Greenhouse Gas Emissions in 2018

Stationary installations and aviation subject to emissions trading in Germany (2018 VET report)

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Executive Summary

Energy and Industry Sector in Germany

In 2018, the European Emissions Trading Scheme (EU ETS) recorded 1,870 stationary installations in Germany. These installations emitted around 422 million tonnes of carbon dioxide equivalent (CO_2eq), which represents a 3.5 percent decrease compared to 2017.

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

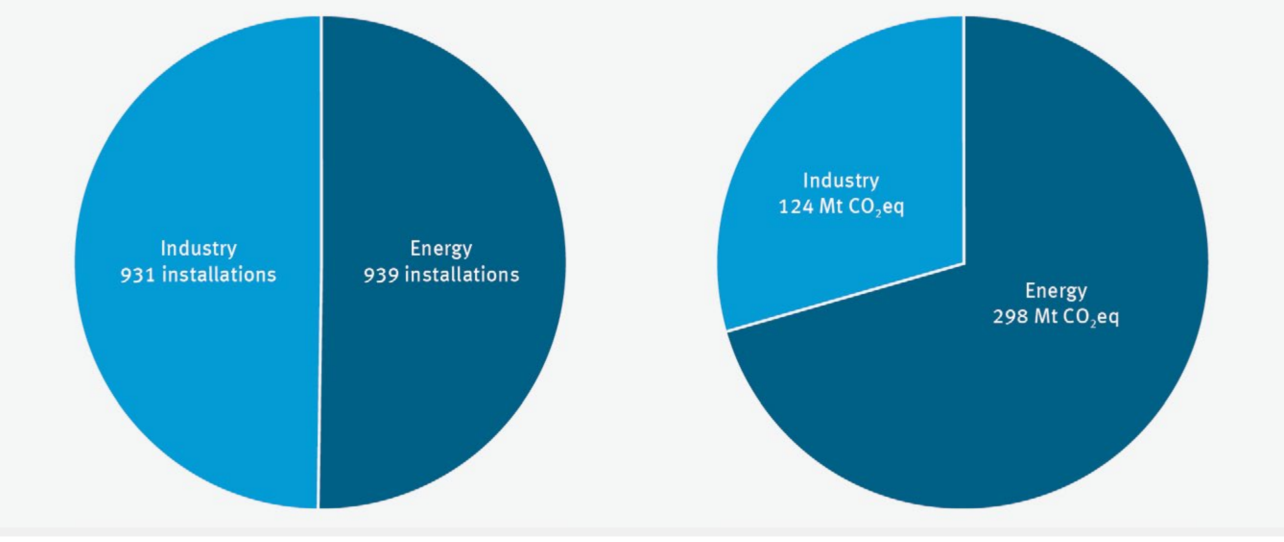

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Figure 1: Distribution of emissions and installations subject to emissions trading in the energy sector (Activities 2 to 6 as per Annex 1 TEHG) and the industrial sector (Activities 1 and 7 to 29 as per Annex 1 TEHG) in Germany in 2018

While the number of installations is divided approximately half and half between the industrial and the energy sectors, the proportion of emissions is different: about 70 percent of emissions subject to emissions trading from German stationary installations is generated by energy installations and 30 percent of the emissions come from industrial installations.

Figure 2 shows the German ETS emissions since 2005, separated into industrial and energy installations. The figure shows the reported emissions for the individual years, i. e. including the emissions from installations that are no longer subject to emissions trading (n. l. ETS)[I]. These are predominantly emissions from energy installations, which is why a subdivision into the energy and industrial sectors has been omitted. In addition, an estimate (scope estimate) was made for emissions prior to 2013 in order to reflect the current scope of emissions trading for previous trading periods. This estimate mainly affects emissions from industrial installations, while the estimated emissions from energy installations are barely visible in the figure. Overall, emissions from German installations subject to emissions trading have thus fallen by around 18 percent since 2005.

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

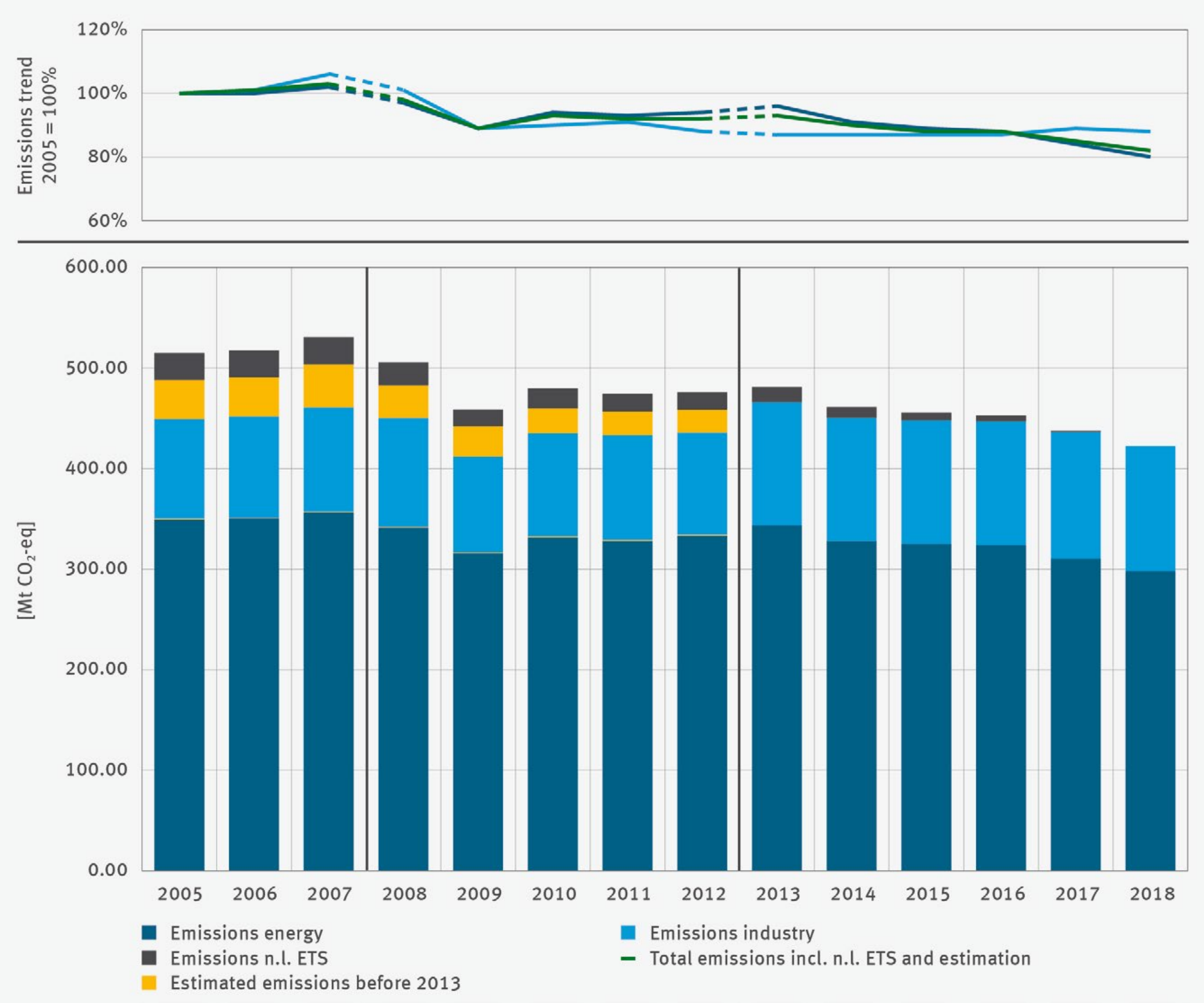

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Figure 2: ETS emissions from the energy and industry sectors in Germany since 2005

Compared with the previous year, emissions from energy installations fell by around four and a half percent to 298 million tonnes of carbon dioxide in 2018. This is attributable to the decline in lignite, hard coal and natural gas usage following a substantial increase in the feed-in of wind power and photovoltaic installations and a slight overall decline in electricity production (decline in export surplus). This means that the relatively sharp decline in emissions from the energy industry is continuing. Emissions from hard coal fell by 6.1 percent in 2018 and from lignite by 2.4 percent. In terms of emissions from lignite, this was mainly due to the transfer of the last two units of the Frimmersdorf power plant to security standby in October 2017, which previously emitted around 3.6 million tonnes of carbon dioxide. The decommissioning of several hard coal units with a total capacity of around 1.4 gigawatts led to a significant reduction in emissions from hard coal. Emissions from natural gas also fell significantly by 6.9 percent.

Since the start of the third trading period in 2013, emissions from energy installations have fallen by 18 percent. Emissions from the energy-intensive industry ranged between 123 and 126 million tonnes of carbon dioxide equivalents between 2013 and 2017 and remained at a similarly high level in 2018 with 124 million tonnes of carbon dioxide equivalents. The decline in total German ETS emissions since 2013 is thus exclusively attributable to the decline in emissions from energy installations.

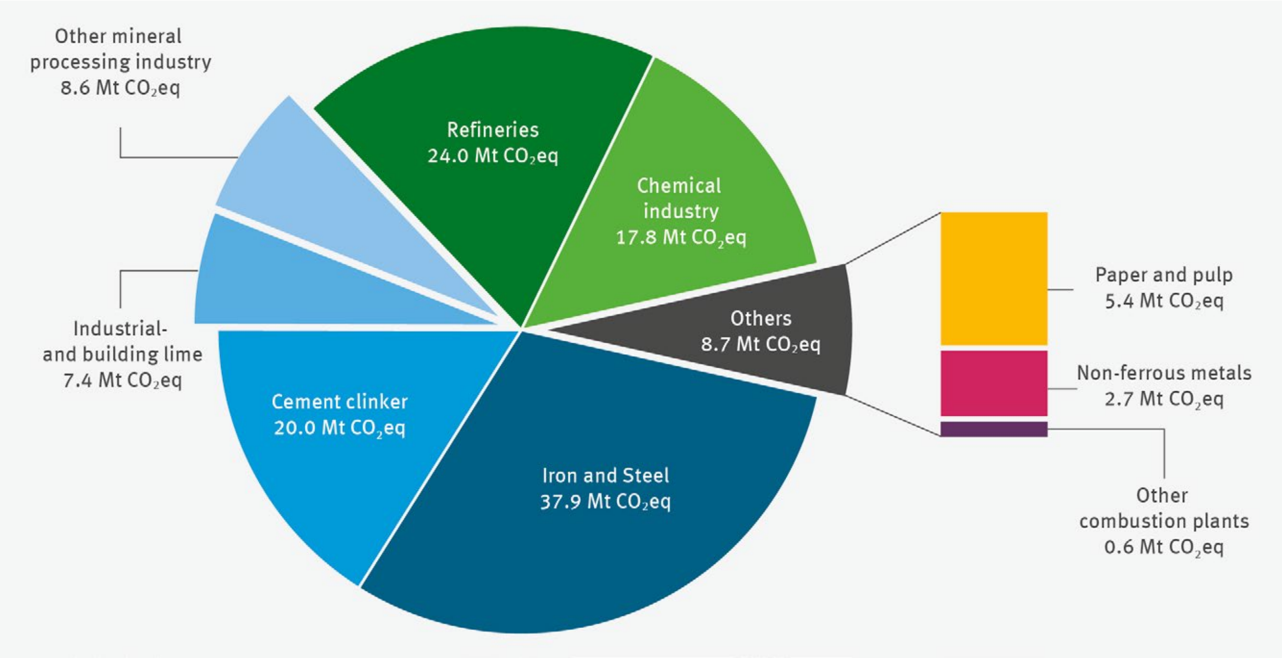

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Figure 3: Distribution between individual sectors in the industrial area emissions in 2018

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 30 percent, followed by refineries (19 percent), cement clinker production (16 percent) and the chemical industry (14 percent). The remaining industrial emissions can be attributed to four further sectors and sub-sectors: other mineral processing industries (seven percent), which includes glass and ceramics production, industrial and building lime (six percent), 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.

The different emission trends in selected industrial sectors compared to the previous year are summarised in Figure 4. In addition, the relative annual changes since 2013 are also shown. In 2018, emissions in almost all sectors remained at a similar level to the previous year; only the emissions from refineries and the cement industry show a noticeable year-on-year decline. Several extraordinary events in 2018 were responsible for the significant decline in the refineries, including the severe explosion at the Vohburg refinery at the beginning of September 2018 followed by a major fire, as well as the overhaul of some installations with production shutdowns lasting several weeks. By contrast, emissions from iron and steel installations, the industry with the highest emissions, remained similarly high year-on-year. Emission trends since 2013 in all sectors – with the exception of the non-ferrous metals industry – have alternated between mostly moderate emission increases and declines.

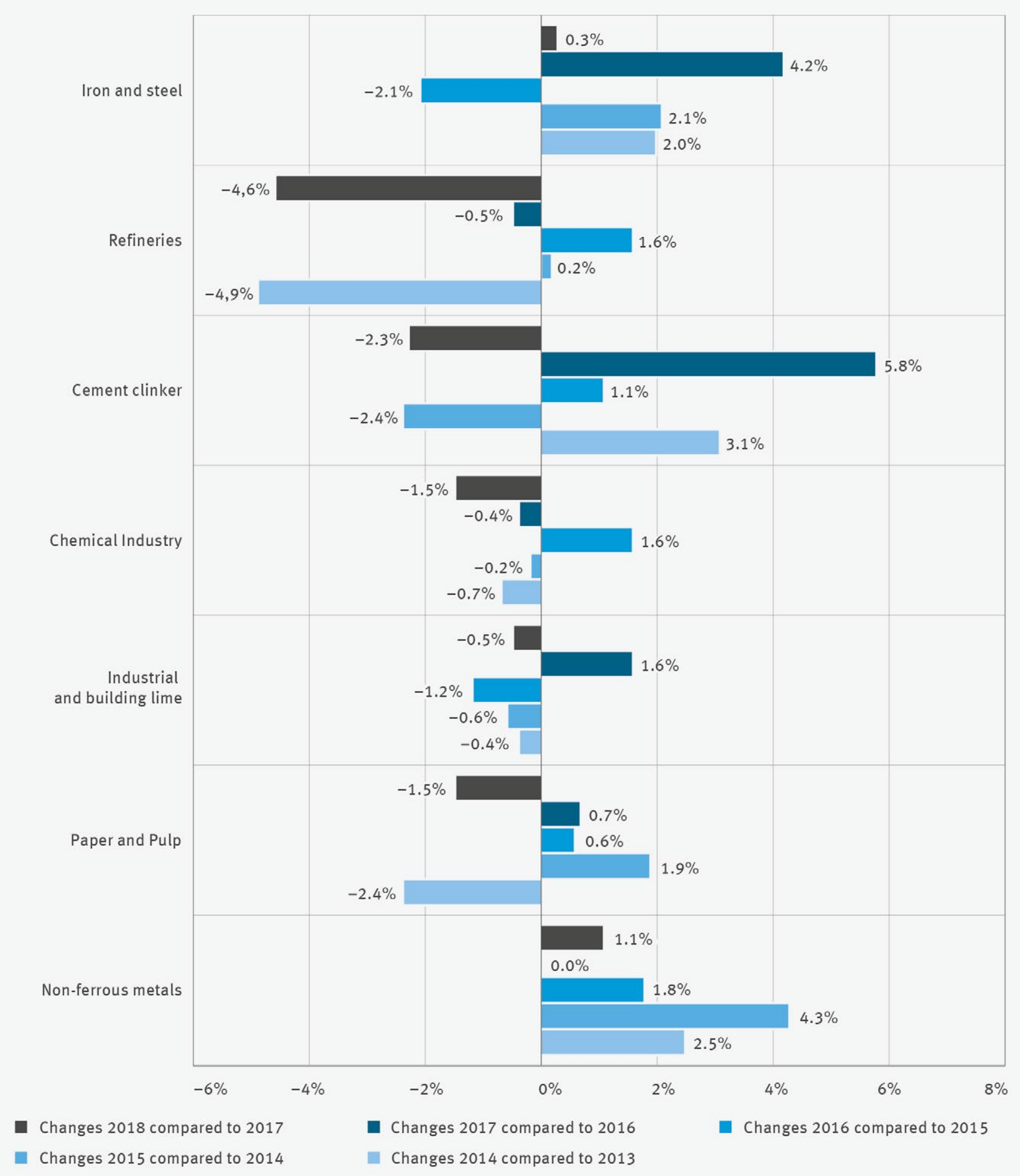

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Figure 4: Annual emission changes in the industrial sectors since 2013

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 grouped together into one power plant in Table 1. In total, these ten power plants or eleven installations produce more than one third (38 percent) of the emissions subject to emissions trading in the stationary sector and slightly more than half (54 percent) of the emissions from energy installations. These ten power plants also emit significantly more than all German industrial installations combined.

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

Installation name (operator)	2018 VET [kt CO_2eq]
Neurath Power Plant (RWE Power AG)	32,157
Niederaußem Power Plant (RWE Power AG)	25,928
Jänschwalde Power Plant (Lausitz Energie Kraftwerke AG)	22,807
Boxberg III and IV Power Plant (Lausitz Energie Kraftwerke AG)	19,001
Weisweiler Power Plant (RWE Power AG)	16,786
Schwarze Pumpe Power Plant (Lausitz Energie Kraftwerke AG)	12,374
Lippendorf Power Plant (Lausitz Energie Kraftwerke AG)*	11,711
Mannheim Large Power Plant (Grosskraftwerk Mannheim Aktiengesellschaft)**	6,741
Moorburg Heat and Power Plant (Vattenfall Heizkraftwerk Moorburg GmbH)	6,248
Schkopau Power Plant (Uniper Kraftwerke GmbH)***	6,058
Total	**159,811**

* 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 block.
** Mannheim Large Power Plant is a joint power plant of the following companies: RWE Generation SE (40%), EnBW (32%) and MVV RHE GmbH (28%).
*** Schkopau Power Plant is a joint power plant of the following companies: Uniper Kraftwerke GmbH (58,1%) and Saale Energie GmbH (41,9%)
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The ten largest emitters among the industrial installations emit significantly less and come exclusively from the iron and steel industry or refineries. Their share of emissions subject to emissions trading in the stationary sector is around nine percent, while they account for 31 percent of emissions from industrial installations.

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

Installation (operator)	2018 VET [kt CO_2eq]
Thyssenkrupp Steel Europe AG Integrated Iron and Steel Works in Duisburg (Thyssenkrupp Steel Europe AG)	8,337
Duisburg Huckingen Plant, Glocke (HKM Hüttenwerke Krupp Mannesmann GmbH)	4,899
Dillingen Plant, amalgamated installation (ROGESA Roheisengesellschaft Saar mbH)	4,683
Salzgitter Plant, Glocke (Salzgitter Flachstahl GmbH)	4,360
PCK Glocke Refinery (PCK Raffinerie GmbH)	3,790
Ruhr Oel GmbH – Scholven Plant (Ruhr Oel GmbH)	2,858
Mineral Oil Refinery Oberrhein, Works 1 and Works 2 (Mineralölraffinerie Oberrhein GmbH & Co. KG)	2,692
Bremen Plant, amalgamated plant (ArcelorMittal Bremen GmbH)	2,621
Wesseling Refinery Plants including Power Plant, Rhineland Refinery (Shell Deutschland Oil GmbH)	2,150
Leuna Mineral Oil Refinery (TOTAL Raffinerie Mitteldeutschland GmbH)	2,135
Total	**38,524**

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Allocation status

In the sixth year of the current trading period, verified emissions of 422 million tonnes of carbon dioxide equivalents from all installations in Germany subject to emissions trading significantly exceeded the free allocation amount for that year. In 2018, around 145 million emission allowances were allocated free of charge to operators of 1,614 of Germany's 1,870 installations. The average allocation coverage was virtually unchanged from the previous year (34.3 percent) and has thus for the first time not fallen since 2013. Taking into account transfers of waste gases from iron, steel and coke production and heat imports in the overall allocation status, the allocation coverage changes substantially between the sectors. As a result of this adjustment, the level of allocation coverage in the industrial sectors will be reduced from 98.5 to 84.5 percent in 2018, while in the energy sector allocation coverage will increase from 7.6 to 13.4 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	No. of installations	2018 allocation amount [1000 EUA]	2018 VET [kt CO_2eq]	2018 allocation surplus [kt CO_2eq]	2018 allocation coverage*	Adjusted 2018 allocation amount** [1000 EUA]	2018 allocation coverage**
Energy	Energy installations	939	22,521	297,930	−275,409	7.6%	39,884	13.4%
		939	22,521	297,930	−275,409	7.6%	39,884	13.4%
Industry	Refineries	23	18,707	24,001	−5,294	77.9%	18,707	77.9%
	Iron and Steel	125	46,774	37,913	8,861	123.4%	32,573	85.9%
	Non-ferrous metals	39	2,347	2,662	−315	88.2%	2,347	88.2%
	Industrial and building lime	40	6,217	7,357	−1,140	84.5%	6,217	84.5%
	Cement clinker	36	17,174	19,998	−2,824	85.9%	17,174	85.9%
	Other mineral-processing industry	253	6,469	8,646	−2,177	74.8%	6,469	74.8%
	Paper and pulp	145	6,067	5,388	679	112.6%	4,412	81.9%
	Chemical industry	232	18,289	17,798	491	102.8%	16,782	94.3%
	Other combustion plants	38	449	601	−153	74.6%	449	74.7%
		931	122,492	124,364	−1,872	98.5%	105,130	84.5%
Total		**1,870**	**145,013**	**422,294**	**−277,281**	**34.3%**	**145,014**	**34.3%**

* Without considering possible adjustments for waste gas transfers and heat imports.
** Considering possible adjustments for waste gas transfers and heat imports.
As of 02/05/2019

Germany and Europe

The emissions trend from installations participating in the ETS (28 EU Member States and Iceland, Liechtenstein, Norway) in 2018 was similar throughout Europe to that in Germany. According to preliminary data of the European Commission, emissions fell by more than four percent in 2018 and amounted to 1.67 billion tonnes of carbon dioxide equivalents. As in Germany, the main reason for this trend was a decline in emissions from electricity generation (more than five percent decline), while there were still no substantial changes in emissions from the overall industrial installations.

However, over a longer period of time, ETS emissions in Europe have fallen much more than in Germany: while emissions from installations in Germany have fallen by around 18 percent since the start of emissions trading in 2005, ETS emissions in Europe have fallen by around 29 percent below the 2005 baseline, although the decline in emissions in the period 2013 to 2018 has slowed down Europe-wide: in 2018 emissions were around 12 percent below the 2013 baseline. This corresponds to the decline in emissions in Germany over the same period.

As in all years since the start of the third trading period, emissions from stationary installations were significantly lower than the maximum available distribution volume (nominal cap) for 2018 of 1.89 billion emission allowances. The reduction in emissions by around 80 million tonnes of carbon dioxide equivalents was therefore greater than the annual reduction in the cap (minus 38 million emission allowances). In 2018, the preliminary emissions from the ETS installations were thus slightly below the emission allowances offered through free allocation, auctioning and exchange quotas for project credits. According to the European Commission, the surplus amounted to around 1.655 billion emission allowances at the end of 2018 and was about the same as at the end of 2017. On the basis of this and the surplus determined in the previous year, the auction volume reduction in the Market Stability Reserve (MSR) in 2019 amounts to a total of 397 million emission allowances (265 million emission allowances in the period of January to August 2019 and 132 million emission allowances in the period of September to December 2019).

Aviation

For 2018, 72 aircraft operators subject to emissions trading administered by Germany reported emissions of 9.4 million tonnes of carbon dioxide. This represents a year-on-year increase of around 3 percent in emissions and a new all-time high after the interim decline in emissions due to the Air Berlin insolvency.

The amount of free allowances allocated fell considerably in 2018 to only around 3.6 million. The reduced allocation volume is mainly attributable to the discontinuation of the allocation to the insolvent Air Berlin. However, since emissions have risen compared to the previous year, the average allocation coverage of aircraft operators fell significantly from 56 percent in 2017 to 38 percent in 2018.

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Abbreviations

AA	Allocation amount
AGEB	Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen)
AR	Activity rate
BNetzA	Federal Network Agency (Bundesnetzagentur)
BImSchV	Federal Exposure Control Ordinance (Bundes-Immissionsschutzverordnung)
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
EA	Emission allowance
EEX	European Energy Exchange
EG	Natural gas
EHRL	Emissions Trading Directive (Emissionshandels-Richtlinie)
EM	Emissions
ER	Emissions report
ERU	Emission Reduction Units (from JI projects)
EU 25	Austria, Belgium, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden
EU 28	EU 25 plus Bulgaria, Croatia, Romania
EU 31	EU 28 und Iceland, Liechtenstein, Norway
EU ETS	European Emissions Trading Scheme
EUA	EU emission allowance
aEUA	EU aviation allowance
EEA	European Economic Area (the same as EU 31)
FGD	Flue gas desulfurisation plant
GW	Gigawatt
HC	Hard coal
ICAO	International Civil Aviation Organisation
ICE	Intercontinental Exchange
kt	Kilotonne or one thousand tonnes
LF	Linear factor
Mt	Million tonnes

MW	Megawatt
NER	New Entrant Reserve (reserve for new entrants)
N_2O	Dinitrogen monoxide, nitrous oxide
n. l. ETS	No longer subject to emissions trading
PFC	Perfluorocarbons
RegO	EU Registry Ordinance
RTI	Rated thermal input
HC	Hard coal
TEHG	German Greenhouse Gas Emission Allowance Trading Act (Treibhausgas-Emissionshandelsgesetz)
TNAC	Total Number of Allowances 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 (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 bis 2020

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

The VET Report's analyses are mainly based on the previous year's verified emissions in the form as they are recorded in the Union Registry. This data is entered by the verifiers 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 of the report 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 interprets the data underlying the evaluations in the 2018 VET Report. Chapter 2 is separated into different sectors and addresses the emissions from stationary installations subject to emissions trading. 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 surplus in the market. 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. The calculations used exact values so that 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 send 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 at the latest by 31.03 of the year following the reporting year. Independent accredited verifiers verify the data in the emissions report. The verifiers 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 2018. 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 – with or without subsequent changes to the data up to the cut-off date – are referred to as annual emissions. The figures showing the 2018 annual emissions will be available for the first time in the autumn of 2019 after DEHSt has reviewed the emission reports but may vary due to new knowledge 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 obliged to make a VET entry and 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 subsequent year		Verified reports as of 28/02/2019	
	Number of reports	VET [kt CO_2eq/a]	No. of installations	Annual emissions [kt CO_2eq/a]
2005	1815	473,681	1830	474,990
2006	1824	477,382	1777	478,068
2007	1882	487,050	1744	487,166
2008	1660	472,599	1672	472,593
2009	1651	428,198	1658	428,295
2010	1628	453,883	1642	454,865
2011	1631	450,267	1649	450,351
2012	1629	452,586	1622	452,596
2013	1929	480,937	1920	480,987
2014	1905	461,173	1903	461,290
2015	1889	455,528	1884	455,634
2016	1863	452,873	1857	452,890
2017	1833	437,647	1827	437,687
2018	1870	422,294		

As of 02/05/2019

The significant increase in emissions between 2012 and 2013 can be traced back to the expansion of the scope at the start of the third trading period. For example, installations for non-ferrous metal processing and aluminium, adipic acid, nitric acid and ammonia production also participated 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 so far only been shown in the emissions trend figures within the sector chapters but not in general figures: for example, the total emissions of installations subject to emissions trading in Germany. In addition, the estimate of the scope correction used in the allocation report for 2013 – 2020, 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 collection. For installations where new activities were added, the difference between historical emissions and data from the allocation application or 2020 data collection was determined. For years in which data is not available, the scope estimate has been determined by linear interpolation (especially for 2011 and 2012).

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 emissions trend for the installations subject to emissions trading in the reporting year. Starting with the 2017 VET report, the figures for emissions trends will 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. This will enable us to show the actual emissions trend of the 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. Installations no longer subject to emissions trading include decommissioned installations and installations that still exist but are no longer subject to emissions trading e. g. because they fall below the 20 Megawatt (MW) rated thermal input (RTI) limit as an energy installation.

Free allocation in 2018

Free allocation as approved for 2018 by the European Commission prior to 28/02/2019 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 2018 are necessarily approved. That is, the representation of the allocation status does not include any potential allocation corrections after 28/02/2019.

The allocation amount approved by the European Commission is included in the National Allocation Table[1] (NAT), which specifies the free basic allocation for 1,763 incumbent installations and the corrections of this basic allocation for individual installations as approved by the European Commission by 28/02/2019. These are some allocation changes resulting from (partial) cessations or capacity reductions. In addition, allocation amounts for new market entrants approved by the European Commission by 28/02/2019 are taken into account, i. e. for new installations or a capacity increase in incumbent installations which became operational from 01/07/2011. As of 28/02/2019, 1,614 installations of those considered in the 2018 VET report received free allocations for 2018 totalling around 145 million allowances.

Emission and production trends

Emission and production trends for some sectors and activities are being compared. To do this, activity rates (AR) of the respective (product) benchmarks collected 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 corresponding figures. In the case of cement clinker, industrial and building lime, the production quantity reported in the emission report and calculated from the material flows was used instead of the activity rate.

The activity rates have been supplemented by external data as far as possible, for example by production data from the respective industrial associations. The relative changes in activity rates and production volumes between 2005 and 2018 compared to 2005 (2005 = 100 percent) and the corresponding emissions (also as relative change compared to 2005) are shown.

It should be noted that the production quantities 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 in the determination of activity rates. These, of course, do not apply to the collection 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 participants.

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 2018 or which were never subject to emissions trading due to small capacities.

1 See DEHSt 2013b

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 2018 EEA). This refers to both sector chapters 2.1 to 2.8 and Section 3 “Germany and Europe: emissions trend, surpluses and prices”.

For 2018, these are supplemented with excerpts (01/04/2019 and 02/05/2019) from the Union Registry published by the European Commission (see COM 2019a and COM 2019b). 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 46, Chapter 7), thereby differences may occur in the amount of emissions per sector for Germany. The boundaries of TEHG activities are in line with those in the EU Union Registry in most sectors, in some cases however, such as the energy installations, this equivalence is not fully given. Due to the fact that the classification is somewhat different, EU registry activities are used for EU comparisons of the respective sector chapters. A comparison of emissions between Germany, the EU 25 states and the new post-2005 EU ETS participants (Bulgaria, Croatia, Romania, Iceland, Liechtenstein, Norway) will be carried out.

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

2.1 Energy installations

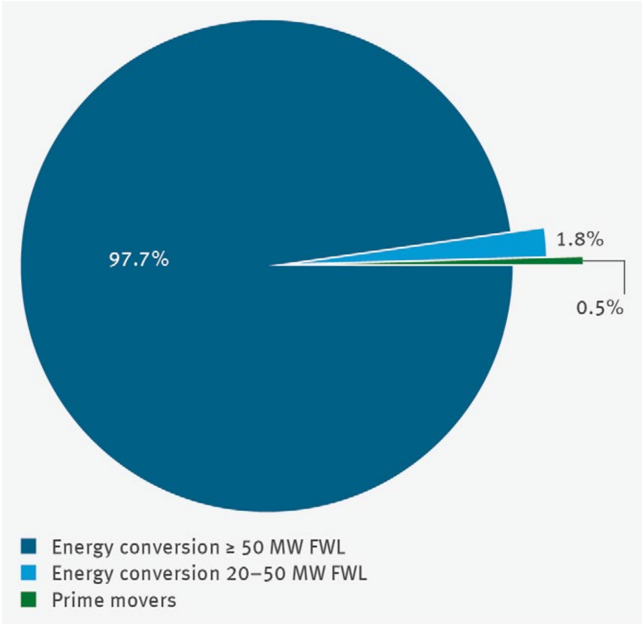
In 2018, 939 energy installations (Activity 2 to 6 Annex 1 TEHG installations) were subject to emissions trading. On balance, participation in emissions trading decreased by three installations compared to 2017.

The emissions from these installations decreased considerably by more than 12 million tonnes of carbon dioxide (minus four percent) and amounted to just under 298 million tonnes in 2018 (see Table 5).

Emissions

With a rough 98-percent share, the majority 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 Figure 5.

Overall, emissions from all large combustion plants have decreased by about 4.1 percent. This reflects the fact that power generation from hard coal has strongly declined once more.



As of 02/05/2019

Figure 5: Shares of 2018 emissions from energy installations (Activities 2 to 6)

Table 5: Energy installations (Activities 2 to 6), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of install-lations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
2	Energy conversion ≥ 50 MW RTI	479	303,567	291,203	–12,364
3	Energy conversion 20 – 50 MW RTI	393	5,302	5,213	–89
4	Energy conversion 20 – 50 MW RTI, other fuels	11	143	134	–9
5	Prime movers (engines)	3	33	22	–11
6	Prime movers (turbines)	53	1,257	1,357	100
Total		**939**	**310,303**	**297,930**	**–12,373**

As of 02/05/2019

On the other hand, energy installations with an RTI between 20 and 50 MW (Activities 3 and 4 as per Annex 1 TEHG) produced about 1.7 percent less emissions compared to 2017. 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.

Measured by the number of degree days, 2018 was on average warmer than 2017 and also warmer than the long-term average. The emissions trend of energy installations between 20 and 50 MW RTI reflects the fact that the net heat production in Germany decreased by 2.4 percent compared to the previous year. Weakened economic performance also contributed to the decrease of emissions, with industrial consumers consuming about 1.8 percent less heat energy than in the previous year.[2]

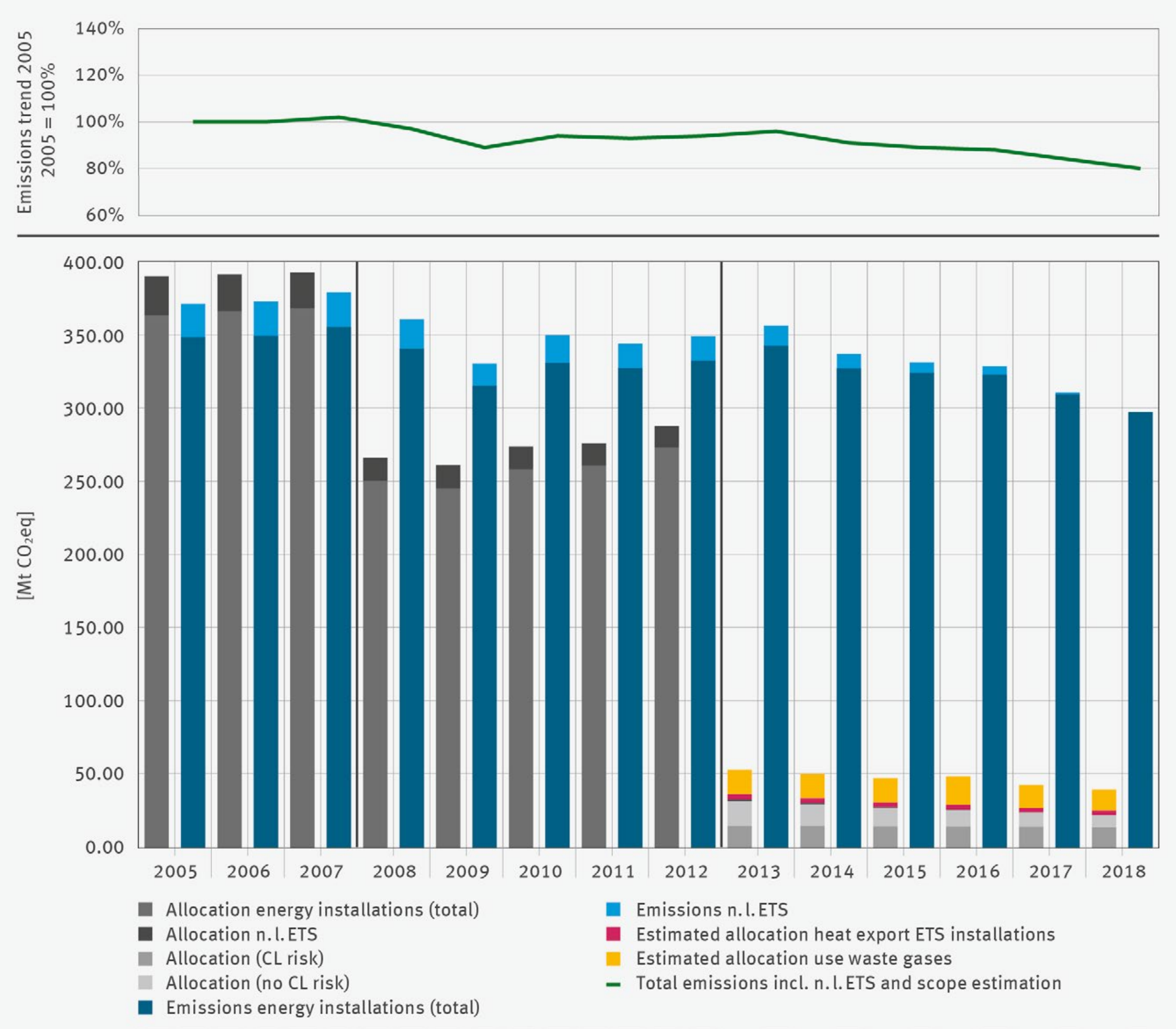
Although the 393 installations were in a similar order of magnitude, Activity 3 and 4 installations emitted significantly less than the large combustion plants. In 2018, they emitted about 5.2 million tonnes of carbon dioxide, i. e. only 1.8 percent of the amount emitted by combustion plants in total.

Only 0.5 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, have significantly increased by roughly seven percent compared to the previous year. This is notable against the background that a larger increase was also observed in previous years.

The operation of these installations depends on the conditions in the natural gas grid: an increase in emissions may result due to increased natural gas consumption in Germany and because of increased transport volumes of natural gas through Germany to neighbouring countries. Natural gas consumption in Germany decreased by around 1.6 percent last year. However, Germany's natural gas imports (+ 43 percent) and natural gas exports (+ 148 percent) increased significantly compared to the previous year.[3]

Figure 6 shows the emissions trend of the energy installations from the start of emissions trading. Installations no longer subject to emissions trading (n. l. ETS) have also been taken into account. In the first trading period emissions increased steadily. At the beginning of the second trading period emissions initially decreased, especially under 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 353 million tonnes of carbon dioxide, returning to the level of 2008. After 2014, the emissions no longer continued to increase. In 2018, the emissions from energy installations have again reduced significantly amounting to under 300 million tonnes of carbon dioxide for the first time.

2 AGEB 2019a
3 AGEB 2019a



As of 02/05/2019

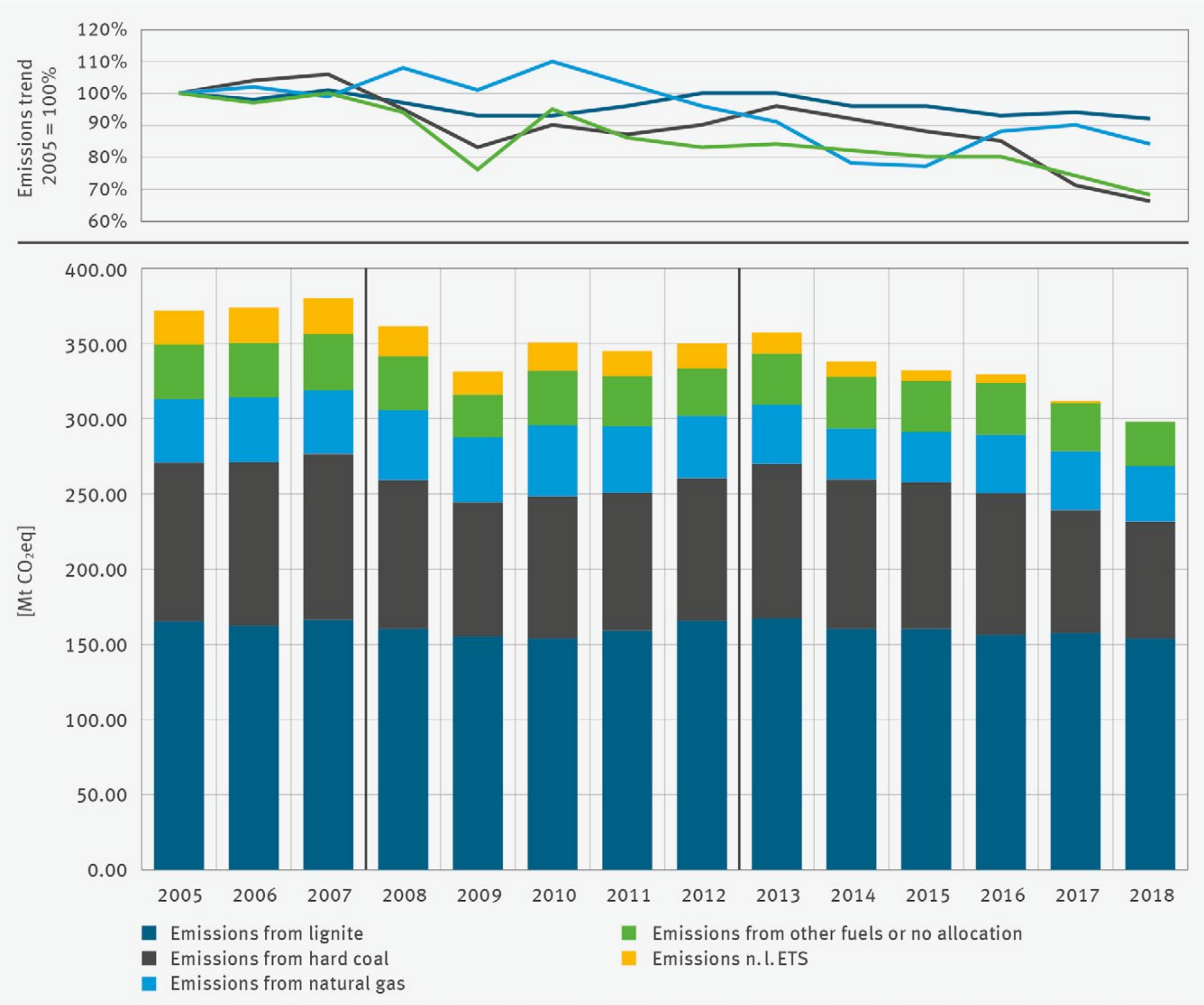
Figure 6: Energy installations (Activities 2 to 6), emissions trend and free allocation in Germany from 2005 to 2018

As a result, energy installations reached their lowest emissions level since the introduction of the EU ETS, but in 2018 still caused 80% of the 2005 emissions.[4]

4 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 § 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, however the third trading period allocation rules do not contain any obligation comparable to § 11 of the 2012 Allocation Act.

