Greenhouse Gas Emissions in 2016

Stationary installations and aviation subject to emissions trading in Germany (VET report 2016)

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Summary

Energy and industrial sectors in Germany

In 2016, the European Emissions Trading Scheme (EU ETS) recorded 1,863 stationary installations in Germany. These installations emitted around 453 million tonnes of carbon dioxide equivalent, which represents a 0.6 percent decrease compared to 2015.

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

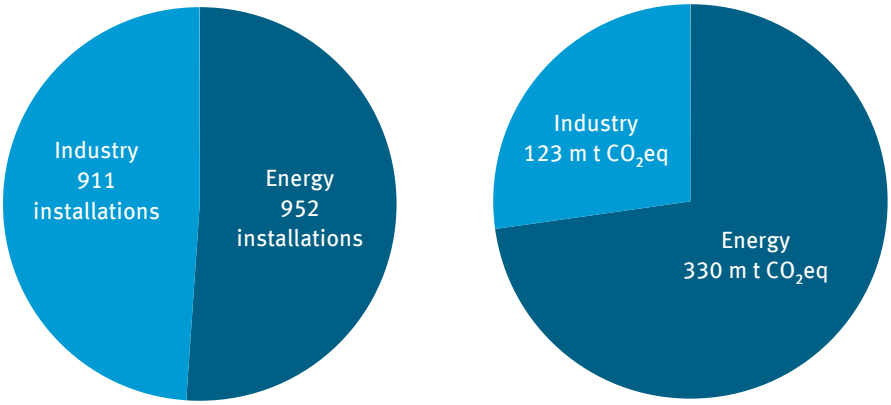

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Figure 1: Distribution of emissions and installations subject to emissions trading to the energy sector (Activities 2 to 6 as per Annex 1 TEHG) and the industrial sector (Activities 1 and 7 to 29 as per Annex 1 TEHG) in Germany in 2016

While the number of installations is divided about half and half between the industrial and the energy sectors, the proportion of emissions is different: about three-quarters of emissions subject to emissions trading from German stationary installations are generated by energy installations, a quarter of the emissions come from industrial installations.

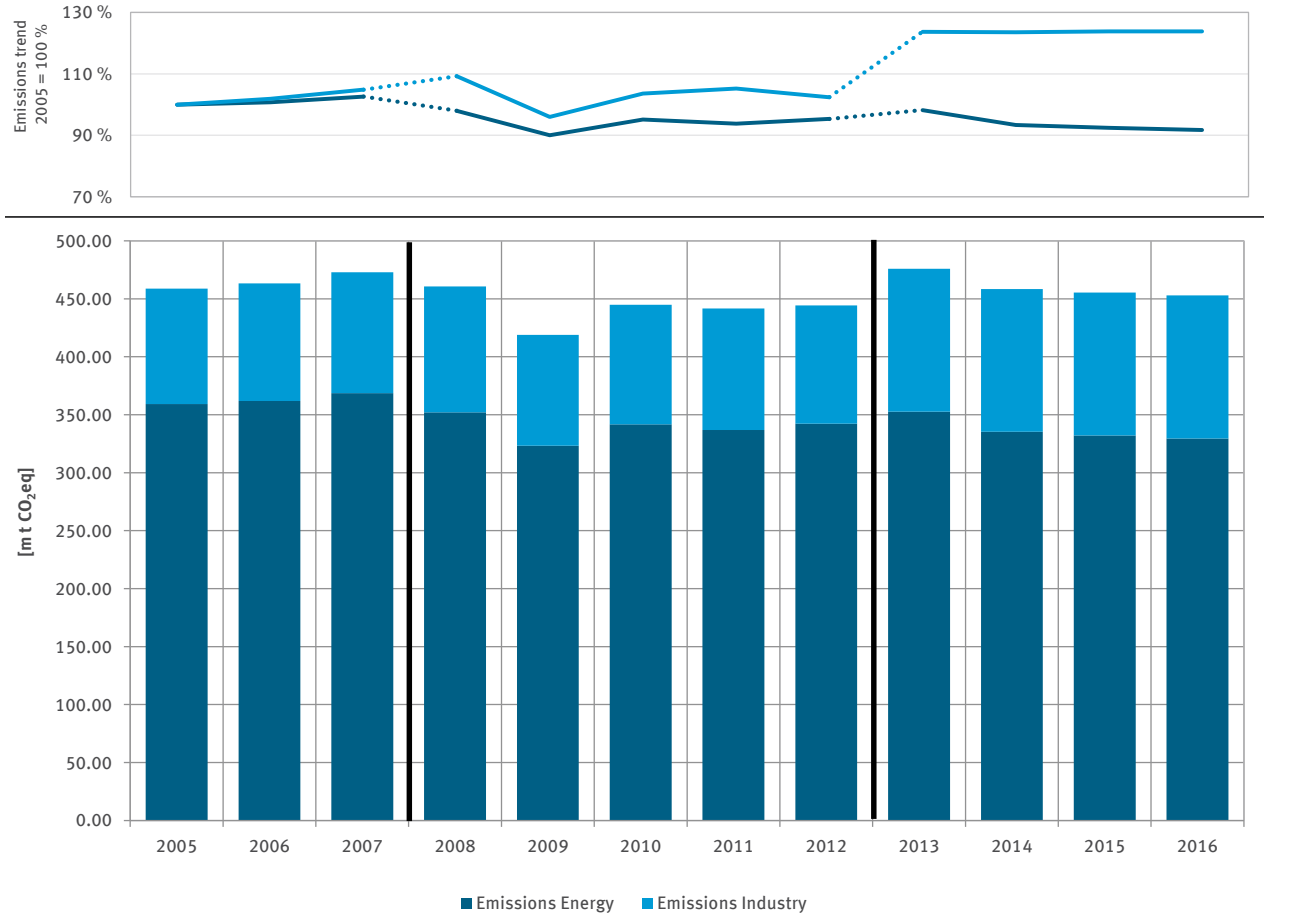

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Figure 2: ETS emissions from the energy and industry sectors since 2005 in Germany

Figure 2 shows the German ETS emissions since 2005 separated into industrial and energy installations. Since the figure only shows the reported emissions of the individual years with no correction of the scope being made over the individual trading periods, only a comparison of emission trends within and not between the individual trading periods makes sense. Compared to the previous year, emissions from energy installations decreased by 0.8 percent to 329 million tonnes of carbon dioxide. The emissions from the energy intensive industry are around 123 million tonnes of carbon dioxide equivalent, the same as in 2013 to 2015. The decrease in total German ETS emissions since 2013 can thus only be attributed to emission reductions in energy installations.

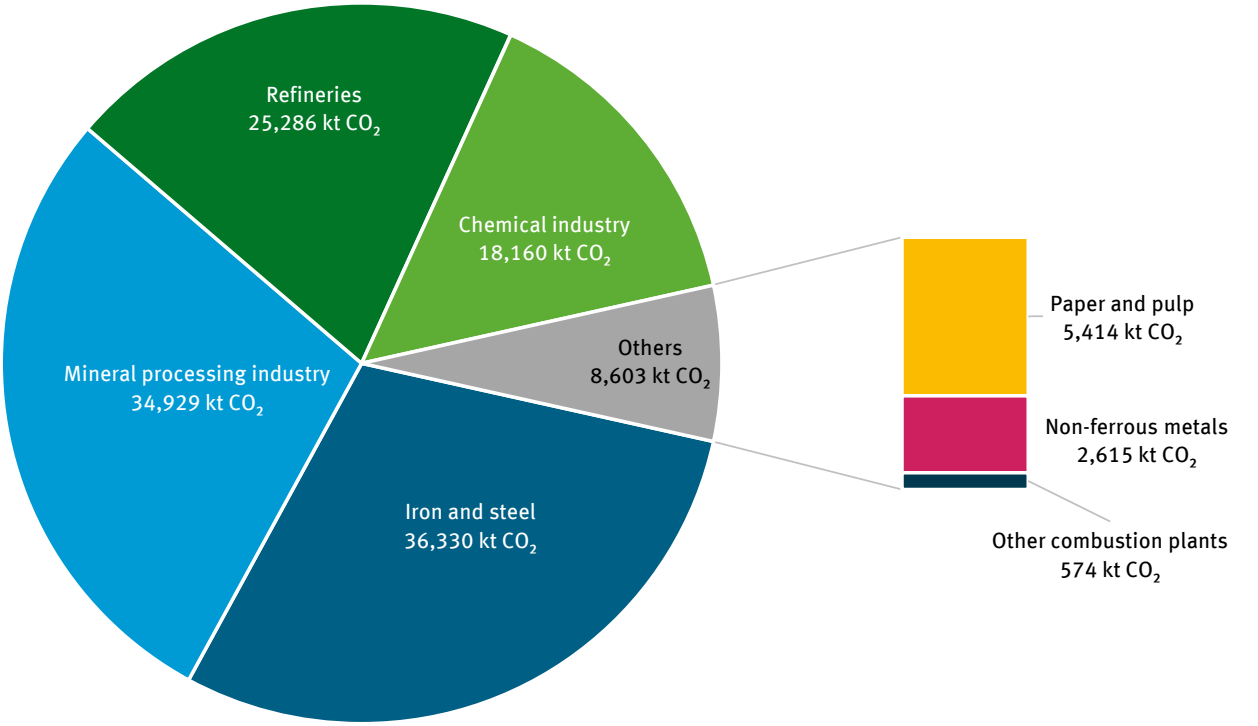

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Figure 3: Share of individual sectors in the industrial area emissions

Figure 3 shows the share of individual industrial sectors in the total emissions from the industry. The iron and steel industry has the largest share of industrial emissions at around 29 percent in spite of an emission reduction on 2015, followed by the mineral processing industry (28 percent) and refineries (21 percent). The remaining 22 percent of industrial emissions can be attributed to three further sectors: chemical industry (15 percent), paper and pulp industry (four percent) and non-ferrous metal industry (two percent). Other combustion plants that cannot be assigned to any of the aforementioned sectors generate only about half a percent of the industrial emissions.

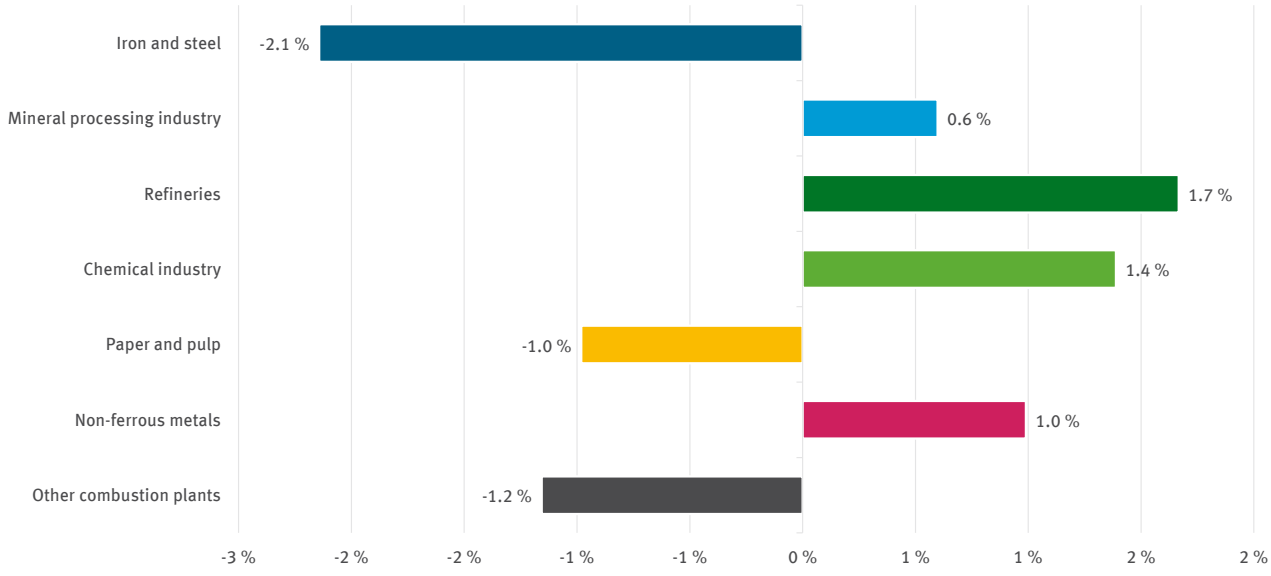

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Figure 4: Emission changes in the industrial sector

The different emission trends in the individual industrial sectors compared to the previous year is summarised in Figure 4: emissions from the iron and steel industry decreased considerably by 2.1 percent. A decline in the production of raw steel could also be observed here, which is less marked than the emission reduction. This suggests a slight decline in emission intensity of raw steel production, while the 2015 intensity still increased on 2014. Emissions from the paper and pulp industry (minus 1.0 percent) and other combustion plants (minus 1.2 percent) decreased moderately. Emissions from the paper industry are thus at their lowest level since the introduction of emissions trading. This is due to an increase in energy efficiency in production and to the continuing decline in the volume of sales of graphic papers, mainly due to the increased use of electronic media. However, emissions from mineral processing, chemical and non-ferrous metal industries as well as refineries increased. For these sectors, an increase in the production of the products most relevant to the respective industries can be seen.

The free allocation for stationary installations in 2016 was 154 million emission allowances. The 2016 industrial activities had an allocation surplus of 4 million emission allowances. This surplus also takes account of the allocation of transferred waste gases from iron, steel and coke production and imported heat amounts from the paper and chemical industry. Assuming that the relevant allocation will be offset or transferred between the operators – approximately 19 million emission allowances altogether would change from the industrial to the energy sector – the industrial sector needed an additional 15 million emission allowances in 2016. The energy sector has a deficit of 303 million tonnes of carbon dioxide (without the offset from the industrial sector). This is because electricity production no longer receives a free allocation since the beginning of the third trading period. Allowances on this scale had to be purchased on the market to meet the surrender obligation of operators for the emissions in the previous year.

Germany and Europe

Emissions from EU-wide installations subject to emissions trading (EU 31) decreased in 2016 by about 2.6 percent to around 1.75 billion tonnes of carbon dioxide equivalent compared to the previous year according to the European Commission (cf. COM 2017e). The emissions from German installations decreased by 0.6 percent which was less than the European average. Overall, ETS emissions in Germany have declined much less since the start of emissions trading in 2005 compared to the European average: while emissions in Germany fell by around 13 percent between 2005 and 2016, they dropped by about 26 percent on European average, i.e. by twice as much, during the same period of time.

A large amount of excess emission allowances has accumulated in the EU ETS since the beginning of the second trading period in 2008, due mainly to the financial and economic crisis, which contributed substantially to the observable decline in prices for emission allowances since mid-2011. The calculated cumulative surplus in the EU ETS as the balance of available emission allowances (free allocations and auctioned emission allowances plus surrendered or exchanged project credits) and verified emissions amounted according to our own calculation to more than 1.6 billion allowances at the end of 2016. Thus, it was below the value at the end of 2015 (see COM 2017e).

Thus the calculated supply available on the market in 2016 was almost twice as high as the annual demand to cover verified emissions. The surplus declined in both 2015 and 2016 compared to the respective previous year. Reasons for this are the retained auction amounts (backloading) and the small, still available use options for project credits.

Aviation

Compared to the originally planned EU ETS scope in aviation, which included the emissions from all flights starting or landing in the European Economic Area (EEA), only emissions from flights which start and land within the EEA were subject to emissions trading between 2013 and 2016 – according to the 2014 EU provisions. A total of 68 aircraft operators subject to emissions trading managed by Germany reported emissions of 9.3 million tonnes of carbon dioxide for 2016, which were 3.8 percent higher than in the previous year.

Over 99 percent of the emissions can be attributed to commercial aircraft operators, which represent about two-thirds of the operators. Non-commercial operators amount to roughly one-third of the operators, but were responsible for less than one percent of the total emissions.

The 2016 free allocation share in the surrender obligation in aviation amounted, on average, to 55 percent.

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Abbreviations

AA	Allocation amount
AGEB	Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen)
AR	Activity rate
BImSchV	Federal Exposure Control Ordinance (Bundes-Immissionsschutzverordnung)
CER	Certified Emission Reductions (from CDM projects)
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
DEHSt	German Emissions Trading Authority at the German Environment Agency
EA	Emission allowance
EEA	European Economic Area (comprises the EU31 Member States)
EEX	European Energy Exchange
ER	Emissions report
ETD	Emissions Trading Directive
EM	Emissions
ERU	Emission Reduction Units (from JI projects)
EU 25	Austria, Belgium, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden
EU 28	EU 25 and Bulgaria, Croatia, Romania
EU 31	EU 28 and Iceland, Liechtenstein, Norway
EU ETS	European Emissions Trading Scheme
EUA	Emission allowance
EUAA	Allowances aviation
ICAO	International Civil Aviation Organisation
ICE	Intercontinental Exchange
kt	Kilotonne or one thousand tonnes
m t	Megatonne or one million tonnes
MW	Megawatt
N_2O	Dinitrogen monoxide, nitrous oxide
PFC	Perfluorocarbons
RegVO	EU Registry Ordinance (EU Registerverordnung)
RTI	Rated thermal input
TEHG	German Greenhouse Gas Emission Allowance Trading Act (Treibhausgas-Emissionshandelsgesetz)

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)
WSA	World Steel Association
WVM	Metal Industry Association (Wirtschaftsvereinigung Metalle e.V.)
WV Stahl	German Steel Federation (Wirtschaftsvereinigung Stahl)
WVZ	Sugar Economic Association (Wirtschaftliche Vereinigung Zucker e.V.)
ZuV 2020	Allocation Ordinance (Zuteilungsverordnung) 2013 to 2020

1 Introduction

Chapter 1 provides an overview of the main contents and results of the 2016 VET report. Divided into different sectors, Chapter 2 addresses the emissions from stationary installations subject to emissions trading. Chapter 3 presents cross-sectoral evaluations regarding stationary installations firstly with regard to the allocation situation of the installations in Germany, secondly with regard to Germany in the EU. Chapter 4 describes emissions subject to emissions trading in the aviation sector managed by Germany. The appendix contains additional information organised in summary tables.

The data presented in the tables are rounded. The calculations used exact values so that sporadic deviations may occur in the representation of the totals.

VET emissions, annual emissions, 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 directly into the so-called "Verified Emissions Table" (VET) 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 1 shows the sums of VET entries and the annual emissions for 2005 to 2015. The first registry entry at the cut-off date of 31.03 in one of the years following the reporting year qualifies as 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 2016 annual emissions will be available for the first time in the autumn of 2017, after DEHSt has reviewed the emission reports and may later 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 obliged to surrender VET entries for the year of closure or decommissioning.

Table 1: VET entries and annual emissions of the audited reports and the respective number of installations

Year	Initial report by 31/03 of subsequent year		Audited reports, as of 28/02/2017	
	Number of reports	VET [kt CO_2eq/a]	Number of installations	Annual emission [kt CO_2eq/a]
2005	1815	473,681	1831	474,580
2006	1824	477,382	1781	477,602
2007	1882	487,050	1751	486,719
2008	1660	472,599	1671	472,098
2009	1651	428,198	1657	427,880
2010	1628	453,883	1641	454,467
2011	1631	450,267	1649	449,925
2012	1629	452,586	1623	452,216
2013	1929	480,937	1915	480,901
2014	1905	461,173	1898	461,178
2015	1889	455,528	1879	455,638
2016	1863	452,873		

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The significant increase in emissions between 2012 and 2013 can be traced back to the expansion of the material application 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. In addition, since 2013 the greenhouse gases nitrous oxide (N_2O, laughing gas) from adipic and nitric acid production and perfluorocarbons (PFCs) from primary aluminium production have been subject to emissions trading.

Free allocations in 2016

Free allocation as approved for 2016 by the European Commission prior to 28/02/2017 is the basis for the assessment of the allocation situation, i.e. comparison of emissions and free allocations. At this time not all allocation changes that are relevant for 2016 are necessarily approved. That is, the representation of the allocation situation does not include any allocation corrections after 28/02/2017.

The allocation amount approved by the European Commission is included in the National Allocation Table NAT[1], which specifies the free basic allocation for 1,763 existing installations and the first corrections of this basic allocation for individual installations as approved by the European Commission by 28/02/2017. These are, amongst others, allocation changes resulting from partial cessations or capacity reductions. In addition, allocation amounts for new market entrants approved by the European Commission by 28/02/2017 are taken into account, i.e. for new installations or a capacity increase in existing installations which became operational from 01/07/2011. As of 28/02/2017, 1,652 installations of those considered in the 2016 VET report received free allocations for 2016 totalling 154 million allowances.

Emission and production trends

Emission and production trends for some sectors and activities are being compared for the first time. 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.

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 2016 compared to 2005 (2005 = 100 percent) and the corresponding emissions (in absolute quantities) 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, for example, not all companies organised into an association necessarily operate installations subject to emissions trading and vice versa. Also, data on activity rates only stems from those installations that are currently subject to emissions trading and have received a basic allocation as existing installations or new market participants, i.e. not all installations subject to 2016 emissions trading and their production are considered – such as energy installations.

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, the report also includes data on installations which were decommissioned before 2016 or which, for example, have not been subject to emissions trading due to small capacities.

EU data

Allocation and emissions data processed by the EEA were primarily used as a basis for the evaluations at EU level both in the sector Chapters 2.1 to 2.8 and in Section 3.2 "Germany and Europe: emissions and surpluses" (see EEA, 2016).

For 2016, these are supplemented with excerpts from the Union Registry published by the European Commission on 03/04/2017 and 02/05/2017 (see COM 2017a and COM 2017b) and Press Release of 17/05/2017 (see COM 2017e). Information on auction volumes has been provided by EEX and ICE.

1 Cf. DEHSt 2013b

The evaluations in the sector chapters are based on a summary of the installations by activities in the EU Union Registry (see Table 55, Chapter 8), thereby differences may occur in the amount of emissions per sector for Germany. Although 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 iron and steel industry where this correspondence 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 industrial sectors – Activities 1 to 29 as per Annex 1 TEHG

2.1 Energy installations

In 2015, 952 energy installations (Activity 2 to 6 Annex 1 TEHG installations) were subject to emissions trading. Eight installations first became subject to emissions trading in 2016 and two installations first are regarded as stand-alone installations due to installation separations. In contrast, 25 energy installations closed their operation or will no longer be regarded individually due to installation merging. On balance, participation in emissions trading decreased by 15 installations compared to 2015.

The emissions from these installations decreased by about 2.5 million tonnes of carbon dioxide compared to the previous year and amounted to about 329 million tonnes in 2016 (see Table 2). The free allocation of 26 million emission allowances and the estimated allocation amount of approximately 19 million emission allowances arising from the use of waste gases from iron, steel and coke production and the export of heat to other installations subject to emissions trading cover nearly 14 percent of emissions.

Table 2: Overview of energy installations (Activities 2 to 6), number of installations, summary of emission and allocation amounts

Sector/Activity	Number of installations	2015 emissions [kt CO_2eq]	2016 allocation amount* [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Energy installations	952	332,075	45,518	329,565	13.8 %

* Extended by the estimated allocation amount from the use of waste gases from iron, steel and coke production and heat export to other ETS installations
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Emissions

Emissions have increased from 543 installations compared to the previous year, while emissions from 392 installations have declined. 17 installations did not emit carbon dioxide in 2016 and, to some extent, in 2015 as well.

With a 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). Although more than half of the 483 large combustion plants have emitted more than in the previous year, on the whole, the emissions from all large combustion plants have decreased by about 0.8 percent (see Table 3). This reflects the fact that although power generation from hard coal and lignite has declined, power generation from natural gas is significantly higher than in 2015.[2]

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Table 3: Energy installations (Activities 2 to 6), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installa-tions	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
2	Energy conversion ≥ 50 MW RTI	2016 VET › 2015 EM	264	138,527	156,448	17,921
		2016 VET ‹ 2015 EM	211	186,825	166,434	-20,391
		2016 VET = 2015 EM	4	0	0	0
		Comparison not possible	4	-	-	-
			483	325,376	322,928	-2,470
3	Energy conversion 20-50 MW RTI	2016 VET › 2015 EM	258	3,146	3,506	360
		2016 VET ‹ 2015 EM	136	2,102	1,811	-291
		2016 VET = 2015 EM	3	0	0	0
		Comparison not possible	6	-	-	-
			403	5,250	5,383	69
4	Energy conversion 20-50 MW RTI, other fuels	2016 VET › 2015 EM	5	69	75	6
		2016 VET ‹ 2015 EM	6	82	78	-4
			11	151	153	2
5	Prime movers (engines)	2016 VET › 2015 EM	1	5	6	1
		2016 VET ‹ 2015 EM	2	57	42	-15
			3	63	49	-14
6	Prime movers (turbines)	2016 VET › 2015 EM	15	267	324	56
		2016 VET ‹ 2015 EM	37	969	729	-240
			52	1,236	1,052	-184
Total			**952**	**332,075**	**329,565**	**-2,597**

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On the other hand, energy installations with a RTI between 20 and 50 MW (Activities 3 and 4 as per Annex 1 TEHG) produced about 2.5 percent more emissions compared to 2015. 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 depend on weather-related heat demand.

