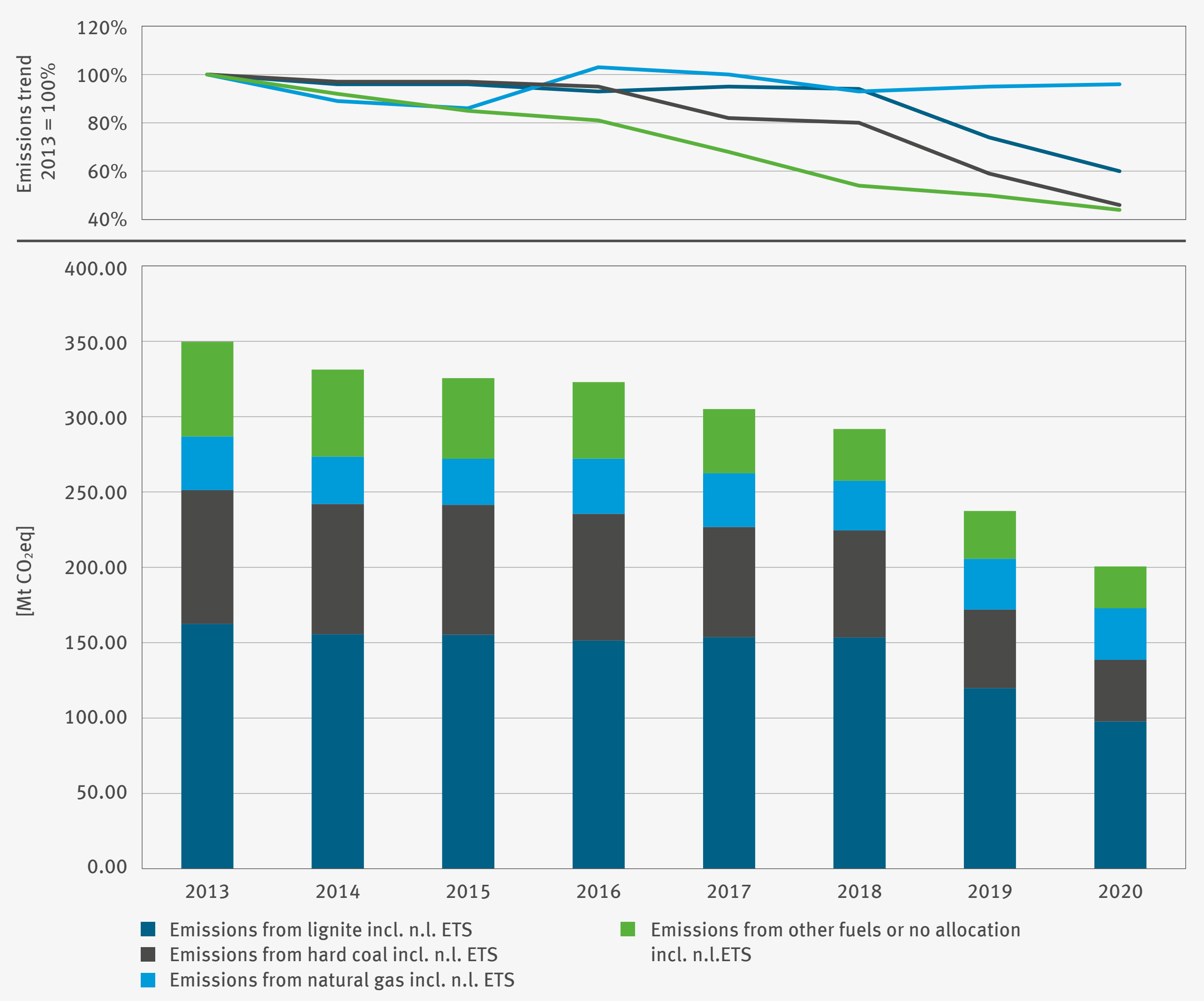
Figure 6: Energy installations (Activities 2 to 6), emissions and free allocation trend in Germany from 2005 to 2020[8]

As a result, energy installations reached their lowest emissions level since the introduction of the EU ETS: in the reporting year 2020 it was 55 percent of the 2005 emissions.

8 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 third trading period, the third 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.



As of 03/05/2021

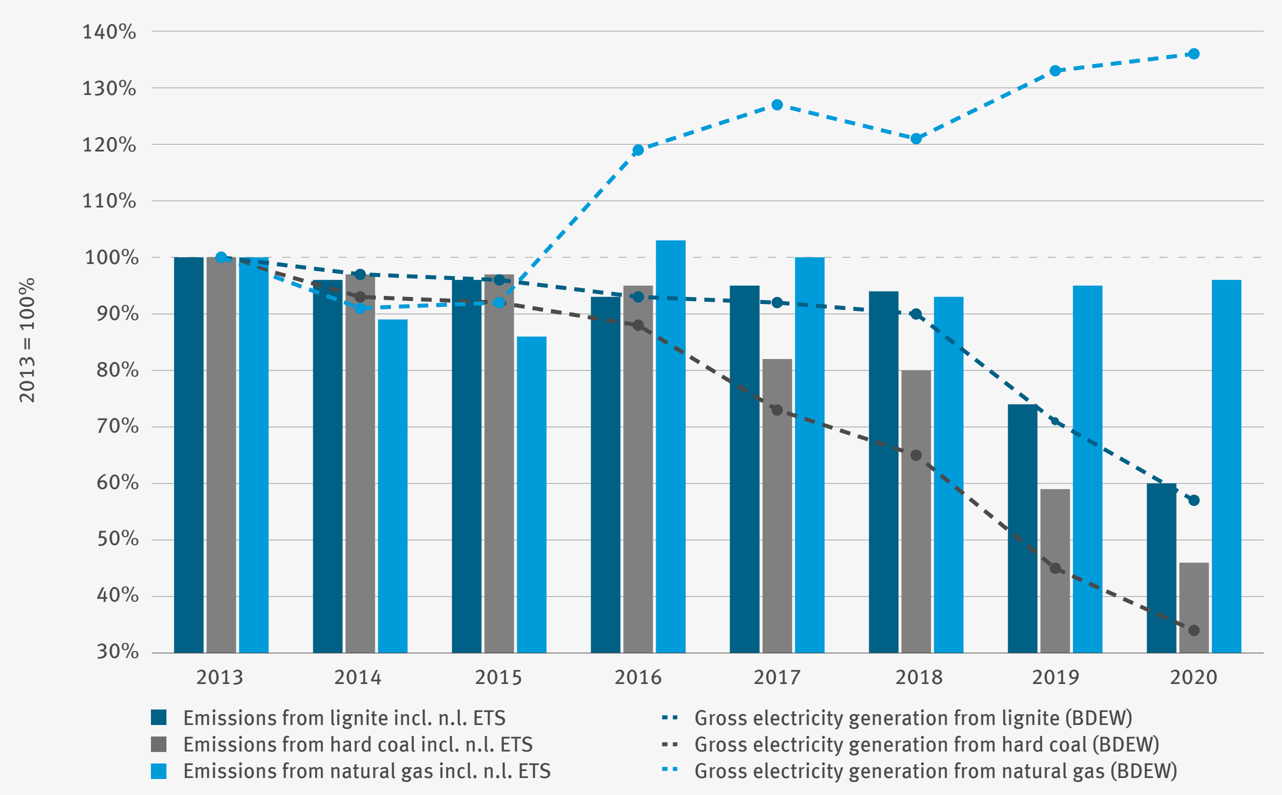
Figure 7: Energy installations (Activities 2 to 6), emissions trend in Germany from 2013 to 2020 according to fuel type

In 2020, emissions from lignite fell to the lowest level since emissions trading began in 2005, although the 18 percent decline in 2020 was somewhat smaller compared to the previous year (minus 22 percent). Emissions from hard coal decreased for the seventh year in a row, but a decrease of about 21 percent in emissions was also lower than in the previous year (2019: minus 27 percent). By contrast, emissions from natural gas-fired plants rose by about two percent, mainly due to the increasing fuel switch from coal to natural gas in electricity generation.

Compared to 2013, the first year of the third trading period, emissions from installations using lignite as their main fuel fell by around 40 percent. The decline in emissions from energy installations using hard coal as their main fuel was even greater at 54 percent. Emissions from natural gas installations were slightly below those in 2013. 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.



As of 03/05/2021

Figure 8: Large combustion plants (Activity 2), emissions and production trend in Germany from 2013 to 2020 compared to 2013

The figures of gross electricity generation and emissions from lignite and hard coal-fired installations (see Figure 8) again shows a clear downward trend in the third trading period. At the same time, it is clear that – compared to 2013 – 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 commissioning of new units in recent years was expected to increase efficiency, and this is also confirmed by studies by the German Environment Agency (UBA)[9] 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.

Natural gas-fired installations show an opposite picture. Electricity generation from this group of installations has increased strongly compared to 2013, while emissions are only just under the 2013 level. This can be explained mainly by an increased use of more efficient installations for electricity generation, but a gradually improving capacity utilisation also plays a role here.

9 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).

Electricity generation and emissions trends from lignite-fired plants also remained largely unchanged in 2020.

Since 2013, gross electricity generation from large combustion plants using hard coal has fallen by 66 percent from 127 terawatt-hours (TWh) to only 43 TWh.[10] According to preliminary estimates this means that in 2020, gross electricity generation from hard coal in Germany dropped to its lowest level in 65 years.[11] An increase in the feed-in from wind power / photovoltaic plants and continued displacement by natural gas power plants were the main causes of the decrease. Power plant closures with a capacity of around 0.2 gigawatts, on the other hand, played a subordinate role, as the first round of tenders for the closure of hard coal capacities did not start until September 2020 and will therefore only be noticeable in the 2021 electricity generation (see also the following infobox: Coal phase-out in Germany). The commissioning of the new Datteln IV power plant (1.1 GW), one of the most efficient hard coal-fired power plants in Europe, originally planned for 2018, took place on 30/05/2020. It may be the last coal-fired power plant to go online in Germany. The economic efficiency of hard-coal-fired plants deteriorated further compared to the previous year due to relatively low natural gas prices and continued high prices for emission allowances (EUA). Especially in the case of less efficient hard coal-fired units, the calculated profit margins (or clean dark spreads) were almost consistently negative (see also the section Fuel Switch / Clean Spreads).

Electricity production from lignite has declined for the seventh year in a row and, according to preliminary estimates, has fallen to its lowest level in at least 40 years in 2020.[12] Since 2013, gross electricity generation from lignite-fired power plants has fallen by about 43 percent from 161 TWh to 92 TWh. For the first time since 2006, lignite is no longer the most important energy source in electricity generation. With a share of about 18 percent, onshore wind power has moved to the top, lignite and natural gas share second place (each with about 16 percent), nuclear power follows with 11 percent and photovoltaics with nine percent. Hard coal now has a market share of only 7.5 percent.[13] Economic efficiency of lignite-fired power plants has also deteriorated further in the past year due to persistently high CO_2 prices and lower electricity market prices. Between October 2016 and October 2019, lignite-fired units with a net installed capacity of around 2.7 GW were transferred to security reserve.[14] After four years in security reserve, the lignite-fired units will be decommissioned permanently. At the end of 2020, another unit of the Niederaussem power plant (297 MW) was also decommissioned in accordance with the Coal Phase-out Act.

For the reasons already mentioned above, electricity production in natural gas-fired power plants reached a new high last year at the expense of coal-fired power plants and it was on a par with lignite for the first time. Since 2013, the gross power generation of natural gas power plants has risen by 36 percent from 68 TWh to 92 TWh.[15] The comparatively small increase in electricity generation compared to the previous year is certainly worthy of note against the backdrop of the significant drop in electricity production in Germany in the wake of the COVID 19 pandemic. The much stronger increase in gross power generation compared to emissions is an indication of improved average installation efficiency, also due to higher workload.

10 BDEW 2021
11 Statistics from the coal industry 2021
12 Statistics from the coal industry 2021
13 BDEW 2021
14 Power plants that are being transferred into security reserve will remain subject to emissions trading for the time being.
15 BDEW 2021

Fuel Switch / Clean Spreads

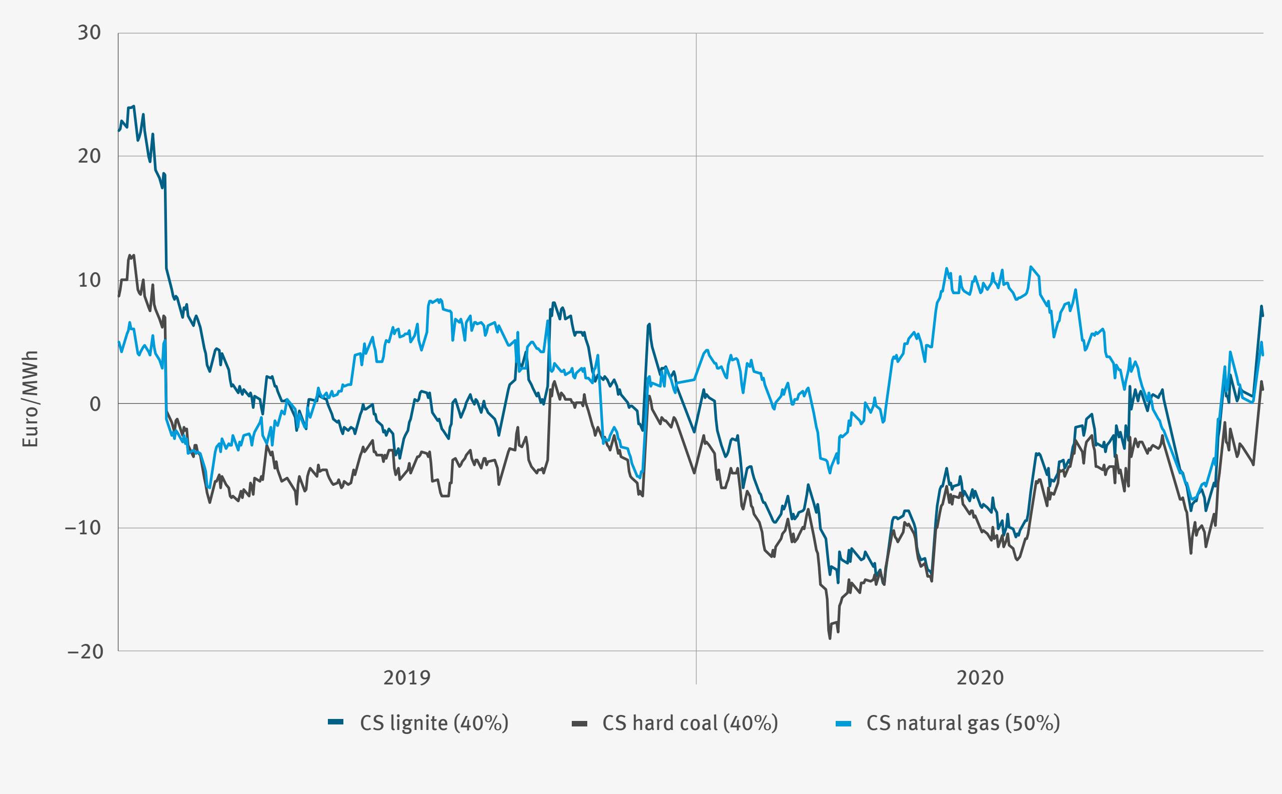
The following figure shows the **calculated** contribution margins or 'clean spreads' for selected types of power plants. The clean spreads are calculated as the balance of the revenue per generated MWh and the variable costs of fuels and emission allowances plus operating costs. The actual contribution margins of the power plant operators may deviate from this and depend, among other things, on the respective hedging strategy[16] of the energy suppliers. In particular larger electric supply companies (utilities) secure their electricity production several years in advance. Heat-controlled power plants can also have a different cost structure.

In 2019, the economic constellation of lignite-fired power plants had already changed fundamentally. While relatively high profit margins could still be achieved in the first quarter of 2019, the calculated contribution margins for lignite or 'clean lignite spreads' decreased significantly in the following months and were negative in some cases. In the first half of 2020, the clean lignite spreads then slid sharply into negative territory and were only able to recover very slowly by the end of the year.

A relatively high CO_2 price combined with almost constant fuel costs for domestic lignite and pandemic-related falling electricity prices[17] (front-month contracts) were the main causes of the deep crash in the first quarter. In the second half of the year, the increasing rise in CO_2 prices was partly overcompensated by higher electricity prices. The clean dark spreads (clean spreads of hard coal) were also arithmetically almost continuously in the negative range last year. In contrast, average natural gas power plants (50 percent efficiency) were able to achieve, at least arithmetically, significantly higher profit margins than some hard coal / lignite plants (40 percent efficiency), especially during the summer months of 2020. Profitability of natural gas plants compared to electricity generation from coal was generally consistently higher last year and within the framework of the assumptions made, also partly due to relatively low natural gas prices. However, it should be noted that larger energy supply companies in particular hedge fuel and CO_2 emission allowance prices several years in advance, so that the current price trend is only reflected in the deployment order of the power plants (merit order) with a certain delay.

16 'Hedging strategy' refers to the use of market strategies to offset the risk of any adverse price movements with regard to fuel and CO_2 prices.

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



As of 07/04/2021
Source: Refinitiv Eikon, ICIS, DEHSt

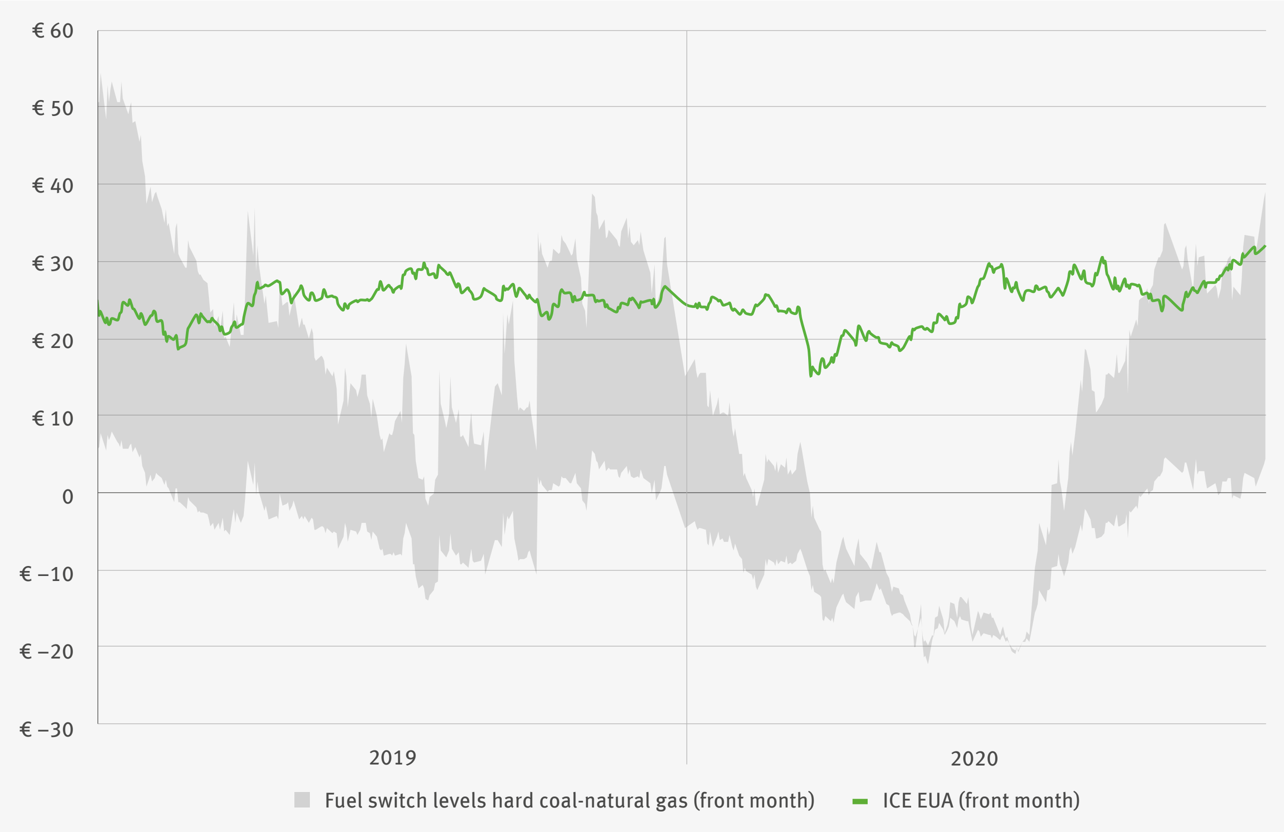
Figure 9: Lignite, hard coal and natural gas clean spreads in 2019 und 2020 (all front month contracts) with efficiencies of 40 and 50 percent respectively

In addition to the EUA price, the following figures also show a range of calculated 'fuel switch levels' for various power plant set-ups (hard coal / lignite to natural gas). The fuel switch indicates the calculated price level for EUA above which the clean spread for natural gas exceeds that for hard coal / lignite. The fuel switch level can thus be used as an indicator of the CO_2 price level at which it becomes more profitable to burn natural gas than hard coal / lignite.

The fall in natural gas prices relative to hard coal (particularly in the period from January to September) led to lower or even negative fuel switch levels overall last year. By the end of May 2020, the price of natural gas (TTF front month[18]) had fallen by up to 70 percent compared with the start of the year, reaching an all time low of 3.38 euros/MWh. In the same period, the price of hard coal (API2 front month[19]) fell by 'only' 20 percent. Accordingly, the calculated fuel switch range was largely in negative territory, i. e. given the assumptions made and the conditions here, a fuel change would have been possible even without an additional CO_2 price. In the second half of the year, natural gas prices rose again significantly and the economic pattern shifted back in favour of hard coal towards the end of the year. From Figure 10, it can be concluded that in the fourth quarter, with EUA prices of around 25 to 30 euros and the resulting change in business cost factors, most hard coal-fired power plants were nevertheless displaced, at least in mathematical terms, by efficient natural gas-fired power plants.

18 Title Transfer Facility (TTF): central hub 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.

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

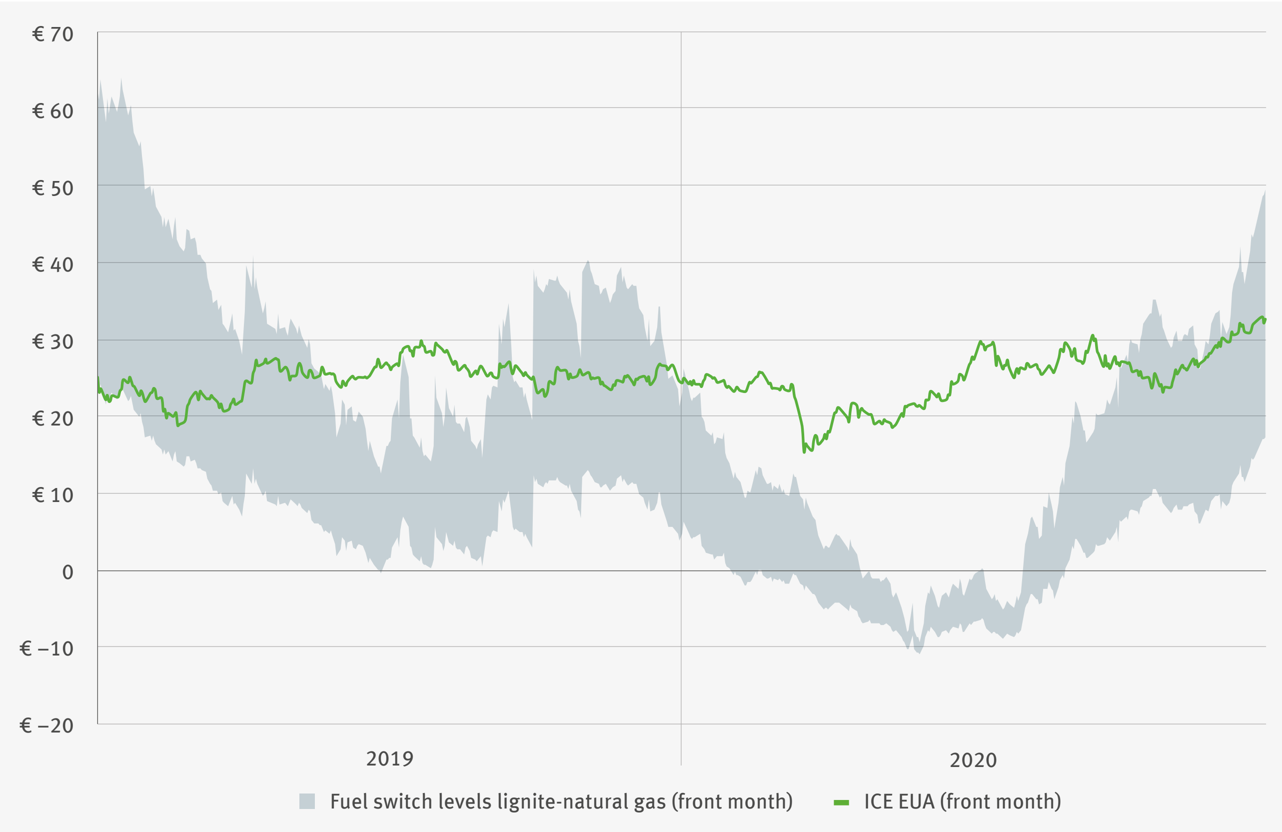


As of 07/04/2021
Source: Refinitiv Eikon, ICIS, DEHSt
* Range HC35%-NG60% to HC45%-NG50%; no volume-weighted representation of the actual available capacities.

Figure 10: Fuel switch levels from hard coal to natural gas* and EUA price in 2019 and 2020[20]

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

Falling natural gas prices, with relatively constant production costs for lignite, also led to a lower fuel switch level between lignite and natural gas compared to the previous year. Here, too, the calculated fuel switch range was briefly in negative territory. Even with higher natural gas prices in the fourth quarter of last year, at an EUA price level of around 25 to 30 euros, some lignite-fired power plants could mathematically speaking, be displaced by natural gas plants.



As of 07/04/2021
Source: Refinitiv Eikon, ICIS, DEHSt
* Range LG32%-NG60% to LG43%-NG50%; no volume-weighted representation of the actual available capacities.

Figure 11: Fuel switch levels from lignite to natural gas* and EUA price in 2019 and 2020

Infobox: Phasing out of coal in Germany

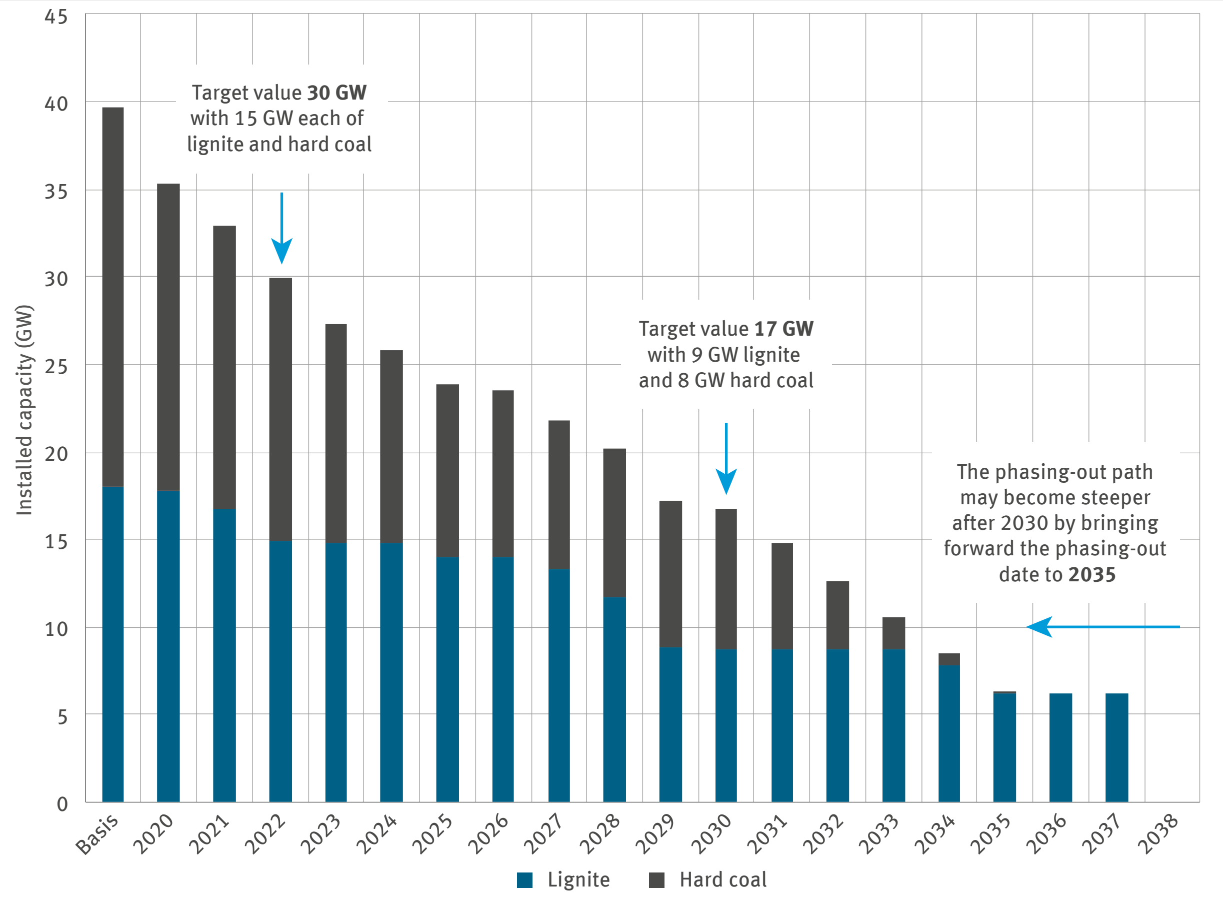
On 29/01/2020, the German Government adopted a draft law on 'Reduction and termination of coal-fired power generation' (KohleausstiegsG). The law came into force on 14/08/2020. The cabinet resolution provides for a gradual reduction of installed electricity generation capacity for lignite and hard coal by 2038, combined with the possibility of bringing forward the phasing-out of coal to 2035. In doing so, the decommissioning path is based on the targets for 2022, 2030 and 2038[21] recommended by the Commission on 'Growth, Structural Change and Employment' (WSB Commission). The lignite capacities are to be decommissioned or transferred to the security reserve according to a non-linear schedule negotiated between the German government, the States (Länder) and the power plant operators and laid down in the Act. In contrast, the Act provides for several rounds of tendering for the decommissioning of hard coal capacities until 2026. In September 2020, the first round of bidding for the decommissioning of hard coal capacities (4 GW) started, which was significantly oversubscribed.[22] A total of eleven plants/power plant units with a bid volume of around 4.8 GW were awarded the contract. These included the two units of the Moorburg CHP plant (1.6 GW), which only went into operation in 2015. These power plants will probably no longer be available to the electricity market from January 2021.[23] The second round started on 04/01/ 2021 with a tender volume of 1.5 GW and was also slightly oversubscribed.[24] It is not yet clear which hard coal units will be taken off the market and when. If insufficient bids for further tenders are received, decommissioning is to be flanked by regulatory measures from 2024. From 2027 onwards, there will only be regulatory closures, taking into account the age sequence. The maximum remaining hard coal capacity is calculated between 2022 and 2030 and between 2030 and 2038 as the difference between the overall target level and the remaining lignite capacity, resulting in a largely linear decommissioning path for coal-fired power generation overall (see Figure 12). As compensation for the commissioning of Datteln IV, which was not foreseen by the WSB Commission, there are to be special tenders for the early decommissioning of hard coal-fired capacity. In 2026, 2029 and 2032 a review will be carried out to determine whether the power plant closures after 2030 can be brought forward by three years in each case. The phasing-out of coal would then be completed by 2035.

21 WSB 2019

22 This means that more capacity was offered for decommissioning than was tendered.

23 Installations that have been awarded a contract may no longer offer the output or power generated by their plants through the use of coal on the electricity market as of 01/01/2021. The transmission system operators are now examining the system relevance for the plants that have been awarded a contract. If the Federal Network Agency approves the system relevance designation of a plant at the request of a transmission system operator, the plant is available to the grid reserve. It is thus no longer allowed to sell electricity on the electricity market, but is still available to safeguard the electricity grid in critical situations.

24 See BNetzA 2021.

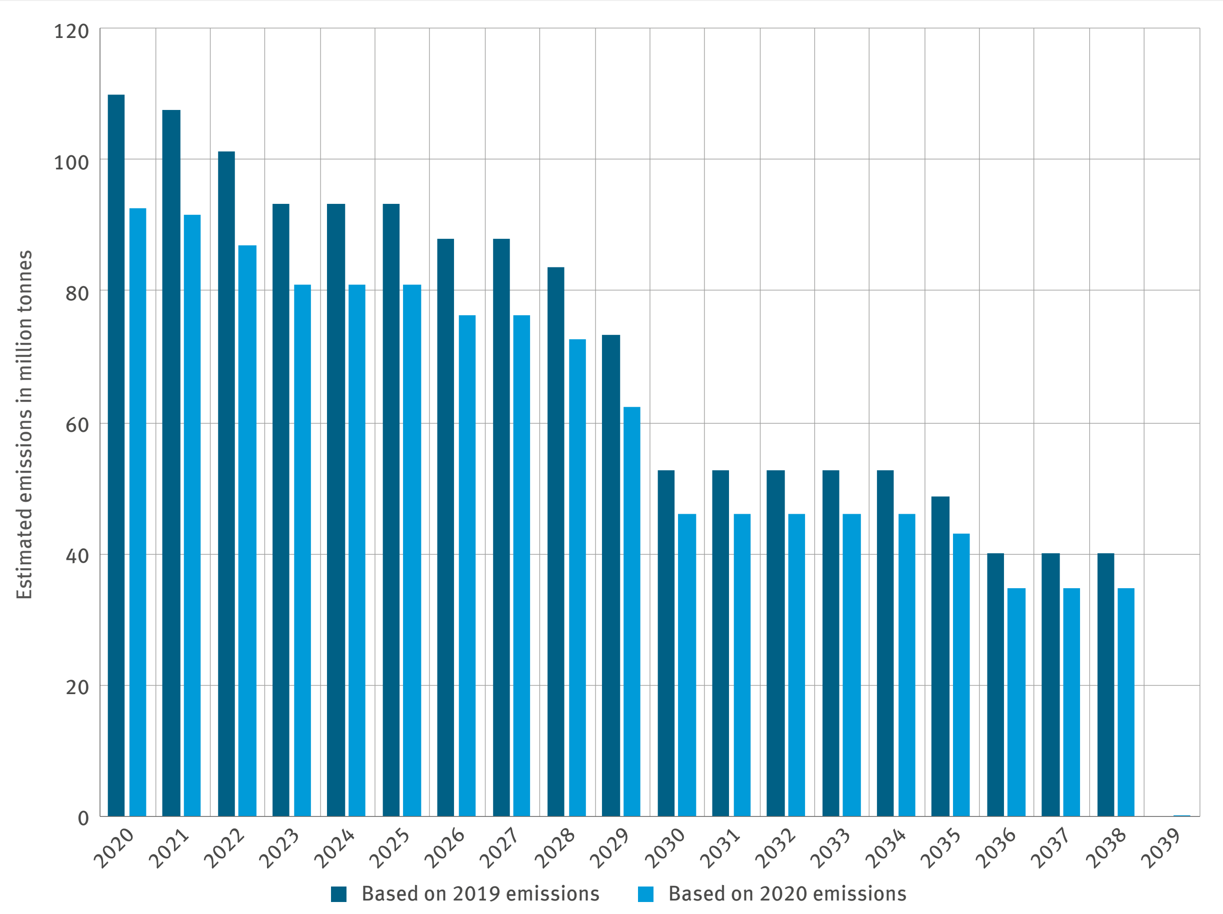


As of 03/05/2021
Source: BMU 2020
Capacity figures refer to the respective year end.

Figure 12: Reduction of electricity generation capacities of lignite and hard coal according to the proposal of the Coal Phase-out Act of 29/01/2020

The closure of coal-fired power plants in Germany will lead to further emission reductions in the EU ETS and thus to a reduced demand for emission allowances. This could have a price-reducing effect and lead to higher emissions in other ETS installations ('waterbed effect'). The resulting net reduction effect could be lower than the historical emissions of the decommissioned power plants for another reason: part of the electricity generation in the decommissioned power plants is likely to be replaced by a higher utilisation of other fossil power plants at home or abroad. Thus the net reduction effect of decommissioned lignite capacities is likely to be greater than that of hard coal. However, the decommissioning of lignite will take place later than that of hard coal (more than 80 percent of lignite capacities are to be shut down only after 2025), which is why a substantial reduction in demand in the EU ETS is not to be expected until the second half of the 2020s (see Figure 13). Already in the years 2016 to 2019, around 2.7 GW of lignite capacities have been transferred to the security reserve. A similar scale is planned for the years 2020 to 2022.

The following figure shows the estimated gross reduction in emissions due to the decommissioning of lignite capacities, i.e. without taking into account the above-mentioned substitution effect. For this purpose, the estimated emissions of the remaining lignite capacities are shown for each year from 2020 onwards. The legally defined decommissioning dates and the historical emissions from the years 2019 and 2020 are used as the basis for the calculation. This also shows the greater decrease in emissions from older lignite plants that are to be decommissioned in the 2020s compared to the previous year.



As of 03/05/2021
Source: EEX, ICIS, DEHSt
Emissions refer to the respective start of year value of the existing capacities.

Figure 13: Estimated decrease in emissions due to the decommissioning of lignite-fired power plants according to the Coal Phase-out Act based on the emissions in 2019 and 2020[25]

The waterbed effect due to the phasing-out of coal is mitigated by two different measures: Since 2019, the Market Stability Reserve (MSR) in the EU ETS has compensated for decline in demand proportionately and with a time lag by reducing EU-wide auction amounts. In addition, to a limited extent Member States will be able to compensate for a drop in demand in the carbon market due to the closure of power plants by voluntarily waiving the auctioning of emission allowances and their subsequent cancellation. In accordance with the provisions of the Coal Phase-out Act, Germany will make use of the option to compensate for the remaining drop in demand by additional cancellation of emission allowances.

25 DEHSt has no information about power plant emissions that are specific to a particular unit. Unit-specific power generation data (lignite units ›300 MW gross electrical output) from the EEX Transparency Platform were used as the basis for the estimated emission values shown. With the help of the respective efficiencies (gross), the respective thermal output was first calculated for the individual units and then the shares of the individual units in the total thermal output of the power plants. For the next step, calculated shares were multiplied by the total emissions of the respective installation (in 2019 and 2020) in order to derive an approximate value for the emissions per unit.

Combustion and energy' activity in the EU

The following figure gives an overview of the EU-wide emissions trend within the combustion activity[26] since the beginning of emissions trading. It differentiates between the emissions trend of German installations, the other Member States that have been participating in emissions trading since 2005 and those that only joined emissions trading after 2005.

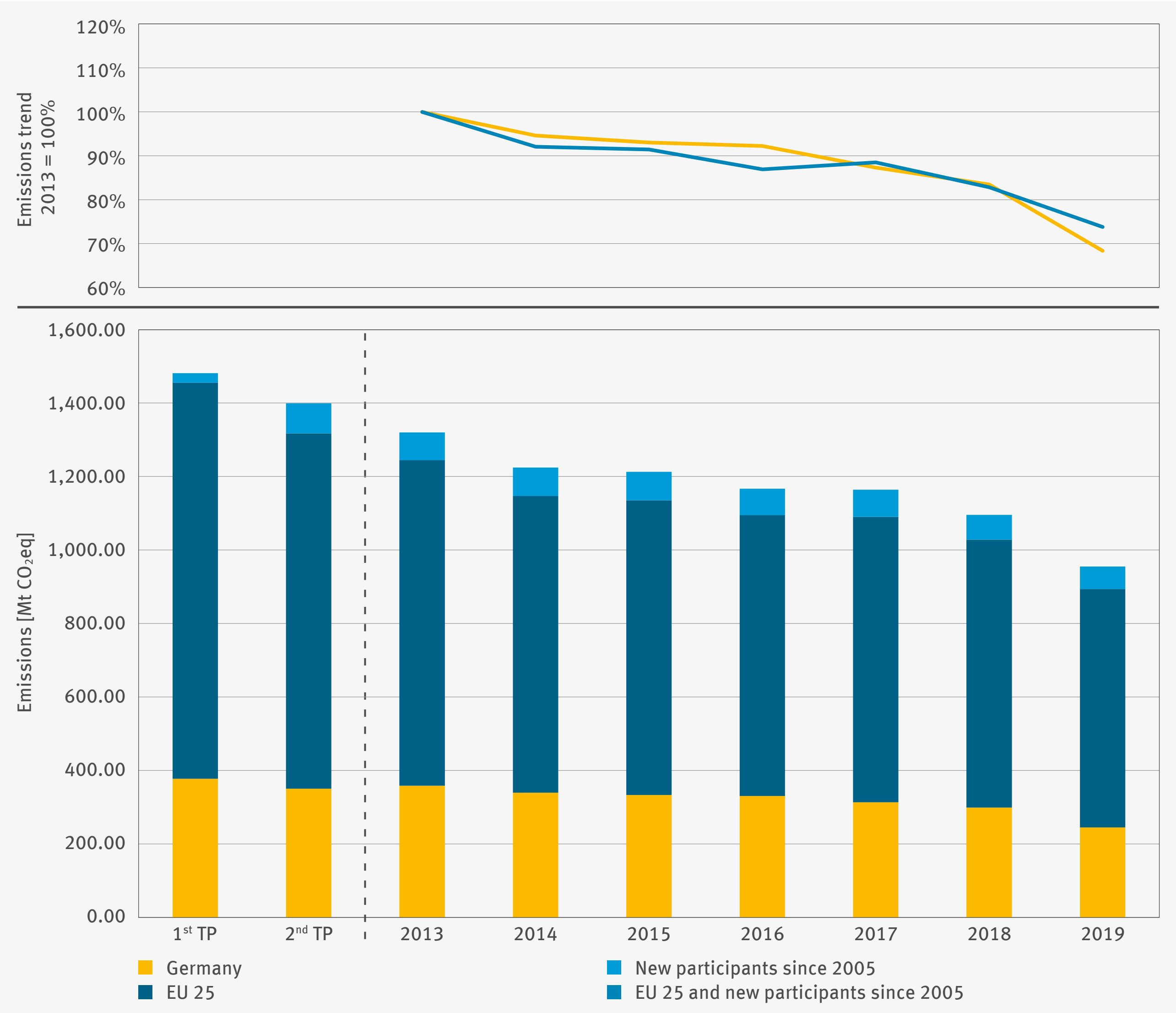


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Figure 14: Combustion and energy emissions trends (Registry Activity 20) in Germany and in the EU up to 2019[27]

26 In contrast to the German scope of emissions trading, which for the activities in Annex 1 TEHG differentiates between six 'Combustion activities', only the activity 'Combustion' is used at EU level. It combines all energy installations and all other combustion activities according to Annex 1 EHRL.