Emissions – divided by main fuels

Figure 7 shows the emissions from energy installations divided by fuels. For this purpose, the installations were assigned to the fuels lignite, hard coal and natural gas according to the largest share of the 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 02/05/2019

Figure 7: Energy installations (Activities 2 to 6), emissions trend from 2005 to 2018 in Germany according to fuel

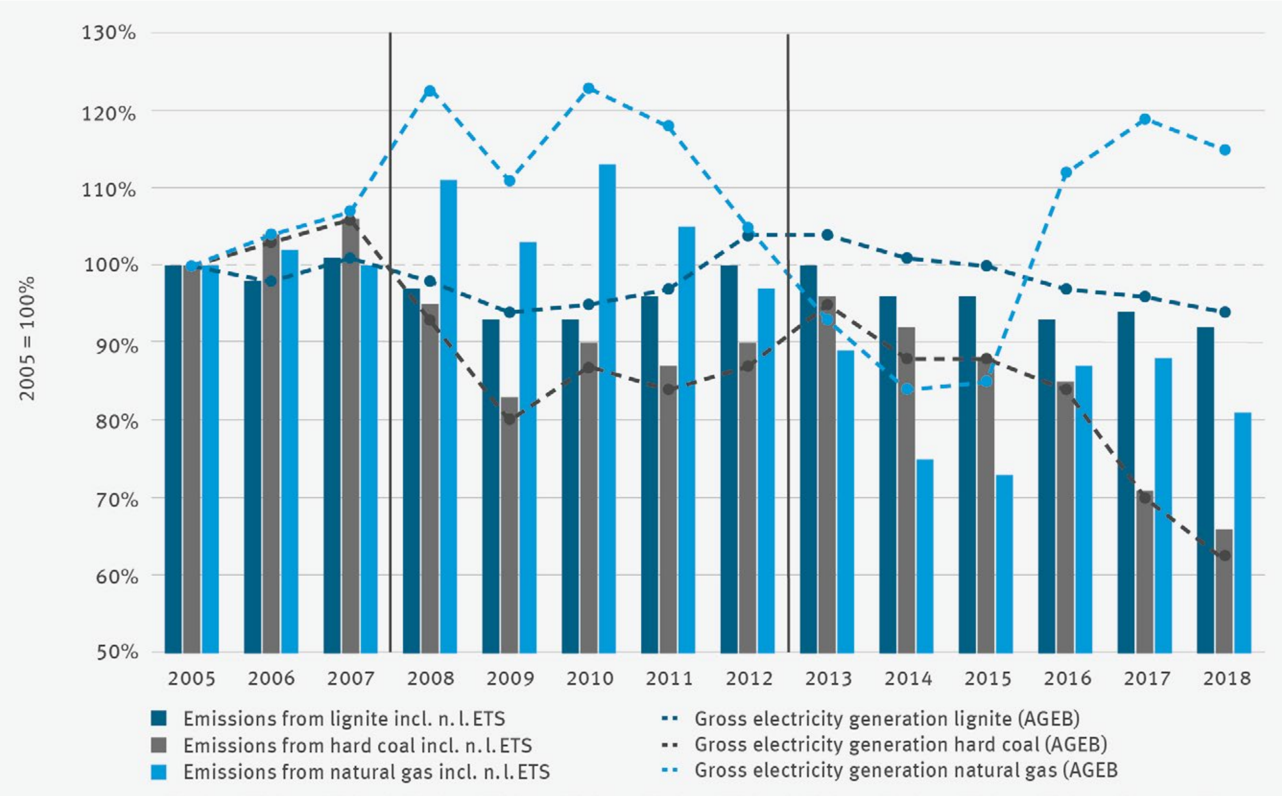
Emissions from lignite fell in 2018 to their lowest level since 2010 for the fifth consecutive year. Compared to hard coal as main fuel, the decline of around 2.4 percent compared to the previous year was comparatively moderate. Although emissions from hard coal also fell for the fifth consecutive year, at 6.1 percent, the decrease was not as strong as in the previous year. Emissions from natural gas-fired installations dropped significantly by 6.9 percent, the lowest level since 2015.[5]

5 The DEHSt press release of 09/04/2019 describes a smaller emissions decrease for natural gas. This is due to the fact that several energy installations were assigned to the main fuel "natural gas" in 2018, whereas they were previously assigned to other fuels. For the VET report, the assignment of these installations has also been adjusted for previous years.

Based on 2005, the first year of emissions trading, emissions from installations that use lignite as their main fuel decreased by roughly eight percent. Emissions from energy installations using hard coal as the main fuel decreased much more noticeably. Compared to 2005, the decline in the 14th year of emissions trading amounted to nearly 34 percent for hard coal and roughly 16 percent for natural gas-fired installations. Installations no longer subject to emissions trading (n. l. ETS) were also considered.

Emissions and production trends

Figure 8 shows the comparison of emissions trends for large combustion plants and gross electricity generation from fossil fuels in Germany divided by lignite, hard coal and natural gas.



As of 02/05/2019

Figure 8: Large combustion plants (Activity 2), emissions and production trend in Germany from 2005 to 2018 compared to 2005

The trend in gross electricity generation and the emissions from large fossil fuel combustion plants, principally determined by the quantity of electricity generated, have an identical profile. This is true even though large combustion plants only account for a proportion of the installations whose electricity generation is included when calculating the total amount of electricity generated in Germany. This in particular applies to hard coal. The almost equal track of the two curves means that the emission intensity of electricity generation from hard coal has not changed significantly. Carbon dioxide emissions associated with generating one megawatt-hour of electricity have therefore also remained unchanged. This is surprising since several large coal-fired power plants with comparatively high efficiency rates have been put into operation in recent years and a number of low-efficiency old plants have been shut down or put into reserve. Therefore, one would have expected that electricity from hard coal would have been produced more efficiently overall and with lower specific emissions. The fact that the figure does not confirm this view can have various causes. First, combined heat and power (CHP) has not been taken into account: increased heat generation in hard coal-fired cogeneration plants would lead to increased emissions at unchanged power generation.

On the other hand, reduced utilisation of the installations, in particular by increased operation in the partial load range, tends to result in efficiency losses and thus increasing specific emissions. These mechanisms may have contributed to the practically identical levels of production and emission from hard coal-fired power plants.

Since 2005 the gross electricity generation of large combustion plants using hard coal has decreased by 38 percent from 134 Terawatt-hours (TWh) to around 83 TWh.[6] Thus, according to preliminary estimates, gross electricity generation from hard coal in Germany in 2018 has fallen to its lowest level in over 40 years.[7] The decommissioning of several hard coal units with a capacity of around 1.4 GW and a significant increase in the feed-in of wind power and photovoltaic installations (PV installations), were the main reasons for the decrease. At the same time, the cost-effectiveness of hard coal-fired plants deteriorated compared to the previous year due to higher global hard coal prices and higher emission allowance prices (EUA). The calculated profit margins (known as clean dark spreads) were in some cases in the negative range (see also “Fuel Switch/ Clean Spreads” section), particularly in the case of older hard coal units. Several decommissioning notifications were also submitted to the Federal Network Agency for 2019. While initially planned for 2018, the start-up of the new Datteln IV power plant (1.1 GW), one of the most efficient coal-fired power plants in Europe, has been delayed until mid-2020.[8]

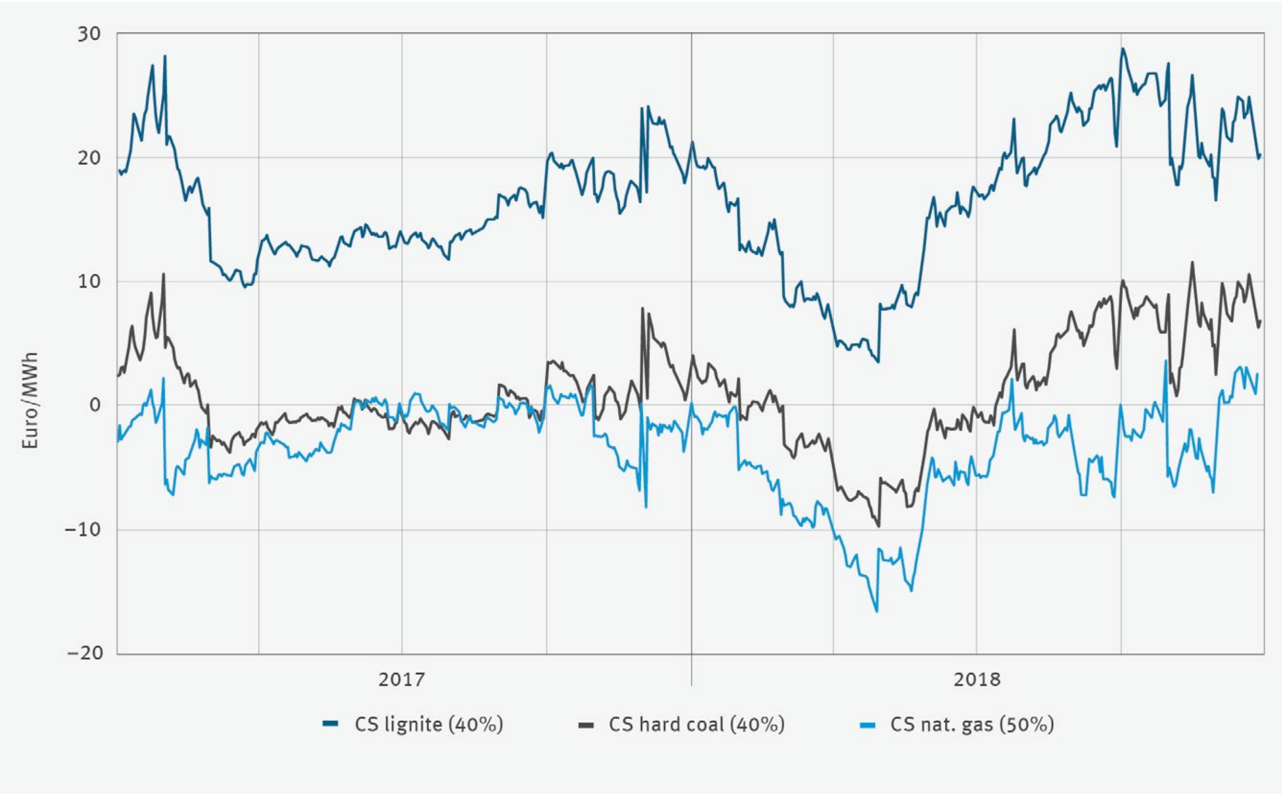
Lignite-based power generation has been decreasing for the fifth consecutive year and, according to preliminary estimates, has decreased in 2018 to its lowest level since 1999. Since 2005, gross power generation by lignite-fired power plants decreased by around six percent from 154 TWh to 145 TWh. With a share of just under 23 percent, lignite remains by far the most important energy source in power generation, followed by onshore wind power (14 percent), natural gas/hard coal (13 percent each) and nuclear power (12 percent).[9] Lignite has also shown a very similar electricity and emissions trend since 2005. Overall, however, emissions decreased slightly more than electricity production over the period. This is almost certainly a consequence of improvements in efficiency, the transfer of older power plant units into security reserve and the operation of modern, more efficient units to replace old, less efficient units. On 01/10/2017, the two remaining units of the Frimmersdorf power plant (a total of 635 MW gross electrical output) were put into reserve for four years.[10] Two units of the Niederaußem power plant (totalling 632 MW) and the relatively modern unit of the Jänschwalde power plant (500 MW) followed in October 2018. In October 2019, one unit each of the Neurath power plant (308 MW) and the Jänschwalde power plant (500 MW) will be transferred to the reserve. In addition, the power plant operator RWE announced at the end of April 2019 that the planning for a new lignite-fired power plant at the Niederaußem site (1.1 GW) had finally been abandoned.[11]

Electricity production in natural gas-fired power plants decreased again last year, after increasing for the last three years consecutively, but reached the level of hard coal-fired power plants for the first time. Since 2005, the gross electricity production of natural gas-fired power plants increased by 15 percent, from 73 TWh to 83 TWh.[12] Emissions also followed the same trend in recent years. The significantly stronger increase in gross electricity generation compared to emissions is an indication of the greatly improved average efficiency of the installations.

6 AGEB 2019b
7 Statistics from the coal industry
8 Uniper 2019
9 AGEB 2019b
10 Power plants that are being converted into security standby will remain subject to emissions trading for the time being
11 RWE 2019.
12 AGEB 2019b

Fuel Switch/Clean Spreads

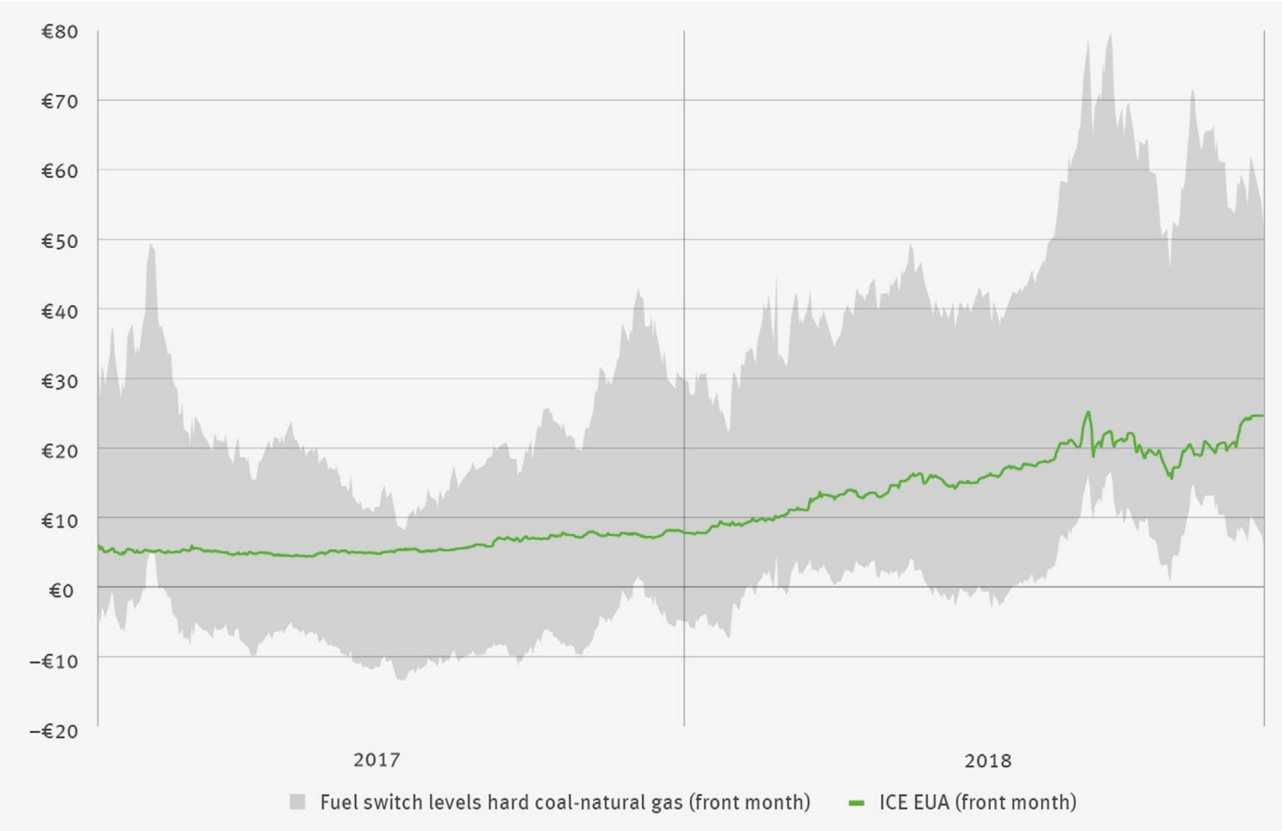
The following figure shows the calculated profit margins (called clean spreads) for selected types of power plants. The clean spreads are calculated as the balance of the revenue per generated MWh and the variable costs of fuels and emission allowances plus operating costs. The rise in electricity prices in the second half of 2018 particularly benefited the operators of lignite and nuclear power plants. Although lignite-fired power plants have been disproportionately affected by higher CO_2 prices, rising input costs have been excessively compensated by the upward trend in electricity prices. The clean lignite spread for a lignite-fired power plant with an efficiency rate of 40 percent increased sharply in particular in the second half of 2018 and ranged between about 20 and 30 euros/MWh. In contrast to volatile world market prices for hard coal and natural gas, the extraction costs for domestic lignite remained at a constant level. Compared to hard coal, the use of lignite produced in Germany remains significantly more attractive from an economic point of view. Profit margins for hard coal and natural gas-fired power plants also increased in the second half of 2018, although the clean spark spread (natural gas) was largely in the negative range. As the figure shows, natural gas and coal-fired power plants with the underlying efficiencies were consistently less profitable than lignite-fired power plants based on clean spreads during the period considered.



Source: Refinitiv Eikon, ICIS, DEHSt
As of 03/04/2019

Figure 9: Lignite, hard coal and natural gas clean spreads in 2017 and 2018 (each for front month contracts)

In addition to the EUA price, the following figure shows a range of calculated "fuel switch levels" for different power plant groups (hard coal to natural gas). The fuel switch indicates the **calculated** price level for EUA from where the clean spread for natural gas exceeds that for hard coal. The fuel switch level is thus a suitable indicator to estimate from which CO_2 price level the burning of natural gas will be more profitable than the use of hard coal. In 2018 natural gas became more expensive relative to hard coal resulting in higher overall fuel switch levels compared to the previous year. The 2018 average bandwidth was between about three and 47 euros.[13] The following figure shows that some hard coal-fired power plants were displaced by efficient natural gas power plants from the mid-load at the end of 2018, at least in terms of calculations due to EUA prices above 20 euros and the resulting change in economic cost factors. At the same time, however, a larger fuel switch in favour of natural gas-fired power plants would reduce demand for EUA with corresponding dampening effects on prices.



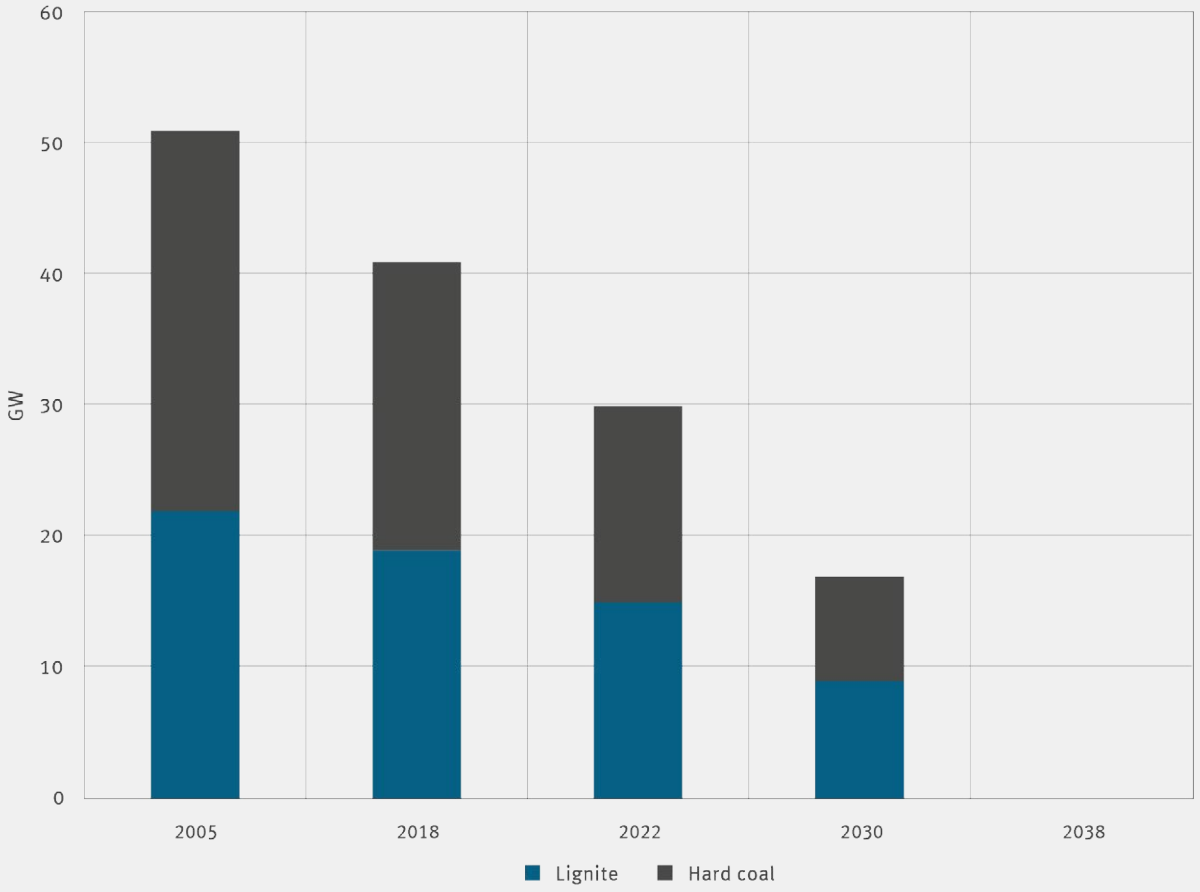
* Range HC35% – NG60% to HC45% – NG50%; no volume-weighted presentation of actual capacities.
Source: Refinitiv Eikon, ICIS, DEHSt
As of 03/04/2019

Figure 10: Fuel switch levels from hard coal to natural gas*, and 2017 and 2018 EUA prices

13 In addition to the fuel prices, the fuel switch level also depends on the efficiency rate of the respective power plants. The range of the average calculated fuel switch prices ranges between 3 euros (hard coal-fired power plant with an efficiency of 35 percent over natural gas-fired power plant with an efficiency of 60 percent) and 47 euros (hard coal-fired power plant with an efficiency of 45 percent compared to a natural gas-fired power plant with an efficiency of 50 percent). This was based on the comparatively volatile front month contracts (hard coal, natural gas).

Planning for a coal exit in Germany

The “Growth, Structural Change and Employment” (WSB) commission commissioned by the Federal Government presented its final report on 26/01/2019. The final report contains recommendations for the gradual reduction of installed lignite and hard coal based power generation capacity by 2038, in order to support the structural change in the affected regions and to mitigate the effects of increased electricity prices. The proposals for the reduction of coal capacities refer to 2022, 2030 and 2038. So-called break-points are envisaged for 2023, 2026 and 2029 where the implementation of the measures and their effects are to be comprehensively evaluated so that a readjustment is possible if needed.



Source: BMWi, BNetzA, WSB.
As of 02/05/2019

Figure 11: Reduction of power generation capacities based on lignite and hard coal according to the WSB Commission’s proposal

The decommissioning of coal-fired power plants leads to emission reductions in Germany and to a reduced demand for emission allowances in the EU ETS. This may have a price-cutting effect. However, the effect of a coal exit on the EU ETS largely depends on the specific form and, in particular, the timing of the implementation measures. The Market Stability Reserve (MSR) has countered demand reductions in the EU ETS since 2019 and it can offset these reductions both proportionally and time-delayed by reducing EU-wide auction volumes. In addition, Member States may compensate for a drop in demand on the coal market due to power plant closures in the future by voluntarily waiving the auctioning of emission allowances and their subsequent cancellation which is also recommended by the WSB Commission.

Allocation status

In the second trading period, energy installations received about 50 percent of the total free allocation for installations subject to emission trading – an average of about 200 million a year – for the product "electricity", then, in the third trading period (see Figure 6), the free allocation for electricity generation was replaced by full auctioning. Accordingly, only about 23 million free emission allowances were granted to energy installations for heat generation in 2018. These cover slightly less than 8 percent of the surrender obligation for emissions from the installations (Table 6). In the third trading period, several factors determine the low allocation coverage of energy installations. In addition to power generation, for which there is no free allocation, high-emission fuels such as lignite and hard coal are preferred in large combustion plants while the allocation for heat production assumes the use of natural gas. Also, the free allocation for energy recovery from waste gases from iron, steel and coke production mainly goes to producers of waste gases while a part of the allocation for heat production does not go to the producers but to heat consumers (see Sections 2.4, 2.7 and 2.8). An allocation volume of about 17 million emission allowances can be estimated from the use of waste gases from iron, steel and coke production and heat export for energy to other installations subject to emissions trading. Taking these estimated quantities into account, a somewhat higher allocation coverage is obtained at around 13 percent (see Table 7 and Figure 6).

Table 6: Energy installations (Activities 2 to 6), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of instal-lations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
2	Energy conversion ≥ 50 MW RTI	479	18,877	291,203	−272,326	6.5%
3	Energy conversion 20 – 50 MW RTI	393	2,987	5,213	−2,226	57.3%
4	Energy conversion 20 – 50 MW RTI, other fuels	11	99	134	−35	73.8%
5	Prime movers (engines)	3	15	22	−8	65.9%
6	Prime movers (turbines)	53	543	1,357	−814	40.0%
Total		**939**	**22,521**	**297,930**	**−275,409**	**7.6%**

There is another well-defined effect: in addition to the decrease in the allocation, which can be attributed to the application of budget securing factors (linear reduction factor and cross-sectoral reduction factor), the allocation for products without carbon leakage risk has also gradually reduced. This reduction factor was 0.8 for the allocation without carbon leakage risk in the first year of the third trading period, it dropped to 0.44 in 2018 and will further decline to 0.3 by the end of the trading period. While an almost total carbon leakage risk was assumed for free allocations to industrial installations due to EU regulations, about half of the free allocation was allocated to energy installations with no carbon leakage risk in 2013. This proportion will fall continuously and will only be about 30 percent of the total allocation for energy installations in 2020.[14] Assuming that emissions will remain at the same level, allocation coverage for energy installations will continue to decrease.

14 DEHSt 2014a

Table 7: Energy installations (Activities 2 to 6), number of installations, allocation amounts, 2018 VET entries and adjusted allocation coverage

Sector/ Activity	No. of instal-lations	Adjusted 2018 allocation amount [1000 EUA]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Adjusted allocation coverage
Energy installations	939	39,884	297,930	−258,046	13.4%

As of 02/05/2019

While large combustion plants only received a free allocation for somewhat less than 7 percent of their emissions, the significance of heat production for energy installations with an RTI between 20 and 50 MW with regard to the allocation status is recognisable. Allocation coverage compared to large combustion plants was greater by a factor of ten and was equal to about 57 percent of their emissions. Activity 4 installations, in which biomass and fuels with biogenic components are used, have an even higher allocation coverage of 74 percent. Prime movers (engines and turbines) have mainly received a free allocation via the fuel benchmark for producing mechanical work.[15] On average, prime movers received a free allocation covering 40 percent of their emissions.

15 See DEHSt 2014a, Chapter "Energy installations"

"Combustion" activity in the EU

Figure 12 shows an overview of the EU-wide emissions trend of the "combustion"[16] activity since the start of emissions trading. It differentiates between the emissions trend of German Activity 1 – 6 installations (Appendix 1 of TEHG), the emissions trend in other Member States who have participated since the beginning of emissions trading and those participants who only joined emissions trading after 2005.

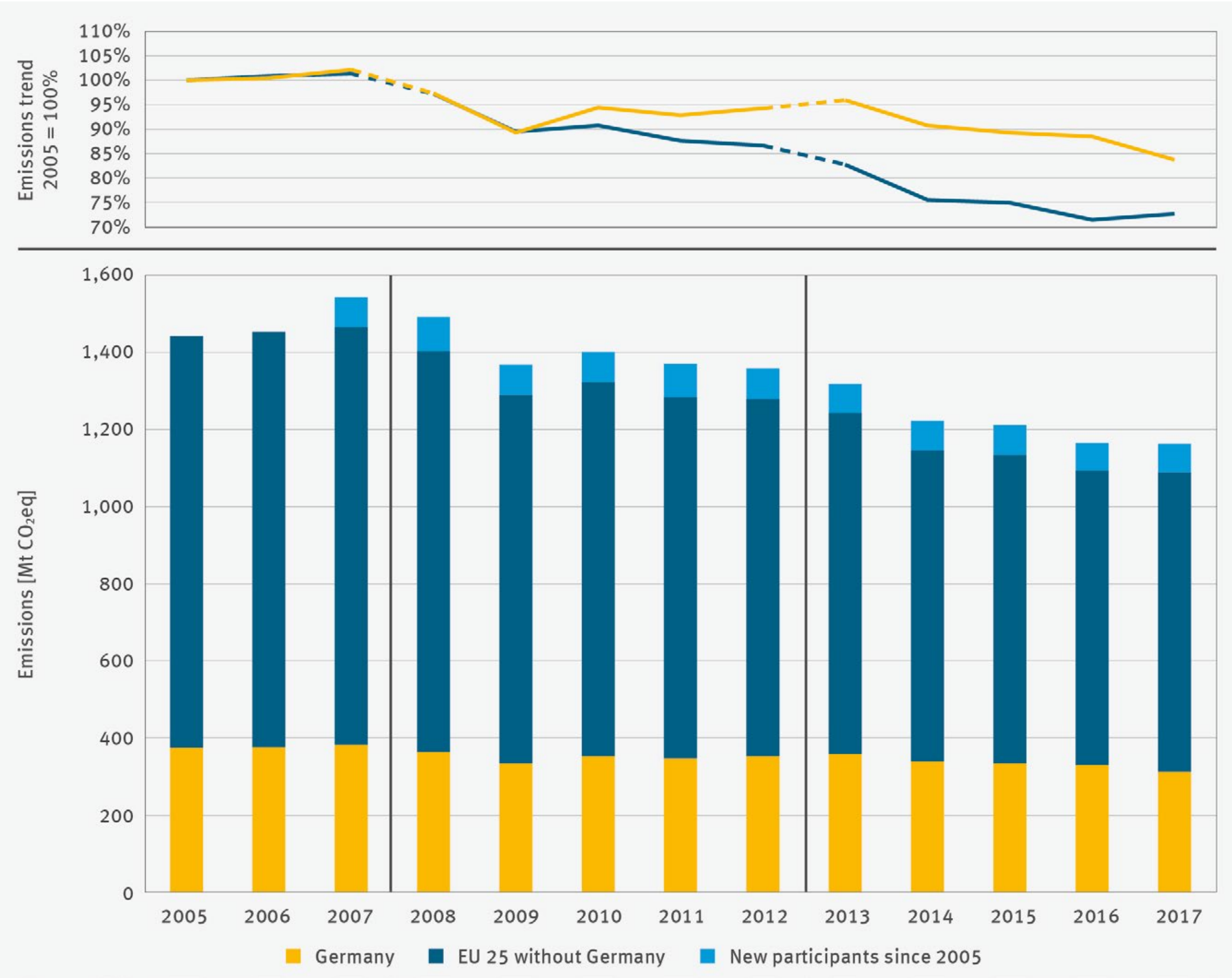


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Figure 12: Emissions trend from 2005 to 2016 from combustion and energy (Registry activity 20) in Germany and the EU[17]

16 In contrast to the German scope of emissions trading, which differentiates between six different "combustion activities" among the activities listed in Annex 1 TEHG, only the activity "combustion" is used at EU level. It covers all energy installations and all other combustion activities in accordance with Annex 1 EHRL

17 Data source: 2018 EEA; the evaluation is based on a summary of the installations according to the activities in the EU Union Registry (see Table 46, Chapter 7). This may lead to differences in the emissions amount per sector for Germany. Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania have been new participants in the EU ETS since 2005.

Until the financial and economic crisis, the emissions trends between German and EU installations to which combustion activity is assigned, corresponded very well. The emissions reached their highest level in 2007 since the introduction of emissions trading, they then fell very significantly during the economic crisis. But the trends have been diverging from 2010: emissions from German installations rose again from 2011 and only started to decrease in 2013. In contrast, apart from an increase in 2010, the average emissions of all other Member States have steadily decreased (see Section 3.1). In 2017, however, emissions from other Member States increased while emissions from German installations declined significantly. By contrast, total emissions in emissions trading in Germany and in the EU as a whole showed the same trend in the 2018 reporting year (see Chapter 3.1) so that a similar trend can be expected for the energy industry as well. Compared to the first year of emissions trading, German installations to which combustion activity is assigned still reached 84 percent of the 2005 emissions in 2017. The emission level from installations from other Member States was down to 73 percent of the 2005 emissions.

In 2017, the share of German installations with combustion activity represents around 27 percent of the total EU emissions from this activity.

2.2 Other combustion

68 installations with a minimum rated thermal input of 20 MW have been subject to emissions trading since 2013 due to the broader definition of “combustion” and have been recorded under Activity 1. This section only covers those 38 Activity 1 installations that are not assigned to other industries in this report. This installation group predominantly includes test rigs for turbines or engines but also process heaters and asphalt mixing plants.

Table 8 shows the allocation and emission data for these installations. In 2018, these installations emitted a total of 601,000 tonnes of carbon dioxide.

Table 8: Other combustion plants (Activity 1), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of instal-lations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
1	Combustion	38	593	601	8

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At almost 75 percent of its actual emissions the allocation coverage is very high, see Table 9.

Table 9: Other combustion plants (Activity 1), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of instal-lations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
1	Combustion	38	449	601	–153	74.6%

As of 02/05/2019

Figure 13 shows the emissions trend since 2005. These installations have only participated in emissions trading since 2013, therefore the 2005 to 2010 figures are data reported by the operators in the allocation process. There is no available emission data for 2011 and 2012. This installation group is very varied so that no general conclusions can be drawn from the emissions trend.

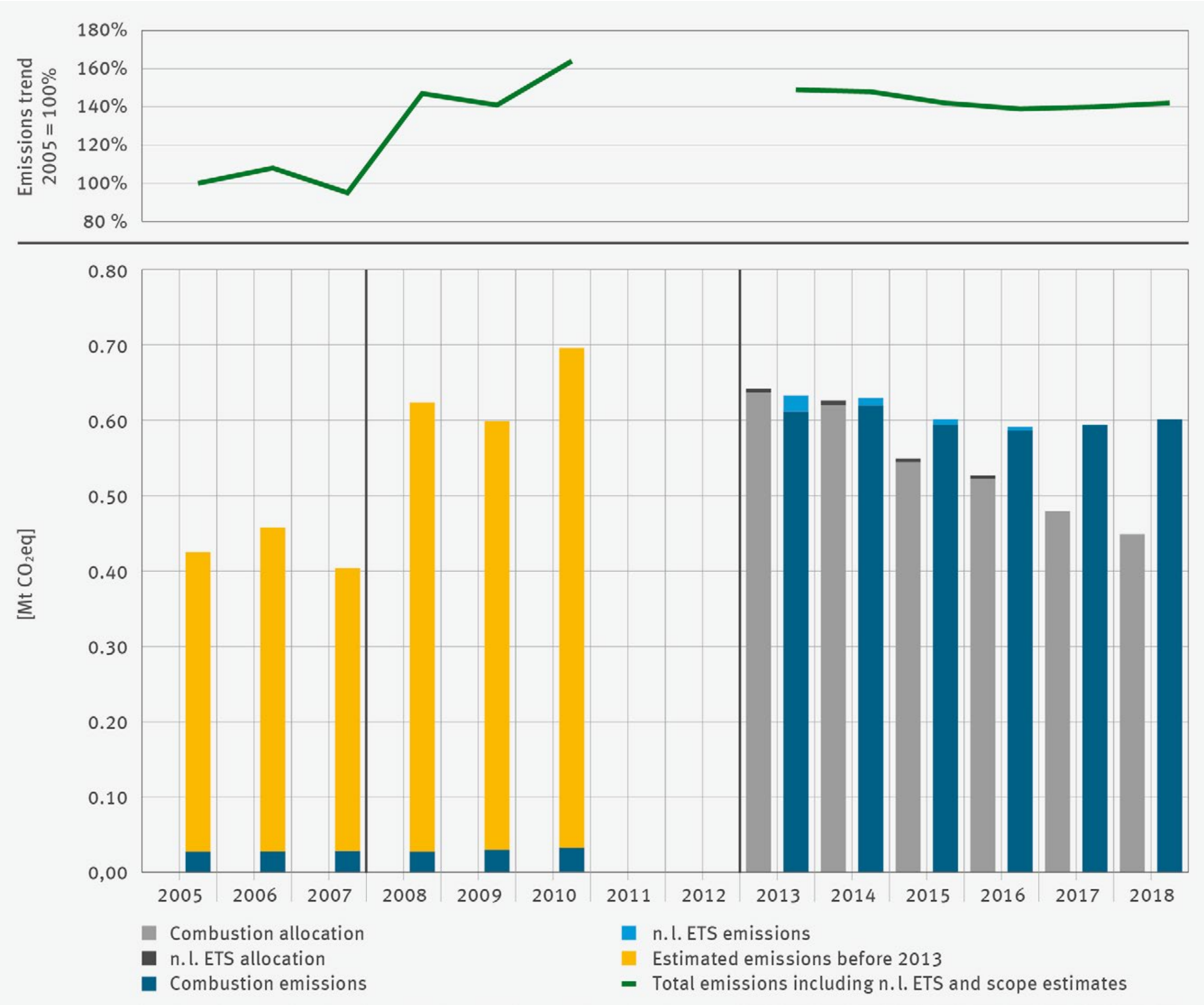

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Figure 13: Other combustion plants (Activity 1), 2005 to 2018 emissions and free allocation trends in Germany[18]

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

2.3 Refineries

As in the previous two years, 23 installations belonged to "refineries" in 2018 (Activity 7 in Annex 1 TEHG). This number still includes the Wilhelmshaven refinery that ceased its refinery operation and currently only operates as a terminal but is still subject to emissions trading.

Power plants are considered together with refineries if the refinery has been approved in conjunction with the power plant as a single installation according to BImSchG or an official "amalgamated installation" notification has been given. If a refinery is operated at the same location by the same operator in a technical network with one or more power plants, but has separate operating licenses for the individual installations, it may apply for the creation of an "amalgamated installation" according to § 28(1)(4c) of TEHG and § 29(3) of the 2020 Allocation Ordinance (ZuV). In total, 14 of the 23 refineries subject to emissions trading include power plants. Of these, 9 refineries have been approved together with one or more power plants, and another 5 installations fall under the above-mentioned regulation for establishing an "amalgamated installation".

Emissions

The total 2018 emissions from refineries were around 24.0 million tonnes of carbon dioxide compared to 25.2 million tonnes of carbon dioxide in 2017. This means that the emissions decreased by around 4.6 percent or around 1.2 million tonnes of carbon dioxide (see Table 10).