Therefore, cooler weather conditions compared to the previous year certainly had an impact on the emission increase. Although 2016 was also one of the warmest years since the start of measurements in 1881, the temperatures, especially in the heating season, were significantly lower in a direct comparison to 2015. The emission trend of energy installations between 20 and 50 MW RTI also reflects the fact that district heating and cooling generation in Germany increased by 2.5 percent compared to the previous year[3]. Even if the 414 installations were in a similar order of magnitude, Activity 3 and 4 installations emitted significantly less than large combustion plants. In 2016, they emitted about 5.5 million tonnes of carbon dioxide, i.e. only 1.7% of the amount emitted by large combustion plants.

Only 0.4 percent of the total emissions from energy installations can be attributed to prime mover engines and turbines (Activities 5 and 6 as per Annex 1 TEHG). Emissions from these installations, which are used for the transport, storage and treatment of natural gas, have decreased significantly by 15 percent compared to the previous year.

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The operation of these installations depends on the conditions in the natural gas grid, and a decrease in emissions would suggest that natural gas consumption in Germany decreased. However, this was not the case in 2016: natural gas consumption in Germany increased last year by 9.5 percent.

However, Germany's natural gas exports decreased by almost one-third after a significant increase in 2015[4]. Significant efficiency gains resulting from modernisation measures may be further reasons for the emission decrease – despite increased domestic consumption. An increased use of electrically operated compressors could also have contributed to a reduction in emissions.

Figure 5 shows the emissions for energy installations since the start of emissions trading. 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. By 2014 the emissions no longer continued to increase. Also in 2016, emissions from energy installations declined, albeit less markedly than in the previous years: While the decline was five percent in 2013/2014 and one percent in 2014/2015, the current decrease is only slightly less than 0.8 percent in 2015-2016.

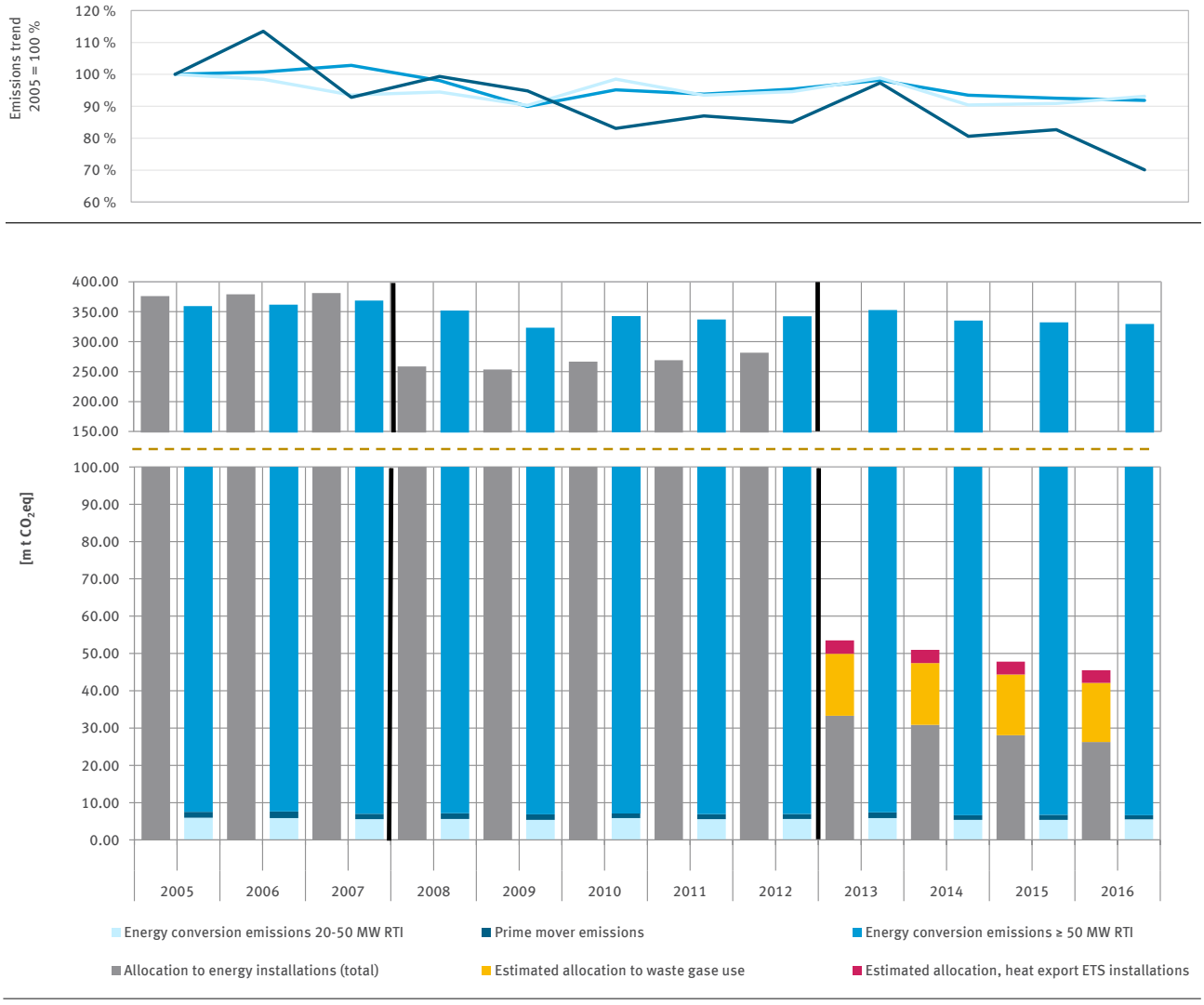

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Figure 5: Energy installations (Activities 2 to 6), emissions and free allocation in Germany from 2005 to 2016[5]

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

Since the introduction of emissions trading, apart from 2009, energy installations have reached the lowest emission level. In 2016, large combustion plants and energy installations between 20 and 50 MW caused 92 and 93 percent of the 2005 emissions, respectively.

The reduction in emissions from prime movers is more pronounced. Compared to 2005, 2016 emissions are only around 70 percent.

Emissions from main fuels

Figure 6 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[6]. 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.

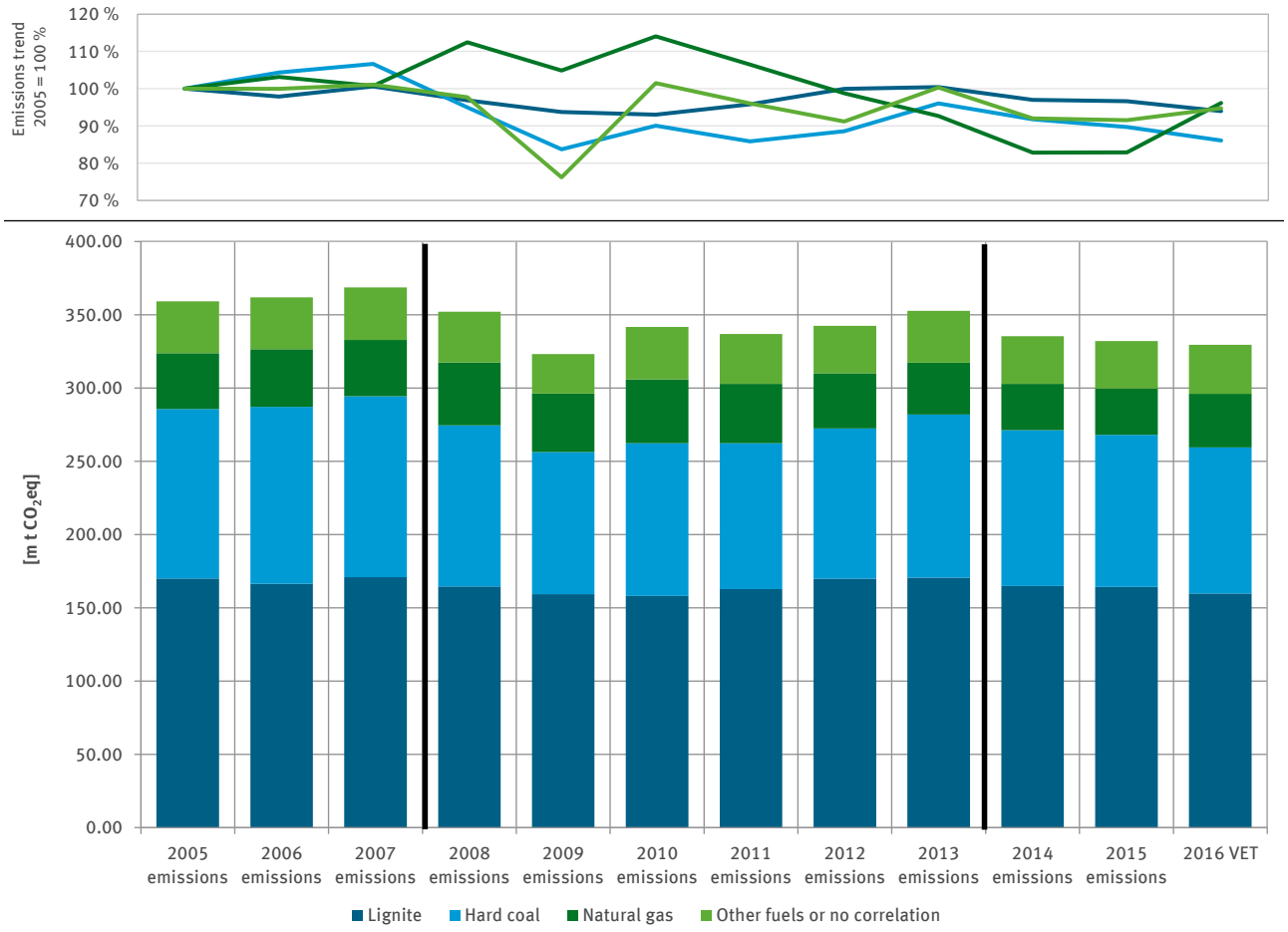

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Figure 6: Energy installations (Activities 2 to 6), emissions from 2005 to 2016 in Germany, according to fuel

Emissions from lignite from 2015 to 2016 decreased by roughly three percent compared to the previous year. This decline is attributable to the decline in producing power from lignite, which also fell by three percent compared to the previous year[7]. The emissions attributable to the main fuel (hard coal) fell for the third year in a row and were four percent below the previous year's figure. In addition to the structural change in energy supply towards renewable energy, this decline is also due to the fact that hard coal has become significantly more expensive. This is also accompanied by a shift in the price structure between hard coal and natural gas, which in turn makes the use of natural gas more attractive.

6 In contrast, the VET reports up to 2014 applied an assignment to a main fuel, provided that more than 80% of energy consumption in an installation could be assigned to a fuel.

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In addition, the cooler weather and the positive effects resulting from the amendment to the Combined Heat and Power Generation Act[8] have led to a very significant increase in the emissions of natural gas-fired installations of 16 percent compared to 2015.

Based on 2005, the first year of emissions trading, emissions from installations that use lignite as the main fuel only decreased by roughly six percent. Emissions from installations using hard coal as the main fuel decreased much more noticeably. Compared to 2005, the decline in the twelfth year of emissions trading amounts to nearly 14 percent for hard coal. After a 17% drop for natural gas in 2015 compared to 2005, the decline for 2016 was only 4% compared to 2005.

Emission and production trends

Figure 7 compares the emission trend of energy installations – differentiated by large combustion plants, energy installations between 20 and 50 MW RTI and prime movers – with the trend of fossil fuelled gross electricity generation in Germany, the activity rates for heat and fuel benchmarks and the average degree days.[9, 10, 11]

Although large combustion plants represent only a part of those installations whose electricity generation is included in the calculation of German gross electricity generation, the trends of fossil fuelled gross electricity generation and emissions from large combustion plants, which are significantly influenced by electricity generation, are largely identical. Slight deviations are likely to result mainly from shifts between electricity generation from hard coal and natural gas. Emissions and electricity generation trends only failed to follow the same trend in 2015/2016: while 2016 fossil fuelled gross electricity generation increased by about two percent, emissions from large combustion plants declined by 0.8 percent. In this case too, changes in the fuel mix are the cause. While electricity generation from emission-intensive coal dropped, much more electricity was generated from the lower-emission natural gas. Compared to 2005, 2016 emissions from large combustion plants decreased by more than eight percent, fossil fuelled gross electricity generation by only seven percent, which indicates an improvement in the specific emissions of electricity generation.

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9 AGEB 2017, Gross electricity generation from lignite, hard coal, natural gas and mineral oil

10 Data on activity rate for the heat benchmark is taken from the allocation applications and the reports on the operation of energy installations. Correspondingly, only those heat amounts are taken into account for which a free allocation is made to the heat producer.

11 Average of the Hamburg-Fuhlsbüttel, Düsseldorf, Berlin-Tempelhof, Dresden-Klotzsche, Frankfurt/M-Airport, München/Airport weather stations. DWD, cf. IWU 2017

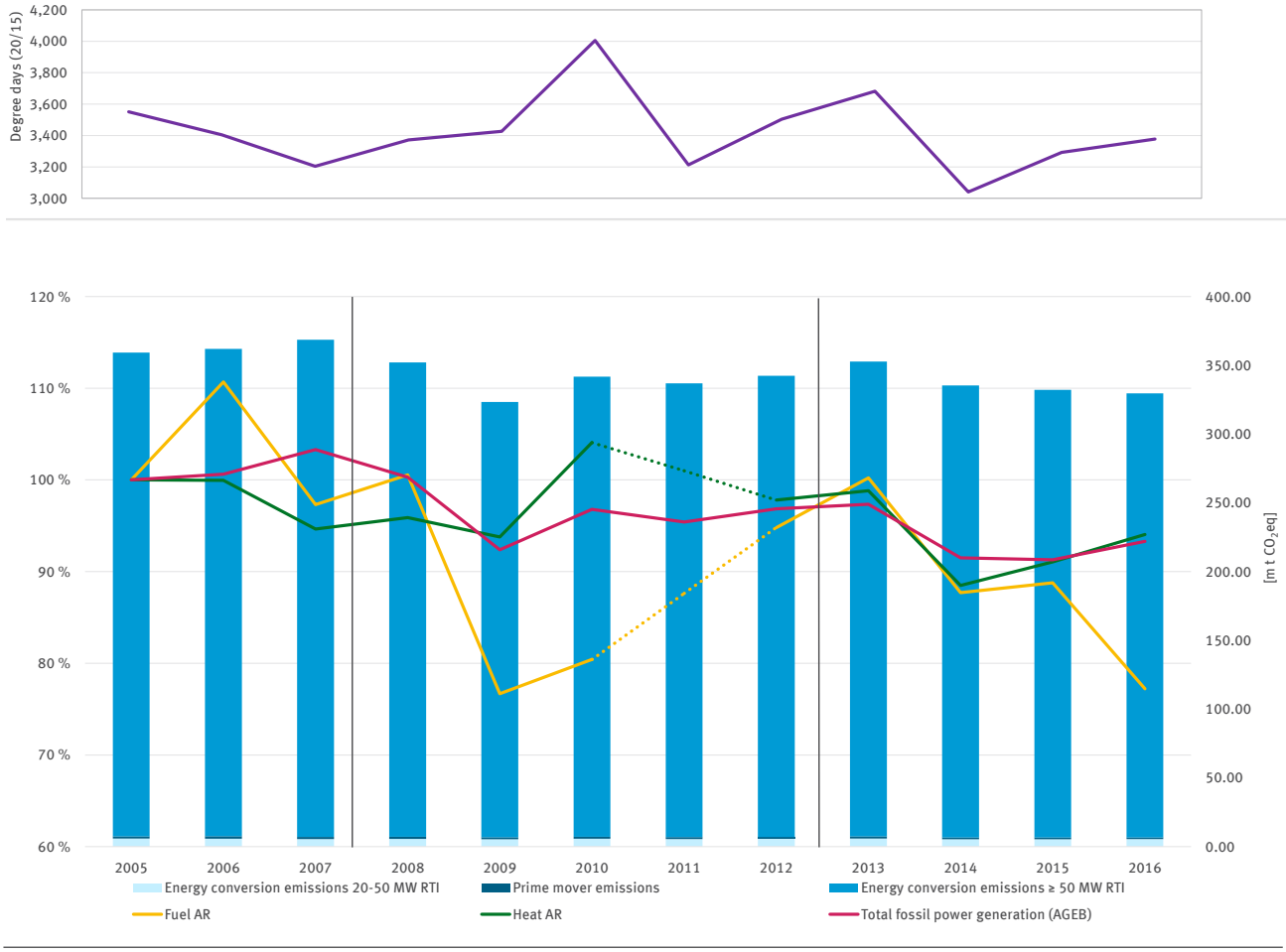

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Figure 7: Energy installations (Activities 2 to 6), emissions and production from 2005 to 2016 in Germany

In the case of energy installations between 20 and 50 MW RTI, whose emissions are characterised by heat demand, the emissions trend corresponds to the activity rates for the heat benchmark and also degree days. Even if some of the heat consumption – for example in the industry – is independent of the weather, the „peaks“ in heat generation and emissions in the colder years of 2010 and 2013 and the 2014 decline, i.e. the warmest year since weather recording started, are clearly recognisable. Compared to 2005, emissions from energy installations between 20 and 50 MW RTI declined by about seven percent, activity rates for „measurable heat“ by about six percent. This can be evaluated as a slight improvement in efficiency. However, the greatest contribution to improving efficiency is not visible: in 2016, more than two-thirds of net heat generation in Germany came from combined heat and power plants (CHP plants)[12].

The trend in emissions and activity rate for the fuel benchmark also reveals weather dependency for prime mover engines in the gas industry. However, it is also affected by other influencing factors such as the industry's cyclical demand or the use of natural gas in electricity generation. Compared to 2005, the emissions from prime mover engines declined by about 30 percent, while the activity rate decreased by only about 23 percent. This also suggests that efficiency has improved significantly.

Allocation status

While 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', the free allocation for electricity generation was replaced by full auctioning in the third trading period (cf. Figure 5). Accordingly, only about 26 million free emission allowances were granted to energy installations for heat generation in 2016. These cover approximately eight percent of the surrender obligation for emissions from the installations (Table 4).

12 Ziesing 2017

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 first of all used 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 goes to producers of waste gases from iron, steel and coke production and a part of the allocation for heat production does not go to the producers but to heat consumers (see Chapters 2.4, 2.7 and 2.8). An allocation volume of about 19 million emission allowances can be estimated from the use of waste gases from iron, steel and coke production and heat export to other installations subject to emissions trading. Taking these estimated quantities into account, a somewhat higher allocation coverage is obtained at around 14% (see Table 2 and Figure 5).

Table 4: Energy installations (Activities 2 to 6), number of installations, allocation amounts, VET entries and 2016 allocation coverage

No.	Activity	2016 VET vs. 2016 allocation	No. of installations	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
2	Energy conversion ≥ 50 MW RTI	2016 VET › 2016 AA	417	321,841	19,984	-301,857	6.2 %
		2016 VET ‹ 2016 AA	56	1,053	1,929	876	183.2 %
		2016 VET = 2016 AA	8	0	0	0	
		Comparison not possible	2	-	-	-	
			483	322,928	21,931	-300,981	6.8 %
3	Energy conversion 20-50 MW RTI	2016 VET › 2016 AA	314	4,737	2,433	-2,304	51.4 %
		2016 VET ‹ 2016 AA	82	646	1,016	370	157.3 %
		2016 VET = 2016 AA	5	0	0	0	
		Comparison not possible	2	-	-	-	
			403	5,383	3,449	-1,934	64.1 %
4	Energy conversion 20-50 MW RTI, other fuels	2016 VET › 2016 AA	3	134	23	-111	17.2 %
		2016 VET ‹ 2016 AA	8	19	105	86	556.4 %
			11	153	128	-25	83.8 %
5	Prime movers (engines)	2016 VET › 2016 AA	2	46	30	-16	65.3 %
		2016 VET ‹ 2016 AA	1	3	5	2	191.7 %
			3	49	35	-14	71.9 %
6	Prime movers (turbines)	2016 VET › 2016 AA	34	921	532	-389	57.8 %
		2016 VET ‹ 2016 AA	18	132	188	56	142.8 %
			52	1,052	720	-332	68.4 %
Total			**952**	**329,565**	**26,263**	**-303,286**	**8.0 %**

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Another effect that will continue to gain influence over this trading period is the gradual reduction of the allocation for products without carbon leakage risk. This reduction factor was 0.8 for the first year of the third trading period, it had dropped to 0.59 in 2016 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[13]. Assuming that emissions remain at the same level, allocation coverage for energy installations will continue to decrease.

While large combustion plants only received a free allocation for somewhat less than seven 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 65 percent of their emissions. Activity 4 installations, in which biomass and fuels with biogenic components are used, have an even higher allocation coverage of 84 percent. Prime movers (engines and turbines) have mainly received a free allocation via the fuel benchmark for producing mechanical work[14]. On average, prime movers received a free allocation covering 69 percent of their emissions.

"Combustion" activity in the EU

Figure 8 shows an overview of the EU-wide emissions trend from the "combustion" activity[15] since the start of emissions trading. It differentiates between the emissions trend of German Activity 1-6 installations (Appendix 1 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.

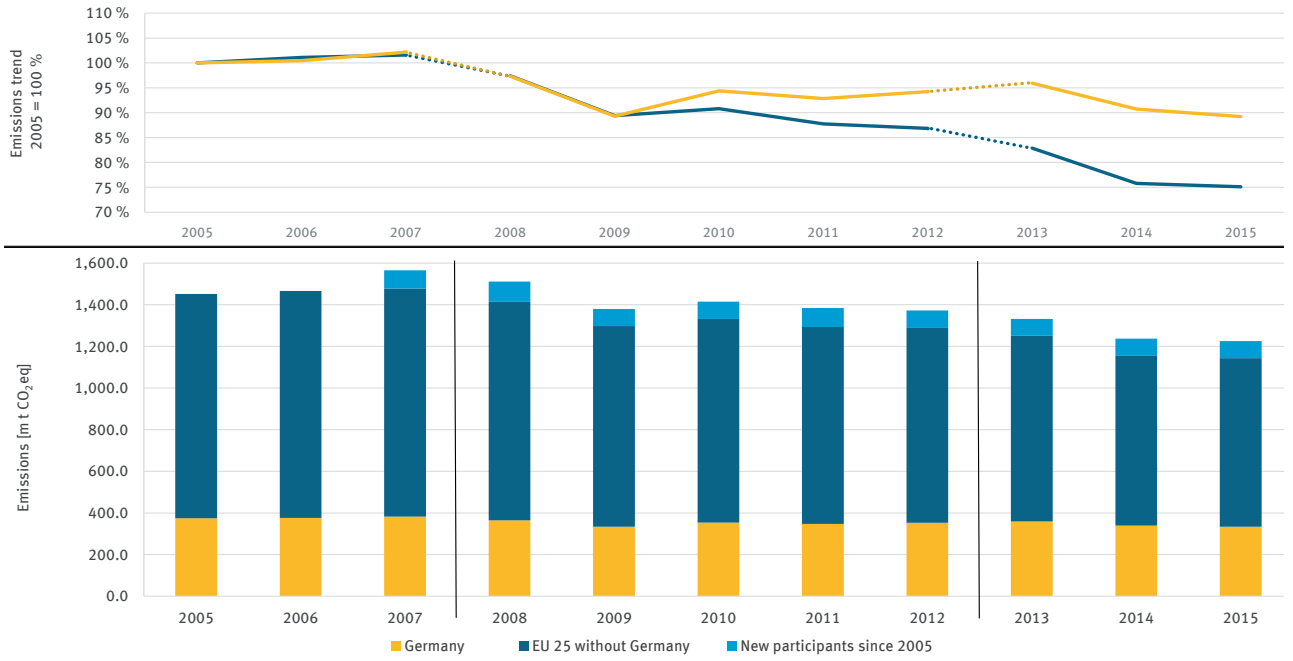

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Figure 8: Emissions trend from 2005 to 2015 from combustion and energy (Registry activity 20) in Germany and the EU[16]

Until the financial and economic crisis, the emissions trends between German and EU installations, to which combustion activity is assigned, correspond very well. The emissions reached their highest level in 2007 since the introduction of emissions trading, then they fell very significantly during the economic crisis.