27 Data source: EEA 2019; the evaluation is based on a combination of installations by activity in the EU Union Registry (see Table 37, Chapter 7), which may lead to differences in the emissions amount per sector for Germany. New participants in the EU ETS after 2005 are Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania.

In the period from 2013 to 2016, emissions assigned to 'Combustion and energy' from installations in the EU had initially fallen more than in Germany. In 2017, however, the emissions from the other Member States increased, while the emissions from German installations decreased significantly. In the following year, the emissions trend levelled off. In 2019, emissions both in Germany and across the EU moved in the same direction again. However, the decline in emissions in Germany, particularly in the energy sector, was greater than in the other Member States. The 2020 reporting year was also characterised by a similar trend (see Chapter 3.1).

Compared to the first year of the third trading period, in 2019 German installations running activities assigned as 'combustion' still produced 68 percent of the emissions in 2013. The emission level of installations from the other Member States was 74 percent of the emissions in 2013. In 2019, the share of German installations running activities assigned as 'Combustion and energy' corresponds to about 26 percent of the total EU-wide emissions from this activity.

2.2 Other combustion

Approximately 65 installations with a rated thermal input of at least 20 MW have been subject to emissions trading since 2013 due to the broader definition of 'combustion' and are included in Activity 1. This section only deals with those 37 installations in Activity 1 that are not assigned to other industrial sectors in this report. This group of installations mainly includes test benches for turbines or engines but also process heaters and asphalt mixing plants.

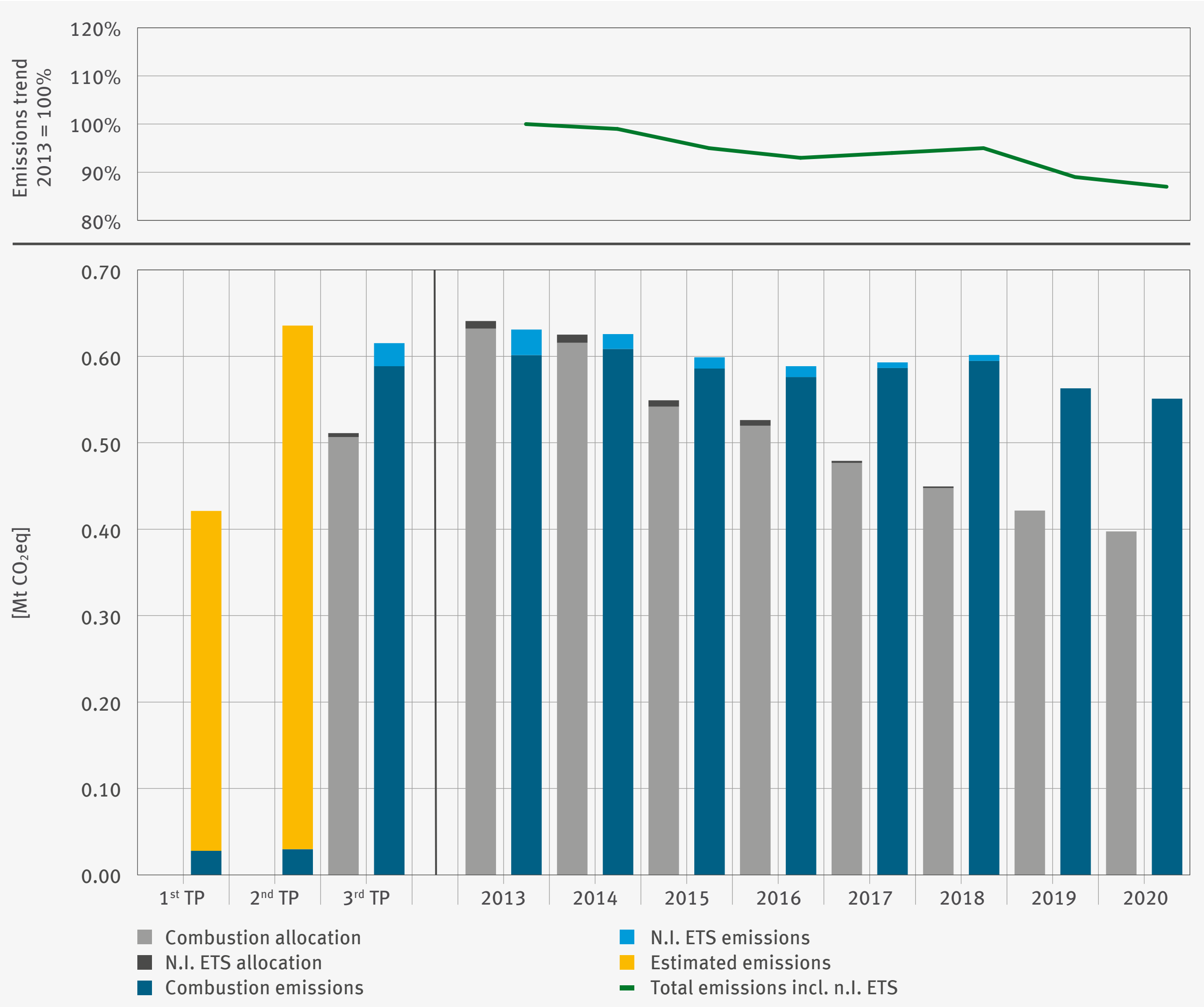
The following table summarises allocation and emissions data for these installations. In total, they emitted around 0.55 million tonnes of carbon dioxide in 2020 and the allocation coverage was around 72 percent of their emissions.

Table 7: Other combustion plants (Activity 1), number of installations, 2019 emissions, 2020 free allocation, 2020 VET entries, allocation coverage

No.	Activity	No. of instal-lations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
1	Combustion	37	563	551	398	72.1%
Total		**37**	**563**	**551**	**398**	**72.1%**

As of 03/05/2021

The following figure shows the emissions trend since the start of emissions trading. As the installations have only been participating in emissions trading since 2013, the figures for 2005 to 2010 are those reported by the operators in the allocation process. No emissions data is available for 2011 and 2012. Overall, emissions have fallen by around 13 percent since the start of the third trading period in 2013. As the composition of this group of installations is very heterogeneous, it is not possible to derive any overall conclusions from the emissions trends.



As of 03/05/2021

Figure 15: Other combustion plants (Activity 1), emissions and free allocation trend in Germany from 2005 to 2020[28]

28 N. I. ETS: installations no longer subject to emissions trading. In the figure, installations that are no longer subject to emissions trading are taken into account retrospectively in order to show the actual emissions trend of European emissions trading in Germany since 2005 and not only the emissions trend of the installations subject to emissions trading in the respective reporting year (see also Chapter 1 Introduction).

2.3 Refineries

In the reporting year 2020, 23 installations subject to emissions trading were refineries (Activity 7 according to Annex 1 TEHG).

In this report, power plants are considered together with refineries provided that the refinery is either licensed together with the power plant as one single installation according to the Federal Immission Control Act (BImSchG), or that DEHSt has determined that it is an 'amalgamated installation' from the allocation procedure. If a refinery at the same site is operated by the same operator in a technical alliance with one or more power plants, but has separate operating licences for the individual installations, they are then deemed to be an 'amalgamated installation' pursuant to Section 28(1)(4c) of the TEHG and Section 29(3) of the Allocation Ordinance (ZuV) 2020. A total of 15 of the refineries include power plants. Of these, nine refineries are licensed together with one power plant or more, and another six installations are covered by the above-mentioned regulation to form an 'amalgamated installation'.

Total emissions from refineries in 2020 were 22.9 million tonnes of carbon dioxide. Compared to 2019, when emissions were 23.6 million tonnes, emissions decreased by around three percent or 688,000 tonnes of carbon dioxide (see Table 8).

Table 8: Refineries (Activity 7), number of installations, 2019 emissions, 2020 free allocation, 2020 VET entries, allocation coverage

No.	Activity	No. of instal-lations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
7	Refineries	23	23,564	22,876	17,767	77.7%
Total		**23**	**23,564**	**22,876**	**17,767**	**77.7%**

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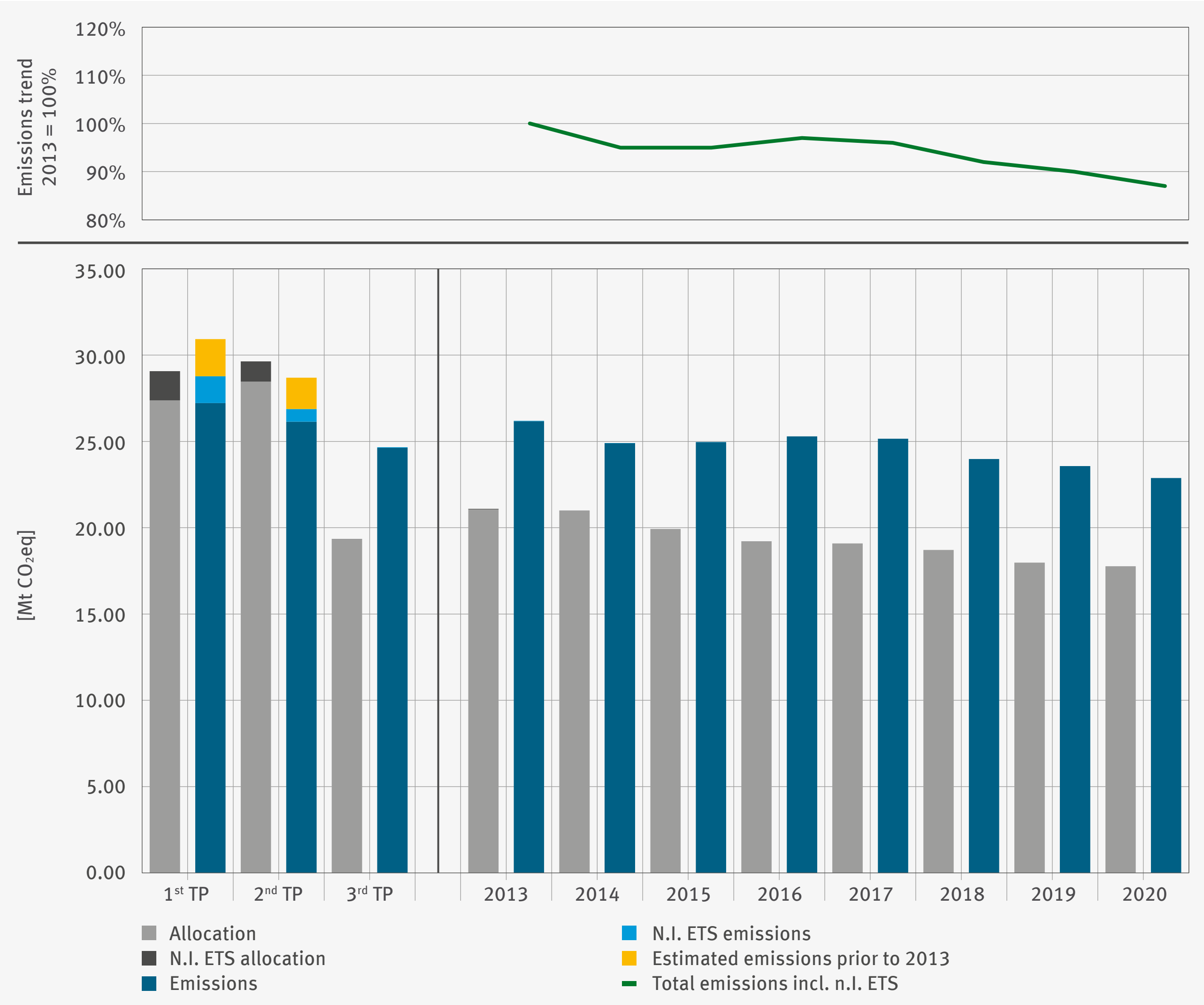
In 2020, the refineries sector had a total shortfall of around 5.1 million emission allowances at a 78 percent allocation coverage. In the previous year, the shortfall was 5.4 million emission allowances with an allocation coverage of around 77 percent (see paragraph 'Trends in the third trading period').

Trends in the third trading period

The upper section of Figure 16 shows the emissions history of refineries for the third trading period. The lower section shows the emissions and allocation amounts. For the first and second trading periods, only the average values per trading period are shown for emissions and free allocation; for the third trading period, the average values and the individual years of the trading period are shown. The figure additionally shows those installations currently no longer subject to emissions trading (n. l. ETS)[29] and the estimated emissions from installations for the period 2005 to 2012 that are not subject to emissions trading until 2013[30].

29 See explanation: 'Taking into account installations no longer subject to emissions trading (n. l. ETS)' in Chapter 1, Introduction

30 Emissions for the period 2005 to 2010 use data from the allocation procedure. No historical emissions are available for 2011 and 2012 so the values for both years were estimated by linear interpolation.



As of 03/05/2021

Figure 16: Refineries (Activity 7), emissions and free allocation trends up to 2020 in Germany

At the beginning of the third trading period, emissions from refineries were around 26 million tonnes of carbon dioxide and from 2014 up to and including 2017, they were around 25 million tonnes. In 2018 and 2019, emissions decreased to about 24 million tonnes of carbon dioxide, and in 2020, they fell slightly once again to around 23 million tonnes.

Overall, emissions fell by around 13 percent between 2013, the start of the third trading period, and 2020. Since 2017, emissions have fallen continuously by between two and four percent compared to the respective previous year. Possible causes for this trend are several extraordinary events in the reporting years 2018 and 2019, such as the low water levels of some flowing waters in 2018 and the associated difficulties in the delivery of raw and auxiliary materials and the removal of the products produced via waterways (see DEHSt 2019 and DEHSt 2020b), as well as the pandemic-related adjustment of production in the refineries. In 2020, demand for aviation fuel fell sharply. In contrast, however, demand for heating oil rose considerably due to the significantly lower price level, which somewhat dampened the decline in production at the German refineries[31].

31 See MWV 2021a and MWV 2021b

The free allocation (cf. Figure 16) was on average higher than the sector's emissions in both the first and second trading periods, but changed in the third trading period. Due to having onsite power plants, refineries have been affected by the discontinuation of free allocation for electricity generation in the third trading period. This has caused a considerable allowance shortage for refineries and, compared to other industrial sectors[32], a significantly higher shortfall from 2013 onwards.

The annual free allocation to refineries – as in all other industrial sectors – has decreased continuously in the third trading period also due to the cross-sectoral correction factor. In 2020, the free allocation for the sector was around 16 percent less than at the beginning of the third trading period.

Emissions and production trend

Figure 17 compares the emissions trend for refineries with the trend in activity rate for the 'CWT' product benchmark (CO_2 weighted tonne), the German gross refinery production and the crude oil use in German refineries. A refinery's CWT value is derived from the sum of the annual input quantities of its individual processes, each weighted with the typical process CO_2 emission intensity. If the time profile of the CWT activity rate differs significantly from that of the gross refinery production, this may indicate a change in the range of refinery products which is reflected in the CWT value. The CWT activity rate does not include the quantities for other benchmark products such as those of steam crackers, nor the product quantities of atypical refineries which predominantly produce lubricants or bitumen for example. In contrast, official statistics[33] on gross refinery production take these quantities into account.

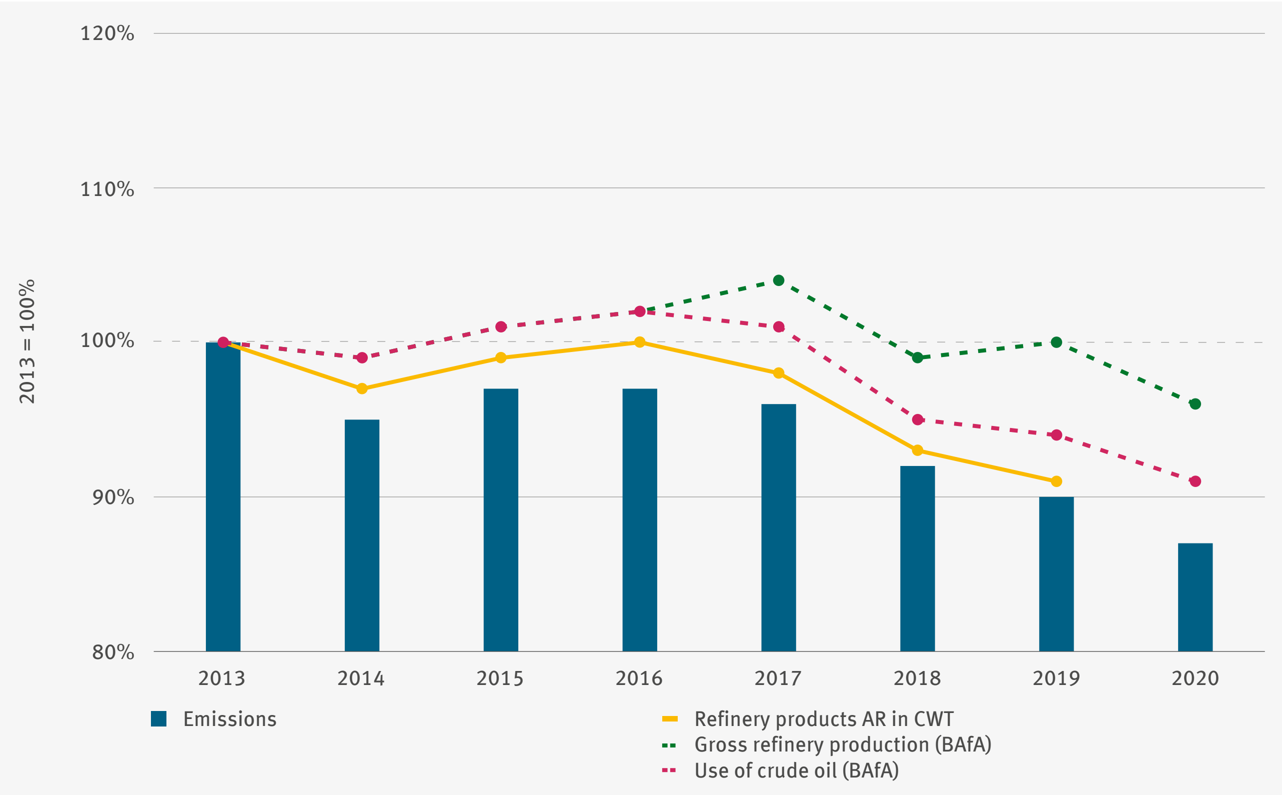


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Figure 17: Refineries (Activity 7), 2013 to 2020 emissions and production trends in Germany, each in relation to 2013

32 A comparative overview of the allocation coverage of selected industrial sectors during the third trading period is presented in Chapter 3.1, Figure 50, page 76.

33 See BAfA 2021a and BAfA 2021b

Figure 17 shows that emissions, crude oil use and CWT activity rate are largely parallel. Until 2016, the gross refinery production profile was identical to crude oil input and analogous to the CWT activity rate. Subsequently, a divergent trend emerged in gross refinery production: in 2017 gross refinery production rose by around two percent compared to 2016, while the other three parameters each decreased by at least one percent. In addition to the reasons already mentioned, methodological changes in the acquisition of official mineral oil statistics may be other potential reasons for this divergent trend in gross refinery production compared to other variables.[34] While emissions, CWT activity rate and crude oil input decreased in 2019, gross refinery production remained unchanged (plus 0.6 percent)[35]. In 2020, gross refinery production, emissions and crude oil input each fell by around three percent compared to 2019.

Overall, the CWT activity rate and crude oil input reflect the trend of emissions reasonably well. The decrease in emissions is likely to be mainly due to the decrease in crude oil input.

34 These were applied to 2017 data for the first time and may lead to breaks in data timelines. See BAfA 2020c

35 See BAfA 2021a and BAfA 2021b (Preliminary values for 2020)

The refineries in the EU

Figure 18 shows the carbon dioxide emissions trend from refineries (Register Activity 21) in Germany and in the EU. In particular, from the third trading period onwards, the mandatory rule for German refineries to form an 'amalgamated installation' pursuant to Section 28(1)(4c) of TEHG and Section 29(3) of 2020 ZuV only enables a limited comparison across trading periods.

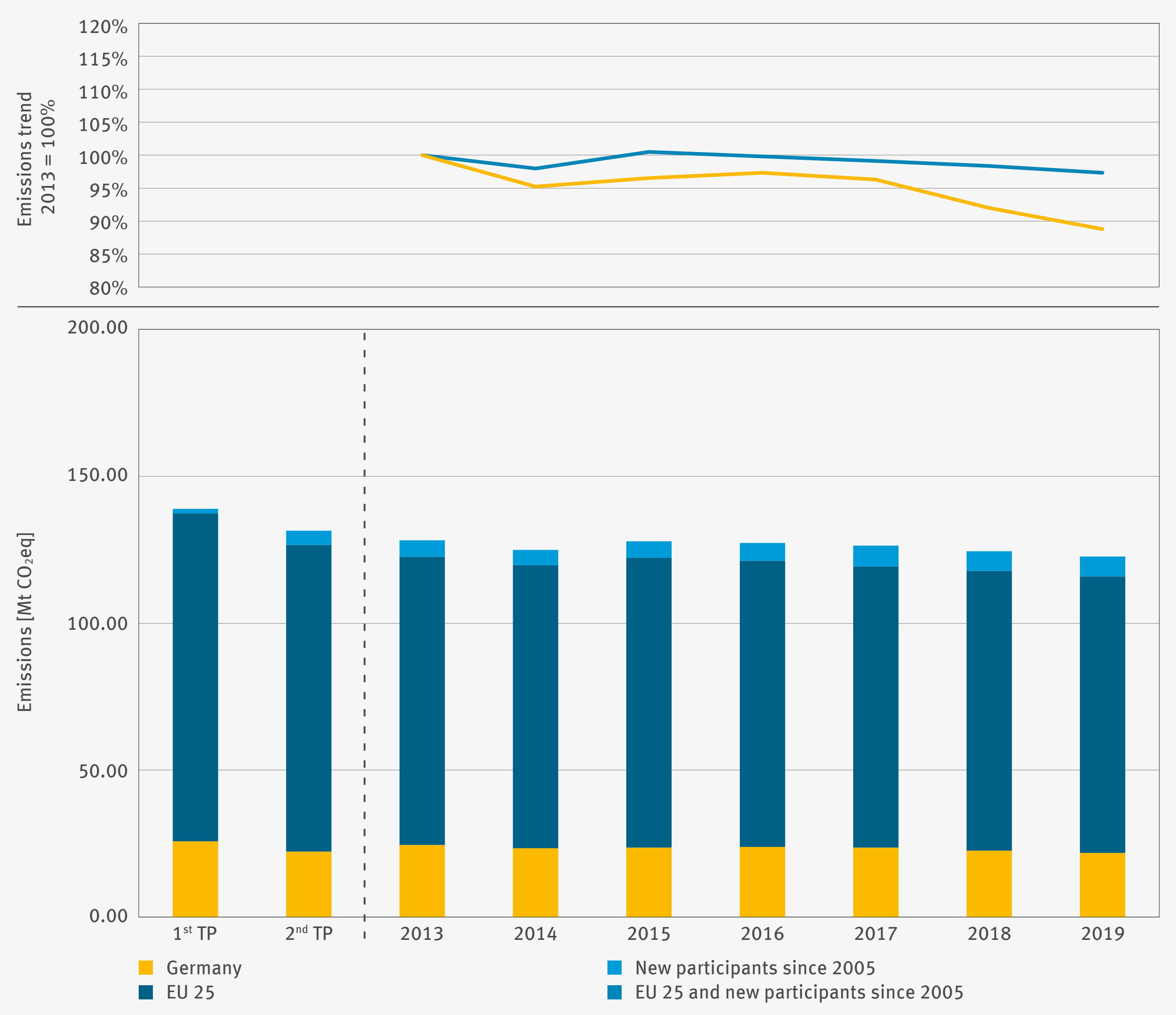

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Figure 18: Emissions trend for refineries (Registry Activity 21) in Germany and in the EU up to 2019[36]

Although emissions at the EU level increased by 2.6 percent in 2015 compared to 2014, they decreased continuously after 2016. A similar picture emerges for the emissions trend of German refineries.

Overall, emissions from installations at the EU level decreased by three percent compared to 2013. According to EEA data (see Figure 18), the decline in emissions from refineries in Germany was around eleven percent since the start of the third trading period until 2019.

36 Data source: EEA 2020; the 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. New participants in the EU ETS after 2005 are Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania.

2.4 Iron and steel industry including coking plants

The iron and steel industry includes Activities 8 to 11 and one Activity 1 installation as per TEHG[37], which means a total of 123 installations that are subject to emissions trading in Germany. The 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 permit 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 the 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 29(2) of the 2020 Allocation Ordinance (ZuV). On other sites, 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 19 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.

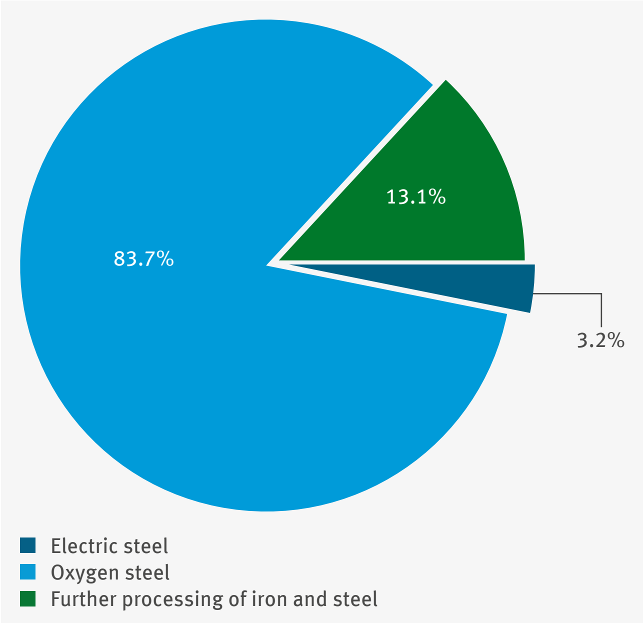

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Figure 19: 2020 emissions distribution in the iron and steel industry (Activities 8 to 11 and 1)

37 This is an independently approved coal grinding and drying installation, which is part of the pig iron production process step.

38 In addition, a small number of Activity 10 installations contain process 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 2021

40 Only the 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 2019 and 2020, differentiated according to Activities 8 to 10, 11 and 1 in line with the explanation above. The emissions from Activities 8 to 10, at 27.2 million tonnes of carbon dioxide combined, were eleven percent lower in 2020 than the previous year's value of 30.7 million tonnes, while crude steel production decreased at the same time by about ten percent to 35.7 million tonnes.[41] Emissions from the blast furnace route (including Activities 8 and 9) were about 26.2 million tonnes of carbon dioxide in 2020, down about 3.5 million tonnes (12 percent) from 29.7 million tonnes in the previous year. Emissions from the electric steel route decreased by about 40,000 tonnes (four percent) from about 1,029,000 tonnes of carbon dioxide to 989,000 tonnes. Emissions from the processing of ferrous metals (Activity 11) decreased by about 0.6 million tonnes (13 percent) to a current 4.1 million tonnes.

Table 9: Iron and steel industry (Activities 8 to 11 and 1), number of installations, 2019 emissions, 2020 free allocation, 2020 VET entries, allocation coverage

No.	Activity	No. of instal-lations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
8, 9, 10	Pig iron and crude steel production*	35	30,735	27,239	41,045	150.7%
11	Ferrous metal processing	87	4,749	4,115	4,122	100.1%
1	Combustion	1	73	47	0	0.0%
	N. l. ETS	*2***	*20*	–	–	–
Total		**123**	**35,577**	**31,401**	**45,167**	**143.8%**

As of 03/05/2021
* 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 2020, the total emissions from transferred and energy-intensive used waste gases from iron, steel and coke production amounted to around 21.2 million tonnes of carbon dioxide (see Table 10), about 3.2 million tonnes less than in 2019.

Table 10: Transfer of waste gases from iron, steel and coke production in 2020 – 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]
3,321	841	16,836	95	121	21,214

As of 03/05/2021
* Emission volumes leaving installation boundaries but remaining within Activities 8 to 10.
** The total amount transferred is 155,088 tonnes of carbon dioxide equivalents, of which 34,166 tonnes are inherently carbon dioxide.

41 See WV Stahl 2020

Transfers within and between Activities 8 to 10 were associated with about 3.3 million tonnes of carbon dioxide emission equivalents (emissions leaving the boundaries of installations but remaining within Activities 8 to 10[42]), i. e. about 0.4 million tonnes less than in 2019. Transfers from these installations to installations for further processing (Activity 11) had related emissions of about 0.8 million tonnes of carbon dioxide (186,000 tonnes less than in 2019). Of the remaining transfers, the majority went to energy installations (around 16.8 million tonnes of carbon dioxide are associated with these transfers, compared with 19.5 million tonnes in the previous year).[43]

Allocation status

Table 9 above not only shows the emissions but also the ratio of emissions to the allocation of the respective year – i. e. 'Allocation coverage' (last column). This was 151 percent in nominal terms for Activities 8 to 10 and 100 percent for Activity 11 in 2020.

However, it can be assumed for Activities 8 to 10 that, following the transfer of waste gases from iron, steel and coke production, waste gas producing installations of the iron and steel industry will transfer emission allowances to waste gas utilising energy installations. The producers receive an allocation for the emissions from the utilisation of the waste gases for energy generation in comparison to natural gas which is the baseline fuel. The benchmark also includes an 'inefficiency surcharge', which reflects the lower efficiency of waste gases 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 2020 corresponded to emissions of 16.8 million tonnes of carbon dioxide (see Section 'Transfer of waste gases from iron, steel and coke production' above).

The estimate of the amount of transferred emission allowances corresponds to the emission volume from the transferred waste gases from iron, steel and coke production produced in comparison to natural gas, plus the 'inefficiency surcharge'.[44] Thus, the 2020 amount of emission allowances transferred to energy installations can be estimated at around 11.3 million emission allowances (compared to 13.4 million in the previous year). This results in an adjusted allocation amount of about 33.9 million emission allowances and an adjusted allocation coverage of 108.0 percent (see Table 11). This means that in 2020, the iron and steel industry arithmetically received eight percent more allocation than it needs to surrender for the reported emissions.

Table 11: Iron and steel industry (Activities 8 to 11 and 1), number of installations, allocation amounts, 2020 VET entries and adjusted allocation coverage

Sector / activity	No. of instal-lations	2020 adjusted allocation amount [1000 EUA]	2020 VET [kt CO_2eq]	2020 allocation deviation from 2020 VET [kt CO_2eq]	Adjusted allocation coverage
Iron and steel	123	33,898	31,401	2,497	108.0%

As of 03/05/2021

42 For a comparison of the different installation boundaries, see the explanations on 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-using installations must surrender emission allowances corresponding to the total volume of carbon dioxide contained in the transferred waste gas.

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

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 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 and for which there is no free allocation.[45] 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 CO_2 costs via the electricity price.[46]

In the case of heat generation, natural gas-based subtraction is also made in the allocation for iron and steel production, but – in contrast to electricity generation – the waste gas user or heat user also receives a direct allocation for the heat generated according to heat benchmark.

Trends in the third Trading Period

Figure 20 shows the trend of the entire sector since the beginning of the EU ETS in 2005. 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 (including installations no longer subject to emissions trading in 2020, 'n.l. ETS') since 2013.

The bottom part of the figure shows both emissions and allocation amounts: the averages of the first, second and third trading periods and the annual values from 2013 onwards. In each case, the columns separately show the installations currently subject to emissions trading and those no longer subject to emissions trading in 2020 (n.l. ETS). 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 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.

Emissions from the iron and steel industry have increased slightly from 2013 to 2018, except for 2016, but, at 35.5 million tonnes in 2019, they were again almost the same as the 2013 figure and significantly lower – by 12 percent –in the 2020 reporting year. Emissions from oxygen steel production were about 10 percent lower than in 2013, while electric steel production and further processing show declines of as much as 14 and 21 percent respectively.

45 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.

46 See DEHSt 2021

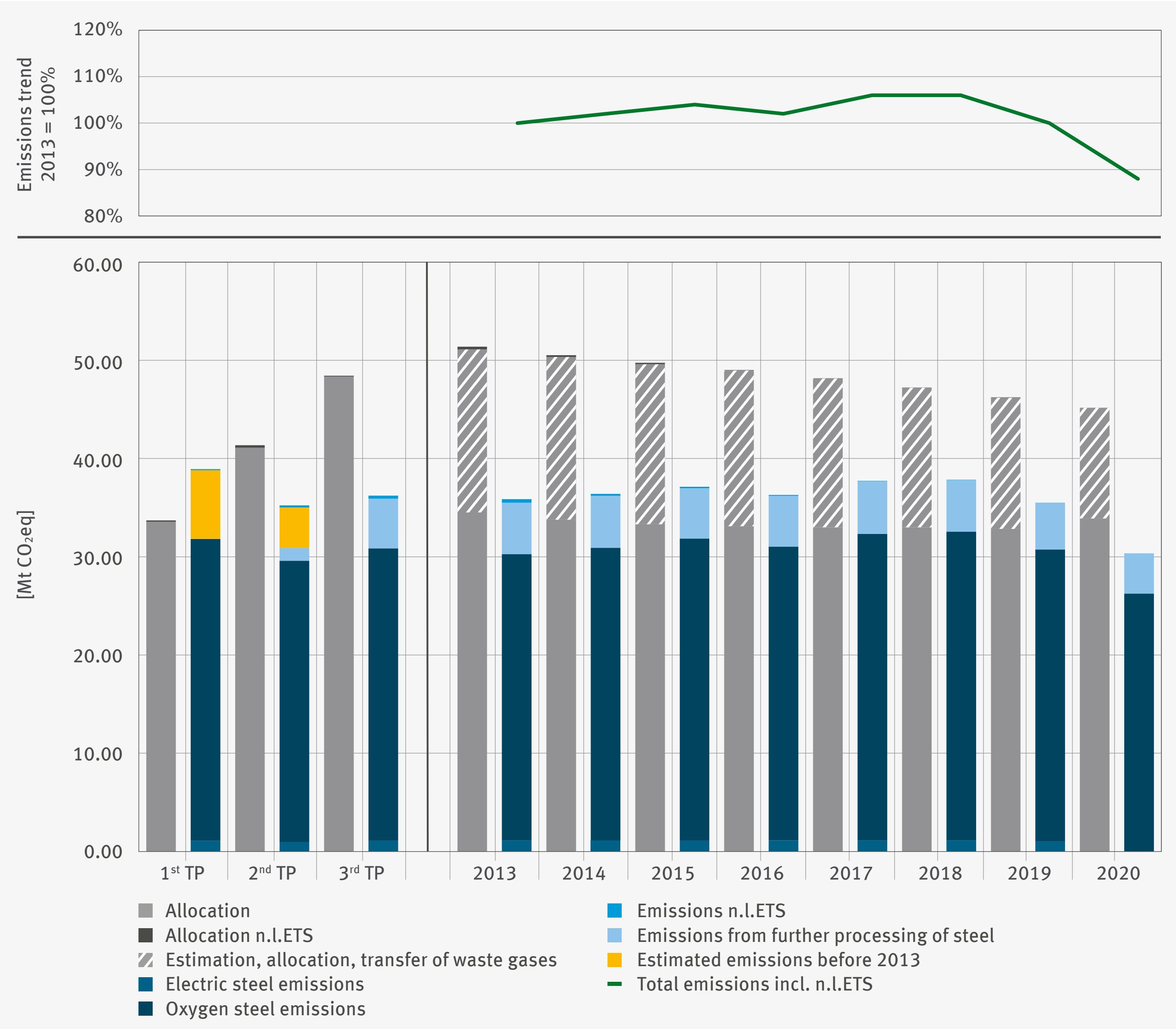

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Figure 20: Iron and steel industry (Activities 8 to 11 and 1), 2005 to 2020 emissions and free allocation trends in Germany[47]

47 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 trading period, the allocation rules for the third trading period do not contain any obligation comparable to Section 11 of the 2012 Allocation Act.

Emissions and production trend

Figure 21 and Figure 22 show the emission and production volume trend for oxygen steel and electric steel each in relation to 2013. 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 of the products[48] supplemented by information from the German Steel Federation (WV Stahl 2019, 2020).[49]

Compared with 2013, emissions from oxygen steel production had increased more than crude steel production by 2018. In 2019 they were again slightly higher than 2013, while production was lower than in 2013. In 2020, as mentioned above, emissions were 12 percent lower than in 2019, while oxygen crude steel production fell by 13 percent (WV Stahl 2021). Compared to the decrease in emissions and oxygen steel production in 2009 as a result of the global financial and economic crisis, the current change was comparatively small compared to 2019: At that time, a decrease of about 24 percent from about 33.5 million tonnes in 2008 to about 25.5 million tonnes of CO_2 in 2009 was recorded.[50] Overall, 2020 emissions were thus 10 percent lower than in 2013; in contrast, oxygen steel production fell by 17 percent in the same period.

At the same time, according to the activity rate of coke production shown in the figure, about 460,000 tonnes more coke was produced in 2019 than in 2013 (in 2018 it was 820,000 more). Net imports of coke by the entire German iron and steel industry dropped by around 1.34 million tonnes between 2013 and 2019 and by as much as 1.6 million tonnes by 2020 (by 1.02 million tonnes in 2018 compared with 2013).[51]

These figures indicate that the increased in-house coke production between 2013 and 2016 as described above increasingly replaced coke previously purchased from abroad. By 2019 and 2020 this proportion seemed to have decreased somewhat, but still exceeded that of 2013. While the declines in 2019 and 2020 also include the effect of lower crude steel production, the values up to and including 2018 allow a more direct conclusion to be drawn on the magnitude of the aforementioned replacement of previously imported coke with in-house production.

This means that direct emissions from coke production, which were previously outside the system boundaries considered here, are now within these boundaries, leading to a relative increase in total direct emissions (of the activities considered) in German installations.

Other factors influencing emission fluctuations in the iron and steel industry may be other changes in the fuel mix, for example, the mutual substitution of natural gas and hard coal causing more emissions. Another reason may lie in changed raw material qualities (ores used).[52]

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

49 WV Stahl 2017 for 2013 to 2017; WV Stahl 2020 for 2014 to 2019; WV Stahl 2021 for 2020. Data from both former sources checked for consistency for the overlapping years of 2014 to 2017; also, the latter two sources for the overlapping year of 2019.

50 See DEHSt 2016, p. 36

51 They even decreased by 1.7 million tonnes from 2012 to 2016. See Federal Statistical Office: Foreign trade statistics list of goods (8-digit), for link see bibliography.

52 Other reasons for the observed changes may be uncertainties in the determination of emissions. These may superimpose potential correlations (e. g. production changes) that unfortunately cannot be verified using the available data (e. g. production shifts, changes in the emissions determining methodology).