Table 10: Refineries (Activity 7), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of installations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
7	Refineries	23	25.157	24.001	−1.156

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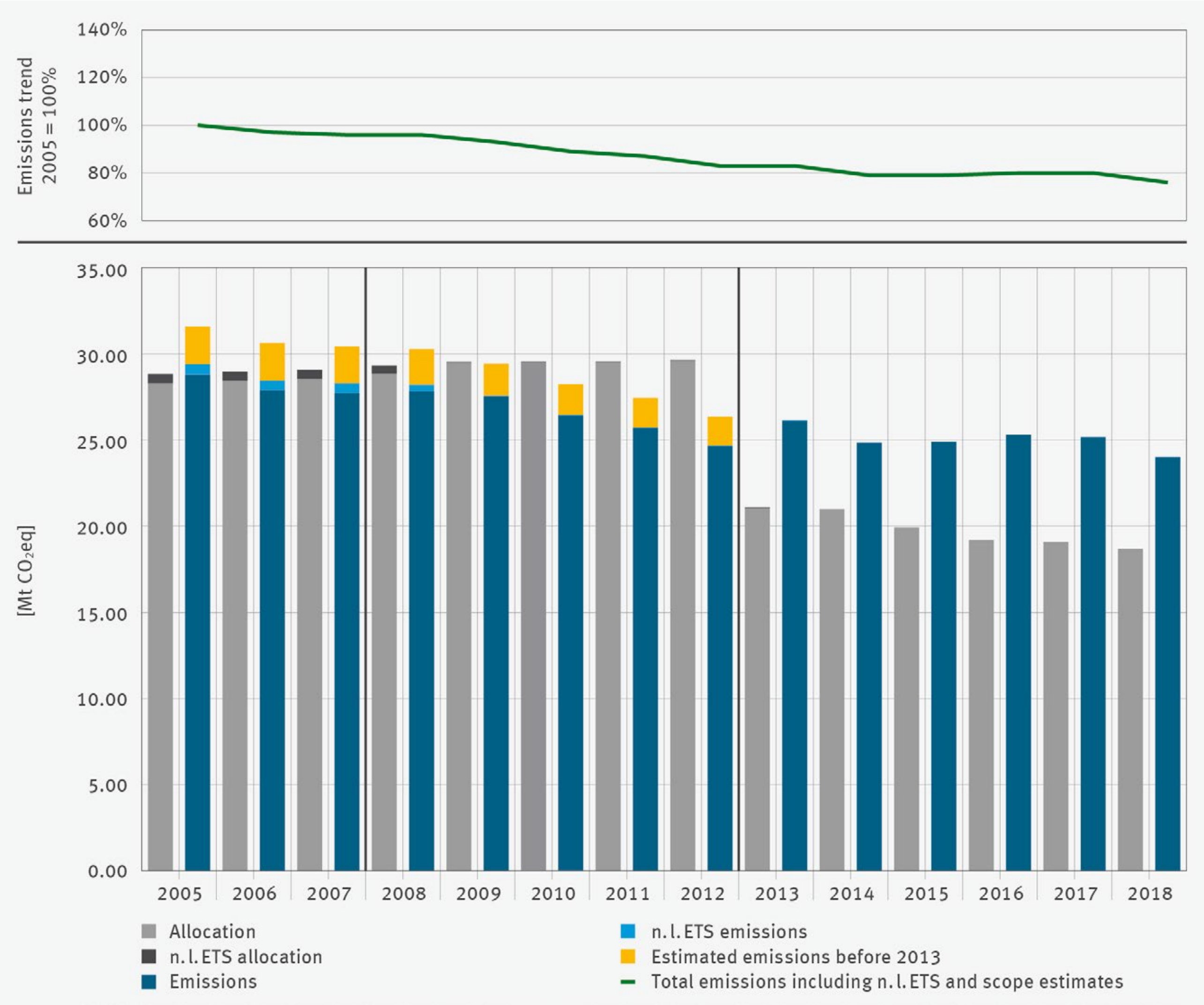
The top section of Figure 14 shows the emissions trend for the sector as a whole since the beginning of the EU ETS in 2005. The bottom section shows the emissions and allocation amounts, supplemented by the presentation of the installations no longer subject to emissions trading (n. l. ETS)[19] and the estimated emissions from the installation subject to emissions trading since 2013 for the 2005 – 2012 period.[20]

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

20 The 2005 – 2010 emissions are based on information from the allocation procedure. There are no historical emissions available for 2011 and 2012, this is why the values for both years were estimated by linear interpolation.

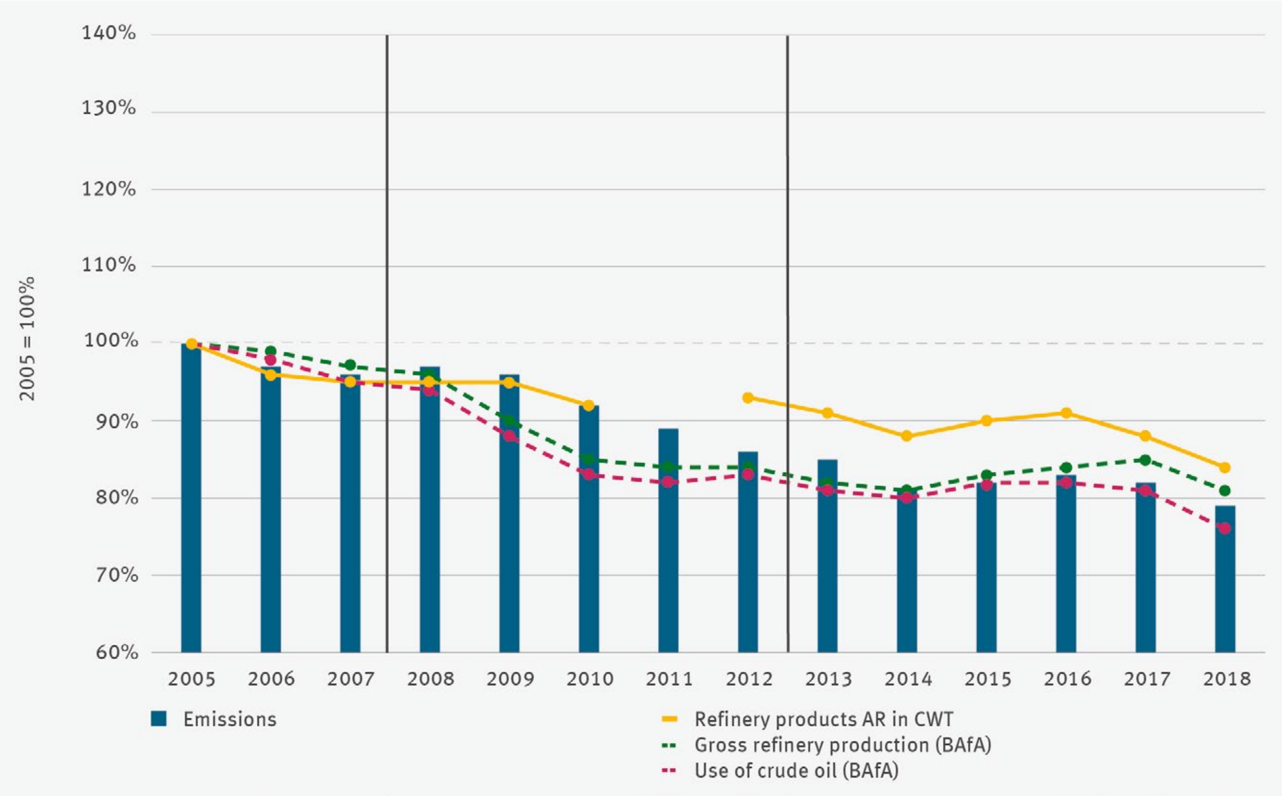


As of 02/05/2019

Figure 14: Refineries (Activity 7), 2005 to 2018 emissions and free allocation trends in Germany, allocation status

After an almost constant decline in emissions in the first and second trading periods, the emissions stabilised in the third trading period and accounted for about 25 million tonnes of carbon dioxide in the 2014 – 2017 period. In 2018, however, a significant decrease in emissions could be observed in the refinery sector. This was due to several extraordinary events in 2018: a major explosion occurred in the Vohburg refinery at the beginning of September 2018 followed by a major fire and since then the facility has been shut down until further notice. Installation overhauls were carried out in several, sometimes even large installations, with several weeks of production shutdown in 2018. Another special situation was the low water level of some rivers due to a dry summer. This caused delivery difficulties for raw materials and auxiliaries and products could not, or only partially, be transported via the waterways. As a result, some refineries, especially along the Rhine, had to adjust their production.

The free allocation was higher than the sector's emissions in both first and second trading periods, except for 2005. This has changed in the third trading period. Due to their power plants, refineries have been affected by the discontinuation of free allocation for electricity generation in the third trading period. This has caused a definite allowance shortage for refineries from 2013 onwards.



As of 02/05/2019

Figure 15: Refineries (Activity 7), 2005 to 2018 emissions and production trends in Germany, each in relation to 2005

Figure 15 compares the emissions trend with the trend of the 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 process-typical CO_2 emission intensity. If the time course of the CWT activity rate differs significantly from that of 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 of 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[21] on gross refinery production take these quantities into account.

Figure 15 shows that the emissions and the 2012 CWT activity rate differ significantly compared to the years until 2010 but run parallel again in the following years. Possible reasons include the use of lower-emission fuels and changes in the product mix towards products whose production is associated with other specific carbon dioxide emissions.[22]

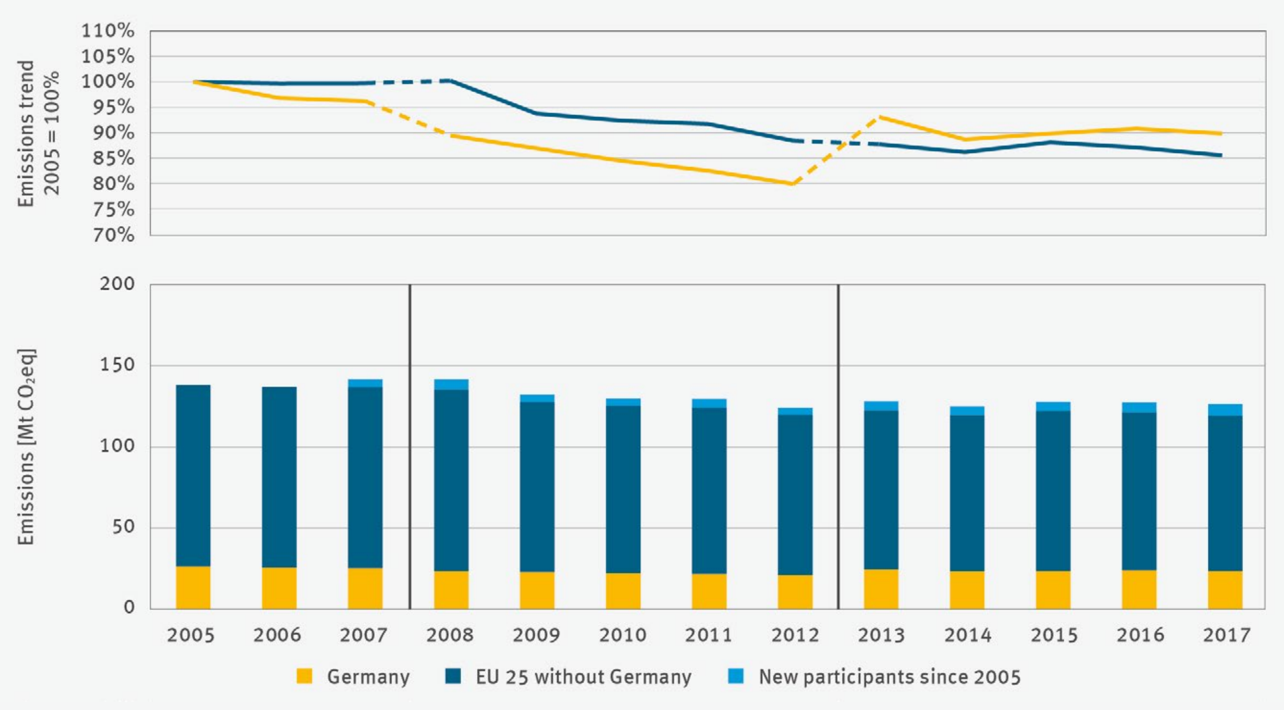
Overall, the emissions trend compares well with the crude oil use, except in 2009 – 2013. The decline in emissions is likely to be mainly attributable to the decline in crude oil use.

21 See BAfA 2019a

22 Other reasons for the observed changes could be uncertainties in emission determination. These could be overlapped by potential correlations (e. g. production changes) that unfortunately cannot be verified with the available data (e. g. production shifts or changes in the emission determination methodology).

Gross refinery production noticeably increased in 2015 for the first time since the start of emissions trading and continued to increase in 2016 and 2017 (by around 1.2 percent per year compared to the previous year).[23] In 2018, however, it decreased by four percent.

It can be concluded that in 2018 all four quantities exhibited a slight decline at roughly the same rate. In addition to the reasons already explained above, another possible cause for the declining gross refinery production and the declining crude oil input in 2018 could be methodological changes in the collection of official mineral oil statistics, which took place in January 2018 and could have led to breaks in the time series of the data.[24]



As of 02/05/2019

Figure 16: 2005 to 2017 emissions trend of refineries (Registry Activity 21) in Germany and in the EU[25]

Figure 16 shows the carbon dioxide emissions trend from refineries (Registry Activity 21) in Germany and the EU. Since emissions between the trading periods are not directly comparable, particularly in Germany, the changes between the individual trading periods are illustrated by dotted lines. The emissions level from the refineries in Germany increased in 2013. This can be attributed in particular to the mandatory establishment of a so-called amalgamated installation from the third trading period according to § 28(1)(4c) TEHG and § 29(3) of the 2020 Allocation Ordinance (ZuV) (see footnote 25). Nothing in particular in the average of the other EU 25 States suggests that there have been any significant changes in the scope during the transition into the third trading period.

Until 2014, emissions from refineries at EU level were steadily declining. Although emissions at the EU level increased by 1.9 percent in 2015 compared to 2014, it is clear that the trend towards a further decline in emissions established at the beginning of the EU ETS continued after 2016. A similar picture emerges for the emissions trend of German refineries.

23 See BAfA 2019a (preliminary figures for 2018)
24 See BAfA 2019b
25 Data source: 2018 EEA; the evaluation is based on a summary of the installations according to the activities in the EU Union Registry (see Table 46, Chapter 7). This can lead to differences in the emission amount per sector in Germany. This is clearly visible in the case of the data on refineries. The adjusted emissions data in Figures 15 and 16 shows no leap between 2012 and 2013. Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania have been new participants in the EU ETS since 2005.

Overall, emissions from installations at the EU level decreased by around 14 percent compared to 2005. According to EEA data (see Figure 16), the decline in emissions from refineries in Germany was around 10% since the introduction of the EU ETS. Based on the adjusted data (Figure 14), the 20 percent decrease is much more pronounced and thus higher than that at the EU level.

Allocation status

Refineries are among the industry sectors affected by the elimination of the free allocation for electricity generation in the third trading period because of their power plants (see "Emissions" section). This leads to a significantly higher purchase requirement compared to other industry sectors.

Table 11: Refineries (Activity 7), number of installations, allocation amount, 2018 VET entries and allocation coverage

No.	Activity	No. of installations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
7	Refineries	23	18,707	24,001	−5,294	77.9%

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In 2018, the refineries sector had to additionally purchase a total of 5.3 million emission allowances at an allocation coverage of about 78 percent. The additional purchase demand of the previous year was 6.3 million emission allowances at an allocation coverage of 75 percent.

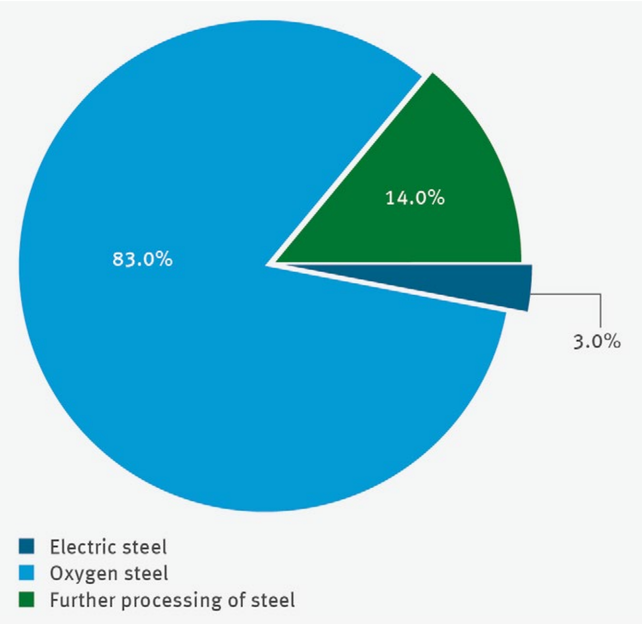
Primarily due to the cross-sectoral correction factor, the annual free allocation and thus the allocation coverage of refineries – the same as in all other industry sectors – has been continuously decreasing in the third trading period. Due to the special circumstances (see "Emissions" section), the current reporting year is nevertheless an exception.

2.4 Iron and steel industry including coking plants

The iron and steel industry includes Activities 8 to 11 as well as one Activity 1 installation as per TEHG[26] which means a total of 125 installations subject to emissions trading in Germany. The assessment of the iron and steel industry summarises Activities No. 8 (coke production), No. 9 (roasting and sintering of metal ores) and No. 10 (pig iron and steel production). The reason for this is that the installations are strongly interlinked and connected in terms of approval regulation, especially in the blast furnace route (production of oxygen steel). Thus, the installations partially include both the production of pig iron and steel as well as the coking plants and sinter plants, which means that the emission data is not available by specific Activity. This is particularly due to the establishment of "amalgamated installations" according to § 24 of TEHG in conjunction with § 29(2) of the 2020 Allocation Ordinance (ZuV). In other cases, coking plants and sinter plants participate in the EU ETS as separate installations. A differentiated view according to Activities would therefore result in a distorted picture due to the different system boundaries.[27]

Emissions

Figure 17 shows that, with a share of 83 percent, steel producing installations via the blast furnace route (oxygen steel) dominate the emissions from the iron and steel industry under emissions trading in Germany. The blast furnace route's share in the production volume of crude steel is around 70 percent.[28] In contrast, the emissions from electric steel production which constitutes 30 percent of the total crude steel production in Germany is comparatively low at three percent.[29] The emissions of further processing of steel (Activity 11) amount to 14 percent.



As of 02/05/2019

Figure 17: 2018 emissions share of the iron and steel industry (Activities 8 to 11 and 1)

Table 12 shows the emissions for 2017 and 2018, as explained above, differentiated by Activities 8 to 10, 11 and 1. With 32.5 million tonnes of carbon dioxide, the combined emissions of Activities 8 to 10 are slightly above the previous year's level of 32.3 million tonnes, while crude steel production decreased by 2 percent to 42.4 million tonnes.[30] Emissions from the blast furnace route (including Activities 8 and 9) amounted to about 31.4 million tonnes of carbon dioxide in 2018, or about 219,000 tonnes (0.7 percent) more than in the previous year, at 31.2 million tonnes. The emissions from the electric steel route amounted to almost 1.2 million tonnes of carbon dioxide (down by 709 tonnes) and therefore hardly changed compared to the previous year. By contrast, emissions from the processing of ferrous metals (Activity 11) decreased by around 121,000 tonnes (2.2 percent) to 5.3 million tonnes.

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

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

28 See German Steel Federation (WV Stahl) 2019

29 Indirect emissions resulting from electricity consumption are added to both types of crude steel production. While these are higher for electric steel production, the blast furnace route clearly dominates emissions even with the inclusion of indirect emissions.

30 See German Steel Federation (WV Stahl) 2019

Table 12: Iron and steel industry (Activities 8 to 11 and 1), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of installations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
8, 9, 10	Pig iron and crude steel production*	35	32,327	32,545	219
11	Ferrous metal processing	89	5,413	5,292	−121
1	Combustion	1	73	76	2
Total		**125**	**37,813**	**37,913**	**100**

* Coking plants, metal ore processing, pig iron and steel production
As of 02/05/2019

Figure 18 shows the trend of the entire sector since the start of the EU ETS in 2005. The green line in the upper part of the figure shows the emissions trend of all installations subject to emissions trading in the respective year including the "n.l. ETS" installations that were no longer subject to emissions trading in 2018. It also considers the estimated emissions until 2012 from the Activity 11 installations newly established from 2013 onwards.

The bottom part shows both the emissions and the allocation amounts. In each case, these separately show the installations currently subject to emissions trading and the installations that are no longer subject to emissions trading in 2018 (n.l. ETS).

The fictitious shares contained in the allocation amounts for the transfer of waste gases from iron, steel and coke production to energy installations are shown in dashed lines (see detailed explanations in the sections "Transfer of waste gases from iron, steel and coke production" and "Allocation status"). These are included in the allocation benchmarks and are thus allocated to steel producers. However, it can be assumed that steel producers pass on emission allowances to the operators of the waste gas-using energy installations to the corresponding extent.

Emissions from the iron and steel industry increased by about 8 percentage points during the first trading period, in line with economic growth, and subsequently declined by 12 percentage points compared to 2007 until the end of the second trading period. Since 2013, with the exception of 2016, a slight increase can be observed. In a direct comparison between 2005 and 2018, emissions increased by around two percent.

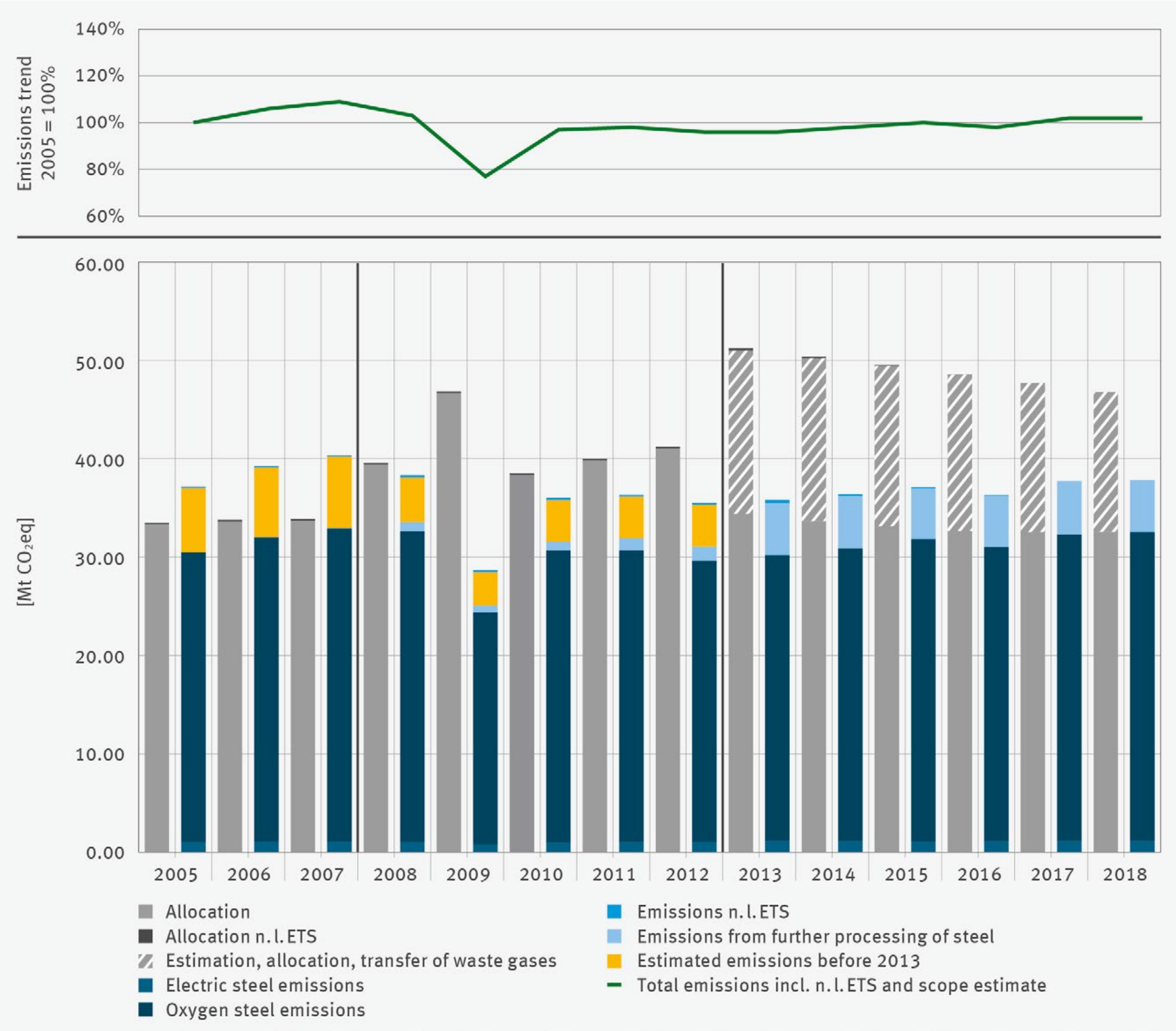


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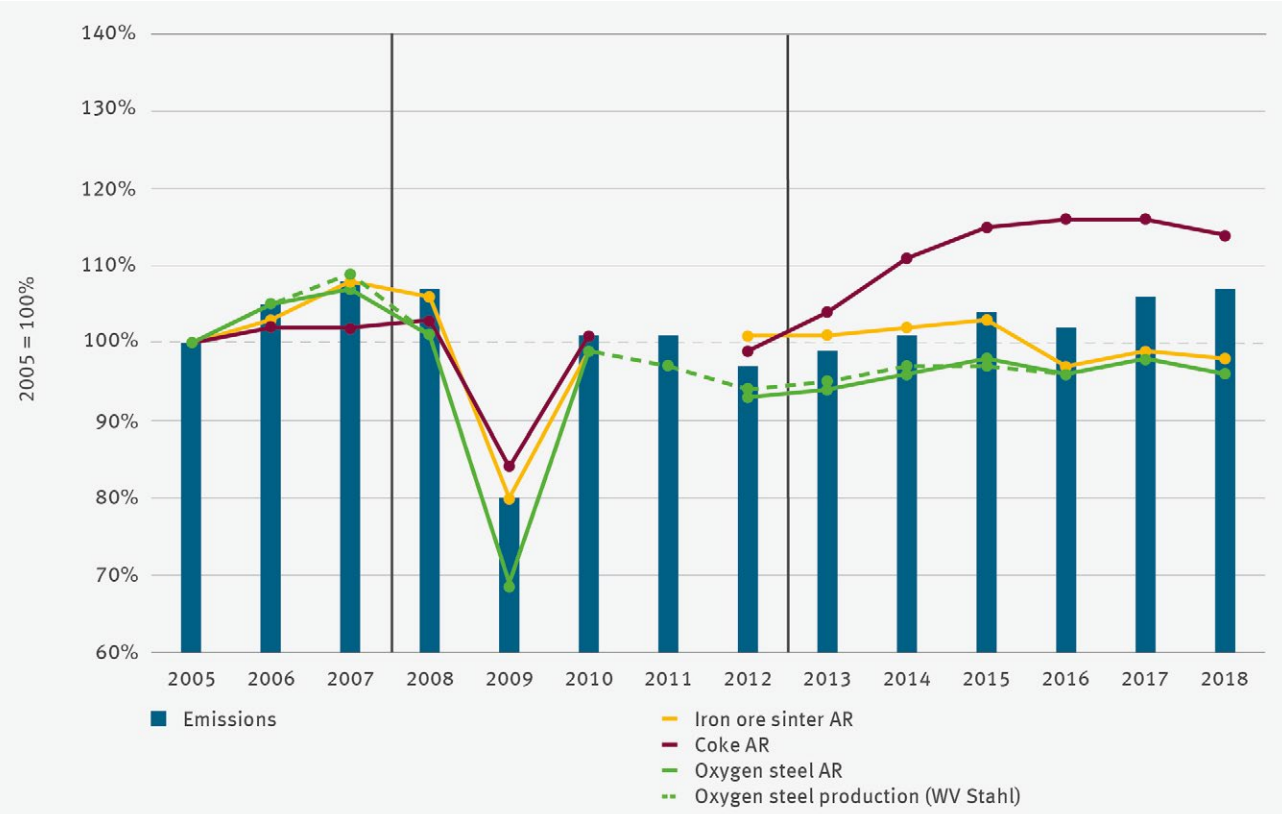
Figure 18: Iron and steel industry (Activities 8 to 11 and 1), 2005 to 2018 emissions and free allocation trends in Germany[31]

31 As in the VET reports of the second trading period, the allocation amounts of this trading period are offset taking into account the provisions of § 11 of the 2012 Allocation Act. According to this regulation, producers of waste gases from iron, steel and coke production were in the second trading period legally obligated to transfer emission allowances in the amount of their annual waste gas transfers to the utilising installations. 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 § 11 of the 2012 Allocation Act

Figure 19 and Figure 20 show the emission and production volume trend for oxygen steel and electric steel each in relation to 2005. In the case of oxygen steel, the activity rates of coke and iron ore sinter are also shown. Their emissions are also included in the emission time series. The figures show the activity rates of the products[32], supplemented by information from the German Steel Federation (WV Stahl; shown in WSA 2015/2018 and WV Stahl 2019).[33]



As of 02/05/2019

Figure 19: Oxygen steel production, 2005 to 2018 emissions and production trends in Germany, each in relation to 2005

Since 2012, emissions from oxygen steel production have increased more than crude steel production. At the same time, about 1.2 million tonnes more coke was produced in 2018 than in 2012 (in 2016, more than 1.4 million tonnes). From 2012 to 2018, net imports of coke by the entire German iron and steel industry decreased by around 1.4 million tonnes.[34]

32 In the case of electric steel, the activity rates for the “carbon steel” and “high-alloy steel” product benchmarks are summarised. 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 the processing into steel in the steel converter. The crude steel amount is generally higher by about 10% (predominantly through the addition of steel scrap in the converter). Since the figure shows the relative trend and since the amount of steel scrap added in the converter is approximately constant, there are no significant deviations.

33 2005 – 2017 time series published by the World Steel Association (WSA) (2015, 2018): Steel Statistical Yearbook 2015 (for 2005 – 2014); Steel Statistical Yearbook 2018 (for 2015 – 2017). Time series from WSA 2015 and 2018 checked for consistency. Data for 2018 from WV steel (2019) – checked for consistency with WSA 2018.

34 From 2012 to 2016, they even decreased by 1.7 million tonnes. See Federal Statistical Office for 2012 – 2018 as well as WV Stahl: Statistical Yearbook of the Steel Industry 2017/2018, page 48/49 (for 2012 to 2016. Figures for these years are identical to the Federal Statistical Office; figures for 2017/18 not yet published).

These figures indicate that the increased in-house production shown from 2012 onwards increasingly replaced coke, which had previously been purchased from abroad. The result of this change is that the direct emissions from coke production, which were formerly outside the system boundaries considered here, now occur within these system boundaries and thus lead to an increase in the total direct emissions (of the activities considered) from German installations. Based on a benchmark of 0.286 tonnes of carbon dioxide per tonne of coke (product benchmark according to the European Commission's CIMs decision[35]), the increased in-house production of coke in the period between 2013 and 2016 has caused an estimated 0.3 million tonnes more carbon dioxide.

Other factors influencing emission fluctuations in the iron and steel industry may be other changes in the fuel mix, for example, a comparatively higher use of more emission-intensive fuels than before such as the substitution of natural gas with hard coal. Another reason may lie in changed raw material qualities (ores).[36]

The following Figure 20 for electric steel shows both the emissions from installations currently subject to emissions trading (dark blue columns) as well as the emissions from all installations subject to emissions trading in the respective year (light blue columns, "emissions including n. l. ETS") in relation to 2015. The significant increase in emissions between 2012 and 2013 is obvious. This increase is due to the newly added Activity 11 installations. They are partially approved together with electric steelworks and are therefore considered together in such cases. Taking account of installations no longer subject to emissions trading (n. l. ETS), it becomes apparent that the general 2011 – 2015 emissions trend continues to decline from 2011 onwards – apart from the increase described above due to the new Activity 11 at the beginning of the third trading period. Since 2015 they again increased slightly. This general trend is consistent with the production trend, with the exception of the 2018 reporting year when emissions remained stable. The relative annual figures of the time series of emissions including n. l. ETS and production (WV Stahl) are lower compared to 2005 than the corresponding time series in relation to the installations currently subject to emissions trading. The background in both cases is that three electric steel installations were decommissioned between 2012 and 2014 but are included in both time series.[37]

35 Decision 2011/278/EU

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

37 Considering these three installations, the production trend based on the activity rates ("Electric steel AR") and the information provided by WV Stahl since 2005 is almost identical. From 2012 onwards, the activity rates trend and association 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.

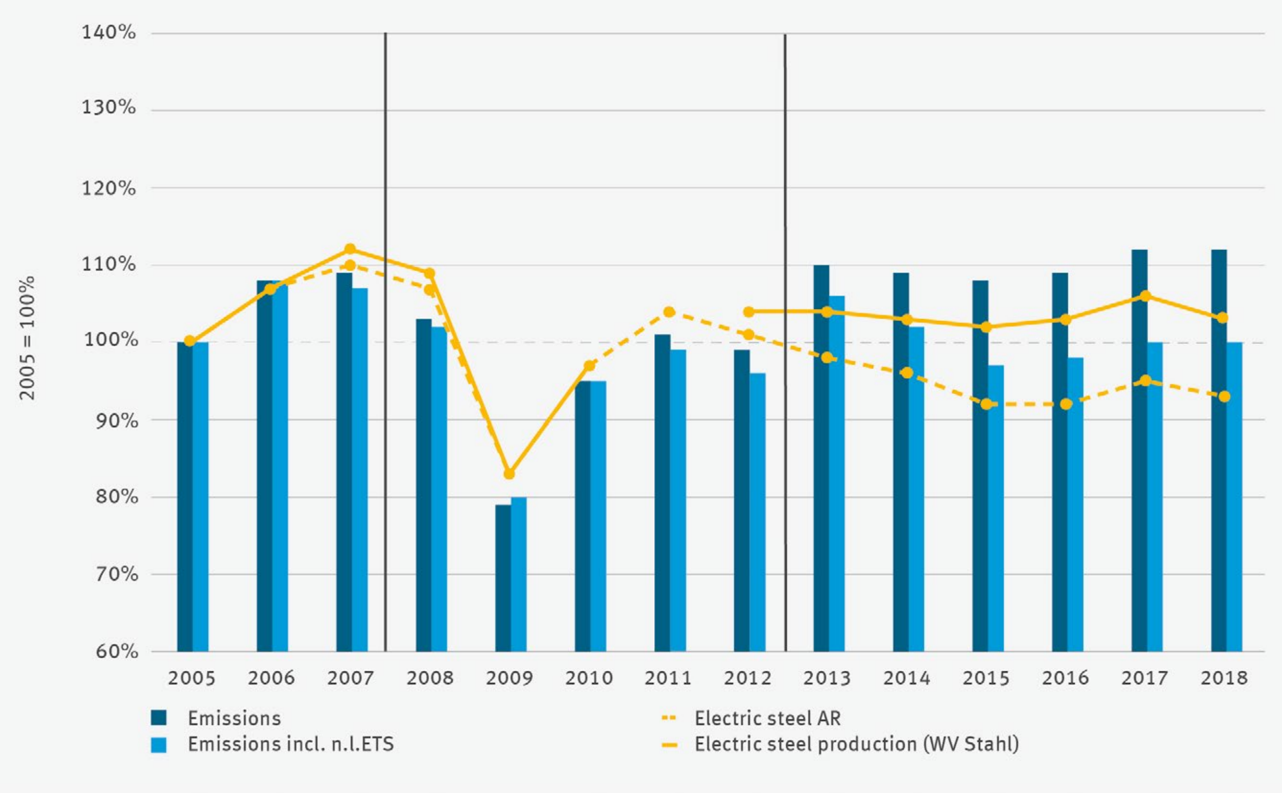


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Figure 20: Electric steel production, 2005 – 2018 emission and production trends in Germany, each in relation to 2005

Figure 21 shows the emissions course for both the EU in total and Germany. The figure illustrates that EU-wide emissions have significantly decreased since 2008, even though new installations have been added since 2013 through an expanded scope.[38] The emissions trend of German installations is very similar, albeit at a higher emission level. The main cause may be the varying production trends. Crude steel production at EU level decreased from 199 million tonnes in 2008 to 168 million tonnes in 2017, i. e. by around 15 percent. The production in Germany decreased over the same period from 45.8 million tonnes (2008) to 43.3 million tonnes (2017), i. e. by roughly six percent, which is a relatively much smaller decrease.[39] This caused an increase in the German share in the total EU emissions in the sector.

38 Figure 21 only shows the emissions of the new Activity 11 from 2013 onwards. It is different from Figure 18 which shows estimated emissions for the first and second trading periods.

39 See WSA 2018

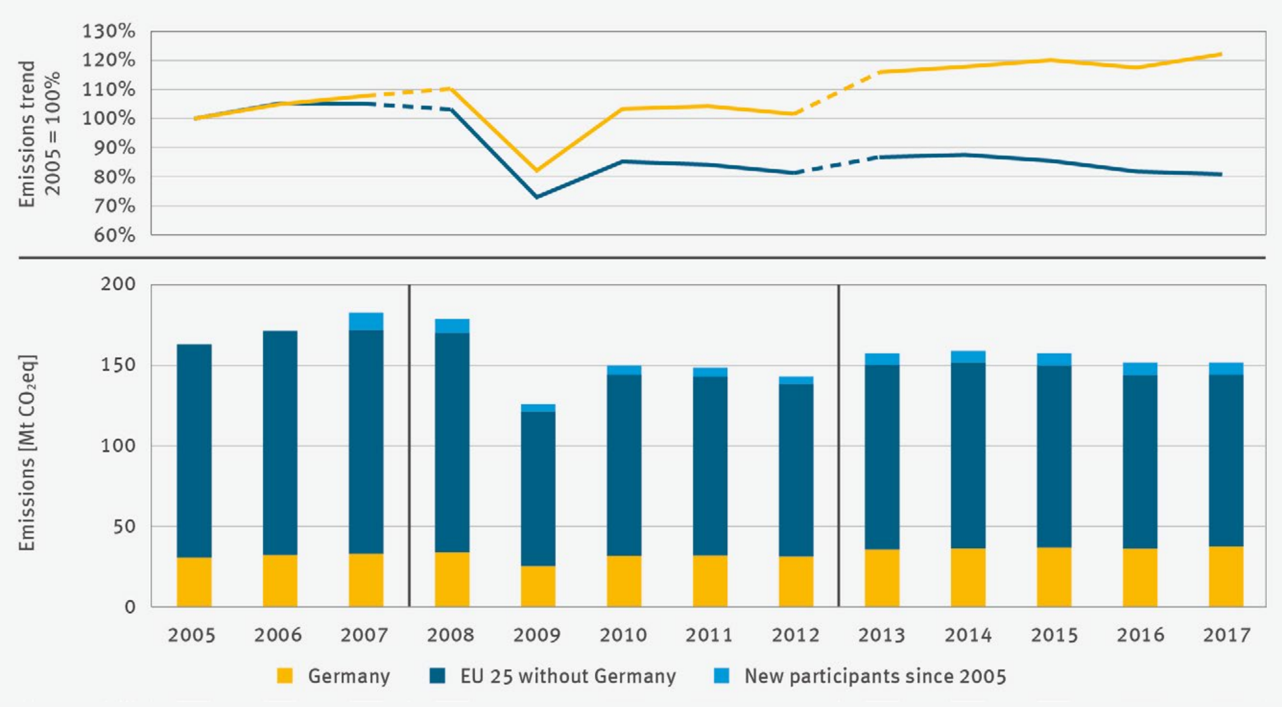

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Figure 21: 2005 – 2017 emissions trend of the iron and steel industry (Registry Activities 23 to 25) in Germany and in the EU[40]

Transfer of waste gases

Characteristic of the "iron and steel" sector is the transfer of waste gases from iron, steel and coke production (blast furnace, converter and coke oven gas) used for energy. In 2018, the transfer and use of waste gases for energy resulted in emissions amounting to around 25.7 million tonnes of carbon dioxide (see Table 13), around 1.1 million tonnes less than in 2017.

Table 13: Transferred waste gases of the iron and steel industry in 2018 – generated in Activities 8 and 10

Transfer to [kt CO_2eq/a]					
Iron and steel producing installations (Activities 8 – 10)*	Ferrous metal processing and combustion installations (Activities 11 and 1)	Energy installations	Refineries	Non-ETS installations**	Total [kt CO_2eq/a]
3,908	1,162	20,355	123	156	25,704

* Emission amounts that leave the installation boundaries but remain within Activities 8 to 10.
**The actual transferred amount totals 191,807 tonnes of carbon dioxide equivalents, of which around 36,303 tonnes are inherent carbon dioxide.
As of 02/05/2019

Around 3.9 million tonnes of carbon dioxide were transferred within and between Activities 8 to 10 (emission amounts that leave the installation boundaries but remain within Activities 8 to 10[41]), which is 0.1 million tonnes less than in 2017. The transfer from these installations to processing installations (Activity 11) amounts to about 1.2 million tonnes of carbon dioxide (about 0.1 million tonnes less than in 2017). Of the remaining transfers, the majority went to energy installations (around 20.4 million tonnes of carbon dioxide compared to 21.3 million in the previous year).