13 DEHSt 2014a

14 Cf. DEHSt 2014a, Chapter "Energy installations"

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

16 Data source: EEA 2016; The evaluation is based on a summary of the installations by activities in the EU Union Registry (cf. Table 52, Chapter 8). This can lead to differences in emission amounts per sector for Germany. New EU ETS participants after 2005 are Bulgaria, Iceland, Croatia, Liechtenstein, Norway and Romania.

But from 2010, the trends are diverging: emissions of German installations rose again from 2010 and only started to decrease in 2013. In contrast, the average emissions of all other Member States – apart from a slight increase in 2010 – have steadily decreased (cf. Section 3.2.1). Compared to the first year of emissions trading, German installations to which combustion activity is assigned, still reached 89 percent of the 2005 emissions in 2015. The emission level from other Member State installations was down to 75 percent of the 2005 emissions.

In 2015, the share of German installations with combustion activity represents around 27 percent of the total EU emissions due to this activity.

2.2 Other combustion

Slightly more than 70 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 43 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 asphalt mixing plants and process heaters. Compared to the previous year, one new installation has been added and two installations no longer participate in emissions trading.

Table 5 shows the data framework of this group where installations emitted a total of 574,000 tonnes of carbon dioxide and still have a high allocation coverage of nearly 90 percent of their actual emissions.

Table 5: Overview of other combustion plants (Activity 1), number of installations, summary of emissions and allocation amounts

Sector/Activity	Number of installations	2015 emissions [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Other combustion plants	43	581	508	574	88.5 %

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Emissions

Even though over half of the installations emitted more than in 2015, the balance for all installations in the group yields an overall emission decrease of 1.2 percent over the previous year (see Table 6).

Table 6: Other combustion plants (Activity 1), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installations	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
1	Combustion	2016 VET › 2015 EM	25	249	274	25
		2016 VET ‹ 2015 EM	16	332	300	-32
		2016 VET = 2015 EM	1	0	0	0
		Comparison not possible	1	-	-	-
Total			**43**	**581**	**574**	**-7**

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Figure 9 shows the emission trend since 2005. These installations have only participated in emissions trading since 2013, therefore the 2005 to 2010 figures are historic data reported by the operators in the allocation process. There is no available emission data for 2011 and 2012. The installation group is very varied so that no general conclusions can be drawn from the emission trend.

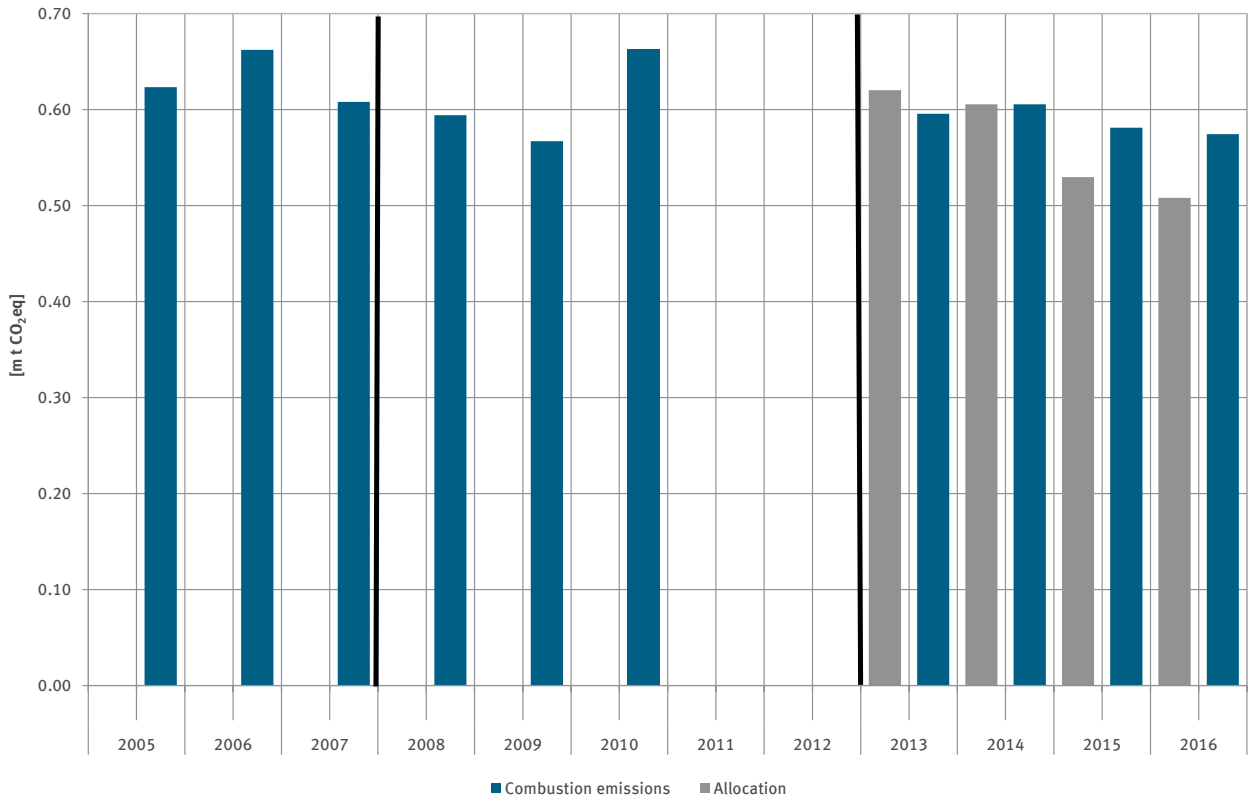

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Figure 9: Other combustion plants (Activity 1), emission and free allocation trend in Germany, 2005-2016

Allocation status

The group as a whole still achieved a high offset using the free emission allowances equivalent to about 90 percent. However, the allocation status for the individual installations is very different: allowances had to be purchased for the majority of installations. The average allocation coverage for these installations is a good 61 percent. In contrast, twelve installations received about 118,000 emission allowances more than was needed to offset their emissions.[17] This corresponds to an average allocation coverage of about 220 percent.

Table 7: Other combustion plants (Activity 1), number of installations, allocation amounts, 2016 VET entries and allocation coverage

No.	Activity	2016 VET vs. 2016 allocation	No. of installa-tions	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
1	Combustion	2016 VET › 2016 AA	30	476	292	-184	61.3 %
		2016 VET ‹ 2016 AA	12	99	216	118	219.3 %
		2016 VET = 2016 AA	1	0	0	0	
Total			**43**	**574**	**508**	**-66**	**88.5 %**

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17 The majority of these installations are engine test rigs whose emissions are subject to large fluctuations from year to year due to an irregular use.

2.3 Refineries

In 2016, 23 installations belonged to refineries (Activity 7 in Annex 1 TEHG).

Two installations were combined, which means there was one less installation compared to 2015. This still includes Wilhelmshaven refinery that ceased its refinery operation and currently only operates as a terminal, but is still subject to emissions trading.

Although the activity description in Annex 1 TEHG remains unchanged for refineries during the third trading period, some installations will face changes in their scope due to the merger of previously separately approved installation sections or due to the establishment of a so-called uniform installation pursuant to § 24 TEHG, which is mandatory for refineries in the third trading period. As a result, all refinery power plants (with the exception of the Leuna and Salzbergen power plants) are considered industrial installations jointly with the associated refinery.[18]

Table 8: Overview of refineries (Activity 7), number of installations, summary of emission and allocation amounts

Sector/Activity	Number of installa-tions	2015 emissions [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Refineries	23	24,871	19,382	25,286	76.7 %

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The total emissions from the refineries amounted to 25.3 million tonnes of carbon dioxide in 2016. Compared to 24.9 million tonnes of carbon dioxide in 2015, the emissions increased by about 1.6 percent or 415,000 tonnes of carbon dioxide (see Table 9).

Same as in 2015, the free allocation was not sufficient to fully cover the emissions subject to surrender and was around six million emission allowances or around 23 percent less than the amount required to meet the obligation to surrender.

Emissions

Table 9 compares the 2015 emissions with the 2016 VET entries.

Table 9: Refineries (Activity 7), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installa-tions	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
7	Refineries	2016 VET › 2015 EM	11	11,331	12,308	977
		2016 VET ‹ 2015 EM	12	13,540	12,978	-562
Total			**23**	**24,871**	**25,286**	**415**

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Specifically, there are eleven installations where emissions increased by 977,000 tonnes, or nine percent, and twelve installations where emissions declined by 562,000 tonnes of carbon dioxide, or four percent.

18 The operators of the Leuna and Salzbergen power plants are not the operators of the respective refineries, which is why the refinery and the power plant do not form a joint installation. Therefore, both power plants are in principle assigned to the energy installations in the VET report (see Section 2.1). Only in Figure 10 and Figure 11 does the section „Refineries“ account for emissions from the two power plants, showing them as complementary to the emissions from the refineries.

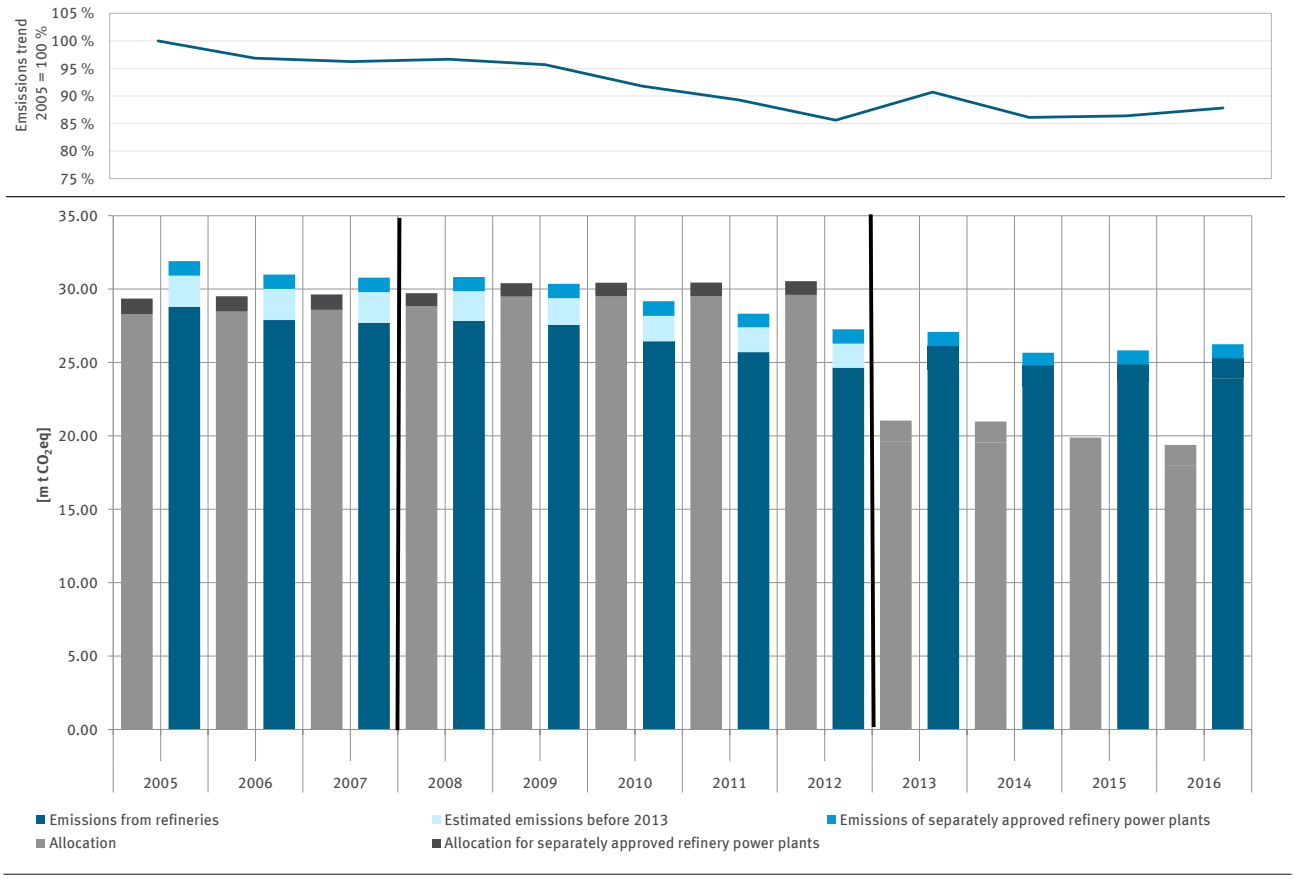

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Figure 10: Refineries (Activity 7), emission and free allocation trends in Germany, 2005 to 2016, allocation status

Figure 10 shows the emissions and the free allocation of the refineries for 2005 to 2016, supplemented by the emissions and allocation amounts for the Leuna and Salzbergen refinery power plants. There was a newly added installation in 2013, for which the figure only shows estimated emissions for the 2005-2012 period[19].

After they continuously declined in the second trading period, emissions stabilised in the third trading period and even increased in 2016 compared to the previous year.

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

19 Emissions from 2005 to 2010 are based on data from the allocation procedure. There are no available historical emissions for 2011 and 2012; the values for both years were estimated through linear interpolation.

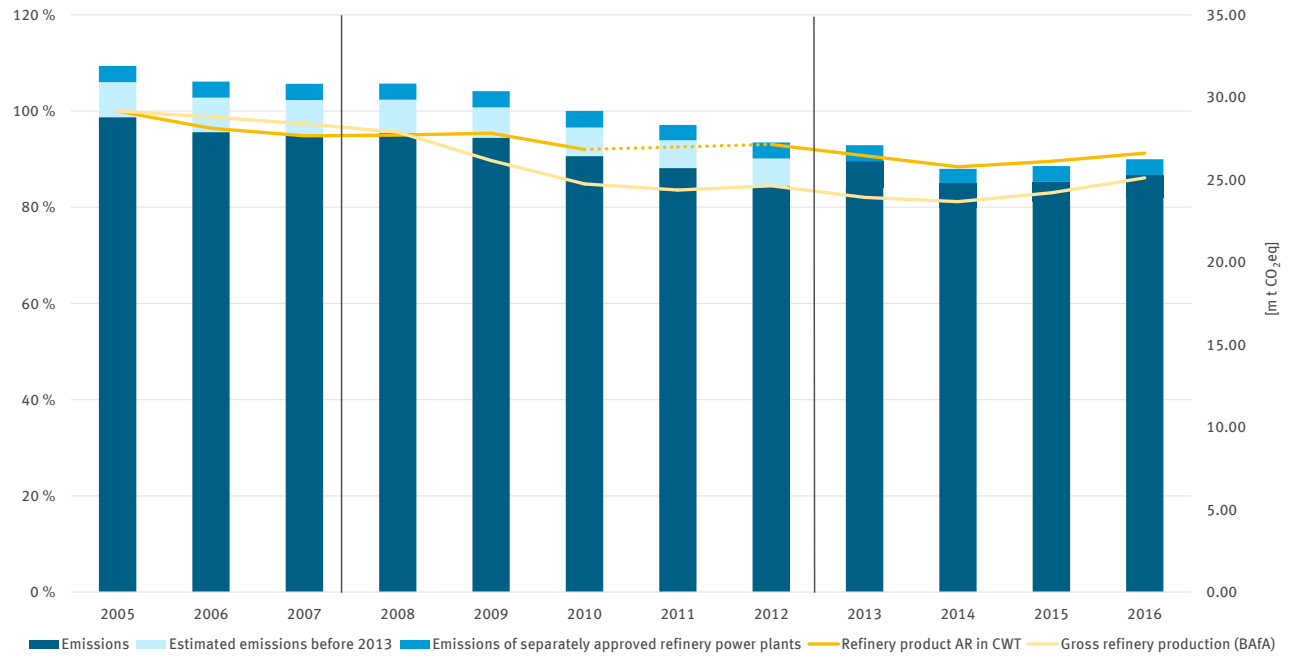

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Figure 11: Refineries (Activity 7), emission and production trends in Germany, 2005 to 2016

Figure 11 compares the emission trend with the activity rate trend for the „CWT“ product benchmark (CO_2 Weighted Tonne) and German gross refinery production. The CWT value of a refinery is derived from the sum of the annual input quantities of its individual processes, each weighted with the process-typical CO_2 emission intensity. The CWT activity rate is, strictly speaking, not a production quantity but the sum of the annual consumption amounts of the sub-processes. Compared to the CWT, it must also be taken into account that the gross refinery production also covers products of atypical refining[20] such as lubricants or bitumen.

Overall, the emission trend reflects the production trend relatively well between 2005 and 2016. The decrease in emissions, especially in the second trading period, could be attributed primarily to the decline in German gross refinery production. This has risen again in 2014 and now continues to increase (plus 3.8 percent compared to 2015)[21]. Emissions have increased less sharply in the same period. Possible reasons for this are the use of low-emission fuels, and a shift in the product mix towards products with lower specific CO_2 emissions.

20 The allocation for atypical refineries is carried out via fallback approaches or other product benchmarks (e.g. „hydrogen“ and „steam cracking“).

21 See BAfA 2017

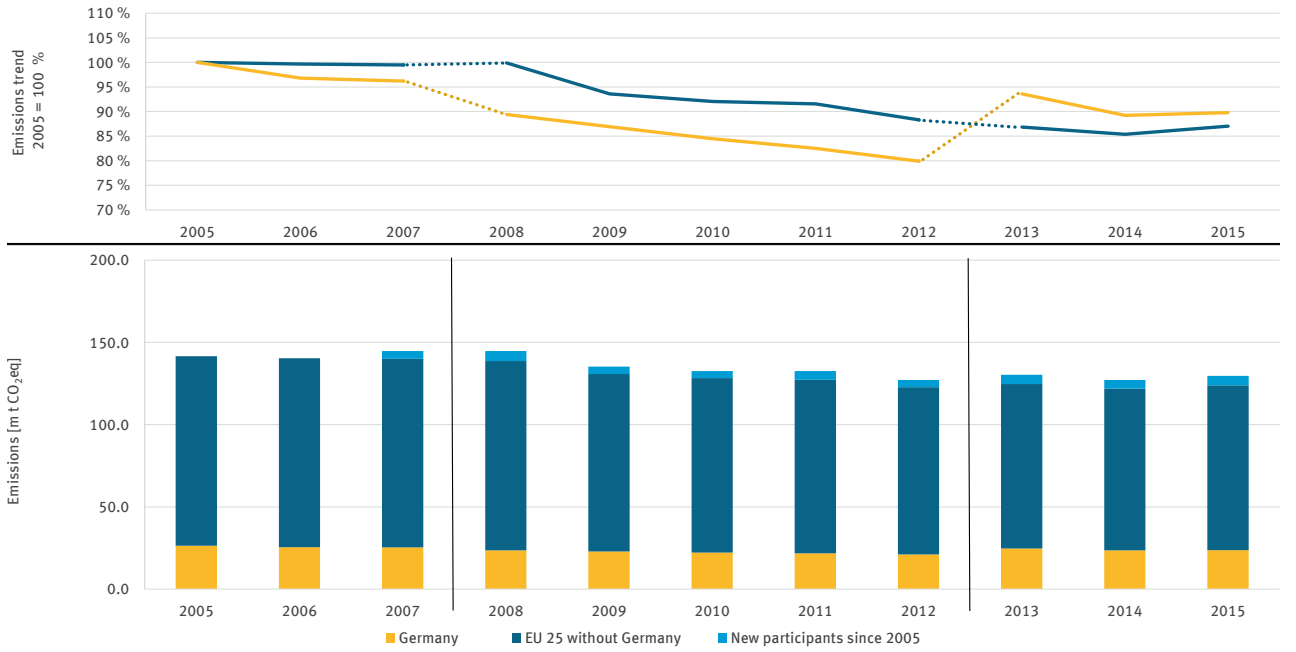

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Figure 12: Emission trend of the refineries (Registry Activity 21) in Germany and in the EU, 2005 to 2015[22]

Figure 12 shows the carbon dioxide emissions trend from the 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 higher level of emissions from the refineries in Germany after 2013 can be attributed in particular to the mandatory establishment of a so-called uniform installation from the third trading period according to § 29 (3) of the 2020 Allocation Ordinance (ZuV), as well as to an additional installation in 2013. Nothing in particular in the average of other EU-25 States suggests that there have been any significant changes in the scope during the transition into the third trading period.

The trend of decreasing emissions did not continue in either the German refineries nor in all of the EU countries in 2015. Compared to 2014, EU emissions increased by slightly more than two percent. At just under one percent, the increase in Germany was barely half as much.

Allocation status

In the majority of installations – 17 out of 23 – free emission allowances allocated in 2016 covered on average 71.6 percent of the emissions subject to surrender (Table 10). They covered around 75 percent in the previous year. As a result, the additional shortfall of installations that could not cover their emissions through free allocation in 2015 has further increased.

Five installations continued to receive a higher allocation than they needed for surrender. Three of these installations were supplied by other operators' power plants. This surplus allocation amounted to 263,000 emission allowances or 7.3 percent in 2016 (this was around 20 percent in 2015).

22 Data source: 2016 EEA. The evaluation is based on a summary of the installations according to the activities in the EU Union Registry (see Table 52, Chapter 8). 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

Table 10: Refineries (Activity 7), number of installations, allocation amounts, VET entries and 2016 allocation coverage

No.	Activity	2016 VET vs. 2016 allocation	No. of installa-tions	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
7	Refineries	2016 VET › 2016 AA	17	21,708	15,542	-6,167	71.6 %
		2016 VET ‹ 2016 AA	5	3,578	3,840	263	107.3 %
		2016 VET = 2016 AA	1	0	0	0	
Total			**23**	**25,286**	**19,382**	**-5,904**	**76.7 %**

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Thus, the sector had an overall shortfall in 2016, just as in 2015. This amounts to around 5.9 million emission allowances (23 percent of the emissions) and is slightly higher than in 2015, when the additional shortfall was around 4.7 million emission allowances or 19 percent.

2.4 Iron and steel industry including coking plants

The iron and steel industry includes Activities 8 to 11 as well as an Activity 1 installation[23] as per TEHG, which means a total of 126 installations subject to emissions trading in Germany. Compared to 2015, the number of installations decreased in Activity 10 by two installations (due to one decommissioning and one regrouping into Activity 11), while Activity 11 increased by one installation (through the aforementioned regrouping; there was also a new installation and a decommissioned installation).

Activities 8 (coke plants), 9 (metal ore processing, i.e. sinter plants) and 10 (pig iron and steel production) are considered as grouped together. 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 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 due to pollution control or the establishment of „uniform installations“ according to § 24 TEHG in conjunction with § 29(3) of the 2020 Allocation Ordinance. In other cases, coking plants and sinter plants participate in the EU ETS as separate installations. In addition, waste gases from iron, steel and coke production are transferred between Activities. A differentiated view according to Activities would therefore result in a distorted picture due to the different system boundaries.[24]

Table 11 shows the emissions for 2015 and 2016 and the adjusted 2016 allocation amounts, i.e. the issued allocation amount minus about 15.9 million emission allowances, which can be estimated from the transfer of waste gases from iron, steel and coke production to energy installations (for detailed explanations, see Sections „Transfer of waste gases from iron, steel and coke production“ and „Allocation Status“). The adjusted allocation coverage results accordingly from the adjusted allocation amount compared to the VET and amounts to 89.9 percent for 2016. This means that the iron and steel industry had to purchase just over ten percent of their required allowances or use the surplus from the second trading period.

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

24 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.