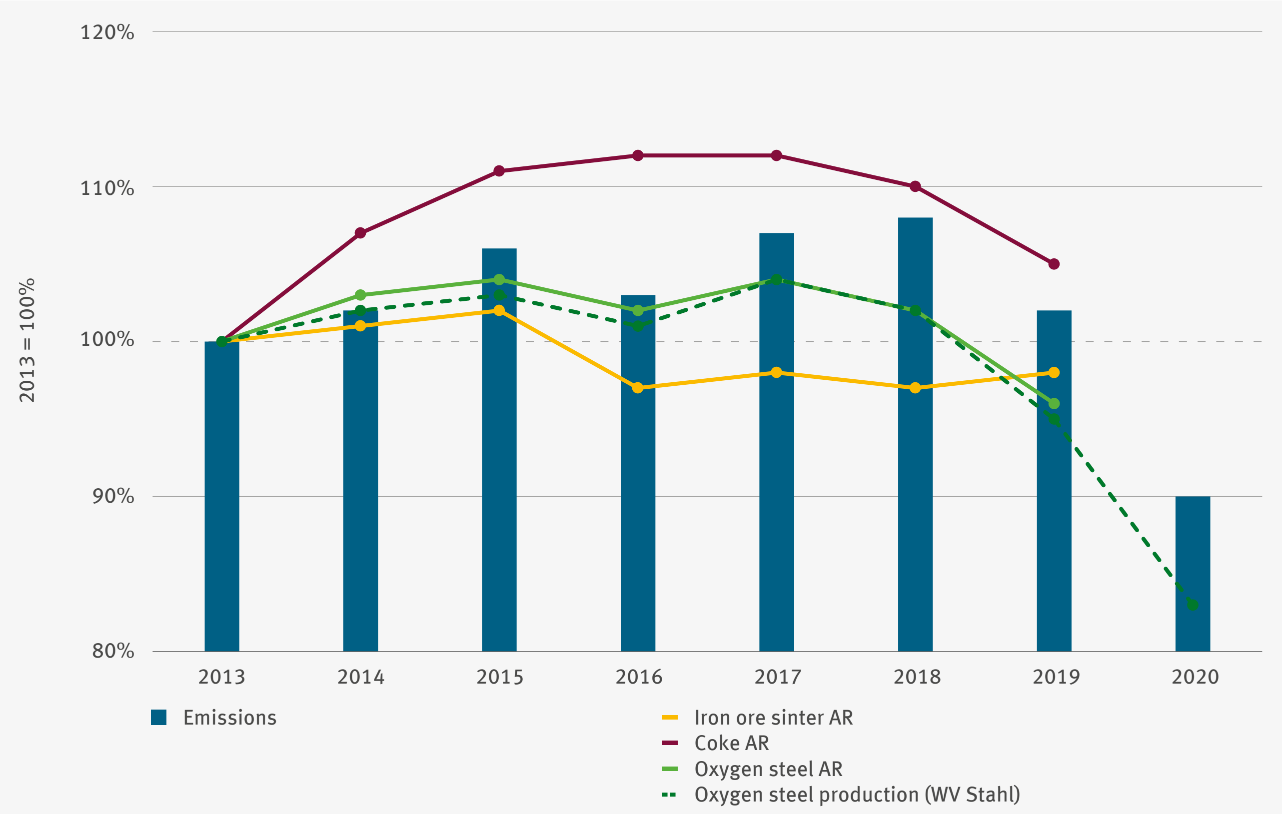

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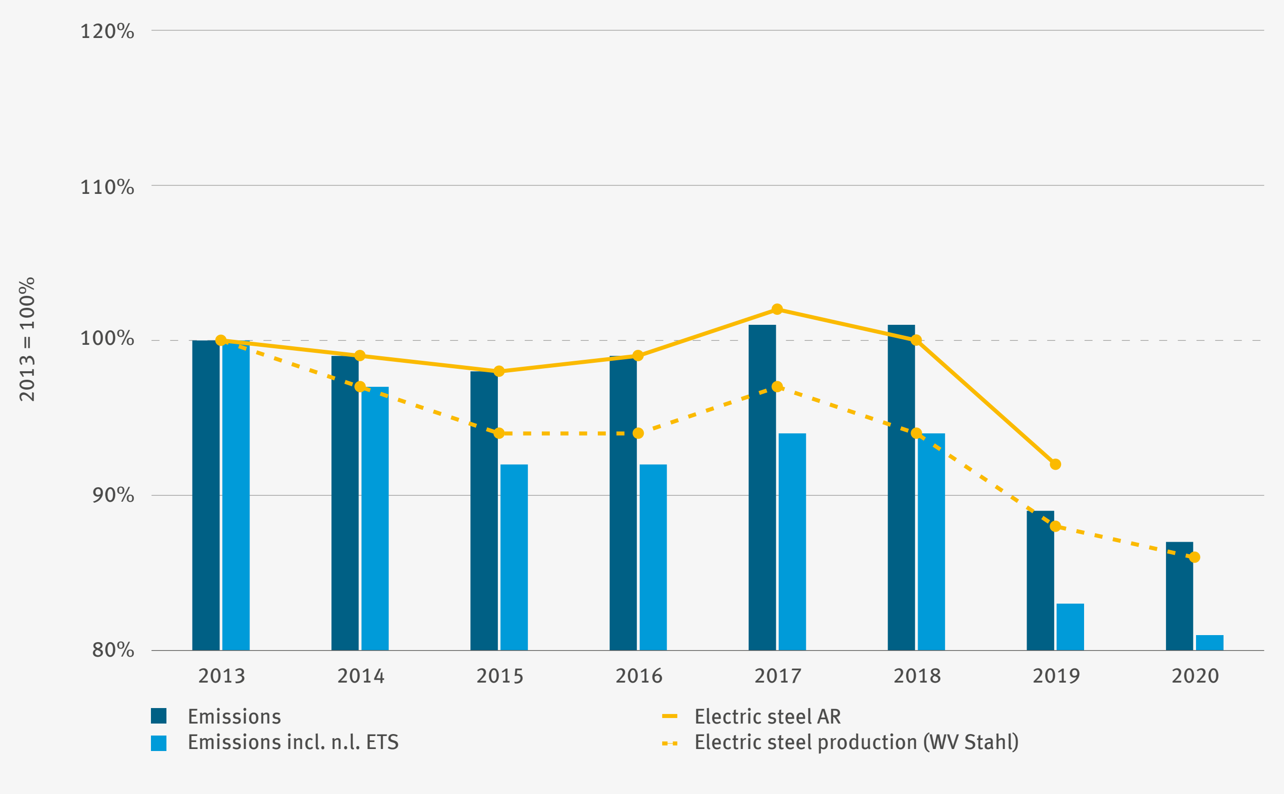
Figure 21: Oxygen steel production, 2013 to 2020 emissions and production trends in Germany, each in relation to 2013

The following Figure 22 for electric arc furnace steel[53] shows both the emissions from installations currently subject to emissions trading (dark blue columns) as well as the emissions from those installations subject to emissions trading in the respective year (light blue columns, 'emissions including n. l. ETS') in relation to 2013. Emissions decreased until 2015, increased slightly until 2018 and decreased significantly in 2019 and again only slightly in 2020 (by four percent in 2020 compared to 2019 at a simultaneous decrease in production of three percent, cf. WV Steel 2021). This general trend is consistent with the production trend, except for 2018 when emissions did not decrease despite a decline in production. The relative annual figures of the emission timelines including n. l. ETS and production (WV Stahl) are lower compared to 2013 than the corresponding timelines in relation to the installations currently subject to emissions trading. The background is that three electric arc furnace steelworks were decommissioned between 2012 and 2014 but they are included in these both timelines.[54]



As of 03/05/2021

Figure 22: Electric arc furnace steel production, 2013 – 2020 emission and production trends in Germany, each in relation to 2013

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

54 Considering these three installations, the production trend based on the activity rates ('Electric arc furnace steel AR') and the information provided by WV Stahl since 2013 are almost identical. The activity rates trend and Association's data in the figure only differ because these three installations are not included in the activity rate and emissions that only relate to installations currently subject to emissions trading.

The EU iron and steel industry

Figure 23 shows the emissions trend in the iron and steel industry both for the EU as a whole and for Germany. It can be seen that EU-wide emissions have decreased since 2013. By contrast, the emissions trend for German installations showed an increase up to 2018 and only returned to roughly the 2013 level in 2019, exceeding those of the starting year of the third trading period 2013 in every year up to 2018.

A probable cause of the emissions decrease at the EU level is likely to be about an eight percent reduction in oxygen crude steel production from 2013 (100.1 million tonnes) to 2019 (92.2 million tonnes).[55] Emissions from pig iron and crude steel production (excluding further processing) are largely determined by emissions in the oxygen steel production ("blast furnace route").

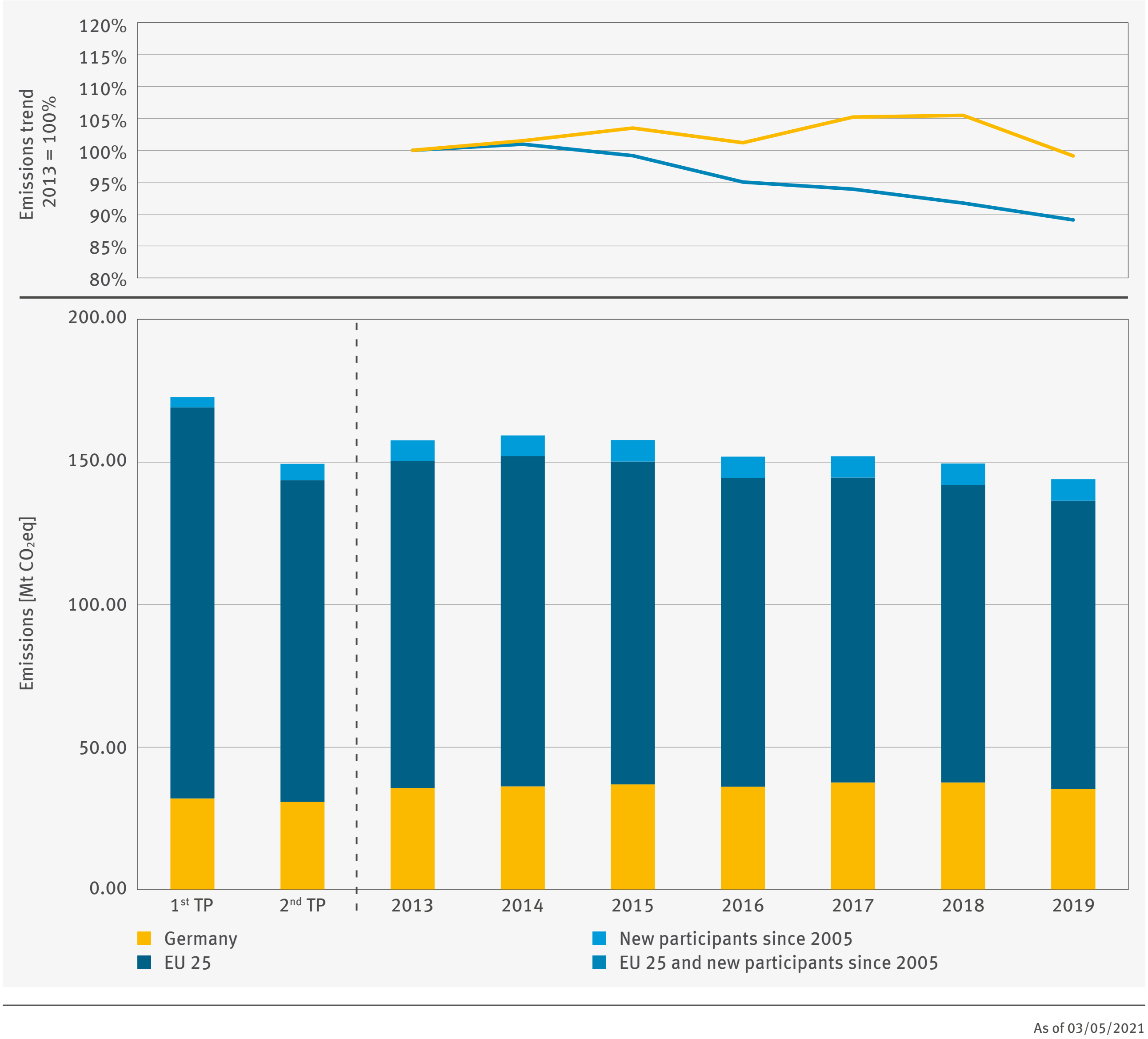


Figure 23: Emissions trend for the iron and steel industry (Registry Activities 23 to 25) in Germany and in the EU up to 2019[56]

55 WSA 2018, WSA 2019, WSA 2020

56 Data source: EEA 2020; the evaluation is based on grouping the installations according to the Activities in the EU Union Registry (see Table 38, Chapter 7). This can lead to differences in the emission amount per sector in Germany. Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania have been new participants in the EU ETS since 2005.

2.5 Non-ferrous metal industry

The non-ferrous metals industry (Activities 12 and 13 according to Annex 1 TEHG) included a total of 38 installations in the 2020 reporting year i. e. one installation fewer compared to the previous year. In 2020, installations subject to emissions trading in the non-ferrous metals industry emitted around 2.5 million tonnes of carbon dioxide equivalents. Thus, as in the previous year, 2020 emissions are about three percent below the level of the previous year. In total, the deficit of the non-ferrous metals industry in 2020 amounted to about 250,000 emission allowances. This corresponds to 10 percent of their surrender obligation.

Figure 24 shows the shares of emissions from the non-ferrous metals industry for 2020, broken down into the products primary aluminium and anode production (Activity 12), secondary aluminium and aluminium processing, installations for the production or processing of lead, zinc or other non-ferrous metals and the production or processing of copper (Activity 13).

The electrolysis installations for primary aluminium production account for the largest share of emissions from the non-ferrous metals industry at about 35 percent. At around 28 percent, the installations for secondary aluminium production and aluminium processing are responsible for the second largest share of the sector's total emissions. Installations for the production or processing of lead, zinc or other non-ferrous metals account for 19 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 15 percent. Emissions from anode production (Activity 12) only account for three percent.

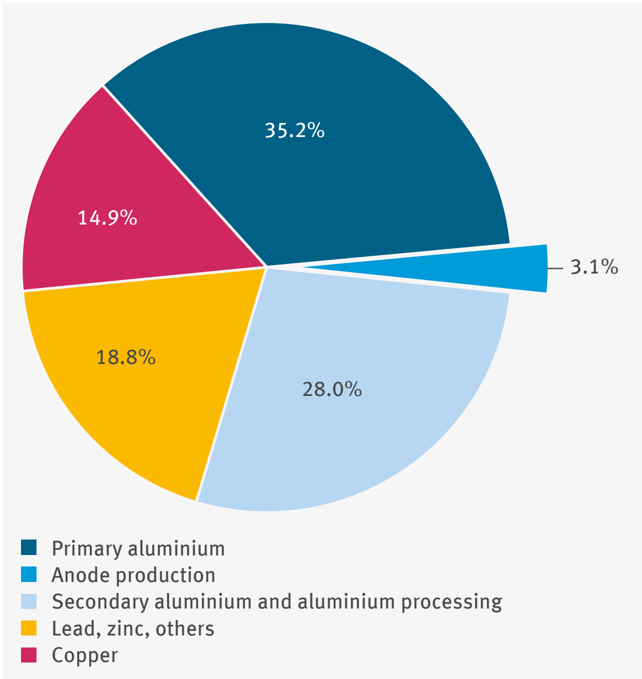


Figure 24: 2020 emission shares from non-ferrous metals industry (Activities 12 and 13)

Table 12 provides an overview of emissions and allocations for the non-ferrous metals industry in 2020.

Table 12: Non-ferrous metals industry (Activities 12 and 13), number of installations, 2019 emissions, 2020 VET entries, 2020 free allowances, and 2020 allocation coverage

No.	Activity	No. of installations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
12	Primary aluminium production	7	955	963	821	85.2%
13	Non-ferrous metal processing	31	1,620	1,550	1,446	93.3%
	N. I. ETS	*1**	*5*	–	–	–
Total		**38**	**2,580**	**2,513**	**2,267**	**90.2%**

As of 03/05/2021
* N. I. 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 then consumed in the production of primary aluminium. The four electrolysis installations for primary aluminium production also emitted PFC (perfluorocarbons) in addition to carbon dioxide. In 2020, these PFC emissions corresponded to almost 77,000 tonnes of carbon dioxide equivalents and their average share in the total emissions from the four electrolysis installations were about nine percent, the same as in the previous year. Overall, the level of emissions from electrolysis installations subject to emissions trading was two percent above the previous year's level.

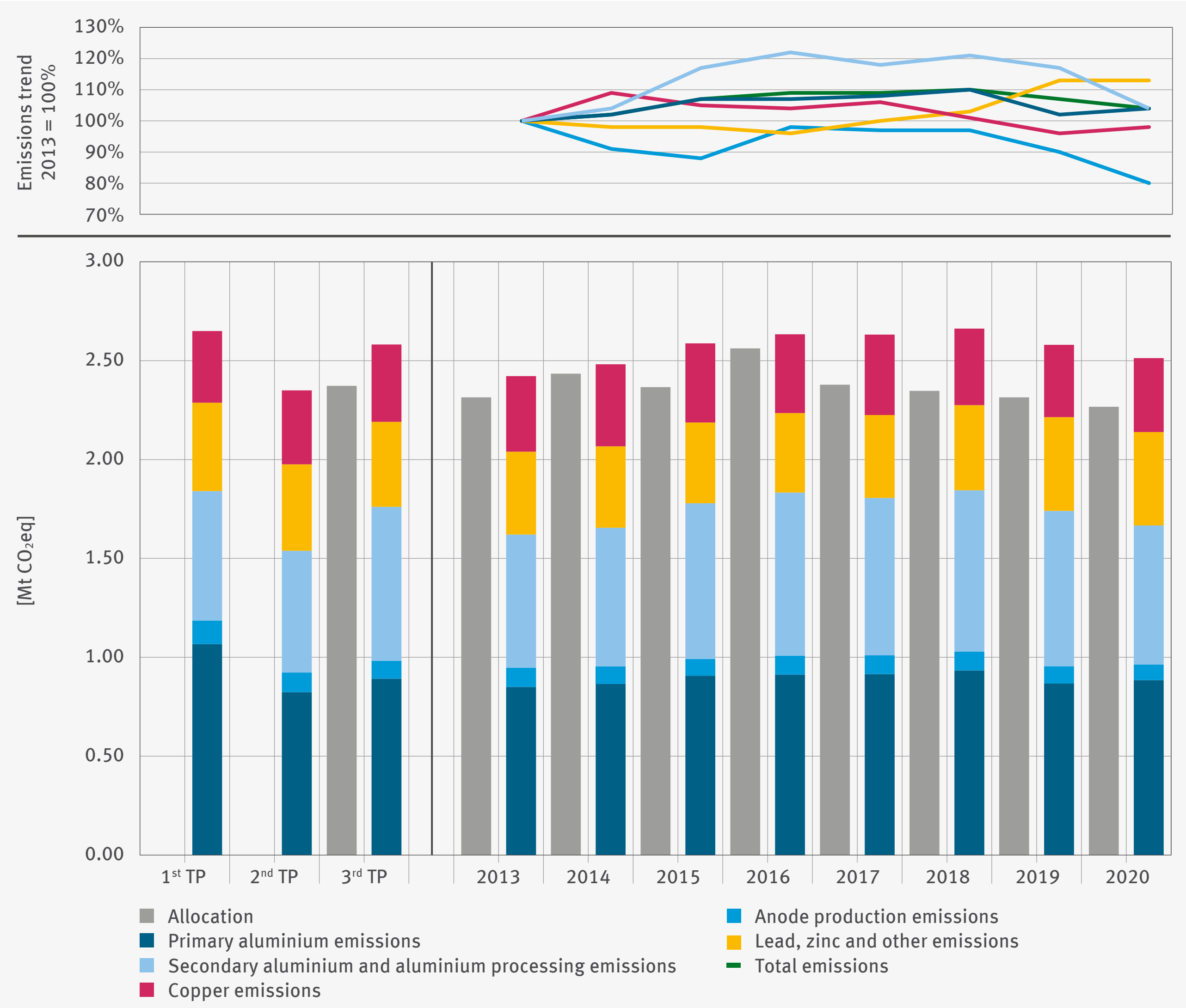
The 31 installations in Activity 13 (production and processing of other non-ferrous metals such as copper, zinc or lead and secondary aluminium) emitted just below 1.6 million tonnes of carbon dioxide equivalents in 2020, four percent less than in 2019.

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 2020 corresponded on average to about 85 percent of their annual emissions compared to 88 percent in 2019.[57] However, until 2014, these operators did not theoretically have to purchase any emission allowances in order to meet their surrender obligations.[58] Activity 13 installations have been slightly better supplied on average across all installations in recent years partly due to the fallback allocation. By 2016, their allocation coverage was 96 percent or greater.[59] In 2020, the allocation coverage was still 93 percent. The increased allocation coverage compared to the previous year (2019: 90 percent) is due to the lower emissions compared to the previous year, which exceeded the annually decrease of free allocation due to the cross-sectoral correction factor.

57 See DEHSt 2020
58 See DEHSt 2015
59 See DEHSt 2017

Trends in the third trading period

Figure 25 shows the emissions from the non-ferrous metals industry subdivided according to the material or product predominantly produced or processed and shown both as absolute emissions and as a percentage emission trend in relation to 2013. The average emissions are indicated as absolute values for the first, second and third trading periods.[60]



As of 03/05/2021

Figure 25: Non-ferrous metals industry (Activities 12 and 13). 2005 – 2020 emissions and free allocation trends in Germany[61]

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 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.

By 2018, emissions from electrolysis installations (primary aluminium) had increased by almost 10 percent from the start of the emissions trading obligation in 2013, then decreased in 2019 and 2020 and are now only four percent above the 2013 level. Emissions from anode production fell by 20 percent from the start of the emissions trading obligation in 2013 by 2020. Compared to 2013, emissions from the installations for secondary aluminium production and aluminium processing rose by 22 percent by 2018. From 2019 onwards, they have fallen and are currently about four percent above the 2013 level, which roughly corresponds to the production trend. Even though the production of primary aluminium increased slightly in 2020 compared to the previous year, the total quantity of aluminium produced (primary and secondary aluminium) fell significantly due to the pandemic-related decline in demand, particularly in the automobile industry and in mechanical engineering. In particular, the slump in demand for castings made of secondary aluminium for the automobile industry played its part.[62]

Emissions from copper production and processing installations have declined significantly to four percent below 2013 levels after an interim sharp increase in 2018 and 2019. In 2020, there was a slight increase, so that emissions are now two percent below the 2013 level. This is also roughly reflected by the production data.

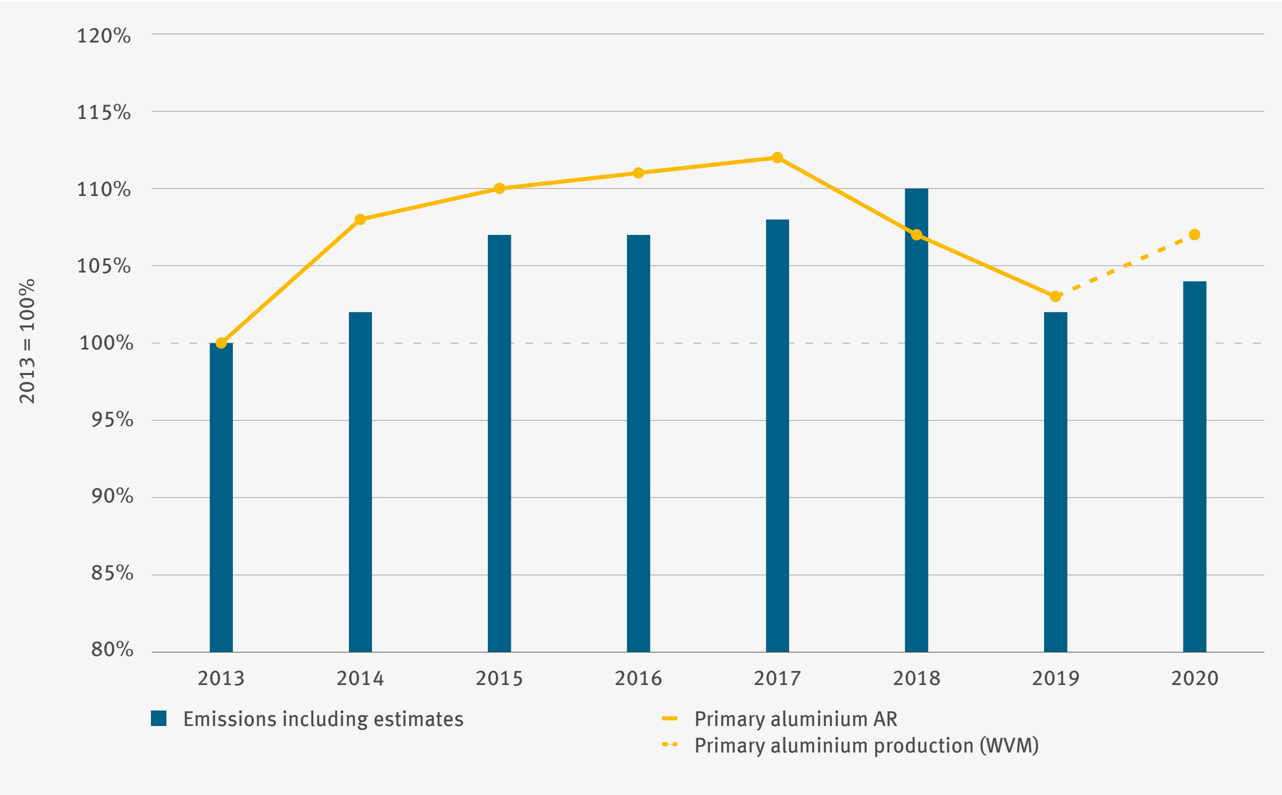
Emissions from installations for the production or processing of lead, zinc or other non-ferrous metals initially decreased since 2013 and increased from 2016. They are now 13 percent higher than in 2013. Production figures for lead, zinc, tin and their alloys have also declined compared to 2019.[63]

62 See WV Metalle 2021 and WV Metalle 2020

63 See WV Metalle 2021

Emissions and production trend

Figure 26 compares the emissions trend with the production data trend for the electrolysis installations for primary aluminium production. These are based on the activity rates (AR) of the product benchmark 'primary aluminium'[64] and the primary aluminium production data by the Metal Industry Association (WV Metalle). The trend of the activity rate is in good agreement with the trend of the WV Metalle data.



As of 03/05/2021

Figure 26: Electrolysis installations, emissions and production trends in Germany in relation to 2013[65]

Figure 26 shows that the emissions trend from the electrolysis installations was relatively well coordinated with the trend of the activity rate of primary aluminium production in the period from 2013 to 2017. The production of primary aluminium increased by 12 percent, while at the same time, emissions from the electrolysis installations rose by eight percent.

In 2018, however, a contrary development was observed. Primary aluminium production fell by four percent to its lowest level since 2013. 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.

In 2019, relative emission trends and production trends were again in good agreement compared to 2013 and were two and three percent above the 2013 level, respectively.

The two percent increase in emissions from the electrolysis installations in 2020 is accompanied by a four percent increase in primary aluminium production.

64 For 2020, the activity rates will only be transmitted to DEHSt in June 2021 so that only the value of the Wirtschaftsvereinigung Metalle (Metal Industry Association) is included in the figure for 2020.

65 Primary aluminium (WV Metalle): see WV Metalle 2020; Production figures for the production of aluminium from ore.

Non-ferrous metals industry in the EU

Figure 27 compares the emissions trend from the non-ferrous metals industry in Germany with the trend in other countries participating in the EU ETS. Activities 12 (Primary aluminium production) and 13 (Non-ferrous metals processing) as per Annex 1 TEHG correspond to activities 26 to 28 in the Union Registry. Registry Activity 26 corresponds to TEHG activity 12: Primary aluminium production. TEHG activity 13 (Non-ferrous metal processing) comprises Registry Activities 27 (Secondary aluminium production) and 28 (Non-ferrous metal production and processing).

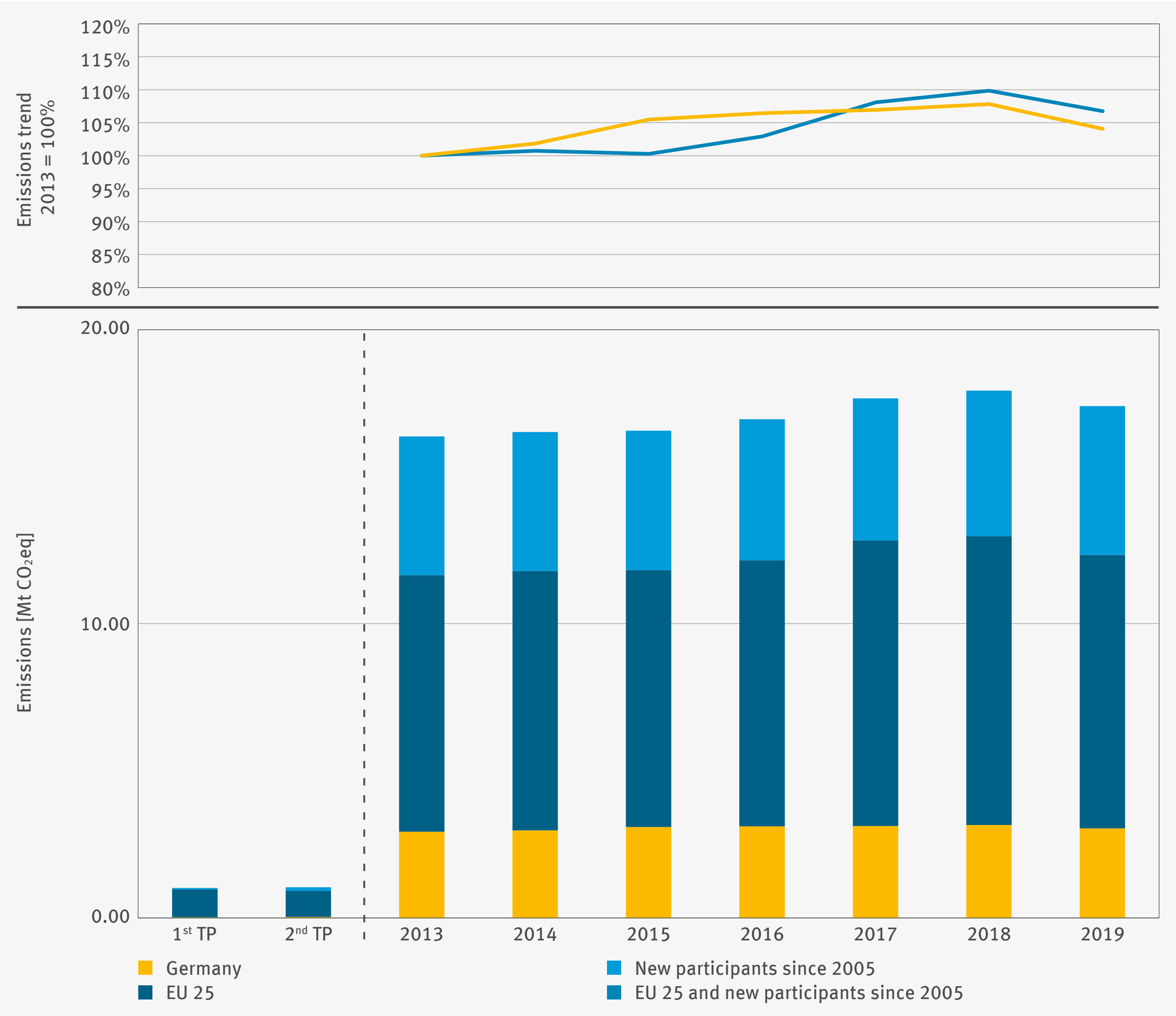


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Figure 27: Emissions trend in the non-ferrous metals industry (Registry Activities 26 to 28) in Germany and in the EU up to 2019[66]

66 Data source: EEA 2020; the evaluation is based on a grouping of the installations by activities in the EU Union Registry (see Table 38, Chapter 7), thereby differences can occur in the emission amounts per sector for Germany. New post-2005 participants in the EU ETS are Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania.

Figure 27 shows increasing emissions from the non-ferrous metals industry both for Germany and the rest of the EU since the start of emissions trading in 2013. The sharp rise in emissions between 2016 and 2017 in the EU is due, among other things, to the commissioning of an installation expansion in Poland. At the end of 2016, a new and expanded electric arc furnace for copper production was commissioned at KGHM mining group's Glogow site. This increased emissions from this installation by 50 percent and the emissions from the Polish non-ferrous metal industry, which is subject to emissions trading, rose by almost 400,000 tonnes of carbon dioxide equivalents. The emissions from the non-ferrous metals industry in the EU in 2018 were thus 10 percent in excess of the 2013 emissions.

In Germany, the increase in emissions in 2018 was less significant at eight percent compared to 2013. In 2019, emissions decreased again to four percent in Germany and seven percent in the EU compared to 2013 due to the economic cycle.

2.6 Mineral processing industry

Within the mineral processing industry, more than half (58.4 percent) of the total 34.5 million tonnes of carbon dioxide equivalents emitted in 2020 is attributable to the production of cement clinker. 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 plants (for example power plant flue gas desulphurisation installations) accounts for a further 24.6 percent of emissions. Glass and mineral fibre production accounts for another 11.5 percent and ceramics installations for around 5.5 percent of emissions.

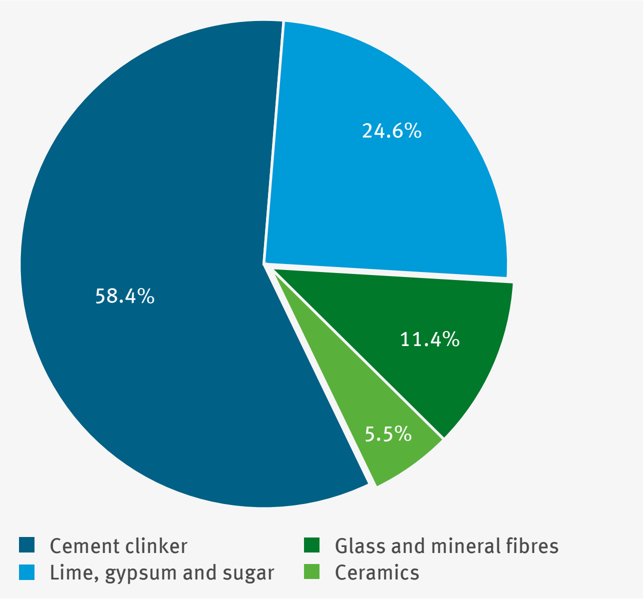

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Figure 28: The mineral processing industry's shares in the 2020 emissions

2.6.1 Cement clinker production

The 35 installations that produce cement clinker and one installation for the manufacture of products from burnt oil shale are hereinafter referred to under the term ‘cement industry’. The installations cover the entire cement clinker production in Germany. The threshold in the scope of the EU ETS is 500 tonnes of cement clinker per day (Activity 14(2), Annex 1 of TEHG) and is exceeded by all installations throughout the industry in Germany.

The cement industry was less affected than other sectors by the restrictions of the pandemic containment. Construction sites continued to operate and construction investment, an essential market for the cement industry, even increased by 1.5 percent in price-adjusted terms compared to the previous year[67]. In 2020, emissions from cement clinker production remained at almost the same level as in the previous year (plus 0.7 percent).

Table 13: Cement clinker production (Activity 14), number of installations, 2019 emissions, 2020 VET entries, 2020 free allocation and 2020 allocation coverage

No.	Activity	No. of instal-lations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
14	Cement clinker production	36	19,989	20,133	16,190	80.4%
Total		**36**	**19,989**	**20,133**	**16,190**	**80.4%**

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In 2020, the free allocation to cement clinker installations was around 3.9 million emission allowances below the emission quantity subject to surrender (see Table 13). This means that the purchase requirement increased further compared to the previous year. The allocation coverage was around 80 percent in 2020 (2019: 84 percent).

Trends in the third trading period

Figure 29 shows the emissions and free allocation trend of the cement clinker installations in the 2013 – 2020 period and additionally the averages of the three trading periods (see columns ‘1st TP’, ‘2nd TP’ and ‘3rd TP’ in the bottom part of the figure).[68]

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 the starting year of the third trading period in 2013.

In the bottom part of the figure (columns), in addition to the installations currently participating (dark blue for their emissions, light grey for their allocation), the emissions (light blue) and allocations (dark grey) for installations that will no longer be subject to emissions trading in 2020 (e. g. due to closures) are also included for the first two trading periods.

Emissions from German clinker production have not changed significantly since the beginning of emissions trading in 2005. A slight decrease in emissions was only recorded in a few years, particularly during the economic and financial crisis (2009 and 2010) – but this is not reflected by the average of the second trading period. Since the start of the third trading period in 2013, and especially between 2015 and 2017, emissions increased significantly, reaching their highest level since 2008 in 2017. Since 2018, emissions have remained relatively constant at around 20 million tonnes of carbon dioxide equivalents per year, about six percent higher in 2020 than in 2013.

67 Bauindustrie 2021, VDZ 2020

68 It should be noted that fixed emission factors have been applied to the process-related emissions in the timelines of the first and second trading periods in Germany (first trading period – 0.53 tonnes CO_2/tonne of cement clinker; second trading period – 0.525 tonnes CO_2/tonne of cement clinker). Since the beginning of the third trading period, operators had to analyse their process-related emissions. It has been found that a number of installations have higher specific process-related emissions. The reported emissions have thus been slightly higher since 2013 than they would have been if the fixed emission factors had been updated.

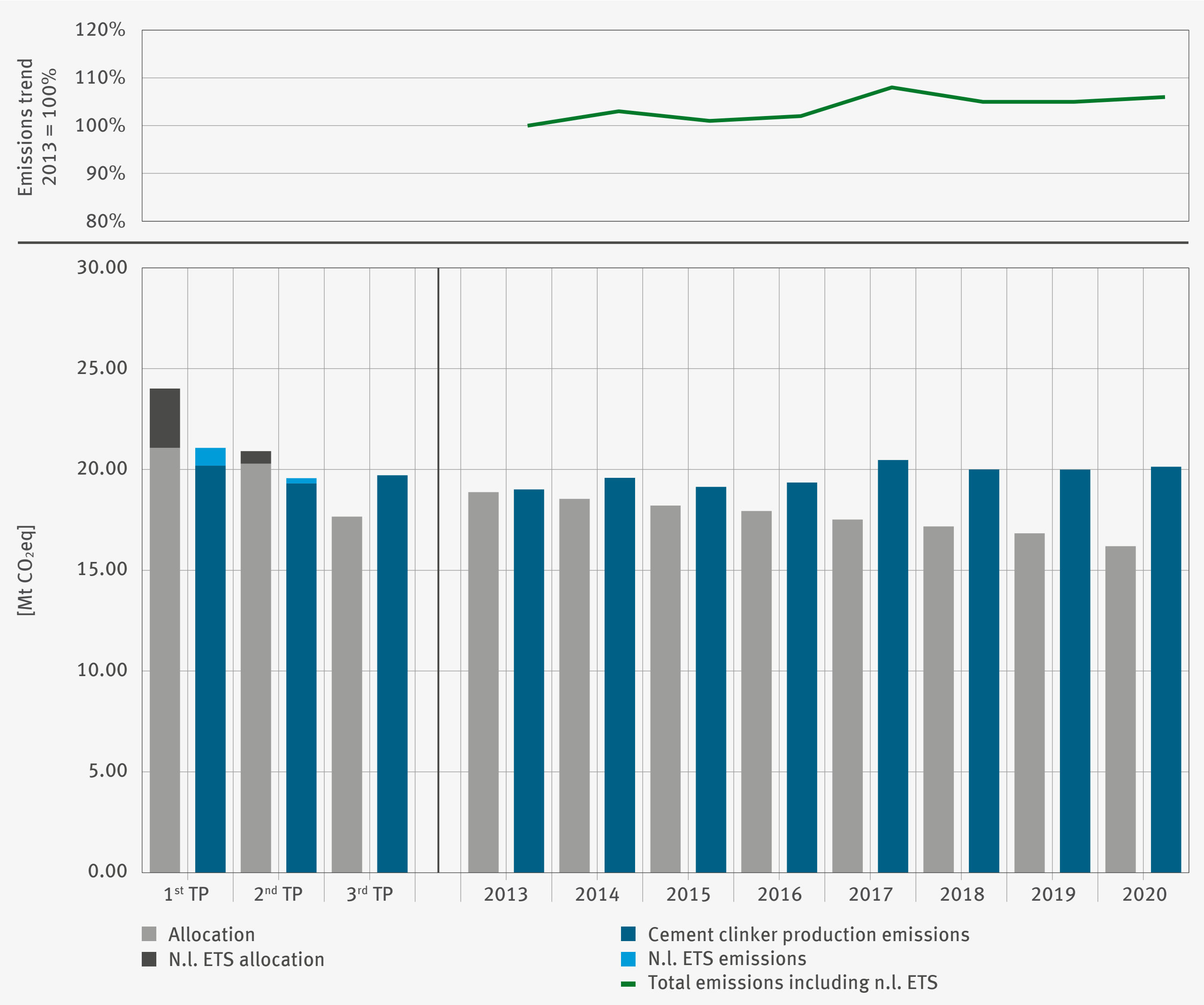

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Figure 29: Cement clinker production (Activity 14), emissions trends, 2005 – 2020 free allocation in Germany

Figure 29 shows that the allocation exceeded the emissions in the first and second trading periods, which was no longer the case from the beginning of the third trading period. In the last four years in particular, emissions were significantly higher than the allocation amounts, which fell steadily due to the cross-sectoral correction factor.

Emissions from cement clinker production are primarily determined by production trends. Figure 30 shows emissions and production (amount of clinker produced as reported in the emissions report) in each case in relation to 2013.[69] Emissions and production trend have shown an almost identical tendency since 2013. This means that the specific emissions from clinker production have not changed significantly since the beginning of the third trading period. Among other things, this can also be attributed to the high proportion of process-related emissions (about two-thirds) from the deacidification of limestone. Common measures for CO_2 reduction (e. g. increasing energy efficiency, use of alternative fuels) have been in use for years but have a limited reduction potential as they usually only affect energy-related emissions.

The specific emission figure of the 34 grey cement clinker installations amounted to 0.793 tonnes of carbon dioxide per tonne of cement clinker in 2020, roughly the same as in the previous year.

69 The production data were evaluated based on of the reported material flows from the emission reports. The cement clinker production amounts also contain 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.

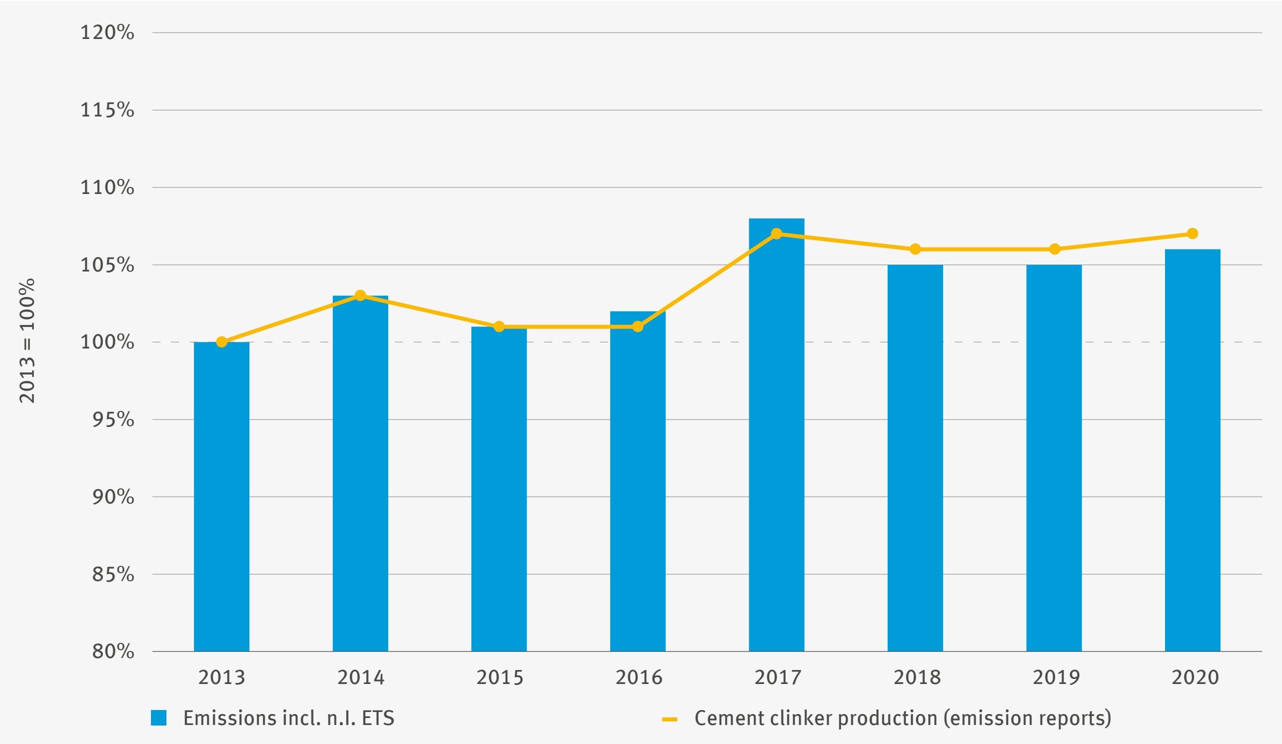

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Figure 30: Cement clinker production (Activity 14), emissions and production trend in Germany in relation to 2013

In the third trading period, the trend in the rest of Europe does not differ significantly from that in Germany (see Figure 31). Since 2013 there has been a steady increase in emissions overall in the EU excluding Germany, especially in 2014 and 2018 (see upper sub-graph). In 2019, emissions in the rest of the EU were seven percent higher than in 2013, while emissions from German cement clinker production increased by five percent in the same period.