40 Data source: 2018 EEA; the evaluation is based on grouping the installations according to the Activities in the EU Union Registry (see Table 46, 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.

41 For the different installation borders, see the explanatory notes on amalgamated installations at the beginning of this chapter.

When the transfer is to installations not subject to emissions trading, the waste gas generating installations must surrender emission allowances for the inherent share of waste gases from iron, steel and coke production, i. e. for the amount of carbon dioxide that cannot be used for energy production. This amount has already been subtracted from the total transferred amount in Table 13 and is already included in the emissions of waste gas generating installations. When the transfer is to installations subject to emissions trading, installations using the waste gases from iron, steel and coke production must surrender emission allowances corresponding to the entire amount of transferred carbon dioxide.

Allocation status

Table 14 compares the allocation status with that of the previous year and differentiates between pig iron and crude steel production on one hand (Activities 8 to 10), and the further processing of ferrous metals (Activity 11) on the other.

Table 14 shows the nominal allocation amounts and allocation coverages. In total, the nominal allocation amounts to 46.8 million emission allowances (of which 42.3 million for Activities 8 to 10). The nominal allocation coverage is therefore 130 percent, while the adjusted allocation coverage is around 86 percent (see Table 15).

Table 14: Iron and steel industry (Activities 8 to 11 and 1), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of installations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
8, 9, 10	Pig iron and crude steel production*	35	42,320	32,545	9,775	130.0%
11	Ferrous metal processing	89	4,453	5,292	–838	84.2%
1	Combustion	1	0	76	–76	0.0%
Total		**125**	**46,774**	**37,913**	**8,861**	**123.4%**

* Coke plants, metal ore processing, pig iron and steel production.
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However, the general premise in relation to the transfer of waste gases from iron, steel and coke production assumes that waste gas producing installations of the iron and steel industry transfer emission allowances to energy installations using waste gases. Producers receive an allocation for emissions from the use of waste gases from iron, steel and coke production for energy that occur in excess compared to the reference fuel natural gas. The benchmark also takes an "inefficiency surcharge" into account. In the case of blast furnace gas, this surcharge takes account of lower efficiency in the energy use of waste gases from iron, steel and coke production compared to the use of natural gas to produce electricity or heat. The number of transferred emission allowances can be estimated based on the actually transferred volumes of waste gases from iron, steel and coke production. For 2018, the amount of waste gases from iron, steel and coke production transferred to energy installations corresponds to emissions of 20.4 million tonnes of carbon dioxide (see above). The estimated amount of transferred emission allowances corresponds to the emission amount from the transferred waste gases from iron, steel and coke production, which, compared to natural gas, incurred in addition to the "inefficiency surcharge".[42] Thus, the 2018 amount of emission allowances transferred to energy installations can be estimated at about 14.2 million allowances. This results in an adjusted allocation amount of about 32.6 million emission allowances and an adjusted allocation coverage of about 85.9 percent. This means that, same as in the previous year, the iron and steel industry must additionally purchase about 14 percent of its required allowances or can cover them with the surplus from the second trading period.

42 See DEHSt 2014a, "Iron and steel industry" chapter

Table 15: Iron and steel industry (Activities 8 to 11 and 1), number of installations, allocation amounts, 2018 VET entries and adjusted allocation coverage

Sector/ Activity	No. of installations	2018 adjusted allocation amount [1000 EUA]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Adjusted allocation coverage
Iron and steel	125	32,573	37,913	−5,340	85.9%

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The evaluation of the allocation coverage of the iron and steel industry must also take into account that a large amount of waste gases from iron, steel and coke production is used to generate electricity. According to the allocation principle in the third trading period, free allocations are not granted for electricity production. This means that a part of the shortfall can be attributed to this principle: electricity production from waste gases receives a free allocation only to the extent of which its generated emissions are higher than those from electricity production from natural gas (which do not receive free allocation).[43] Insofar as the generated electricity is again used for iron or steel production, the operator can apply for compensation for the additional costs arising from the assumed transfer of CO_2 costs in the electricity price[44].

Heat production is subject to a natural gas-based subtraction in the allocation for the iron and steel production too; however, unlike in electricity production, the user of heat or waste gases from iron, steel and coke production receives a direct allocation for the heat generated according to the heat benchmark.

43 See DEHSt 2014a, "Iron and steel industry" chapter: Waste gases have a special feature when it comes to free allocation, which results from the requirements of the Emissions Trading Directive: as an exception, the production of electricity from residual gases receives a free allocation, unlike electricity production from other fuels. These rules are supposed to ensure that emissions trading does not suppress or prevent the use of the usually high-emission residual gases that are less efficient to use than conventional fuels. This just compensates for the drawback of using inefficient residual gases compared to electricity or heat production from natural gas and ensures that there is no further betterment of residual gases.

44 See DEHSt 2019

2.5 Non-ferrous metal industry

The non-ferrous metal industry (Activities 12 and 13 according to Appendix 1 TEHG) included a total of 39 installations in the 2018 reporting year and therefore did not change compared to the previous year. In 2018, installations subject to emissions trading of the non-ferrous metal industry emitted around 2.7 million tonnes of carbon dioxide equivalents. Thus 2018 emissions were about one percent above the level of the previous year.

Emissions

Figure 22 shows that Activity 12 (primary aluminium) electrolysis installations accounted for the largest share of emissions within the nonferrous metals industry at around 35 percent. Installations for secondary aluminium production and aluminium processing (Activity 13) at about 31 percent had the second largest share of the sector's total emissions. The installations for manufacturing or processing lead, zinc or other non-ferrous metals in Activity 13 accounted for 16 percent of non-ferrous metal industry emissions. The share of copper production and processing installations (Activity 13) in the sector emissions was slightly smaller at around 15 percent. The emissions from anode production (Activity 12) only accounted for less than four percent.

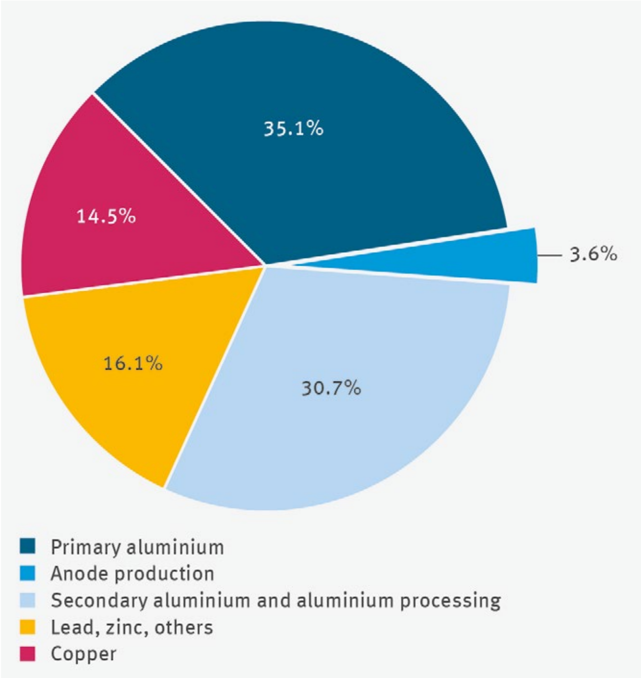

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Figure 22: 2018 emission shares from non-ferrous metal industry (Activities 12 and 13)

Table 16: Non-ferrous metal industry (Activities 12 and 13), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of installations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
12	Primary aluminium production	7	1,010	1,029	19
13	Non-ferrous metal processing	32	1,622	1,633	11
Total		**39**	**2,632**	**2,662**	**30**

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Seven installations produced primary aluminium (Activity 12). They emitted slightly more than one million tonnes of carbon dioxide equivalents. There are three installations among them that produce anodes used in primary aluminium production. The remaining four Activity 12 installations are electrolysis installations for primary aluminium production. In addition to carbon dioxide, these four installations emit PFC (perfluorocarbons). The 2018 PFC emissions were about 126,000 tonnes of carbon dioxide equivalents and were thus about 50 percent higher than in the previous year. Their average share of emissions from the four electrolysis installations increased to 14 percent, compared to nine percent in the previous year. Overall, the level of emissions from electrolysis installations subject to emissions trading was 1.9 percent above the level of the previous year. The 32 installations for the production and processing of other non-ferrous metals such as copper, zinc, lead and secondary aluminium (Activity 13) emitted approximately 1.6 million tonnes of carbon dioxide equivalents in 2018 and the level of emissions was thus just under 0.7 percent higher than in the previous year.

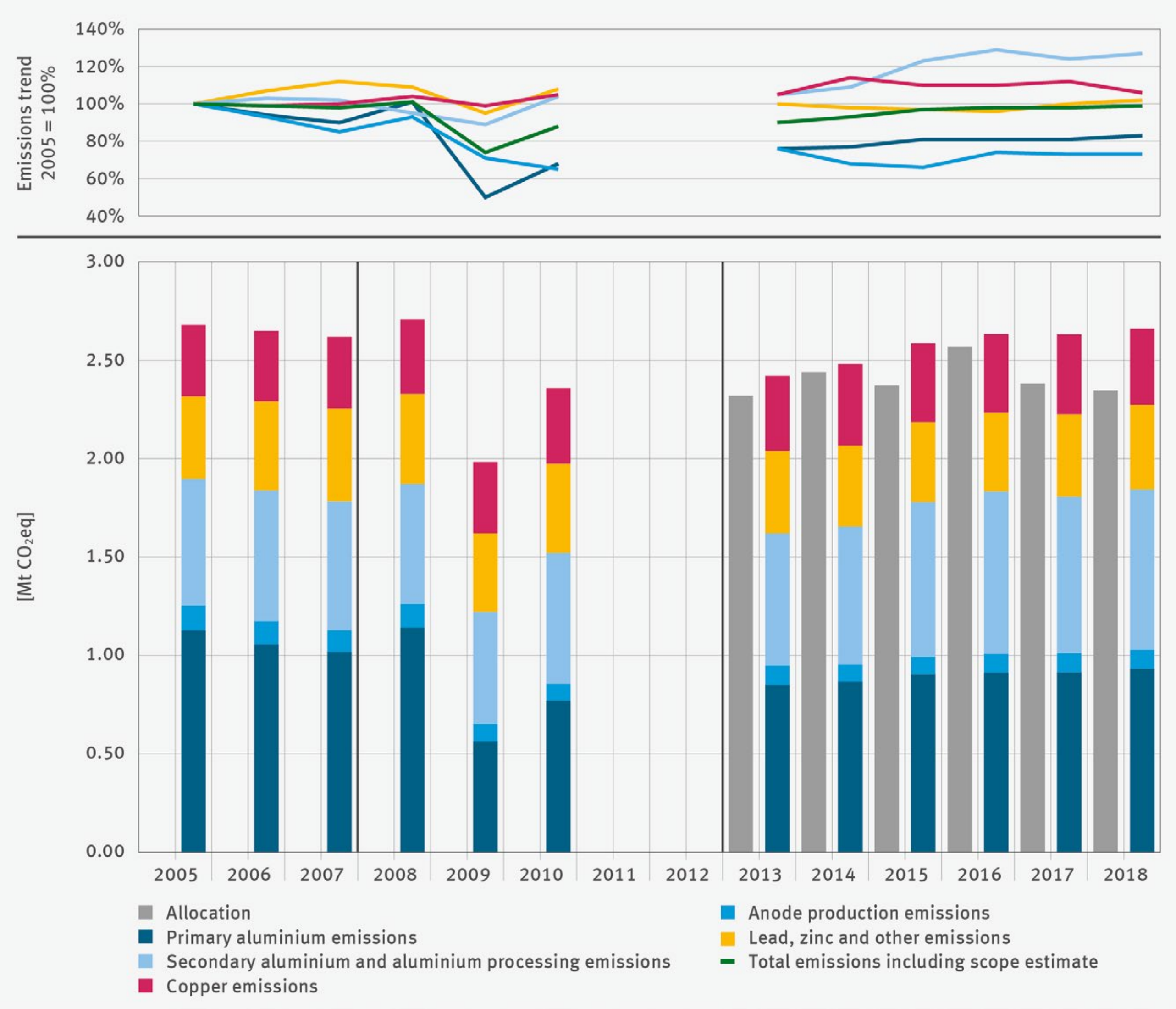

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Figure 23: Non-ferrous metal industry (Activities 12 and 13). 2005 – 2018 emissions and free allocation trends in Germany[45]

45 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 segment that produces or processes non-ferrous metals. The free allocation and emissions from these installations during the first and second trading periods are not included in the figure

Figure 23 divides emissions from the non-ferrous metal industry according to the predominantly produced or processed materials or products and shows both absolute emissions and the percentage emissions trends in relation to 2005. Since installations of the non-ferrous metal industry chiefly became subject to emissions trading with the start of the third trading period, emissions data cannot be analysed based on emission reports before 2013. Instead, however, 2005 – 2010 emissions data from the allocation process of the third trading period can be used for a general overview of the emissions trend in the sector.[46] Emissions data for the non-ferrous metal industry is not available for 2011 and 2012.

Due to these limitations, the following description of the emissions trend of the non-ferrous metal industry in emissions trading starts from only 2013. The emissions from Activity 12 electrolysis installations (primary aluminium) increased by nearly 10 percent since being subject to emissions trading in 2013. Emissions from anode production (Activity 12) decreased by nearly three percent by 2018.

The emissions from installations producing secondary aluminium and processing aluminium (Activity 13) have also increased – by over 21 percent since 2013. The production of secondary aluminium has also increased during this period. In addition, the number of installations has increased by two new units since 2013. After a sharp increase in the meantime, emissions from copper production and processing installations (Activity 13) fell again significantly in 2018 and were now only 1.4 percent higher than in 2013. Emissions from installations producing or processing lead, zinc or other non-ferrous metals (Activity 13) have increased since 2013 and are now 2.6 percent above the 2013 level.

Emission and production trends

Figure 24 compares the emissions from primary aluminium production installations (i. e. the electrolysis installations) with the production data trend. These are based on the activity rates (AR) of the "primary aluminium" product benchmark as well as the data on the primary aluminium production of the Metals Economic Association (WV Metals).

The trend in activity rates concurs with the Association data trend. The fact that the relative trend of activity rate and Association data has not been congruent since 2007, but progressed in parallel, may be explained by the fact that production capacities for the production of primary aluminium had been decommissioned during this time. The production volumes of the decommissioned installations are considered in the Association data, but not in the activity rates, meaning that the representation of the Association production data from 2007 onwards deviates more from the 2005 starting year than the timeline of the activity rates.

46 The 2009 and 2010 emissions were estimated for five installations (using linear interpolation of the data between 2008 and 2013). This also concerns the three anode production installations.

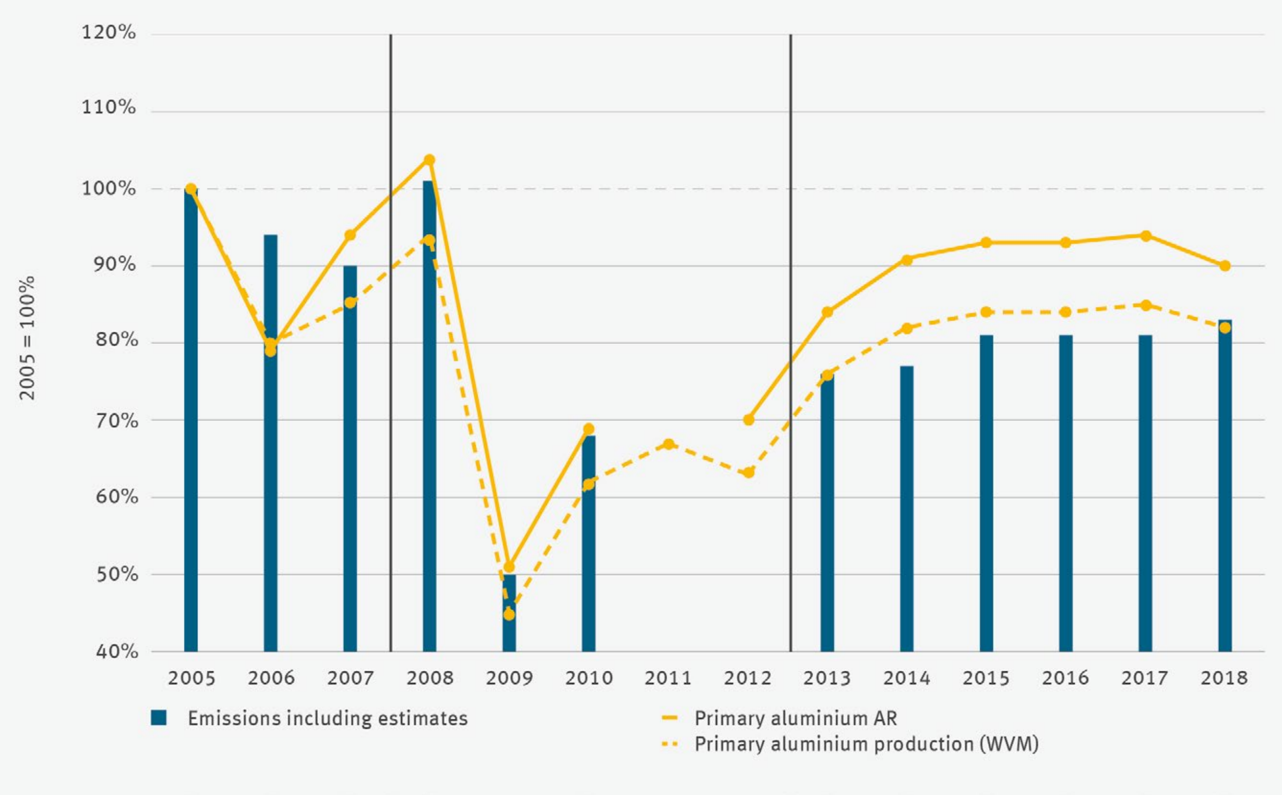

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Figure 24: Electrolysis installations, 2005 – 2018 emission and production trends in Germany, each in relation to 2005[47]

Figure 24 shows that the emissions trend of the electrolysis installations coincided relatively well with the activity rate or primary aluminium production trends in the 2013 – 2017 period. In the past year, however, an opposite trend could be observed. Between the beginning of the third trading period in 2013 and 2017, primary aluminium production increased by 12 percent. At the same time, the emissions from the electrolysis installations rose by eight percent.

In 2018, primary aluminium production decreased by four percent to its lowest level since 2013. By contrast, an increase in emissions of about two percent was recorded. As a result of the decline in production, the installations were undersupplied in 2018, which may explain the higher specific emissions.

47 Primary aluminium (WVMetalle): see WVMetalle 2019; production figures for the production of aluminium from ore.

Allocation status

Overall, the non-ferrous metal industry had an allocation shortfall of around 315,000 emission allowances in 2018.

Table 17: Non-ferrous metal industry (Activities 12 and 13), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of installations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
12	Primary aluminium production	7	855	1,029	−173	83.2%
13	Processing of non-ferrous metals	32	1,492	1,633	−141	91.3%
Total		**39**	**2,347**	**2,662**	**−315**	**88.2%**

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Activity 12 installations receive a free allocation according to product benchmark ("Aluminium" or "Preburnt Anodes"). On average, the free allocation for these installations corresponded to about 83 percent of their annual emissions in 2018 compared to 86 percent in 2017.[48] Purely numerically, the operators of these installations have not had to acquire allowances before 2014 in order to meet their surrender obligations.[49] However, in 2018, they had to purchase emission allowances for about 17 percent of their surrender obligations. On one hand this is on account of their increased emissions compared to the previous year, and the annually declining free allocation due to the cross-sectoral correction factor on the other. Activity 13 installations have been better supplied in previous years, among others due to the fallback allocation. Until 2016, their allocation coverage was 96 percent and higher.[50] The 2018 allocation coverage however was only 91 percent due to increasing emissions and the regular reduction of allocation due to the cross-sectoral correction factor.

48 See DEHSt 2017
49 See DEHSt 2015
50 See DEHSt 2017

2.6 Mineral processing industry

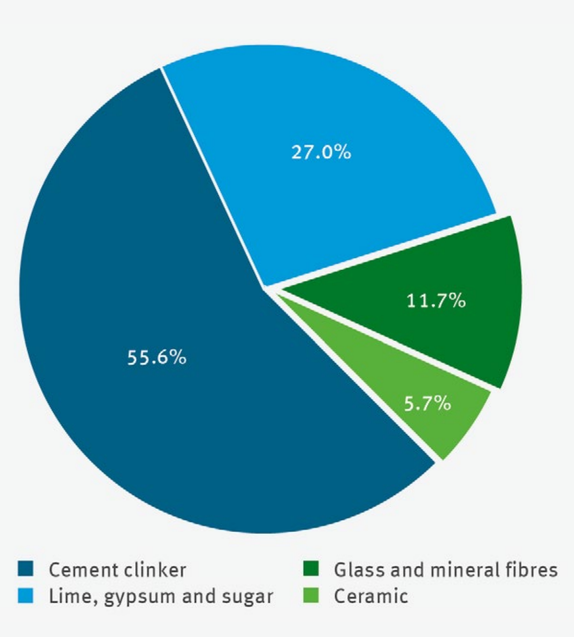

Figure 25: The mineral processing industry's share in the 2018 emissions

Installations producing cement clinker are accountable for more than half (55.6 percent) of the mineral processing industry's 2018 total emissions which are 36 million tonnes of carbon dioxide equivalents. The production of lime, gypsum and sugar, which, in addition to industrial and building lime installations, also includes the sugar industry and gypsum processing plants (for example power plant flue gas desulphurisation installations), accounts for a further 27 percent of emissions. Glass and mineral fibre producing installations accounted for another 11.7 percent, while the ceramics installations caused 5.7 percent of emissions.

1.1.1 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, since the threshold in the scope of the EU ETS of 500 tonnes of cement clinker per day (Activity 14(2), Annex 1 of TEHG) in Germany is far exceeded by all installations in the industry.

Emissions

In 2018, despite stable building activity and cement demand being at a high level[51], emissions declined slightly by 2.3 percent (around 468,000 tonnes of carbon dioxide equivalents), after emissions had risen steadily in previous years. In the third trading period emissions were only higher in 2017.

Table 18: Cement clinker production (Activity 14), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of installations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
14	Cement clinker production	36	20,466	19,998	−468

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51 Central Federation of the German Construction Industry (2019), VDZ 2018b

Figure 26 shows the emissions trend and free allocation of cement clinker installations in the 2005 – 2018 period.[52] The green line in the upper part of the figure represents the emissions trend compared to the base year 2005, i. e. all installations subject to emissions trading in the respective year. In addition to the currently participating installations (dark blue for their emissions, light grey for their allocation), the bottom part of the figure (columns) shows the emissions (light blue) and allocations (dark grey) of installations that were no longer subject to emissions trading in 2018 (e. g. due to decommissioning).

Emissions from German clinker production have not changed significantly since the beginning of emissions trading. A slight decline in emissions only occurred in a few years, in particular during the economic and financial crisis (in 2009 and 2010). Between 2015 and 2017, emissions increased significantly, reaching their highest level since 2008 in 2017. In 2018, emissions returned to roughly the same base level as in 2005.

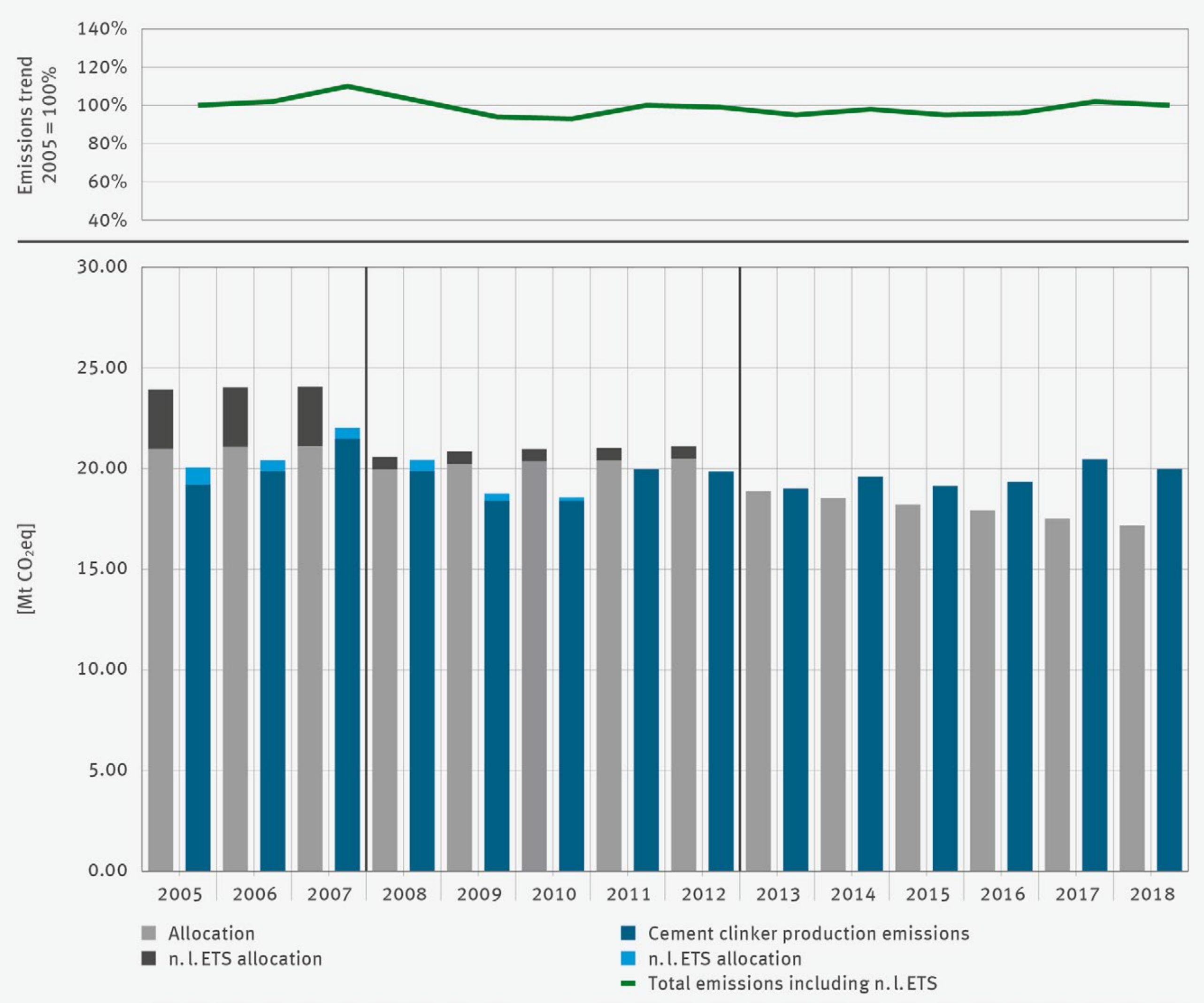

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Figure 26: Cement clinker production (Activity 14), 2005 – 2018 emissions and free allocation trends in Germany

52 It should be noted that fixed emission factors have been applied to the process-related emissions in the time series 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 must analyse their process-related emissions. It has been found that most installations (even the most efficient ones) 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.

In the first two trading periods, the free allocation of all installations was in part significantly higher than the emissions and remained largely constant in the period from 2008 to 2012, while emissions decreased as a result of production declines. Since the beginning of the third trading period, the allocation coverage has been steadily declining with free allocation decreasing every year due to the increasing budget cuts (cross-sectoral correction factor) while emissions remained stable or even showed a slight growth.

The emissions of cement clinker production are primarily determined by the production trend. Figure 27 depicts emissions and production (amount of produced clinker reported in the emissions reports and production data of the German Cement Works Association, VDZ) always in relation to 2005.[53] The trend of emissions and production is almost identical. This means that the specific emissions of clinker production remained virtually unchanged between 2005 and 2018. The 2018 specific emission value of the 34 grey cement clinker installations was 0.795 tonnes of carbon dioxide per tonne of cement clinker, roughly equivalent to the previous year's figures.

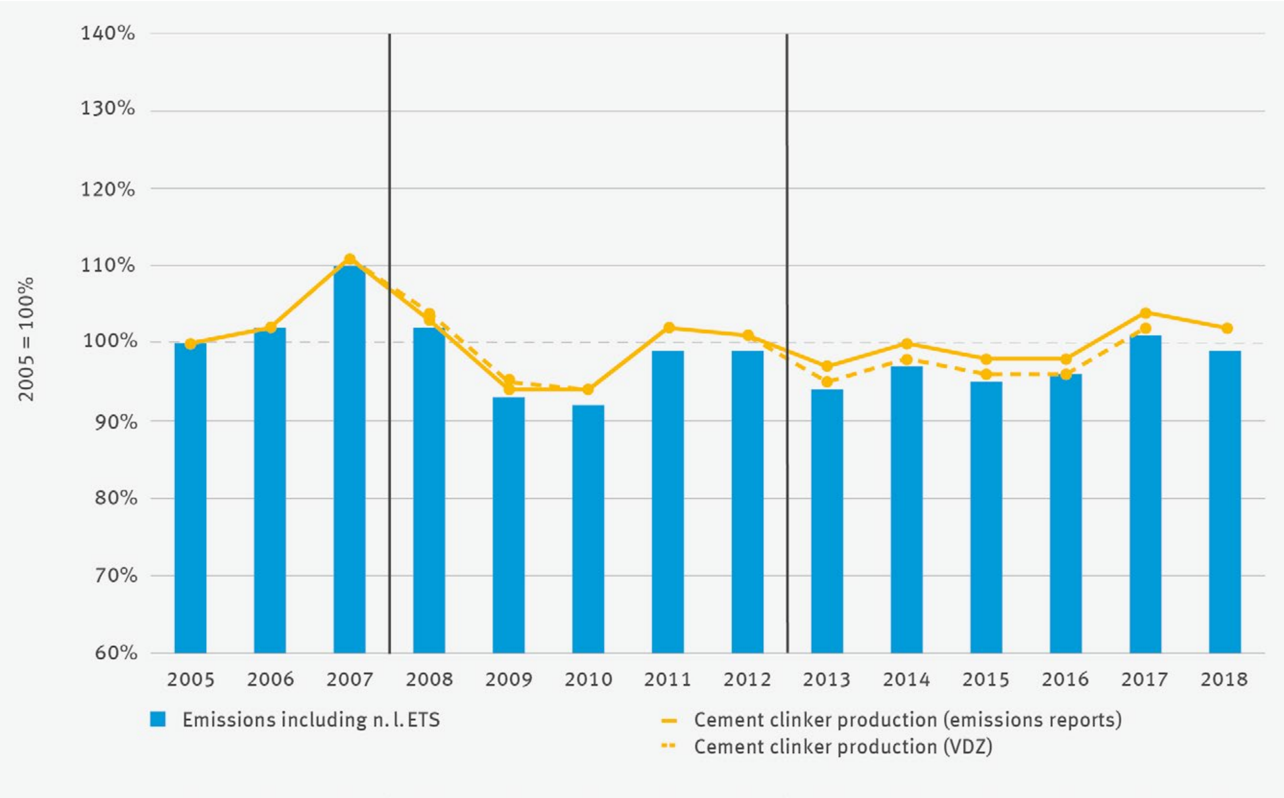

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Figure 27: Cement clinker production (Activity 14), emissions and production trends[54] in Germany, each in relation to 2005

The trend in the rest of Europe differs significantly from that in Germany (see Figure 28). There, the production slump and the subsequent noticeable decline in emissions as a result of the economic and financial crisis in 2009 were noticeably more pronounced and emissions have remained at a much lower level since 2012. In the rest of Europe (EU25 excluding Germany), emissions from cement clinker production in 2017 were only around 69 percent of the starting level in 2005. The main reasons for these trends were the decline in cement clinker production by about half in Spain and Italy compared to 2005.[54]

53 The production data were evaluated based on of the material flows from the emission reports. The cement clinker production quantities 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. VDZ data from: VDZ 2018a

54 Source for production data: VDZ

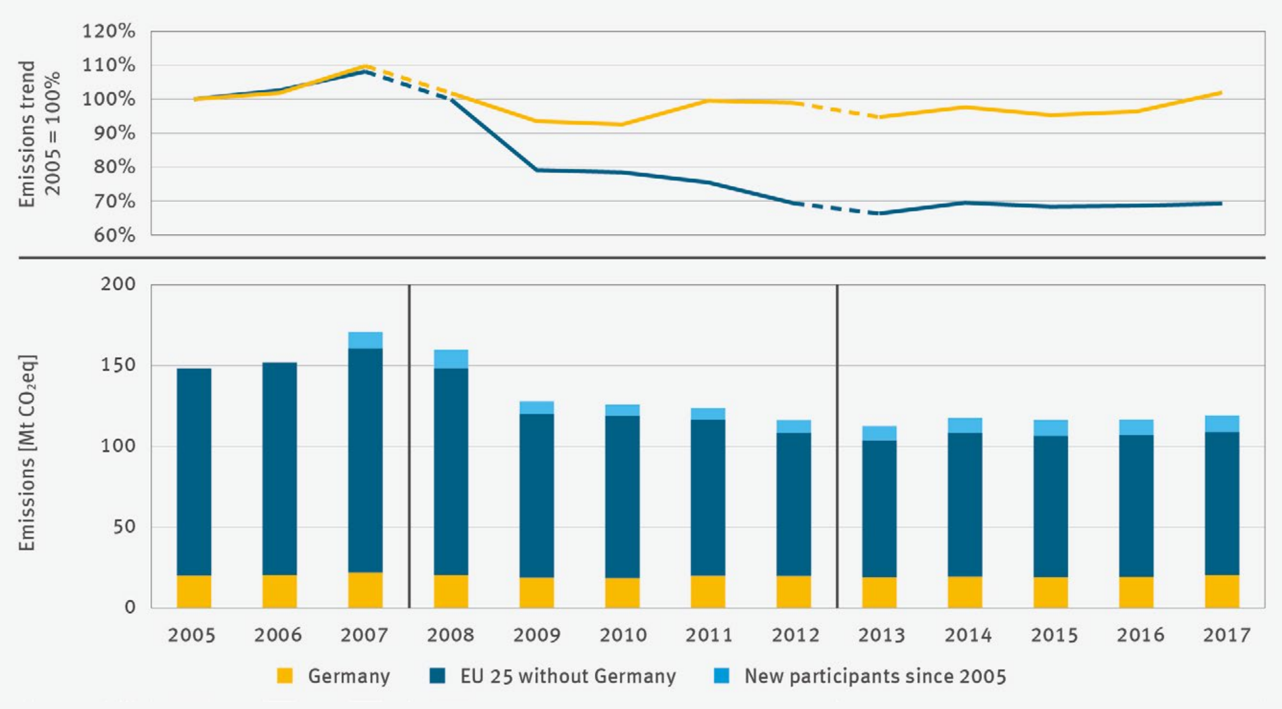

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Figure 28: 2005 to 2017 emissions trend of cement clinker production (Registry Activity 29) in Germany and in the EU[55]

In contrast, after a noticeable increase in 2017, emissions in the sector in Germany were even two percent above the level of 2005 (including installations that were no longer subject to emissions trading in 2017). Germany's share of total emissions of cement clinker production in Europe rose from 14 percent in 2005 (EU25) to just under 17 percent in 2017 (EU31). Germany is now the largest cement clinker producer in the EU, ahead of Spain, Italy and France.[56]

Allocation status

The 2018 free allocation to the cement clinker installations was around 2.8 million emission allowances below the amount required for the surrender obligation (see Table 16). The additional purchase demands slightly improved compared to the previous year due to somewhat lower emissions. The 2018 allocation coverage was slightly less than 86 percent.

Table 19: Cement clinker production (Activity 14), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of installations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
14	Production of cement clinker	36	17,174	19,998	−2,824	85.9%

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55 Data source: EEA 2018. The evaluation is based on a grouping of the installations by activities in the Union Registry (see Table 46, 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.

56 VDZ 2018b

In 2018, only eight installations managed to stay below the product benchmark for grey cement clinker (0.766 tonnes of carbon dioxide/tonne of grey cement clinker), which is relevant for the free allocation.[57] This means that around three-quarters of the grey cement clinker installations had higher specific emissions.

2.6.2 Lime, gypsum and sugar production

This section summarises the emissions from Activity 15 "Lime production" and Activity 19 "Gypsum production". Together, these installations account for 27 percent of the mineral processing industry's emissions (see Figure 25).

Activity 15 includes two different industrial sectors: industrial and building lime and the sugar industry. 40 of these installations produce lime or dolime for the construction, paper, chemical, iron and steel industries and environmental technology and are referred to in this section as the "industrial and building lime" category.

This category also includes a limestone drying plant (combustion plant, Activity 1). Within the mineral processing industry 20.4 percent of the emissions are related to the production of industrial and building lime (see Figure 29).

Activity 15 also includes 20 installations that use lime for sugar production and require heat and electricity in the manufacturing process.[58] The sugar industry also includes other partial activities such as beet slice drying and caramelisation installations. The sugar industry's installations accounted for around 5.8 percent

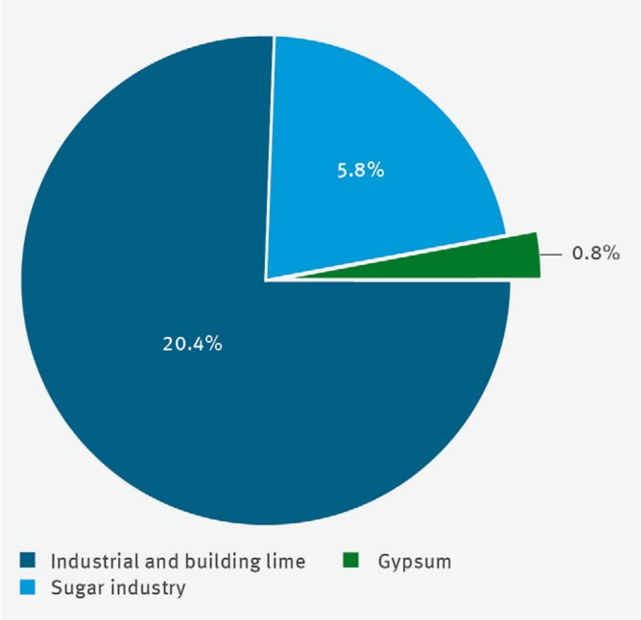

Figure 29: Lime, gypsum and sugar production (Activities 1, 15 and 19) shares in the 2018 emissions of the mineral processing industry of the emissions within the mineral processing industry in 2018.

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

Emissions

The emissions from the production of industrial and building lime amounted to around 7.4 million tonnes of carbon dioxide in 2018, almost equalling the previous year's figures.

By contrast, emissions from sugar installations increased sharply again by 6.8 percent compared to the previous year and accounted for around 2.1 million tonnes of carbon dioxide.

The emissions from gypsum installations remained almost unchanged at around 270,000 tonnes of carbon dioxide.

57 The production volumes for cement clinker also contain dust production volumes converted into cement clinker equivalents.

58 Since 2013, the energy installations of the sugar industry have also been operated under the "lime production" Activity, while energy and lime installations were considered separately in the second trading period. This section retroactively assigns the energy installations to the "lime production" Activity.

Table 20: Lime, gypsum and sugar production (Activities 1, 15 and 19), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of installations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
15	Lime production	40	7,395	7,357	−38
	Sugar production	20	1,949	2,081	131
		60	9,345	9,438	93
19	Gypsum production	9	269	271	2
1	Combustion	1	18	20	2
Total		**70**	**9,632**	**9,729**	**97**

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Emissions trend and production of industrial and building lime and gypsum

Figure 30 shows the emissions trend and free allocation for the production of industrial and building lime and gypsum since the beginning of emissions trading in 2005. The lines in the top part of the figure describe the emissions trend of all installations subject to emissions trading in the respective year compared to 2005. The bottom part of the figure (columns) shows the emissions and allocations of the installations no longer subject to emissions trading in 2018 (n.l. ETS) (marked in light blue or dark grey) in addition to the installations currently subject to emissions trading (dark blue or light grey).