Table 11: Overview of the iron and steel industry (Activities 8 to 11 and 1), number of installations, summary of emission and allocation amounts

Sector/Activity	No. of installations	2015 emissions [kt CO_2eq]	2016 allocation amount* [1000 EUA]	2016 VET [kt CO_2eq]	Adjusted allocation coverage
Iron and steel	126	37,125	32,676	36,330	89.9 %

* Adjusted for the estimated allocation amount for transferred waste gases from iron, steel and coke production
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The nominal allocation without considering the adjustment amounts to 48.5 million emission allowances. The nominal supply for the entire action field therefore amounts to 133.6 percent.

Emissions

Table 12 shows the emissions trend compared to the previous year. The collective emissions from Activities 8 to 10 decreased by 801,000 million tonnes of carbon dioxide, i.e. by 2.5 percent compared to the previous year, while the production of crude steel decreased by 1.4 percent compared to 2015. Emissions from blast furnace route producing oxygen steel (including Activities 8 and 9) decreased by 822,000 tonnes of carbon dioxide (2.7 percent) compared to 2015. Emissions from electric steel production increased by 2.0 percent (22,000 tonnes of carbon dioxide). Emissions from ferrous metal processing (Activity 11) increased slightly by 8,000 tonnes.

Table 12: Iron and steel industry (Activities 8 to 11 and 1), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installations	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
8, 9, 10	Pig iron and crude steel production*	2016 VET > 2015 EM	17	15,542	16,383	840
		2016 VET < 2015 EM	18	16,287	14,646	-1,641
			35	31,829	31,029	-801
11	Ferrous metal processing	2016 VET > 2015 EM	47	2,705	2,879	174
		2016 VET < 2015 EM	42	2,531	2,364	-167
		Comparison not possible	1	-	-	-
			90	5,236	5,252	8
1	Combustion	2016 VET < 2015 EM	1	60	49	-12
			1	60	49	-12
Total			**126**	**37,125**	**36,330**	**-805**

* Coke ovens, metal ore processing, pig iron and steel production
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Figure 13 shows the historical emissions trend since the start of the EU ETS in 2005 as well as the allocation amounts. In the case of emissions up to and including 2012, it considers the reported emissions of the installation inventory according to the scope of the second trading period as well as the estimated historical emissions of the installations that were newly added to the emissions trading in 2013 under Activity 11 (see also DEHSt 2014b)[25].

25 For the presentation of this second trading period inventory, there was no retroactive revision of the inventory changes compared to the first trading period. This means that for 2005 to 2007, these bars represent the as-is emissions of the scope of the first trading period. Between these periods, however, there was no significant expansion of the scope in terms of emissions.

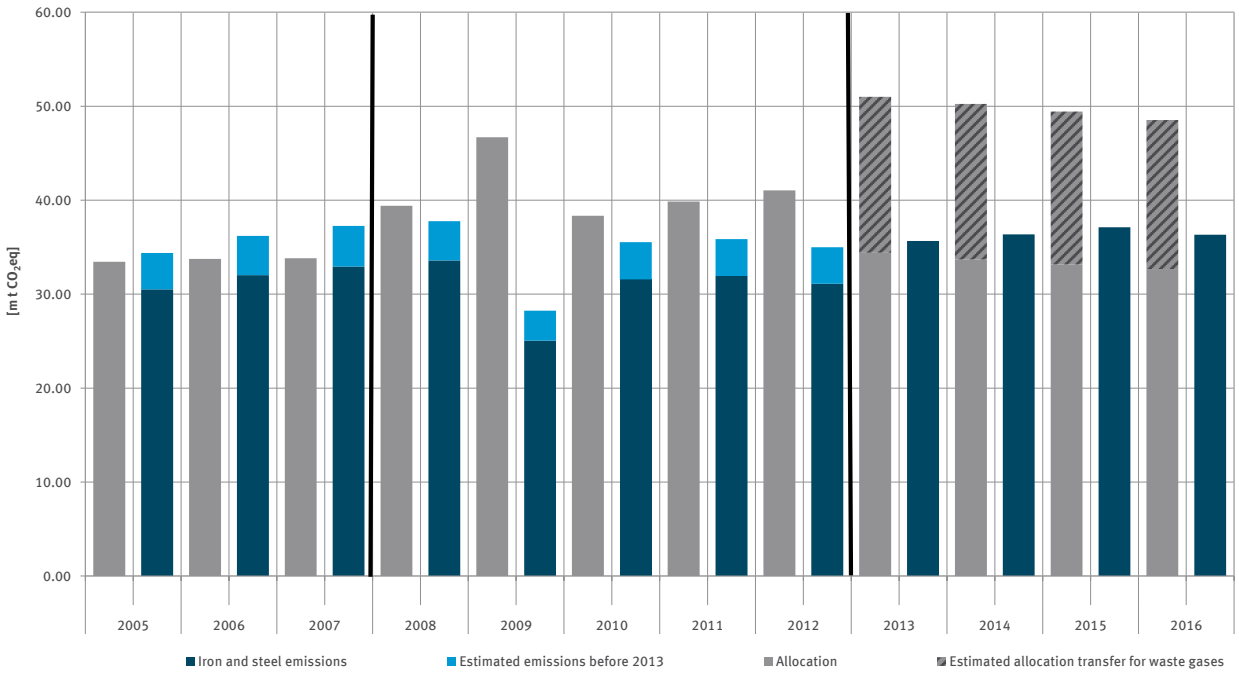

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Figure 13: Iron and steel industry (Activities 8 to 11 and 1), emission and free allocation trend in Germany, 2005 to 2016[26]

In line with the respective economic development, the total emissions have risen during the first trading period and declined slightly during the second trading period. They increased somewhat between 2013 and 2015, and decreased roughly to the value of 2014 in 2016. A clear trend towards a reduction of emissions cannot yet be deduced.

Figure 14 compares the emission and production trends. A distinction is made in both emissions and production between crude steel from blast furnaces (oxygen steel) and crude steel produced in the electric arc furnace (electric steel).[27] The activity rates of both products[28] are shown, supplemented by information provided by the German Steel Economic Association (WV Stahl).[29]

26 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. Under this scheme, producers of waste gases from iron, steel and coke production in the second trading period were legally obliged to pass emission allowances in the amount of their annual waste gas forwarding to the utilising installations. This also explains the fluctuating allocation in the second trading period since the forwarded waste gas amounts were very different 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.

27 Emissions from blast furnaces also contain emissions from coking plants and sinter plants.

28 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 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.

29 2005-2015 time period published by World Steel Association (WSA): Steel Statistical Yearbook; provisional value for 2016 on the WV Stahl website; see WSA (2015, 2016): Steel Statistical Yearbook 2015 (for 2005-2014); Steel Statistical Yearbook 2016 (for 2006-2015) and WV Stahl (2017): Crude steel production in Germany.

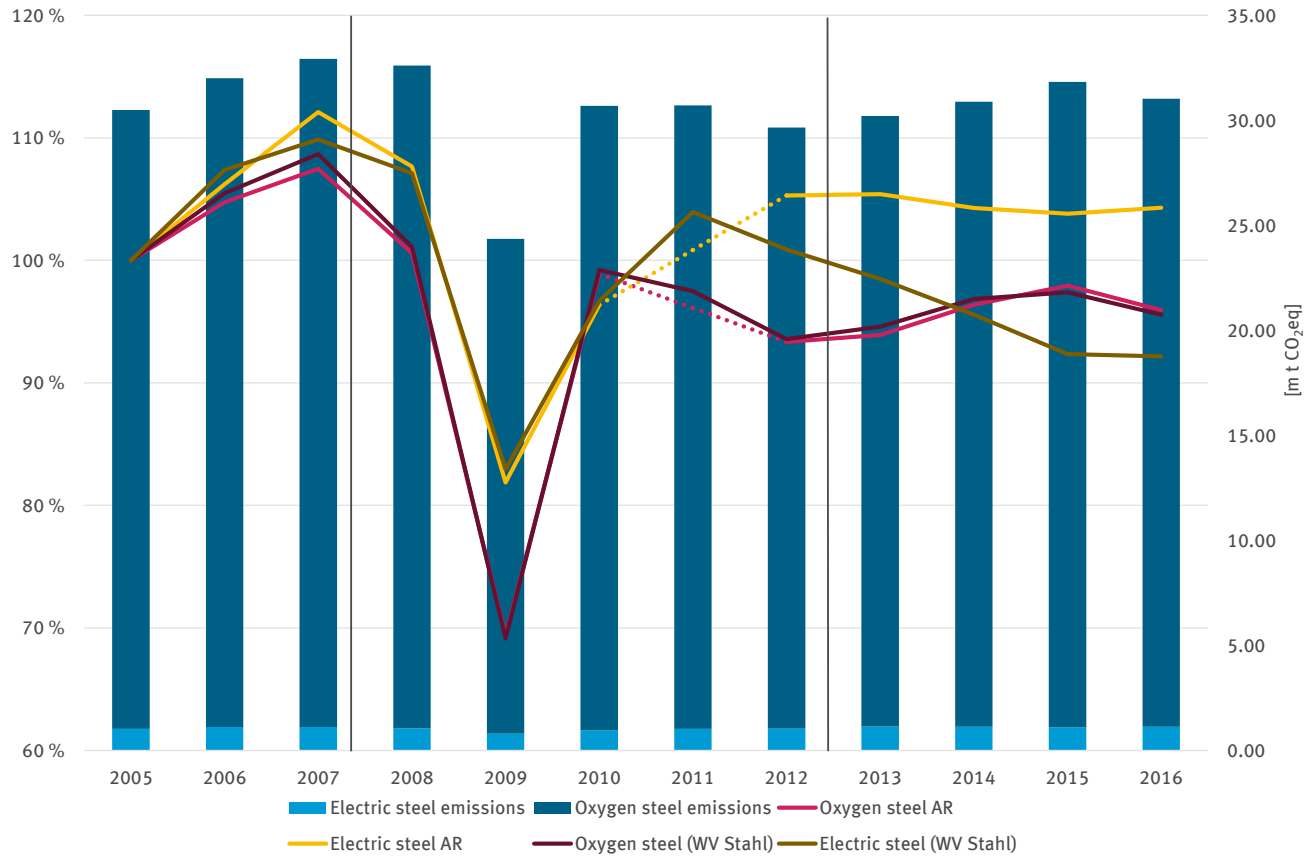

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Figure 14: Pig iron and crude steel production (Activities 8 to 10), emission and production trends in Germany, 2005 to 2016

The production trend for oxygen steel based on the activity rates and the data from WV Stahl have almost coincided since 2005, which also applies to electric steel. The figure only shows a gap between the activity rates trend and associated data as of 2012 because three electrical steelworks were decommissioned between 2012 and 2014. These installations are included in the production data of WV Stahl, but not in the activity rate nor in the emissions that relate only to installations that are currently subject to emissions trading.

The figure shows relatively similar emission and production trends for oxygen steel. Both the emissions from oxygen steel (minus 2.7 percent) and production (minus 1.9 percent) declined in 2016.[30] Emissions from electric steel production increased by 2.0 percent, while their production fell by 0.2 percent. However, these emissions carry little weight by comparison, since oxygen steel production including Activities 8 and 9 clearly dominates the emissions of raw steel production in Germany with a share of more than 95 percent.

Overall, Figure 14 shows a slight decrease in the emission intensity of crude steel production compared to 2015, while the 2015 intensity was still higher than in 2014. One reason for changes in specific emissions could be the domestic production of coke: the activity rate for the „coke“ product benchmark has increased by a total of about 18 percent since 2012. The increased production of coke that replaces imported coke may be an explanation for increased emissions. Further major factors for 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 could be the change in raw material quality (ores).

30 See BDSV 2017: Press release of 17/03/2017 - 2016 Steel scrap balance: another difficult year for the steel recycling industry. The production figures are provisional.

Figure 15 shows the historical emissions trend for both the EU 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. The emissions trend of German installations is very similar, albeit at a higher emission level, which can be partly attributed to the installations added in 2013.[31] However, the main cause may be the varying trends in iron and steel production. Crude steel production at EU level decreased from 198 million tonnes in 2008 to 166 million tonnes in 2015, i.e. by 17 percent. The production in Germany decreased over the same period from 45.8 million tonnes (2008) to 42.7 million tonnes (2015), i.e. by seven percent, which is relatively much less.[32] This caused an increase of the German share in the total EU emissions in the sector.

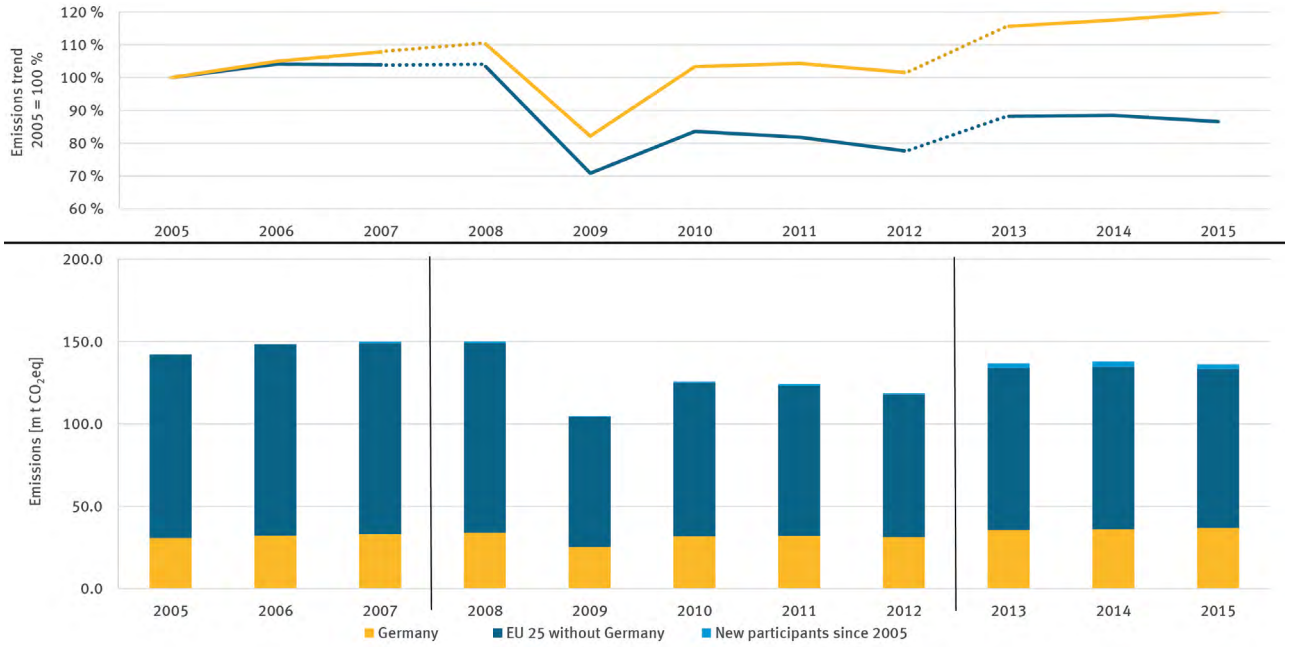

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Figure 15: Emissions trends of the iron and steel industry (Registry Activities 23 to 25) in Germany and in the EU, 2005 to 2015[33]

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). In 2016 the transfer of waste gases resulted in emissions amounting to around 27 million tonnes of carbon dioxide (see Table 13), around 0.3 million tonnes less than in 2015.

Table 13: Transferred waste gases in the iron and steel industry in 2016 – generated in Activities 8 and 10

Transfer to [kt CO_2eq/a]					Total [kt CO_2eq/a]
Iron and steel production installations (Activities 8 and 10)*	Ferrous metal processing and combustion installations (Activities 11 and 1)	Energy installations	Refineries	Non-ETS installations**	
3,745	1,285	21,659	107	147	26,944

* Emission amounts that leave the installation boundaries, but remain within Activities 8 to 10
** The actual transferred amount totals 192,000 tonnes of carbon dioxide equivalent, of which around 45,000 tonnes are inherent carbon dioxide.
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31 Figure 15 only shows the emissions of the new Activity 11 from 2013 onwards. It is different from Figure 13, where estimated emissions have been added for the first and second trading periods.

32 See WSA 2016

33 Data source: EEA 2016; The evaluation is based on grouping the installations according to the activities in the EU Union Registry (see Table 52, Chapter 8). 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.

Around 3.8 million tonnes of carbon dioxide (almost constant) were transferred within and between Activities 8 to 10 (emission amounts that leave the installation borders, but remain within Activities 8 to 10). The transfers from these installations to processing installations (Activity 11) amount to 1.3 million tonnes of carbon dioxide. The majority of the remaining transfers went to energy installations (around 21.7 million tonnes of carbon dioxide, compared to 21.9 million in the previous year).

When the transfer is to installations not subject to emissions trading, the waste gas generating installation 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 had already been subtracted from the total transferred amount in Table 13. 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 for the entire amount of transferred carbon dioxide equivalents.

Allocation status

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

Table 14 shows the nominal allocation amounts and allocation coverage. Overall, the nominal allocation amounts to 48.5 million emission allowances (of which 44 million for Activity 10), setting the nominal allocation coverage at 133.6 percent. However, the general premise in relation to the transfer of waste gases for iron, steel and coke production assumes that waste gas producing installations of the iron and steel industry transfer emission allowances to energy instal¬lations using waste gases. Producers receive an allocation for emissions from waste gases from iron, steel and coke production that occur in excess to the reference fuel natural gas. The benchmark also takes an "inefficiency surcharge" into account, which shows the generally lower efficiency in the energetic 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 2016, the amount of waste gases from iron, steel and coke production transferred to energy installations corresponds to emissions of 21.7 million tonnes of carbon dioxide. 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 the extra "inefficiency surcharge".[34] Thus, the 2016 amount of emission allowances transferred to energy installations can be estimated at about 15.9 million allowances. This results in an adjusted allocation amount of about 32.7 million emission allowances and an adjusted allocation coverage of about 89.9 percent. This means that the iron and steel industry must additionally purchase about ten percent of its required allowances, or can cover them with the surplus from the second trading period.

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

Table 14: Iron and steel industry (Activities 8 to 11 and 1), number of installations, allocation amounts, VET entries and allocation coverage, 2016

No.	Activity	2016 VET vs. 2016 allocation	No. of installations	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
8, 9, 10	Pig iron and crude steel production	2016 VET > 2016 AA	16	4,756	1,609	-3,147	33.8 %
		2016 VET < 2016 AA	19	26,273	42,375	16,102	161.3 %
			35	31,029	43,984	12,955	141.8 %
11	Ferrous metal processing	2016 VET > 2016 AA	58	3,828	2,807	-1,021	73.3 %
		2016 VET < 2016 AA	32	1,424	1,740	316	122.2 %
			90	5,252	4,547	-705	86.6 %
1	Combustion	2016 VET > 2016 AA	1	49	0	-49	0.0 %
			1	49	0	-49	0.0 %
Total			**126**	**36,330**	**48,531**	**12,201**	**133.6 %**

* Coke plants, metal ore processing, pig iron and steel production
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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)[35]. The operator that in turn uses the produced electricity for sinter, coke, iron and steel production can apply for compensation for the additional costs arising from the assumed transfer of CO_2 costs in the electricity price.

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

2.5 Non-ferrous metal industry

Same as in 2015, the non-ferrous metal industry (Activities 12 and 13 according to TEHG Appendix 1) includes a total of 38 installations in the 2016 reporting year.

Table 15: Overview of the non-ferrous metal industry (Activities 12 and 13), number of installations, summary of emissions and allocation amounts

Sector/Activity	No. of installations	2015 emissions [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Non-ferrous metals	38	2,590	2,425	2,615	92.7 %

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35 See DEHSt 2014a, "Iron and steel industry" chapter: Residual 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 rectification of residual gases.

Non-ferrous metal industry installations subject to emissions trading emitted around 2.6 million tonnes of carbon dioxide equivalents in 2016. Compared to 2015, this represents an increase of about one percent.

Emissions

Table 16: Non-ferrous metal industry (Activities 12 and 13), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installations	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
12	Primary aluminium production	2016 VET › 2015 EM	6	728	744	16
		2016 VET ‹ 2015 EM	1	264	264	0
			7	992	1,008	16
13	Non-ferrous metal processing	2016 VET › 2015 EM	19	1,057	1,103	46
		2016 VET ‹ 2015 EM	12	541	505	-36
			31	1,598	1,607	10
Total			**38**	**2,590**	**2,615**	**26**

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Seven installations produce primary aluminium (Activity 12). They emitted around one million tonnes of carbon dioxide equivalents, which is 1.6 percent more than in the previous year. 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 2016 PFC emissions correspond to about 95,500 tonnes of carbon dioxide and are thus approximately 0.7 percent higher than in the previous year. Compared to the previous year, the average share of emissions from the four electrolysis installations remained the same at roughly 10.5 percent. Overall, emissions from electrolysis installations subject to emissions trading also increased by around 0.7 percent compared to the previous year. The 31 installations for the production and processing of other non-ferrous metals such as copper, zinc or lead (Activity 13) emitted approximately 1.6 million tonnes of carbon dioxide in 2016 and thus continue to account for roughly 62 percent of emissions subject to emissions trading in the non-ferrous metal industry. This is around 0.6 percent more than in the previous year. Secondary aluminium production is also classified as Activity 13.

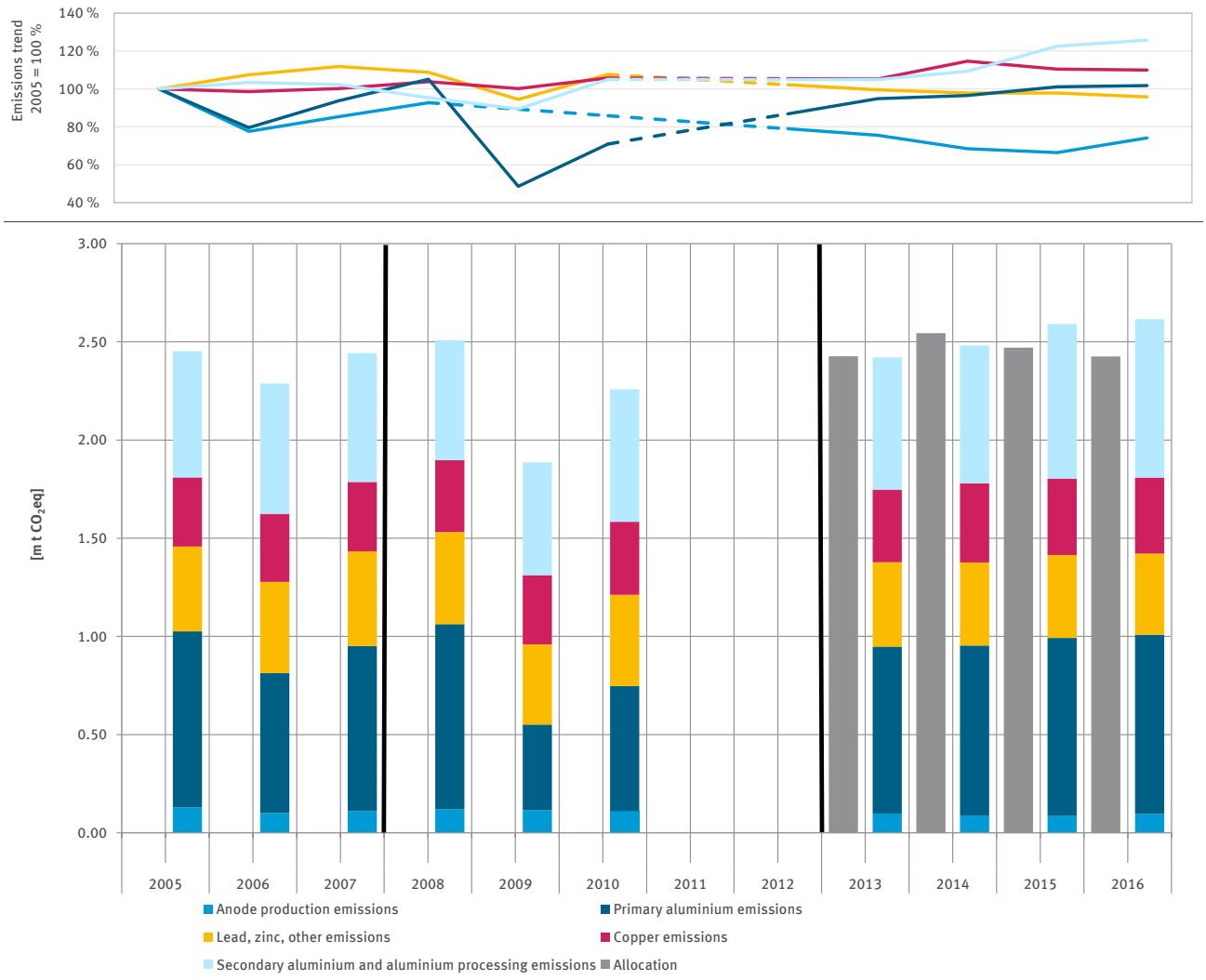

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Figure 16: Non-ferrous metal industry (Activities12 and 13). Emission and free allocation trend in Germany, 2005 to 2016[36]

Figure 16 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 emission trends in relation to the starting year 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 emission trend in the sector[37]. Emission data for the non-ferrous metal industry is not available for 2011 and 2012.