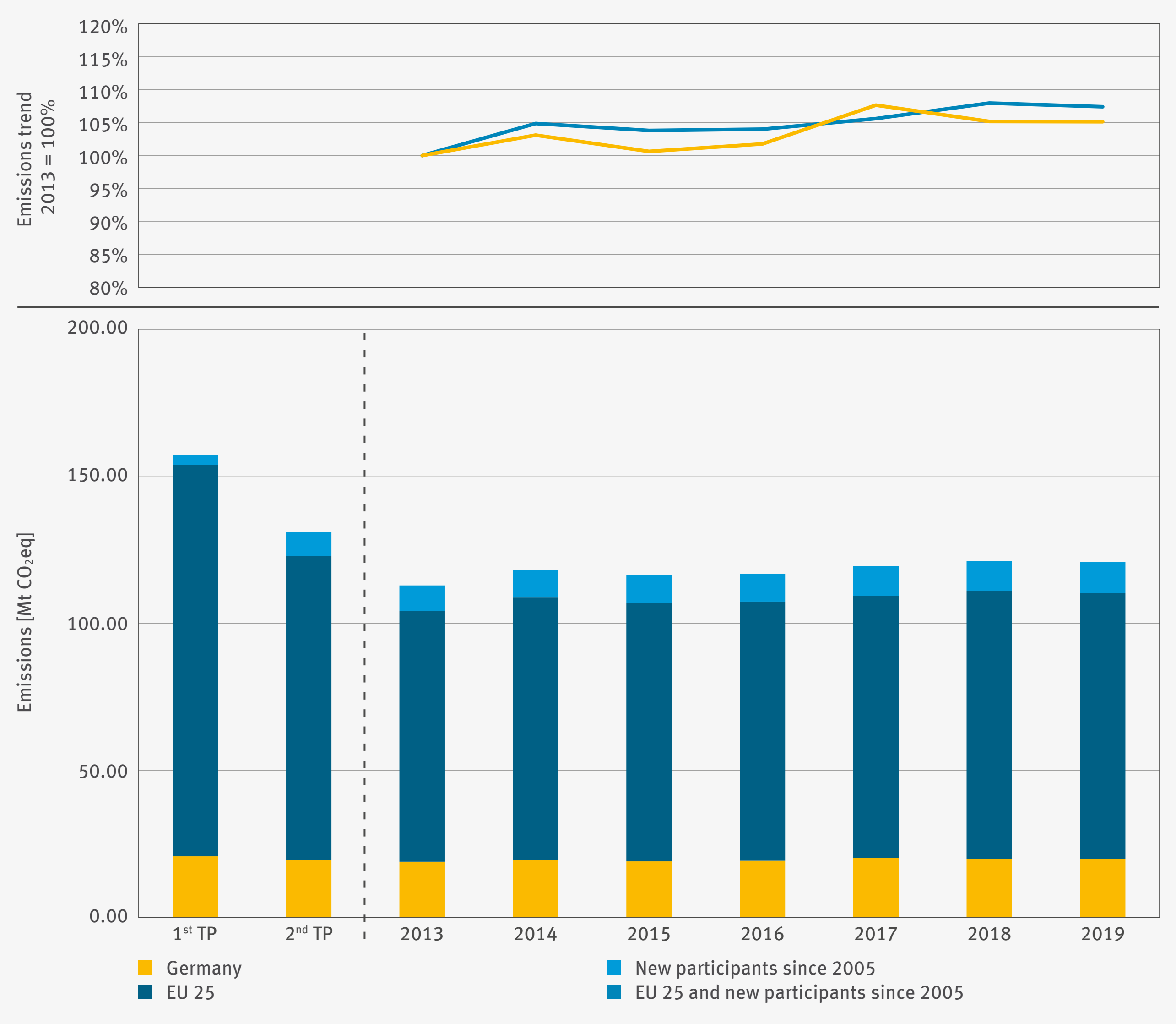

Figure 31: Emissions trend for cement clinker production (Registry Activity 29) in Germany and in the EU up to 2019[70]

70 Data source: EEA 2020; the evaluation is based on a summary of installations according to activities in the EU Union Registry (see Table 38, Chapter 7), which may lead to differences in the emission volume per sector for Germany. New participants in the EU ETS after 2005 are Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania.

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 24.6 percent of emissions in the mineral processing industry (see Figure 28).

Activity 15 includes two different industrial sectors: industrial and building lime and the sugar industry. As last year, 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, 18.5 percent of the emissions are attributable to the production of industrial and building lime (see Figure 32).

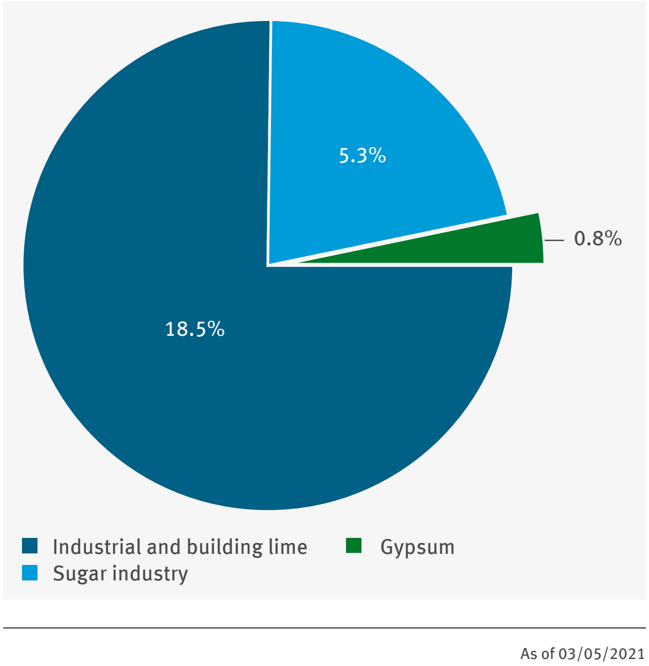

Figure 32: Shares of lime, gypsum and sugar production (Activities 1, 15 and 19) in the 2020 emissions in the mineral processing industry

Activity 15 also includes 20 installations that use lime for sugar production and require heat and electricity in the manufacturing process.[71] The sugar industry also includes other sub-activities, such as beet slice drying and caramelisation installations. In 2020, the sugar industry installations accounted for around 5.3 percent of the emissions within the mineral processing industry.

Activity 19 ‘Gypsum production’ includes nine installations that mainly purchase and process FGD gypsum from large power plants with flue gas desulphurisation (FGD) facilities. 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’.

71 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.

Table 14: Lime, gypsum and sugar production (Activities 1, 15 and 19), number of installations, 2019 emissions, 2020 free allocation, 2020 VET entries, allocation coverage

No.	Activity	No. of instal-lations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
15	Lime production	39	6,874	6,378	5,947	93.2%
	Sugar production	20	1,902	1,835	1,121	61.1%
		59	**8,776**	**8,213**	**7,068**	**86.1%**
19	Gypsum production	9	273	276	276	99.9%
		9	**273**	**276**	**276**	**99.9%**
1	Combustion	1	15	13	3	26.5%
		1	**15**	**13**	**3**	**26.5%**
Total		**69**	**9,064**	**8,502**	**7,348**	**86.4%**

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Emissions from the production of industrial and building lime in 2020 amounted to around 6.4 million tonnes of carbon dioxide which is around seven percent below the previous year's figure. The number of emission allowances allocated free of charge was around 93 percent, i. e. operators had to purchase around 431,000 emission allowances or around seven percent of the necessary emission allowances to meet their surrender obligation in 2020 (see Table 14).

Sugar plant emissions were also significantly down on the previous year (minus 3.5 percent) and amounted to about 1.8 million tonnes of carbon dioxide. In 2020, operators had to purchase around 714,000 additional emission allowances, which corresponds to 39 percent of their emissions in that year.

Emissions from gypsum plants remained virtually unchanged at around 275,000 tonnes of carbon dioxide. In 2020, the gypsum plants were allocated as many emission allowances free of charge as they needed to cover their surrender obligation for the year. The level of allocation was 100 percent.

The combustion plant (limestone drying) received an allocation for 2020 that corresponded to 26.5 percent of its emissions.

Trends in the third trading period – Industrial and building lime and gypsum

Figure 33 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 lines in the upper part of the figure show the emissions trend for all installations in both sectors that are subject to emissions trading in the respective year compared to 2013. The lower part of the figure contains not only the installations currently subject to emissions trading (dark blue and light grey) but also the emissions and allocations of installations that will no longer be subject to emissions trading in 2020 (n. l. ETS) (marked light blue and dark grey). The estimated emissions of installations not subject to emissions trading until 2013 for the period 2005 to 2012 are shown in yellow[72]. For the first and second trading periods, only the average values per trading period are shown for emissions and free allocation.

For the third trading period, the average values and the individual years of the trading period are shown as a time series.

72 Emissions resulting from the extended scope of the third trading period were estimated for the period 2005 to 2012 using data from the allocation process.

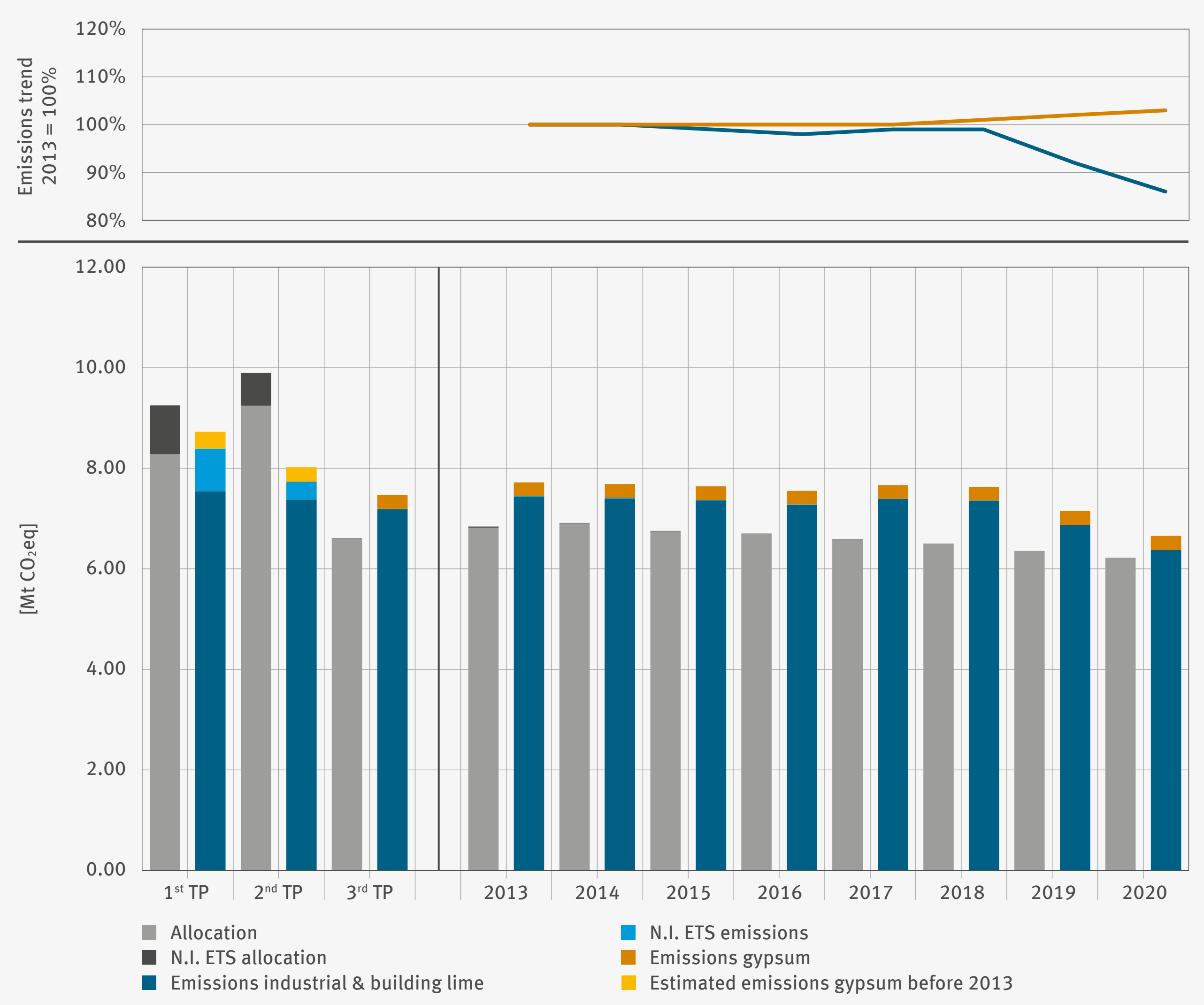

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Figure 33: Industrial and building lime production (Activity 15) and gypsum production (Activity 19) in Germany, emissions and free allocation trends for 2005 to 2020.

After emissions fell from the first to the second trading period due to the economic situation, they rose slightly again at the beginning of the third trading period. However, emissions from 2013 onwards are only comparable with those from the second trading period to a limited extent. This is because fixed emission factors were used in the first and second trading periods, whereas the emission factors since 2013 have to be determined on an installation-specific basis, which–in contrast to the case of cement clinker manufacturers (see Footnote 69)–led to lower emissions on average. In addition, the emissions from 2013 onwards were corrected retrospectively for one installation following the implementation of the European Court of Justice ruling C-460/15-Schaefer Kalk and are also therefore somewhat lower than in the previous trading periods.[73]

Since 2013, emissions have been constant at the 2013 level up until 2018. The production and emissions from industrial and building lime plants are mainly determined by the economic situation of the steel and construction industries. In line with the decline in production in the iron and steel sector since 2018, emissions from industrial and building lime plants have fallen by around seven percent each year.

73 The lower emissions do not represent a reduction in emissions compared to the past, but take into account the fact that the CO_2 stored (chemically bound) in the end product PCC (precipitated calcium carbonate) and thus not released into the atmosphere, is not considered an emission within the meaning of the ETS Directive and therefore there is no surrender obligation in emissions trading. Due to the retrospective correction for the years 2013 to 2016, there are also minor deviations from the previous years' reports

The nine gypsum producing installations have only been included in emissions trading since the beginning of the third trading period. These installations did not receive a free allocation before 2013 and only estimates based on the data from the allocation procedure are available for the emissions. Emissions from gypsum producing installations averaged around 270,000 tonnes of carbon dioxide and remained largely unchanged from the time the plants were included in emissions trading until the middle of the third trading period, with a slight upward trend in the last three reporting years.

Figure 33 also clearly shows that free allocation was higher than emissions in both the first and second trading periods. The allocation situation changed significantly with the start of the third trading period: due to the cross-sectoral correction factor, the annual free allocation in the industrial and building lime and gypsum sectors–as in all other industrial sectors–decreased continuously in the third trading period. The free allocation in relation to total emissions was less than 90 percent for each of the years 2013 to 2019. In 2020, due to the decrease in emissions from industrial and building lime plants, this level was around 94 percent, which is higher than in previous years.

Emissions and production trends – industrial and building lime

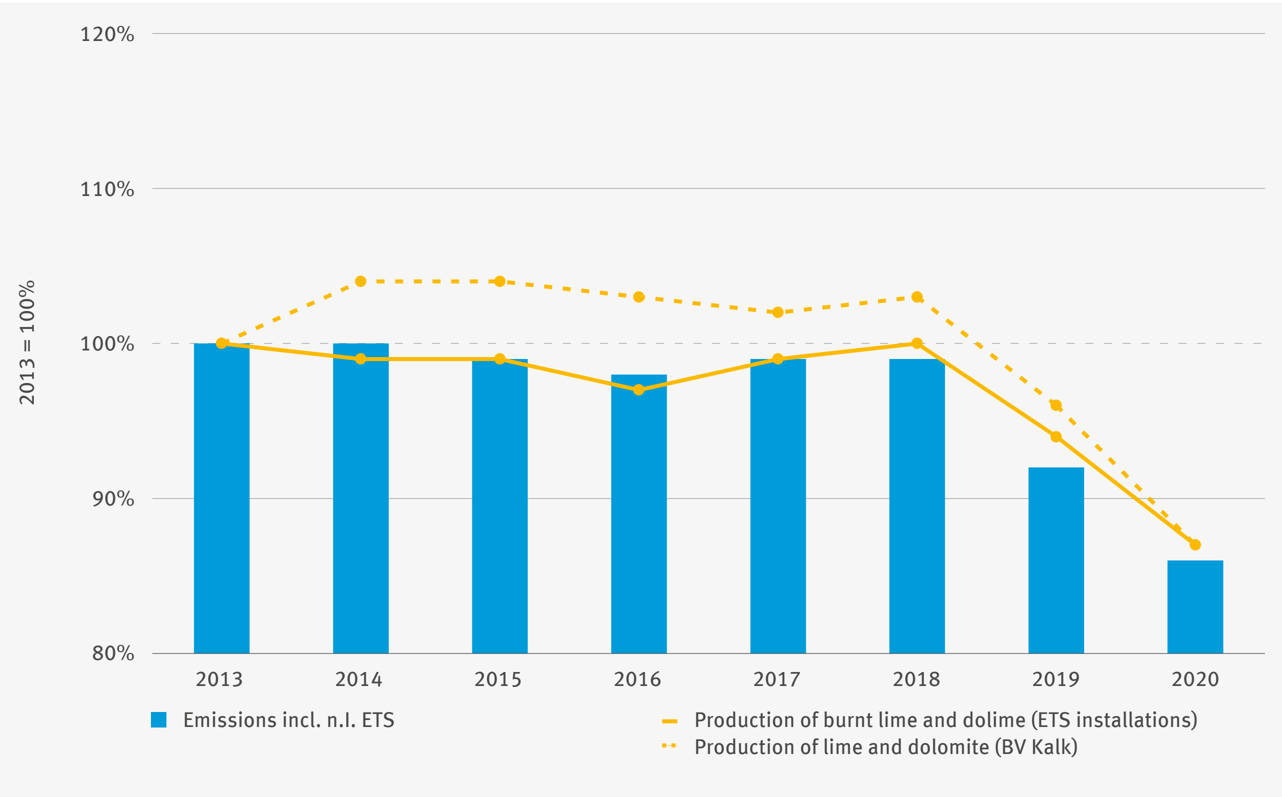

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Figure 34: Industrial and building lime production (Activity 15), emissions and production trends[74] in Germany in relation to 2013

Figure 34 shows the emissions and production trends in relation to 2013. 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 2013 to 2019 basically reflects the trend of lime production. 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 2020, 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.

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

Trends in the third trading period – sugar industry

The upper section of Figure 35 shows the emissions trend of the sugar industry for the third trading period. The lower section shows the emissions and free allocation of the sugar industry including the associated energy installations. Data for the first, second and third trading periods are presented as average values for each trading period and as annual values from 2013 up to and including 2020.[75] The figure is supplemented by the inclusion of installations that are currently no longer subject to emissions trading (n.l. ETS) and the estimated emissions from installations that were only subject to emissions trading from 2013 for the period 2005 to 2012.

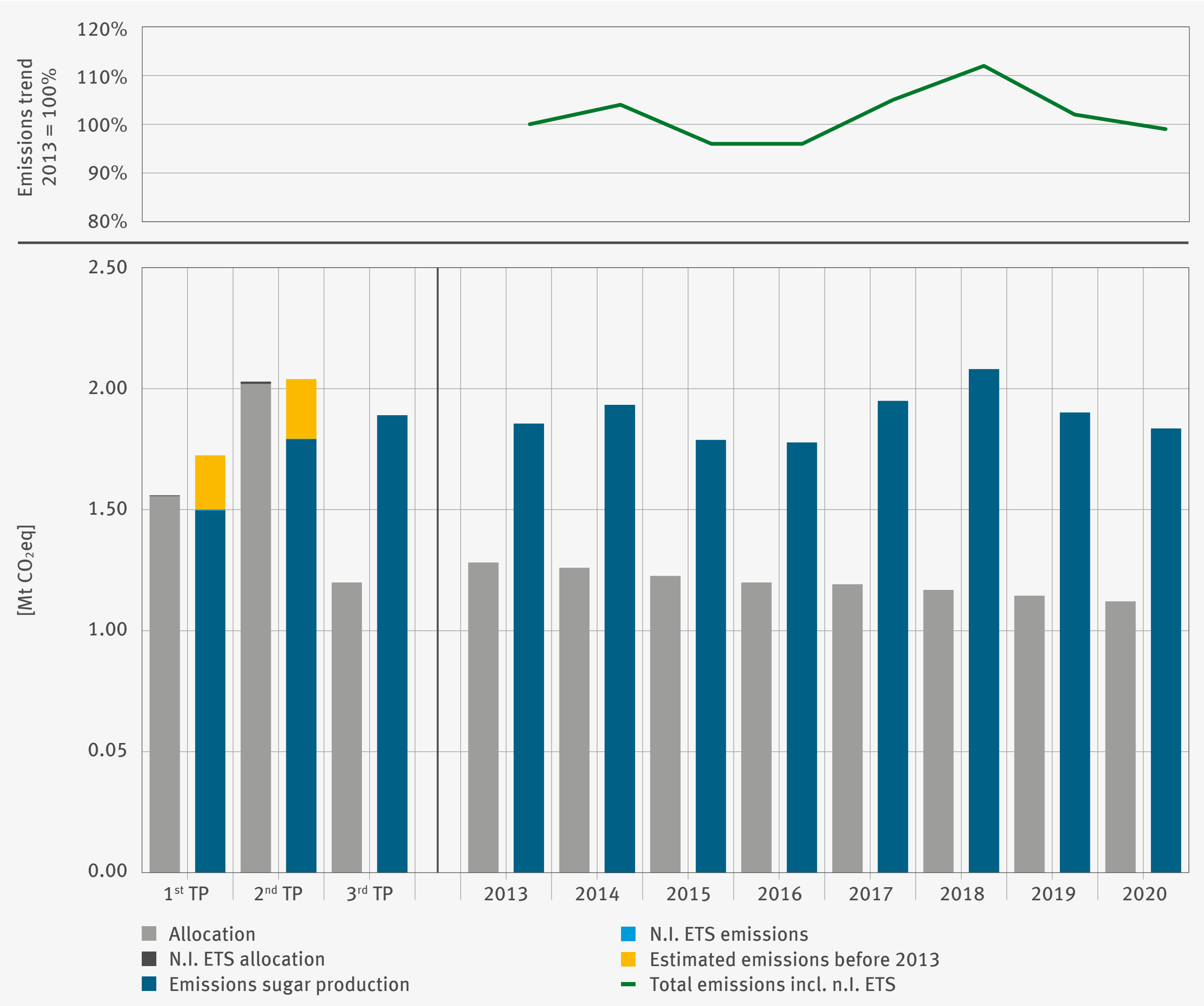

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Figure 35: Emissions and free allocation trends in the sugar industry from 2005 to 2020 (Activity 15)

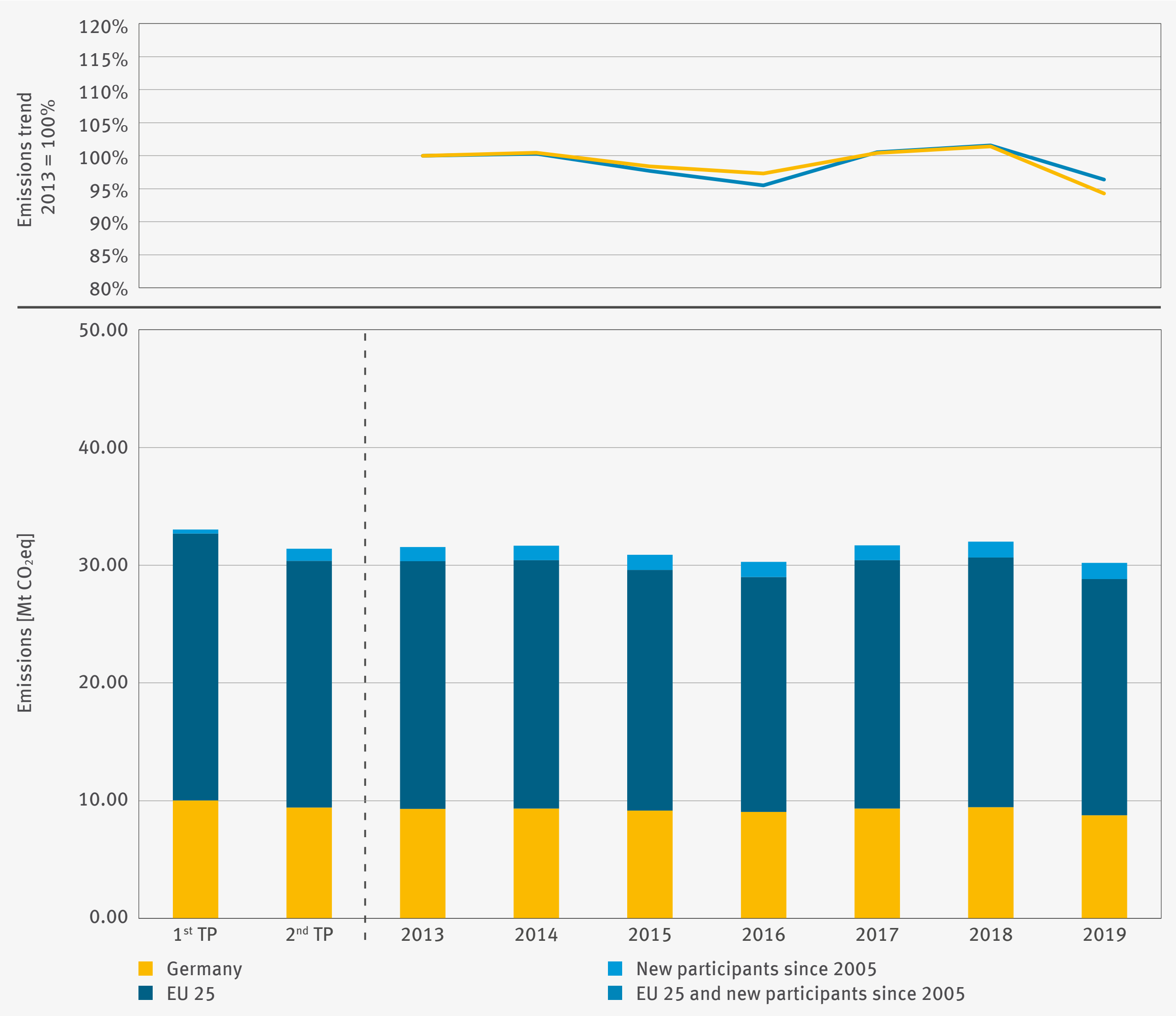
In addition to fuel input, emissions from sugar installations are primarily influenced by the quality and quantity of the sugar beet harvest and are therefore subject to annual fluctuations due to weather conditions. No clear trend can be discerned when looking at the emissions trend in the sugar industry since 2013. Only in 2017 and 2018 did emissions increase significantly over two years and were 12 percent higher than in 2013. In 2019, emissions fell again by 8.6 percent compared to 2018 and in the current reporting year they were once again below the emissions of the previous year (minus 3.5 percent).

75 Emissions resulting from the extended scope of the third trading period were estimated for the period 2005 to 2012 using data from the allocation process.

For a comparison of emissions and free allocation, the emissions within the scope of the respective trading period must be considered, 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 in the third trading period receive significantly fewer emission allowances free of charge than they need to cover their emissions. In addition, there is the (annually stronger) cross-sectoral correction factor. While in 2013 the allocation coverage was still around 69 percent of emissions, in 2020 it was only around 61 percent.

The activity 'Lime production' in the EU

Figure 36 compares the emissions trend of lime production in Germany (with no separation of the lime and sugar industries) with the trend in the other EU ETS Member States.



As of 03/05/2021

Figure 36: Emissions trend for lime production (Registry Activity 30) in Germany and the EU up to 2019[76]

76 Data source: EEA 2020; the evaluation is based on a combination of installations according to activities in the EU Union Registry (see Table 38, Chapter 7), which may lead to differences in the emission volume per sector for Germany. New participants in the EU ETS after 2005 are Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania

The figures for Germany differ in part from those mentioned earlier in this section, as the emissions reported by the EEA in the Union Registry were allocated slightly differently in some cases, particularly in the earlier trading periods.[77] Due to changes in the scope and in the allocation of installations to the activity 'Lime production', the figures between the trading periods are only comparable to a limited extent. Therefore, the trend in the third trading period is the primary focus of this report: since the beginning of the third trading period, emissions have remained largely stable, apart from a decline in 2015 and 2016. Compared to 2014, this decrease was around 3.1 percent for Germany in 2016 and around 4.8 percent for the other ETS Member States. In 2017 and 2018, emissions from lime production in both Germany and the rest of the EU were back at a level similar to that at the beginning of the trading period and subsequently decreased by the same amount: compared to 2018 to 2019, emissions for Germany decreased by seven percent and emissions at EU-level installations decreased by five percent.

Overall, emissions at EU-level installations decreased by around four percent compared to 2013. For lime production in Germany, the decrease in emissions according to EEA data (see Figure 18) was six percent from the beginning of the third trading period.

2.6.3 Glass and mineral fibre production

This section includes Activities 16 (Glass production) and 18 (Production of mineral fibres). These activities account for about 11.5 percent of the emissions within the mineral processing industry. Emissions mainly arise in the production of flat and hollow glass (see Figure 37).

Overall, emissions from the installations for glass and mineral fibre production, subject to emissions trading in 2020, fell by 2.6 percent to around 3.9 million tonnes of carbon dioxide compared to the previous year. A total of 76 installations were covered, 69 of which were glass production and seven mineral fibre. One plant from Activity 16 was shut down.

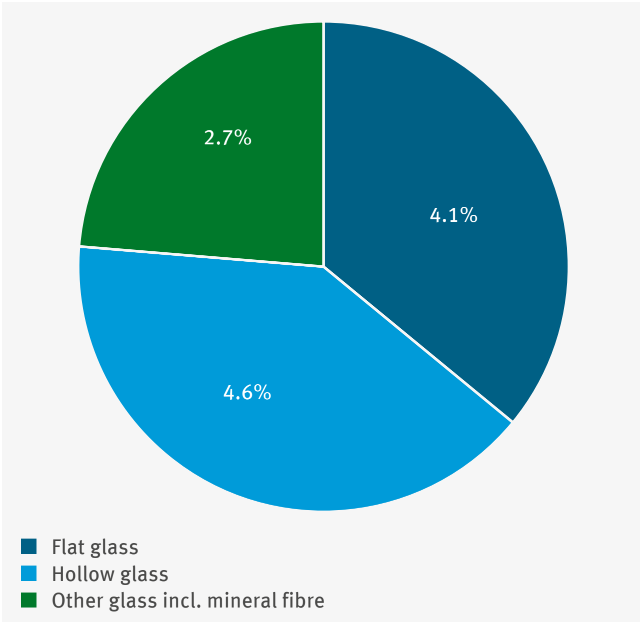


Figure 37: Shares of production of glass and mineral fibre in the emissions from the mineral processing industry in 2020 (Activity 16 and 18)

Table 15 shows the emissions in 2020 compared to the previous year, differentiated by economic sector.[78] Emissions from the production of hollow glass were, as in 2019, around 1.6 million tonnes of carbon dioxide. There are also no changes in emissions from the manufacture of mineral fibre compared to the previous year. Emissions from the production of flat glass have decreased by 4.7 percent. The largest percentage decrease in emissions is shown in the economic sector 'Manufacture, finishing and processing of other glass including technical glassware' with 5.6 percent compared to 2019, but this is not greatly significant due its low absolute level.

77 The energy installations of the sugar industry in Germany were allocated to the combustion plants in the second trading period.
78 The allocation is based on information provided by the operators.

Table 15: Glass and mineral fibre production (Activities 16 and 18), number of installations, 2019 emissions, 2020 free allocation, 2020 VET entries, allocation coverage

No.	Activity	No. of instal-lations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
16	Production of hollow glass	33	1,595	1,598	1,211	75.8%
	Production of glass fibre and goods thereof	8	188	188	122	64.7%
	Production, finishing and processing of flat glass	15	1,497	1,426	1,143	80.2%
	Production, finishing and processing of other glass including technical glassware	13	409	386	329	85.2%
		69	**3,689**	**3,599**	**2,805**	**77.9%**
18	Production of glass fibre and goods thereof	1	9	8	4	56.2%
	Production of other non-metallic mineral goods n. e. c.	6	352	342	268	78.4%
		7	**361**	**350**	**272**	**77.9%**
	N. l. ETS	*1**	*4*	–	–	–
Total		**76**	**4,054**	**3,949**	**3,077**	**77.9%**

As of 03/05/2021
* N. l. ETS not included in total number of installations.

The aggregated shortfall of all installations was 872,000 emission allowances, of which Activity 16 (Glass production) alone accounts for around 794,000. In 2020 the allocation coverage of all installations for glass and mineral fibre production was around 78 percent.

Trends in the third trading period

Figure 38 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 and second trading period, only the average values per trading period are indicated. For the third trading period, the average values and the individual years are shown. The lines in the upper part of the figure show the emissions trend since 2013 for all installations subject to emissions trading in the respective year (including installations no longer subject to emissions trading in 2020, n. l. ETS).[79]

79 For mineral fibre production, which was only included in emissions trading in the second trading period, an estimate was made based on data from the allocation procedure.

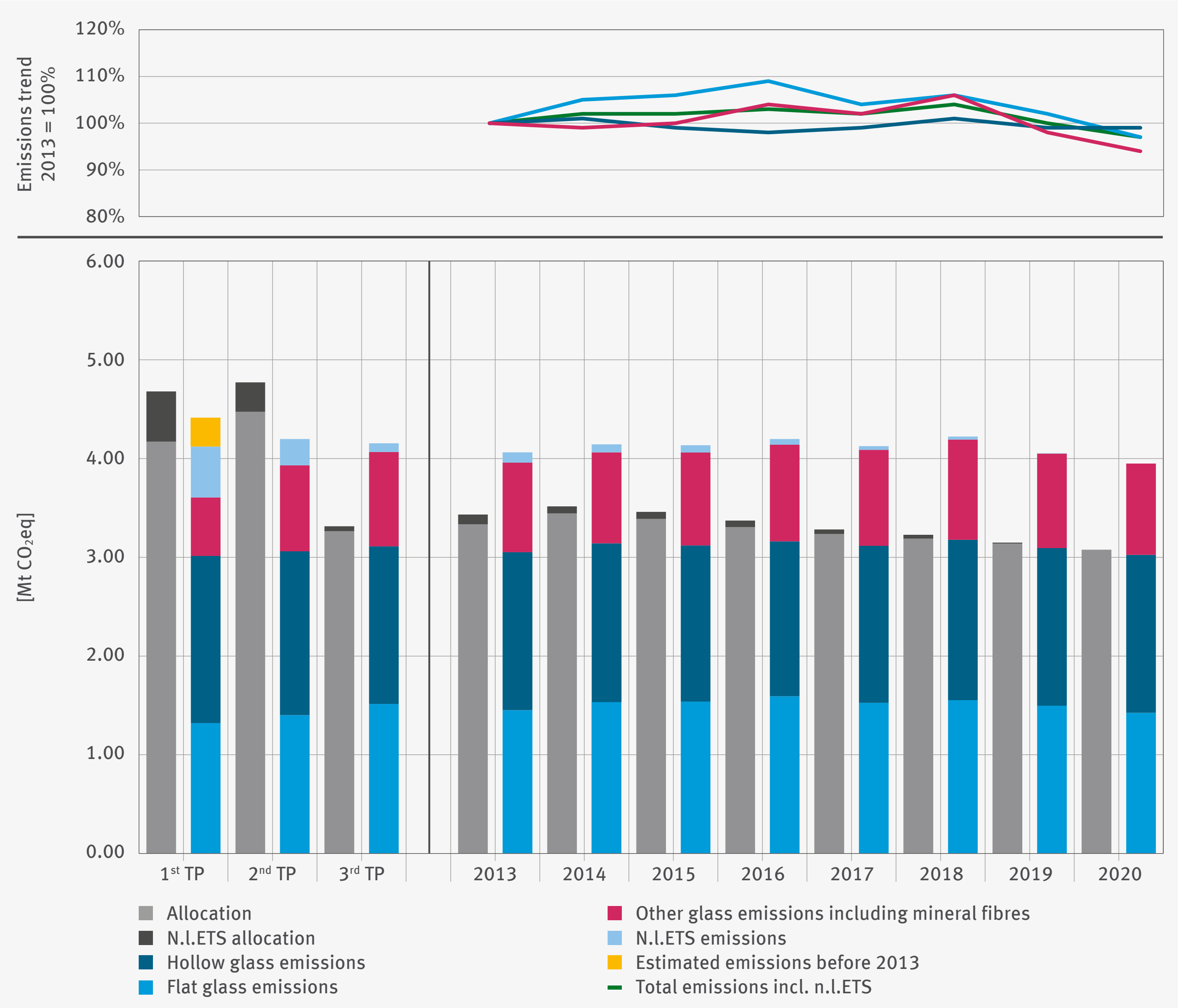


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Figure 38: Glass and mineral fibres production (Activities 16 and 18), 2005 – 2020 emissions and free allocation trends in Germany

No permanent or only minor changes in emissions can be observed in the sector as a whole. After a cyclical decline in emissions in the second trading period, emissions for the entire sector have been slightly above 4 million tonnes of carbon dioxide with minor annual fluctuations since 2013.

Emissions from hollow glass manufacture have been relatively constant at around 1.6 million tonnes of carbon dioxide annually since the start of the trading period.

The production and emissions from flat glass manufacturing installations are determined by the economic situation in the automobile and construction industries. In line with the development of these industrial sectors, emissions rose in the middle of the trading period and then decreased by around 8.2 percent since 2018 compared to the current reporting year.

The decrease in emissions from installations for the manufacture of other glass including mineral fibres has been around six percent since the beginning of the third trading period and around eleven percent compared to 2018. This category includes emissions from the 'manufacture, refining and processing of other glass including technical glassware', 'manufacture of other non-metallic mineral products n. e. c.' and the 'manufacture of glass fibres and articles thereof'.

Only emissions within the current respective scope may be considered (without the yellow column sections) for comparison with the free allocation. As in the other sectors, the allocation situation of the glass industry has changed significantly since the beginning of the third trading period due to the cross-sectoral correction factor so that installations had an annual shortfall. The allocation coverage has fallen from around 85 percent in 2013 to around 78 percent in 2020.

2.6.4 Ceramics production

The ceramics industry consists of numerous installations with a broad product range and comparatively low emissions in comparison to the other sectors subject to emissions trading. The transition between trading periods brought about changes in the scope of emissions trading that have affected the incumbent installations. 140 installations from the ceramics industry were subject to emissions trading in 2020, as in the previous year. These installations accounted for around 5.5 percent of the emissions from the mineral processing industry (see Figure 28).

Emissions from ceramics installations subject to emissions trading in 2020 decreased by 5.8 percent compared to the previous year.

Table 16: Ceramics production (Activity 17), number of installations, 2019 emissions, 2020 VET entries, 2020 free allocations and allocation coverage

No.	Activity	No. of instal-lations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
17	Ceramics production	140	1,994	1,878	1,607	85.6%
Total		**140**	**1,994**	**1,878**	**1,607**	**85.6%**

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The average allocation coverage of the ceramic installations was around 86 percent in 2020.

However, around 26 percent of the installations will continue to receive more free emission allowances than are required for surrender.

Trends in the third trading period

Figure 39 shows the emissions and free allocation trend in the ceramics industry since the start of emissions trading in 2005. The line in the top of the figure shows the emissions trend of all installations subject to emissions trading in the respective year compared to 2013. The bottom part of the figure contains not only the installations currently subject to emissions trading (dark blue and light grey) but also the emissions from and allocations to installations that were no longer subject to emissions trading in 2019 (n.l.ETS) (light blue and dark grey). The emissions from installations that have only been subject to emissions trading since the third trading period were estimated for the period 2005 to 2012 using data from the allocation process (yellow column section). For the first and second trading period, the average emissions and free allocation figures per trading period are only shown. For the third trading period, the average values and the individual years of the trading period are shown.

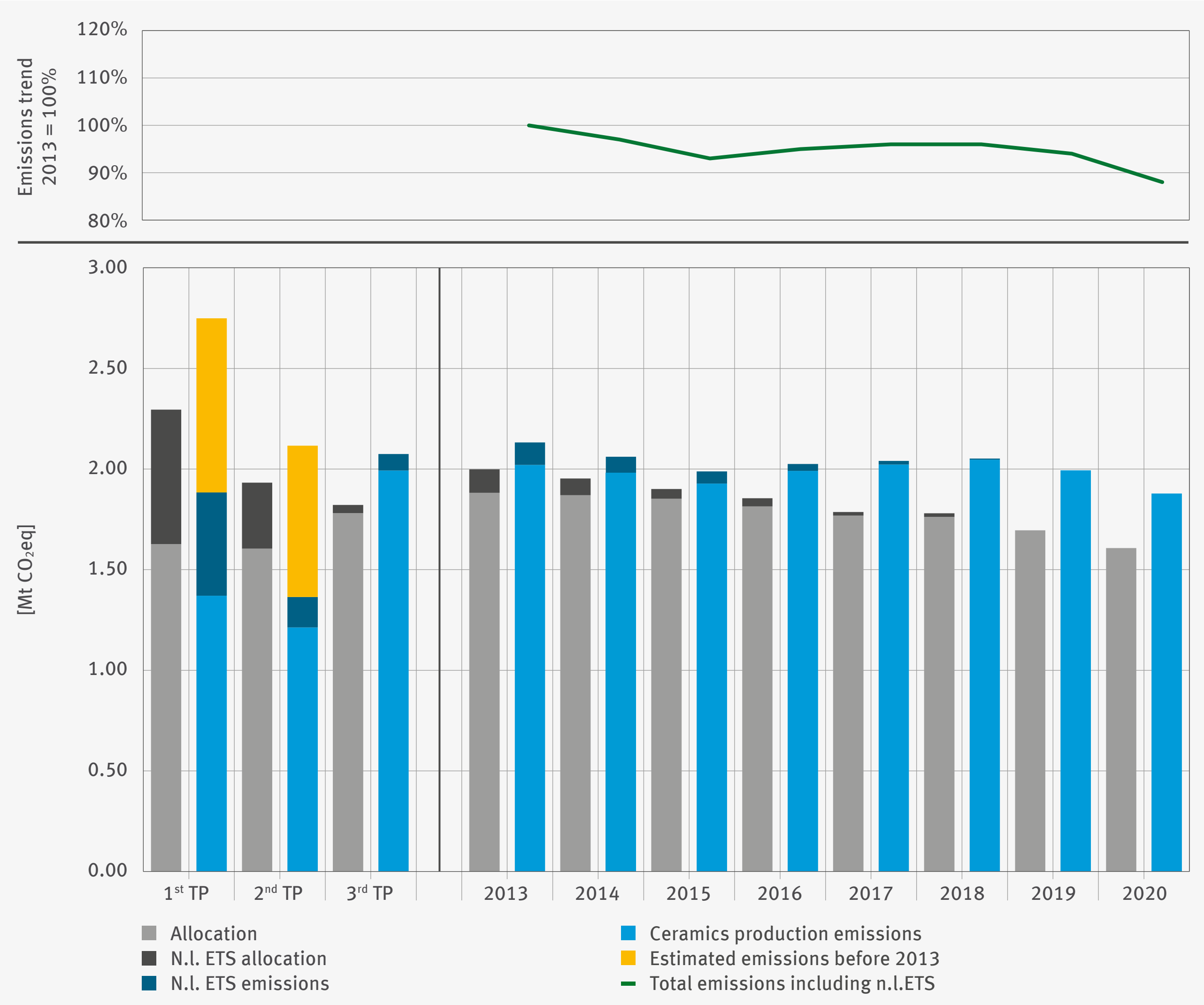

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Figure 39: Ceramics production (Activity 17), 2005 – 2020 emissions and free allocation trends in Germany

Emissions from ceramic installations decreased by 12 percent since the beginning of the third trading period up to 2020. From 2014, emissions were relatively constant at around 2 million tonnes of carbon dioxide and were around 94.2 percent of the previous year's emissions in 2020.