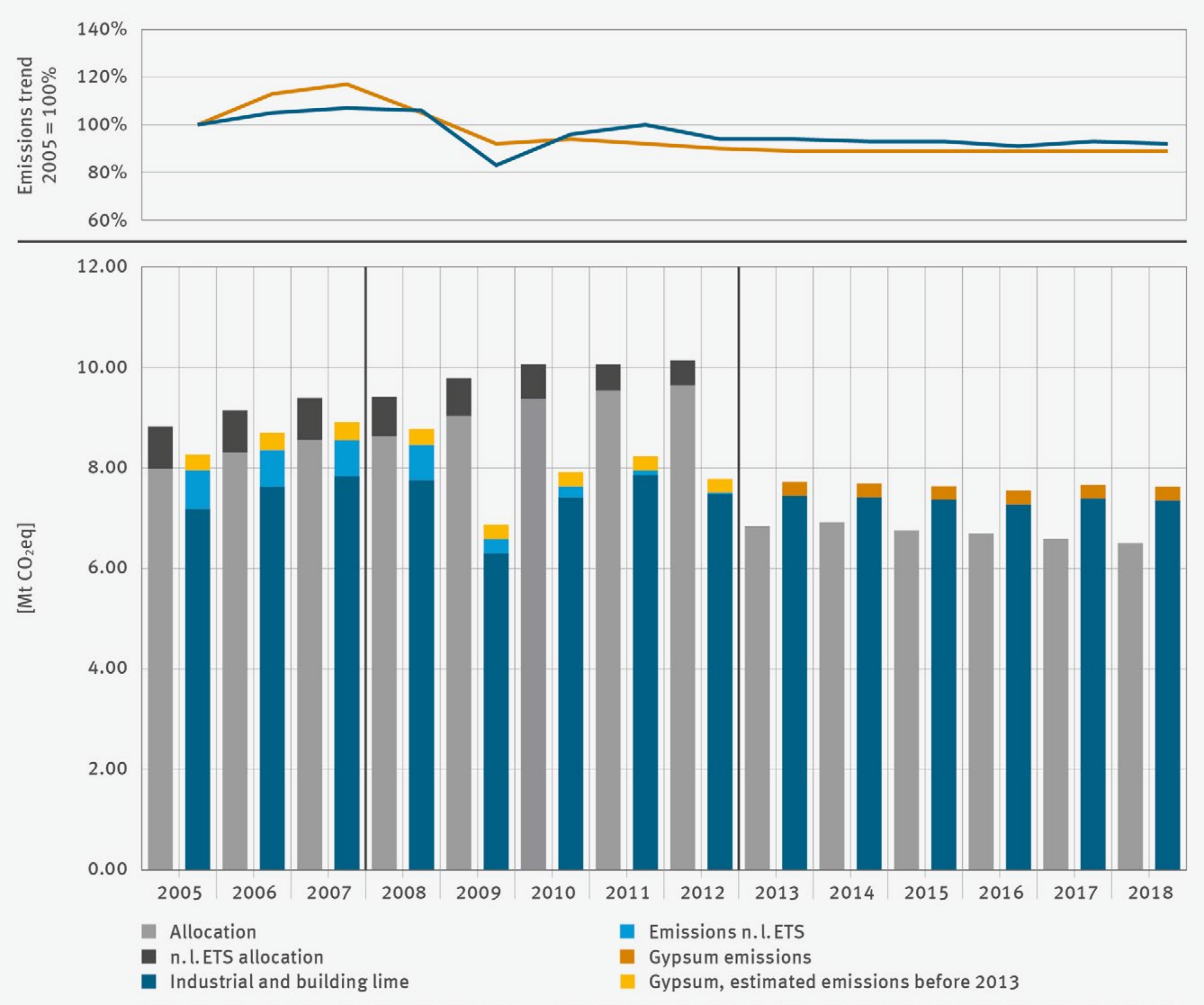

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Figure 30: Industrial and building lime production (Activity 15) and gypsum production (Activity 19), 2005 – 2018 emissions and free allocation trends in Germany

The production and emissions of industrial and building lime installations are mainly determined by the economic trend of the steel and construction industry. Following an increase in emissions between 2005 and 2008, emissions decreased by 17 percent due to the financial and economic crisis in 2009 but increased again in subsequent years. Since then, emissions have remained largely constant at the 2010 level. However, post-2013 emissions can only be compared to a limited extent with those from the second trading period since fixed emission factors were used in the first and second trading periods, whereas emission factors have had to be determined installation-specific since 2013 which, unlike in the case of cement clinker manufacturers (see footnote 53), leads on average to lower emissions. In addition, post-2013 emissions have been retroactively adjusted for an installation after the implementation of the judgment of the European Court of Justice C-460/16 (Schaefer Kalk) and are therefore also slightly lower than in previous trading periods.[59]

59 The lower emissions do not represent a reduction in emissions compared to past years, but take into account the fact that the case in question does not assess the CO_2 stored (chemically bound) in the final product PCC (precipitated calcium carbonate) – and thus not released into the atmosphere – as emissions within the meaning of ET Directive and thus excludes it from the surrender obligation in emissions trading. Due to the retroactive correction for the years 2013 to 2016, there are also minor deviations from the previous year's reports.

Figure 30 also clearly shows that, in both the first and second trading periods, free allocation was higher than the emissions every year and continued to increase despite a decline in emissions in the second trading period. The allocation status has changed significantly since the beginning of the third trading period: free allocation was lower than the emissions in all years after 2013, and since 2017 they have been less than 90 percent of the emissions of the respective year.

The nine gypsum-producing installations have been included in emissions trading only since the beginning of the third trading period. Therefore, these installations did not receive a free allocation prior to 2013 and only estimates based on data from the allocation process are available for the emissions. Emissions in 2018 are around one percent above the figure of 2013 and are therefore largely unchanged since the inclusion of the installations in emissions trading.

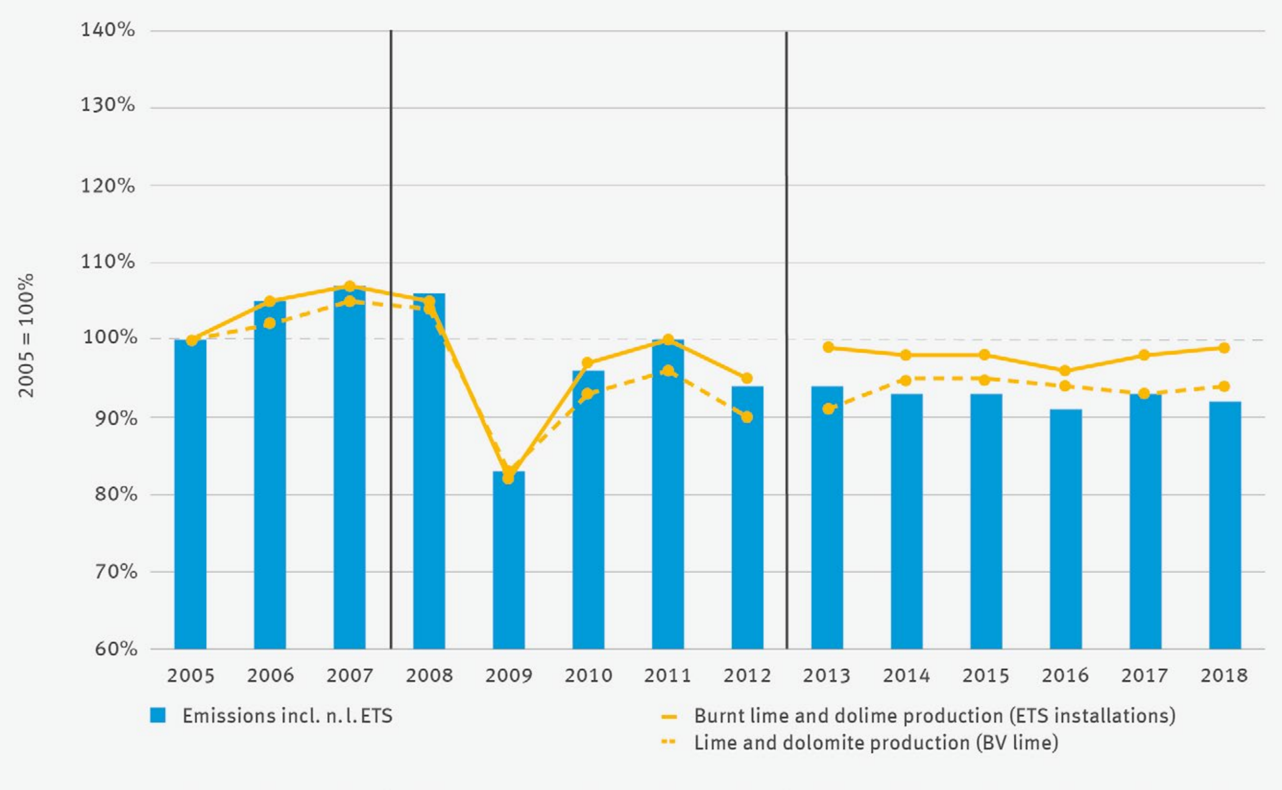

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Figure 31: Industrial and building lime production (Activity 15), emissions and production trends[60] in Germany, each in relation to 2005

The 2005 – 2018 emissions trend essentially reflects that of lime production although the different emission factors for process emissions permit a very limited comparison between those emissions reported in the third trading period and the previous period. Figure 31 shows the emissions and production trends, each in relation to 2005. The solid line shows the trend of all installations subject to emissions trading in the respective years. On the other hand, data from the Association of the German Lime Industry (BV Kalk) (dotted line) only covers the installations included in the Association. The deviation of emission and production trends in the third trading period can be attributed to the changes in reporting described above, not to an improvement of specific emissions. In fact, specific emissions have remained largely unchanged in recent years despite the use of more efficient furnaces, due to the simultaneously increased use of pulverised lignite as fuel. The specific benchmark of lime installations in 2018 was 1.1 tonnes of carbon dioxide per tonne of quicklime or dolime, almost identical to the previous year's figures.

60 Emissions stemming from the extended scope of the third trading period have been estimated for the 2005 – 2012 period using data from the allocation procedure.

Emissions trend and production of the sugar industry

In addition to the use of fuel, the emissions from the sugar installations are primarily influenced by the quality and quantity of the sugar beet harvest and are thus subject to weather dependent annual fluctuations. Figure 32 shows the emissions[61] and free allocations of the sugar industry, including associated energy installations since 2005. The emissions from installations that were no longer subject to emissions trading in 2018 are marked in light blue (columns) in the bottom part of the figure and their free allocation is marked in dark grey.

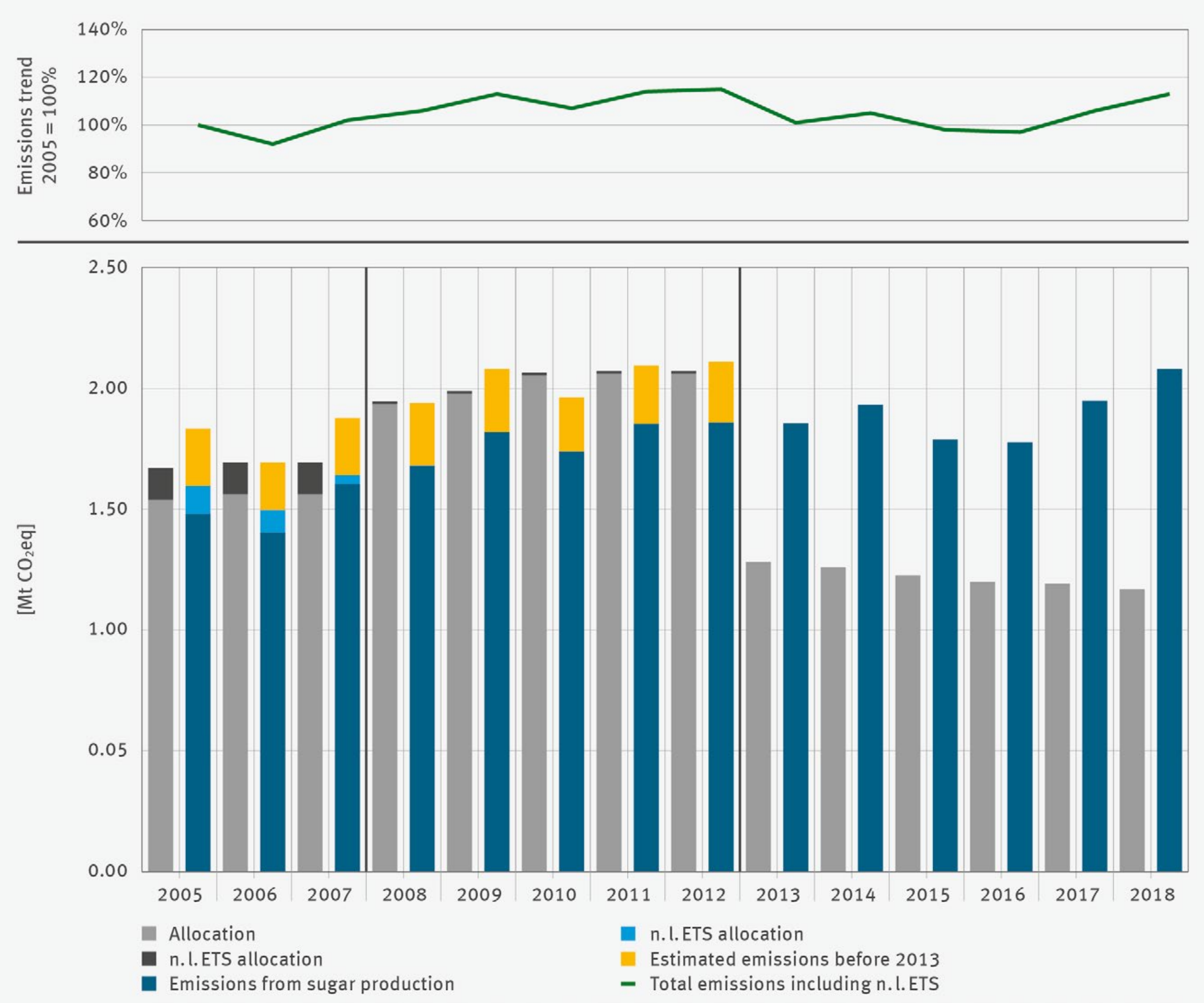

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Figure 32: 2005 – 2018 emissions and free allocation trends of the sugar industry (Activity 15)

Until 2012, except for a few years, emissions had increased. At the beginning of the third trading period, emissions were more volatile. Emissions increased significantly in both 2017 and 2018 and are 12 percent above the 2013 level (13 percent above the 2005 level).

61 Emissions stemming from the extended scope of the third trading period have been estimated for the 2005 – 2012 period using data from the allocation procedure.

When comparing emissions with the free allocation, the emissions must be considered within the applicable scope of the trading period, meaning without the retrospectively estimated emissions (without the yellow column section). Figure 32 shows that the free allocation of sugar installations was significantly higher than the emissions in the first two trading periods. By eliminating the free allocation for electricity generation in particular, sugar installations received significantly fewer emission allowances in the third trading period than they needed to cover their emissions. While the 2013 allocation coverage still amounted to 70 percent of the emissions, in 2018 it only amounted to 56 percent. In addition to the annual budget cut, this is due to the significant increase in production compared with the base period for the allocation.

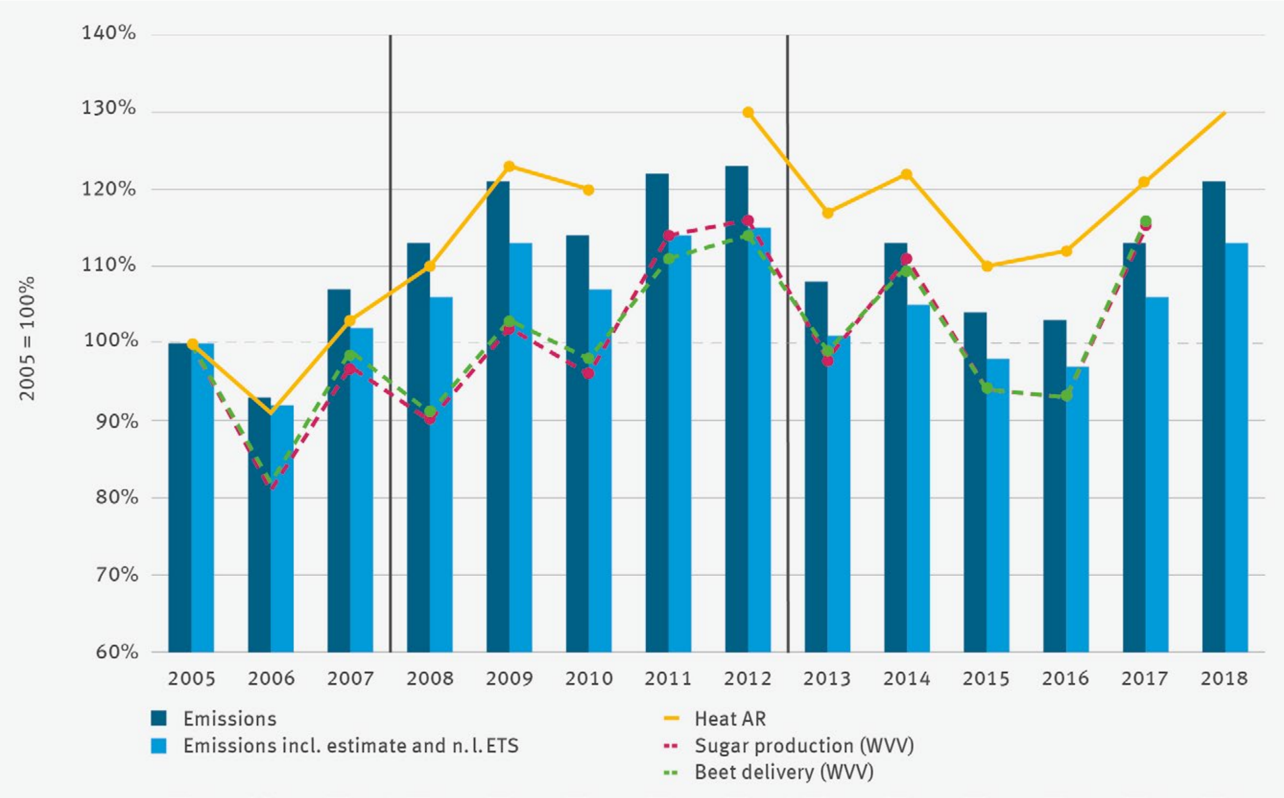

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Figure 33: Sugar production (Activity 15), emissions and production trends[62] in Germany, each in relation to 2005

A large part of the emissions from sugar installations is accounted for by heat generation so that Figure 33 compares the activity rate trend for the heat benchmark in relation to the 2005 starting year with the emissions trend during the same period. The emissions and activity rate trends are relatively similar in the sugar industry too. However, the activity rates are in some cases significantly higher than the emissions compared to 2005, particularly since the middle of the second trading period. This indicates that specific emissions have been reduced due to, for example, better waste heat recovery and the use of lower-emission fuels. However, specific emissions are also influenced by the quality of available sugar beet and may be subject to significant fluctu-ations.

In contrast to the activity rate, sugar production or beet delivery also includes the production of installations that were no longer subject to emissions trading in 2018. The comparison with the emissions including n. l. ETS (light blue columns) also shows that the emissions and production trends were similar – while large deviations occur in certain years, a fundamental trend in the tendency of specific emissions was not discernible.

62 Source for beet delivery and sugar production: Sugar Economic Association (WVZ)

"Lime production" activity in the EU

Figure 34 compares the emissions trend of lime production (no separation of lime and sugar industry in this case) in Germany with the trend in the other ETS member states. The figures for Germany differ partially from the figures mentioned earlier in this section since emissions in the Union Registry were allocated somewhat differently, especially in previous trading periods.[63] Because of changes in the scope and the assignment of installations to the "lime production" activity, the figures between the trading periods are only comparable to a limited extent.

It is noticeable that within the second trading period, emissions in Germany declined slightly less than in the rest of Europe and have increased once more since 2010. Since the beginning of the third trading period, emissions have remained largely stable except for a decrease in 2016 which was somewhat less marked in Germany.[64]

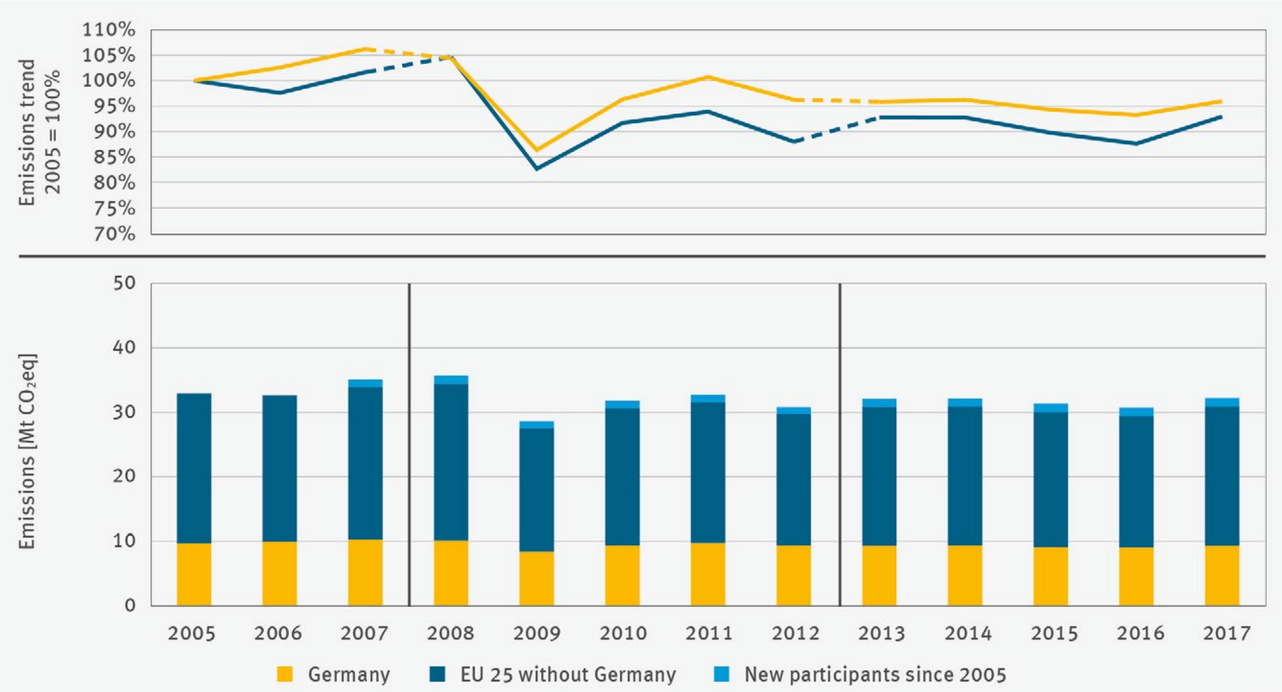

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Figure 34: 2005 – 2018 emissions trend of lime production (Registry Activity 30) in Germany and in the EU[64]

63 In the second trading period, the energy installations of the sugar industry in Germany were assigned to the combustion plants

64 Data source: 2018 EEA; the evaluation is based on a combination of the installations by activities in the EU Union Registry (see Table 46, Chapter 7), thereby differences can occur in the emission amounts per sector for Germany. Bulgaria, Croatia, Iceland, Liechtenstein, Norway and Romania have been new participants in the EU ETS since 2005.

Allocation status

The allocation status of the industry branches covered in this section – industrial and building lime, sugar and gypsum – differs significantly. In general, the allocation coverage decreased in all industry branches because emissions did not decrease to the same extent (or not at all) as did the free allocation, which is subject to increasing annual reduction due to the cross-sectoral correction factor.

Table 21: Lime, gypsum and sugar production (Activity 1, 15 and 19), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of instal-lations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
15	Lime production	40	6,217	7,357	−1,140	84.5%
	Sugar production	20	1,168	2,081	−912	56.1%
		60	7,385	9,438	−2,053	78.2%
19	Gypsum production	9	288	271	17	106.1%
1	Combustion	1	5	20	−15	26.5%
Total		**82**	**4,125**	**4,223**	**98**	**85.9%**

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There was a total coverage deficit of around 1.1 million emission allowances for installations producing industrial and building lime, which means that the installations had to additionally purchase emission allowances amounting to around 15.5 percent of their surrender obligation for 2018.

The relative shortfall is much higher for sugar installations: in 2018, these installations had to additionally buy around 912,000 emission allowances, which equates to 43.9 percent of their emissions of the year.

The allocation coverage of gypsum installations was 106.1 percent, meaning that the installations received more emission allowances than they needed to cover their surrender obligation. The combustion (limestone drying) plant received a free allocation for just 26.5 percent of its 2018 emissions.

2.6.3 Glass and mineral fibres production

This section covers Activities 16 (glass production) and 18 (mineral fibres production). These Activities account for around 10.7 percent of the emissions within the mineral processing industry. Emissions mainly arise in the production of flat and hollow glass (see Figure 35).

Emissions

Overall, the 2018 emissions from the glass and mineral fibre producing installations subject to emissions trading increased by 2.5 percent compared to the previous year to around 4.2 million tonnes of carbon dioxide. 82 installations were recorded, 75 of which were glass producing installations and 7 mineral fibre producing installations. Table 22 shows the 2018 emissions compared to the previous year differentiated by economic branch[65].

Emissions from hollow glass production increased slightly compared to 2017 (plus 2.1 percent). Emissions from the production of mineral fibres also increased by around 4.9 percent, which is not significant due to their low absolute volume. Emissions from the production of flat glass, which is used for instance in the automobile and construction industries, remained virtually unchanged.

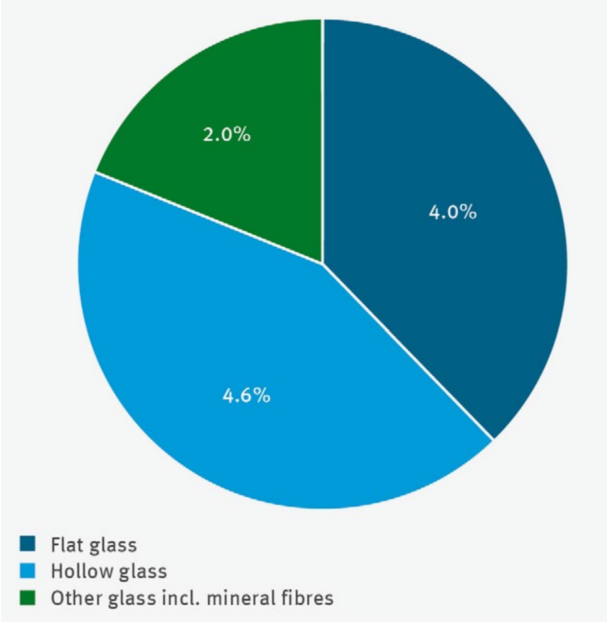

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Figure 35: Glass and mineral fibres production (Activities 16 and 18) shares in the 2018 emissions of the mineral processing industry

Table 22: Glass and mineral fibres production (Activities 16 and 18), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of installations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
16	Hollow glass production	37	1,623	1,657	34
	Production of glass fibres and goods thereof	9	212	211	0
	Production, finishing and processing of flat glass	14	1,401	1,428	27
	Production, finishing and processing of other glass including technical glassware	15	503	521	18
		75	3,739	3,818	79
18	Production of other goods from non-metallic minerals n. e. c.	5	327	350	23
	Production of glass fibres and goods thereof	2	59	55	−4
		7	386	405	19
Total		**82**	**4,125**	**4,223**	**98**

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65 The assignment is based on information provided by the operator.

Figure 36 shows the emissions and free allocation trends in glass and mineral fibre production since 2005. The green line in the upper part of the figure describes the emissions trend of all installations subject to emissions trading in the respective year (including the installations no longer subject to emissions trading in 2018 – n.l. ETS).[66]

There are only minor and no permanent changes in the emissions of the industry as a whole. Following a decline in emissions in the second trading period due to the economic trend, emissions have been above 4 million tonnes of carbon dioxide since 2013 with minor annual fluctuations.

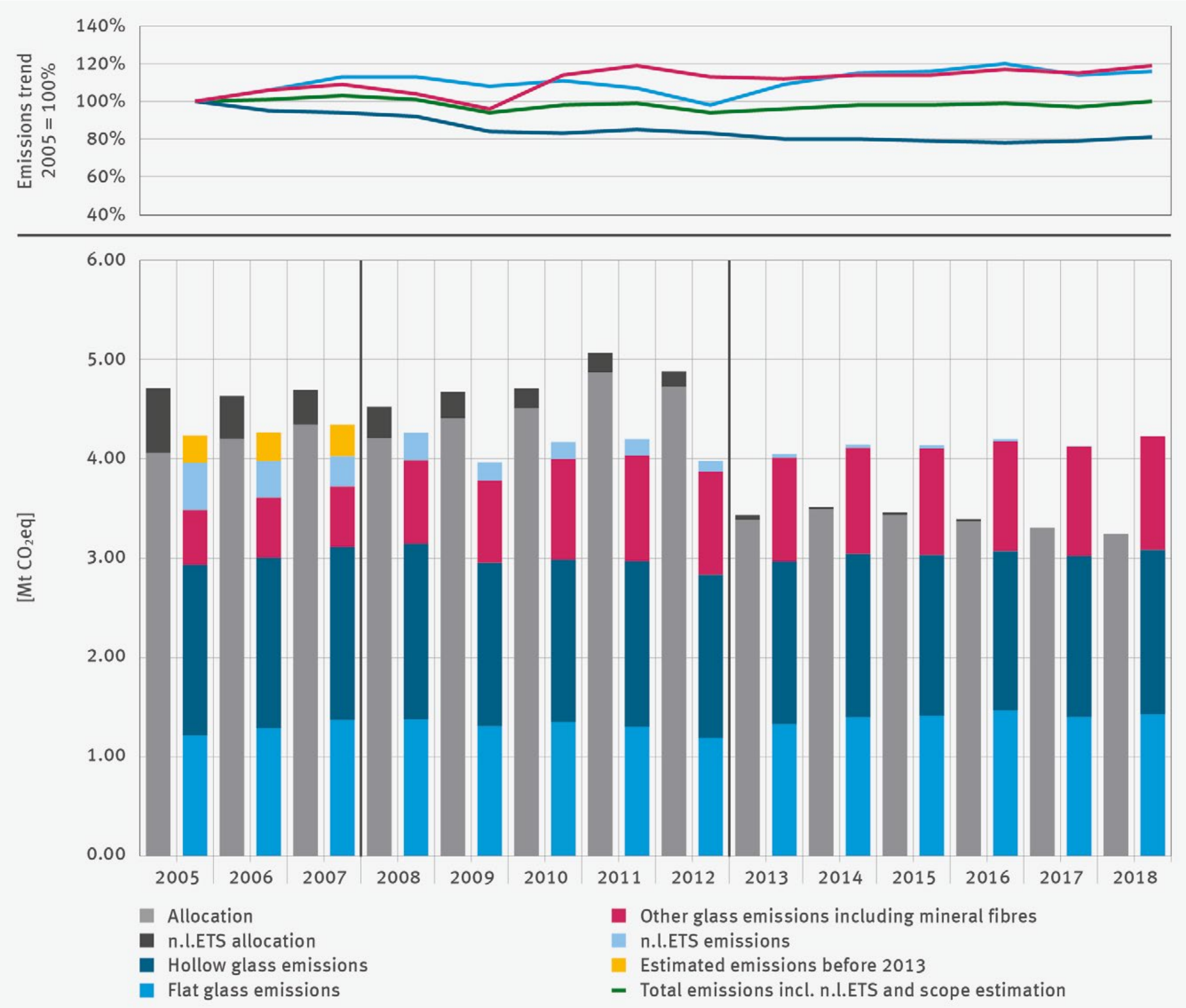

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Figure 36: Glass and mineral fibres production (Activities 16 and 18), 2005 – 2018 emissions and free allocation trends in Germany

However, the trend in the individual economic sectors is significantly different: the emissions from the production of flat glass are subject to stronger cyclical fluctuations than the emissions from the production of hollow glass. With the exception of 2012, they were well above the emissions in 2005. By contrast, emissions from the production of hollow glass were steadily decreasing until 2017 – albeit very weakly since 2013 – and were only 81 percent of the 2005 starting figure in 2018. Moreover, Figure 36 shows that the allocation status of the glass industry has changed significantly in the third trading period and the allocation coverage has decreased since 2013 from around 85 percent to around 77 percent.

66 For the production of mineral fibres, which were not included in emissions trading until the second trading period, an estimate was made based on data from the allocation procedure.

Allocation status

Compared to 2017, the aggregated shortfall of all installations has once again increased to 982,000 emission allowances, of which around 860,000 are for glass production (see Table 23). The 2018 allocation coverage was around 76.7 percent, the allocation coverage being lower for mineral fibres (70.4 percent) than for flat glass (just under 77 percent) and hollow glass (78 percent).

Table 23: Glass and mineral fibres production (Activities 16 and 18), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of installations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
16	Hollow glass production	37	1,293	1,657	–364	78.0%
	Production of glass fibres and goods thereof	9	136	211	–75	64.6%
	Production, finishing and processing of flat glass	14	1,098	1,428	–329	76.9%
	Production, finishing and processing of other glass including technical glassware	15	428	521	–94	82.0%
		75	2,956	3,818	–862	77.4%
18	Production of other goods from non-metallic minerals n. e. c.	5	258	350	–92	73.7%
	Production of glass fibres and goods thereof	2	27	55	–28	49.1%
		7	285	405	–120	70.4%
Total		**82**	**3,241**	**4,223**	**–982**	**76.7%**

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2.6.4 Ceramics production

Compared to the other sectors subject to emissions trading, the ceramics industry consists of numerous installations with a broad product range and comparatively low emissions. The transition between trading periods brought about changes in the scope of emissions trading that have affected the incumbent installations. In 2018, 141 installations from the ceramics industry were subject to emissions trading, two less than in the previous year. These installations caused around 5.7 percent of the emissions from the mineral processing industry.

Emissions

The emissions from the ceramics installations subject to emissions trading in 2018 were at about the level as in the previous year (plus 0.5 percent).

Table 24: Ceramics production (Activity 17), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of installations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
17	Ceramics production	141	2,041	2,051	10

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Figure 37 shows the emissions and free allocation trends of the ceramics industry since 2005. All installations subject to emissions trading in the respective year are shown, including the installations no longer subject to emissions trading in 2018 (n.l. ETS). These are shown separately in the bottom part of the figure (dark blue column section). Emissions from installations that have only been included in emissions trading since the third trading period were estimated for the 2005 to 2012 period using data from the allocation procedure (yellow column section).

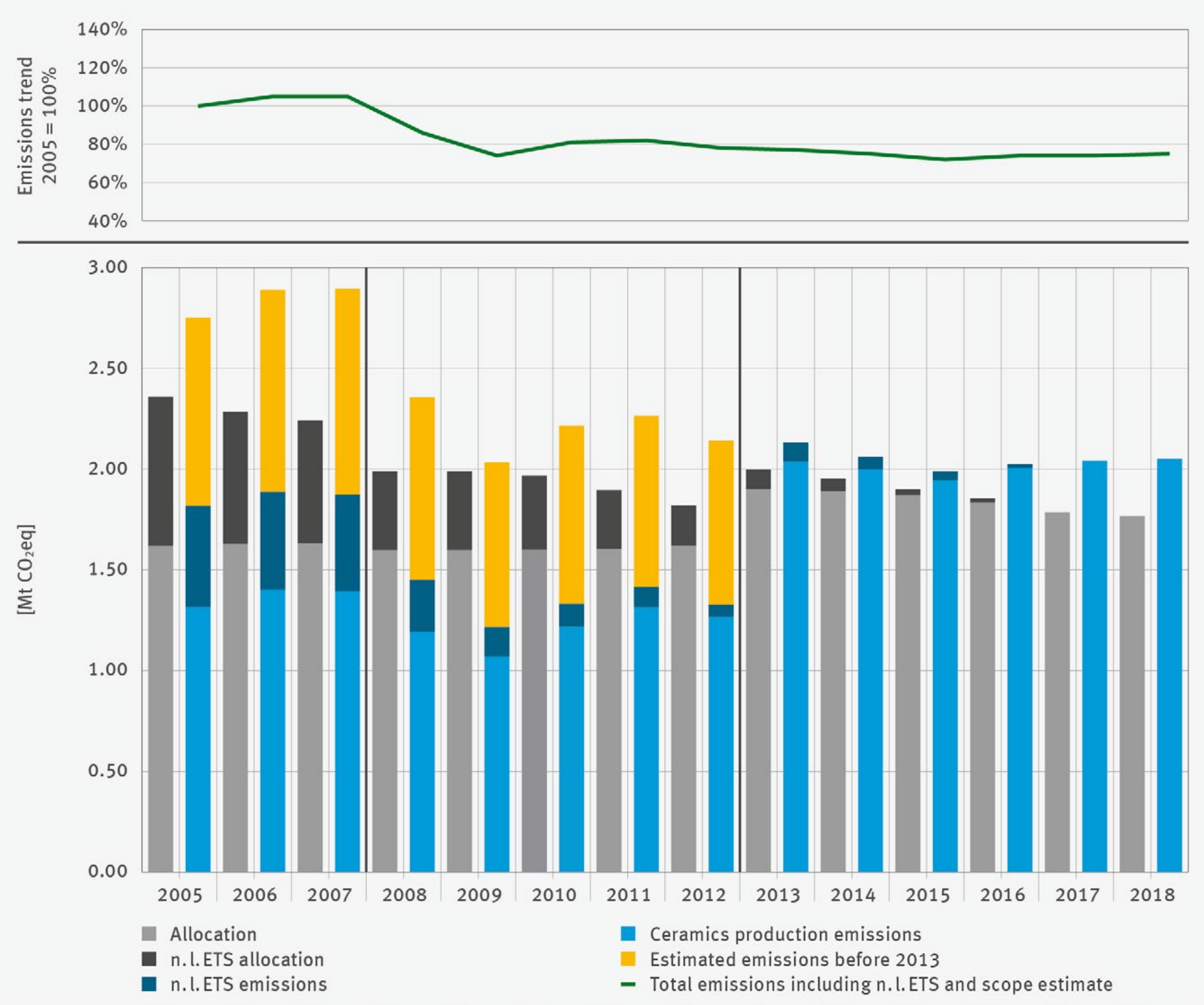

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Figure 37: Ceramics production (Activity 17), 2005 – 2018 emissions and free allocation trends in Germany

The decrease in emissions in the second trading period is clearly visible. Since the beginning of the third trading period, emissions have remained relatively constant at around 2 million tonnes of carbon dioxide.

The emissions of the scope applicable to the trading period (without the yellow column sections) may only be considered as a comparison to the free allocation. As in other sectors, the allocation status of the ceramics industry has changed significantly in the third trading period so that the installations have had an overall shortfall since 2013. The allocation coverage has dropped from around 94 percent in 2013 to around 86 percent in 2018.

Allocation status

The average allocation coverage of ceramics installations was around 86 percent in 2018 and was again less than in the previous year. However, about 29 percent of the installations continue to receive more free emission allowances than they require for surrender.

Table 25: Ceramics production (Activity 17), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of installations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
17	Ceramics production	141	1,767	2,051	−284	86.1%

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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).

As a result of plant closures, the number of installations in the Activity "paper production" fell from 147 installations in 2017 to 145 in 2018. Five installations are assigned to pulp production and 142 to paper production. The paper and pulp industry's installations emitted just under 5.4 million tonnes of carbon dioxide in 2018.

Thus 2018 emissions were just under 1.5 percent below the level of the previous year. As shown in Figure 38, paper production has a share of just over 97 percent. The pulp production corresponds to slightly less than three percent of the emissions.

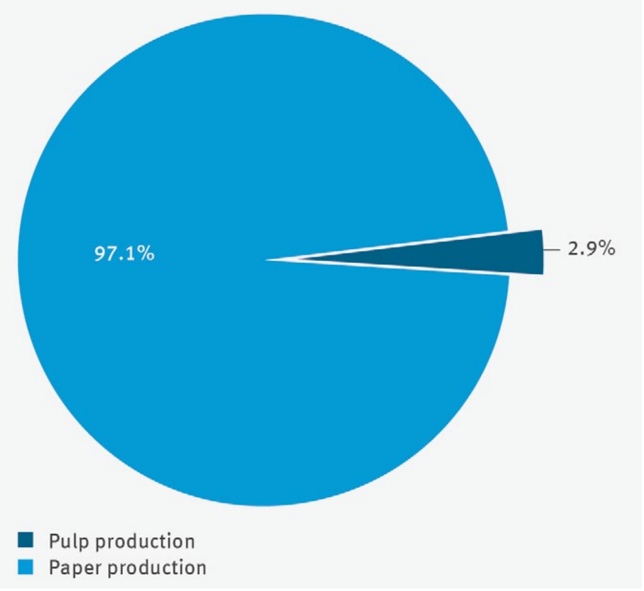

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Figure 38: Shares of the 2018 emissions from the paper and pulp industry (Activities 20 and 21)

Emissions

In pulp production, the 2017 emissions of 144,000 tonnes of carbon dioxide subject to surrender increased by nine percent to 157,000 tonnes of carbon dioxide in 2018 (see Table 26). In the "paper production" Activity, emissions have fallen by 92,000 tonnes of carbon dioxide, down just 1.7 percent, to 5.2 million tonnes of carbon dioxide compared to 2017. According to association data, paper production fell by 1.1 percent in the same period.[67]

67 See VDP (2019), Press Release of 21/02/2019

Table 26: Paper and pulp industry (Activities 20 and 21), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of installations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
20	Pulp production	5	144	157	12
21	Paper production	140	5.323	5.231	−92
Total		**145**	**5.468**	**5.388**	**−80**

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Overall in the paper and pulp industry, emissions have remained relatively constant since the start of the third trading period, reaching a level of about 5.4 million tonnes (see Figure 39). Compared to 2008 (the first year of the second trading period), they decreased by about 16 percent. Reasons for the trend since 2008 and 2013 are not only the increase in energy efficiency in production but also the downward trend in production (see below with reference to Figure 40).