Due to these limitations, the following description of the emission trend of the non-ferrous metals industry in emissions trading starts from only 2013. With 35 percent, Activity 12 electrolysis installations had the largest share of emissions of the non-ferrous metal industry sector in 2016. Their emissions increased significantly by 7 percent since being subject to emissions trading in 2013. Emissions from anode production (Activity 12) account for four percent of the non-ferrous metal industry emissions. Their emissions decreased until 2015 since being subject to emission trading in 2013, but slightly increased from 2015 to 2016.

36 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 installations that produce or process non-ferrous metals. The free allocation and emissions of these energy installations during the first and second trading periods are not shown in the figure.

37 The emissions of five installations were estimated for 2009 and 2010 (linear interpolation of the data between 2008 and 2013). This includes, among others, the three installations that produce anodes.

With 31 percent, the production of secondary aluminium and aluminium processing (Activity 13) installations are second to the electrolysis installations in the total emissions of the sector. Their emissions have also increased since 2013. Activity 13 installations for copper production and processing account for 15 percent of the non-ferrous metal industry emissions. After an increase from 2013 to 2014, emissions decreased again. Installations for the production or processing of lead, zinc or other non-ferrous metals (Activity 13) account for 16 percent of the total emissions of the sector. Their emissions have decreased slightly since 2013.

Emission and production trend

Figure 17 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 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 reduced through decommissioning during this time. The production volumes of the decommissioned installations are taken into account in the Association data, but not in the activity rates.

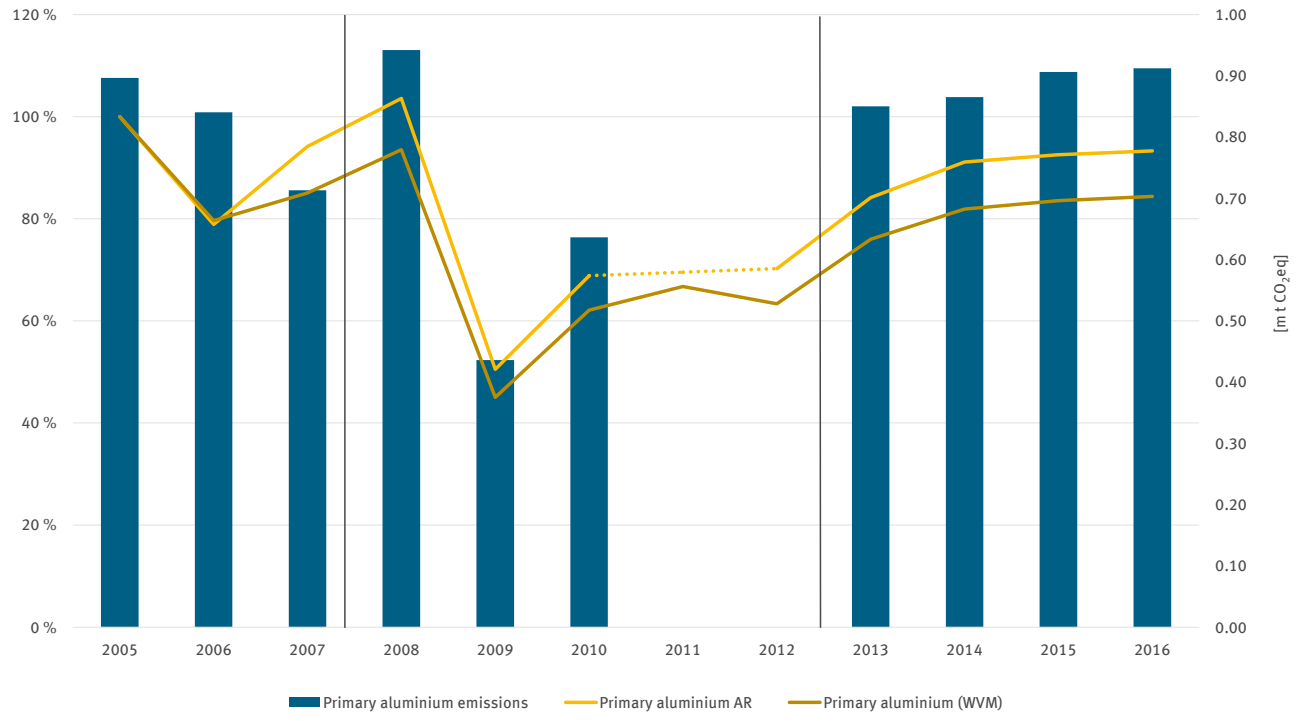

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Figure 17: Electrolysis installations, emission and production trends in Germany, 2005 to 2016[38]

Figure 17 shows that the emission trend of the electrolysis installations coincides relatively well with the activity rate or primary aluminium production trend. The production of primary aluminium has increased by eleven percent since the beginning of the third trading period in 2013. As described above, the emissions from the electrolysis installations have increased by seven percent since 2013. As a result of production increase, the installations were also better utilised in 2016, which led to lower specific emissions. However, the specific emissions per tonne of product continue to surpass the product benchmark of 1,514 tonnes of carbon dioxide[39] per tonne of primary aluminium produced.

38 Primary aluminium (WVM): see WV Metals 2017; production figures for the production of aluminium from ore

39 The product benchmark is based on the average emissions from the ten percent most efficient installations in the EU in 2007 and 2008 (see also 2014a, Chapter 3.1).

Allocation status

Overall, the non-ferrous metals industry had an allocation shortfall of around 190,000 emission allowances in 2016.

Table 17: Non-ferrous metal industry (Activities 12 and 13), number of installations, allocation amounts, VET entries and allocation coverage in 2016

No.	Activity	2016 VET vs. 2016 allocation	No. of installa-tions	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
12	Primary alumini-um production	2016 VET › 2016 AA	6	751	580	-171	77.3 %
		2016 VET ‹ 2016 AA	1	257	309	52	120.1 %
			7	1,008	889	-119	88.2 %
13	Non-ferrous metal processing	2016 VET › 2016 AA	22	1,167	862	-306	73.8 %
		2016 VET ‹ 2016 AA	9	440	674	234	153.3 %
			31	1,607	1,536	-71	95.6 %
Total			**38**	**2,615**	**2,425**	**-190**	**92.7 %**

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Activity 12 installations receive a free allocation according to product benchmark ("Aluminium" or "Preburnt Anodes"[40]). On average, the free allocation for these installations corresponded to about 88 percent of their annual emissions in 2016 compared to 91 percent in 2015[41]. In purely mathematical terms, the operators of these installations did not have to purchase allow¬ances to meet their surrender obligations for 2014[42], but in in 2016, they had to purchase emission allowances for about twelve percent of their surrender obligations. On one hand this is on account of their increased emissions compared to the previous year, and the annually decline in free allocation due to the cross-sectoral correction factor on the other. Activity 13 installations are better supplied on average, among others due to the fallback allocation. Their 2016 allocation coverage decreased to only 96 percent compared to 98 percent in the previous year[43].

2.6 Mineral processing industry

2.6.1 Cement clinker production

The 35 installations that produce cement clinker and one installation for the manufacture of products from burnt oil shale are hereinafter referred to under the term "cement industry". Compared to the previous year, their emissions increased by approximately 216,000 tonnes of carbon dioxide, or 1.1 percent, to slightly more than 19.3 million tonnes of carbon dioxide. The free allocation for 2016 covers 92 percent of these emissions. The allocation coverage decreased compared to the previous year.

Table 18: Overview of cement clinker production (Activity 14), number of installations, summary of emissions and allocation amounts

Sector/Activity	No. of installa-tions	2015 emissions [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Cement clinker production	36	19,132	17,798	19,348	92.0 %

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40 See DEHSt 2014a, "Non-ferrous metals industry" chapter
41 See DEHSt 2016, "Non-ferrous metals industry" chapter
42 See DEHSt 2014b, "Non-ferrous metals industry" chapter
43 See DEHSt 2016, "Non-ferrous metals industry" chapter

The entry threshold in the EU ETS scope of 500 tonnes of cement clinker produced per day (Activity 14, Part 2, Annex 1 TEHG) continues to be far exceeded by all installations in the industry in Germany; therefore the installations cover the entire cement clinker production in Germany. One installation was permanently decommissioned in 2016 and is no longer included in the evaluations.

Emissions

In the cement industry, emissions increased by a total of 216,000 tonnes of carbon dioxide, or 1.1 percent compared to 2015. In 20 installations they increased by 817,000 tonnes of carbon dioxide; in 16 installations decreased by 601,000 tonnes (Table 19).

Table 19: Production of cement clinker (Activity 14), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installations	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
14	Cement clinker production	2016 VET › 2015 EM	20	9,215	10,032	817
		2016 VET ‹ 2015 EM	16	9,917	9,316	-601
Total			**36**	**19,132**	**19,348**	**216**

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Figure 18 shows the carbon dioxide emission and free allocation trends in the cement industry from 2005 to 2016. They clearly declined after the peak in 2007 following an emis¬sion increase in each year of the first trading period, especially in 2009 and 2010. They then rose again in the last two years of the 2nd trading period (2011 and 2012) almost to the same level of 2008. Since 2013, emissions have remained roughly at the starting level of 2005, with marginal annual fluctuations[44].

44 It should be noted that a fixed emission factor has 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 emission factors. It has been found that most installations (even the most efficient ones) have higher specific process-related emis¬sions. The reported emissions have thus been slightly higher due to this monitoring regulation change since 2013 than they would have been if the fixed emission factors had been updated.

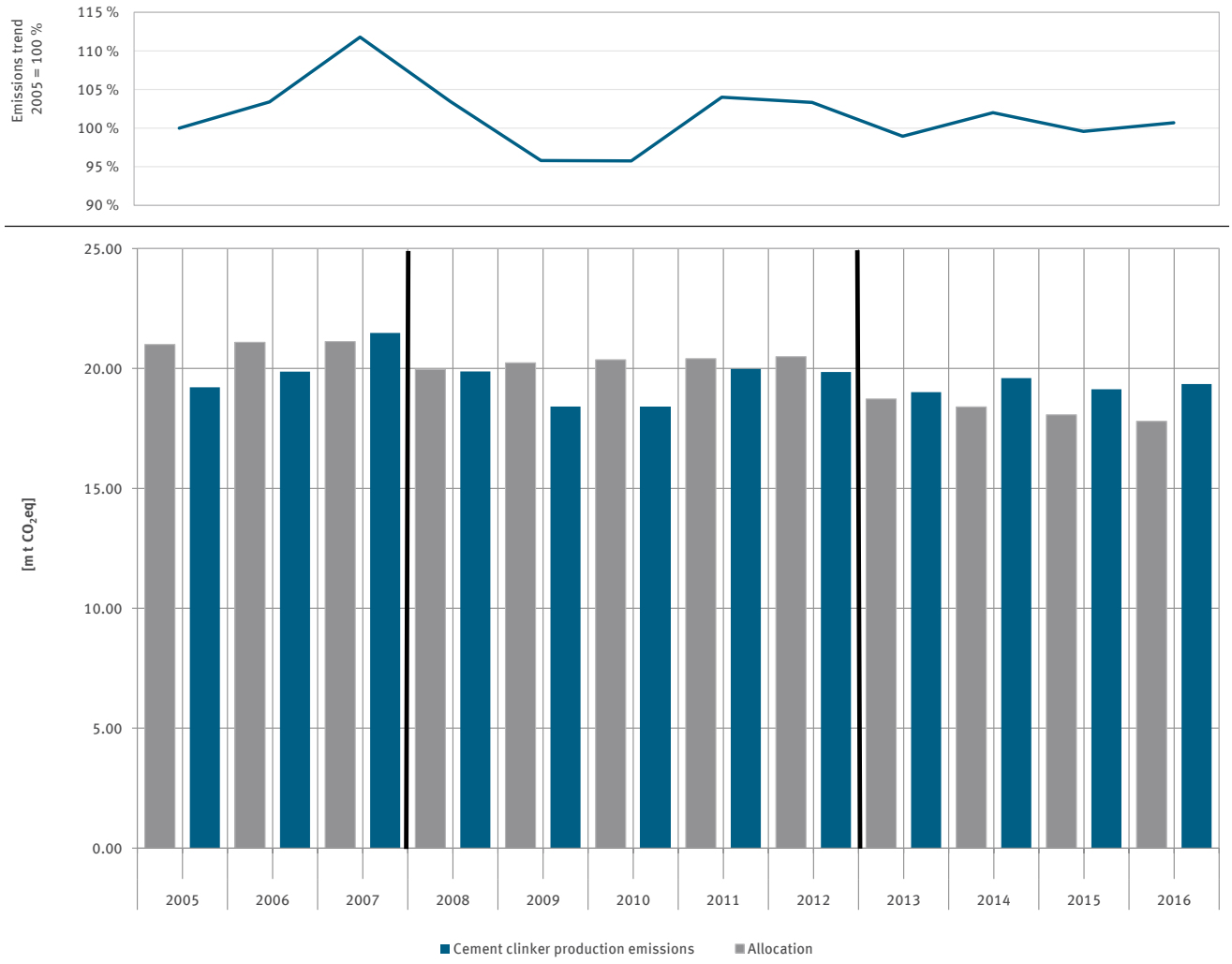

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Figure 18: Cement clinker production (Activity 14), emission and free allocation trends in Germany, 2005 to 2016

In the first and second trading periods, free allocation exceeded the emissions in almost every year: except 2007, when the free allocation did not fully cover the emissions which led to a minor shortfall. The allocation coverage has been steadily declining since the beginning of the third trading period. This is because free allocation decreases more sharply than emissions due to the increasing budgetary cuts (cross-sectoral correction factor).

Figure 19 compares the emissions trend in the cement industry with the production data trend, which are based on the activity rates of the „Grey cement clinker“ and „White cement clinker“ product benchmarks as well as the German Association of Cement Works' clinker production data (VDZ e.V.).

Overall, the emissions trend reflects the production trend between 2005 and 2016 very well. The activity rates and the Association data for clinker production are largely identical despite differences in the method of collecting data. The specific emissions from clinker production have not lastingly improved between 2005 and 2016. This is also reflected in the emissions and activity rates for clinker production when directly comparing 2005 and 2016: the 2016 emissions and the activity rates are about one percent higher than the respective values for 2005. On the other hand, the cement industry's specific emissions (i.e. not only those of clinker production but of the cement industry as a whole) decreased between 2005 and 2015 according to VDZ data[45].

45 VDZ 2015

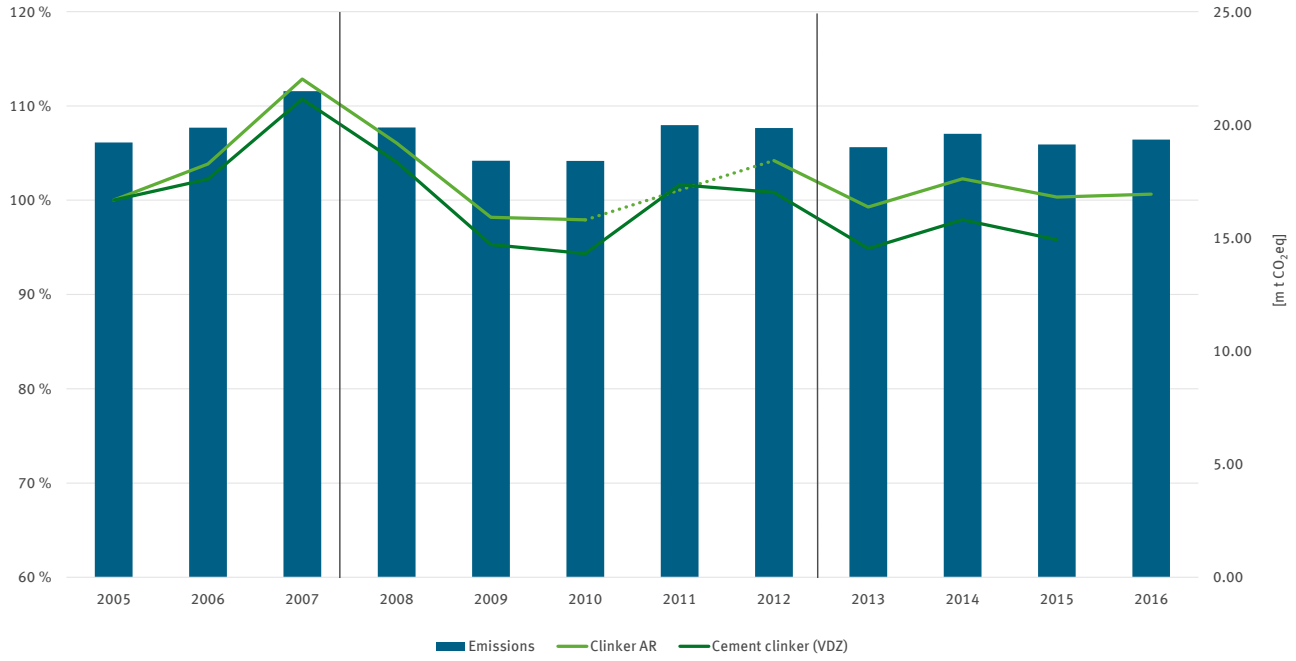

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Figure 19: Cement clinker production (Activity 14), emission and production trend in Germany, 2005 to 2016

The emissions trend in Germany was significantly different from the rest of Europe where the decline in production and consequent significant reduction in emissions due to the 2009 economic and financial crisis have been much stronger. This reduction in emissions continued until 2013 (see Figure 20). While emissions from cement clinker production amounted to only about 67 percent of the 2005 initial level across the EU in 2015, emissions from this sector in Germany have only decreased by around five percent compared to 2005. Overall, Germany emitted nearly 17 percent of the 2015 total emissions from the cement clinker production in Europe (EU-31).

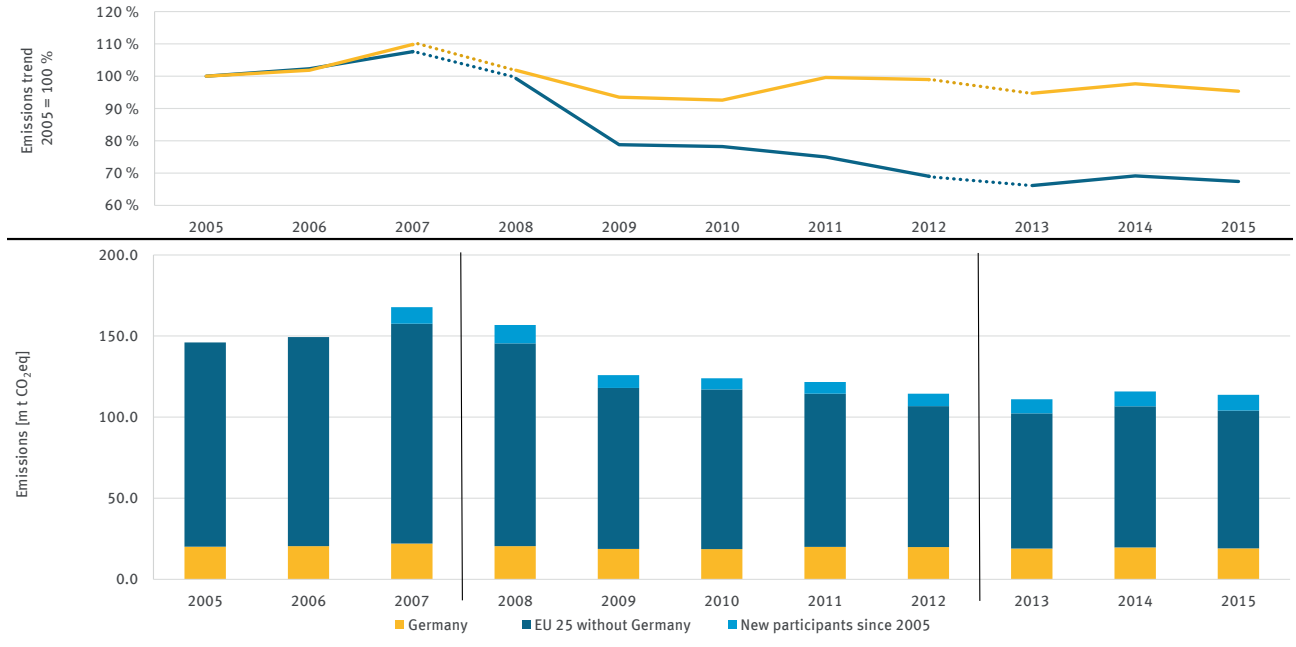

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Figure 20: 2005 to 2015 emissions trend of cement clinker production (Registry Activity 29) in Germany and in the EU[46]

46 Data source: EEA 2016. The evaluation is based on a grouping of the installations by activities in the EU Union Registry (see Table 52, Chapter 8), thereby diffe¬rences can occur in the emission amounts per sector for Germany. New post-2005 participants in the EU ETS are Bulgaria, Croatia, Iceland, Liechtenstein, Norway and Romania.

Allocation status

For 2016, the free allocation to the cement industry (Table 20) was about 1.6 million emission allowances, or eight percent below the amount needed to meet the surrender obligation. In total, 27 installations had a deficit of 2.3 million emission allowances, nine installations had a surplus of 722,000 emission allowances.

Table 20: Cement clinker production (Activity 14), number of installations, allocation amounts, 2016 VET entries and allocation coverage

No.	Activity	2016 VET vs. 2016 allocation	No. of installa-tions	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
14	Cement clinker production	2016 VET › 2016 AA	27	13,914	11,641	-2,272	83.7 %
		2016 VET ‹ 2016 AA	9	5,434	6,156	722	113.3 %
Total			**36**	**19,348**	**17,798**	**-1,550**	**92.0 %**

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The amount to be purchased was thus higher than in the previous year but lower than expected in the context of the allocation according to the product benchmark (0.766 tonnes of CO_2/tonne of grey cement clinker) and the application of the cross-sectoral correction factor[47]. This discrepancy can be explained mainly by the fact that the 2016 production and thus the emissions were lower than in the years of the 2005-2008 period. In 2016, six installations fell below the product benchmark[48], which means that more than 80 percent of the grey cement producing installations had higher specific emissions.

In 2016, the specific emissions of grey cement clinker installations amounted to 0.803 tonnes of carbon dioxide per tonne of cement clinker across all 34 installations and thus deteriorated compared to 2015. Similar to the trend shown in Figure 19, the specific emissions remained largely unchanged over the last ten years.

2.6.2 Lime production (including sugar)

The 63 lime producing installations are comprised of two different industrial sectors: 42 installations produce lime or dolime for the construction, paper, chemical, the iron and steel industry and environmental technology. Their emission trend is dominated by the economy of both the steel and construction industries. A further 20 installations require heat and electricity and use lime for sugar production. From the third trading period on, these installations, together with the sugar industry's energy installations, have fitted into the lime production activity, while in the second trading period, energy and lime installations were considered separately. In addition, due to the broader definition of "combustion", further partial activities, especially beet slice drying and caramelisation installations, have been added to sugar production. The lime sector also includes a limestone drying plant, which was first included in emissions trading as an Activity 1 combustion plant in the third trading period.

The 2016 emissions of Activity 15 "Lime production" (plus the limestone drying plant) amounted to a total of 9.1 million tonnes of carbon dioxide and thus decreased by one percent compared to the previous year. The free allocation on average covered 83.5 percent of the emissions. The comparatively low allocation coverage is also explained by the electricity production in the sugar industry which does not receive free allocation during the third trading period.