It is only the emissions in the current scope (without the yellow column sections) that may be considered as a comparison to free allocations. As in other sectors, the allocation status of the ceramics industry changed significantly in the beginning of the third trading period so that the installations have had an overall shortfall since 2013. The allocation coverage dropped from around 94 percent in 2013 to around 86 percent in 2020.

2.7 Paper and pulp industry

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

The number of installations increased from 145 in 2019 to 146 in 2020. Five installations were assigned to pulp production and 141 to paper production. The paper and pulp industry's installations emitted about 5 million tonnes of carbon dioxide in 2020. Thus 2020 emissions were about 2.2 percent below the previous year's level. Figure 40 shows that paper production had a share of 97 percent. Pulp production only accounts for three percent of emissions.

In the pulp manufacturing activity, emissions subject to surrender have increased by over six percent from 141,000 tonnes of carbon dioxide in 2019 to 150,000 tonnes of carbon dioxide in the 2020 reporting year (see Table 17). In the paper manufacturing activity, emissions have decreased by 120,000 tonnes of carbon dioxide, or almost 2.4 percent, to about 4.9 million tonnes of carbon dioxide. Paper production fell by 3.3 percent in the same period according to association data.[80]

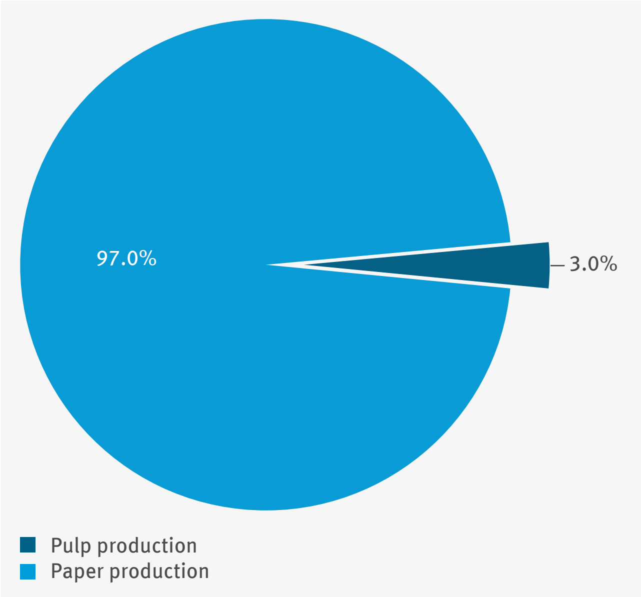

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Figure 40: Shares of the 2020 emissions from the paper and pulp industry (Activities 20 and 21)

The operators of 141 installations in the paper production activity received approx. 5.6 million emission allowances for 2020, i.e. about 780,000 more than they needed to surrender in 2020 according to the VET figures (4.9 million, see Table 17). By contrast, pulp industry installations have a significant overall shortfall of about 54 percent of 2020 emissions.

Table 17: Paper and pulp industry (Activities 20 and 21), number of installations, 2019 emissions, 2020 free allocation, 2020 VET entries and allocation coverage

No.	Activity	No. of instal-lations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
20	Paper production	5	141	150	81	53.6%
21	Pulp production	141	4,971	4,851	5,631	116.1%
Total		**146**	**5,112**	**5,001**	**5,711**	**114.2%**

As of 03/05/2021

80 See VDP (2021), Press release of 01/03/2021

However, the picture changes in terms of allocation coverage (Table 18) if the allocation is adjusted by the estimated allocation amount for heat imports[81]. Overall, the allocation share attributable to heat imports from other installations subject to emissions trading can be estimated at slightly less than 1.6 million emission allowances (cf. Figure 41, shaded area).[82] The allocation coverage in the activities paper production (Activity 21) and pulp production (Activity 20) would fall to around 82 percent without this share (adjusted allocation coverage). This indicates an overall shortfall.

Table 18: Paper and pulp industry (Activities 20 and 21), number of installations, allocation amounts, 2020 VET entries and adjusted allocation coverage

Sector / activity	No. of instal-lations	2020 adjusted allocation amount [1000 EUA]	VET 2020 [kt CO_2-Äq]	2020 allocation deviation from 2020 VET [kt CO_2eq]	Adjusted allocation coverage
Paper and pulp	146	4,116	5,001	–885	82.3%

As of 03/05/2021

Trends in the third trading period

Figure 41 shows the emissions and free allocation trends for the pulp and paper industry in the entire third trading period (2013 to 2020) and the averages of the three completed trading periods (see columns '1st TP', '2nd TP' and '3rd TP' in the bottom part of the figure). The green line in the top shows the emission trend compared to the starting year of the third trading period 2013, i. e. all installations subject to emissions trading in the respective year.

Overall, emissions from the pulp and paper industry have remained relatively constant since the beginning of the third trading period, levelling off at approximately 5.4 million tonnes by 2018. However, in the last two years of the third trading period, there has been a significant decrease in emissions (see Figure 41). Emissions fell by about twelve percent overall by the end of the third trading period compared to the first year of the third trading period. The reasons for this are essentially the production trend and an increase in energy efficiency in production since 2013 (see Figure 42).

81 Many installations engaged in these activities import heat from other installations subject to emissions trading and receive a free allocation in return while the emissions are generated by the heat generating installation. It can be assumed that part of this free allocation is passed on to the heat generating installation.

82 Only the information from the Allocation report (DEHSt 2014a) can be used as an estimate. This figure was derived based on data on heat imports from other EU ETS installations from the allocation procedure (cf. Chapter 7.8 of the Allocation report). This estimate cannot be adjusted to the current situation regarding heat imports in the paper industry as no current data is available.

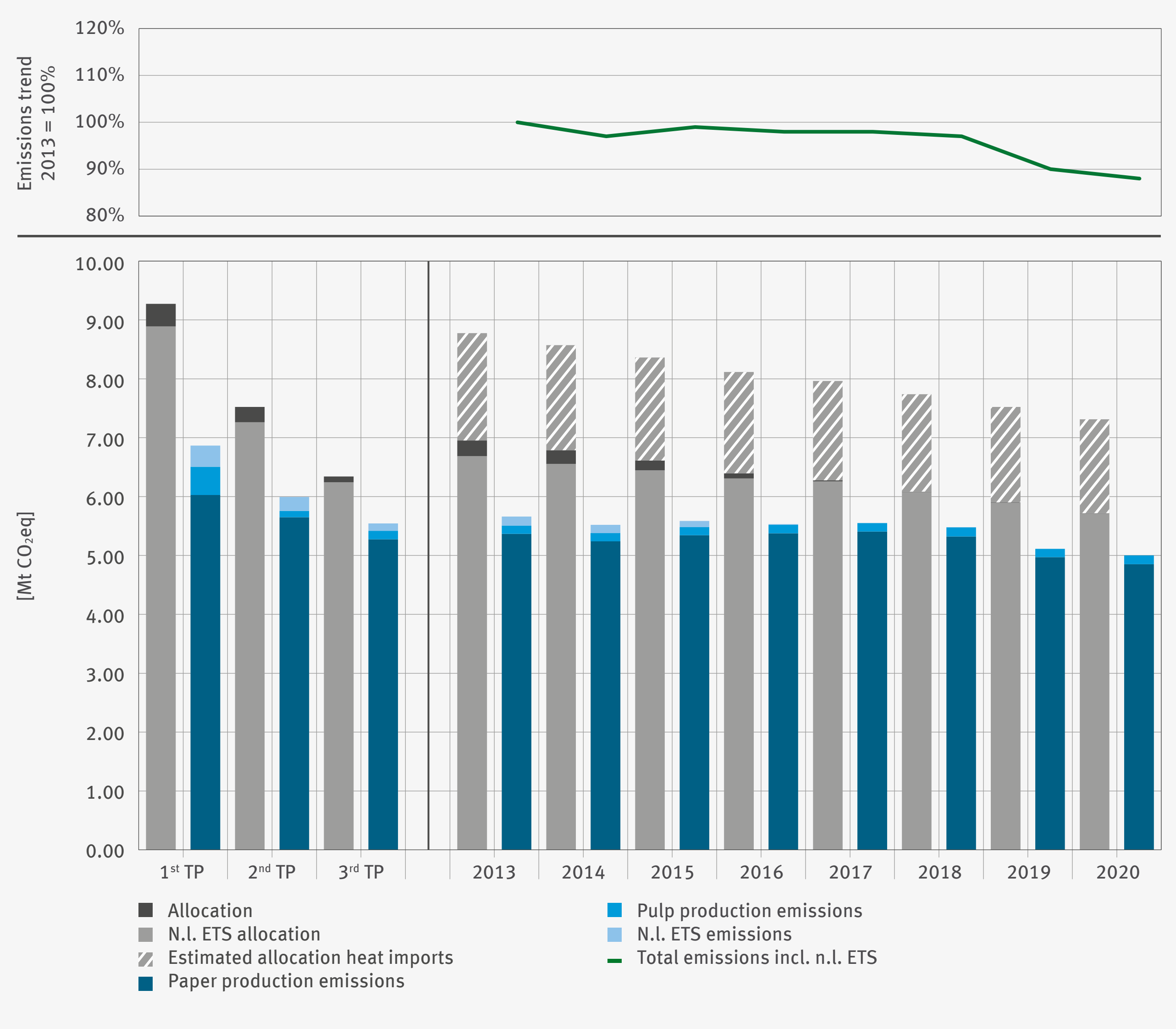

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Figure 41: Paper and pulp industry (Activities 20 and 21), free allocation and emissions trend from 2005 to 2020 in Germany[83]

Figure 42 compares the paper industry's emissions trend with that of the production data. For this purpose, the activity rates of the product benchmarks for 'Fine paper' and 'Newsprint' have been combined to form 'Graphic papers'. The activity rates of the product benchmarks for 'Cardboard' and 'Testliner and fluting' were combined to form 'Packaging'. The activity rates of the product benchmark for 'Tissue paper' (German term: Hygienepapier) are also shown. The activity rates are compared with the relevant data of The German Pulp and Paper Association (VDP) up to 2019. For 2020, only the VDP production data are available.

83 N. l. ETS: Installations no longer subject to emissions trading are taken into account retroactively in the figure in order to show the actual emissions trend of the European Emissions Trading Scheme in Germany since 2005 and not only the emissions trend of installations subject to emissions trading in the respective reporting year (see also Chapter 1 Introduction).

In accordance with the VDP production data, a noticeable decrease in the activity rate for graphic papers compared to the previous year can be observed up to 2019. This trend continues in 2020 according to the available production data of the VDP. A decline is visible over the entire third trading period, which has intensified in recent years. In the 2020 reporting year, the COVID 19 pandemic is also likely to play a role as a reason for the acceleration of this trend: in addition to the trend towards digitalisation, which was intensified by the lockdown, one-off effects such as the closure of sales outlets and the postponement of advertising measures should also be mentioned.[84] In the case of tissue papers, a relatively constant trend at a similar level can be observed in the period from 2016 to 2019, both in the production data and in the activity rate. However, a noticeable increase is visible in the VDP production data in the 2020 reporting year. The reason for this is the increased demand and production of sanitary paper in the wake of the increased hoarding purchases, especially at the beginning of the COVID 19 pandemic. According to the available VDP production data, the production increases already observed in previous years for packaging products will continue in 2020. Here, too, the increased demand for food packaging and online trade during the lockdown is likely to have played a role.[85] In a comparison of the product groups, the strongest increase in packaging products can be observed in the third trading period.

Overall, the activity rates and VDP production data cannot be properly compared since not all installations participate in emissions trading. This may be an explanation for the discrepancy between the different levels of VDP production data and activity rates.

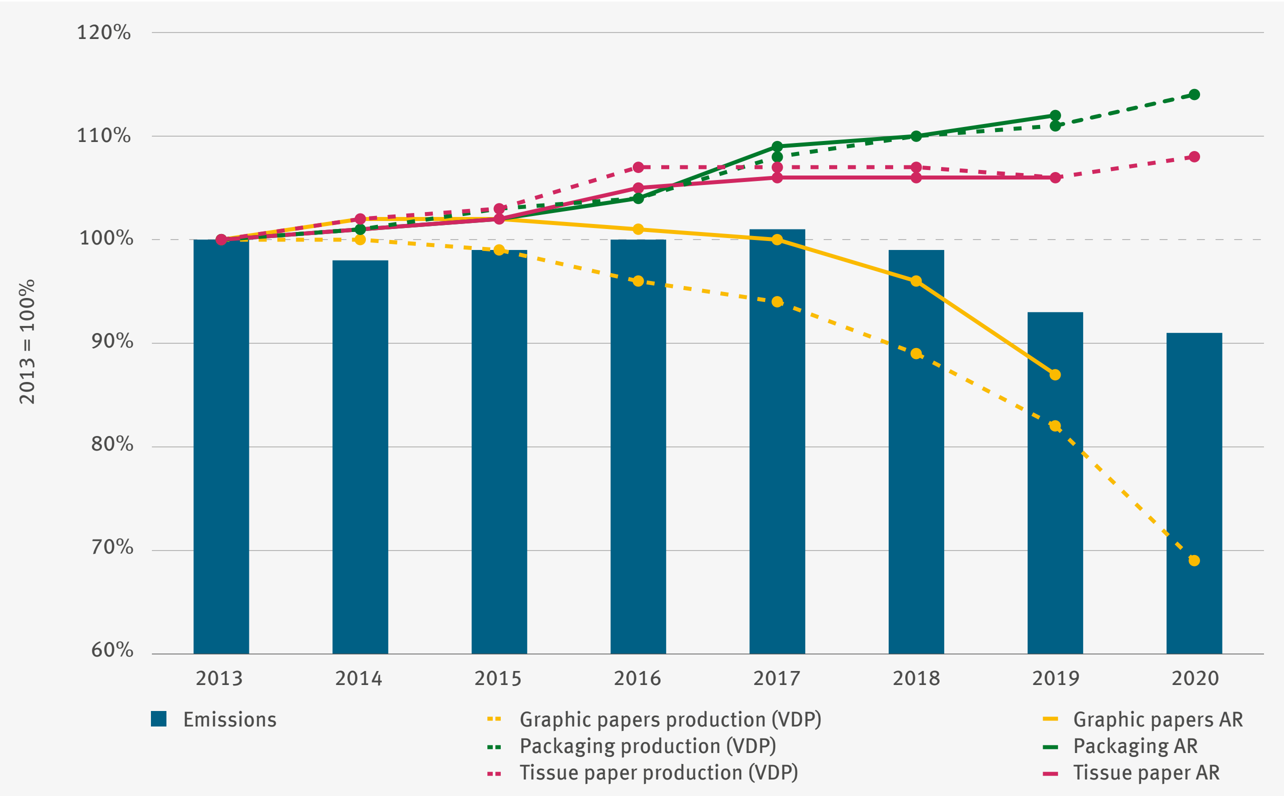

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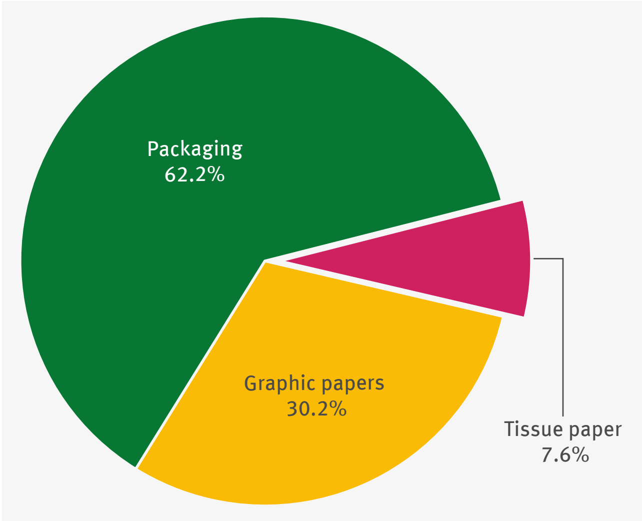
Figure 42: Paper production (Activity 21), emissions and production trends in Germany from 2013 to 2020 compared to 2013

84 See VDP 2021, Press Release of 01/03/2021

85 See VDP 2021, Press Release of 01/03/2021

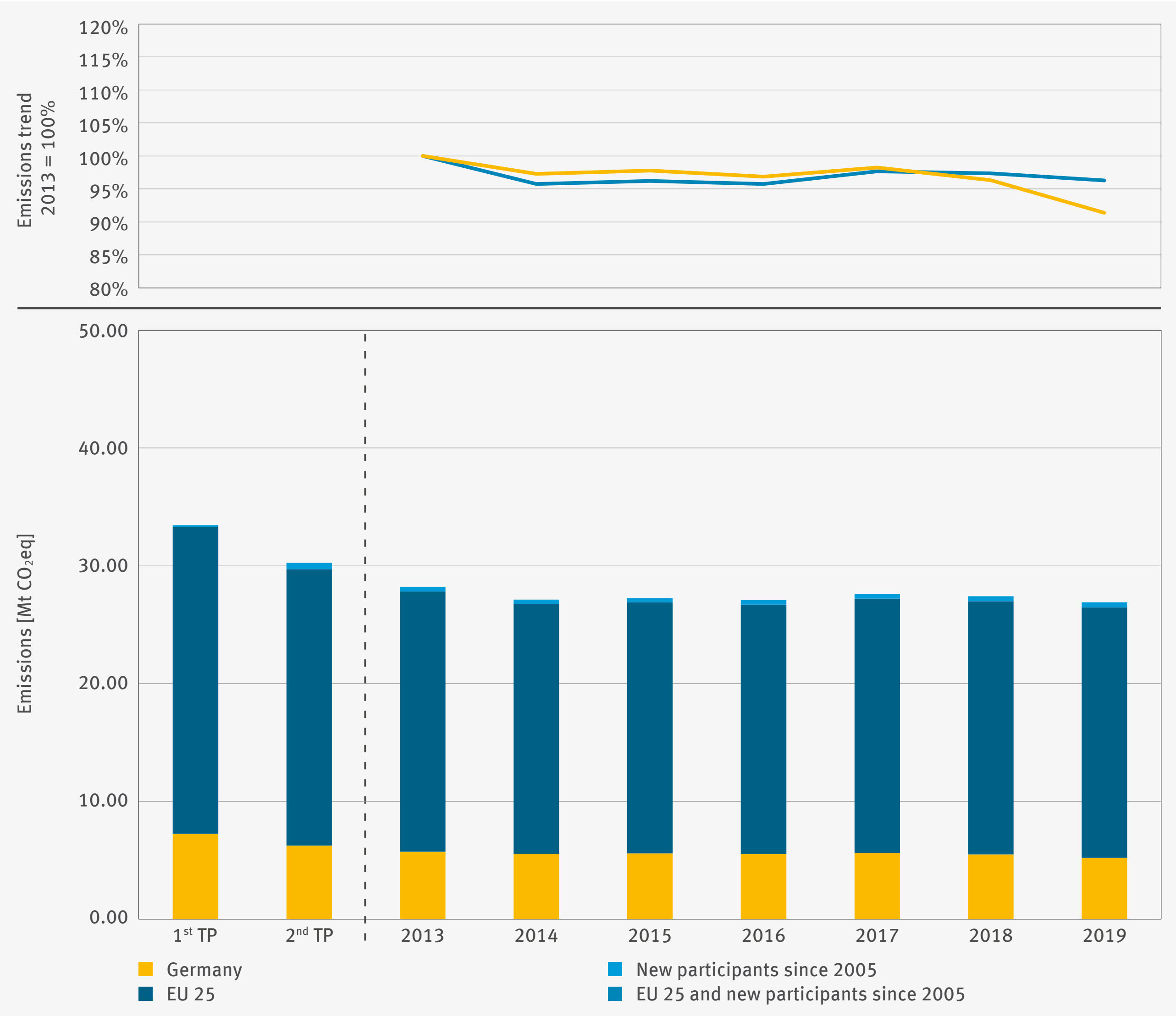
Figure 43 shows the 2020 shares of the above paper production sectors such as Packaging, Graphic papers and Tissue paper using the VDP production data. Packaging production accounts for about 62 percent which is the largest share. Graphic papers have a share of about 30 percent and tissue papers account for slightly less than eight percent.



As of 03/05/2021

Figure 43: Significance of the production of graphic paper, tissue paper and packaging paper for the paper industry subject to emissions trading with shares of 2020 VDP production data

Figure 44 below shows the emissions trend for both the entire EU and Germany. It can be seen that overall emissions from the paper and pulp industry (Registry activities 35 and 36) were clearly decreasing in both the EU and Germany in the third trading period. The decrease in the EU and in Germany was relatively uniform until 2017. Only in 2017 were emissions at EU level and in Germany approximately two percent above the 2016 level. Since 2018, a downward trend in emissions has again been visible where the 2019 emission reduction in Germany of around five percent was clearly greater than the EU's approximately one percent.



As of 03/05/2021

Figure 44: Emissions trend in the paper and pulp industry (Registry activities 35 and 36) in Germany and in the EU up to 2019[86]

86 Data source: EEA 2019; the evaluation is based on grouping the installations by activities in the EU Union Registry (see Table 37, Chapter 7), which can cause differences in the emissions amount in Germany's sectors. New participants in the EU ETS after 2005 are Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania.

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 MW – 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. The chemical industry comprised 226 installations in 2020. The number of incumbent installations has remained relatively constant on balance. The emissions from the chemical industry amounted to around 16.9 million tonnes of carbon dioxide equivalents in 2020, which represent a share of 15 percent of the total emissions from all installations subject to emissions trading.

Figure 45 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. Hydrogen and synthesis gas production (Activity 28) and 'Others' fall into the next largest categories at 10 and seven percent, respectively. The category 'Others' includes installations of Activity 1 (Combustion) and Activity 25 (Glyoxal and glyoxylic acid production). Other activities have the smallest share at less than five percent each.

Emissions from the 226 installations amounted to 16.9 million tonnes of carbon dioxide equivalents in the reporting year. This was 23,000 tonnes of carbon dioxide equivalents or 0.1 percent more than in the previous year. The number of installations also includes 41 polymerisation plants that have been subject to the EU ETS for the first time since 2018 and, with around 101,000 tonnes of carbon dioxide equivalents, are assigned to Activity 27 (production of bulk organic chemicals).

In detail, the picture is mixed. Emissions decreased in some activities and increased in others. Emission increases over the previous year occurred within Activity 27 (production of bulk organic chemicals) with an increase of 270,000 tonnes of carbon dioxide (up 3.6 percent) and Activity 26 (ammonia production) with an increase of 125,000 tonnes of carbon dioxide (up three percent).

Activity 27 (production of bulk organic chemicals) also had the largest absolute change in emissions, followed by Activity 1, 25 (Others) with a decrease of 198,000 tonnes of carbon dioxide (minus 14 percent).

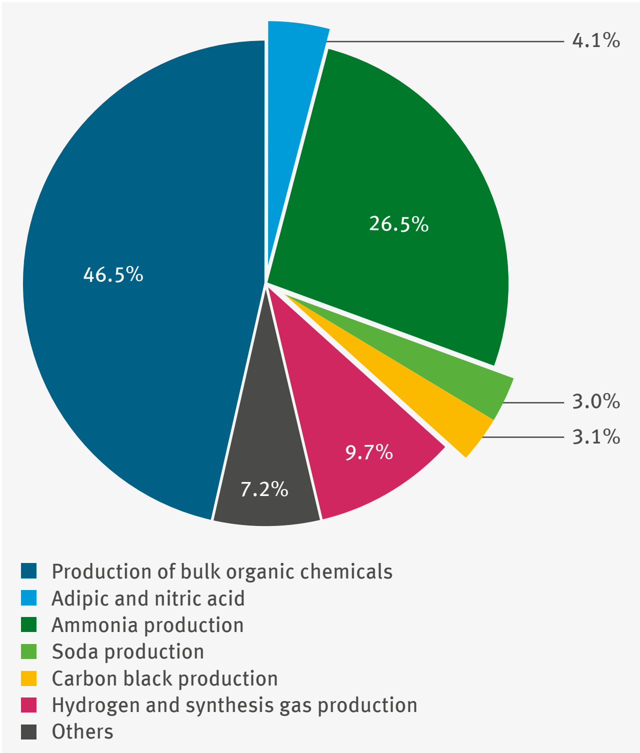


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Figure 45: Shares of 2020 emissions from the chemical industry (Activities 22 to 29 and 1)

Table 19: Chemical industry (Activities 22 to 29 and 1), number of installations, 2019 emissions, 2020 free allocations, 2020 VET entries and allocation coverage

No.	Activity	No. of installations	2019 emissions [kt CO_2eq]	2020 VET [kt CO_2eq]	2020 allocation amount [1000 EUA]	2020 allocation coverage
22	Carbon black production	4	579	518	408	78.9%
23, 24	Adipic and nitric acid	11	672	687	1,579	229.7%
26	Ammonia production	5	4,363	4,488	3,484	77.6%
27	Production of bulk organic chemicals	158	7,594	7,864	8,557	108.8%
28	Hydrogen and synthesis gas production	15	1,715	1,633	1,453	89.0%
29	Soda production	6	557	511	956	187.1%
1, 25	Others	27	1,419	1,221	1,220	99.9%
	N. l. ETS	*1**	*0*	–	–	–
Total			**16,899**	**16,922**	**17,657**	**104.3%**

As of 03/05/2021
* 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 2020 the nitrous oxide emissions amounted to around 581,000 tonnes of carbon dioxide equivalents and accounted on average for 84.6 percent of the total emissions from these installations.

Allocation status

Compared to other industrial sectors, the chemical industry's installations are, on average, adequately provided with free emission allowances (see Table 19).

In 2020, chemical industry installations were allocated 17.7 million emission allowances. This allocation amount was four percent above the total amount of allowances required for surrender. In the previous year, the allocation coverage was 107 percent.

As in previous years of the third trading period, the largest relative surplus allocation with free emission allowances could be observed in the adipic and nitric acid production installations (229.7 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 the bulk organic chemical production installations (109 percent or 693,000 emission allowances) and soda production installations (187 percent or 445,000 emission allowances). In particular, this can be attributed to the allocation rules for cross-installation heat flows: many installations involved in these activities import heat from other installations subject to emissions trading and receive a free allocation in return, while the emissions are produced by heat-generating installations. In addition, many processes producing bulk organic chemicals are exothermic. Efficient heat recovery systems allow a large proportion of the reaction heat to be used without causing additional emissions.

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 2020: the operators of ammonia installations had to purchase a total of one million emission allowances (22.4 percent). Carbon black producers needed 110,000 emission allowances (21.1 percent).

The shortfall for hydrogen and synthesis gas production remained at a level similar to that of the previous year (180,000 emission allowances or 11.0 percent).

Table 20: Chemical industry (Activities 22 to 29 and 1), number of installations, 2020 VET entries, 2020 allocation amounts and adjusted allocation coverage

Sector / Activity	No. of installations	2020 adjusted allocation amount [1000 EUA]	2020 VET [kt CO_2eq]	2020 allocation deviation from 2020 VET [kt CO_2eq]	Adjusted allocation coverage
Chemical industry	226	16,230	16,922	–692	95.9%

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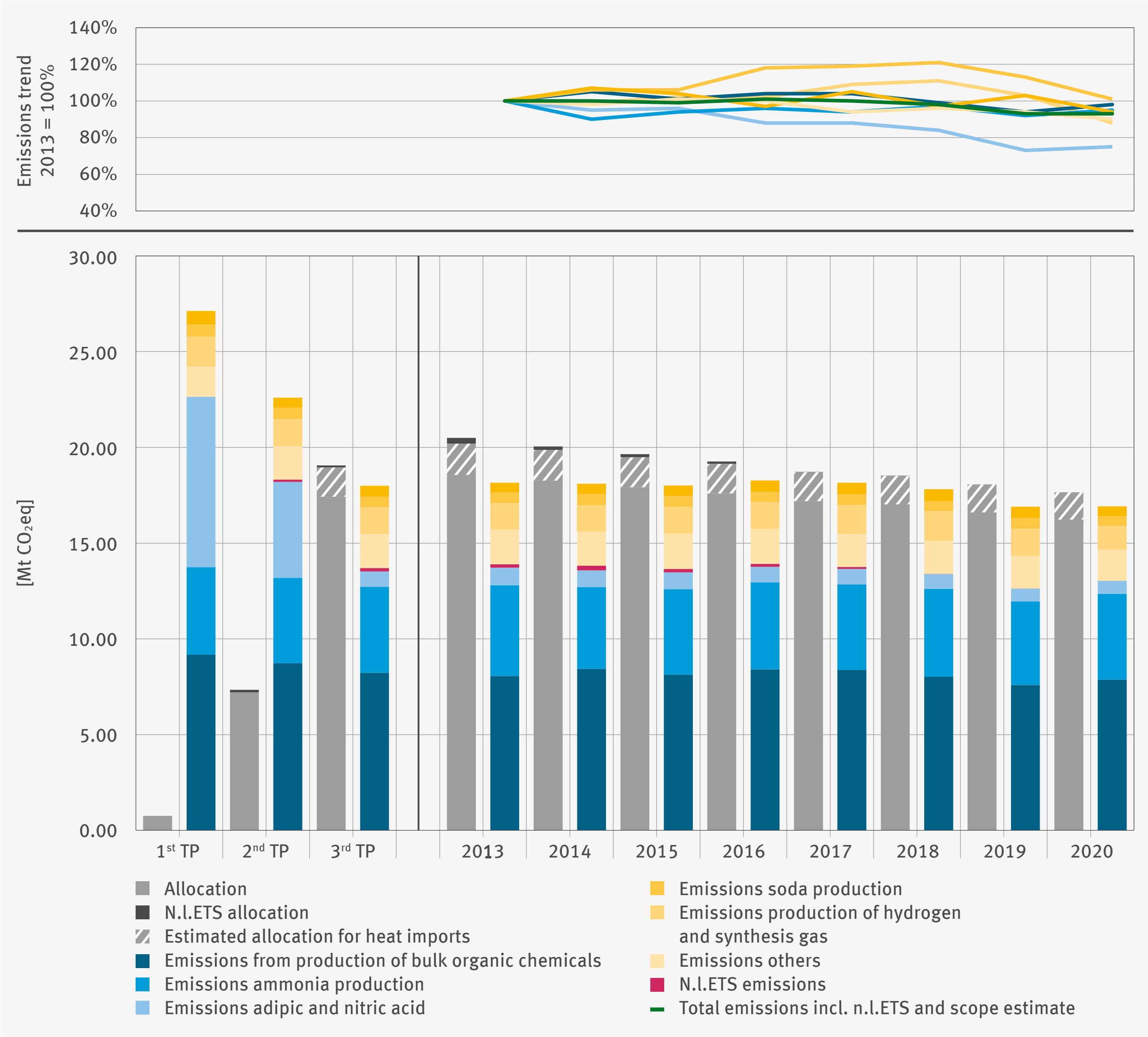
Even after adjusting the free allocation by an estimated allocation for imported heat, the chemical industry's installations are, on average, still relatively well provided with free emission allowances compared to other sectors. After subtracting the estimated allocation amount due to heat imports from other installations subject to emissions trading amounting to approx. 1.6 million emission allowances[87], the chemical industry's adjusted allocation coverage would still be 95.9 percent, which would be a minor decrease over the previous year.

Trends in the third trading period

Figure 46 shows the emissions and free allocation trend of the chemical industry in the period from 2013 to 2020 and, additionally, the averages of each trading period (see columns '1st TP', '2nd TP' and '3rd TP' in the bottom part of the figure). The lines in the top part show the emission trends of the individual activities and of the entire industry compared to the starting year 2013 of the third trading period. The majority of the installations have only reported their emissions since the third trading period so the first and second trading period figures are largely estimated.

Total emissions from the chemical industry remained at roughly the same level in the first few years of the third trading period, only decreasing visibly from 2018 onwards, and were around three to 12 percent below the 2013 level in 2020. Emissions from the various activities fluctuated according to production. The only significant exception is the activity of adipic and nitric acid production: in this sector, emissions have fallen by 25 percent since the start of the third trading period in 2013. This is also one of the key factors for the decrease in emissions (minus seven percent compared to 2013) in the chemical industry as a whole during the third trading period.

87 Only the data from the Allocation Report (DEHSt 2014a) can be used as an estimate. This figure was derived based on data on heat imports from other EU ETS installations from the allocation procedure (cf. Section 7.8 of the Allocation Report). It is not possible to adapt this estimate to the current situation regarding heat imports in the chemical industry as no current data is available



As of 03/05/2021

Figure 46: Chemical industry (Activities 22 to 29 and 1), emissions and free allocation trends in Germany from 2005 to 2020[88]

The decrease in emissions from adipic and nitric acid production in the first and second trading periods largely resulted from the implementation 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 the industry, immission control requirements and above all implementing joint implementation projects in Germany. However, new replacement buildings and further reduction measures have reduced emissions after 2013.

88 N. l. ETS: In the figure, installations that are no longer subject to emissions trading are taken into account retroactively in order to show the actual emissions trend of the European Emissions Trading Scheme in Germany since 2005 and not only the emissions trend of installations subject to emissions trading in the respective reporting year (see also Chapter 1 Introduction).

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.[89] However, this pandemic effect is not directly reflected in the emissions as the affected areas of the chemical industry hardly have any direct emissions.

Figure 46 shows the increase of the allocation from the first to the third trading period according to the extended scope of emissions trading for the chemical industry. Energy installations were already included in emissions trading from the first trading period. Some installations for the production of carbon black, and ethylene and propylene production (steam crackers) were added as early as in the second trading period and were assigned to the chemical industry. Figure 46 also highlights the annual decrease of free allocation since the start of the third trading period due to the cross-sectoral correction factor applied while the emissions trend was fairly constant.

Emissions and production trend

Figure 47 and Figure 48 below show the Activity 27 and 26 emissions which are the highest within the chemical industry. The corresponding activity rates from the annual operational reports and the corresponding data of the German Chemical Industry Association (VCI) are also shown.

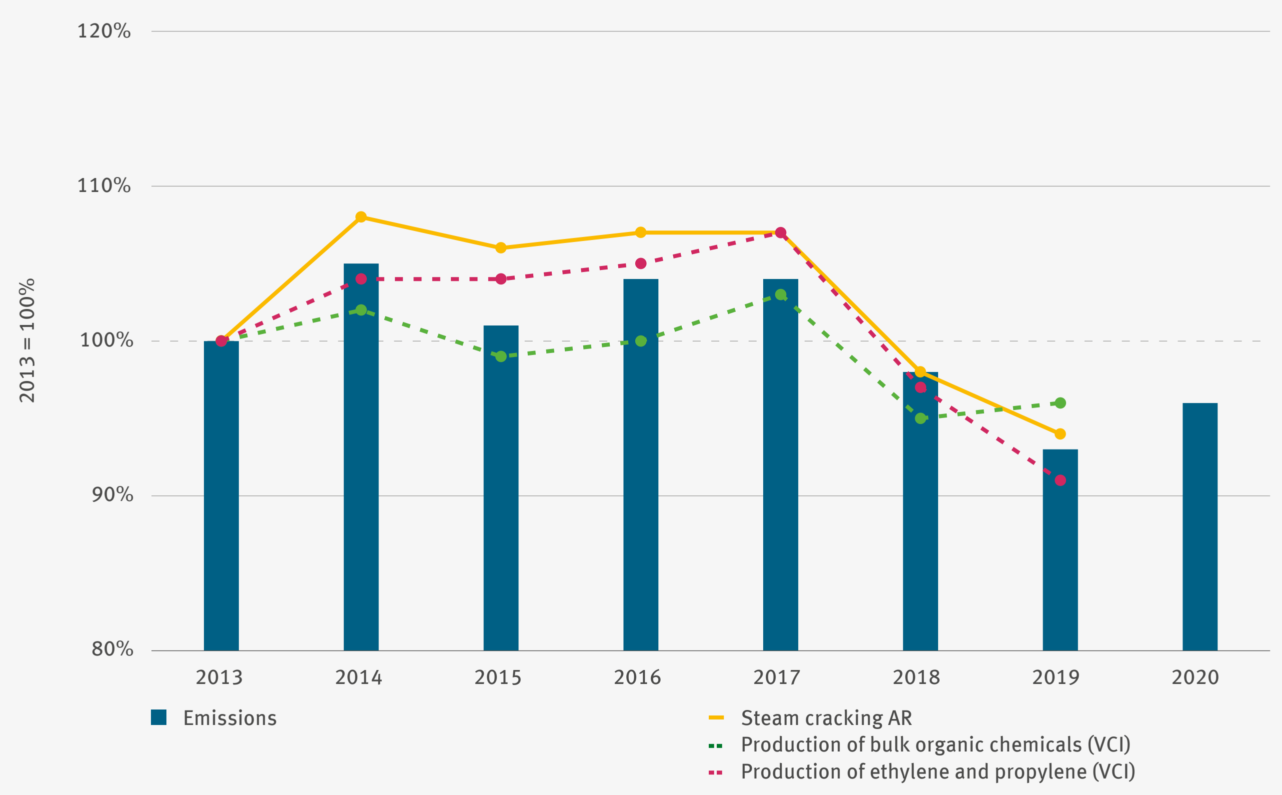
Activity 27 in Figure 47 is the activity rate for the 'steam cracking' product benchmark, as this product benchmark makes up a large part of the total allocation in the production of bulk organic chemicals activity. In addition to the activity rate, the VCI data was included in the illustration comprising an index for bulk organic chemicals and an index for ethylene and propylene being the key products arising from steam cracking.[90]

In principle, emissions, activity rates and production indices were within a similar corridor from 2013 to 2019. The activity rate of the steam cracking product benchmark increased somewhat more steeply than the production index for ethylene and propylene. Both make up only partial areas of the production of bulk organic chemicals, this is why the emission trends are similar but not identical. The differences between the emissions and the VCI production index for bulk organic chemicals can be explained by the fact that the VCI index only includes a selection of typical products but not all of them. Looking at the 2013 – 2020 tendency, a slow decline in emissions since 2017 can be observed. Part of the decreasing emissions can be explained by a decline in demand from Germany and abroad.[91] At the same time, occasional effects such as the overhaul of crackers have a strong influence on the emissions trend of the activity. In 2018, for example, there was a reduction in emissions of around 187,000 tonnes of carbon dioxide equivalents. In 2019, emissions decreased by as much as 372,000 tonnes due to the overhaul of the Böhlen cracker. In 2020, the cracker has already achieved over 90 percent of its 2018 level.

89 VCI 2020a

90 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 2020), while the index for ethylene and propylene comprises only these products. Data gaps for some products were interpolated. The 2018 xylene figure is missing in the VCI publication and has not been included in the index. Therefore the 2018 index is not identical to the previous year but the tendency remains the same.

91 VCI 2019

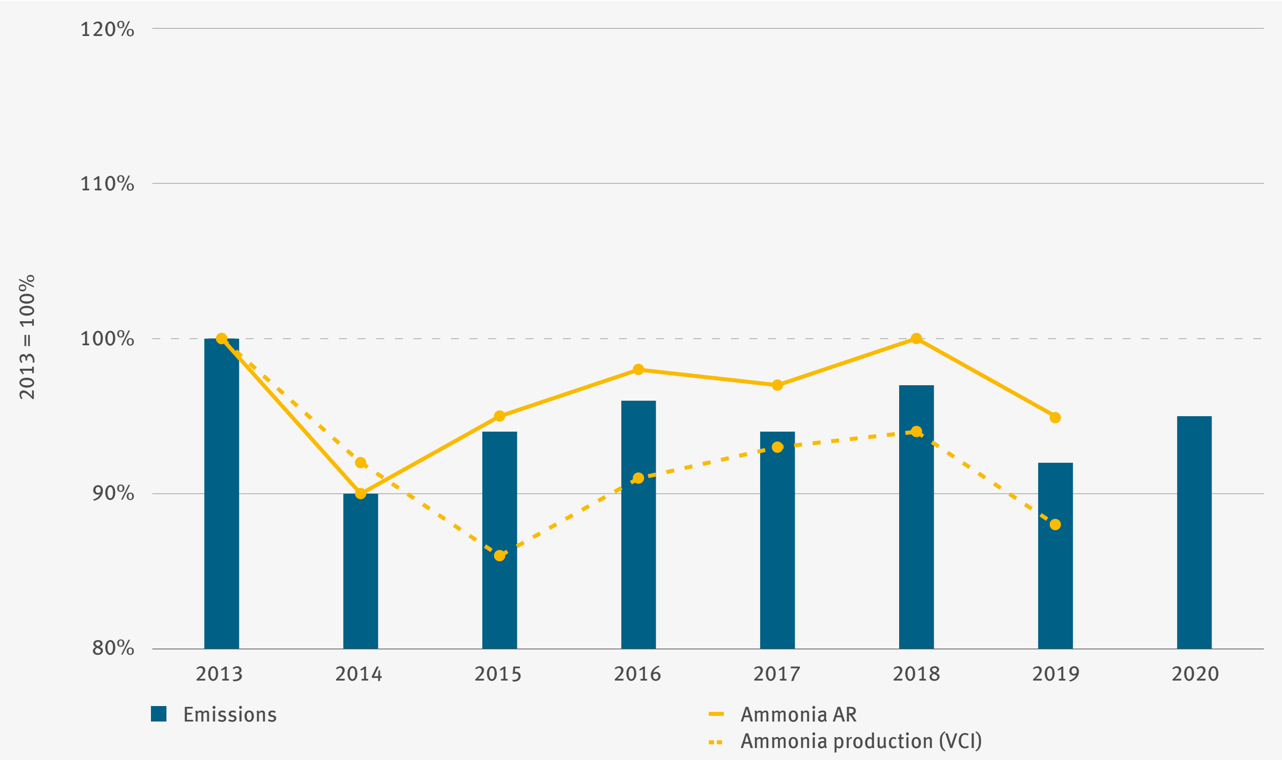


As of 03/05/2021

Figure 47: Production of bulk organic chemicals (Activity 27), 2013 – 2020 emissions and production trends in Germany, each in relation to 2013[92]

The emissions trend for ammonia production (see Figure 48) corresponds relatively well to the trend of activity rate and the Association's data. An inverse trend of the emissions and activity rate compared to the Association's data was only observed in 2015. One ammonia-producing installation is included in the refinery activity because it is approved as a refinery as per Section 4 TEHG. This relatively large installation showed a strong decrease in emissions in 2015 but is not included in the ammonia activity rate however, it is included in the VCI production figures. This can lead to a deviation from the Association's data. After this slump in 2015, however, production data is again approaching the trend of activity rate and emissions.