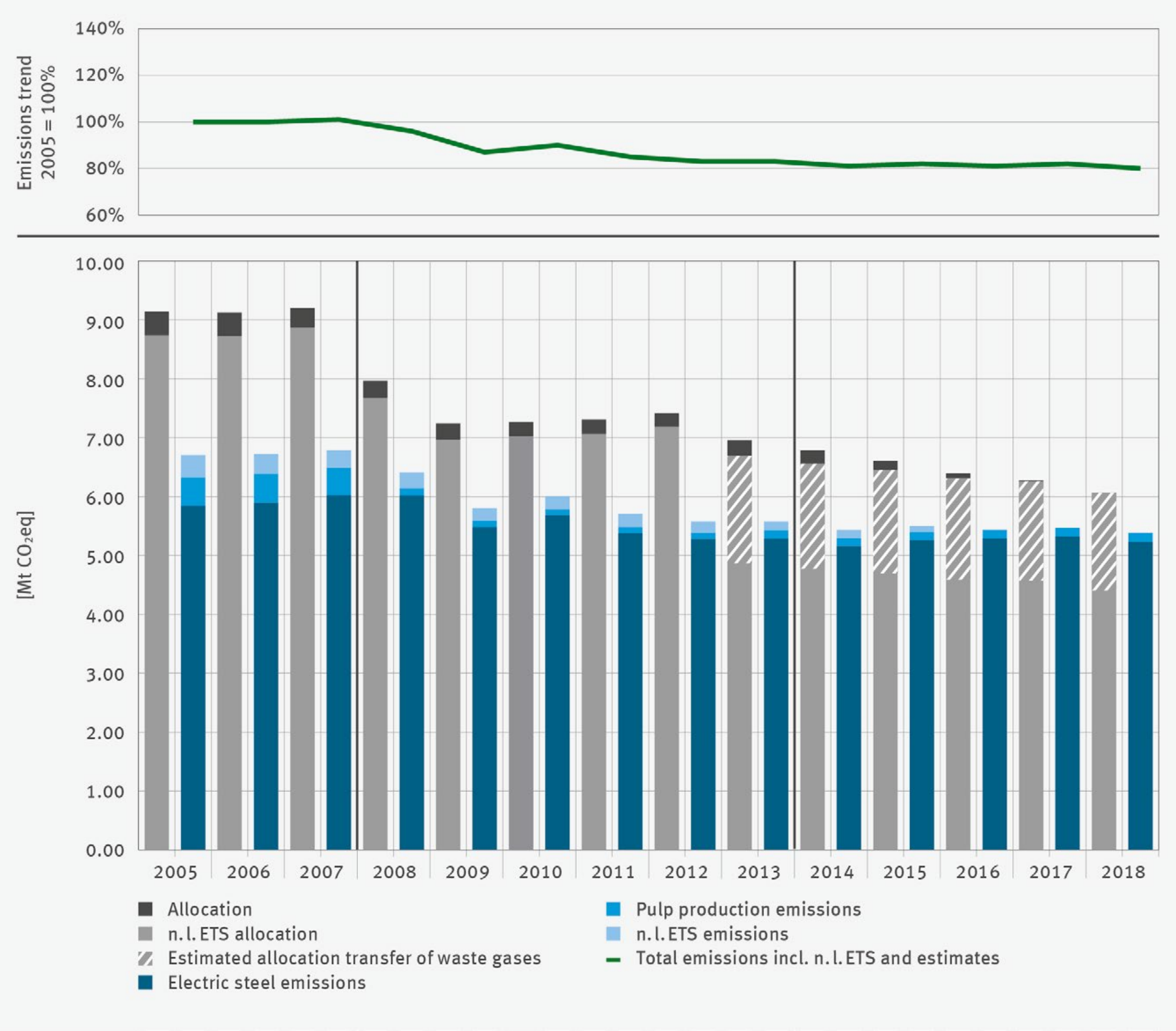

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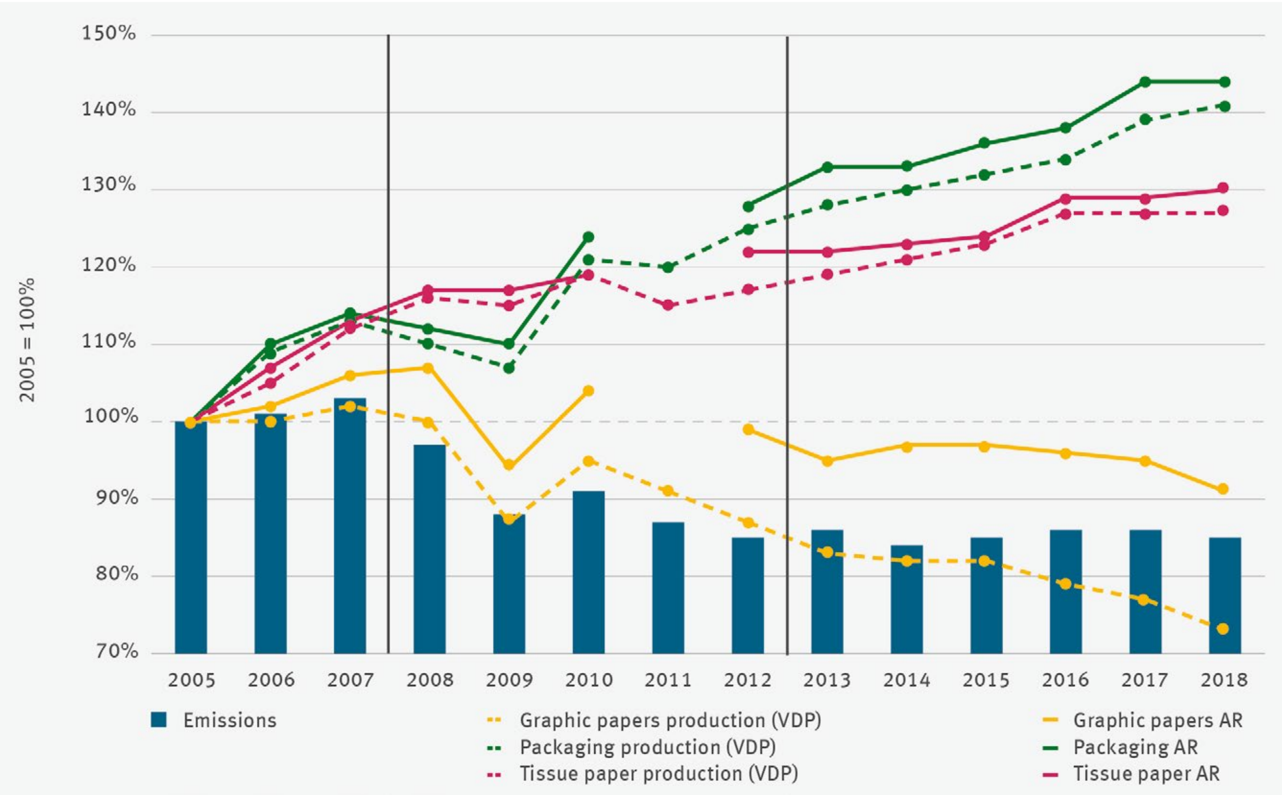
Figure 39: Paper and pulp industry (Activities 20 and 21), free allocation and emissions trend from 2005 to 2018 in Germany[68]

68 n. l. ETS: Installations no longer subject to emissions trading. In the Figure, the installations no longer subject to emissions trading are retroactively included in order to display the true trend of the European emissions trade 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).

Figure 40 compares the emissions trends of the paper industry with the production data trends. For this purpose, the activity rates of the product emission values for "fine paper" and "newsprint paper" were combined into "graphic papers" and the activity rates of product emission values for "cardboard" as well as "testliner and fluting" into "packaging". In addition, the activity rates of the product emission value for "tissue paper" are shown (in the figure as "Tissue paper AR"). The activity rates are compared with the corresponding data of the German Pulp and Paper Association (VDP, Verband Deutscher Papierfabriken).

In paper production, there is a noticeable decrease in the activity rate of graphic papers compared to the previous year in line with the production data of the VDP. Similarly, a decline is visible from 2008 and during the third trading period. For tissue papers, the increasing trend over the years is reflected in both the production data and the activity rate. For packaging products, the highest increase since 2005 and 2008 can be observed in the product group comparison. Compared with the previous year, the association's production data showed a further increase, while the relative change in the activity rate remained constant.

Overall, a full comparability of some activity rates and VDP production data are limited, since not all installations participate in the emissions trading. This could be a possible explanation for the discrepancy between the different levels of the VDP production data and of activity rates.



As of 02/05/2019

Figure 40: Paper production (Activity 21), emissions and production trends[69] in Germany from 2005 to 2018 compared to 2005

69 VDP data (performance reports of the respective year)

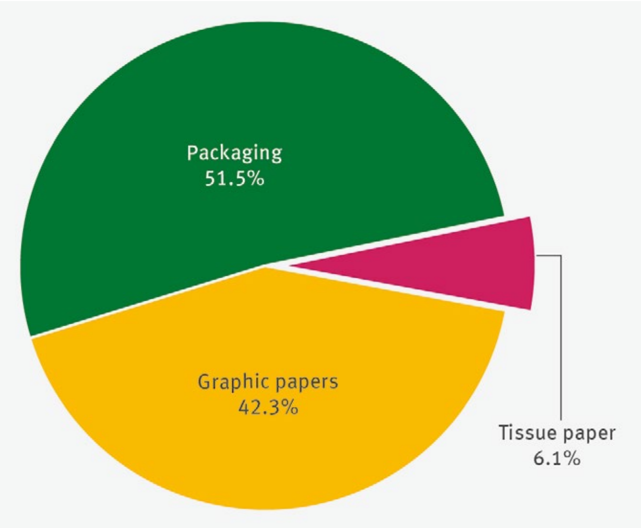


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Figure 41: Significance of the production of graphic paper, tissue paper and packaging paper for the paper industry subject to emissions trading, with shares of each of the areas based on their activity rates

Figure 41 shows the 2018 shares of the paper production areas of packaging, graphic paper and tissue paper for displayed above using the data from the corresponding activity rates (in tonnes). The packaging production here makes up the largest share at slightly below 52 percent. Graphic papers have a share of around 42 percent and tissue paper just over six percent.

The following Figure 42 shows the emissions trends both for the EU as a whole and for Germany. It can be seen that the 2005 – 2017 emissions from the paper and pulp industry (Registry activities 35 and 36) are clearly decreasing both in the EU and in Germany. With the exception of the 2009 crisis year, when a relatively large drop in emissions occurred, emission reduction in the EU and in Germany has run relatively smoothly over the last decade. Only in 2017 were emissions at EU level and in Germany about two percent above the level of 2016.[70]

70 Technical and special papers are not taken into account in Figures 40 and 41, since no comparable activity rate (production data) is available using the fallback approach in this group.

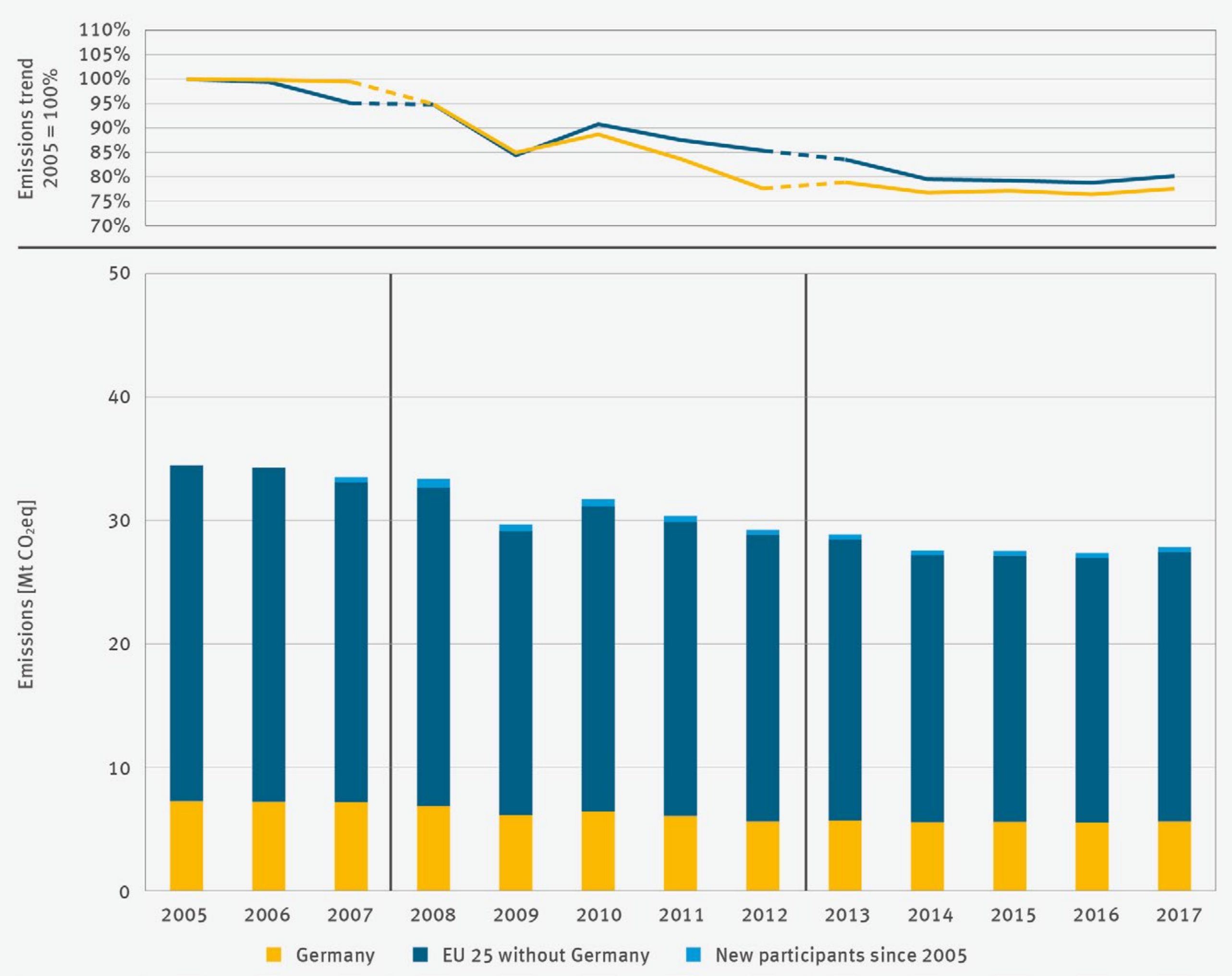

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Figure 42: Emissions trend in the paper and pulp industry (Registry activities 35 and 36) in Germany and in the EU from 2005 to 2017[71]

Allocation

The operators of the 140 installations in the Activity "Paper" acquired a total of slightly less than 6 million emission allowances for 2018, which is around 750,000 more than they would need for surrender according to 2018 VET figures (5.2 million, see Table 27).

The pulp industry's installations, however, have a significant deficit of around 45 percent of the 2018 emissions.

71 Data source: EEA 2018; the evaluation is based on grouping the installations by activities in the EU Union Registry (see Table 46, Chapter 7), through which differences can occur in the emissions amount per sector for Germany. New participants in the EU-ETS after 2005 are Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania.

Table 27: Paper and pulp industry (Activities 20 and 21), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of instal-lations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
20	Pulp production	5	87	157	–70	55.4%
21	Paper production	140	5,980	5,231	749	114.3%
Total		**145**	**6,067**	**5,388**	**679**	**112.6%**

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If an adjustment is made to the allocation by the estimated allocation amount for heat imports, the picture changes with respect to the allocation coverage (Table 28). Overall, the allocation share that derives from heat imports from other installations subject to emissions trading is estimated to be around 1.7 million emission allowances (see Figure 39).[72] Without this share, the allocation coverage of the paper production activity (Activity 21) and pulp production (Activity 20) would sink to just below 82 percent (adjusted allocation coverage). This corresponds in total to a deficit.

Table 28: Paper and pulp industry (Activities 20 and 21), number of installations, allocation amounts, 2018 VET entries and adjusted allocation coverage

Sector/ Activity	No. of instal-lations	2018 adjusted allocation amount [1000 EUA]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Adjusted allocation coverage
Paper and pulp	145	4,412	5,388	–976	81.9%

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72 As an estimated figure, it can only be based on the information from the allocation report (DEHSt 2014a). This figure was derived based on the heat imports data from other EU ETS installations from the allocation process (see Section 7.8 of the allocation report). An adjustment of this estimate to the current situation with the heat imports in the paper industry is not possible, since no current data is available.

2.8 Chemical industry

The chemical industry comprises Activities 22 to 29 as per Annex 1 TEHG, which for the most part were for the first time included to emissions trading 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, because of their rated thermal input of a minimum of 20 MW, fall under Activity 1 in Annex 1 TEHG – for example, installations for the production of titanium dioxide or other inorganic chemistry installations. Installations generating electricity and heat for the chemical industry, however, are classified as energy installations, provided they are approved independently in terms of pollution control and are therefore not included in this sector chapter. The chemical industry comprised 232 plants in 2018. This number included 48 polymerisation plants for the first time since the introduction of the EU ETS.

The number of incumbent installations has remained relatively constant on balance. The emissions of the chemical industry amounted in 2018 to around 18 million tonnes of carbon dioxide equivalents, which represent a share of 4.2 percent of the total emissions from all installations subject to emissions trading.

Emissions

The percentage shares of the chemical industry emissions are displayed in Figure 43. They are clearly dominated by the production of bulk organic chemicals (Activity 27) at 45 percent, followed by ammonia production (Activity 26) at almost 26 percent. Hydrogen and synthesis gas production (Activity 28) and “Others” are the next biggest categories at ten and nine percent, respectively. The remaining activities have the smallest shares at less than five percent each. In the “Others” category, installations of Activity 1 (Combustion) and Activity 25 (glyoxal and glyoxylic acid production) are combined.

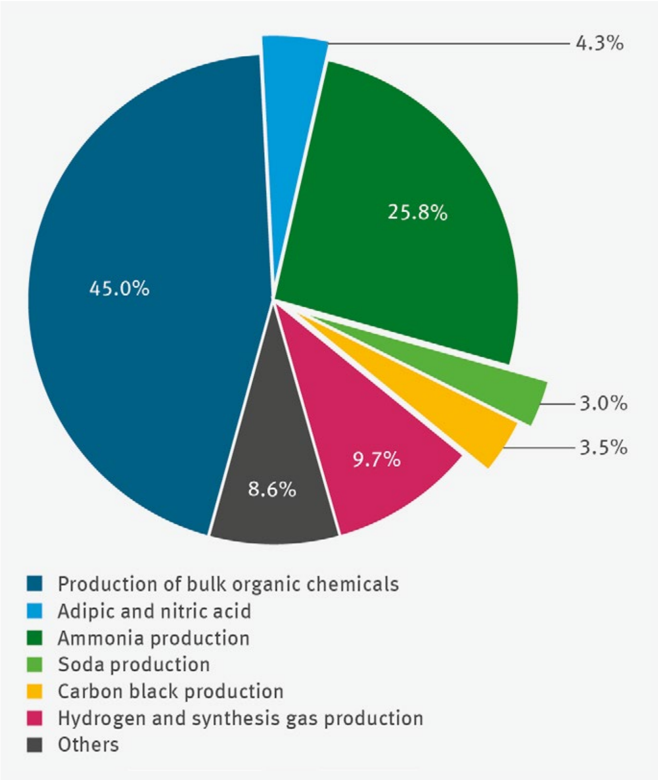

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Figure 43: Shares of 2018 emissions from the chemical Industry (Activities 22 to 29 and 1)

The emissions from the 232 installations amounted to 17,798 kilotonnes of carbon dioxide equivalents or 280,000 tonnes of carbon dioxide equivalents or 1.5 percent less than in the previous year. This already includes the 48 newly added polymerisation plants with a total of around 107,000 tonnes of carbon dioxide, which are assigned to the production of bulk organic chemicals. The decline in emissions in the field of the incumbent installations has therefore been higher than the current figures suggest at first glance.

In detail, in almost all sectors of activity, there has been both an increase and a decrease in emissions. The biggest changes compared to the previous year occurred in Activity 27 (production of bulk organic chemicals) with a decrease of 354,000 tonnes of carbon dioxide (minus 4.2 percent) and Activity 26 (ammonia production) with an increase of 137,000 tonnes of carbon dioxide (plus 3.1 percent), followed by activity 29 (soda production) with a decrease of 64,000 tonnes of carbon dioxide (minus 10.6 percent).

Table 29: Chemical industry (Activities 22 to 29 and 1), number of installations, 2017 emissions and 2018 VET entries

No.	Activity	No. of instal-lations	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions [kt CO_2eq]
22	Carbon black production	4	608	621	13
23, 24	Adipic and nitric acid	11	813	773	−40
26	Ammonia production	5	4,455	4,593	137
27	Production of bulk organic chemicals	162	8,355	8,002	−354
28	Hydrogen and synthesis gas production	15	1,718	1,735	16
29	Soda production	6	604	540	−64
1, 25	Others	29	1,524	1,536	12
Total		**232**	**18,078**	**17,798**	**−280**

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Activities 23 and 24 include eleven installations that produce adipic or nitric acid and are subject to emissions trading both with their carbon dioxide and nitrous oxide (dinitrogen monoxide, N_2O) emissions. In 2018 the nitrous oxide emissions amounted to around 650,000 tonnes of carbon dioxide equivalents and accounted on average for 84 percent of the total emissions from these installations.

Since the majority of the installations first reported their verified emission at the start of the third trading period, the emissions trend of the sectors since 2005 can only be estimated (see Figure 44). For the installations that were not or were only partially subject to emissions trading in the first and second trading period but have obtained an allocation for the third trading period, information on their historical emissions is available from the allocation processes.[73] These generally cover the period from 2005 to 2010. Emissions for the years for which there are no available emissions data from the allocation processes and the emissions for the years 2011 and 2012 were estimated by linear interpolation.

73 The nitrous oxide emissions of the adipic and nitric acid installations reported in the allocation procedure differ from the emissions from the National Inventory Report (see DEHSt 2014b).

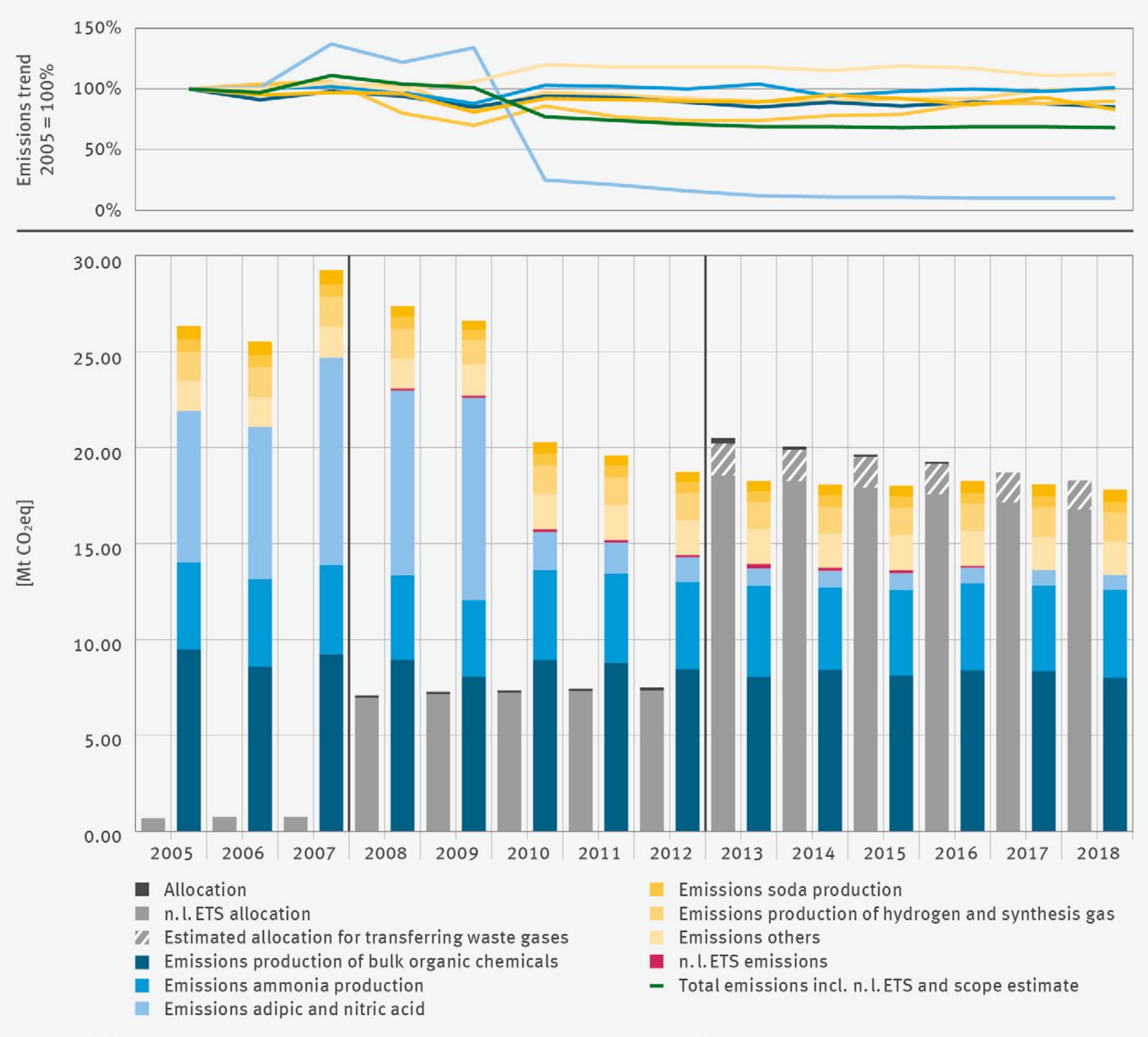

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Figure 44: Chemical industry (Activities 22 to 29 and 1), emissions and free allocation trends in Germany from 2005 to 2018[74]

The decline in emissions from adipic and nitric acid production since 2010 is clearly noticeable. The implementation of reduction technologies reduced nitrous oxide emissions at a relatively low cost. As a result of the voluntary commitment by the industry, pollution control requirements and, above all, the implementation of Joint Implementation projects in Germany, substantial emissions reductions could already be achieved even before the start of the emissions trading obligation. However, emissions reductions could also be achieved beyond 2013 through replacement construction and further reduction measures.

During the 2009 economic crisis, there was also a decline in emissions from the chemical industry, where with the exception of the emissions from the production of adipic and nitric acid, the emissions level dropped in 2010 to levels of those before the crisis. In some sectors, such as hydrogen and synthesis gas production, emissions increased from 2010 due to new installations. However, they have been falling again slightly since 2015.

74 n. l. ETS: installations no longer subject to emissions trading. In the figure, the installations no longer subject to emissions trading are taken into account retroactively in order to illustrate 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").

Figure 44 also shows the rise 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, ethylene and propylene (steam crackers) were added in the second trading period and were assigned to the chemical industry. Figure 45 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 approximately constant.

The following Figure 45 and Figure 46 will show the emissions of Activities 27 and 26 as those with the highest emissions within the chemical industry. These are supplemented by the corresponding activity rates from the annual reports on operation and the corresponding data of the German Chemical Industry Association (VCI).

For Activity 27 in Figure 45, this is the activity rate for the “steam cracking” product benchmark, as this product benchmark makes up a big part of the total allocation in the production of bulk organic chemicals activity. In addition to the activity rate, the VCI data were included in the illustration. These are on the one hand an index for bulk organic chemicals, and on the other an index for ethylene and propylene, the main products arising from steam cracking.[75]

In the first and at the start of the second trading period, the activity rate of the product benchmark “steam cracking”, the index of bulk organic chemicals (VCI) and the index of ethylene and propylene are almost identical to the emissions trend of the production of bulk organic chemicals. Subsequent to the collapse due to the 2009 financial and economic crisis, the 2010 index for ethylene and propylene rises faster than that of the remaining time series. However, the trends remain similar until 2013. From 2013 there’s a further divergence of the different time series: the activity rate of the product benchmark “steam cracking” increases more steeply and approaches again the production index for ethylene and propylene. A similar trend is expected to be process-related. Both display only some areas of the production of bulk organic chemicals, which is why the emissions trend is similar but not identical. The fluctuations between the emissions and the production index of the bulk organic chemicals of the VCI and the slight level difference can be explained as due to the index of the VCI containing only a selection of typical products but not all of them. Considering the total time progression from 2005 to 2018, there’s a slow decrease of the emissions where the decline of the production occurs somewhat less steeply. Part of the decreasing emissions can be explained by a decline in demand from home and abroad. At the same time, effects such as the overhaul of a cracker, which caused emissions to be reduced by about 187,000 tonnes of carbon dioxide equivalents, come into play.[76]

75 The index for bulk organic chemicals consists of all the organic chemical production data published by the VCI from the publication “Chemie in Zahlen” (“Chemistry in figures”, VCI 2013, VCI 2018), and the index for ethylene and propylene consists only of these products. Data gaps for some products were interpolated

76 VCI 2018Q4

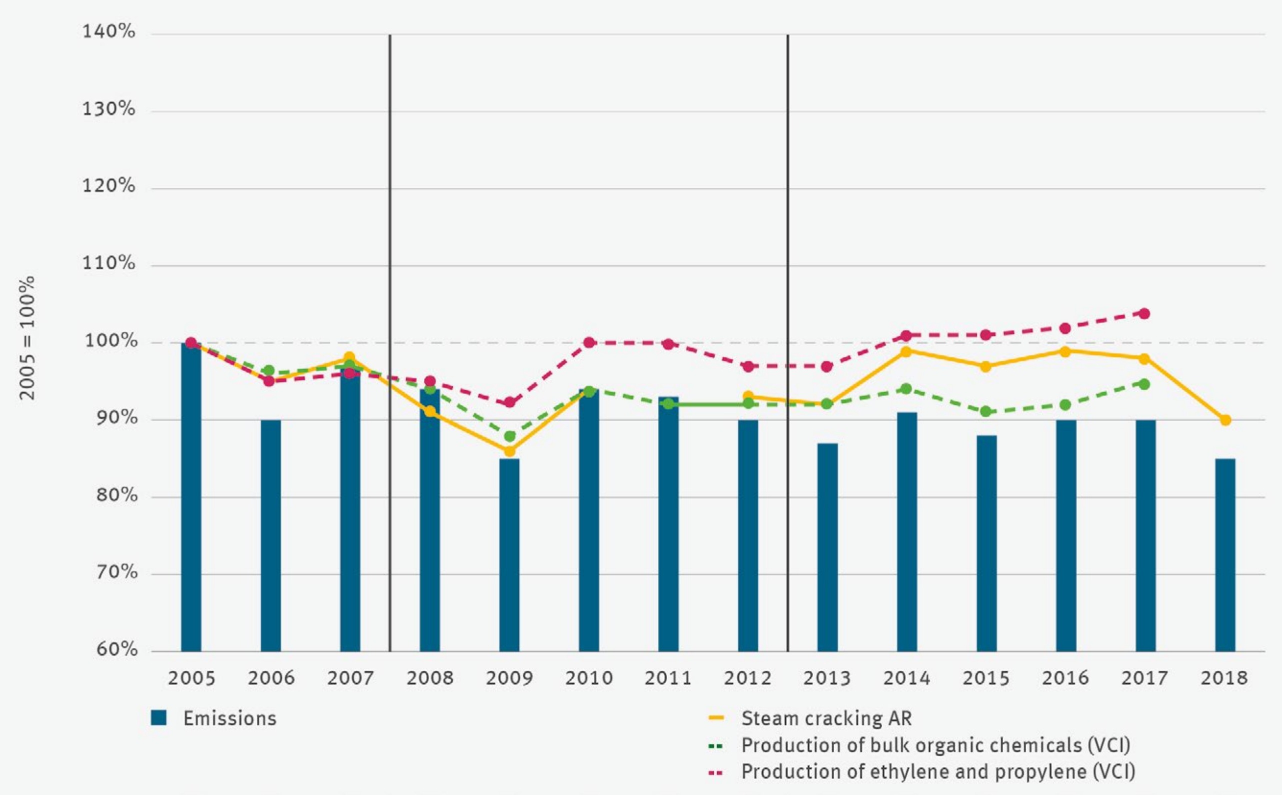

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Figure 45: Production of bulk organic chemicals (Activity 27), 2005 – 2018 emissions and production trends in Germany, each in relation to 2005[77]

The emissions trend from ammonia production (see Figure 46) corresponds relatively well to the trend of activity rate and to the Association data. Only in 2015 is there an inverse trend of the emissions and activity rate compared to the Association data. One ammonia-producing installation is included in the refineries activity because it is approved as a refinery as per § 4 TEHG. This relatively large installation experienced a strong decrease in emissions in 2015 but is not included in the activity rate of ammonia. This can lead to a deviation from the Association data. From 2016, however, production once again ran parallel to the activity rate and emissions.

77 VCI 2013, VCI 2018

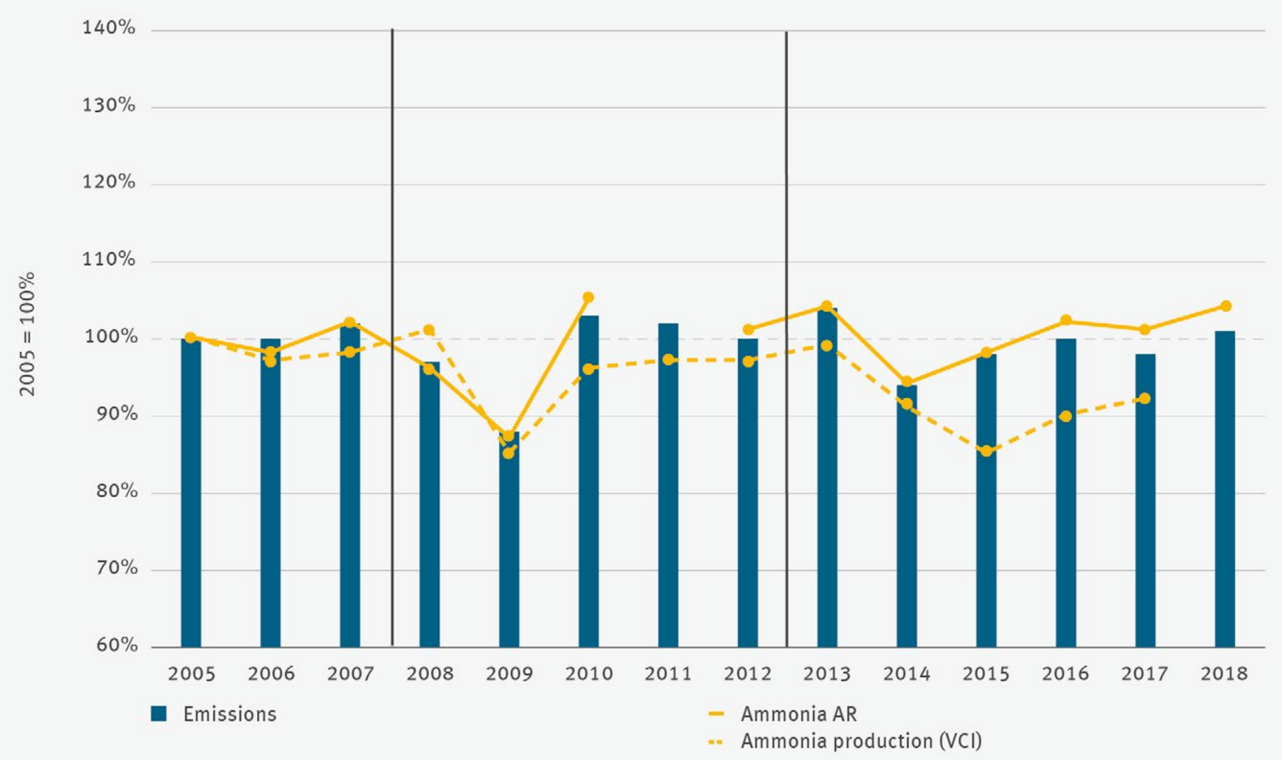

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Figure 46: Ammonia production (Activity 26), 2005 – 2018 emissions and production trends in Germany, each in relation to 2005[78]

Allocation status

Compared with other industry sectors, the installations of the chemical industry are on average adequately equipped with free emission allowances (see also Section 2.9). This is also the case after an adjustment of the allocation coverage.

In 2018, installations of the chemical installations received around 491,000 free emission allowances or 2.8 percent more than they needed for their surrender obligation. Compared to the previous year, this calculated surplus clearly fell by around 246,000 (minus 33.3 percent) emission allowances. Among other reasons for the decline are the cross-sectoral correction factor and allocation corrections due to decommissioning or partial shutdowns.

For five activities, the amount of free emission allowances exceeded emissions by a total of around 2.2 million. In contrast, four activities received a total of around 1.7 million fewer free emission allowances than they needed to meet their surrender obligation.

78 VCI 2013, VCI 2018

Table 30: Chemical industry (Activities 22 to 29 and 1), number of installations, allocation amounts, 2018 VET entries and allocation coverage

No.	Activity	No. of installations	2018 allocation amount [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
22	Carbon black production	4	430	621	−190	69.3%
23, 24	Adipic and nitric acid	11	1,645	773	872	212.8%
26	Ammonia production	5	3,524	4,593	−1.068	76.7%
27	Production of bulk organic chemicals	162	8,856	8,002	854	110.7%
28	Production of hydrogen and synthesis gas	15	1,516	1,735	−218	87.4%
29	Soda production	6	1,024	540	484	189.6%
1, 25	Others	29	1,293	1,536	−243	84.2%
Total		**232**	**18,289**	**17,798**	**491**	**102.8%**

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The largest relative surplus of free emission allowances can be seen in the installations producing adipic and nitric acid (213 percent). This can be explained by the installation and further development of N_2O emission reduction technologies in the installations so that their specific emissions are well below the specific product benchmarks for adipic acid and nitric acid, which are relevant for allocation throughout the EU.

The installations for the production of bulk organic chemicals also have a clear allocation surplus compared to their emissions (111 percent or 854,000 emission allowances)[79] and the installations for soda production as well (190 percent or 484,000 emission allowances). This can be ascribed in particular to the allocation rules for cross-boundary heat flows: many installations of these activities import heat from other installations subject to emissions trading and obtain for this a free allocation, while emissions arise from the heat-generating installation. Moreover, many processes for the production of bulk organic chemicals are exothermal. A large fraction of the reaction heat can be used without releasing additional emissions through efficient heat recovery systems.

In comparison, the free allocation for the installations producing carbon black, ammonia and hydrogen or synthesis gas are not sufficient to completely cover the emissions of the installations in 2018: for the operators of ammonia installations there was an overall additional purchase requirement of 1.1 million (23.3 percent) emission allowances. For the manufacturers of carbon black, these amounted to 190,000 emission allowances (30.7 percent).

The shortfall for hydrogen and synthesis gas production increased more notably compared to the previous year (218,000 emission allowances or 12.6 percent) than for the other installations.

79 The 48 polymer installations added have not received any allocation at this time. The allocation coverage therefore refers to the previous number of installations

Table 31: Chemical industry (Activities 22 to 29 and 1), number of installations, allocation amounts, 2018 VET entries and adjusted allocation coverage

Sector/ Activity	No. of installations	Adjusted 2018 allocation amount [1000 EUA]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Adjusted allocation coverage
Chemical industry	232	16,782	17,798	−1,016	94.3%

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After the subtraction of an estimated allocation amount of around 1.6 million emission allowances[80] that results from heat imports from other installations subject to emissions trading, the allocation coverage of the chemical industry would still amount to only 94.3 percent (adjusted allocation coverage).

2.9 Overview of the allocation status in Germany

Even in the sixth year of the current trading period, the verified emissions of all installations subject to emissions trading in Germany with 422.3 million tonnes of carbon dioxide equivalents significantly exceeded the free allocation amount for the current year.[81] Overall around 145 million emission allowances were allocated free of charge to operators of 1,614 of the total 1,870 German installations in 2018. Thereby, the free allocation covered on average 34.3 percent of the verified emissions of all installations in Germany (2017: 34.3 percent). The average allocation coverage therefore barely changed and remained at the level of the previous year, since decreases in emissions and allocation almost offset each other. Table 32 shows the allocation and emissions status differentiated according to Activities (1 to 29). The comparison of the individual activities clearly reflects initially the large differences between energy and industrial installations in terms of the third-trading-period allocation rules.