47 See DEHSt 2014a

48 White cement and burnt oil shale have different product benchmarks than grey cement clinker and were therefore not included in the evaluation of specific emissions. However, dusts were added to the cement clinker production volumes

Table 21: Overview of lime production (Activity 15, including sugar), number of installations, summary of emissions and allocation amounts

Sector/Activity	No. of installations	2015 emissions [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Lime production (including sugar)	63	9,195	7,591	9,093	83.5 %

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One installation was completely decommissioned in 2016 and is no longer included in the evaluations. Two installations were each merged with one other installation in 2016, which means that the number of installations that issued a report on emissions decreased to a total of 63 installations compared to the previous year. Three other installations have ceased operation and no longer report emissions, but are still subject to emissions trading and are therefore included in the evaluations.

Emissions

The 2016 emissions from lime production for blast furnaces, power plants and the construction industry decreased slightly by 92,000 tonnes (minus 1.2 percent) compared to the previous year and amounted to 7.3 million tonnes of carbon dioxide. This is partly due to declining shipments to the iron and steel industry and to a lower demand for desulphurisation in lignite-fired power plants, which was nevertheless not fully offset by the stronger demand from the construction industry. The 2016 emissions from sugar production installations also declined slightly compared to the previous year (minus 0.6 percent) and amounted to around 1.7 million tonnes of carbon dioxide.

21 installations from industrial and building lime producers reported higher emissions than in the previous year, while 19 installations reported lower emissions. Three installations have ceased operation and reported zero emissions (two of which have reported the same for the previous three years). The emissions from sugar production fell in twelve installations, while eight installations reported higher emissions than in 2015.

Table 22: Lime production (Activity 15), number if installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installations	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
15	Lime production	2016 VET › 2015 EM	21	2,774	2,956	182
		2016 VET ‹ 2015 EM	19	4,619	4,345	-274
		2016 VET = 2015 EM	2	0	0	0
			42	7,393	7,301	-92
	Sugar production	2016 VET › 2015 EM	8	652	763	111
		2016 VET ‹ 2015 EM	12	1,136	1,015	-121
			20	1,788	1,778	-11
			62	9,181	9,079	-103
1	Combustion	2016 VET › 2015 EM	1	13	15	2
			1	13	15	2
			1	13	15	2
Total			**63**	**9,195**	**9,093**	**-101**

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The following figures show the emission trend of the lime industry since the beginning of emissions trading in 2005, divided into industrial and building lime production (Figure 21) and sugar production (Figure 22).

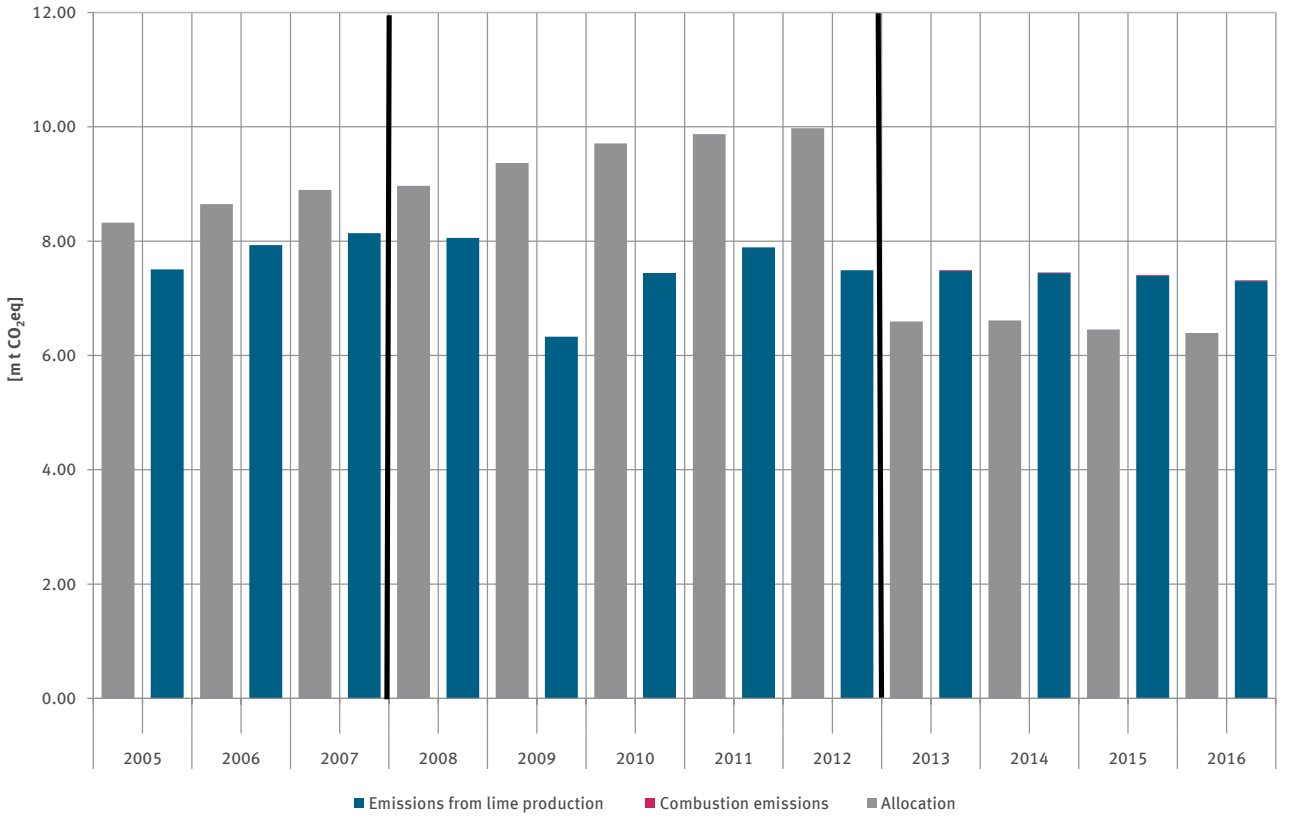

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Figure 21: Industrial and building lime production (Activity 15), emission trend and free allocation in Germany, 2005 to 2016

The emissions from lime production steadily increased during the first trading period (see Figure 21) and remained constant during the transition to the second trading period. In 2009, which was heavily affected by the financial and economic crisis, emissions from lime kilns, whose production is economically dependent on the steel and construction industry, fell dramatically. In 2010 and 2011 they increased again due to the recovering economic situation. Apart from clearly higher emissions in 2011, emissions have largely been constant at about the 2010 level and below the starting level of 2005. However, post-2013 emissions can only be compared to some extent with those from the second trading period on methodological grounds[49]. The figure also clearly shows that the free allocation was higher than the emissions every year in both the first and second trading periods, and increased steadily despite a decline in emissions. The allocation status changed significantly at the beginning of the third trading period: the free allocation was lower than the emissions in every year and amounted to less than 90 percent of the emissions of the respective year. With the exception of 2014, free allocation decreased compared to the respective previous year.

Figure 22 shows the emissions from the sugar industry since 2005. The emissions deriving from the extended scope of the third trading period were estimated for the first and second trading period[50, 51]. However, since there was no retrospective estimation for free allocation, emissions must be considered in the respective scope of the trading period in order to facilitate comparison between emissions and free allocation.

49 Due to a change in methodology in the determination of emissions between 2012 and 2013 and the extended scope of emissions trading from 2013, pre-2013 emissions cannot be directly compared with post-2013 emissions (see DEHSt 2014b, Section „Lime production (including sugar)“).

50 See DEHSt 2014b, Section “Lime production“

51 There are no emissions available for the extended scope in 2011 and 2012. The reported emissions for both years were supplemented by the average emissions of the extended scope of 2005 to 2010 (around 15 percent of the total emissions).

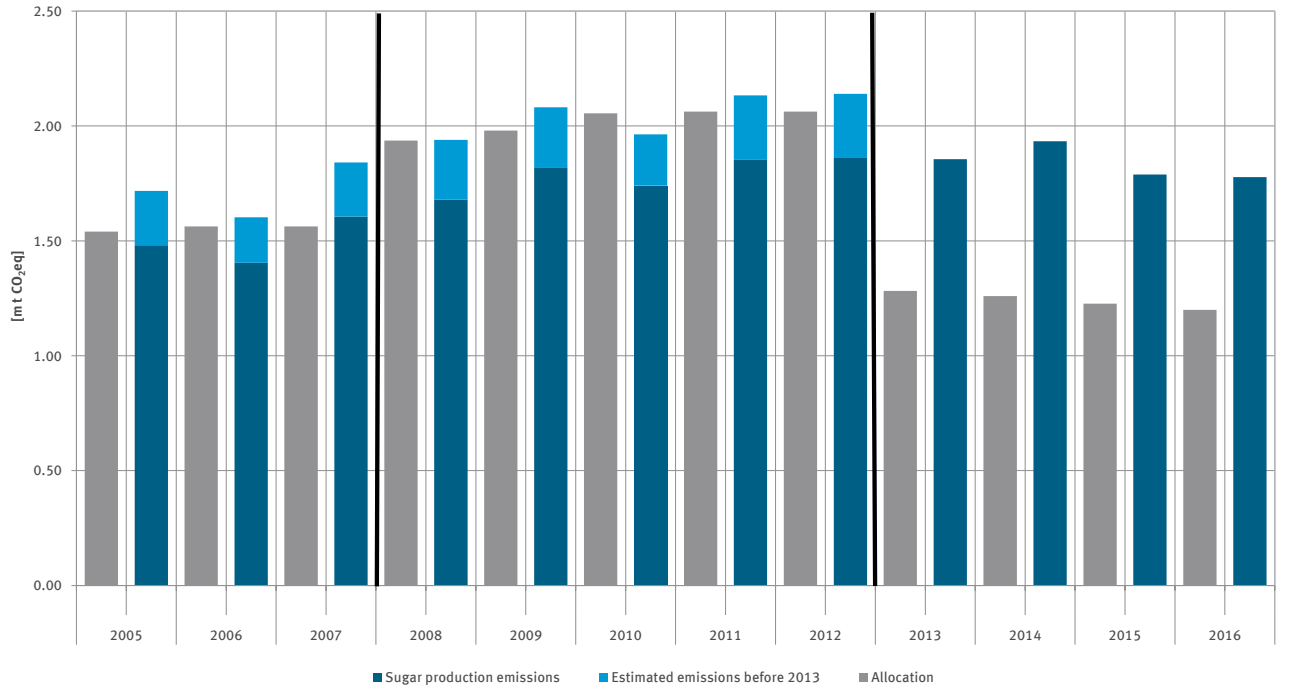

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Figure 22: Emissions and free allocation trends in the sugar industry (Activity 15), 2005 to 2016

The emissions from sugar production have increased between 2005 and 2012, with the exception of a few specific years. Part of this increase in emissions is due to the reform of the EU sugar market regulation in 2006. As a result, installations were decommissioned and, in return, the utilisation of the remaining installations significantly increased.[52] After a decrease in emissions in 2013 and an increase in 2014, the 2015 and 2016 emissions were below the level of 2013.

The allocation status of sugar producers differs significantly from the industrial and building lime producing installations, even though the sugar installations also received more free emission allowances in the first and second trading periods than they needed to cover the surrender obligation of their emissions. By eliminating the free allocation for electricity generation from the third trading period, the allocation coverage has been less than 70 percent of the respective year's emissions since 2013.

Figure 23 compares the emission trend of lime production – differentiated according to the lime and sugar industry – with the production data trend. The production data of the lime industry are the activity rates of the „lime", „dolomitic lime" and „sinter dolomite" product benchmarks, as well as data on the Association of the German Lime Industry's lime production (BV Kalk e.V.). In addition to the emissions, the figure also shows the sugar industry's activity rate for the heat benchmark[53].

52 See WVZ 2016

53 The product benchmark for lime is not used for the sugar industry's lime installations. In addition, a large proportion of the emissions from sugar installations are attributable to heat generation, which means that the activity rate for the heat benchmark is taken as the reference value.

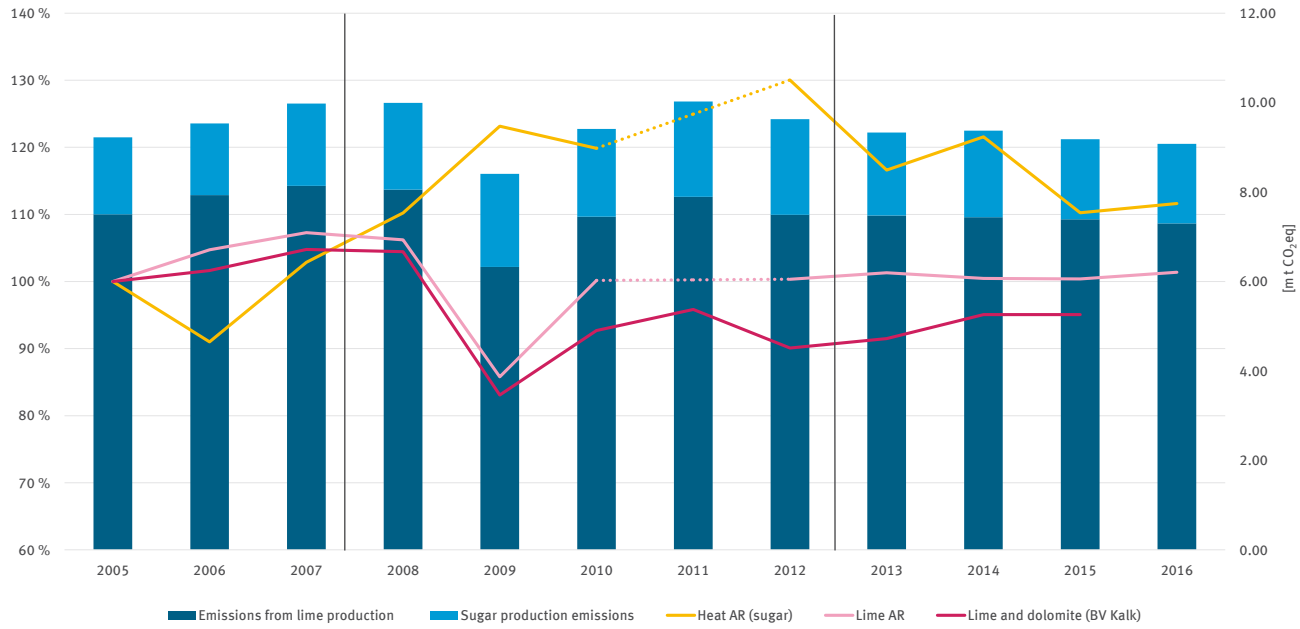

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Figure 23: Lime production (Activity 15), emission and production trend[54] in Germany, 2005 to 2016

The emission trend also reflects the production trend well between 2005 and 2016 for the lime industry. Despite differences in the survey method, the activity rates and the Association data for lime production are roughly the same, although the data for individual years differs more clearly. Compared to 2005, the lime industry's emissions decreased by almost three percent in 2016, while the activity rates increased slightly by more than one percent. This indicates a decrease in specific emissions in a direct comparison between 2005 and 2016. Changes in fuel mix are not likely to be the reason for the decrease, since high-emission pulverised lignite has been increasingly used as fuel in recent years. However, some new and significantly more energy efficient lime-kilns have been built in recent years.

The same goes for the sugar industry, where the comparison of the emission trend where the activity rate trend for heat generation also indicates that specific emissions have been reduced as a result of modernisation measures (for example, utilising waste heat) and the use of low-emission fuels. While the 2016 activity rate was almost twelve percent higher than in 2005, 2016 emissions increased by just under four percent compared to 2005. However, specific emissions from sugar installations are also influenced by the (weather-dependent) quality and quantity of sugar beet crops, which means that specific emissions can be subject to significant fluctuations.

Figure 24 compares the emissions from lime production (lime and sugar industry) in Germany with the trend in the other EU-25 Member States and the new Member States since 2005, including Norway, Liechtenstein and Iceland. In Germany there have in part been major changes in the transitions between the trading periods in the scope or in the allocation of power plants in the sugar industry. Therefore, emissions from the different trading periods – at least in Germany – are only partially comparable with each other. The connection between the periods is therefore shown as a dotted line. Also, there are sometimes differences between the values for Germany, since the emissions are allocated in the Union Registry in a slightly different way or some other installation size is used than that in the present report. Despite these limitations in comparability between the periods, Figure 24 clearly shows that for lime production there were differences between the emission trends in Germany and the rest of Europe. The average European emission reduction due to the 2009 economic and financial crisis was slightly greater than in Germany (approximately minus 18 percent compared to the 2005 base level while it was minus 14 percent in Germany), and the emissions have again risen significantly in Germany since 2010.

54 Production data sources: Association of the German Lime Industry (BV Kalk), Sugar Economic Association (WVZ e.V.)

In 2015, emissions in Germany were once again almost at the 2005 level (around 94 percent), while they were only around 89 percent of the 2005 initial value in the remaining Member States. Overall, Germany emits about 29 percent of the total EU (EU-31) emissions from lime production.

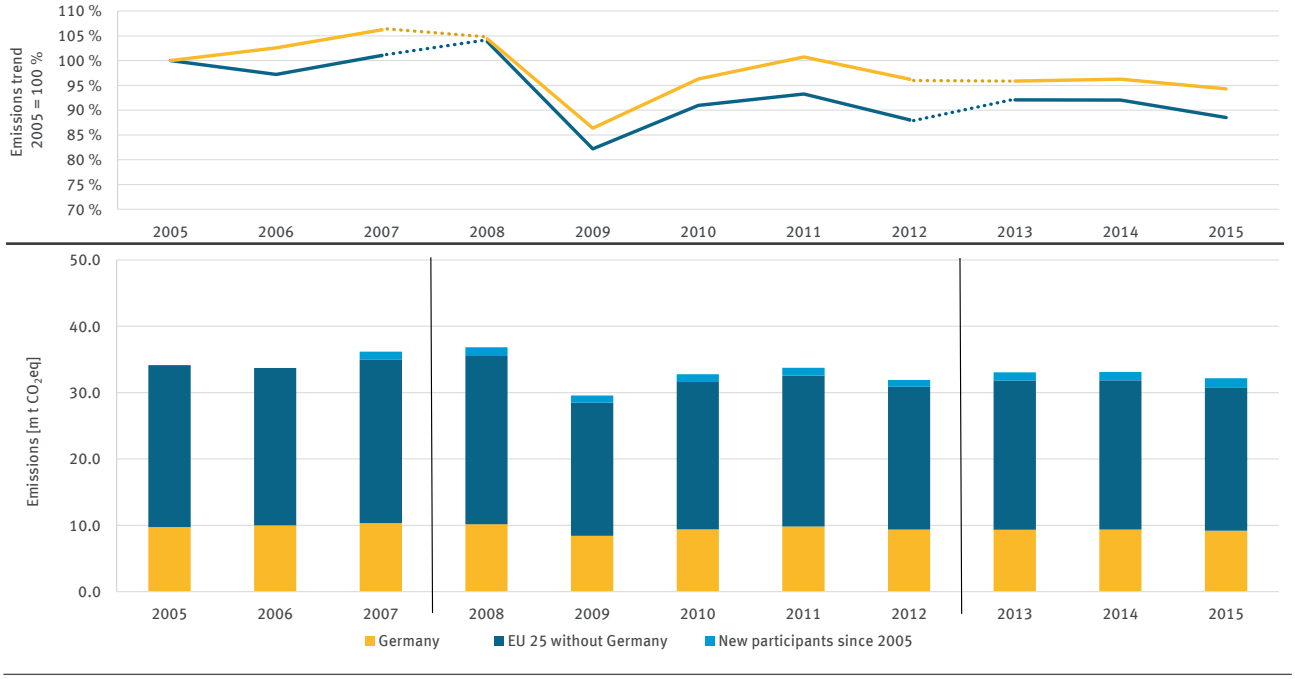

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Figure 24: 2005 to 2015 emissions trend of lime production (Registry Activity 30) in Germany and in the EU[55]

Allocation status

Industrial and building lime production had a total deficit of 917,000 emission allowances, which corresponds to an allowance shortfall of 12.6 percent of the 2016 emissions. The sugar industry's deficit was 578,000 emission allowances meaning that their relative shortfall was significantly higher at around 33 percent of the 2016 emissions. The allocation situation has slightly deteriorated in these two industrial sectors since the free allocation exhibited a stronger decrease compared to the previous year than the emissions due to increasing budget cuts (cross-sectoral correction factor). 27 lime producing installations, i.e. somewhat less than two-thirds of the lime producers, had to purchase approximately 1.2 million additional emission allowances in order to comply with their surrender obligations. Twelve installations had a surplus.

55 Data source: EEA 2016; The evaluation is based on a combination of the installations by activities in EU Union Registry (cf. Table 55, Chapter 7), thereby differences can occur in the emission amounts per sector for Germany. New post-2005 participants in the EU ETS are Bulgaria, Croatia, Iceland, Liechtenstein, Norway and Romania.

Table 23: Lime production (Activity 15), number of installations, allocation amounts, 2016 VET entries and allocation coverage

No.	Activity	2016 VET vs. 2016 allocation	No. of installa-tions	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
15	Lime production	2016 VET › 2016 AA	27	6,070	4,857	-1,213	80.0 %
		2016 VET ‹ 2016 AA	12	1,231	1,527	296	124.0 %
		2016 VET = 2016 AA	3	0	0	0	
			42	7,301	6,384	-917	87.4 %
	Sugar production	2016 VET › 2016 AA	19	1,750	1,158	-592	66.2 %
		2016 VET ‹ 2016 AA	1	28	41	14	148.6 %
			20	1,778	1,199	-578	67.5 %
			62	9,079	7,583	-1,495	83.5 %
1	Combustion	2016 VET › 2016 AA	1	15	7	-7	50.4 %
			1	15	7	-7	50.4 %
			1	15	7	-7	50.4 %
Total			**63**	**9,093**	**7,591**	**-1,502**	**83.5 %**

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All but one sugar producing installations had to purchase additional emission allowances with a total of 592,000. The sugar industry's power production for which no free allocation is granted in the third trading period plays a role in this fact. The free allocation for the Activity 1 combustion plant was also considerably below its reported 2016 emissions.

2.6.3 Production of glass and mineral fibres

The production of glass and mineral fibres includes activities 16 (glass production) and 18 (mineral fibre production). In 2016, a total of 86 installations were recorded, of which 79 installations produced glass and seven installations mineral fibres. The 2016 carbon dioxide emissions increased compared to the previous year to about 4.2 million tonnes of carbon dioxide (plus 1.3 percent). The free allocation covers about 80.9 percent of the emissions.

Table 24: Overview of glass and mineral fibre production (Activities 16 and 18), number of installations, summary of emissions and allocation amounts

Sector/Activity	No. of installa-tions	2015 emissions [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Production of glass and mineral fibres	86	4,138	3,392	4,194	80.9 %

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Emissions

The 2016 emissions from glass production installations (Activity 16) increased by 1.2 percent compared to 2015 and amounted to approximately 3.8 million tonnes of carbon dioxide. Just over half of the installations reported higher emissions in 2016 than in the previous year, a total of about 132,000 more tonnes of carbon dioxide. The emissions decreased by 82,000 tonnes in the other installations. Three installations ceased operation and reported zero emissions. The emissions from mineral fibre production installations (Activity 18) increased by 2.5 percent compared to the previous year to about 372,000 tonnes of carbon dioxide.

Table 25 divides the emissions trend according to the German Classification of Economic Activities ("Wirtschaftszweig 2008") which bases the allocation on the information supplied by operators. In the production of flat glass, which is used in the car making and construction industries, the 2016 emissions increased once more (plus 3.5 percent). In contrast, the emissions from hollow glass production slightly decreased (minus 0.8 percent).