92 VCI 2013, VCI 2020b. The association's production data are regularly only available with a one-year delay, and the activity rates for 2020 are only exceptionally available from June and not from January of the following year. See explanations in Chapter 1 (Introduction).



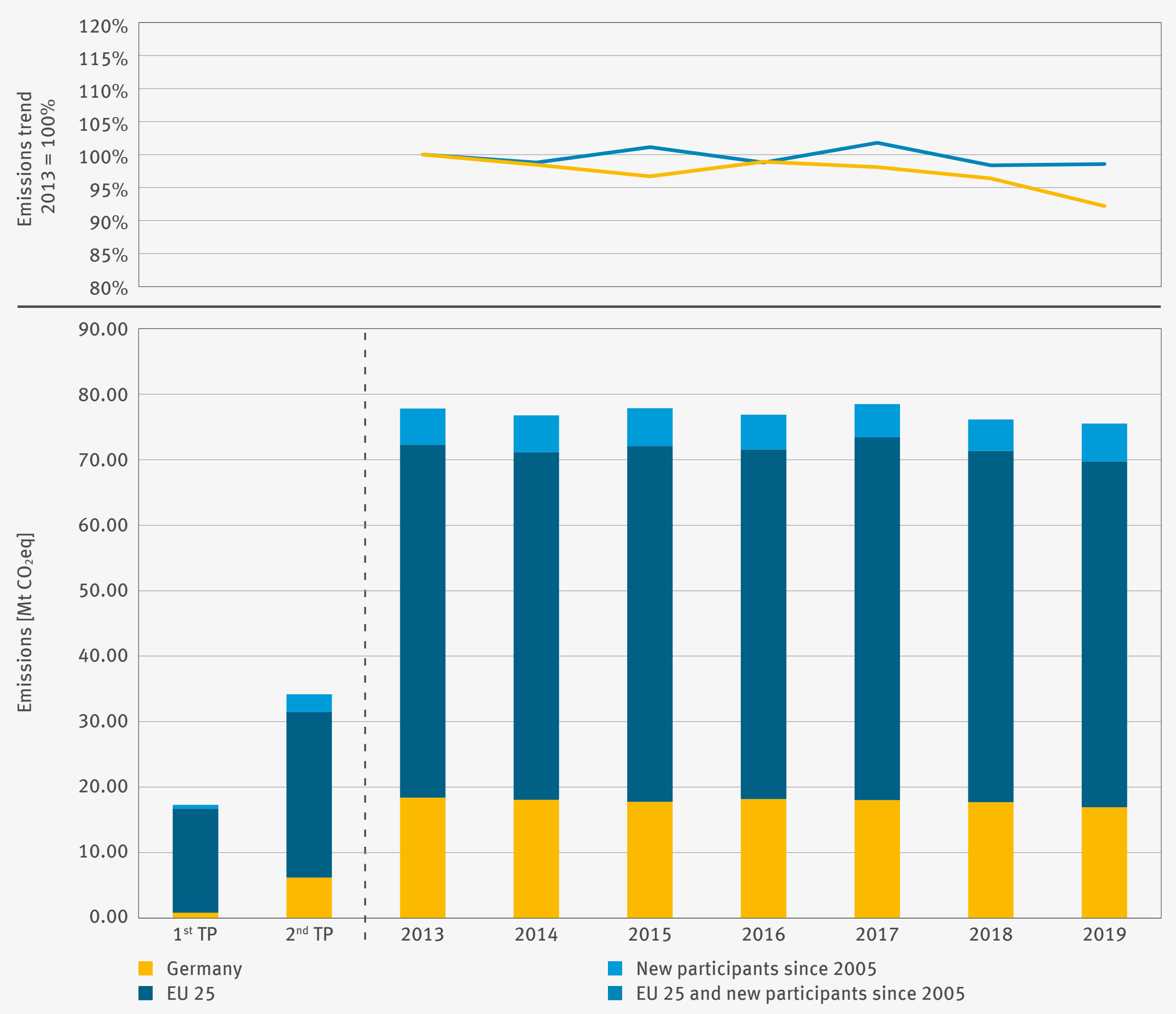
As of 03/05/2021

Figure 48: Ammonia production (Activity 26), 2013 – 2020 emissions and production trends in Germany, each in relation to 2013[93]

The chemical industry in the EU

A look at the chemical industry in a European comparison provides a picture similar to that of Germany. Figure 49 shows that an increasing number of activities were included in the scope of emissions trading for the chemical industry in the first and second trading period. In the third trading period, emissions in Germany decreased by eight percent within the 2013 – 2019 period and by four percent from 2018 to 2019. No clear trend is discernible in a European comparison: emissions fluctuated around their initial figure by plus or minus two percent. The relative trend shows that other Member States experienced fluctuations rather opposite to those in Germany, which was particularly pronounced between 2015 and 2017, however 2018 produced an emission decrease both in Europe and Germany.

93 VCI 2013, VCI 2019b



As of 03/05/2021

Figure 49: Emissions trend in the chemical industry (Registry activities 37 to 44) in Germany and in the EU up to 2019[94]

94 Data source: EEA 2020; the evaluation is based on grouping the installations by activities in the EU Union Registry (see Table 38, Chapter 7), which can cause differences in the emissions amount in Germany's sectors. New participants in the EU ETS after 2005 are Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania.

2.9 Overview of the allocation status in Germany

In the eighth, and final year of the third trading period, the verified emissions of all installations subject to emissions trading in Germany, at 320.3 million tonnes of carbon dioxide equivalents significantly exceeded the free allocation amount for the current year.[95] In 2020, a total of around 136.3 million emissions allowances were allocated free of charge to operators of 1,601 of the 1,817 German installations.

The free allocation thus covered an average of 42.6 percent of the verified emissions from all installations in Germany (2019: 38.8 percent). This means that the average allocation coverage was around four percentage points higher than in the previous year due to the strong decrease in emissions. Table 21 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 the third trading-period allocation rules.

Table 21: 2020 allocation status by activities (non-adjusted allocation coverage)

Sector	No.	Activity	No. of instal-lations	2020 allocation amount [1000 EUA	2020 VET [kt CO_2eq]	2020 allocation deviation from 2020 VET [kt CO_2eq]	2020 allocation coverage*	2019 allocation coverage*
Energy	2	Energy conversion >= 50 MW RTI	469	16,171	200,678	−184,508	8.1%	7.4%
	3	Energy conversion 20 – 50 MW RTI	365	2,470	4,895	−2,425	50.5%	53.1%
	4	Energy conversion 20 – 50 MW RTI, other fuels	13	79	143	−64	55.0%	63.1%
	5	Prime movers (engines)	3	10	42	−32	22.8%	21.0%
	6	Prime movers (turbines)	53	362	791	−428	45.8%	35.9%
			903	**19,091**	**206,549**	**−187,458**	**9.2%**	**8.5%**
Industry	1	Combustion	65	1,613	1,820	−207	88.6%	81.5%
	7	Refineries	23	17,767	22,876	−5,108	77.7%	76.3%
	8, 9, 10	Production of pig iron and crude steel**	35	41,045	27,239	13,807	150.7%	136.4%
	8	Coking plants	4	1,570	3,306	−1,735	47.5%	43.0%
	9	Processing of metal ores	1	62	81	−19	76.9%	80.4%
	10	Production of pig iron and steel	30	39,413	23,852	15,561	165.2%	149.5%
	11	Processing of ferrous metals	87	4,122	4,115	6	100.1%	90.4%
	12	Production of primary aluminium	7	821	963	−142	85.2%	87.7%

95 The number of installations of the 2020 reporting year is used throughout in Section 2.9

Sector	No.	Activity	No. of instal-lations	2020 allocation amount [1000 EUA	2020 VET [kt CO_2eq]	2020 allocation deviation from 2020 VET [kt CO_2eq]	2020 allocation coverage*	2019 allocation coverage*
Industry	13	Processing of non-ferrous metals	31	1,446	1,550	−104	93.3%	91.1%
	14	Production of cement clinker	36	16,190	20,133	−3,943	80.4%	84.2%
	15	Lime production	59	7,068	8,213	−1,145	86.1%	82.3%
	16	Glass production	69	2,805	3,599	−794	77.9%	77.5%
	17	Ceramics production	140	1,607	1,878	−271	85.6%	85.1%
	18	Production of mineral fibres	7	272	350	−77	77.9%	77.5%
	19	Gypsum production	9	276	276	0	99.9%	103.2%
	20	Pulp production	5	81	150	−70	53.6%	58.2%
	21	Paper production	141	5,631	4,851	780	116.1%	116.9%
	22	Carbon black production	4	408	518	−109	78.9%	72.4%
	23	Production of nitric acid	8	627	576	51	108.9%	114.7%
	24	Production of adipic acid	3	951	111	840	857.4%	852.3%
	25	Production of glyoxal and glyoxylic acid	1	7	12	−4	62.7%	74.9%
	26	Ammonia production	5	3,484	4,488	−1,005	77.6%	81.6%
	27	Production of bulk organic chemicals	158	8,557	7,864	694	108.8%	115.3%
	28	Production of hydro-gen and synthesis gas	15	1,453	1,633	−180	89.0%	86.6%
	29	Soda production	6	956	511	445	187.1%	175.2%
			914	117,190	113,726	3,464	103.0%	100.6%
Total			**1,817**	**136,281**	**320,275**	**−183,994**	**42.6%**	**38.8%**

As of 03/05/2021
* Without considering possible adjustments for the transfer of waste gases and for heat imports
** Coking plants, metal ores processing, production of pig iron and steel

The operators of the 914 installations with industrial activities received a total allocation of 117.2 million emission allowances for the 2020 reporting year. This compares with the total verified emissions of 113.7 million tonnes of carbon dioxide equivalents. The allocation corresponded to 103 percent of the surrender obligations of these installations (100.6 percent in 2019) and again exceeded the 100 percent mark.

However, at 90.5 percent (2019: 86.8 percent) the adjusted allocation coverage[96] remains considerably below the 100 percent mark (cf. the following sections with Table 22 and Table 23).

96 See explanations to the adjusted allocation coverage in the Glossary (Chapter 8).

The situation is different for the 903 energy installations (Activities 2 to 6). Due to the discontinuation of the free allocation for power generation in the third trading period, the 2020 ratio of allocation to verified emissions was only 9.2 percent on average thus slightly higher than in the previous year (2019 – 8.5 percent). Overall, in 2020 the energy installations received an allocation of 19.1 million emission allowances for heat generation while the verified emissions amounted to 206.6 million tonnes of carbon dioxide equivalents. The emissions of these installations at about 15 percent clearly decreased more acutely than the allocation, which was however, also about eight percent lower than in the previous year. The noticeable decrease in allocation can be attributed to the fact that no carbon leakage risk applies to a significant part of the allocation to energy installations (see Section 2.1).

Apart from the energy sector, power generation in industry also no longer receives free allocations. This applies to refineries and to the paper industry since (heat and) power stations are usually in operation in both sectors. Thus in 2020, refineries received an allocation that corresponded to only 77.7 percent of their verified emissions (2019: 76.3 percent). The allocation in the paper industry, however, does not indicate that part of the emissions is attributable to power generation. These installations even showed a 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 116.1 percent (116.9 percent in 2019).

35 pig iron and steel production installations nominally received on average a clearly higher allocation (150.7 percent, 2019: 136.4 percent) compared to the 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 123 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 108.0 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 2020, an estimated 11.3 million emission allowances were assigned to waste gas transfer from industrial installations to energy installations and around three million emission allowances to heat imports from industrial installations to energy installations.[97]

Assuming that these allocation amounts were settled between industry and energy sector operators, the industry sector exhibited a deficit of around 10.8 million emission allowances in 2020. Thus, the allocation coverage for the industrial sector would be 90.5 percent instead of the aforementioned 103 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 22). Conversely, under the assumptions made for the energy sector, the allocation coverage as a ratio of adjusted allocation to verified emissions for 2019 increased from 9.2 to 16.2 percent. Table 22 summarises the allocation status adjusted by transferred waste gases from iron, steel and coke production and imported heat for 2020 at the sector level.

97 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 22: Adjusted allocation coverage (taking into account waste gases from iron, steel and coke production and heat imports)

Sector	Sector 3rd TP	No. of installations	2020 allocation amount [1000 EUA]	2020 VET [kt CO_2eq]	2020 allocation deviation from 2020 VET [kt CO_2eq]	2020 allocation coverage*	2020 adjusted allocation amount** [1000 EUA]	2020 allocation coverage **
Energy	Energy installations	903	19,091	206,549	−187,458	9.2%	33,382	16.2%
		903	**19,091**	**206,549**	**−187,458**	**9.2%**	**33,382**	**16.2%**
Industry	Refineries	23	17,767	22,876	−5,108	77.7%	17,767	77.7%
	Iron and steel	123	45,167	31,401	13,765	143.8%	33,898	108.0%
	Non-ferrous metals	38	2,267	2,513	−246	90.2%	2,267	90.2%
	Industrial and building lime	39	5,947	6,378	−431	93.2%	5,947	93.2%
	Cement clinker	36	16,190	20,133	−3,943	80.4%	16,190	80.4%
	Other mineral processing industry	246	6,085	7,951	−1,866	76.5%	6,085	76.5%
	Paper and pulp	146	5,711	5,001	710	114.2%	4,116	82.3%
	Chemical industry	226	17,657	16,922	735	104.3%	16,230	95.9%
	Other combustion plants	37	398	551	−154	72.1%	398	72.2%
		914	**117,190**	**113,726**	**3,464**	**103.0%**	**102,898**	**90.5%**
Total		**1,817**	**136,281**	**320,275**	**−183,994**	**42.6%**	**136,280**	**42.6%**

As of 03/05/2021
* 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

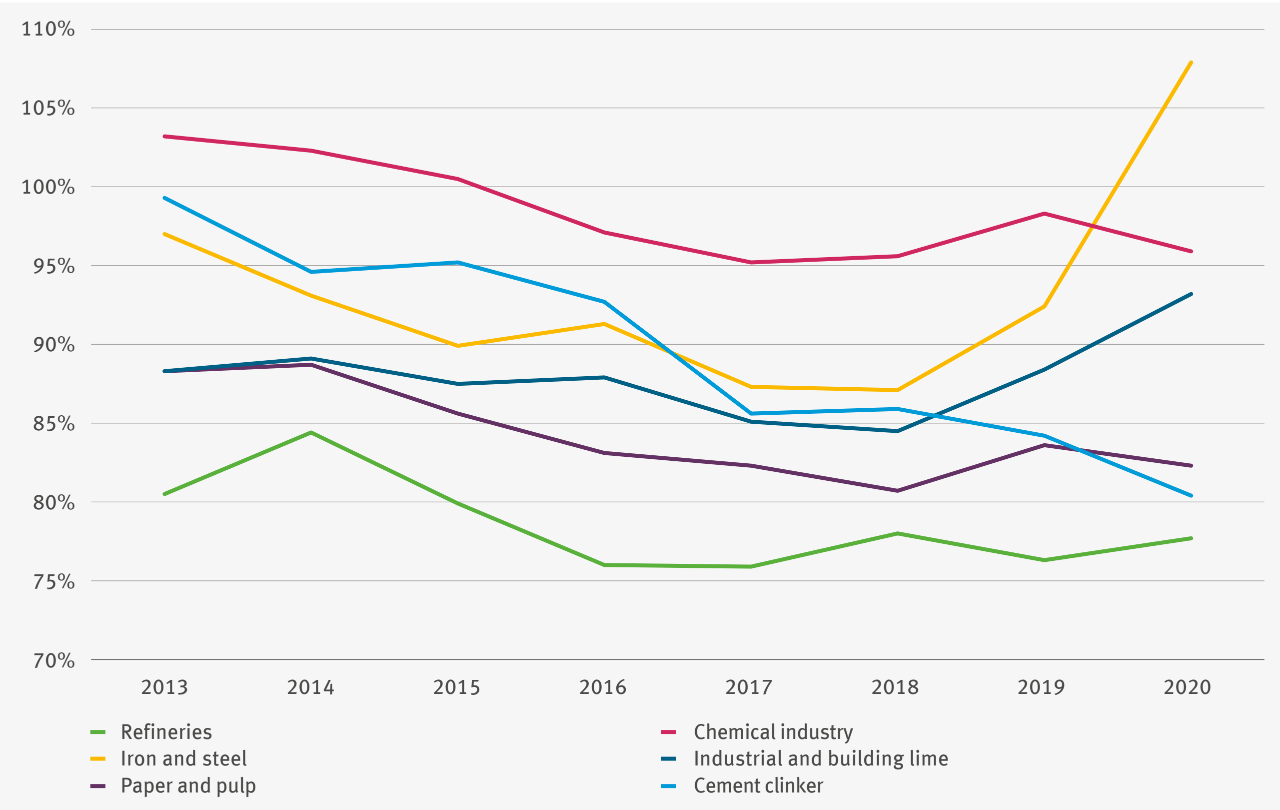
Table 23 and Figure 49 show the trend for adjusted allocation coverage in the course of the third trading period. Relative to 2013, both energy and industrial installations received on average a decreasing free allocation in the first year of the third trading period. However, similar to 2019, the year 2020 showed a slight increase in allocation coverage for both energy and industrial installations (see Table 23).

Table 23: Adjusted allocation coverage since 2013

Industry / sector	2013 allocation coverage*	2014 allocation coverage*	2015 allocation coverage*	2016 allocation coverage*	2017 allocation coverage*	2018 allocation coverage*	2019 allocation coverage*	2020 allocation coverage*
Energy	15.5%	15.5%	14.7%	14.1%	13.9%	13.5%	15.3%	16.2%
Industry	92.9%	92.0%	89.6%	88.1%	85.0%	85.0%	86.8%	90.5%

As of 03/05/2021
* Considering possible adjustments for the transfer of waste gases and for heat imports

An increase in allocation coverage can be seen in all sectors broken down to sector level with the exception of the paper, cement and chemical industries (see Figure 50). For the majority of sectors, the change in the adjusted allocation was more than compensated for by a greater reduction in emissions having an opposite effect.



As of 03/05/2021

Figure 50: Adjusted allocation coverage trends for the largest emitters within the industrial sectors since 2013

For further consideration of the current allocation status, the following section includes not only the allocation surpluses (and deficits) for 2020 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 third 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 96.7 million allowances[98]. Assuming that the allocations for transferred waste gases from iron, steel and coke production and imported heat (145.3 million allowances for 2013 to 2020) are offset between industrial and energy sector operators, the industrial sector shows a cumulative deficit of 110.3 million emission allowances for the concluded third trading period. This deficit has increased continuously in previous years. Until 2019, it had been compensated for, at least in terms of calculation, by the surplus accumulated in the second trading period. In 2020 this imputed surplus has now almost completely dissipated. The total allocation deficit for industrial activities in the period 2008 to 2020 would still amount to around 13.6 million emission allowances. Table 24 summarises the aggregated results, differentiated at sector level.

Table 24: Aggregated allocation status in the second and third trading period

Industry / sector		Cumulative allocation surplus			
		No. of installations	2008–2012 adjusted* [M EUA]	2013–2020 adjusted** [M EUA]	2008–2020 total adjusted** [M EUA]
Energy	Energy installations	903	−358.3	−2.003.4	−2.361.7
		903	**−358.3**	**−2.003.4**	**−2.361.7**
Industry	Refineries	23	11.6	−42.1	−30.5
	Iron and steel	123	52.1	−20.3	31.8
	Non-ferrous metals	38	0.0	−1.5	−1.5
	Cement clinker	36	4.9	−16.4	−11.5
	Industrial and building lime	39	9.5	−7.0	2.5
	Other mineral processing industry	246	6.0	−13.4	−7.4
	Paper and pulp	146	7.5	−6.7	0.8
	Chemical industry	226	5.0	−2.1	2.9
	Other combustion plants	37	0.0	−0.6	−0.6
		914	**96.7**	**−110.3**	**−13.6**
Total		**1,817**	**−261.7**	**−2,113.7**	**−2,375.3**

As of 03/05/2021
* 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

98 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 shortfall of 358.3 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[99] in addition to the ambitious level of the benchmarks set at that time and the proportionate reduction to secure the budget. Since the beginning of the third trading period, full auctioning has been in effect for electricity generation throughout Europe. As a result, the energy sector's cumulative shortfalls at the end of the third trading period increased to a total of 2,361.7 million emission allowances (of which 2,003.4 million allowances in the third trading period). This takes into account the balance from the second trading period and assumes offsetting the free allocation for waste gases from iron, steel and coke production and heat imports between the industrial sector and the energy sector.

Use of project credits

When assessing cumulative under and over allocation, it should be noted that in the second trading period, operators were able to surrender project credits (CERs/ERUs from CDM/JI projects[100]) in addition to emission allowances (EUA). German operators were allowed to surrender CER/ERUs up to an amount corresponding to 22 percent of their allocation. Unused claims generally remained in place in the third trading period[101]. Operators without a previous claim may in principle use CER/ERUs up to an amount corresponding to 4.5 percent of their aggregated emissions in the third trading period. Since the prices for project credits are always below the price level of EUA (see Section 3.3 on price trends with Figure 53 and Table 26), the usage claims lead to an effective relaxation of the allocation status for the installations concerned.

For the 1,817 installations considered in this report, the total claim for the use of project credits is 414.3 million allowances at the end of the third trading period. This claim relates to the entire period from 2008 to 2020[102]. Of these, 270.7 million project credits have already been surrendered in the second trading period (2008 to 2012). In the third trading period, a further 141.8 million credits were used by the installations under consideration for conversion into EUA.

From the fourth trading period onwards, it is no longer possible to use project credits in the EU ETS; this also includes unused claims from the second and third trading periods. Table 25 summarises the aggregated results differentiated by the industrial sector and the energy sector.

Table 25: Surrendered and converted project credits in the second and third trading period

Sector	No. of installations	2008 – 2020 total claim for CER / ERU use [M]	2008 – 2012 surrendered CER / ERU [M]	2013 – 2020 converted CER / ERU [M]	2008 – 2020 residual claim for CER / ERU use [M]
Industry	914	154.5	123.5	29.7	1.3
Energy	903	259.8	147.2	112.1	0.5
Total	**1,817**	**414.3**	**270.7**	**141.8**	**1.8**

As of 03/05/2021

99 The free allocation for electricity generation was increased by 38 million allowances annually in accordance with the provisions of Section 20 Allocation Act 2012, to be reduced in favour of the disposal budget.

100 CDM = Clean Development Mechanism; JI = Joint Implementation

101 However, CER/ERUs can no longer be surrendered directly but must be converted into EUAs in the Union Registry.

102 The total claim reported takes into account claims from the second trading period as well as claims derived from emissions for the reporting years 2013 to 2018. In the course of the third trading period, the total claim will increase further depending on the verified emissions for the years 2019 to 2020.

Infobox: German involvement in the use of the Kyoto Protocol's project mechanisms

In 2006, during the first trading period of the EU ETS, the use of credits from the project mechanisms of the Kyoto Protocol was permitted by an amendment to the Emissions Trading Directive[103]. In accordance with the 'credit and baseline' approach, these mechanisms enabled additional certified emission reductions in a transparent and internationally coordinated review process, which can be used to a predefined extent for the surrender obligation in the EU ETS. Subsequently, these credits can also contribute to the fulfilment of the emission reduction obligations of parties of the Kyoto Protocol. This approach is based on the idea that emission reductions can be realised where the costs are lowest because it is of secondary importance where the emissions of globally effective greenhouse gases such as carbon dioxide are reduced.

The required national approval body for projects of this type was established in the DEHSt at the German Environment Agency. Between 2008 and 2012, projects implemented in Germany under Joint Implementation (JI) were eligible for recognition base on the Project Mechanisms Act (ProMechG) in addition to projects abroad. Based on 25 projects reviewed and recognised by DEHSt, credits (Emission Reduction Units, ERUs) amounting to 13,580,270 ERUs were generated in the sectors not subject to emissions trading and made available for emissions trading.

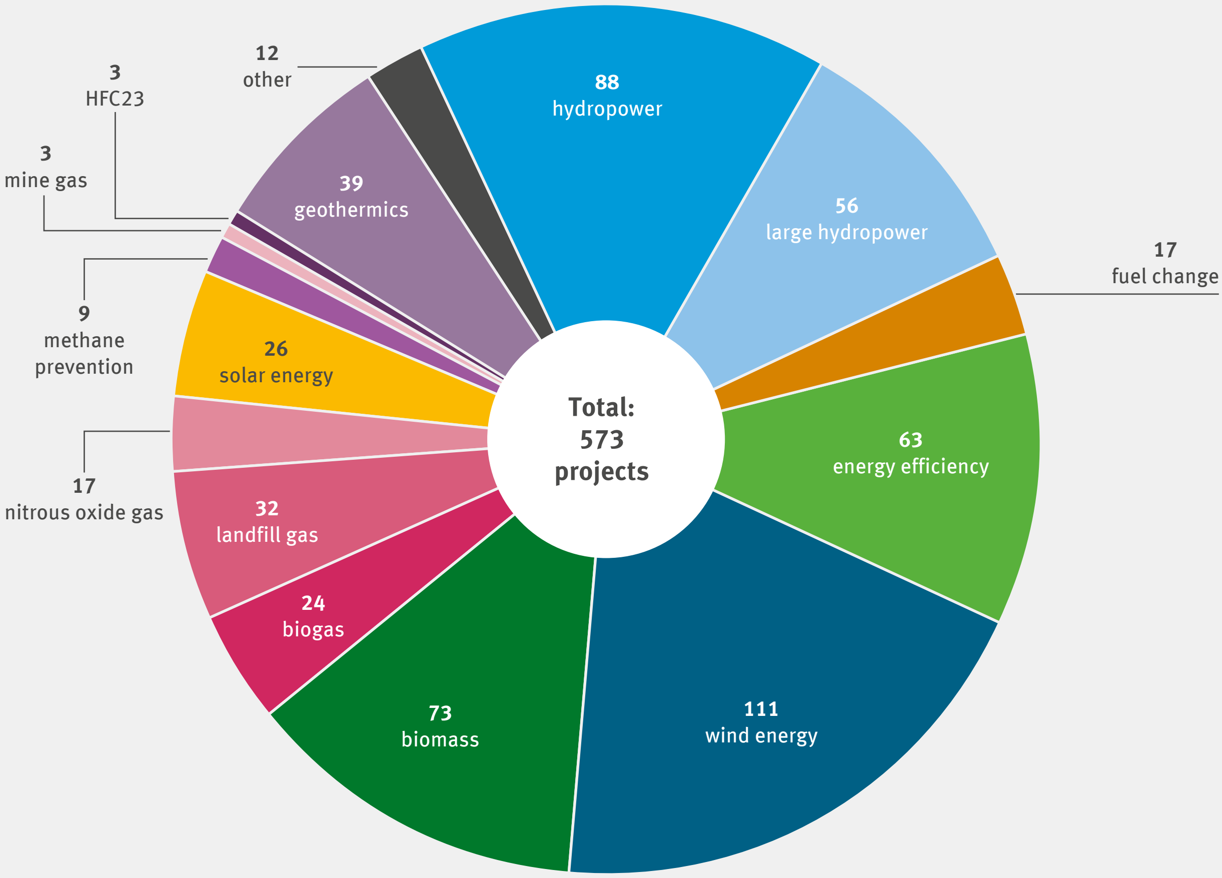
During this period, German companies also participated in 33 JI projects in other industrialised countries in order to acquire credits (ERUs) there.

However, German companies' participation in projects in developing countries under the Clean Development Mechanism (CDM) was the most extensive. This instrument could also be used during the second commitment period of the Kyoto Protocol from 2013 onwards, meaning German approval could be given for 515 projects up to 2020. Various project types were created in the field of energy generation, industry, households, waste management or agriculture. From a German perspective, the host countries are distributed worldwide, with a focus on the emerging Asian economies which were quick to access this investment instrument in the climate-friendly modernisation of their industries (see Figure 51). In addition to the cost-effective fulfilment of mitigation obligations, the CDM also aimed to contribute to the sustainable development of host countries, for example through technology transfer or improvements in the working and living conditions of the population. This was achieved by improving air quality or increasing the availability of energy from renewable sources. Through a mandatory surrender on the generated credits (Certified Emission Reductions, CERs) amounting to two percent, financial contributions were also generated for the adaptation fund of the Framework Convention on Climate Change.

During this time, a liquid secondary market was established worldwide between the generation of credits and their surrender for compliance which was characterised by a large number of specialised stakeholders such as project developers, verifiers and traders. A direct relationship between project development and companies obliged to surrender in the EU ETS was not mandatory in this context, meaning that the credit yield of a project cannot be reflected in the concrete surrender of a participating company. However, when the EU's utilisation quota was largely exhausted from 2013 onwards, there was a massive drop in prices due to a lack of demand from other states (see Figure 56, page 95).

With the end of the second commitment period of the Kyoto Protocol, which coincided with the third trading period in the EU, the possibility of using credits from the project mechanisms comes to an end. The fourth trading period, which serves to implement the European reduction commitment from the Paris Agreement (NDC), no longer envisages the use of credits.

103 EU 2014 b



As of 03/05/2021

Figure 51: Projects approved by Germany (project types CDM, JI domestic, JI abroad)

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

The emissions from the approximately 10,000 ETS installations in the 31 countries participating in the European Emissions Trading Scheme[104] in 2020 were around 11.2 percent below the emissions in 2019 and, according to the European Commission, amounted to about 1.33 billion tonnes of carbon dioxide equivalents[105]. This is the strongest annual decrease since the beginning of emissions trading. The drop in emissions of almost 180 million tonnes of carbon dioxide equivalents compared to the previous year was thus more than five times as large as the annual reduction in the cap (minus 38 million emission allowances). In all years of the third trading period, emissions from stationary installations were significantly lower than the maximum number of allowances available for the respective year (nominal cap), on average by around 250 million tonnes of carbon dioxide equivalents.

However, the actual number of allowances available is lower than the nominal cap. This is partly due to the Market Stability Reserve (MSR), which has been in effect since 2019 which reduces the quantities of emission allowances (EUAs) to be auctioned. In 2020, the EUA volumes to be auctioned were reduced by around 376 million EUAs[106] across the EU. However, almost 200 million more emission allowances were auctioned than in the previous year, partly because The United Kingdom, whose auctions were partially suspended in 2019, auctioned remaining quantities from 2019 in 2020. This, combined with the relatively sharp decrease in emissions, meant that the surplus despite MSR increased significantly against the previous year for the first time since 2015 (plus 14 percent compared with the end of the previous year). According to the European Commission, the surplus at the end of 2020 was around 1.6 billion emission allowances[107].

3.1 Emission trends in the EU ETS Member States

According to the European Commission, emissions from installations participating in the EU ETS decreased by 11.2 percent in 2020 compared to 2019, amounting to 1.33 billion tonnes of carbon dioxide equivalents. The decrease in emissions was even greater than in 2009 during the economic and financial crisis. The trend across Europe was similar to Germany, where emissions in the stationary sector decreased by about 12 percent. As in previous years, the strongest decrease in emissions was recorded in emissions from electricity generation (14.9 percent decrease)[108]. The reason for this was the significant decrease in electricity generation from coal-fired power plants by a total of about 22 percent compared to the previous year due to a specific combination of exceptional effects in the past year[109]. Favourable weather conditions and low electricity consumption resulting from the pandemic restrictions led to a record value for the share of renewable energy sources in electricity generation (39 percent). In addition, the comparatively high EUA price and low gas prices contributed to an increased fuel switch from coal to natural gas[110]. As a result of industrial production restrictions during the pandemic constraints, emissions from industrial installations also decreased significantly in 2020 (around seven percent) compared to previous years.

104 EU 27 plus The United Kingdom, Iceland, Liechtenstein and Norway. The United Kingdom ceased to be a member of the EU on 31/01/2020 but participated in the EU ETS until 31/12/2020. A national emissions trading system has been in force there since 01/01/2021.

105 COM 2021d. The data published on the European Commission website on 15/04/2021 are provisional and based on the entries of 01/04/2021. At that time not all installations had reported their emissions. Unless otherwise stated, the data mentioned in this section is based on the more recent information of 05/05/2021 (COM 2021b).

106 The total reduction for all 31 Member States participating in the EU ETS was 376 million EUA. Of this, The United Kingdom accounted for around 44 million EUAs in mathematical terms. However, United Kingdom's regular auctions were initially suspended in 2019; from March 2020, the remaining quantities from 2019 will also be auctioned in addition to the regular UK auction quantities for 2020.

107 COM 2021c (TNAC communication of 12/05/2021)

108 COM 2021d

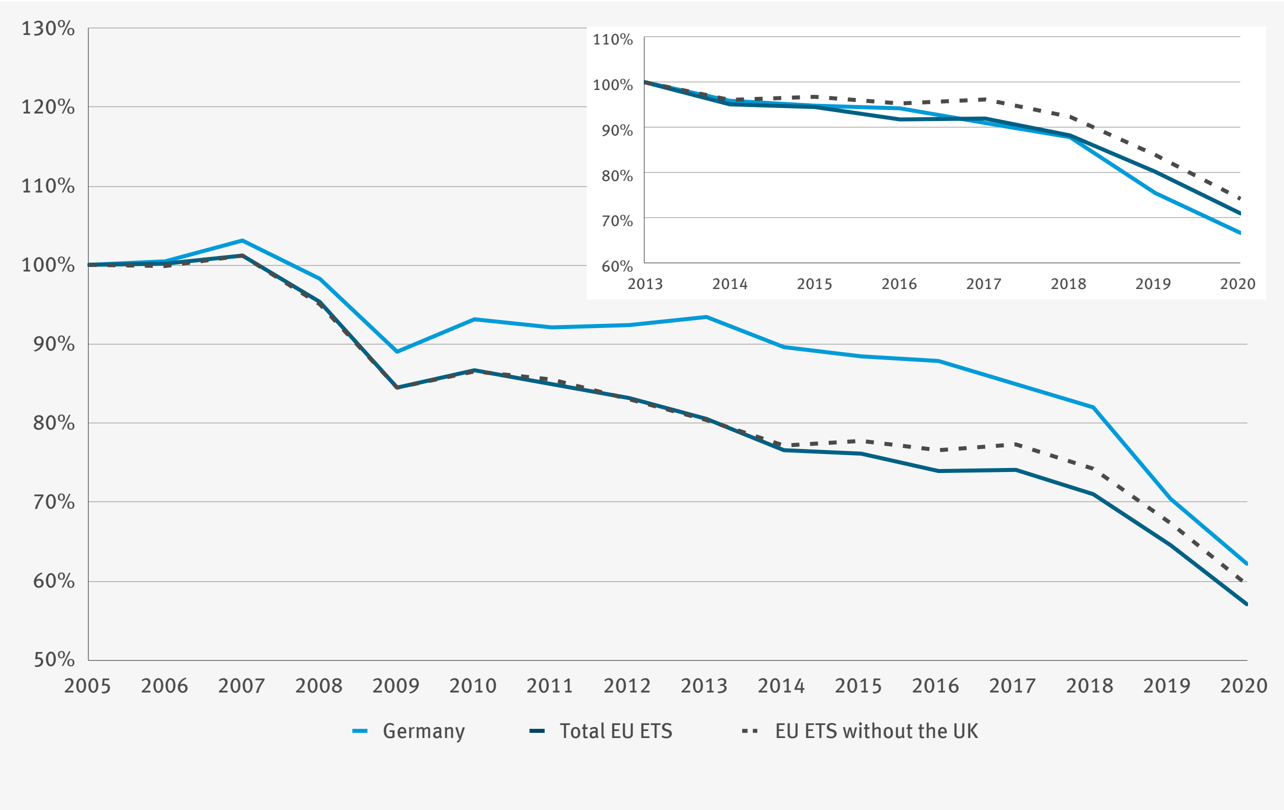
109 DG Energy 2021

110 The share of renewable energies in electricity generation (39 percent) exceeded the share of fossil electricity generation (36 percent) for the first time in 2020. DG Energy 2021.

Since the start of emissions trading in 2005, emissions from EU ETS installations across Europe have decreased by around 43 percent compared to the baseline, while emissions from installations in Germany have decreased to a slightly lesser extent, by 38 percent (compare Figure 52).

The emissions decline took place predominantly in the second trading period, when emissions decreased by 12 percent between 2008 and 2012 as a result of the economic and financial crisis. After the decline in emissions slowed somewhat at the beginning of the third trading period, emissions have once more significantly decreased since 2018. 2019 recorded the strongest decline in emissions since 2009. In 2020, emissions decreased very sharply once more and were around 29 percent below the 2013 level. On average, emissions across Europe have decreased by around 80 million tonnes of carbon dioxide equivalents per year since the start of the trading period, more than twice as much as the cap cut by around 38 million emission allowances every year.

After emissions in Germany decreased slightly less in the second trading period and in the first half of the third trading period than in other EU ETS Member States, the emissions trend of German installations aligned with the European trend in the following years: overall, emissions have actually declined somewhat more in Germany since the beginning of the third trading period (minus 33 percent) than in the EU ETS states as a whole (minus 29 percent). This is predominantly due to the significant emissions decrease from German energy installations in 2019 and 2020.



As of 03/05/2021

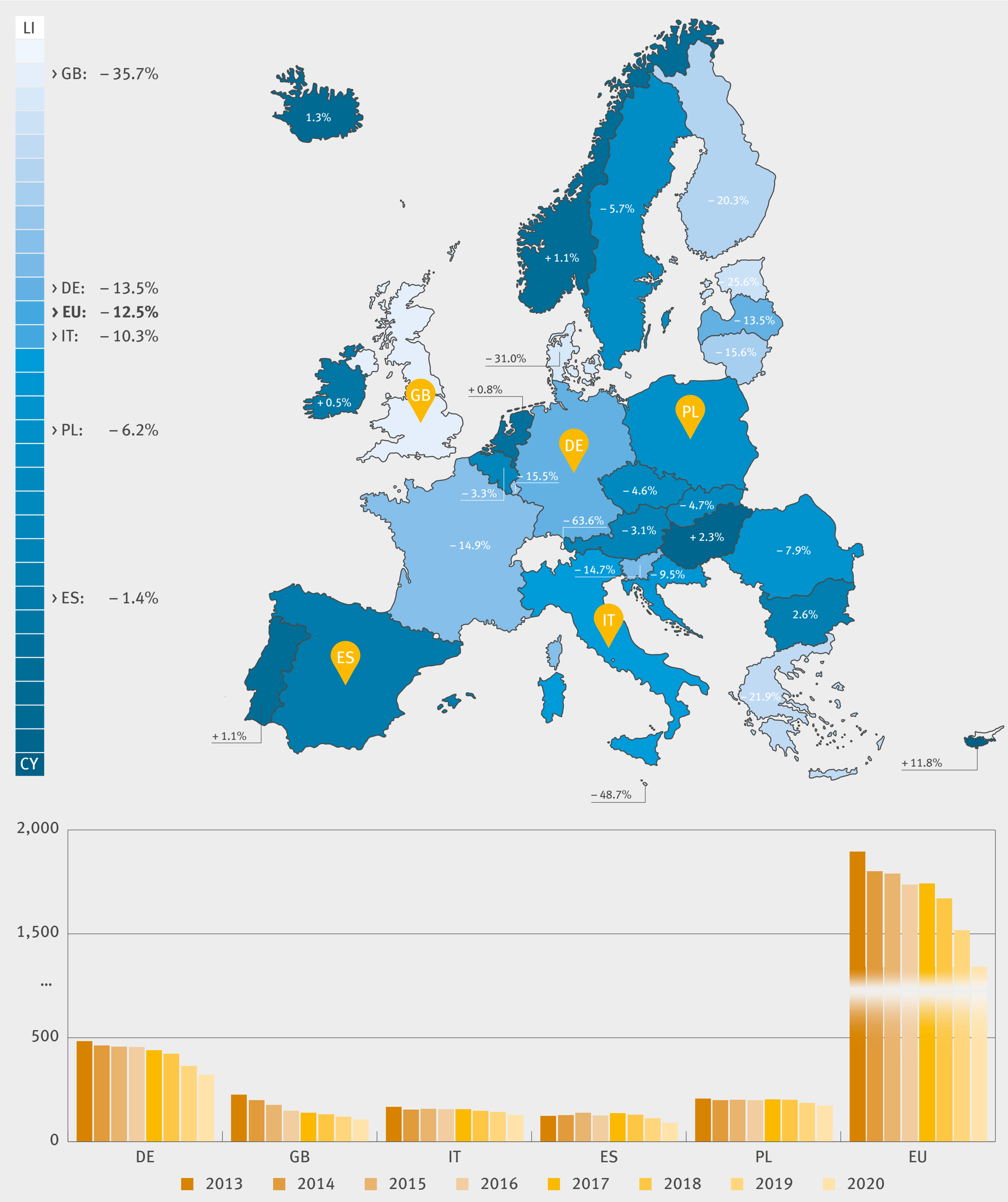
Figure 52: Emissions trends in Germany compared to the stationary EU ETS emissions in all Member States (2005 emissions plus emissions estimate for extended scope of the third trading period = 100 percent)[111]

111 Preliminary figures for 2020. Sources: EEA 2020 for the years 2005 to 2019, COM 2021b for 2020.

The emissions trend in the individual EU ETS Member States also varied greatly in the third trading period. The United Kingdom[112] in particular made an above-average contribution to the emissions decline between 2013 and 2020: according to preliminary data, 2020 EU ETS emissions there were around 53 percent lower than in 2013. In contrast, emissions in the 30 other EU ETS Member States excluding the United Kingdom only decreased by around 26 percent between 2013 and 2020. Germany has made an above-average contribution to the emissions decline, particularly in the last three years between 2018 and 2020. In other states that have a major influence on the Europe-wide trend due to their emission levels (Italy, Spain, Poland), the emissions reduction is less pronounced.