Table 32: 2018 allocation status by activities (non-adjusted allocation coverage)

Sector	No.	Activity	No. of installations	2018 allocation amount [1000 EUA]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	2018 allocation coverage*	2017 allocation coverage*
Energy	2	Energy conversion ≥ 50 MW RTI	479	18,877	291,203	−272,326	6.5%	6.8%
	3	Energy conversion 20 – 50 MW RTI	393	2,987	5,213	−2,226	57.3%	59.9%
	4	Energy conversion 20 – 50 MW RTI, other fuels	11	99	134	−35	73.8%	79.0%
	5	Prime movers (engines)	3	15	22	−8	65.9%	80.8%
	6	Prime movers (turbines)	53	543	1,357	−814	40.0%	45.5%
			939	22,521	297,930	−275,409	7.6%	7.9%

80 The estimate can only be based on the information given in the Allocation Report (DEHSt 2014a). This figure was derived from the data on heat imports from other EU ETS installations from the allocation procedure (see Section 7.8 of the allocation report). It is not possible to adjust this estimate to the current situation with regard to heat imports in the chemical industry, as no current data are available.

81 Throughout Section 2.9 the current number of installations in the reporting year 2018 are used as a basis. Therefore, the reported changes in the allocation volumes and emissions compared to the previous year deviate from the figures given in the summary. The summary shows the changes compared to the actual existing installations of the previous year.

Sector	No.	Activity	No. of instal-lations	2018 allocation amount [1000 EUA]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	2018 allocation coverage*	2017 allocation coverage*
Industry	1	Combustion	68	1,739	2,222	−483	78.3%	81.7%
	7	Refineries	23	18,707	24,001	−5,294	77.9%	75.9%
	8, 9, 10	Production of pig iron and crude steel**	35	42,320	32,545	9,775	130.0%	133.5%
	8	Coking plants	4	1,638	3,853	−2,214	42.5%	42.3%
	9	Processing of metal ores	1	65	81	−16	80.5%	95.3%
	10	Production of pig iron and steel	30	40,617	28,612	12,005	142.0%	146.4%
	11	Ferrous metal processing	89	4,453	5,292	−838	84.2%	84.1%
	12	Production of primary aluminium	7	855	1,029	−173	83.2%	86.4%
	13	Processing of non-ferrous metals	32	1,492	1,633	−141	91.3%	93.2%
	14	Production of cement clinker	36	17,174	19,998	−2,824	85.9%	85.6%
	15	Lime production	60	7,385	9,438	−2,053	78.2%	80.2%
	16	Glass production	75	2,956	3,818	−862	77.4%	80.6%
	17	Ceramics production	141	1,767	2,051	−284	86.1%	87.5%
	18	Production of mineral fibres	7	285	405	−120	70.4%	72.9%
	19	Gypsum production	9	288	271	17	106.1%	109.0%
	20	Pulp production	5	87	157	−70	55.4%	61.3%
	21	Paper production	140	5,980	5,231	749	114.3%	116.0%
	22	Carbon black produc-tion	4	430	621	−190	69.3%	72.6%
	23	Production of nitric acid	8	654	661	−7	98.9%	97.9%
	24	Production of adipic acid	3	991	112	880	887.7%	767.3%
	25	Production of glyoxal and glyoxylic acid	1	8	11	−3	71.3%	79.2%
	26	Ammonia production	5	3,524	4,593	−1,068	76.7%	80.7%
	27	Production of bulk organic chemicals	162	8,856	8,002	854	110.7%	107.9%
	28	Production of hydrogen and synthesis gas	15	1,516	1,735	−218	87.4%	92.3%
	29	Soda production	6	1,024	540	484	189.6%	173.0%
			931	122,492	124,364	−1,872	98.5%	99.2%
Total			**1,870**	**145,013**	**422,294**	**−277,281**	**34.3%**	**34.3%**

* 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
As of 02/05/2019

The operators of the 931 installations with industrial activities received for the 2018 reporting year a total allocation of 122.5 million emission allowances. This compares with the total verified emissions of 124.4 million tonnes of carbon dioxide equivalents. The allocation corresponded to 98.5 percent of the surrender obligations of these installations (99.2 percent in 2017) and was thereby below the 100-percent mark, same as the previous year.

The adjusted allocation coverage[82] at 84.5 percent (2017: 84.6 percent) is well below the 100-percent mark (see the following sections with Table 33 and Table 34).

The situation is different for the 939 energy installations (Activities 2 to 6). Due to the discontinuation of the free allocation for power generation in the third trading period, the 2018 ratio of allocation to verified emissions was only 7.6 percent on average, thus slightly lower than in the previous year (2017: 7.9 percent). Overall, the energy installations received in 2018 an allocation of 22.5 million emission allowances for heat generation, while the verified emissions amounted to 297.9 million tonnes of carbon dioxide equivalents. The allocation of these installations at 7.9 percent clearly decreased sharper than the emissions, which however were also four 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).

In addition to the energy sector, power generation in industry does also no longer receive allocations free of charge. This applies, for example, to refineries and to the paper industry since (heat and) power stations are usually in operation in both industries. In 2018, refineries received an allocation that corresponded therefore to only 77.9 percent of their verified emissions (75.9 percent in 2017). In the paper industry on the other hand, the allocation coverage does not show that part of the emissions is attributable to power generation. In particular, these installations even indicated through the allocation rules for cross-boundary heat flows that they had an allocation surplus of free emission allowances (see Section 2.7). The installations of the paper industry exhibited a ratio of allocation to verified emissions of 114.3 percent (116 percent in 2017).

Installations for the production of pig iron and steel received nominally a clearly higher allocation (142 percent, 2017: 146.4 percent) compared to the emissions. This is substantiated through the allocation rules for the high-emission waste gases that arise in the iron and steel industry but that are partially transferred to energy installations. The overall allocation coverage of the entire recorded iron and steel industry adjusted by the allocation amount for the transfer of waste gases from iron, steel and coke production is around 85.9 percent (see 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 and heat imports from other installations subject to emissions trading has a significant impact on the allocation coverage for the sectors concerned. An estimated 14.2 million emission allowances could be assigned in 2018 to waste gas transfer from industrial installations to energy installations and around 3.2 million emission allowances to heat imports from industry to energy installations.[83]

Assuming that these allocation amounts were settled among industry and energy sector operators, the industry sector exhibited a deficit of around 19.2 million emission allowances in 2018. Thus, the allocation coverage for the industrial sector would be 84.5 instead of the aforementioned 98.5 percent, which corresponds to a significant deficit.

The sectors affected here are iron and steel, paper and pulp, and the chemical industry (see Table 33). Conversely, under the assumptions made for the energy sector, the coverage as a ratio of adjusted allocation to verified emissions for 2018 increased from 7.6 to 13.4 percent. Table 33 summarises the allocation status adjusted by transferred waste gases from iron, steel and coke production and imported heat for 2018 at the sector level.

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

83 See explanations on the allocation estimate in Sections 2.1 “Energy installations”, 2.4 “Iron and steel industry including coking plants”, 2.7 “Pulp and paper” and 2.8 “Chemical industry”.

Table 33: Adjusted allocation coverage (taking into account waste gases from iron, steel and coke production and heat imports)

Industry	Sector	No. of instal-lations	2018 allocation amount [1000 EUA]	2018 VET [kt CO_2eq]	2018 allocation deviation from 2018 VET [kt CO_2eq]	2018 allocation coverage*	Adjusted 2018 allocation amount** [1000 EUA]	Adjusted 2018 allocation coverage**
Energy	Energy installations	939	22,521	297,930	−275,409	7.6%	39,884	13.4%
		939	**22,521**	**297,930**	**−275,409**	**7.6%**	**39,884**	**13.4%**
Industry	Refineries	23	18,707	24,001	−5,294	77.9%	18,707	77.9%
	Iron and steel	125	46,774	37,913	8,861	123.4%	32,573	85.9%
	Non-ferrous metals	39	2,347	2,662	−315	88.2%	2,347	88.2%
	Industrial and building lime	40	6,217	7,357	−1,140	84.5%	6,217	84.5%
	Cement clinker	36	17,174	19,998	−2,824	85.9%	17,174	85.9%
	Other mineral-processing industry	253	6,469	8,646	−2,177	74.8%	6,469	74.8%
	Paper and pulp	145	6,067	5,388	679	112.6%	4,412	81.9%
	Chemical industry	232	18,289	17,798	491	102.8%	16,782	94.3%
	Other combus-tion plants	38	449	601	−153	74.6%	449	74.7%
		931	**122,492**	**124,364**	**−1,872**	**98.5%**	**105,130**	**84.5%**
Total		**1,870**	**145,013**	**422,294**	**−277,281**	**34.3%**	**145,014**	**34.3%**

* Without considering potential adjustments for waste gas transfers and heat imports
** Considering potential adjustments for waste gas transfers and heat imports
As of 02/05/2019

Table 34 and Figure 47 show the adjusted coverage trend during the third trading period. As for 2013, the start of the third trading period, both the energy and industrial installations received on average a decreasing coverage (see Table 34). This basic trend also holds at the sector level, although the adjusted allocation coverage for a few of the years certainly exceeded the value of the previous year (see Figure 47). For these years the change in the adjusted allocation of the affected sectors was overcompensated by a counteracting larger reduction of emissions.

Table 34: Adjusted coverage since 2013

Industry/sector	Allocation coverage*					
	2013	2014	2015	2016	2017	2018
Energy	15.5%	15.4%	14.6%	14.0%	13.8%	13.4%
Industry	92.9%	91.9%	89.5%	87.8%	84.6%	84.5%

*Considering possible offsettings for waste gas transfers and heat imports
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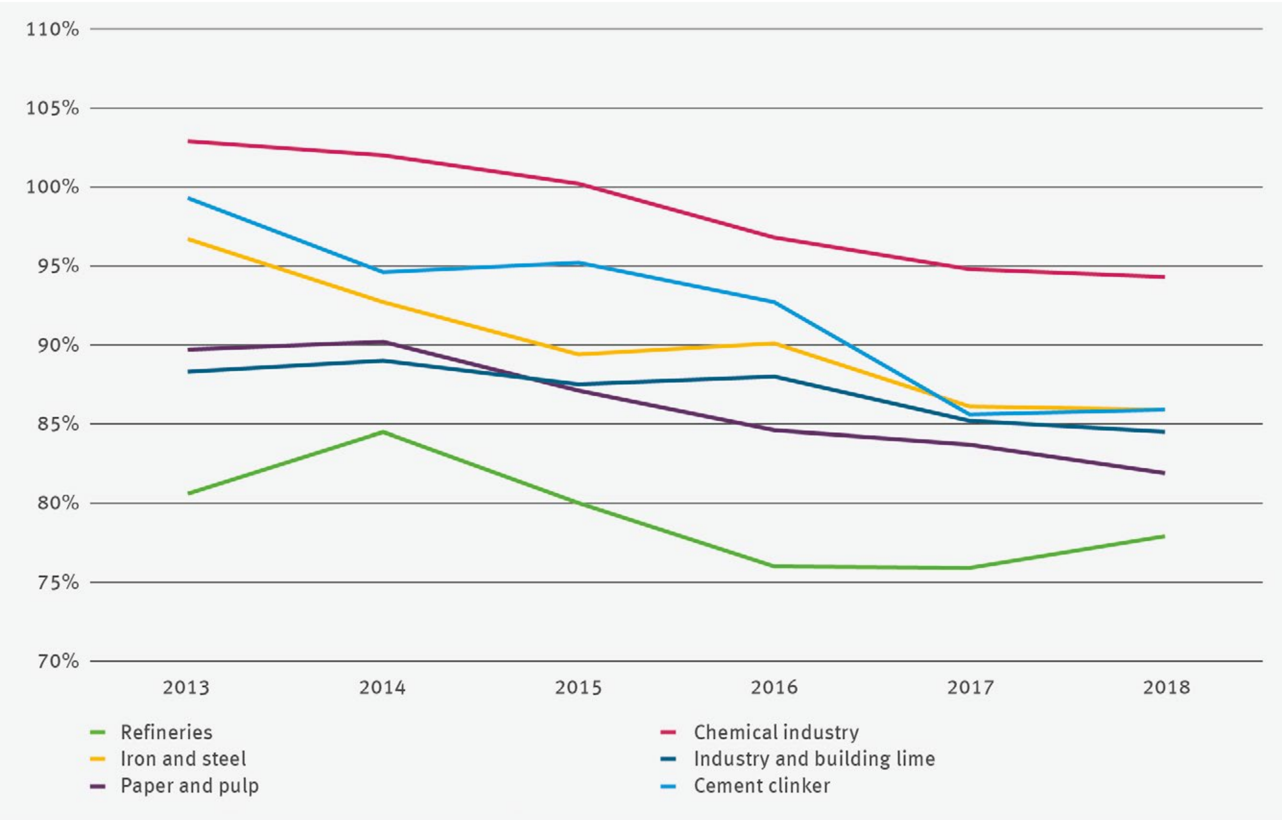

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Figure 47: Adjusted coverage trend of the biggest emission sources among the industry sectors since 2013

Allocation status in the overall 2008 to 2018 period

Besides the 2018 allocation surpluses (deficits), the corresponding figures from the previous years for the installations considered in this report are also included below in order to obtain an extended review of the current allocation status. This seems appropriate because emission allowances allocated since 2008 could be converted into emission allowances for the current trading period and therefore can continue to be used for surrender obligations in emissions trading (in so-called banking).

For industrial activities, an overall cumulative allocation surplus resulted from the balance of free allocation and verified emissions in the second trading period (2008 to 2012) totalling 99.9 million allowances.[84] Under the assumption that the allocations for transferred waste gases from iron, steel and coke production and imported heat (114.6 million allowances for 2013 to 2018) have been settled between the operators of the industry and energy sectors, the industry sector exhibits a cumulative deficit of 85.3 million emissions allowances for the first six years of the current trading period. This deficit grew continuously in the past years but is up to now, at least in calculated figures, still fully offset by the surpluses accrued in the second trading period. The total allocation surplus for industrial activities in the period from 2008 to 2018 would be in total 14.6 million emission allowances according to this delineation. If the previous trend is continued, this calculated surplus will be completely eliminated by the end of the current trading period. Table 35 summarises the aggregated results differentiated at sector level.

Table 35: Aggregated allocation status in the second and third trading periods

Industry	Sector	No. of installations	Cumulative allocation surplus		
			Adjusted 2008 – 2012* [M EUA]	Adjusted 2013 – 2018** [M EUA]	Total adjusted 2008 – 2018** [M EUA]
Energy	Energy installations	939	−360.9	−1,649.1	−2,010.0
		939	−360.9	−1,649.1	−2,010.0
Industry	Refineries	23	14.8	−31.4	−16.6
	Iron and steel	125	52.1	−21.9	30.2
	Non-ferrous metals	39	0.0	−1.0	−1.0
	Cement clinker	36	4.9	−9.3	−4.4
	Industrial and building lime	40	9.5	−5.7	3.8
	Other mineral-processing industry	253	6.1	−9.5	−3.4
	Paper and pulp	145	7.5	−4.5	3.0
	Chemische Industry	232	4.9	−1.6	3.3
	Other combustion plants	38	0.0	−0.4	−0.4
		931	99.9	−85.3	14.6
Total		**1,870**	**−261.0**	**−1,734.4**	**−1,995.4**

* Incl. redistribution of emission allowances for transferred waste gases pursuant to § 11 Allocation Act
** Considering possible offsettings for waste gas transfers and heat import
As of 02/05/2019

84 Incl. redistribution of emission allowances for transferred waste gases pursuant to § 11 Allocation Act 2012.

Unlike in the industrial sector, this resulted in an allocation deficit of 360.9 million emission allowances for the energy installations already in the second trading period. Apart from the ambitious level of the benchmarks at the time and the proportional cuts to secure the budget, this is also due to the fact that the free allocation for power generation had already been reduced in Germany in the second trading period in favour of auctioning emission allowances.[85] Auctioning has been the exclusive standard for power generation in Europe since the start of the third trading period. The cumulative shortfall in the energy industry thereby increased to a total of 2,010 million emission allowances (1,649.1 million allowances of it in the third trading period) up to and including 2018 when the balance from the second trading period is taken into account and assuming an offsetting of the free allocation for waste gases and heat imports between the industry sectors and the energy industry.

Use of project credits

In assessing the cumulative allocation deficits and surpluses, it is important to note that in addition to emission allowances (EUA), operators were also able to surrender project credits (CER/ERU from CDM/JI projects) in the second trading period. German operators were allowed to surrender CER/ERU up to an amount equal to 22 percent of their allocation. Unused entitlements generally continue to remain in effect in the third trading period.[86] Operators without prior claims can basically use CER/ERU up to an amount equal to 4.5 percent of their aggregated emissions in the third trading period. Since the prices of project credits are always below the EUA price levels, their claim for use leads to an effective relaxation of the allocation situation for the installations concerned (see Section 3.1 on price trends with Figure 51 and Table 36 in this Section).

The total claim to use project credits currently stands at 420 million allowances for the 1,870 installations considered in this report. This claim relates to the entire 2008 – 2020 period.[87] 278 million project credits thereof have already been used for surrender in the second trading period (2008 – 2012). Another 129,2 million credits were used by the installations in the current trading period for conversion into EUA.

A residual claim for use totalling 12,7 million project credits currently remains based on the total specified claim. This corresponds to three percent of all identified German installations' total specified claim. For the 939 energy installations, the residual claims amount to 9.8 million project credits, or 3.7 percent of their total claim. The 931 industrial installations can convert 2.9 million credits into EUA (which is 1.9 percent of their total claim). Table 36 summarises the aggregated results differentiated by industry and energy sectors.

Table 36: Surrendered and converted project credits in the second and third trading periods

Sector	No. of installations	CER/ERU utilisation claim 2008 – 2020 total [M]	CER/ERU surrendered for 2008 – 2012 [M]	CER/ERU converted in 2013 – 2020 [M]	CER/ERU residual utilisation claim 2008 – 2020 [M]
Energy	939	266.1	154.0	102.3	9.8
Industry	931	153.9	124.1	27.0	2.9
Total	**1,870**	**420.0**	**278.0**	**129.2**	**12.7**

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85 The free allocation for power generation was reduced in accordance with the provisions of § 20 of the 2012 Allocation Act by 38 million allocations yearly favouring the sales budget.

86 CER/ERU are however no longer directly usable for surrender but must be converted in the Union Registry to EUA.

87 Besides claims from the second trading period, the specified total claim also takes into account claims that derive from the emissions for the 2013 to 2018 reporting years. As the third trading period proceeds, the total claim will continue to increase, depending on the verified emissions from 2019 to 2020.

3 Germany and Europe: emissions, surplus and price trends

According to the European Commission's preliminary data in 2018, emissions from approximately 10,800 ETS installations in the countries[88] participating in the European emissions trading system amounted to around 1.67 billion tonnes of carbon dioxide equivalents, more than four percent below the 2017 emissions.[89] As in all years since the beginning of the third trading period, emissions from stationary installations were significantly lower than the maximum available distribution volume for 2018 (nominal cap) of 1.89 billion emission allowances. The reduction in emissions by around 80 million tonnes of carbon dioxide equivalents compared to the previous year was thus significantly greater than the annual reduction of the cap (minus 38 million emission allowances). The 2018 preliminary emissions of the ETS installations were thus slightly below the emission allowance supply made available by free allocation, auctioning and exchange quotas for project credits. According to the European Commission, the surplus in the stationary area was around 1.655 billion emission allowances at the end of 2018, about the same as at the end of 2017.[90]

3.1 Emissions trends in the EU ETS and in Germany

The emissions trend of installations participating in the ETS (EU31) was similar throughout Europe in 2018 as in Germany. According to the European Commission's provisional figures, emissions fell by more than four percent in 2018 to around 1.67 billion tonnes of carbon dioxide equivalents. As a result, 2018 emissions – around 220 million tonnes of carbon dioxide or more than eleven percent – were well below the nominal cap. The main reason for this trend, as in Germany, was a reduction in emissions from electricity generation (more than five percent decrease), while emissions from industrial installations as a whole continued to undergo no substantial changes.[91]

However, over a longer period, ETS emissions across Europe have decreased much more sharply than in Germany: while emissions from installations in Germany have fallen by around 18 percent since the start of emissions trading in 2005[92], ETS emissions across Europe have been around 29 percent below the 2005 baseline (see Figure 48).

88 EU 28 plus Iceland, Liechtenstein and Norway.

89 COM 2019b. At that time, more than 99 percent of the installations had reported their emissions.

90 COM 2019c

91 Carbon Pulse (2019), Agora Energiewende (Energy Transition)/Sandbag (2019)

92 Based on European Environment Agency (EEA) data the decline in emissions between 2005 and 2018 is just under 19 percent. The reason for the deviation from the DEHSt calculations is that the EEA estimates historical emissions slightly higher between 2005 and 2012 to reflect the extended scope of the third trading period.

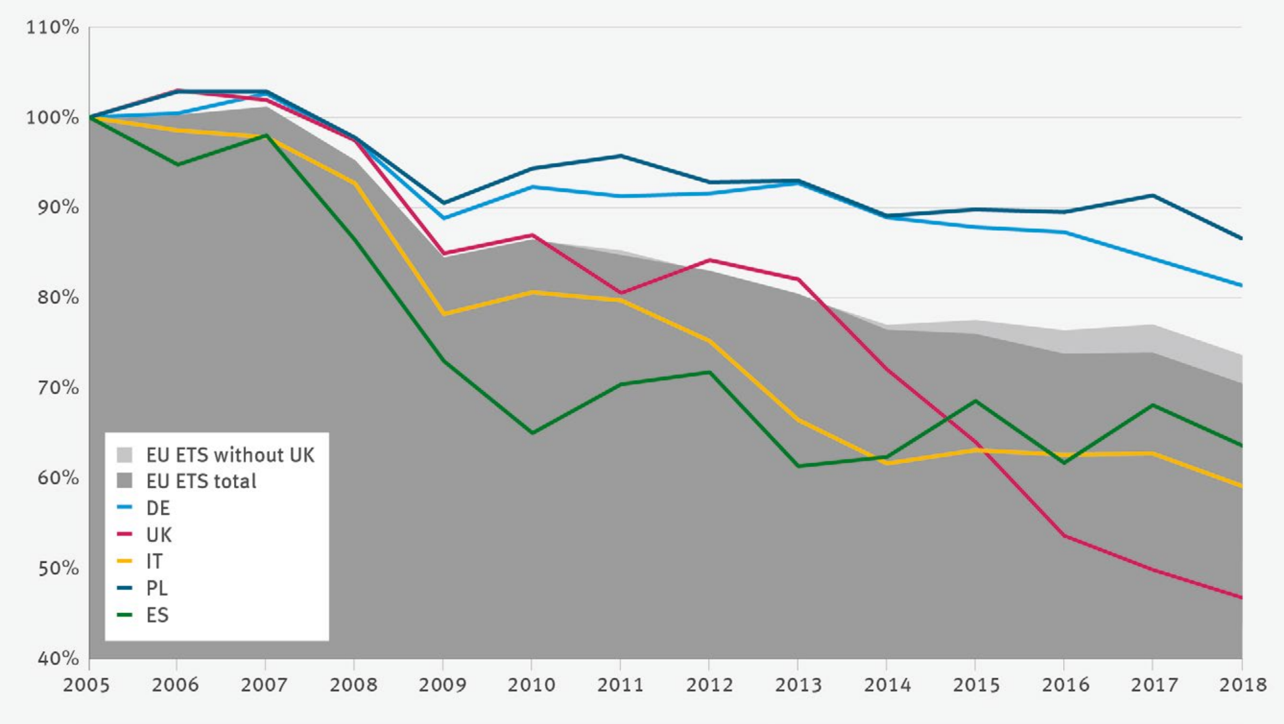

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Figure 48: Emissions trend of the largest European emitters compared to the stationary ETS emissions of all Member States (2005 emissions plus emission estimate for the extended scope of the third trading period = 100 percent)[93]

The decline in emissions in particular occurred in the second trading period, when emissions fell by 12 percent as a result of the economic and financial crisis between 2008 and 2012 or an average of 63 million tonnes of carbon dioxide per year. Since the beginning of the third trading period, the rate in decreasing emission has slowed down: in 2018, emissions were around 12 percent below 2013 levels, a decrease on average of two percent or more than 46 million tonnes of carbon dioxide equivalents per year. On average, emissions fell more than the cap, which is cut by 38 million emission allowances each year.

Emission trends varied widely in the five largest ETS Member States[94] In the third trading period, it was the United Kingdom in particular that contributed to the reduction of emissions, although it is uncertain whether it will stay within the EU ETS[95] at the time of going to press. According to preliminary data, 2018 ETS emissions were around 43 percent below the 2013 level (53 percent below the 2005 level), which corresponds to an average emission reduction of seven percent per year. By contrast, emissions in the 30 other ETS Member States excluding United Kingdom fell by only around 8 percent (or around 1 percent per year on average) between 2013 and 2018.

Between 2013 and 2018, Germany and Italy recorded emission reductions of 12 and 11 percent, respectively. In contrast, emissions in Poland have not fallen so much since 2013 (minus seven percent[96]). In Spain, emissions fluctuate very much depending on how much hydropower is available for power generation or if it has to be replaced by electricity from coal-fired power plants. No clear trend in emissions can be recognised.

93 2018 figures are preliminary. Sources: EEA 2018 for the 2005 – 2017 period, COM 2019b for 2018

94 Germany, Poland, Italy, the United Kingdom and Spain together account for around 61 percent (2018) of total stationary ETS emissions.

95 For 2018, UK installation and aircraft operators will be required to report and surrender regularly. Since the beginning of 2019, auctions and free allocations have been suspended in the UK.

96 Based on preliminary data (COM 2019b).

3.2 Emissions and free allocation trends in the industry

The shares in the industrial emissions of the Member States covered by the ETS[97] differs from the shares of total emissions: Germany accounted for the largest share of industrial emissions in 2017 (22%), followed by Spain (10%), Italy (nine percent) and France (eight percent). Industrial emissions in Poland and the United Kingdom were roughly equal in 2017 (around seven percent each).

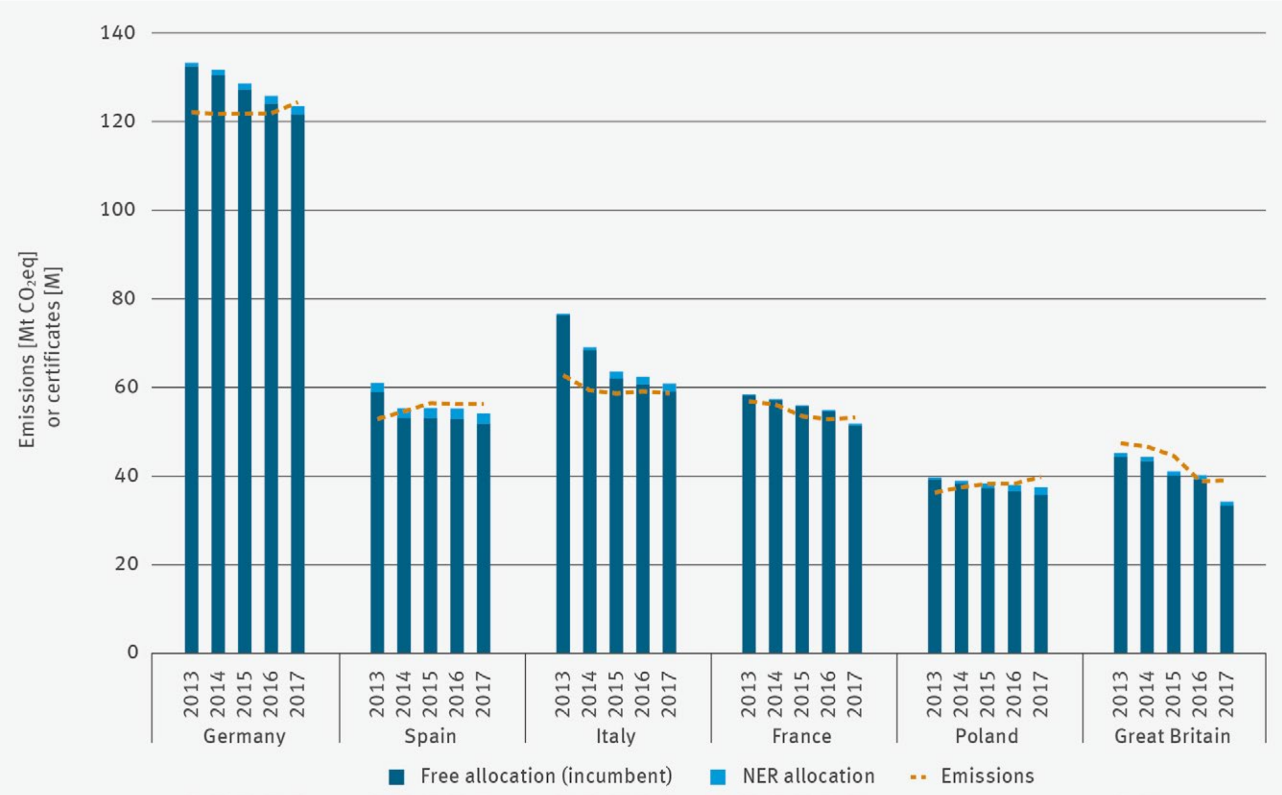
Figure 49 shows the emissions and free allocation trends in industry in these six Member States. Regarding the relationship between emissions and free allocation, it should be noted that in some Member States there is a free allocation for industrial activities where the emissions come from combustion plants. For example, steel industry installations receive a free allocation for emissions from waste gases from iron, steel and coke production, while the emissions occur from installations which burn these waste gases (primarily power plants in Germany).[98] There are similar deviations between allocation and emissions in the chemical and paper industry regarding the use of process heat.[99]

While in Italy free allocation to industry has consistently been higher than emissions since 2013 (in Germany and France, this was also the case up to and including 2016, albeit to a lesser extent than in Italy), in the five other countries considered here 2017 emissions were higher than the free allocation. The highest coverage with free allocation to industrial installations is provided in Italy, where allocation coverage fell from 122 percent in 2013 to 104 percent in 2017. UK installations have the lowest level of allocation coverage, where allocation coverage dropped from 95 percent to 88 percent over the same period.

97 Activities 21 – 99 in the EUTL. In order to avoid inconsistencies in assigning installations to activities, the evaluation is limited to the 2013 to 2017 period, based on the assignment made by the European Environment Agency in the ETS Dataviewer.

98 If it is assumed that the relevant allocations will be passed on from the steel producers to the power plant operators, this results in a lower actual free allocation for the industrial sector in Germany by around 14 million emission allowances. It is not known whether and to what extent such deviations exist in other Member States.

99 The free allocation for heat is also granted in these sectors if the emissions are generated by an external heat supplier (combustion plant). This effect accounts for around 3.2 million emission allowances in Germany. The extent of this effect in other Member States is unknown..



As of 02/05/2019

Figure 49: Industrial emissions and free allocation since 2013 in the six Member States with the highest industrial emissions in the EU ETS

In all Member States, the number of free emission allowances allocated is decreasing, but at different speeds or varying degrees: free allocation for incumbent installations experienced the largest decrease in Italy and the UK (minus 23 and minus 25 percent, respectively). The reason for this is likely to be allocation cuts due to (partial) cessation of operations, capacity reductions and decommissioning of installations. Italy has recorded a significant decline in steel and cement production compared to the baseline period for free allocation[100] , while steel production declined sharply in the United Kingdom in 2015 and 2016 leading to allocation cuts in subsequent years.[101] This effect was also observed in Spain between 2013 and 2014. Since then, the free allocation has remained comparatively stable in Spain, which once again has seen growing industrial (mainly cement) production and thus presumably better plant utilisation.

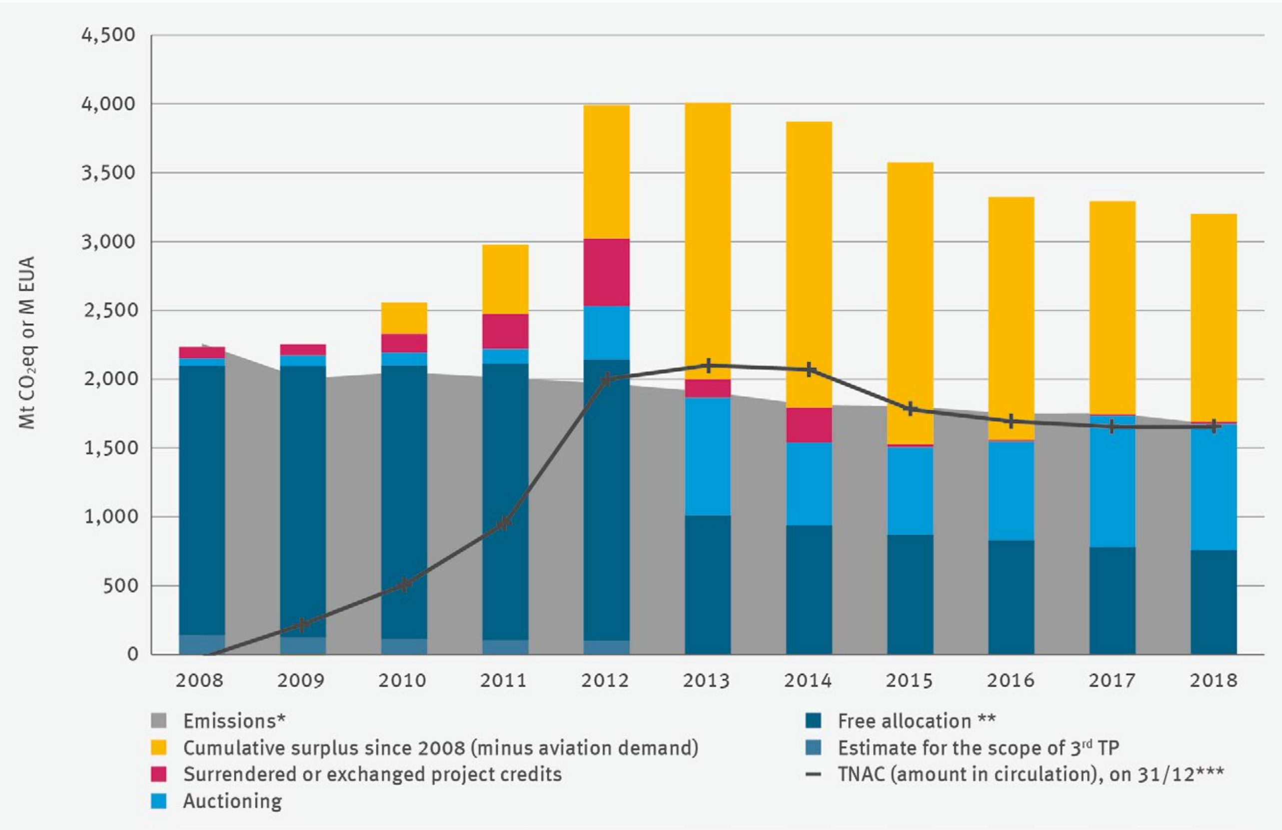
Compared to their share of free allocation for incumbent installations, Spain and Poland have an overproportionally large share of free allocation to new entrants and capacity extensions, while Germany and France have allocated significantly less free emission allowances to new entrants and capacity extensions.

100 The activity rates in 2005 – 2008 or 2009 – 2010 were decisive for the free allocation.
101 DEHSt (2018) and World Steel Association (2019).

3.3 Demand and supply in the stationary sector

Figure 50 shows the supply available in the respective year in comparison to the demand in the same year. Emission allowances unused and transferred in the past must also be taken into account in addition to freely allocated and auctioned emission allowances plus surrendered or exchanged project credits. The column section “Cumulative surplus since 2008” refers to the surplus available in the respective year having been transferred from the previous year. The 2018 column section thus corresponds to the accumulated surplus at the end of 2017. This figure also takes into account the cumulative net demand by aviation for EUAs since 2012. Because of this additional demand for EUAs by aviation, stationary installations have fewer emission allowances available (see section “Aviation emissions”).

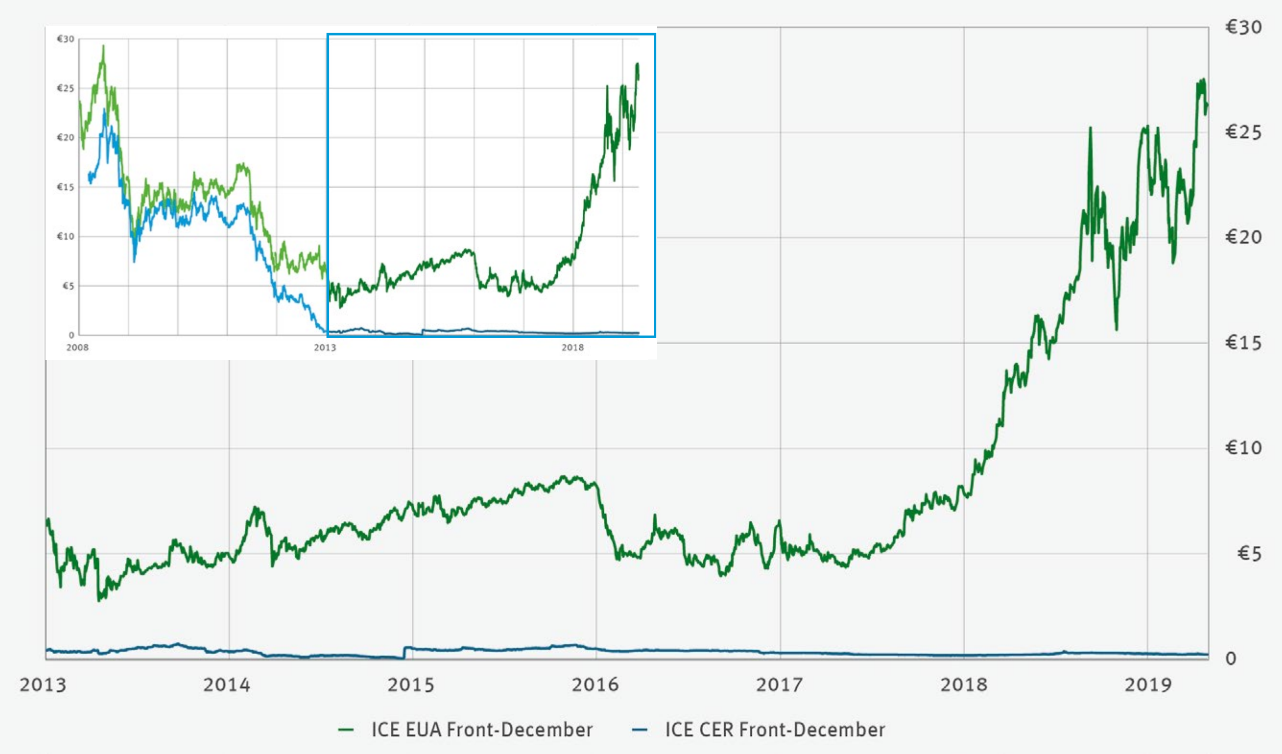
By contrast, the parameter called TNAC (Total Number of Allowances in Circulation or amount in circulation) as a surplus indicator, refers only to the stationary sector. This figure, calculated by the European Commission every year in May for the previous year, is decisive for the reduction in the auction volume by the Market Stability Reserve (MSR).



* Including estimate for the scope of the third trading period
** Including transitionally free allocation according to Article 10c
*** EU COM data
As of 02/05/2019

Figure 50: Demand and supply in the overall system: comparison of emissions with the available emission allowances and amount in circulation trend since 2008[102] as determined by the European Commission

102 Sources: EEA 2018 for the 2005 – 2017 period, COM 2019a and 2019b for 2018 and further, preliminary figures published by the EU Commission, as well as EEX/ICE information for auction volumes. The TNAC data are taken from the European Commission’s 2012 – 2017 Carbon Market Reports and the TNAC Communications (COM 2018 and COM 2019c).



Source: ICE, Refinitiv Eikon, presentation: DEHSt
As of 02/05/2019

Figure 51: Price trends of emission allowances (EUA) and international project credits (CER) in the second and third trading periods

The surplus in emissions trading has noticeably declined since 2014, when backloading began. The market surplus, which not only takes into account supply and demand in the stationary sector but also the additional demand from aviation, fell by a slightly greater extent than the TNAC and, according to provisional figures, also declined in 2018: the net demand for aviation in 2018 was around 30 million of emission allowances (EUA), it has accumulated around 121 million emission allowances since 2012 (see section "Aviation emissions") and reduced the surplus available to market to the same extent. A continued increase in net demand from aviation would lead to greater discrepancies between the market surplus and the TNAC in the future. The official value of TNAC at the end of 2018, according to the European Commission, was 1.655 billion emission allowances. The TNAC has thus barely changed from the previous year (plus 335,000 emission allowances) and remained well above the MSR threshold (833 million emission allowances). This value is decisive for the auction volume reduction by the MSR in the period 01/09/2019 to 31/08/2020. In 2019, a total of around 397 million emission allowances will not be auctioned as planned but will be moved to the MSR. Therefore, a significant decline in market surplus and TNAC is expected by the end of 2019.