Table 25: Production of glass and mineral fibre (Activities 16 and 18), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installations	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
16	Production of hollow glass	2016 VET › 2015 EM	16	683	716	32
		2016 VET ‹ 2015 EM	18	898	853	-45
		2016 VET = 2015 EM	1	0	0	0
			35	1,581	1,568	-13
	Production of glass fibres and goods thereof	2016 VET › 2015 EM	6	181	198	16
		2016 VET ‹ 2015 EM	4	25	21	-4
			10	206	219	13
	Production, finishing and processing of flat gas	2016 VET › 2015 EM	12	1,277	1,343	66
		2016 VET ‹ 2015 EM	3	151	135	-16
			15	1,428	1,478	50
	Production, finishing and processing of other glass including technical glassware	2016 VET › 2015 EM	8	328	345	17
		2016 VET ‹ 2015 EM	9	229	212	-17
		2016 VET = 2015 EM	1	0	0	0
		Comparison not possible	1	-	-	-
			19	561	557	1
			79	3,775	3,822	51
18	Production of glass fibres and goods thereof	2016 VET › 2015 EM	1	48	50	1
		2016 VET ‹ 2015 EM	1	8	7	-2
			2	56	56	0
	Production of other goods from non-metallic minerals n. e. c.	2016 VET › 2015 EM	4	231	241	10
		2016 VET ‹ 2015 EM	1	75	74	-1
			5	306	315	9
			7	363	372	9
Total			**86**	**4,138**	**4,194**	**60**

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Figure 25 shows the emissions trends from glass and mineral fibre production (Activities 16 and 18) since the beginning of emissions trading in 2005. After a continuous increase between 2005 and 2008, the emissions fell in 2009, the year of the financial and economic crisis. Since then, emissions have increased and amount to over four million tonnes of carbon dioxide per year, with the exception of 2012. The emissions reached their peak in 2016 since the start of emissions trading, with around 4.2 million tonnes of carbon dioxide[56].

56 This also applies without taking into account the mineral fibres included in the EU-ETS since 2008.

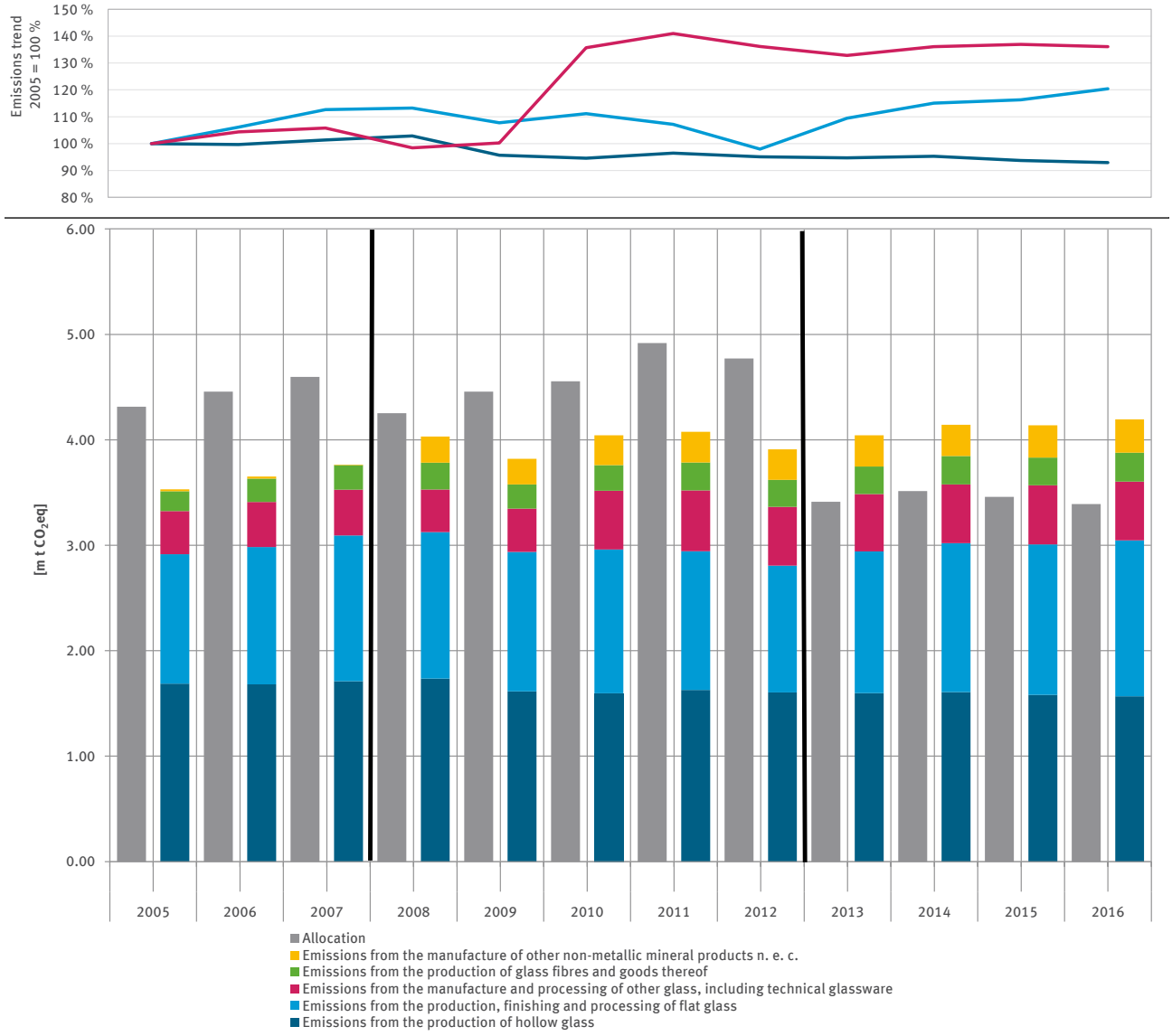

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Figure 25: Production of glass and mineral fibre (Activities 16 and 18), emission and free allocation trend in Germany, 2005 to 2016

The free allocation trend was different: a clear over-allocation of free emission allowances can be identified in the first and second trading periods. However, the free allowances granted have no longer been sufficient to cover the emissions since the beginning of the third trading period. The allocation coverage was 85 percent or less in all years.

The emissions trend of individual sectors of the industry is markedly different: the emissions from the production of flat glass increased continuously between 2005 and 2008. After a decline in emissions presumably due to economic circumstances in 2009, 2011 and 2012, emissions have increased again since 2013 and reached a new peak in 2016 since the start of emissions trading.

Emissions from the production of other (technical) glass have increased the most since 2005 and are roughly 36 percent above the 2005 emissions. The emissions from the production of hollow glass have largely remained stable since 2010 (following a slight decrease due to economic circumstances) and amounted, in 2016, to 93 percent of the 2005 value and were thus at the lowest level since the beginning of emissions trading.

An increase or decrease in production is not necessarily reflected in the glass industry's emission trend. To ensure that the melt does not solidify in the glass trough during production, installations must be continuously supplied with heat energy even at low utilisation.

Allocation status

The 2016 free allocation was once again not enough to cover the year's emissions from activities 16 and 18. Overall, the deficit amounted to 802,000 emission allowances compared to the emissions, of which 715,000 in glass production (see Table 26). The allocation coverage has once again slightly worsened compared to the previous year and amounted to 80.9 percent in 2016 (81.4 percent in the production of glass and 76.6 percent in the production of mineral fibres). The deficit is slightly greater in flat glass than for hollow glass.

Table 26: Production of glass and mineral fibre (Activities 16 and 18), number of installations, allocation amounts, 2016 VET entries and allocation coverage

No.	Activity	2016 VET vs. 2016 allocation	No. of installa-tions	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
16	Production of hollow glass	2016 VET › 2016 AA	28	1,309	1,026	-283	78.4 %
		2016 VET ‹ 2016 AA	6	259	297	37	114.4 %
		2016 VET = 2016 AA	1	0	0	0	
			35	1,568	1,323	-246	84.3 %
	Production of glass fibres and goods thereof	2016 VET › 2016 AA	8	188	110	-77	58.9 %
		2016 VET ‹ 2016 AA	2	31	36	5	116.3 %
			10	219	147	-72	67.0 %
	Production, finishing and processing of flat gas	2016 VET › 2016 AA	13	1,459	1,126	-333	77.2 %
		2016 VET ‹ 2016 AA	2	19	25	6	133.5 %
			15	1,478	1,151	-326	77.9 %
	Production, finishing and processing of other glass including technical glassware	2016 VET › 2016 AA	11	486	395	-91	81.2 %
		2016 VET ‹ 2016 AA	6	71	91	20	128.5 %
		2016 VET = 2016 AA	1	0	0	0	
		Comparison not possible	1	-	-	-	
			19	557	486	-71	87.2 %
			79	3,822	3,107	-715	81.3 %
18	Production of glass fibres and goods thereof	2016 VET › 2016 AA	2	56	28	-28	50.2 %
			2	56	28	-28	50.2 %
	Production of other goods from non-metallic minerals n. e. c.	2016 VET › 2016 AA	4	249	186	-63	74.7 %
		2016 VET ‹ 2016 AA	1	67	71	4	106.2 %
			5	315	257	-59	81.4 %
			7	372	285	-87	76.6 %
Total			**86**	**4,194**	**3,392**	**-802**	**80.9 %**

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2.6.4 Ceramics and gypsum production

The emissions from Activities 17 “Ceramics production” and 19 “Gypsum production” are editorially summarised in this report and amounted to a total of 2.3 million tonnes of carbon dioxide in 2016 and thus increased by 1.7 percent compared to the previous year. The free allocation covered on average 94 percent of the emissions.

A new ceramics installation has been included in emissions trading so that a total of 148 ceramics and nine gypsum installations are covered by emissions trading.

Table 27: Overview of ceramics production (Activity 17) and gypsum production (Activity 19), number of installations, summary of emissions and allocation amounts

Sector/Activity	No. of installations	2015 emissions [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Ceramics and gypsum production	157	2,257	2,157	2,295	94.0 %

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Emissions

Emissions from ceramics production increased by 1.9 percent (plus 39,000 tonnes of carbon dioxide), while emissions from gypsum production remained constant (plus 0.1 percent compared to 2015). 89 installations, that is more than half of the ceramics installations, reported an emission increase in 2016 compared to the previous year. 56 installations reported an emissions decrease. Two ceramics installations reported zero emissions as in the previous year, while one installation ceased operation and also reported zero emissions in 2016.

In the case of gypsum producing installations, installations with emission reductions were balanced out by installations with emission increases.

Table 28: Ceramics production (Activity 17) and gypsum production (Activity 19), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installations	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
17	Ceramics production	2016 VET › 2015 EM	89	1,203	1,336	133
		2016 VET ‹ 2015 EM	56	782	689	-93
		2016 VET = 2015 EM	2	0	0	0
		Comparison not possible	1	-	-	-
			148	1,988	2,025	39
19	Gypsum production	2016 VET › 2015 EM	4	151	156	5
		2016 VET ‹ 2015 EM	5	118	113	-5
			9	269	269	0
Total			**157**	**2,257**	**2,295**	**40**

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Figure 26 shows the emissions trend and allocations since 2005 for Activities 17 (ceramics production) and 19 (gypsum production). Since 50 ceramics and nine gypsum installations were newly included in emissions trading due to the extended scope at the beginning of the third trading period and because these installations lack complete information regarding their past emissions, these emissions were partly estimated[57]. However, for the comparison of emissions and free allocation, the emissions must be considered in the applicable scope of the trading period because no estimate has been made retroactively for the free allocation.

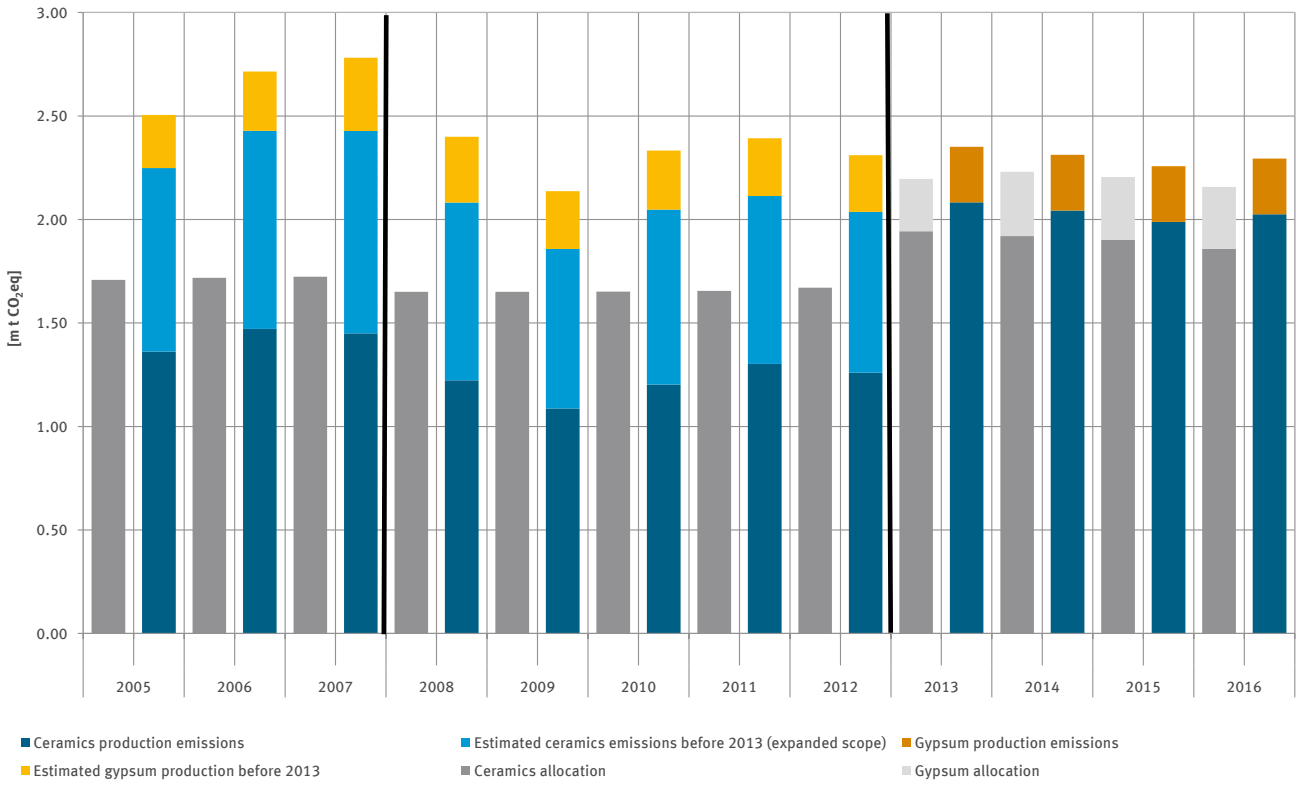

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Figure 26: Ceramics production (Activity 17) and gypsum production (Activity 19), emissions trend and free allocation from 2005 to 2016 in Germany

The declining emissions trend in the ceramics industry, which has been observed since 2011, does not continue in 2016 and emissions increase again. While the free allocation in the first and second trading periods was significantly higher than the emissions, free allocation was no longer sufficient since the beginning of the third trading period to cover the emissions of the ceramics industry.

Allocation status

The allocation coverage for the installations varies widely: On average, 20 percent of the emissions from 90 installations were not covered by the free allocation in 2016, whereas 55 installations received an over-supply of the same proportion.

The average allocation coverage of the installations for ceramics production is approximately 92 percent, which is a drop of approximately 3.7 percent compared to the previous year.

On the other hand, the average allocation coverage of gypsum production installations is 111 percent, which also decreased slightly compared to the previous year.

57 In ceramics, the data from 2005 to 2010 come from the applications for free allocation in the third trading period with some missing information for 2009 and 2010 added as interpolated values. For 2011 and 2012, emissions from the emission reports were used for those installations included in the second trading period and the values were interpolated for newly added installations. Gypsum installations underwent an analogous procedure and 2011 and 2012 emissions were interpolated.

Table 29: 2016 Ceramics production (Activity 17) and gypsum production (Activity 19), number of installations, allocation amounts, VET entries and allocation coverage

No.	Activity	2016 VET vs. 2016 allocation	No. of installations	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
17	Ceramics production	2016 VET › 2016 AA	90	1,411	1,119	-291	79.3 %
		2016 VET ‹ 2016 AA	55	615	739	124	120.2 %
		2016 VET = 2016 AA	2	0	0	0	
		Comparison not possible	1	-	-	-	
			148	2,025	1,858	-167	91.8 %
19	Gypsum production	2016 VET › 2016 AA	2	57	47	-10	82.5 %
		2016 VET ‹ 2016 AA	7	213	252	40	118.6 %
			9	269	299	30	111.0 %
Total			**157**	**2,295**	**2,157**	**-137**	**94.0 %**

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2.7 Paper and pulp industry

The sector includes pulp production and paper, cardboard or paperboard manufacture (Activities 20 and 21 as per Annex 1 TEHG). Since two installations are no longer subject to emissions trading, the number of installations in the paper production activity fell to 150 compared to 152 installations in 2015. Five installations are associated with pulp production and 145 with paper production. Pulp and paper industry installations emitted slightly less than 5.5 million tonnes of carbon dioxide in 2016. This corresponds to the level of the previous year.

Table 30: Overview of the paper and pulp industry (Activities 20 and 21), number of installations, summary of emission and allocation amounts

Sector/Activity	No. of installations	2015 emissions [kt CO_2eq]	2016 allocation amount* [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Paper and pulp	150	5,467	4,623	5,414	85.4 %

* Adjusted for the estimated allocation amount for heat imports
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Emissions

In pulp production, the amount of emissions subject to emission trading rose by five percent from 137,000 tonnes of carbon dioxide in 2015 to 144,000 tonnes (see Table 31).

Overall in the paper production activity, a slight decrease of emissions by 50,000 to 5.27 million tonnes of carbon dioxide compared to 2015 is recorded. Around 48 percent of the installations, increased their emissions by about 199,000 tonnes of carbon dioxide in total, and about 41 percent of the installations decreased their emissions by 179,000 tonnes of carbon dioxide altogether. Similarly as in the chemical industry, there are also 16 so-called zero-emission installations in the paper and pulp industry, which from the third trading period are subject to emissions trading although they do not produce carbon dioxide emissions.

Table 31: Paper and pulp industry (Activities 20 and 21), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installa-tions	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
20	Pulp production	2016 VET › 2015 EM	2	43	52	9
		2016 VET ‹ 2015 EM	2	94	92	-2
		2016 VET = 2015 EM	1	0	0	0
			5	137	144	7
21	Paper production	2016 VET › 2015 EM	69	2,708	2,907	199
		2016 VET ‹ 2015 EM	59	2,541	2,363	-179
		2016 VET = 2015 EM	16	0	0	0
		Comparison not possible	1	-	-	-
			145	5,330	5,270	20
Total			**150**	**5,467**	**5,414**	**27**

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Compared to the previous year, emissions fell by about one percent between 2015 and 2016. At the same time, the production of the German paper industry remained stable or only slightly below the previous year's level.[58]

Emissions remained below the 2009 level in the first four years of the third trading period and therefore reached the lowest level since the introduction of emissions trading (see Figure 27). Compared to 2008 (the first year of the second trading period) they decreased by about 13 percent.

In addition to the increase in energy efficiency in production, the reason for this is the continuing decline in the volume of graphic papers, mainly due to the increased use of electronic media. In the areas of packaging and hygiene, however, according to association reports there is sustained growth with the hygiene sector growing more strongly than the packaging sector.[59] Overall, production remained stable on a year-by-year basis.

58 Cf. VDP 2017, Press release of 21/02/2017
59 Cf. VDP 2017, Press release of 21/02/2017

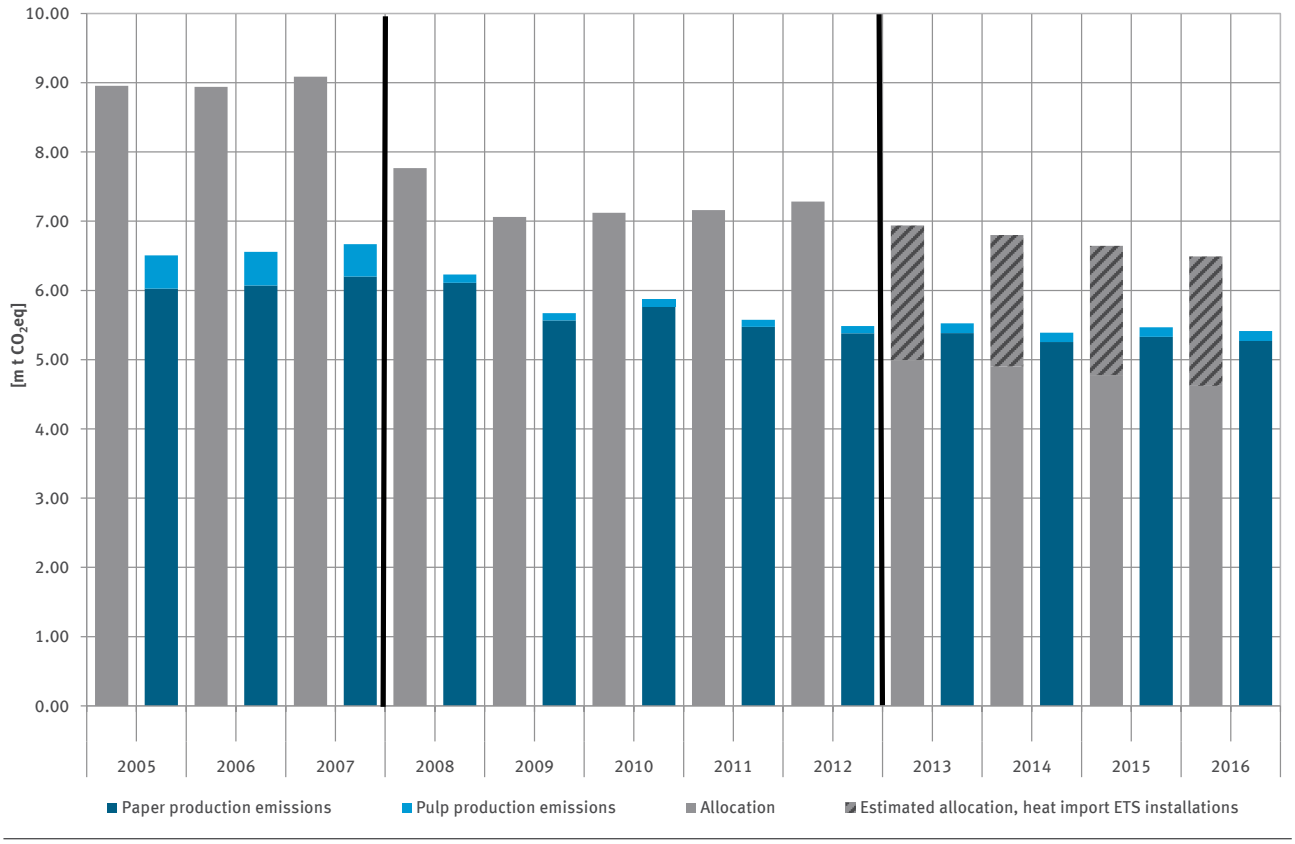

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Figure 27: Paper and pulp industry (Activities 20 and 21), free allocation and emissions trends from 2005 to 2016 in Germany

Figure 28 compares the emissions trends of the paper industry with the production data trends. For this purpose, the activity rates of the product benchmarks for „fine paper“ and „newsprint paper“ were combined into „graphic papers“ and the activity rates of product benchmarks for „cardboard“ as well as „testliner and fluting“ into „packaging“. In addition, the activity rates of the product benchmark for „tissue paper“ are shown. The activity rates are compared with the corresponding data of the German Pulp and Paper Association (VDP, Verband Deutscher Papierfabriken).

In paper production, on the one hand a slight decrease in the activity rate of graphic papers can be observed compared with the previous year and on the other hand a further increase in the activity rate of tissue paper is observed in accordance with VDP production data. Although the VDP‘s association figures for production trends show a similar trend overall to the activity rates in the three categories, the VDP data show a slight increase in the production of packaging while the activity rate shows a minimal decline in packaging. Overall, a full comparability of the activity rates and the production data of the VDP is limited in parts since, among other things, not all installations in the emissions trading are necessarily organised in the VDP.