In order to depict the trend over the entire trading period and, in particular, to hide exceptional effects in individual years – such as the COVID 19 pandemic in 2020 – the following map depicts the average emissions between 2014 and 2020 in comparison with the 2013 baseline. On average, this results in an annual reduction of around twelve percent across Europe. While EU ETS installations in some countries in addition to the UK, such as Denmark, Finland, Estonia and Greece, recorded average emissions reduction of more than 20 percent, average emissions in other countries such as Ireland, the Netherlands, Norway, Portugal, Hungary and Cyprus actually increased.

112 The United Kingdom left the EU on 31/01/2020. However, for the years 2019 and 2020, UK installations and aircraft operators will continue to be subject to the regular reporting and surrender obligations.



As of 03/05/2021

Figure 53: Average emissions trend in the EU ETS Member States in the third trading period (average annual emissions in 2014 to 2020 compared to 2013 in percent)[113]

113 Based on COM 2021b.

3.2 Supply and demand of stationary installations (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. Nominal annual emission caps are also shown in addition to emission allowances allocated for free and auctioned as well as project credits surrendered or converted.

After a large surplus of unused emission allowances had built up in the course of the second trading period (2008 to 2012) and even at the beginning of the third trading period, a partial reduction was seen in recent years. This was primarily achieved by reducing the auction volumes between 2014 and 2016 through back-loading, and through the Market Stability Reserve (MSR) since 2019. If the quantity of emission allowances in circulation exceeds the threshold of 833 million emission allowances, the EUA quantities earmarked for auctioning are reduced by 24 percent of the quantity in circulation in the following twelve months and transferred to the MSR. As an indicator of the surplus, the European Commission determines an official value of the quantity in circulation each year, the so-called TNAC (Total Number of Allowances in Circulation). This figure is decisive for the auction quantity reduction through the MSR and corresponds to the difference between emission allowances issued (supply) and emission allowances surrendered (demand) in the stationary sector that had accumulated since 2008, taking into account surrendered and converted project credits as well as voluntarily cancelled emission allowances.

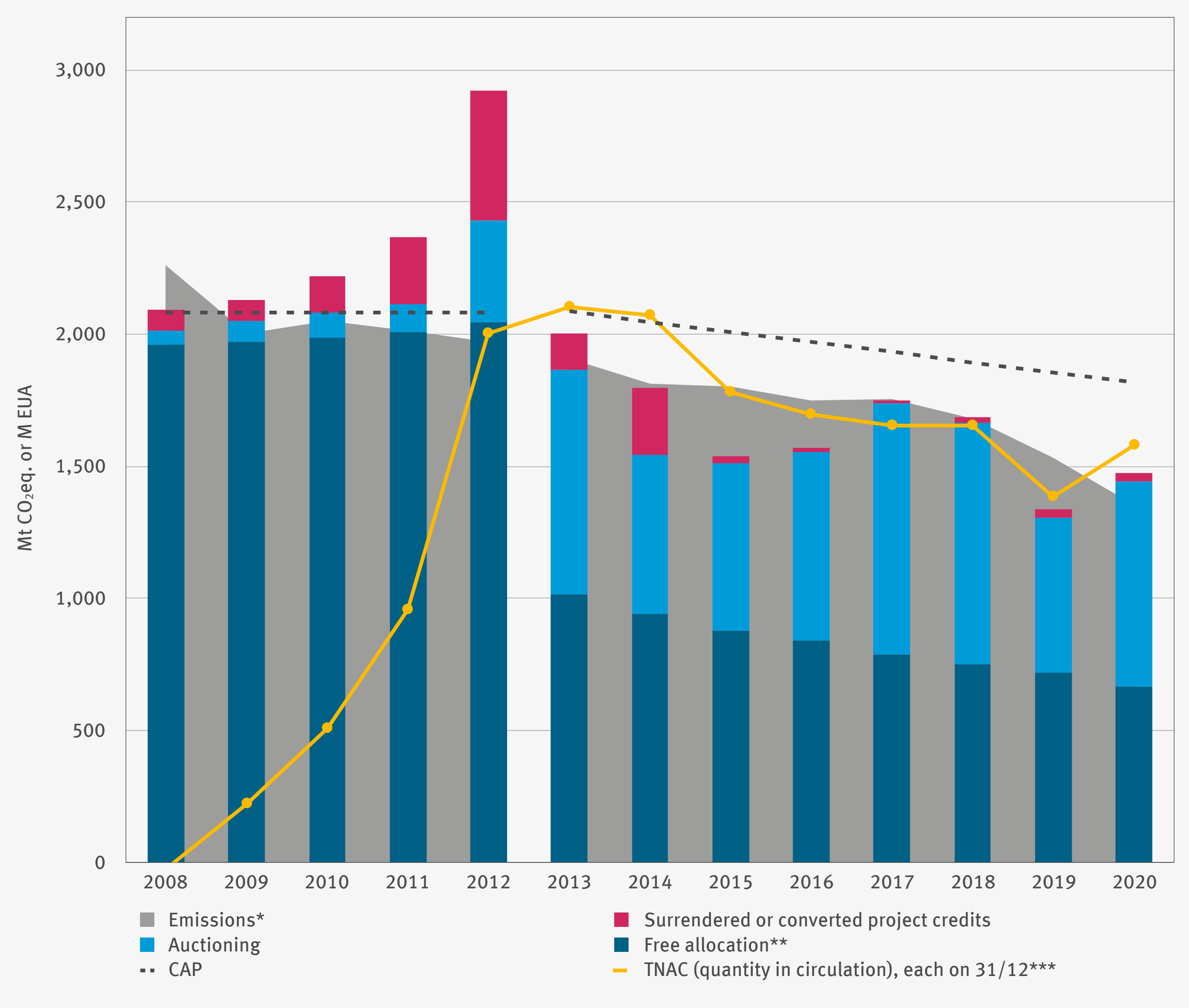
According to the European Commission, the TNAC amounted to 1.58 billion emission allowances[114] at the end of 2020 and thus increased significantly year-on-year for the first time since 2015 (up 14 percent year-on-year). The value also remains well above the upper MSR threshold above which auction volume reductions take place. Since emissions decreased relatively sharply in 2020 as a result of the COVID 19 crisis and more was auctioned than in the previous year due to various exceptional effects[115], the MSR mechanism could not prevent the surplus from increasing again. The current value of the TNAC is decisive for the auction volume reduction through the MSR between 01/09/2021 and 31/08/2022. In this period, a total of around 379 million fewer emission allowances than planned will be auctioned and transferred to the MSR.

The TNAC does **not** account for supply and demand in aviation[116]. In 2020, aviation emissions were below the available supply for the sector for the first time. In previous years, the sector had consistently been a net demand generator, reducing the actual surplus available to the stationary sector in the market. The net demand of aviation cumulated between 2012 and 2020 amounted to around 143.6 million emission allowances (see Section 4.3).

114 COM 2021c.

115 The British auctions scheduled for 2019 did not take place until 2020. In addition, 50 million EUAs were auctioned to feed the Innovation Fund and residual volumes of emission allowances not allocated under Article 10c.

116 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 also not taken into account in the calculation of the TNAC.



As of 03/05/2021
* Due to the change of the EU ETS scope between the second and third trading periods, emissions from 2013 onwards are not directly comparable with the emissions in 2012 and earlier. Therefore, the presentation of emissions between 2012 and 2013 is interrupted.
** Incl. transitional free allocation as per Article 10c
***Data from EU COM

Figure 54: Demand and supply in the overall system: comparison of emissions with the available emission allowances and trends in the amount in circulation since 2008 as determined by the European Commission[117]

The Figure also shows the structural imbalance between cap and emissions, which grew steadily in the third trading period. On average, emissions in the years 2013 to 2020 were around 250 million tonnes of carbon dioxide equivalents below the annual cap.

117 Sources: EEA 2020 for the years 2005 to 2019, COM 2021a and COM 2021b for 2020 as well as other data published by the EU Commission and information from EEX/ICE for auction volumes. The data on TNAC is taken from the Carbon Market Reports of the European Commission from 2012 to 2017 and the Communications on TNAC 2018 to 2021.

3.3 Price trends for EUA and project credits

EUA prices have fluctuated considerably in recent years. At the beginning of the second trading period, prices for EUA briefly reached a level of 25 to 30 euros. By the beginning of 2009, prices had fallen to less than ten euros, but stabilised at around 15 euros between 2009 and 2011. From mid-2011 onwards, the price dropped continuously, driven by the growing surpluses on the carbon market. In April 2013, the price finally fell to under three euros, the lowest level since the beginning of the second trading period. 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. After the price had fluctuated in a range between four and six euros, in May 2017 the carbon market began a steady upward trend. This trend was significantly reinforced in 2018 with the political agreement on the amendment of the ETS Directive, which included a significant reduction in existing carbon market surpluses. In the first half of 2018 a price level of more than 15 euros was reached, in September 2018 the 25 euros mark was exceeded. In the following months the strong upward trend did not initially continue. The price trend was characterised by short-term ups and downs before reaching almost 30 euros in July 2019, the highest level since 2006. This meant that the price of EUA had increased six-fold in two years. At the end of 2019, the price was roughly at the same level as in the beginning of the year, at around 25 euros. The price of EUA fell significantly in March 2020, falling briefly to below 15 euros as a result of the severe turbulence on the international equity and energy markets in the wake of the COVID 19 pandemic. In the following months, however, the EUA price increased significantly again and already exceeded the 30 euros mark in July. After a subsequent consolidation phase, the EUA price rose to over 33 euros in December. At the close of trading on 31/12/2020, the EUA reference contract was quoted just under 33 percent above the value at the beginning of the year. The strong price increase continued in 2021, with the 40 euros mark being exceeded for the first time in March and the highest level since the start of the EU ETS in 2005 being reached in May at over 50 euros. The EUA price is currently around 56 euros (as of 17/05/2021).

Since 2008, the price level for project credits (CERs/ERUs) has been consistently below the price for EUAs. The relative price markdown compared to EUA has increased since the end of the second trading period. Since the end of March 2021, CER contracts have no longer been offered for trading on the ICE (see section on the use of project credits starting on page 87); on the last trading day (22/03/2021), an exchange traded CER was quoted at just under 50 cents. This corresponded to around one percent of the market value of an EUA. The price trend for EUAs and CER/ERUs in the period January 2008 to April 2021 is shown in the figure below.

As of 17/05/2021
Source: ICE, Refinitiv Eikon, DEHSt representation

Figure 55: Price trends for emission allowances (EUA) and international project credits (CERs) in the second and third trading period

In addition, the following table shows the average prices for EUAs and CERs for the completed second trading period, the third trading period and the calendar year 2020. In the second trading period the relevant average price for an EUA was 13.62 euro (CER €10.00), in the period from January 2013 to April 2021 12.96 euros (CER €0.31). In the calendar year 2020 the prices were 24.78 euros (EUA) and 0.24 euros (CER).

Table 26: Average prices for emission allowances (EUA) and international project credits (CERs) in the second and third trading period

Time period	2nd trading period 03/2008 – 04/2013 [€]	3rd trading period 01/2013 – 04/2020 [€]	3rd trading period 2020 reporting year [€]
Price EUA*	13.62	12.96	24.78
Price CER**	10.00	0.31	0.24

* VWAP ICE EUA front-december
** ICE CER front December (from 15/12/2020 CER March 2021 Future; CER prices only available until 22/03/2021)
Source: ICE, Refinitiv Eikon, DEHSt calculation

3.4 Auction amounts and revenue

Since the start of the third trading period, auctioning has been the standard allocation method for stationary activities in the European Emissions Trading System (EU ETS) 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 entrants reserve.

Allocation through auctions complies 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 for climate protection measures. In Germany since 2012, almost all auction revenues have been flowing into the Energy and Climate Fund (EKF).

The following table summarises the auction results of the current trading period for Germany and other EU Member States on an annual basis. In addition to emission allowances for stationary installations (EUA), the aviation allowances (EUAA) are also shown. The auction amounts trend in the period 2014 to 2016 was significantly influenced by the 'backloading' decision. This decision provided for the planned auction amounts to be reduced by around 900 million EUA across the EU. In accordance with this decision, the German auction amounts were also reduced by around 174 million EUA in the same period. In addition, the Market Stability Reserve (MSR) has been in force since the beginning of 2019. In line with the MSR mechanism, the EUA amount to be auctioned between 2019 and 2020 was reduced by slightly less than 800 million EUA across the EU, while the German auction amounts were reduced by around 85 million EUA in 2019 and 81 million EUA in 2020.
In addition to the adjustments of auction amounts, the EUA price trend on the lead markets had a significant effect on the revenue trend for the individual years (see Section 3.4).

Table 27: Auction amounts and revenues since 2013 for Germany and EU wide

EUA				
Year	Germany		EU wide	
	Auction amounts in Mt	Revenues in M€	Auction amounts 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

* EU incl. NER amounts from 2nd TP; 2012 early auctions not considered
*** EU incl. UK, Norway, Iceland, Liechtenstein
Source: EEX, ICE, DEHSt calculation

EUAA				
Year	Germany		EU wide	
	Auction amounts in Mt	Revenues in M€	Auction amounts 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

** 2012 German aviation auction not considered
*** EU incl. UK, Norway, Iceland, Liechtensteinn
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 CO_2 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)[118] (full scope). 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[119].

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 (see Table 28).

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.[120]

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. 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.[121, 122]

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[123]. Under the 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, CO_2 emissions have to be monitored and reported since 01/01/2020. For the flights subject to reporting, the surrender of the corresponding quantity of allowances is mandatory. This had to be done by 30/04/2021 for the first time for the 2020 emissions.

118 In addition to EU 27, the European Economic Area (EEA) also included Norway, Iceland and Liechtenstein in 2012 and 2013. Since joining the EU in 2014, Croatia also belongs to the EEA.

119 Exceptions are described in Table 28.

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

121 EU 2014a

122 EU 2017a

123 EU 2017b

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 full scope of emissions[124]. Another restriction from 2013 onwards yielded the current reduced scope which is about 16 percent of the full scope.[125]

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.[118, 119, 120, 122]

The latest resolution[122] 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).[126]

The current regulation to reduce the scope of the EU ETS will be reviewed after an assessment of its environmental effectiveness and, if necessary, the concretisation of further details on the implementation of CORSIA at the European level[122]. In mid-2021, the European Commission will present proposals for reforming the European emissions trading system in line with the European Green Deal. It can be assumed that this package will also contain proposals on the handling and further implementation of CORSIA in the European Union.

Table 28 summarises the trend of the aviation scope to date.

124 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.

125 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.

126 ICAO 2016

Table 28: Overview of the EU ETS scope in aviation

<table>
<tr><th rowspan="3">Period</th><th rowspan="3">Description of scope[1]</th><th rowspan="3">Reporting obligation</th><th rowspan="3">Surrender obligation</th><th colspan="4">Extent of scope</th></tr>
<tr><th colspan="2">Geographic</th><th colspan="2">Exclusion criteria[2]</th></tr>
<tr><th>Flights within and between EU ETS Member States[3]</th><th>Flights to/from third countries</th><th>Commercial operators[4]</th><th>Non-commercial operators</th></tr>
<tr><td>01/01/2010 – 31/12/2011</td><td>Full scope</td><td>x</td><td>–</td><td>x</td><td>x</td><td rowspan="3">Flights < 243 per four months or full scope emissions < 10,000 t CO_2/a</td><td rowspan="2">–</td></tr>
<tr><td>01/01/2012 – 31/12/2012</td><td>Stop-the-clock</td><td colspan="2">x[5]</td><td>x</td><td>Switzerland, Croatia</td></tr>
<tr><td>01/01/2013 – 31/12/2023[7]</td><td rowspan="2">Reduced scope</td><td colspan="2">x</td><td>x[6]</td><td>–</td><td rowspan="2">Full scope emissions < 1,000 t CO_2/a [8]</td></tr>
<tr><td>01/01/2020[9] – 31/12/2023</td><td colspan="2"></td><td>x[6]</td><td></td><td></td></tr>
</table>

[1] See Glossary for the definitions of scope.
[2] In addition to the criteria listed in the table, flights with a maximum take-off weight of less than 5,700 kg, military, police, customs, non-EU governments, research, sightseeing and training flights are excluded.
[3] The Group of EU ETS Member States includes all EU Member States as well as Norway, Iceland and Liechtenstein (the latter has no airport). Since it joined the EU in 2014, Croatia also belongs to the Group of EU ETS Member States.
[4] Commercial operators are defined as operators that offer public transport services in exchange for remuneration.
[5] Within the framework of stop-the-clock (StC) regulations, operators could choose to report for the StC scope or according to the 'full scope' and surrender accordingly.
[6] Flights between EEA States and European areas in the outermost regions (i. e. Canary Islands) are thus exempt from the emissions trading obligation.
[7] The final date has been postponed by the Regulation (EU) 2017/2392 of the European Parliament and of the Council from 31/12/2016 to 31/12/2023.
[8] The exemption holds according to the current view until 31/12/2030.
[9] The linking agreement between the EU and Switzerland has applied from 01/01/2020.

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.[127]

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.[128]

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 – 2020 and third trading period overview

Germany is responsible for around 500 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.

Of the approximately 500 aircraft operators, 48 have reported the emissions of their flights subject to emissions trading for 2020. The total number of 48 operators to be classified as subject to emissions trading is the lowest number since 2013 and corresponds to about 70 percent of the operators subject to emissions trading in previous years. This can be explained by the sharp drop in traffic as a result of the COVID 19 pandemic. According to IATA, European airlines saw a 73.7 percent drop in traffic in 2020 compared to 2019. Capacity (measured in available seat-kilometres or ASKs) decreased by 66.3 percent and the load factor decreased to 66.8 percent.[129]

127 The ratification of the withdrawal agreement with the EU ensures an orderly exit of the UK from the EU. Among other things, the withdrawal agreement stipulates that all EU ETS rules will be maintained in the UK until the end of the third trading period. Aircraft operators currently administered by the UK which continue to participate in the EU ETS are expected to be distributed to other Member States. The EU Commission's list of administering Member States will be adjusted for this purpose.

128 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 (see also Table 28).

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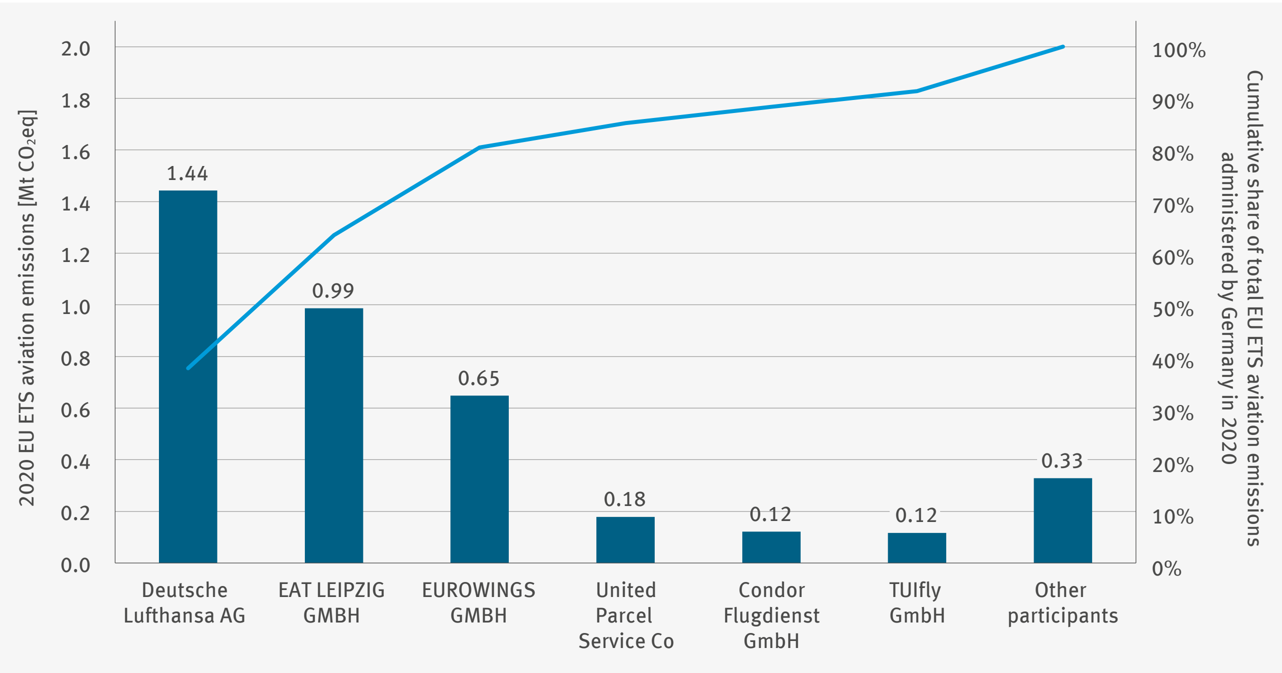
Around 83 percent of the operators subject to emissions trading had a commercial status and around 17 percent a non-commercial status in the 2020 reporting year. The share of non-commercial operators was thus on the decline. The share of emissions from non-commercial operators subject to emissions trading is – as in the previous year – only 0.3 percent (see Table 29).

Table 29: Aviation (aircraft operators administered by Germany), number of aircraft operators subject to emissions trading, 2019 CO_2 emissions, 2020 allocation, 2020 CO_2 emissions and allocation coverage differentiated by commercial and non-commercial operators

Operator category	No. of operators subject to emissions trading	2019 emissions [kt CO_2eq]	2020 emissions [kt CO_2eq]	No. of operators with 2020 allocation	2020 allocation amount [1000 EUAA]	Allocation coverage
Commercial	40	8,949	3,813	29	3,513	92.1%
Non-commercial	8	21	11	7	1	7.2%
2019 not subject to ET	*19**	*40*	–	–	–	–
Total	**48**	**9,010**	**3,824**	**36**	**3,513**	**91.9%**

As of 03/05/2021
* 2020 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 2019, total emissions in 2020 were concentrated on a small group of aircraft operators where more than 90 percent of the total emissions were caused by six commercial operators (compare Figure 56). Nevertheless, the emissions of these large operators all decreased significantly compared to the previous year.



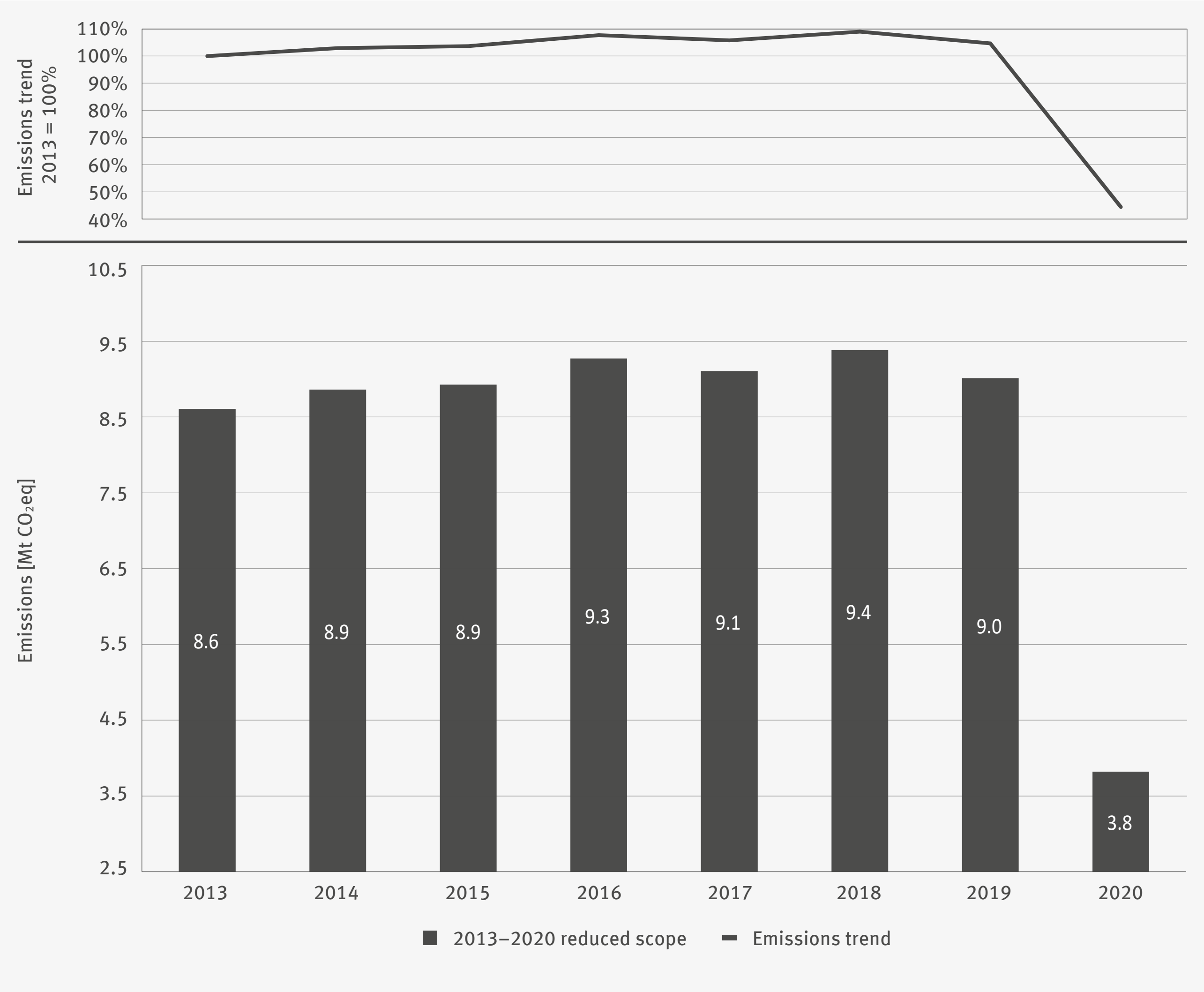
As of 03/05/2021

Figure 56: Aviation (aircraft operators administered by Germany), emissions of the six operators with the largest emissions in 2020 (bars, left-hand side axis) and their cumulative share of total aviation emissions administered by Germany (line, right-hand side axis)

The emissions by aircraft operators administered by Germany totalled around 4 million tonnes of carbon dioxide in 2020. They fell by around 5 million tonnes of carbon dioxide or around 55 percent compared to the previous year and correspond to the lowest emission level since 2013. This is by far the strongest decrease since the introduction of the reduced scope in 2013.

The severity of the decline in emissions due to the COVID 19 pandemic can be seen in Figure 57 and Table 30, where the 2020 values are placed in the context of the relatively continuous emissions growth in the third trading period since 2013.

More than two-thirds of the operators administered by Germany subject to emissions trading in 2020 show decreases in emissions compared to 2019. Particularly the four largest operators (see Figure 56) who show between 70 and 75 percent decrease in their emissions. Only the emissions of cargo airlines (EAT Leipzig GmbH and United Parcel and Co) remained at the same level as in 2019. In addition, there are emission decreases of 45,000 tonnes of carbon dioxide due to the discontinuation of the emissions trading obligation for 20 operators; 10 of these were still subject to emissions trading in 2019 (see Table 29).



As of 03/05/2021

Figure 57: Aviation (aircraft operators administered by Germany), trend of aviation emissions in the reduced scope from 2013 to 2020[130]

130 The chart shows the 2014 and 2015 emissions as 8.9 million tonnes of CO_2 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 CO_2 for 2014 and 8.93 million tonnes of CO_2 for 2015.

Irrespective of the sharp decline in emissions, the amount of 2020 free allocation for aviation was around 3.5 million emission allowances (EUAA) i. e. the same level as in the previous year. Around 5.1 million EUAAs were still allocated annually between 2013 and 2017 (see Table 30). 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 in the period 2013 to 2017 which was stopped with the discontinuation of operations for the entire remaining trading period. However, there were no over-allocations to operators administered by Germany who stepped in to replace Air Berlin's missing transport services.

The difference between the operators' aggregated emissions and the amount of EUAA allocated to them free of charge thus decreased significantly in 2020 compared to 2019. Their average allocation coverage[131] increased from around 40 percent in 2019 to 92 percent in the following period (see Table 30).

Table 30: Aviation (aircraft operators administered by Germany), overview about the 2013 – 2020 period

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	62	5,141	8,610	59.7%	
2014	67	5,130	8,861	57.9%	2.92%
2015	67	5,082	8,929	56.9%	0.77%
2016	67	5,100	9,274	55.0%	3.86%
2017	72	5,078	9,105	55.8%	–1.82%
2018	67	3,558	9,386	37.9%	3.08%
2019	67	3,515	9,010	39.0%	–4.00%
2020	48	3,513	3,824	91.9%	–57.56%

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4.3 Emissions and available emission allowances for aviation at the European level – 2020 and overview of the third trading period

The previous sections presented the allocation and emission trends for aircraft operators administered by Germany. The emissions of these aircraft operators accounted for around 15 percent of total European aviation emissions under the EU ETS in 2020.[132]

In 2020, the emissions of all aircraft operators subject to emissions trading in the EU ETS were around 24.8 million tonnes and thus about 64 percent below the previous year's level. Analogous to the situation in Germany, this very significant decline is due to the massive worldwide slump in air traffic services as a result of the COVID 19 pandemic. The seriousness of the drop in emissions due to the COVID 19 pandemic can be seen in Figure 58, where the 2020 values are placed in the context of the relatively continuous growth in emissions in the third trading period since 2013.

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.

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

132 The share was about 14 percent in the two previous years, just over 16 percent at the beginning of the 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.

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 provides almost constant allocation and auction volumes for the entire 2013 – 2020 period[133]. 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, significantly more EUAAs were auctioned than originally planned because the 2013 auctions were wholly suspended.

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[134]. The amount of newly issued EUAA exceeded emissions only in the current 2020 reporting year. Despite the exceptional effect in 2020, there was a shortfall of around 161 million EUAA in total for the fulfilment of the surrender obligation in the period 2012 to 2020.

Operators were able to offset the missing certificates by purchasing EUAA from the stationary EU ETS[135] and, to a limited extent, 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[136]. This was around 142 million tonnes in the period from 2012 to 2020, i. e. since the beginning of the surrender obligation in aviation until the end of the third 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 31 million in 2019. Only in 2020 did the supply of EUAA plus the use quota of project credits exceed the level of emissions amounting to around 12 million tonnes.

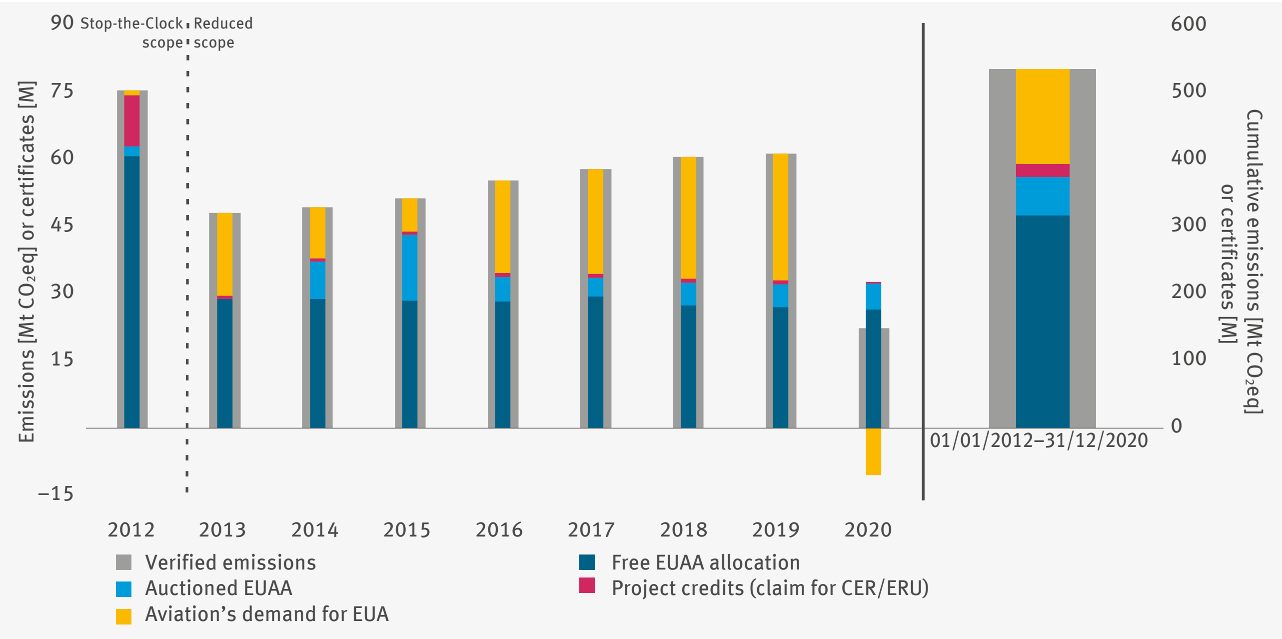

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Figure 58: Aviation (aircraft operators administered by Germany), emissions, supply of usable emission allowances (EUAA, CER/ERU) and aviation demand for EUAs for aviation subject to emissions trading in Europe (left: 2012 to 2020 annual figures, right: cumulative)

133 The total amount of EUAA allocated free of charge and auctioned is to amount to 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). The EU Auctioning Regulation provides for 15 percent of the volume of EUAA in circulation to be auctioned each year.

134 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.

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

136 The actual use of claims has not been reported in the EUTL since 2013, which is why the usage claims are utilised in this case. For 2012, the claims accounted for 15 percent of the emissions verified that year (about 12.6 million allowances, with just under 11 million surrendered). Between 2013 and 2020, the total demand corresponded to 1.5 percent of the verified total emissions during the period concerned.

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 Organization (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[137] 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 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 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.

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 CO_2 with aircraft with of a maximum take-off mass greater than 5.7 t on all international flights within the basic 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.

In the 2019 reporting year, the 14 aircraft operators managed by DEHSt under CORSIA emitted 29.05 million tonnes of CO_2 on international flights. As a result of the COVID 19 pandemic, these figures decreased to 11 aircraft operators with 11.98 million tonnes of CO_2 (see Table 31). On flights between third countries, 0.57 (0.62) million tonnes of CO_2 were voluntarily reported in 2019 (2020).

137 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 Organization for the monitoring, reporting and verification of aviation emissions for the purposes of implementing a global market-based mechanism.

Table 31: CO_2 emissions of German aircraft operators in 2019 and 2020 under CORSIA

Operator	CORSIA CO_2 emissions [t] 2019	CORSIA CO_2 emissions [t] 2020
Condor Flugdienst GmbH	2,432,633	732,330
DC Aviation GmbH	11,464	below CORSIA threshold
Deutsche Lufthansa AG	18,083,555	5,276,782
Lufthansa Cargo AG	1,739,057	1,485,592
Aerologic GmbH	1,372,672	1,925,208
AIR HAMBURG	86,834	98,806
AIR X CHARTER (GERMANY) GMBH & CO. KG	13,371	below CORSIA threshold
EAT LEIPZIG GMBH	1,079,697	1,205,882
TUIfly GmbH	952,921	325,846
K5-AVIATION GMBH	16,954	16,185
SUNEXPRESS DEUTSCHL.	299,156	55,588
MHS Aviation GmbH	10,057	below CORSIA threshold
EUROWINGS GMBH	2,851,542	797,534
SUNDAIR GMBH	96,141	63,855
Total	**29,046,054**	**11,983,608**

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From the start of the 2021 reporting year, ICAO will publish the total international emissions per aircraft operator per year, including emissions on routes subject to cancellation and the use of emission estimation tools, in accordance with Annex 16, Volume IV, Supplement 5.

5 States (Länder)

Table 32: Overview of the 2019 verified emissions per state (Land), by activities

2019 emissions [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	0	0	0	0	0	0	0	0	100	1,300	400	0	0	0	100	0	2,100
2	Energy conversion >= 50 MW RTI	31,500	4,500	11,800	7,300	5,700	4,700	6,200	2,400	15,100	98,900	4,900	2,100	2,500	30,300	8,300	900	236,900
3	Energy conversion 20–50 MW RTI	100	100	500	800	100	400	200	0	700	1,100	300	100	200	100	100	100	5,000
4	Energy conversion 20–50 MW RTI, other fuels	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	100
5	Prime movers (engines)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Prime movers (turbines)	300	0	100	200	0	100	0	0	200	200	0	0	0	0	0	100	1,200
7	Refineries	3,400	0	2,700	3,200	0	0	1,000	0	1,200	7,200	0	2,400	0	0	2,500	0	23,600
8	Coking plants	0	0	0	0	0	0	0	0	0	2,700	0	0	1,000	0	0	0	3,700
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	100
10	Production of pig iron and steel	1,600	0	100	100	2,200	0	100	0	4,400	13,400	0	0	4,800	100	0	0	26,900
11	Processing of ferrous metals	300	0	200	100	600	400	300	0	500	1,500	100	0	700	100	100	100	4,700
12	Production of primary aluminium	0	0	0	0	0	0	300	0	0	700	0	0	0	0	0	0	1,000
13	Processing of non-ferrous metals	0	0	0	200	0	0	200	0	200	700	100	0	0	100	100	0	1,600
14	Production of cement clinker	1,200	0	3,500	4,000	0	300	0	0	1,200	5,200	900	1,100	0	0	1,600	1,000	20,000
15	Lime production	400	0	400	1,000	0	400	0	100	800	3,700	500	0	0	0	1,300	200	8,800
16	Glass production	100	0	100	700	0	0	0	0	400	1,000	300	0	0	200	600	200	3,700

2019 emissions [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
17	Ceramics production	100	0	100	700	0	0	0	0	200	300	200	0	0	200	100	100	2,000
18	Production of mineral fibres	0	0	0	100	0	0	0	0	0	100	0	0	0	100	100	0	400
19	Gypsum production	100	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	300
20	Pulp production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	100
21	Paper production	100	0	700	700	0	300	0	0	900	1,300	400	100	0	400	100	0	5,000
22	Carbon black production	0	0	0	0	0	0	0	0	0	600	0	0	0	0	0	0	600
23	Nitric acid production	0	0	0	0	0	0	0	200	0	0	300	0	0	0	0	0	600
24	Adipic acid production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	100
25	Production of glyoxal and glyoxylic acid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Ammonia production	0	0	0	0	0	0	0	0	0	500	1,500	0	0	0	2,400	0	4,400
27	Production of bulk organic chemicals	0	0	0	500	0	100	0	0	200	3,900	1,500	200	0	900	200	0	7,600
28	Production of hydrogen and synthesis gas	0	0	0	0	0	0	100	0	0	400	400	100	0	0	700	0	1,700
29	Soda production	0	0	0	0	0	0	0	0	0	100	100	0	0	0	400	0	600
Total		**39,300**	**4,600**	**20,400**	**19,900**	**8,500**	**6,700**	**8,200**	**2,700**	**26,100**	**144,900**	**11,700**	**6,100**	**9,300**	**32,600**	**18,800**	**2,800**	**362,700**

As of 03/05/2021

Table 33: Overview of the 2020 VET entries per state (Land), by activities

2020 VET [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	36	0	22	49	0	1	2	4	141	1,122	349	0	0	0	87	7	1,820
2	Energy conversion >= 50 MW RTI	26,951	4,681	9,532	7,321	3,502	4,055	3,008	1,616	13,289	82,905	4,946	2,154	2,251	26,327	7,226	915	200,678
3	Energy conversion 20 – 50 MW RTI	116	140	499	838	108	397	174	26	719	1,053	297	102	142	66	109	109	4,895
4	Energy conversion 20 – 50 MW RTI, other fuels	0	7	7	3	0	0	0	0	20	69	7	0	0	0	0	30	143
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	22,876
8	Coking plants	0	0	0	0	0	0	0	0	0	2,695	0	0	611	0	0	0	3,306
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	74	0	4,005	11,250	0	0	4,138	74	0	42	23,852
11	Processing of ferrous metals	262	0	160	52	467	323	313	0	411	1,230	113	0	543	100	82	60	4,115
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	186	660	43	0	40	110	131	0	1,550
14	Production of cement clinker	1,259	0	3,584	3,912	0	326	0	0	1,187	5,179	866	1,066	0	0	1,669	1,087	20,133
15	Lime production	352	0	391	952	0	425	0	91	772	3,250	475	0	0	0	1,329	176	8,213
16	Glass production	135	0	120	721	0	3	0	23	347	916	267	38	0	227	562	240	3,599
17	Ceramics production	97	0	75	674	27	23	0	0	218	262	151	0	21	147	98	85	1,878

2020 VET [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
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	0	23	0	0	0	0	3	0	0	0	0	0	75	49	150
21	Paper production	67	0	723	623	0	263	0	4	833	1,241	490	84	0	340	163	19	4,851
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
25	Production of glyoxal and glyoxylic acid	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	12
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	45	0	4	237	3,897	1,563	151	0	1,228	147	2	7,864
28	Production of hydrogen and synthesis gas	11	0	0	45	0	0	48	0	20	365	460	117	0	0	567	0	1,633
29	Soda production	0	0	0	0	0	0	0	0	0	105	71	0	0	0	335	0	511
Total		**34,724**	**4,828**	**18,014**	**19,263**	**6,453**	**5,932**	**4,996**	**1,988**	**23,801**	**125,330**	**11,931**	**6,062**	**7,745**	**28,775**	**17,567**	**2,865**	**320,275**

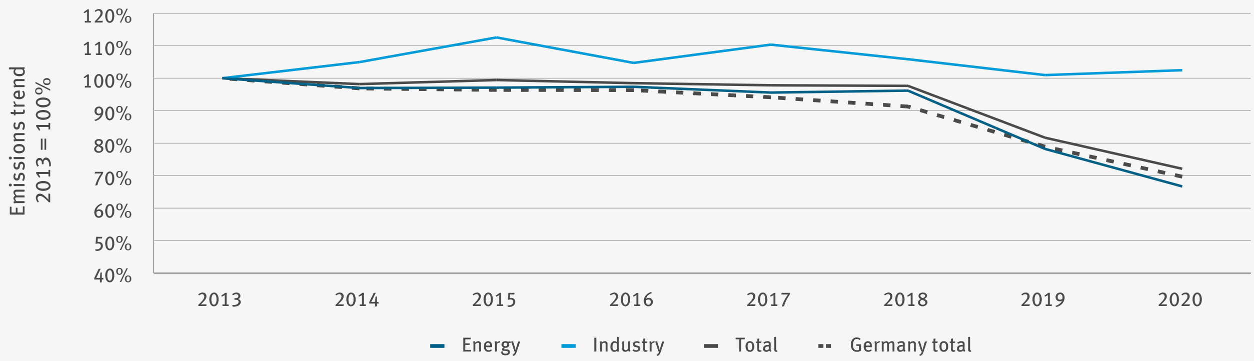
As of 03/05/2021

Table 34: Overview of the 2020 allocation amounts per state (Land), by activities