3.4 EUA und project credit price trends

The EUA price history has been subject to strong fluctuations in the past. At the start of the second trading period the EUA price reached a level of 25 to 30 euros. Until the start of 2009 prices initially fell to less than ten euros, then stabilised at about 15 euros between 2009 and 2011. From mid-2011, the price then dropped continuously driven by growing surpluses on the carbon market. In April 2013, finally, the lowest level since the start of the second trading period of under three euros was reached. The price gradually stabilised again by the end of 2015 and climbed to a level of about eight euros, but another price fall to around five euros occurred around the turn of 2015/2016. Since then the price has fluctuated in a range between four and seven euros, and in May 2017 a constant upwards trend began on the carbon market. This trend intensified significantly in the autumn of 2017 with the political agreement to amend the Emissions Trading Directive as this reform also included a significant reduction of the existing surplus on the carbon market, then in the first half of 2018, a price level of over 15 euros was achieved. Finally, in September 2018, the highest level since 2008 was reached at over 25 euros. Thus, the price of EUA had quintupled in less than one and a half years. In the following months, the strong upward trend did not continue at first. The price trend over the winter of 2018/2019 was initially characterised by short-term upward and downward movements before reaching a new 11-year high in April at just under 28 euros. Currently, the price is quoted at around 25 euros (as of 13/05/2019).

Since 2008 the project credit (CER/ERU) price level has always moved below the EUA price. The relative price difference between this and the EUA has increased since the end of the second trading period. Currently, an exchange-traded CER is only listed at around 20 cents. This corresponds to about one percent of an EUA's market value. Figure 51 shows the price trends for EUA and CER/ERU in the period from January 2008 to April 2019.

In addition, Table 37 shows the average EUA and CER prices for the completed second, the current third trading period and the 2018 calendar year.[103] The average price for EUA was 13.62 euros (CER: 10.00 euros) in the second trading period and 8.35 euros (CER: 0.32 euros) in the period from January 2013 to April 2019. In the 2018 calendar year the prices were 15.96 euros (EUA) and 0.24 euros (CER).

Table 37: Average prices for emission allowances (EUAs) and international project credits (CERs) in the second and third trading periods

Time period	2nd trading period 03/2008 – 04/2013 [euro]	3rd trading period 01/2013 – 04/2019 [euro]	3rd trading period 01/2018 – 12/2018 [euro]
EUA price*	13.62	8.35	15.96
CER price**	10.00	0.32	0.24

* VWAP ICE EUA front-December
** ICE CER front-December
Source: ICE, Refinitiv Eikon, DEHSt calculation
As of 02/05/2019

103 The reference contract for the following consideration is taken as the futures contract traded on the London Energy and Commodity Exchange ICE in December of the current or following year (the so-called front-December futures) on EUA and CER.

4 Emissions in aviation

4.1 The EU emissions trading trend in aviation

In addition to stationary activities, aviation has also been included in the European Emissions Trading Scheme (EU ETS) since the beginning of 2012 and must surrender emission certificates equal to its 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)[104] (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.[105]

The Emissions Trading Directive provides the delimitation of aviation emissions included in the EU ETS. The scope of the Directive was adjusted twice in previous years (see Table 38). First, the scope for the 2012 reporting year was significantly restricted by the so-called "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.[106]

The scope was further limited between 2013 and 2016 and 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. Unlike in 2012, this also applied to flights from the EEA to Switzerland and back. 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.[107, 108]

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.[106, 107, 108]

The latest decision[108] for 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 from 2021 onwards and to compensate for excess emissions (CORSIA)[109]. In the first two phases of CORSIA (2021 to 2023 and 2024 to 2026), states may voluntarily decide to participate[110] The EU and its Member States have already announced their intention to participate in this voluntary phase.[111] As of 2027, participation is then mandatory for all states that are not exempted by the CORSIA exemption regulations.

The current regulation to reduce the scope will be reviewed following an environmental impact assessment and, where appropriate, clarification of further details of CORSIA implementation at the European level.[110] Table 38 summarises the trend of the aviation scope to date.

104 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.

105 Exceptions are described in Table 38.

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

107 EU 2014

108 EU 2017

109 Carbon Offsetting and Reduction Scheme for International Aviation, ICAO 2016

110 As of 2019, all states are required to monitor and report the emissions of international aviation. "Participation" in this case means the obligation not only to report emissions from international aviation, but also to compensate for any relevant excess emissions by surrendering corresponding allowances. The compensation obligation for relevant excess emissions only applies to routes between participating states. However, this obligation applies to all aircraft operators regardless of their country of origin. The aim is to avoid distortions of competition.

111 ICAO 2019

Table 38: Overview of the EU ETS scope in aviation

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

[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 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.

4.2 Assignment of aviation emissions to Member States

The assignment of ETS emissions to an EU Member State is organised fundamentally differently in aviation than in stationary activities. The so-called territorial principle applies to stationary installations. Accordingly, 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 grants the operating license. If the operator is a non-commercial operator or the operating license was issued outside the EU, the assignment will go to the EU Member State in which the aircraft operator causes the largest estimated share of emissions.

This system also differs significantly from the emission assignment in the national greenhouse gas inventory. In that inventory, a country is accredited with all aviation emissions (whether subject to emissions trading or not) from flights starting within its territory. Within the EU ETS, Germany also administers flights that do not start in Germany; their emissions are not contained in the German greenhouse gas inventory. Furthermore, under the EU ETS, a part of the aviation emissions from flights starting in Germany are administered by other EU Member States. The emissions form these flights are in turn attributed to the German inventory.[112]

Due to the differences in allocation 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 administered by Germany in emissions trading. This circumstance must be taken into account when interpreting the following evaluations.

112 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 38).

4.3 Overview of aircraft operators administered by Germany

According to the list of administrative Member States, Germany is responsible for around 500 aircraft operators for the 2018 reporting year. This assignment is purely administrative because not all of these operators perform activities subject to emissions trading every year. Furthermore, cases of decommissioning and insolvency proceedings are also included in this list whilst the number of aircraft operators with activities subject to emissions trading decreases significantly by excluding small emitters with less than 1,000 tonnes of carbon dioxide per year.

Table 39 summarises the number of operators subject to emissions trading that are administered by Germany, their emissions subject to emissions trading and the emission allowances allocated to them free of charge for the 2013 – 2018 period.

Table 39: Aviation (aircraft operators administered by Germany), overview for the 2013 – 2018 period

Year	No. of operators subject to emissions trading	Allocation amount [1000 aEUA]	Emissions [kt CO_2eq]	Allocation coverage
2013	62	5,160	8,610	59.9%
2014	67	5,149	8,861	58.1%
2015	67	5,101	8,929	57.1%
2016	67	5,100	9,274	55.0%
2017	72	5,098	9,105	56.0%
2018	72	3,578	9,385	38.1%

As of 02/05/2019

Of the roughly 500 aircraft operators, 67 reported emissions from their 2018 flights subject to emissions trading, and another five are estimated to be subject to emissions trading based on data from the European Organisation for the Safety of Air Navigation (EUROCONTROL). The reported emissions totalled around 9.4 million tonnes of carbon dioxide.[113] The aviation emissions administered by Germany in the EU ETS thus increased by around 3 percent compared to the previous year. They reach a new historic high after the temporary drop in emissions due to the insolvency of Air Berlin.

By contrast, the amount of free allocation in 2018 was only about 3.6 million allowances for aviation (aEUA). In 2017, just under 5.1 million aEUA were allocated. The significantly reduced allocation volume is attributable to the insolvency of Air Berlin that received an allocation of approximately 1.5 million aEUAs in each of the previous years. The issuance of aEUAs to Air Berlin will cease with the cessation of operations for the entire remaining trading period. However, there is no additional allocation to operators administered by Germany that have expanded their offer to compensate for Air Berlin's absent transport capacities.

The difference between the operators' aggregated emissions and the amount of aEUA allocated to them free of charge increased accordingly. Their average allocation coverage[114] fell from the previous year's 56 percent to only around 38 percent of their emissions, the lowest level since the inclusion of aviation in emissions trading.

113 2018 emission data is based on the operators' VET records or, if already available, on their emissions reports. Emission data for all previous years are exclusively based on the operators' emission reports. The unreported emissions (neither VET entry nor emissions report available) add up to just under 20,000 tonnes according to Eurocontrol data. They are therefore negligible for the present analysis of the trend at the level of aircraft operators administered by Germany and are not included in the 2018 emission data in this report.

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

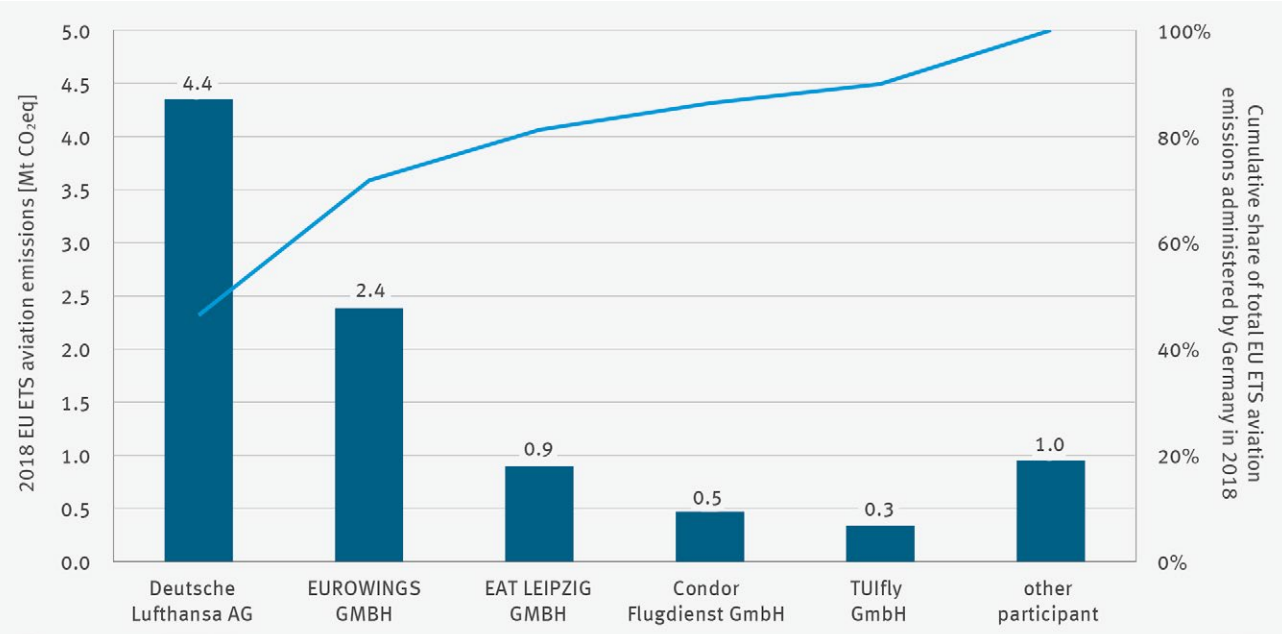
Table 40 shows the CO_2 emissions from aircraft operators administered by Germany differentiated by commercial and non-commercial operators. Thus, in the 2018 reporting year, about three-quarters of the operators had a commercial status and about one quarter were non-commercial. This means that the number of non-commercial operators subject to emissions trading has further reduced compared to previous years. Their share of emissions has fallen to just 0.3 percent.

Table 40: Aviation (aircraft operators administered by Germany), number of aircraft operators subject to emissions trading, CO_2 emissions in 2017 and 2018 differentiated by commercial and non-commercial operators

Operator category	No. of operators subject to emissions trading	2017 emissions [kt CO_2eq]	2018 VET [kt CO_2eq]	2018 VET deviation from 2017 emissions
Commercial	53	8,265	9,358	1,093
Non-commercial	19	27	28	1
Total	**72**	**8,292**	**9,385**	**1,093**

As of 02/05/2019

Compared with 2017, the concentration of emissions from the large commercial operators has continued to increase. While in 2017 the seven largest commercial emitters administered by Germany accounted for more than 90 percent of total emissions, this share was achieved by only five other commercial operators in 2018 (see Figure 52).[115] While Air Berlin entirely ceased operations in 2018 following bankruptcy, the Lufthansa subsidiary Germanwings flies almost exclusively under Eurowings flight numbers which is part of the Lufthansa Group.[116]



As of 02/05/2019

Figure 52: Aviation (aircraft operators administered by Germany), the largest aircraft operators administered by Germany

115 The "biggest operators administered by Germany" are defined here in terms of their 2018 emissions for the current scope.
116 See e.g. Airliners 2017

4.4 Emissions trend

Figure 53 shows the EU ETS aviation emissions administered by Germany for the 2010 to 2018 period, i. e. since the start of the reporting obligation, but since 2013 has focused on the emissions growth in the current reduced scope.

The extent of the scope limitations described in Section 4.1 also becomes apparent from the figure. The total emissions from flights administered by Germany totalled more than 52 million tonnes of carbon dioxide in 2010 and 2011. The first limitation of the EU's stop-the-clock decision in 2012 reduced the volume of emissions administered by Germany to about 16 million tonnes of carbon dioxide and thus to about 30 percent of the full scope.[117] This was then further restricted in 2013 thereby reducing the volume of aviation emissions administered by Germany to around 16 percent of the full scope.

Since 2013, emissions within the reduced scope have increased from 8.6 to 9.4 million tonnes in 2018. This represents an 8.5 percent increase over the entire period or a 1.7 percent average annual growth. Fluctuations around this trend, in particular the 2017 decline in emissions compared to the previous year, can be explained by the insolvency of Air Berlin airline administered by Germany. Only a part of Air Berlin's capacity lost in 2017 could be replaced by other airlines, some of which are administered by other Member States.[118]

Compared to the previous year, emissions from aviation administered by Germany in the EU ETS have risen by around 3 percent and are thus just above the 2.5 percent 3-year average of 2013 – 2016. This suggests that market adjustments such as the Air Berlin bankruptcy and current shifts among market shares – also to operators not administered by Germany – only dulled the rising emissions trend in aviation administered by Germany over the short term. Emissions growth in aviation administered by Germany could have been even greater if a part of the emissions had not been relocated to non-German administered operators.

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

118 See ADV 2018

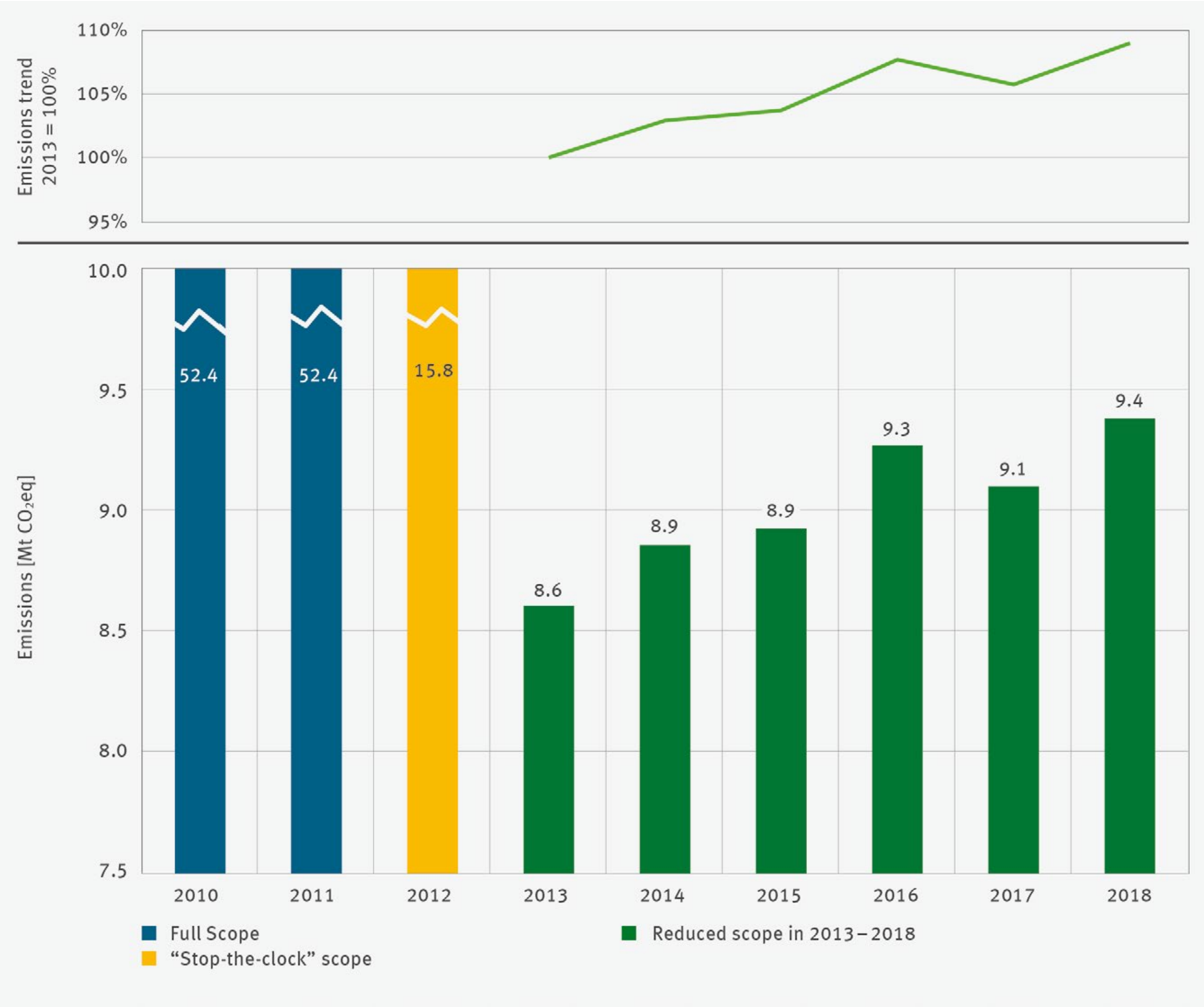


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Figure 53: Aviation (aircraft operators administered by Germany), 2010 to 2018 emission trend subject to emissions trading[119]

119 The 2014 and 2015 emissions are shown in the graph to be identical, i. e. 8.9 million t CO_2, but the columns have different heights. This is due to the rounding after the decimal point: the values are 8.86 million t CO_2 for 2014 and 8.93 million t CO_2 for 2015 after a rounding in the second place behind the decimal point.

4.5 Allocation status

50 of the 72 aircraft operators that were likely to be subject to emissions trading in the 2018 reporting year received a free allocation of aEUA. On average, the free allocation only covered 38 percent of the emissions from these aircraft operators (see Table 41 and the following explanations).

The same as in previous years, non-commercial aircraft operators are covered by aEUAs to a much lesser extent than commercial operators.[120] Their 2018 allocation coverage was 3.5 percent which was very low. The low coverage level can be attributed to the EU-wide allocation rules in aviation: the amount of free allocation results from the transport performance of the operators in tonne-kilometres in the 2010 base year as well as the aviation benchmark.[121] With regard to their transport performance, non-commercial aircraft operators have significantly higher fuel consumption and therefore higher emissions than commercial operators. This is usually due to the use of smaller aircraft types, the low utilisation rate and the mode of operation.

The significant decline in the 2018 allocation volume for commercial operators compared to the previous year was mainly due to the bankruptcy of Air Berlin, whose allocation claim stopped with the cessation of operations. In previous years, the free allocation to Air Berlin amounted to around 1.5 million aEUA. The significant reduction in the average allocation coverage for the commercial operators administered by Germany is the result of the absence of the allocation volume for Air Berlin. The offsetting of flights offered by Air Berlin by other operators also administered by Germany (in particular Eurowings and Lufthansa) and the emissions caused by them however, were not offset by additional allocations to operators with an extended transport supply pursuant to EU-wide uniform allocation rules.

Table 41: Aviation (aircraft operators administered by Germany), 2018 overview of number of allocation recipients, emissions, allocation volumes and allocation coverage differentiated by commercial and non-commercial operators

Operator category	No. of operators subject to ET	No. of operators with 2018 allocation	2018 VET [kt CO_2eq]	2018 allocation volume [1000 aEUA]	2018 allocation deviation from 2018 VET [kt CO_2eq]	Allocation coverage
Commercial	53	38	9,358	3,577	−5,781	38.2%
Non-commercial	19	12	28	1	−27	3.5%
Total	**72**	**50**	**9,385**	**3,578**	**−5,808**	**38.1%**

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120 See DEHSt 2018 for example
121 See DEHSt 2012b, Section 3.1.2 “Allocation Benchmarks”

4.6 Emissions and available emission allowances for aviation at the European level

The previous sections presented the allocation and emissions trends for the aircraft operators administered by Germany. However, the 2018 emissions from these aircraft operators account for just over 14 percent of the total European aviation emissions in the EU ETS.[122] This section therefore serves to integrate the German trend into the overall European context.

Figure 54 summarises the entire European situation. Accordingly, the total emissions of all EU ETS operators subject to emissions trading rose from about 53 million tonnes of carbon dioxide in 2013 by an annual average of 4.5 percent to around 67 million by 2018. The 2018 increase was around 4 percent compared to the previous year, slightly below the historical trend.

The increasing emissions are offset by an almost constant allocation since 2016 which includes not only aEUAs allocated free of charge but also ones from auctions. In principle, the Emissions Trading Directive provides almost constant allocation and auction volumes for the entire 2013 – 2020 period.[123] 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 aEUAs were auctioned than originally planned because the 2013 auctions were wholly suspended.

Irrespective of the auction features described above, total emissions – in all years of the third trading period – were significantly higher than the aEUA allocation volume.[124] In the 2012 – 2018 period, the overall surrender obligation was missing a total of about 139 million aEUAs. However, operators were able to offset the missing certificates by purchasing EUAs from the stationary EU ETS[125] and, to a limited extent by buying international project credits, as these could be used to fulfil their surrender liability. Subtracting the international project credits from the gap in the coverage, yields the demand by aviation for EUAs from the stationary EU ETS.[126] This gap amounted to about 121 million tonnes in the 2012 – 2018 period, i. e. since the start of allocation and surrender obligation for aviation (see Figure 54). Since meeting the scheduled auction volumes in 2016, the annual demand by aviation for EUA has increased from an average of around 23 million, about 14.2 percent annually, to around 30 million in 2018. The extra demand by aviation for EUAs therefore created additional EUA shortages.

122 The share was also about 14 percent in the previous year, just over 16 percent at the beginning of the trading period and still at around 19 percent under the 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.

123 The total amount of aEUA allocated free of charge and auctioned should amount to 97 percent of the 2012 historical aviation emissions (2004 – 2006 average) and 95 percent of historical emissions multiplied by eight for each year of the third trading period (2013 – 2020). The EU Auctioning Ordinance envisages that 15 percent of the amount of aEUA in circulation will be auctioned each year.

124 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.

125 However, operators of stationary installations cannot rely on aEUA.

126 The actual use of claims has not been reported in the EUTL since 2013, which is why the use of 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 corresponds to 1.5 percent of the verified total emissions during the period in question.

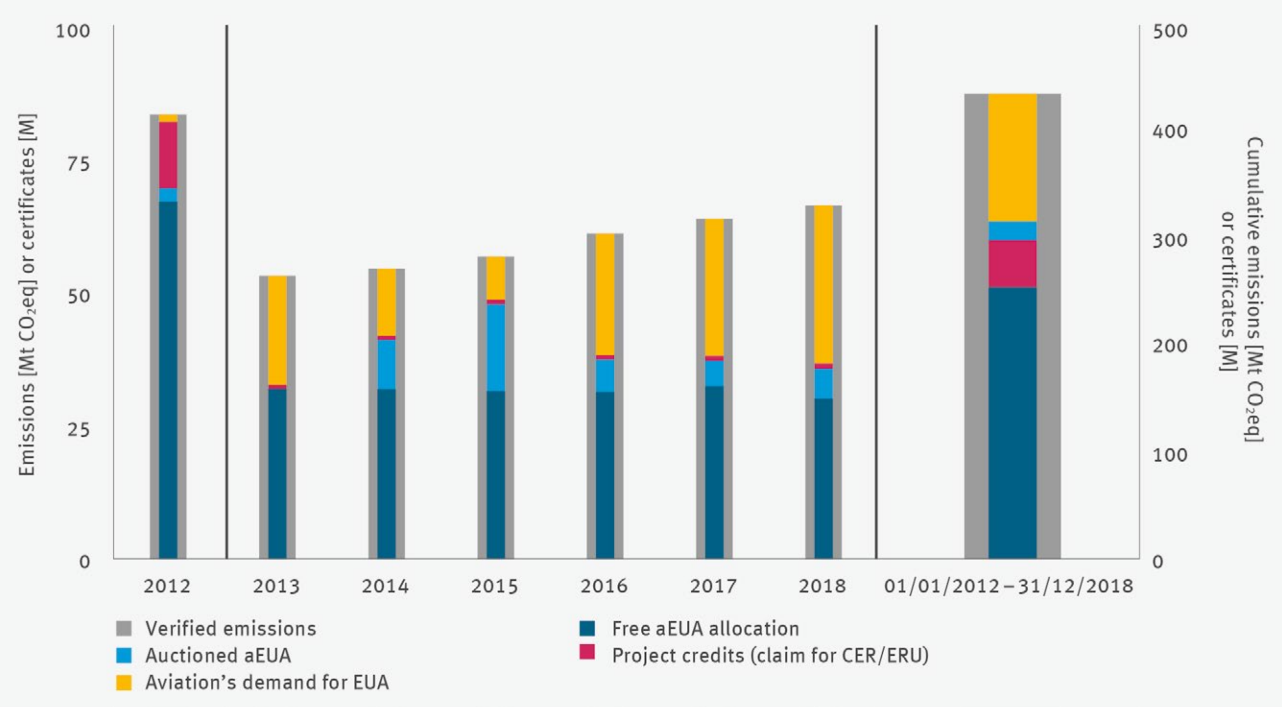

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Figure 54: Aviation (aircraft operators administered by Germany), emissions, supply of usable emission allowances (aEUA, CER/ERU) and aviation demand for EUA for aviation subject to emissions trading in Europe (left: 2012 to 2018 annual values, right: cumulative)

5 States (Länder)

Table 42: Overview of the 2017 verified emissions per state (Land), by activities

2017 emissions [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BY	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	28	0	27	65	0	2	4	5	149	1,393	420	0	0	0	96	11	2,199
2	Energy conversion ≥ 50 MW RTI	38,635	6,407	16,480	8,645	6,746	5,695	7,721	3,043	18,342	134,106	5,004	3,090	4,979	33,436	10,240	998	303,567
3	Energy conversion 20 – 50 MW RTI	128	176	594	831	118	398	205	32	728	1,114	307	100	211	107	132	121	5,302
4	Energy conversion 20 – 50 MW RTI, other fuels	0	0	11	2	0	0	0	0	26	69	0	0	0	0	0	36	143
5	Prime movers (engines)	0	0	0	14	0	0	0	0	19	0	0	0	0	0	0	0	33
6	Prime movers (turbines)	289	0	60	246	0	118	0	0	193	210	31	0	0	0	21	88	1,257
7	Refineries	3,844	0	2,833	3,566	0	0	999	0	1,100	8,082	1	2,485	0	0	2,247	0	25,157
8	Coking plants	0	0	0	0	0	0	0	0	0	2,921	0	0	1,031	0	0	0	3,952
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	69	0	0	0	0	0	0	69
10	Production of pig iron and steel	1,700	0	121	169	2,545	39	84	0	4,576	13,603	0	0	5,341	84	0	44	28,305
11	Ferrous metal processing	293	0	233	95	624	452	346	0	463	1,608	124	0	893	134	86	62	5,413
12	Production of primary aluminium	0	0	0	0	0	0	273	0	0	737	0	0	0	0	0	0	1,010
13	Processing of non-ferrous metals	0	0	17	171	0	0	216	0	148	724	58	0	50	103	135	0	1,622
14	Production of cement clinker	1,310	0	3,716	3,765	0	316	0	0	1,223	5,490	889	1,072	0	0	1,619	1,067	20,466

2017 emissions [kt CO_2eq]		State (Land)																
No.	**Activity**	**BB**	**BE**	**BW**	**BY**	**HB**	**HE**	**HH**	**MW**	**LS**	**NW**	**RP**	**SH**	**SL**	**SN**	**ST**	**TH**	**Total**
15	Lime production	446	0	444	1,063	0	455	0	84	846	3,966	498	0	0	0	1,354	188	9,345
16	Glass production	122	0	141	753	0	4	0	20	350	1,005	289	38	0	243	534	240	3,739
17	Ceramics production	118	0	100	711	31	25	0	0	213	322	149	0	26	160	93	94	2,041
18	Production of mineral fibres	0	0	52	100	0	0	0	0	7	69	0	0	0	96	62	0	386
19	Gypsum production	96	0	23	82	0	0	0	0	19	25	0	0	0	24	0	0	269
20	Pulp production	0	0	0	16	0	0	0	0	3	0	0	0	0	0	73	52	144
21	Paper production	67	0	793	752	0	263	0	7	916	1,535	411	132	0	392	36	19	5,323
22	Carbon black production	0	0	0	0	0	0	0	0	0	608	0	0	0	0	0	0	608
23	Nitric acid production	0	0	0	0	0	0	0	152	0	69	392	0	0	39	29	0	681
24	Adipic acid production	0	0	0	0	0	0	0	0	0	23	0	0	0	0	109	0	132
25	Production of glyoxal and glyoxylic acid	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	10
26	Ammonia production	0	0	0	0	0	0	0	0	0	628	1,505	0	0	0	2,322	0	4,455
27	Production of bulk organic chemicals	0	0	47	543	0	54	0	0	254	4,129	1,639	169	0	1,386	136	0	8,355
28	Production of hydrogen and synthesis gas	37	0	0	54	0	0	52	0	13	386	393	123	0	0	660	0	1,718
29	Soda production	0	0	0	0	0	0	0	0	0	167	79	0	0	0	358	0	604
Total		**47,113**	**6,584**	**25,693**	**21,643**	**10,062**	**7,820**	**9,899**	**3,343**	**29,589**	**183,060**	**12,198**	**7,209**	**12,533**	**36,202**	**20,342**	**3,019**	**436,307**

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Table 43: Overview of the 2018 VET entries per state (Land), by activities

2018 VET [kt CO_2eq]		State (Land)																
No.	Activity	BB	BE	BW	BY	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	31	0	27	62	0	1	4	6	141	1,442	404	0	0	0	92	11	2,222
2	Energy conversion ≥ 50 MW RTI	38,784	5,298	16,399	7,551	6,173	5,188	7,781	2,528	17,657	128,216	4,659	3,260	2,608	33,452	10,644	1,004	291,203
3	Energy conversion 20 – 50 MW RTI	123	158	574	812	108	386	202	40	726	1,130	301	99	206	112	125	112	5,213
4	Energy conversion 20 – 50 MW RTI, other fuels	0	0	9	3	0	0	0	0	25	66	0	0	0	0	0	31	134
5	Prime movers (engines)	0	0	0	13	0	0	0	0	10	0	0	0	0	0	0	0	22
6	Prime movers (turbines)	387	0	61	272	0	87	0	0	192	170	31	0	0	1	25	132	1,357
7	Refineries	3,790	0	2,692	3,358	0	0	828	0	1,254	7,160	0	2,318	0	0	2,600	0	24,001
8	Coking plants	0	0	0	0	0	0	0	0	0	2,881	0	0	972	0	0	0	3,853
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	1,612	0	113	170	2,621	41	83	0	4,676	13,777	0	0	5,397	80	0	43	28,612
11	Ferrous metal processing	295	0	214	92	622	450	318	0	486	1,605	119	0	806	134	89	62	5,292
12	Production of primary aluminium	0	0	0	0	0	0	288	0	0	740	0	0	0	0	0	0	1,029
13	Processing of non-ferrous metals	0	0	19	165	0	0	218	0	154	720	59	0	48	113	138	0	1,633
14	Production of cement clinker	1,141	0	3,689	3,807	0	336	0	0	1,230	5,307	828	1,064	0	0	1,587	1,011	19,998
15	Lime production	425	0	449	1,107	0	452	0	83	805	3,995	509	0	0	0	1,430	183	9,438
16	Glass production	132	0	155	719	0	4	0	23	340	1,037	307	38	0	235	585	242	3,818

2018 VET [kt CO_2eq]		State (Land)																
No.	**Activity**	**BB**	**BE**	**BW**	**BY**	**HB**	**HE**	**HH**	**MW**	**LS**	**NW**	**RP**	**SH**	**SL**	**SN**	**ST**	**TH**	**Total**
17	Ceramics production	117	0	95	728	29	25	0	0	218	299	166	0	25	155	97	97	2,051
18	Production of mineral fibres	0	0	47	102	0	0	0	0	8	82	0	0	0	101	64	0	405
19	Gypsum production	97	0	22	86	0	0	0	0	18	25	0	0	0	23	0	0	271
20	Pulp production	0	0	0	19	0	0	0	0	4	0	0	0	0	0	80	54	157
21	Paper production	53	0	762	775	0	270	0	6	895	1,472	410	133	0	401	37	19	5,231
22	Carbon black production	0	0	0	0	0	0	0	0	0	621	0	0	0	0	0	0	621
23	Nitric acid production	0	0	0	0	0	0	0	163	0	52	371	0	0	36	38	0	661
24	Adipic acid production	0	0	0	0	0	0	0	0	0	26	0	0	0	0	86	0	112
25	Production of glyoxal and glyoxylic acid	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	11
26	Ammonia production	0	0	0	0	0	0	0	0	0	598	1,403	0	0	0	2,592	0	4,593
27	Production of bulk organic chemicals	0	0	52	538	0	59	0	5	243	3,917	1,499	183	0	1,341	164	0	8,002
28	Production of hydrogen and synthesis gas	39	0	0	51	0	0	55	0	18	374	372	109	0	0	716	0	1,735
29	Soda production	0	0	0	0	0	0	0	0	0	149	69	0	0	0	322	0	540
Total		**47.026**	**5.456**	**25.379**	**20.429**	**9.554**	**7.298**	**9.779**	**2.855**	**29.100**	**175.941**	**11.517**	**7.205**	**10.062**	**36.183**	**21.511**	**3.000**	**422.294**

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Table 44: Overview of the 2017 allocation amounts per state (Land), by activities

2018 allocation amount [1000 EUA]		State (Land)																
Nr.	Activity	BB	BE	BW	BY	HB	HE	HH	MW	LI	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	34	0	26	24	0	43	2	7	104	1,020	387	0	0	0	92	1	1,739
2	Energy conversion ≥ 50 MW RTI	902	880	1,187	1,814	137	1,255	398	261	2,009	5,509	1,848	421	257	666	1,049	284	18,877
3	Energy conversion 20 – 50 MW RTI	47	70	349	425	52	268	143	65	484	616	161	39	98	42	47	81	2,987
4	Energy conversion 20 – 50 MW RTI, other fuels	0	0	34	25	0	0	0	0	22	11	0	0	0	0	0	6	99
5	Prime movers (engines)	0	0	0	5	0	0	0	0	10	0	0	0	0	0	0	0	15
6	Prime movers (turbines)	113	0	28	77	0	44	0	0	111	90	12	0	0	0	10	58	543
7	Refineries	1,813	0	2,041	2,753	0	0	855	0	962	6,203	0	1,930	0	0	2,150	0	18,707
8	Coking plants	0	0	0	0	0	0	0	0	0	1,371	0	0	267	0	0	0	1,638
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	65	0	0	0	0	0	0	65
10	Production of pig iron and steel	2,768	0	142	139	3,603	45	68	0	5,584	22,410	0	0	5,728	86	0	44	40,617
11	Ferrous metal processing	240	0	209	74	258	370	294	0	419	1,632	113	0	598	101	92	56	4,453
12	Production of primary aluminium	0	0	0	0	0	0	198	0	0	657	0	0	0	0	0	0	855
13	Processing of non-ferrous metals	0	0	14	130	0	0	259	0	176	588	61	0	43	117	105	0	1,492
14	Production of cement clinker	1,256	0	2,719	3,152	0	230	0	0	962	4,778	664	934	0	0	1,627	852	17,174
15	Lime production	292	0	486	910	0	320	0	53	622	3,111	462	0	0	0	960	169	7,385
16	Glass production	91	0	124	617	0	4	0	6	280	790	181	32	0	193	455	183	2,956

2018 allocation amount [1000 EUA]		State (Land)																
Nr.	Activity	BB	BE	BW	BY	HB	HE	HH	MW	LI	NW	RP	SH	SL	SN	ST	TH	Total
17	Ceramics production	90	0	93	615	27	23	0	0	165	296	137	0	23	135	75	87	1,767
18	Production of mineral fibres	0	0	23	78	0	0	0	0	5	68	0	0	0	59	53	0	285
19	Gypsum production	93	0	27	89	0	0	0	0	23	33	0	0	0	23	0	0	288
20	Pulp production	0	0	8	9	0	0	0	0	8	0	0	0	0	0	41	21	87
21	Paper production	379	0	828	1,224	0	307	0	6	1,022	1,050	453	161	0	312	110	128	5,980
22	Carbon black production	0	0	0	0	0	0	0	0	0	430	0	0	0	0	0	0	430
23	Nitric acid production	0	0	0	0	0	0	0	263	0	157	177	0	0	25	32	0	654
24	Adipic acid production	0	0	0	0	0	0	0	0	0	210	550	0	0	0	232	0	991
25	Production of glyoxal and glyoxylic acid	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	8
26	Ammonia production	0	0	0	0	0	0	0	0	0	500	1,364	0	0	0	1,660	0	3,524
27	Production of bulk organic chemicals	0	0	17	430	0	104	0	0	480	4,333	2,255	133	0	938	165	0	8,856
28	Production of hydrogen and synthesis gas	22	0	0	55	0	0	37	0	12	423	583	63	0	0	322	0	1,516
29	Soda production	0	0	0	0	0	0	0	0	0	209	96	0	0	0	719	0	1,024
Total		**8,140**	**950**	**8,356**	**12,647**	**4,077**	**3,013**	**2,254**	**660**	**13,456**	**56,559**	**9,513**	**3,713**	**7,015**	**2,697**	**9,994**	**1,970**	**145,013**

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6 Main fuels by sectors

Table 45: 2018 emissions and allocations* for stationary installations in EU ETS using the main fuels natural gas, lignite and hard coal (*no redistribution of waste gases from iron, steel and coke production)

Sector/Activity	Main fuel	2018 allocation amount [1000 EUA]	2018 VET [kt CO_2eq]
Energy installations	Lignite	1,582	153,950
	Hard coal	3,814	77,678
	Natural gas	12,599	36,799
Other combustion plants	Lignite	116	243
	Hard coal	119	133
	Natural gas	85	71
Refineries	Natural gas	1,482	1,534
Iron and steel	Lignite	9	230
	Hard coal	5,433	4,554
	Natural gas	17,565	14,093
Non-ferrous metals	Hard coal	43	54
	Natural gas	1,252	1,472
Cement clinker	Lignite	1,653	1,863
Industrial and building lime	Lignite	3,879	4,794
	Hard coal	987	1,102
	Natural gas	1,112	1,189
Other mineral-processing industry	Lignite	284	755
	Hard coal	447	672
	Natural gas	5,569	6,965
Paper and pulp	Lignite	155	315
	Hard coal	256	712
	Natural gas	4,404	4,055
Chemical industry	Lignite	270	126
	Hard coal	928	471
	Natural gas	8,083	8,623
Sum		72,126	322,453
Complement: main fuel is not natural gas, hard coal or lignite		72,886	99,839
Total		**145,012**	**422,292**

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7 Industries, sectors and activities in the EU ETS

Table 46: Activities (short description) according to Annex 1 TEHG and summary of sectors and fields

TEHG No.	Activity	Sector	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 installations, 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	Ferrous metal processing		
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 47: Activities (short description) according to Annex 1 TEHG and equivalent in the Union Registry (Registry Activity)

TEHG No.	TEHG activity	Registry Ordinance No.	Registry Ordinance 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	Ferrous metal processing	25	Ferrous metal processing
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	Mineral fibres production	33	Mineral fibres production
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 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 not sufficient 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 of industry sectors and added for 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 most used 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.

Linear factor

The factor is applied to power generators and new market participants for a linear reduction of the annual allocation amount. The linear factor is reduced by 1.74 percent annually from the 2013 baseline 1, meaning that the linear factor was 0.9130 in 2018.

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-generators 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 for 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 have been added. In the relevant figures in the report, this adjustment of the 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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