2020 allocation amount [1000 EUA]		State (Land)																
No.	Activity	BB	BE	BW	Bv	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	22	0	17	16	0	41	1	6	100	963	371	0	0	0	74	1	1,613
2	Energy conversion >= 50 MW RTI	748	600	962	1,500	106	1,045	319	170	1,988	4,803	1,748	293	227	505	942	215	16,171
3	Energy conversion 20 – 50 MW RTI	31	36	259	381	39	255	118	21	446	517	135	31	70	28	32	70	2,470
4	Energy conversion 20 – 50 MW RTI, other fuels	0	2	23	17	0	0	0	0	20	7	6	0	0	0	0	4	79
5	Prime movers (engines)	0	0	0	3	0	0	0	0	6	0	0	0	0	0	0	0	10
6	Prime movers (turbines)	74	0	18	48	0	28	0	0	87	50	7	0	0	0	7	44	362
7	Refineries	1,734	0	1,958	2,464	0	0	820	0	923	5,953	0	1,851	0	0	2,063	0	17,767
8	Coking plants	0	0	0	0	0	0	0	0	0	1,316	0	0	255	0	0	0	1,570
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	62	0	0	0	0	0	0	62
10	Production of pig iron and steel	2,656	0	136	134	3,767	43	65	0	5,358	21,631	0	0	5,497	83	0	42	39,413
11	Processing of ferrous metals	230	0	200	54	244	346	282	0	402	1,491	109	0	540	83	88	54	4,122
12	Production of primary aluminium	0	0	0	0	0	0	190	0	0	630	0	0	0	0	0	0	821
13	Processing of non-ferrous metals	0	0	14	125	0	0	248	0	188	559	58	0	41	112	101	0	1,446
14	Production of cement clinker	1,205	0	2,609	3,025	0	221	0	0	923	4,586	637	897	0	0	1,270	817	16,190
15	Lime production	280	0	467	881	0	308	0	51	563	2,992	443	0	0	0	921	162	7,068
16	Glass production	95	0	119	546	0	4	0	6	268	757	173	30	0	176	443	188	2,805
17	Ceramics production	87	0	79	576	26	22	0	0	158	232	140	0	22	118	70	78	1,607

2020 allocation amount [1000 EUA]		State (Land)																
No.	**Activity**	**BB**	**BE**	**BW**	**Bv**	**HB**	**HE**	**HH**	**MW**	**LS**	**NW**	**RP**	**SH**	**SL**	**SN**	**ST**	**TH**	**Total**
18	Production of mineral fibres	0	0	22	74	0	0	0	0	4	65	0	0	0	57	50	0	272
19	Gypsum production	89	0	26	86	0	0	0	0	22	32	0	0	0	22	0	0	276
20	Pulp production	0	0	8	8	0	0	0	0	5	0	0	0	0	0	39	20	81
21	Paper production	379	0	754	1,156	0	294	0	6	963	1,011	432	111	0	297	105	123	5,631
22	Carbon black production	0	0	0	0	0	0	0	0	0	408	0	0	0	0	0	0	408
23	Nitric acid production	0	0	0	0	0	0	0	252	0	150	170	0	0	24	30	0	627
24	Adipic acid production	0	0	0	0	0	0	0	0	0	201	527	0	0	0	223	0	951
25	Production of glyoxal and glyoxylic acid	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	7
26	Ammonia production	0	0	0	0	0	0	0	0	0	487	1,309	0	0	0	1,688	0	3,484
27	Production of bulk organic chemicals	0	0	23	451	0	86	0	3	474	4,159	2,154	148	0	885	175	0	8,557
28	Production of hydrogen and synthesis gas	21	0	0	53	0	0	36	0	11	405	559	61	0	0	308	0	1,453
29	Soda production	0	0	0	0	0	0	0	0	0	200	63	0	0	0	692	0	956
Total		**7,652**	**638**	**7,695**	**11,597**	**4,181**	**2,692**	**2,079**	**515**	**12,909**	**53,668**	**9,052**	**3,421**	**6,653**	**2,389**	**9,321**	**1,818**	**136,281**

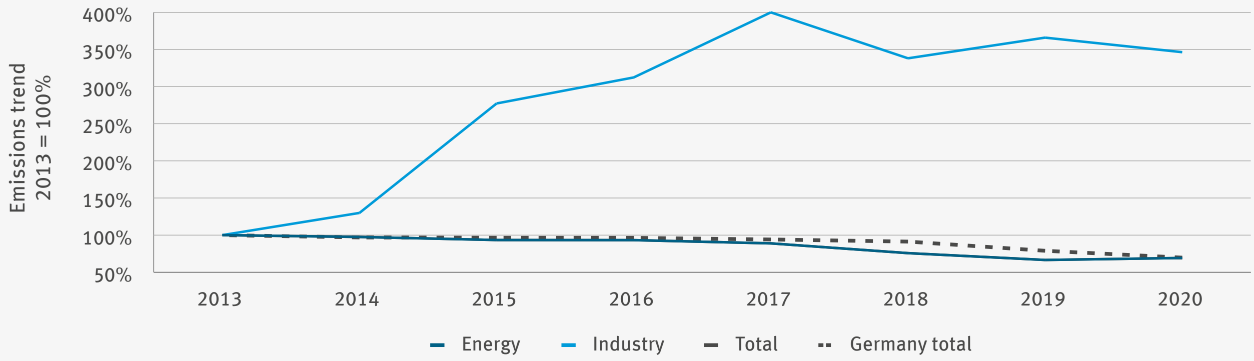
As of 03/05/2021



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	33	40,843,533	39,609,187	39,659,023	39,766,808	39,038,385	39,282,612	31,951,552	27,238,142
Industry	37	7,305,227	7,667,470	8,222,038	7,649,472	8,060,637	7,732,422	7,375,642	7,485,938
BB	70	48,148,760	47,276,657	47,881,061	47,416,280	47,099,022	47,015,034	39,327,194	34,724,080
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

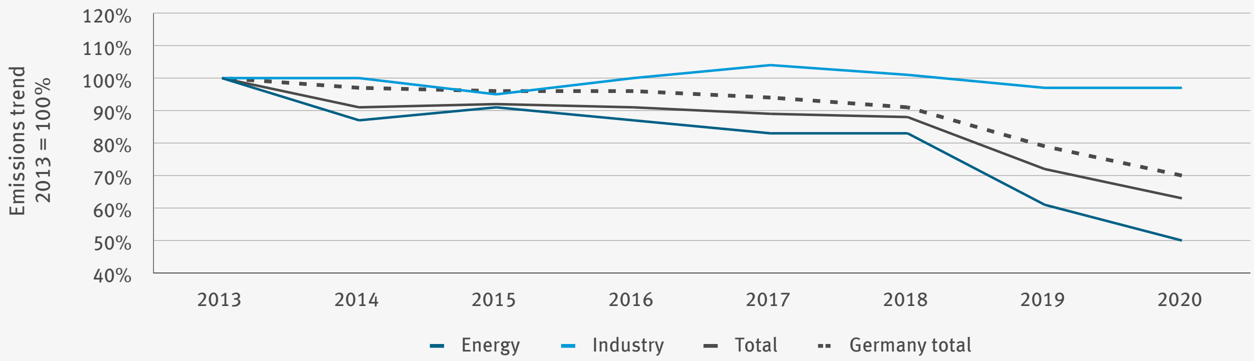
Figure 59: Emissions trends in Brandenburg since 2013



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	28	6,976,644	6,802,781	6,515,429	6,506,098	6,201,481	5,284,093	4,641,725	4,827,705
Industry	1	97	126	269	303	388	328	355	336
BE	29	6,976,741	6,802,907	6,515,698	6,506,401	6,201,869	5,284,421	4,642,080	4,828,041
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

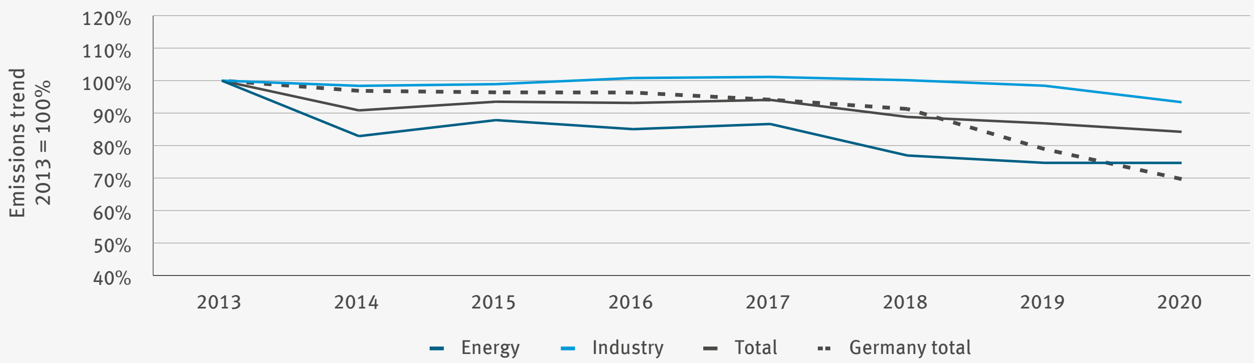
Figure 60: Emissions trends in Berlin since 2013



No. of intallations subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	87	20,274,666	17,726,750	18,412,302	17,678,241	16,923,348	16,861,433	12,387,113	10,067,474
Industry	57	8,213,442	8,208,543	7,765,894	8,193,981	8,546,913	8,335,262	7,982,433	7,947,008
BW	144	28,488,108	25,935,293	26,178,196	25,872,222	25,470,261	25,196,695	20,369,546	18,014,482
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

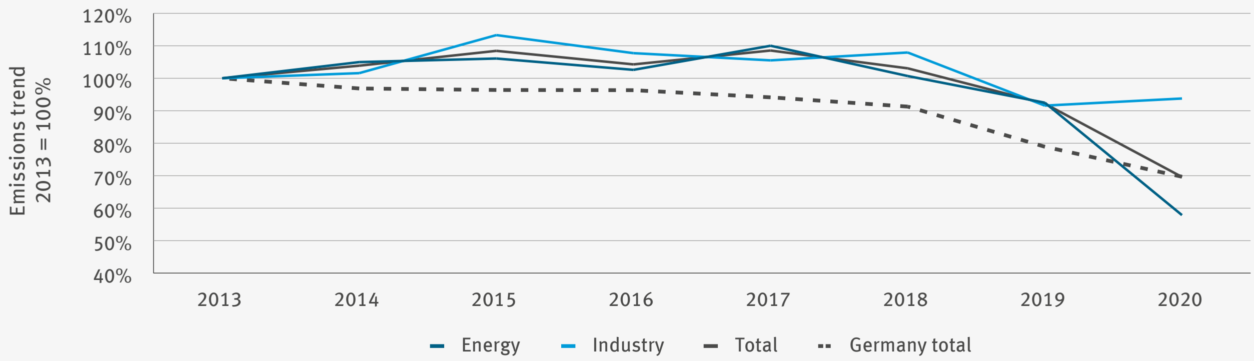
Figure 61: Emissions trends in Baden-Württemberg since 2013



No. of intallations subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	132	11,152,753	9,246,706	9,796,596	9,486,953	9,663,345	8,582,006	8,330,231	8,327,583
Industry	130	11,713,667	11,525,110	11,586,392	11,807,715	11,847,601	11,728,910	11,530,198	10,935,512
BV	262	22,866,420	20,771,816	21,382,988	21,294,668	21,510,946	20,310,916	19,860,429	19,263,095
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

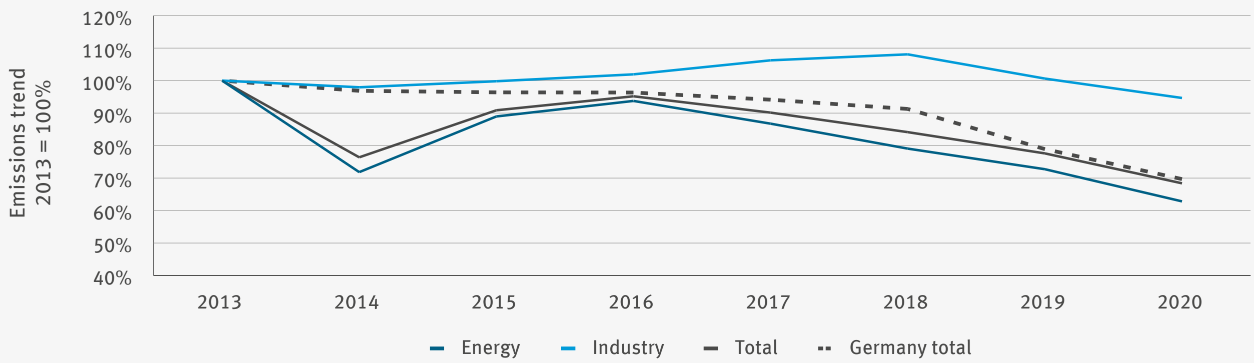
Figure 62: Emissions trends in Bavaria since 2013



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	21	6,238,461	6,548,923	6,617,536	6,400,039	6,863,150	6,281,389	5,769,346	3,610,178
Industry	5	3,031,823	3,079,685	3,434,809	3,266,247	3,198,937	3,272,392	2,776,633	2,842,823
HB	26	9,270,284	9,628,608	10,052,345	9,666,286	10,062,087	9,553,781	8,545,979	6,453,001
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

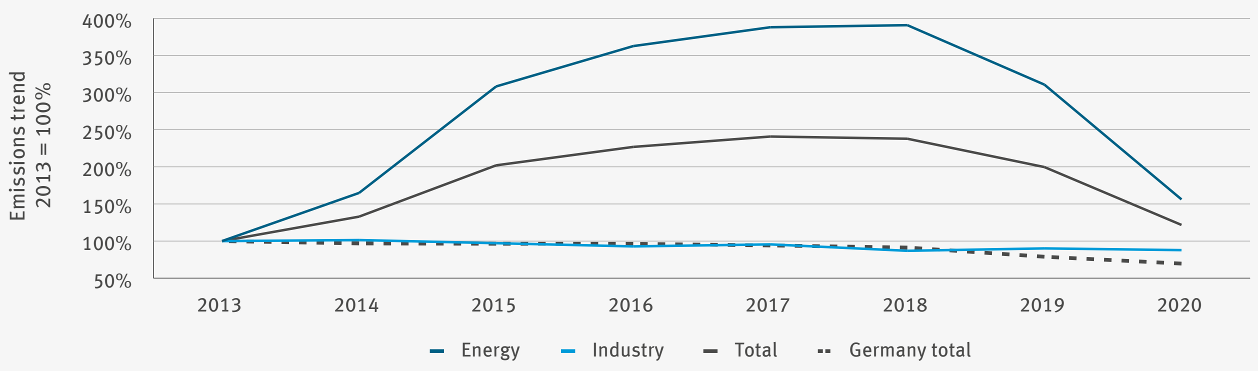
Figure 63: Emissions trends in Bremen since 2013



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	64	7,159,613	5,142,455	6,370,151	6,712,383	6,210,668	5,661,089	5,207,320	4,498,305
Industry	32	1,514,631	1,483,579	1,511,827	1,543,880	1,609,243	1,637,095	1,524,128	1,433,676
HE	96	8,674,244	6,626,034	7,881,978	8,256,263	7,819,911	7,298,184	6,731,448	5,931,981
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

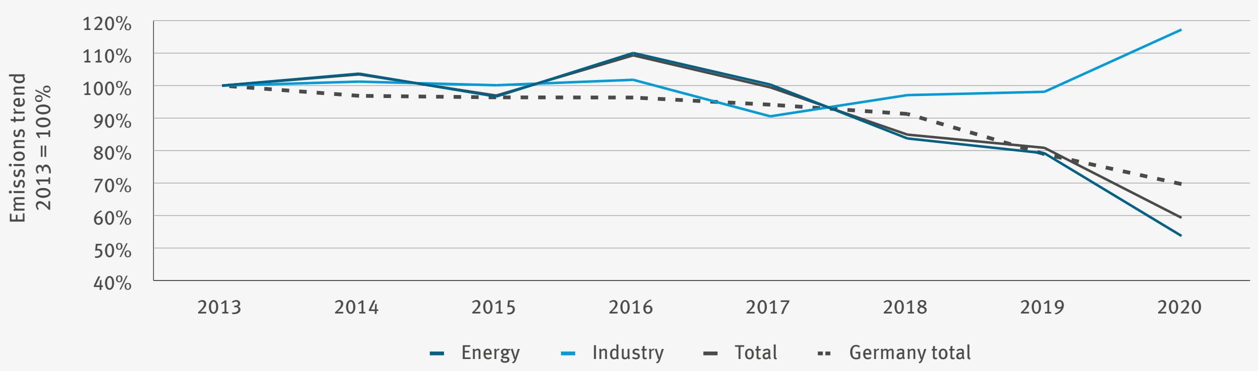
Figure 64: Emissions trends in Hesse since 2013



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	23	2,038,312	3,360,593	6,283,784	7,391,513	7,908,893	7,965,776	6,332,900	3,182,003
Industry	13	2,065,504	2,094,271	2,006,953	1,917,660	1,973,900	1,795,127	1,862,121	1,814,071
HH	36	4,103,816	5,454,864	8,290,737	9,309,173	9,882,793	9,760,903	8,195,021	4,996,074
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

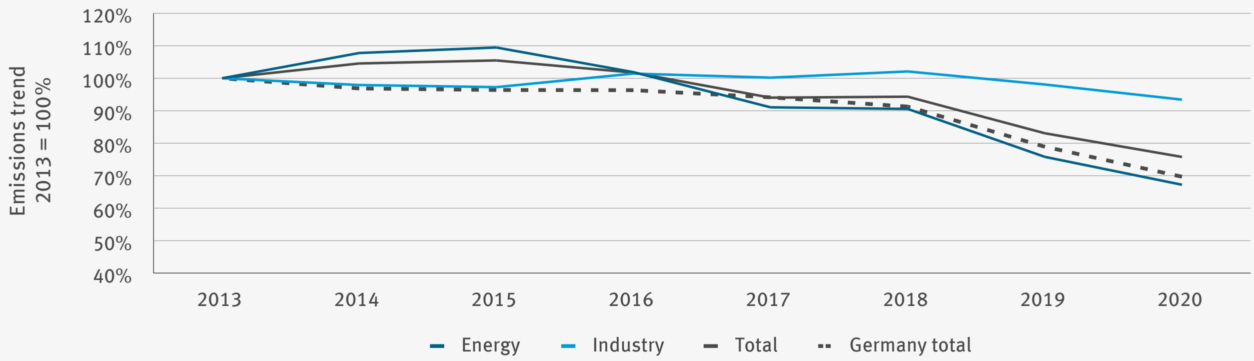
Figure 65: Emissions trends in Hamburg since 2013



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	20	3,056,423	3,168,782	2,953,648	3,363,596	3,066,554	2,559,461	2,420,170	1,642,103
Industry	6	295,377	299,021	295,724	300,669	267,457	286,751	289,775	346,327
MW	26	3,351,800	3,467,803	3,249,372	3,664,265	3,334,011	2,846,212	2,709,945	1,988,430
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

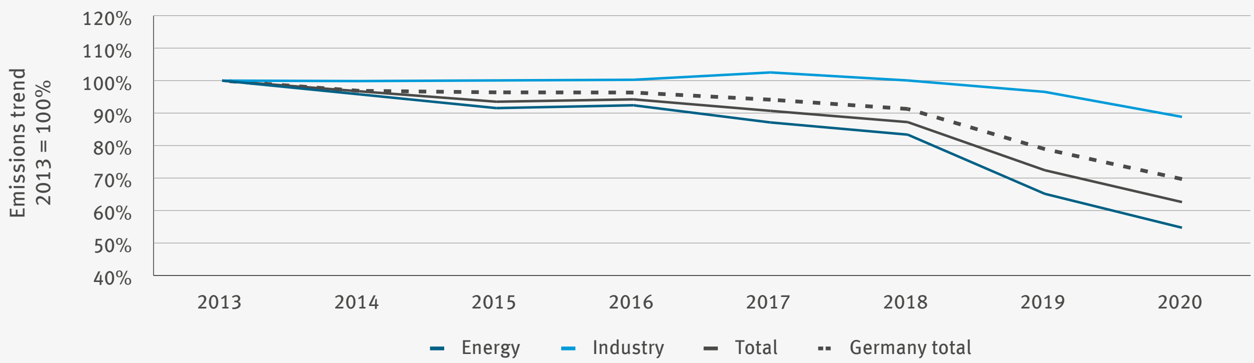
Figure 66: Emissions trends in Mecklenburg-Western Pomerania since 2013



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	91	21,153,988	22,799,198	23,157,491	21,552,124	19,260,452	19,156,817	16,034,919	14,219,973
Industry	89	10,255,512	10,042,495	9,975,370	10,403,234	10,275,157	10,470,650	10,058,409	9,580,968
LS	180	31,409,500	32,841,693	33,132,861	31,955,358	29,535,609	29,627,467	26,093,328	23,800,941
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

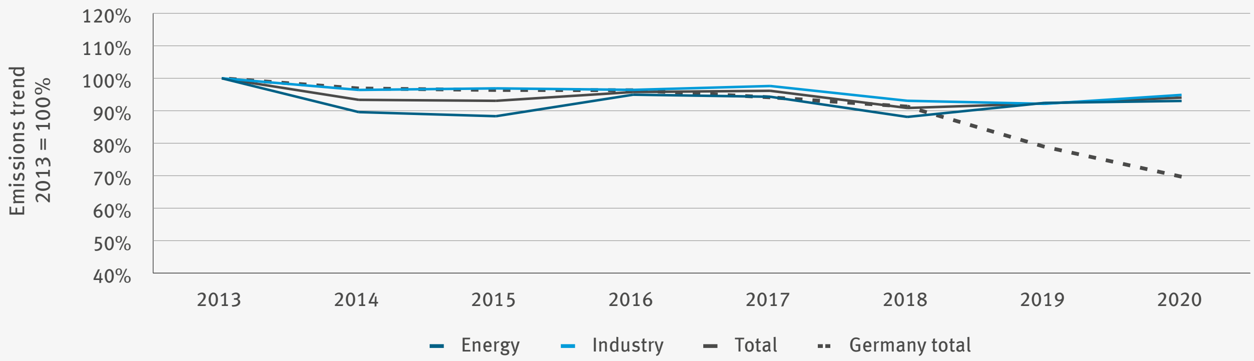
Figure 67: Emissions trends in Lower Saxony since 2013



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	208	153,835,546	147,344,917	140,817,766	142,160,018	134,023,670	128,259,002	100,222,410	84,172,681
Industry	284	46,328,044	46,261,804	46,353,818	46,448,667	47,495,305	46,350,090	44,721,751	41,156,846
NW	492	200,163,590	193,606,721	187,171,584	188,608,685	181,518,975	174,609,092	144,944,161	125,329,527
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

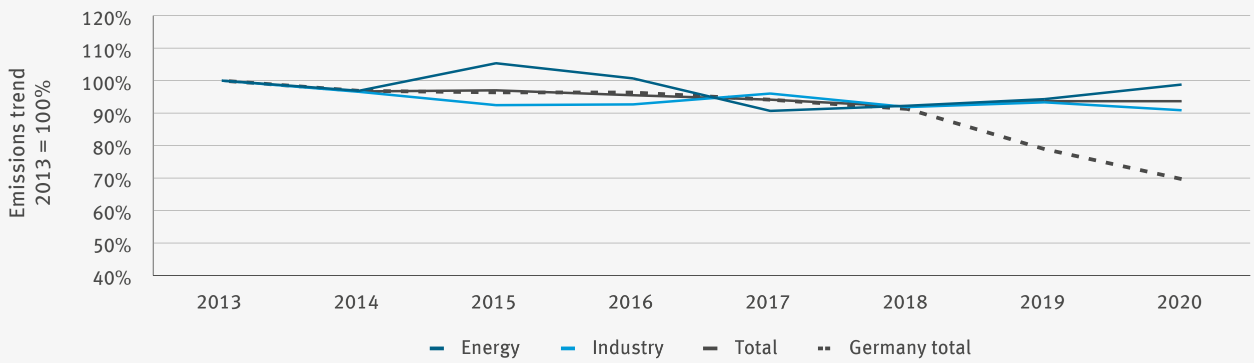
Figure 68: Emissions trends in North Rhine-Westphalia since 2013



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	47	5,664,441	5,074,198	5,002,778	5,378,077	5,342,116	4,990,227	5,234,948	5,269,053
Industry	94	7,021,068	6,769,056	6,802,560	6,770,364	6,853,678	6,534,506	6,468,732	6,661,732
RP	141	12,685,509	11,843,254	11,805,338	12,148,441	12,195,794	11,524,733	11,703,680	11,930,785
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

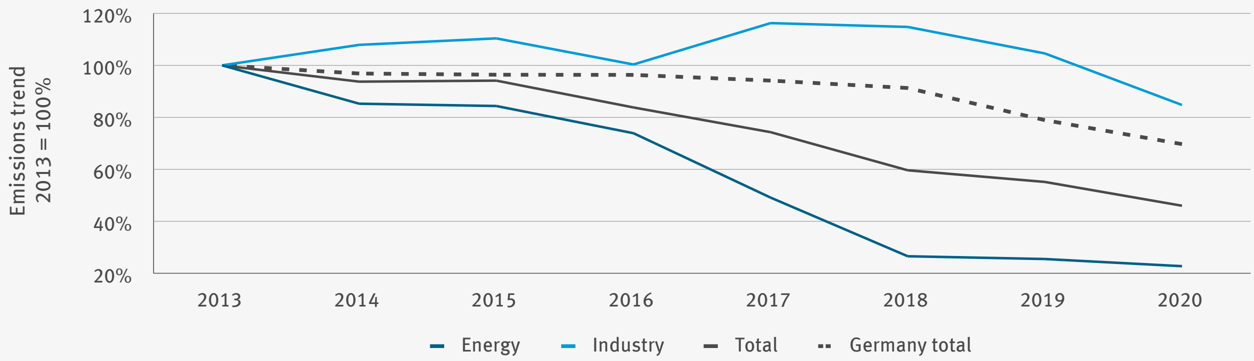
Figure 69: Emissions trends in Rhineland-Palatinate since 2013



No. of intalla-tions subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	27	2,286,167	2,214,642	2,408,533	2,301,623	2,073,078	2,109,177	2,155,911	2,258,612
Industry	12	4,185,296	4,041,190	3,869,482	3,878,750	4,018,903	3,844,468	3,905,841	3,803,484
SH	39	6,471,463	6,255,832	6,278,015	6,180,373	6,091,981	5,953,645	6,061,752	6,062,096
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

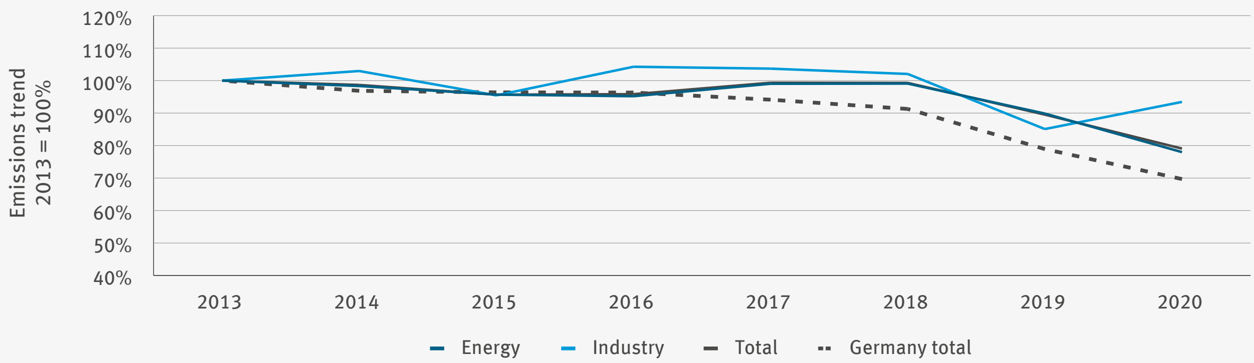
Figure 70: Emissions trends in Schleswig-Holstein since 2013



No. of intallations subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	21	10,527,679	8,974,133	8,881,493	7,778,418	5,170,227	2,793,688	2,681,975	2,392,274
Industry	18	6,315,189	6,813,308	6,970,900	6,336,640	7,341,870	7,248,626	6,604,874	5,352,515
SL	39	16,842,868	15,787,441	15,852,393	14,115,058	12,512,097	10,042,314	9,286,849	7,744,789
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

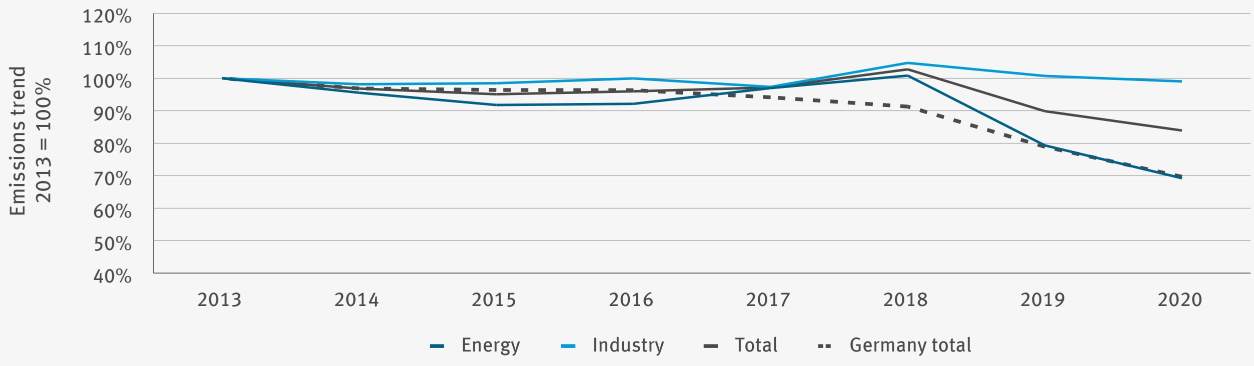
Figure 71: Emissions trends in Saarland since 2013



No. of intallations subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	37	33,844,417	33,283,651	32,385,250	32,219,811	33,515,180	33,537,891	30,413,312	26,396,634
Industry	48	2,545,400	2,620,720	2,429,873	2,654,189	2,639,394	2,597,472	2,165,873	2,378,771
SN	85	36,389,817	35,904,371	34,815,123	34,874,000	36,154,574	36,135,363	32,579,185	28,775,405
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

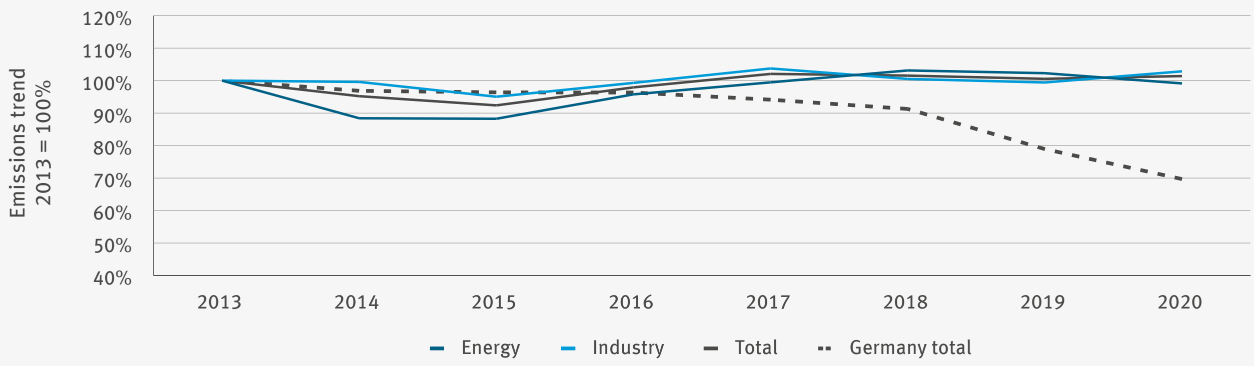
Figure 72: Emissions trends in Saxony since 2013



No. of intallations subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	42	10,613,381	10,140,810	9,740,059	9,778,121	10,293,062	10,700,001	8,419,394	7,347,899
Industry	59	10,319,718	10,129,439	10,162,126	10,314,262	10,045,036	10,807,975	10,392,540	10,219,273
ST	101	20,933,099	20,270,249	19,902,185	20,092,383	20,338,098	21,507,976	18,811,934	17,567,172
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

As of 03/05/2021

Figure 73: Emissions trends in Saxony-Anhalt since 2013



No. of intallations subject to ET in 2020		2013 emissions [t CO_2eq]	2014 emissions [t CO_2eq]	2015 emissions [t CO_2eq]	2016 emissions [t CO_2eq]	2017 emissions [t CO_2eq]	2018 emissions [t CO_2eq]	2019 emissions [t CO_2eq]	VET 2020 [t CO_2eq]
Energy	22	1,107,909	979,470	977,854	1,061,059	1,102,070	1,142,532	1,133,264	1,098,375
Industry	29	1,717,544	1,710,725	1,632,385	1,705,544	1,781,843	1,726,515	1,707,709	1,766,713
TH	51	2,825,453	2,690,195	2,610,239	2,766,603	2,883,913	2,869,047	2,840,973	2,865,088
DE	*1,817*	*459,601,472*	*445,163,738*	*443,000,113*	*442,726,459*	*432,611,941*	*419,535,783*	*362,703,504*	*320,274,987*

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Figure 74: Emissions trends in Thuringia since 2013

6 Main Fuels by Sectors

Table 35: 2013 – 2020 emissions for stationary installations in EU ETS using the main fuels natural gas, lignite and hard coal

Sector / activity	Main fuel	2013 emissions [kt CO_2eq]	2014 emissions [kt CO_2eq]	2015 emissions [kt CO_2eq]	2016 emissions [kt CO_2eq]	2017 emissions [kt CO_2eq]	2018 emissions [kt CO_2eq]	2019 emissions [kt CO_2eq]	2020 emissions [kt CO_2eq]
Energy installations	Lignite	162,557	155,647	155,244	151,528	153,636	153,427	119,941	97,806
	Hard coal	88,884	86,556	86,372	84,235	73,310	71,251	52,206	41,036
	Natural gas	41,500	36,819	36,037	41,932	41,331	38,661	39,200	39,118
Other combustion plants	Lignite	252	260	239	224	240	236	228	231
	Hard coal	115	129	126	130	131	133	125	114
	Natural gas	98	93	92	89	89	87	80	73
Refineries	Natural gas	1,783	1,644	1,392	1,544	1,651	1,534	1,627	1,613
Iron and steel	Lignite	244	207	245	267	222	230	185	198
	Hard coal	8,688	8,987	8,925	8,696	9,587	9,454	9,396	7,819
	Natural gas	8,721	8,951	9,336	8,979	9,185	9,128	8,239	7,882
Non-ferrous metals	Hard coal	51	51	49	52	55	54	60	58
	Erdgas	1,458	1,502	1,564	1,603	1,579	1,630	1,577	1,501
Cement clinker	Natural gas	2,651	2,636	2,641	2,604	2,823	2,645	2,386	2,752
Industrial and building lime	Lignite	4,695	4,724	4,751	4,790	4,915	4,903	4,509	4,106
	Hard coal	1,216	1,233	1,145	1,170	1,135	1,143	1,130	1,105
	Natural gas	1,264	1,169	1,200	1,173	1,188	1,251	1,144	1,081
Other mineral processing industry	Lignite	638	681	646	681	740	755	666	641
	Hard coal	568	577	556	556	594	638	575	584
	Natural gas	6,505	6,605	6,472	6,646	6,694	6,885	6,671	6,455

Sector / activity	Main fuel	2013 emissions [kt CO_2eq]	2014 emissions [kt CO_2eq]	2015 emissions [kt CO_2eq]	2016 emissions [kt CO_2eq]	2017 emissions [kt CO_2eq]	2018 emissions [kt CO_2eq]	2019 emissions [kt CO_2eq]	2020 emissions [kt CO_2eq]
Paper and pulp	Lignite	495	478	475	493	483	464	468	459
	Hard coal	642	628	644	633	610	587	526	450
	Natural gas	3,862	3,784	3,885	3,937	3,989	3,975	3,821	3,756
Chemical industry	Lignite	44	41	38	40	41	40	37	38
	Hard coal	458	483	472	448	488	455	480	440
	Natural gas	8,968	8,798	8,702	8,745	8,738	8,809	8,518	8,366
Sum		**346,356**	**332,683**	**331,246**	**331,196**	**323,456**	**318,375**	**263,795**	**227,681**
Complement: main fuel is not natural gas, hard coal or lignite		134,647	128,557	124,356	121,601	114,139	104,449	99,516	92,594
Total		**481,003**	**461,240**	**455,602**	**452,797**	**437,594**	**422,825**	**363,310**	**320,275**

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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. If the operator does not indicate whether a fuel was actually used as a fuel or, for example, as a reducing agent in the installation, all fuels are also counted as fuels.

Table 36: Number of stationary installations in 2013 – 2020 in EU ETS using the main fuels natural gas, lignite and hard coal

Sector / activity	Main fuel	2013	2014	2015	2016	2017	2018	2019	2020
Energy installations	Lignite	19	20	20	20	20	20	20	20
	Hard coal	48	48	48	48	49	49	49	49
	Natural gas	608	617	620	626	631	631	631	631
Other combustion plants	Lignite	2	2	2	2	2	2	2	2
	Hard coal	1	1	1	1	1	1	1	1
	Natural gas	9	9	10	10	10	10	10	10
Refineries	Natural gas	5	5	5	5	5	5	5	5
Iron and steel	Lignite	1	1	1	1	1	1	1	1
	Hard coal	7	7	7	7	7	7	7	7
	Natural gas	89	90	90	91	92	92	92	92
Non-ferrous metals	Hard coal	1	1	1	1	1	1	1	1
	Natural gas	30	31	31	31	32	32	32	32
Cement clinker	Lignite	5	5	5	5	5	5	5	5
Industrial and building lime	Lignite	18	18	18	18	18	18	18	18
	Hard coal	10	10	10	10	10	10	10	10
	Natural gas	9	9	9	9	9	9	9	9
Other mineral processing industry	Lignite	6	6	6	6	6	6	6	6
	Hard coal	7	7	7	7	7	7	7	7
	Natural gas	216	216	216	217	217	217	217	217
Paper and pulp	Lignite	5	5	5	5	5	5	5	5
	Hard coal	3	3	3	3	3	3	3	3
	Natural gas	104	106	106	106	107	107	107	107

Sector / activity	Main fuel	2013	2014	2015	2016	2017	2018	2019	2020
Chemical industry	Lignite	1	1	1	1	1	1	1	1
	Hard coal	3	3	3	3	3	3	3	3
	Natural gas	73	74	75	75	75	75	75	75
Sum		**1,280**	**1,295**	**1,300**	**1,308**	**1,317**	**1,317**	**1,317**	**1,317**
Complement: main fuel is not natural gas, hard coal or lignite		642	609	585	550	513	549	530	500
Total		**1,922**	**1,904**	**1,885**	**1,858**	**1,830**	**1,866**	**1,847**	**1,817**

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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. If the operator does not indicate whether a fuel was actually used as a fuel or, for example, as a reducing agent in the installation, all fuels are also counted as fuels.

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	Sectors	Industry
2	Energy conversion ≥ 50 MW RTI	Energy installations	Energy
3	Energy conversion 20 – 50 MW RTI		
4	Energy conversion 20 – 50 MW RTI, other fuels		
5	Prime movers (engines)		
6	Prime movers (turbines)		
1	Combustion	Other combustion plants, iron and steel, non-ferrous metals, mineral processing industry, chemical industry	Industry
7	Refineries	Refineries	
8	Coking plants	Iron and steel	
9	Processing of metal ores		
10	Production of pig iron and steel		
11	Processing of ferrous metals		
12	Production of primary aluminium	Non-ferrous metals	
13	Processing of non-ferrous metals		
14	Production of cement clinker	Mineral processing industry	
15	Lime production		
16	Glass production		
17	Ceramics production		
18	Mineral fibres production		
19	Gypsum production		
20	Pulp production	Paper and pulp	
21	Paper production		
22	Carbon black production	Chemical industry	
23	Nitric acid production		
24	Adipic acid production		
25	Production of glyoxal and glyoxylic acid		
26	Ammonia production		
27	Production of bulk organic chemicals		
28	Production of hydrogen and synthesis gas		
29	Soda production		

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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. I. ETS energy emissions [Mt CO_2eq]	N. I. ETS industry emissions [Mt CO_2eq]	Estimated emissions [Mt CO_2eq]	Total [Mt CO_2eq]
2005 emissions	340.1	98.2	31.8	4.9	39.9	514.9
2006 emissions	341.0	100.2	32.6	4.3	39.7	517.8
2007 emissions	347.2	103.1	32.7	4.1	43.6	530.7
2008 emissions	332.5	107.5	28.8	3.7	33.1	505.6
2009 emissions	308.1	94.9	23.1	2.2	30.5	458.8
2010 emissions	324.6	102.9	25.9	1.5	25.0	479.9
2011 emissions	322.6	104.6	22.1	1.0	24.2	474.5
2012 emissions	327.1	101.9	22.8	0.8	23.4	476.0
2013 emissions	336.8	122.8	20.4	1.0	0.1	481.1
2014 emissions	322.4	122.7	15.4	0.7	0.1	461.3
2015 emissions	320.0	123.0	12.0	0.6	0.1	455.7
2016 emissions	319.5	123.2	9.7	0.3	0.1	452.8
2017 emissions	306.7	126.0	4.9	0.1	0.1	437.8
2018 emissions	295.2	124.4	3.2	0.1	0.0	422.9
2019 emissions	243.3	119.4	0.6	0.0	0.0	363.3
2020 emissions	206.5	113.7	0.0	0.0	0.0	320.2
No. of installations	903	914	495	271		

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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.

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 CO_2 (carbon dioxide) or CO_2 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.

Full scope of EU ETS in aviation

It includes carbon dioxide emissions from all flights which land at or take off from airports in the European Economic Area States. Exceptions are described in Section 4.1.

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 this installation. In contrast, previous VET reports until 2014 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 is reduced by 1.74 percent annually from the 2013 baseline 1, i.e. the linear factor was 0.8244 in 2020.

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

Installations no longer subject to emissions trading include, for example, 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 MW 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). This factor is determined by the European Commission every single year and applies uniformly throughout the EU to all industrial sectors (in a cross-sectoral way).

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.

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