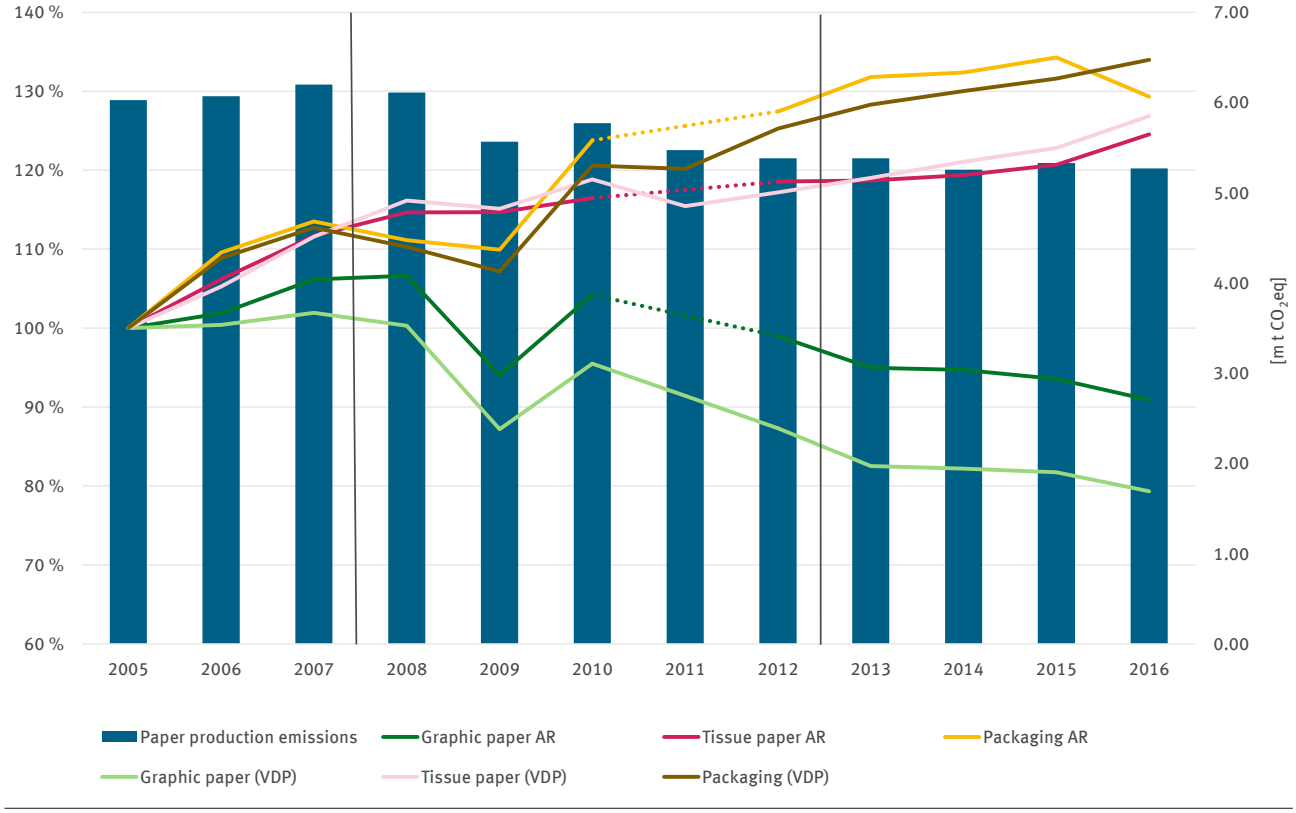

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Figure 28: Paper production (Activity 21), emissions and production trends[60] from 2005 to 2016 in Germany

The following Figure 29 shows the emissions trends both for the EU as a whole and for Germany. It can be seen that the 2005-2015 emissions from the paper and pulp industry (Registry activities 35 and 36) are clearly declining both in the EU (22 percent) and in Germany (23 percent). 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. Since 2014 the decline has slowed significantly both in Germany and at the EU level.

60 VDP data (Performance reports for the respective years)

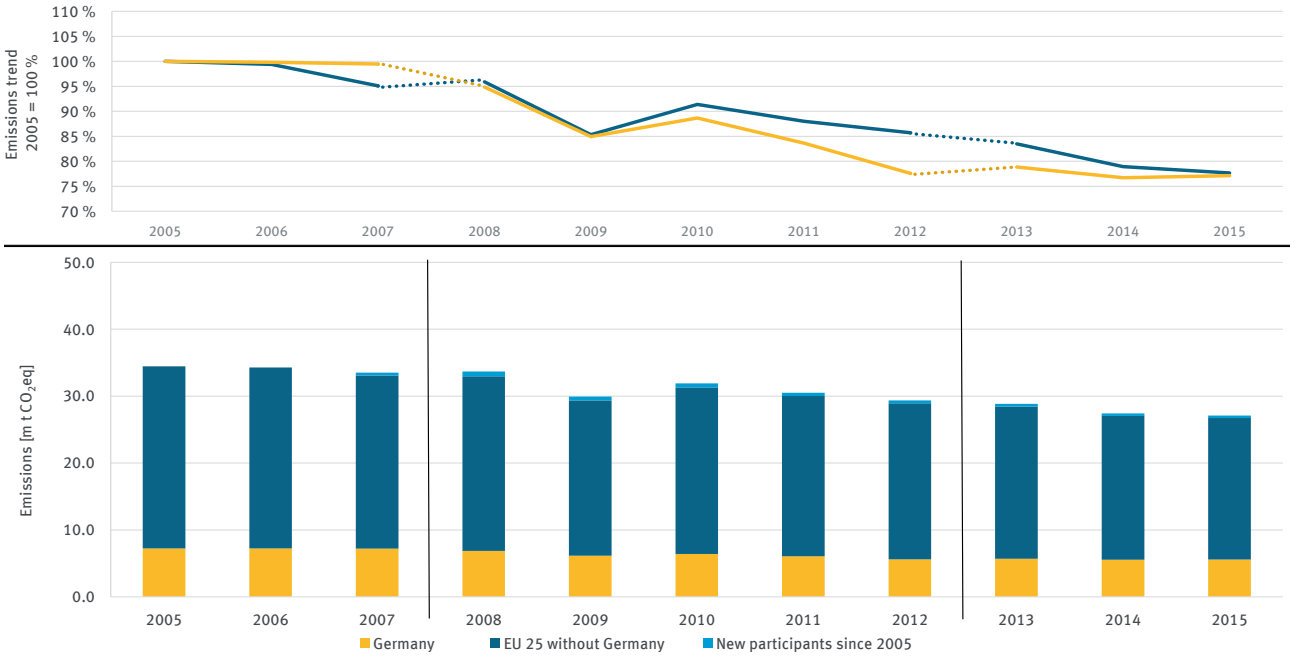

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Figure 29: Emissions trend of the paper and pulp industry (Registry activities 35 and 36) in Germany and in the EU from 2005 to 2014[61]

Allocation

The operators of the 145 installations in the paper activity acquired a total of 6.4 million emission allowances for 2016, which is just under 1.1 million or 23 percent more than they would need for surrender according to 2016 VET figures (5.3 million emission allowances, see Table 32). However, this surplus is very unevenly distributed among the installations: while for 68 installations the allocation exceeds the emissions by almost 2.9 million tonnes, i.e. the 2016 allocations are more than three times as high as the 2016 emissions, 74 installations are underfunded by just under 1.8 million allowances. Basically, on the one hand this is due to the fact that power generation is no longer granted an allocation and on the other the allocation for heat imports is distributed very unevenly.

The installations of the pulp industry, however, have a significant total deficit of around 33 percent of the 2016 emissions.

Table 32: 2016 paper and pulp industry (Activities 20 and 21), number of installations, allocation amounts, VET entries and allocation coverage

No.	Activity	2016 VET vs. 2016 allocation	No. of installations	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
20	Pulp production	2016 VET › 2016 AA	3	140	80	-60	57.0 %
		2016 VET ‹ 2016 AA	2	4	17	13	453.9 %
			5	144	97	-47	67.1 %

61 Data source: EEA 2016. The evaluation is based on a summary of the installations by activities in the EU Union Registry (cf. Table 52, Chapter 8) and 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.

No.	Activity	2016 VET vs. 2016 allocation	No. of installa-tions	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
21	Paper production	2016 VET › 2016 AA	74	4,077	2,317	-1,760	56.8 %
		2016 VET ‹ 2016 AA	68	1,193	4,042	2,850	338.9 %
		2016 VET = 2016 AA	2	0	0	0	
		Comparison not possible	1	-	-	-	
			145	5,270	6,359	1,089	120.7 %
Total			**150**	**5,414**	**6,456**	**1,042**	**119.2 %**

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Overall, the proportion of allocation that is due to heat imports of other installations subject to emissions trading can be estimated at around 1.8 million emission allowances (cf. Figure 27)[62]. Without this share, the allocation coverage of the paper production activity (Activity 21) and pulp production activity (Activity 20) would decrease to almost 85 percent (adjusted allocation coverage), which corresponds to a minor deficit.

2.8 Chemical Industry

The chemical industry comprises Activities 22 to 29 as per Annex 1 TEHG, which for the most part were added to emissions trading at the start of the third trading period. Also allocated 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 for the generation of electricity and heat for the chemical industry, however, are only classified as chemical industry installations provided they are approved in terms of pollution control together with the chemical installation.

The number of existing installations remained constant at 189 installations.

The emissions from the chemical industry amounted in 2016 to around 18.2 million tonnes carbon dioxide equivalent.

Table 33: Overview of the chemical industry (Activities 22 to 29 and 1), number of installations, summary of emission and allocation amounts

Sector/Activity	No. of installa-tions	2015 emissions [kt CO_2eq]	2016 allocation amount* [1000 EUA]	2016 VET [kt CO_2eq]	Allocation coverage
Chemical Industry	189	17,911	17,604	18,160	96.9 %

* Adjusted for the estimated 2016 allocation amount for heat imports
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Emissions

The emissions from 189 installations rose by 249,000 tonnes of carbon dioxide equivalent or 1.4 percent compared to the previous year.

62 Data from the allocation report (DEHSt 2014a) can only be used as an estimate to provide a basis. This value was derived based on data on heat imports from other EU ETS installations from the allocation procedure (cf. Chapter 7.8 of the allocation report). This estimate cannot be adjusted to the current situation of heat imports in the paper industry because of the lack of any current data.

Table 34: Chemical industry (Activities 22 to 29 and 1), number of installations, 2015 emissions and 2016 VET entries

No.	Activity	2016 VET vs. 2015 emissions	No. of installations	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 emissions [kt CO_2eq]
22	Carbon black production	2016 VET > 2015 EM	4	545	606	61
		2016 VET < 2015 EM	1	133	98	-36
			5	678	703	25
23, 24	Adipic and nitric acid	2016 VET > 2015 EM	3	198	212	14
		2016 VET < 2015 EM	6	683	599	-84
		2016 VET = 2015 EM	2	0	0	0
			11	881	811	-70
26	Ammonia production	2016 VET > 2015 EM	3	2,533	2,794	261
		2016 VET < 2015 EM	2	1,931	1,754	-177
			5	4,463	4,548	85
27	Production of bulk organic chemicals	2016 VET > 2015 EM	51	4,192	4,686	494
		2016 VET < 2015 EM	35	3,829	3,599	-231
		2016 VET = 2015 EM	30	0	0	0
		Comparison not possible	1	-	-	-
			117	8,023	8,285	264
28	Production of hydrogen and synthesis gas	2016 VET > 2015 EM	5	407	517	110
		2016 VET < 2015 EM	10	1,434	1,298	-136
			15	1,842	1,815	-27
29	Soda production	2016 VET > 2015 EM	1	163	166	2
		2016 VET < 2015 EM	4	438	404	-35
		2016 VET = 2015 EM	1	0	0	0
			6	602	569	-32
1, 25	Miscellaneous	2016 VET > 2015 EM	14	714	790	76
		2016 VET < 2015 EM	16	709	639	-70
			30	1,423	1,429	6
Total			**189**	**17,911**	**18,160**	**251**

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In detail, in almost all sectors of activity there has been both an increase and a decrease in emissions. Activity 27 (production of bulk organic chemicals) showed the biggest changes compared to the previous year at a rise of 264,000 tonnes of carbon dioxide (plus 3.2 percent) and Activity 26 (ammonia production) at an increase of 85,000 tonnes of carbon dioxide (plus 1.9 percent). Activities 27 and 26 had the highest emissions within the chemical industry with 8.3 million and 4.5 million tonnes of carbon dioxide respectively, followed by Activity 28 (production of hydrogen and synthesis gas) with 1.8 million tonnes of carbon dioxide. The „Miscellaneous" category includes installations of Activity 1 (combustion) and Activity 25 (production of glyoxal and glyoxylic acid).

Among Activities 23 and 24 there are eleven installations producing adipic or nitric acid that are subject to emissions trading due to both their carbon dioxide and nitrous oxide (dinitrogen monoxide, N_2O) emissions. In 2016, nitrous oxide emissions corresponded to 667,000 tonnes of carbon dioxide equivalent, making up an average of 82 percent of the total emissions for these installations.

Similar to the paper industry, there are also 33 zero-emission installations in the chemical industry – mainly in the production of bulk organic chemicals. A part of these installations has been subject to emissions trading from the third trading period, although they do not discharge any carbon dioxide or nitrous oxide emissions. For the remainder of the „zero-emission installations“, the CO_2 and N_2O emissions are forwarded to other installations where they are used or emitted in the receiving installations.

Since the majority of installations only reported their verified emissions from the start of the third trading period, the sector‘s emissions trends since 2005 can only be estimated (see Figure 30). For installations that were not, or only partially, subject to emissions trading in the first and second trading period, but have received an allocation for the third trading period, information about their historic emissions is available from the allocation process. These generally cover the 2005-2010 period. Emissions in the years with no emission data available from the allocation process and for 2011 and 2012 were estimated using linear interpolation.

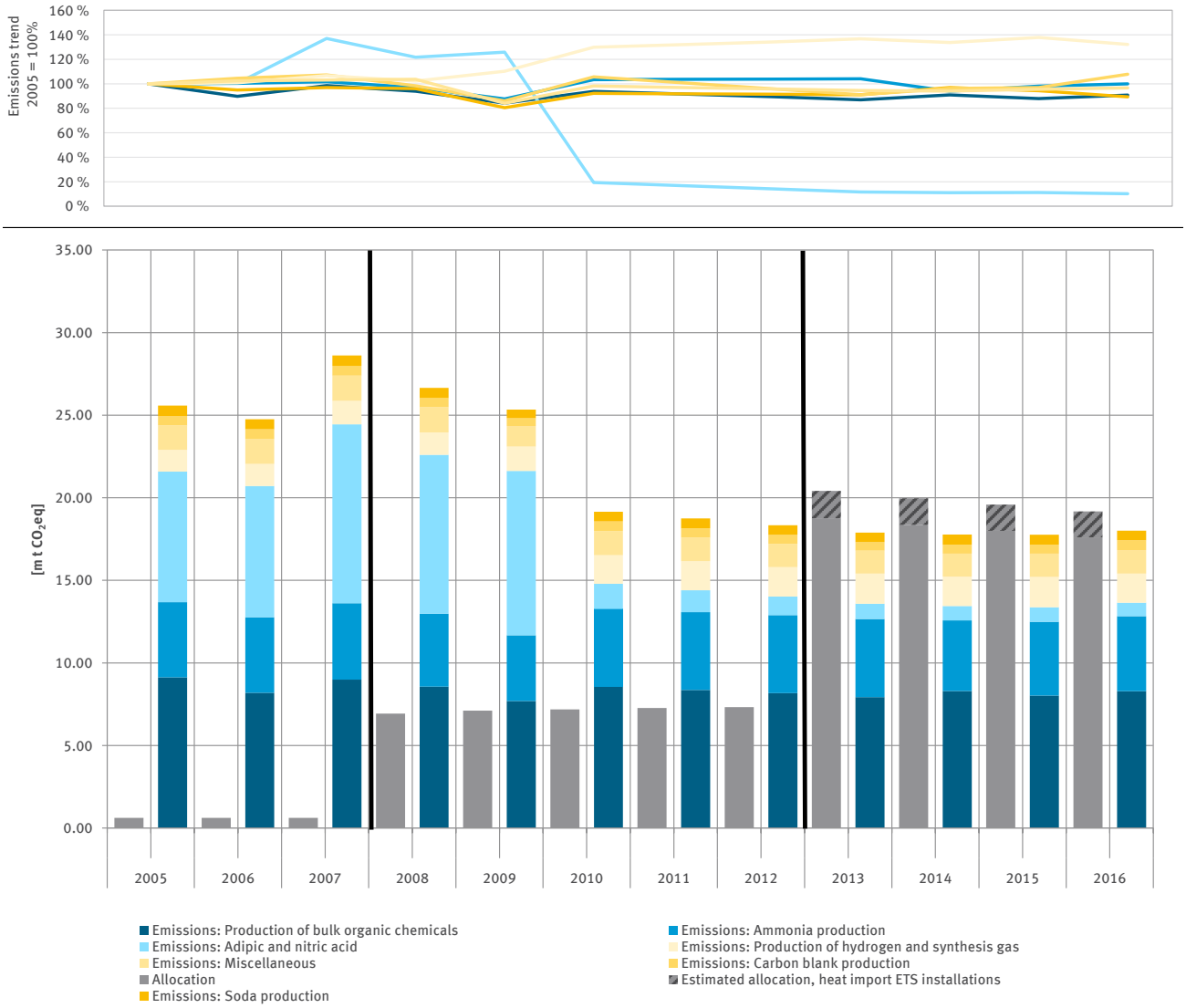

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Figure 30: Chemical industry (Activities 22 to 29 and 1), emissions trend and free allocation in Germany for 2005 to 2016

The decrease in emissions from adipic and nitric acid production since 2010 is clearly noticeable. The implementation of reduction technologies reduced nitrous oxide emissions relatively inexpensively. As a result of voluntary commitment by the industry, pollution control requirements and, above all, the implementation of Joint Implementation projects in Germany, substantial reductions in emissions could be achieved even before the start of the emissions trading obligation.

During the 2009 economic crisis, there was also a reduction in emissions from the chemical industry and the emission level dropped in 2010 to levels similar to those before the crisis. In some areas such as hydrogen and synthesis gas production emissions rose due to new installations starting in 2010, but declined again however slightly since 2015.

The figure also shows the increase in allocation from the first to the third trading period according to the extended scope of application to the chemical industry in emissions trading. Already included in emissions trading were carbon black, ethylene and propylene (steam crackers). Likewise, energy installations that have been approved in accordance with pollution control requirements together with the chemical installation have already been subject to emissions trading.

Figure 31 depicts emissions and production data for the production of bulk organic chemicals and ammonia, the activities with the highest emissions within the sector. For the production of ammonia, the production data are the activity rates of both the product benchmark „ammonia“ as well as data on the ammonia production of the German Chemical Industry Association (VCI, Verband der Chemischen Industrie). In addition to the association data[63], the activity rates for the product benchmark „steam cracking“ and for the heat emission value[64] are shown for the production of bulk organic chemicals.

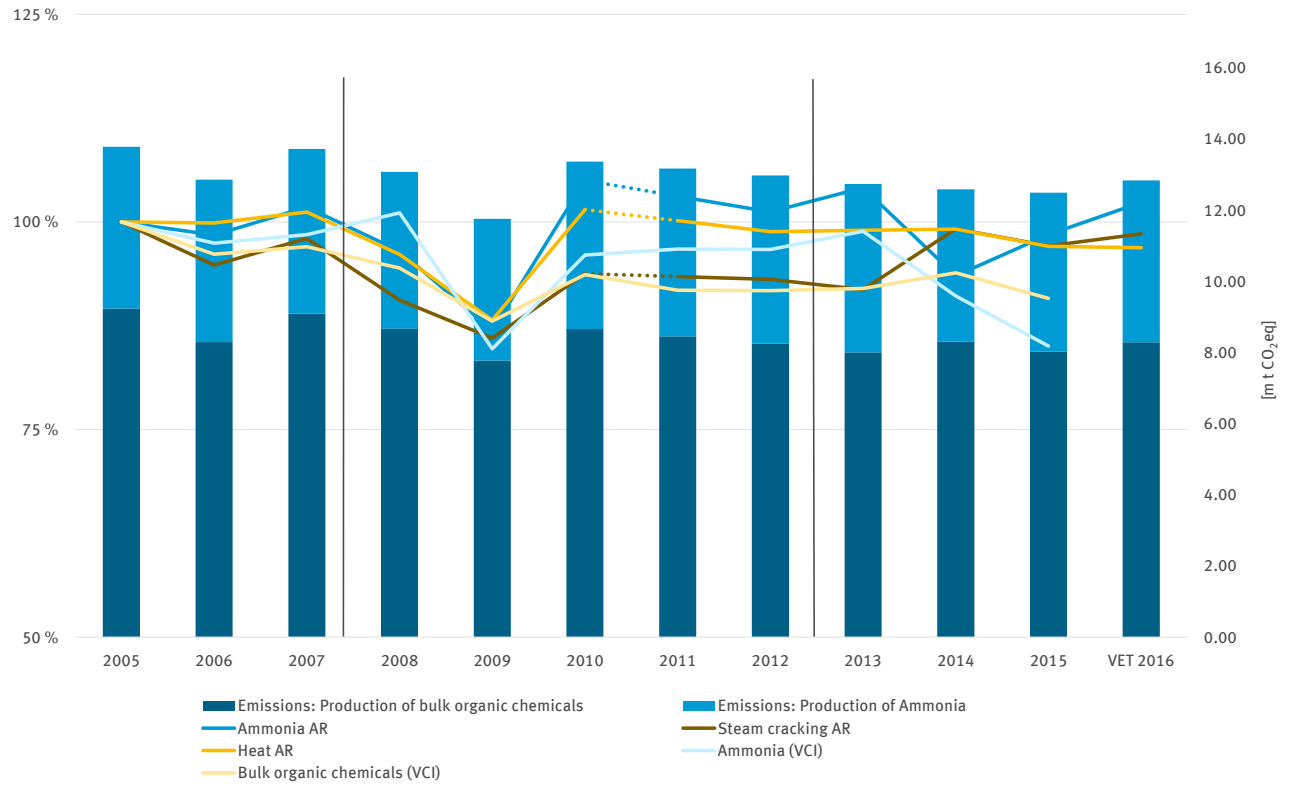

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Figure 31: Production of ammonia, bulk organic chemicals, hydrogen (Activities 26 to 28), emissions and production trends from 2005 to 2016 in Germany[65]

63 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 2016). Data gaps on some products have been interpolated.

64 The activity rates for the heat benchmark were selected in addition to steam cracking since the allocation for the production of bulk organic chemicals is predominantly based on these two benchmarks and their proportions in the allocation are roughly the same (DEHSt 2014a).

65 VCI 2013, VCI 2016

Despite methodological deviations, the emissions trend in ammonia production is relatively consistent with the trends of the activity rates and the association data. Differences between the activity rates and the association data can also be attributed to the fact that an installation that produces ammonia is assigned to the „refineries“ sector on the basis of its approval pursuant to § 4 TEHG. Its production is therefore not included in the activity rate, but it is presumably in the association data.

The activity rates for the product benchmark „steam cracking“ and the heat benchmark are more consistent with the emissions trend of the bulk organic chemicals than would be expected from the EU-wide allocation rules for cross-boundary heat flows[66]. The VCI‘s production data course is also similar. Differences between the activity rates and the VCI data in individual years are also due to the fact that the association data represent a product mix and not just „steam cracking“.

Allocation status

Table 35: Chemical Industry (Activities 22 to 29 and 1), number of installations, 2016 allocation amounts, VET entries and allocation coverage

No.	Activity	2016 VET vs. 2016 allocation	No. of installa-tions	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
22	Carbon black production	2016 VET › 2016 AA	4	700	521	-179	74.4 %
		2016 VET ‹ 2016 AA	1	3	11	8	330.0 %
			5	703	532	-171	75.6 %
23, 24	Adipic and nitric acid	2016 VET › 2016 AA	4	452	277	-174	61.4 %
		2016 VET ‹ 2016 AA	7	360	1,483	1,124	412.4 %
			11	811	1,760	949	217.0 %
26	Ammonia produc-tion	2016 VET › 2016 AA	4	3,655	2,765	-890	75.7 %
		2016 VET ‹ 2016 AA	1	893	901	8	100.9 %
			5	4,548	3,667	-881	80.6 %
27	Production of bulk organic chemicals	2016 VET › 2016 AA	36	6,096	4,357	-1,739	71.5 %
		2016 VET ‹ 2016 AA	66	2,189	4,839	2,650	221.1 %
		2016 VET = 2016 AA	14	0	0	0	
		Comparison not possible	1	-	-	-	
			117	8,285	9,195	910	111.0 %
28	Production of hydrogen and synthesis gas	2016 VET › 2016 AA	8	1,007	478	-529	47.5 %
		2016 VET ‹ 2016 AA	7	808	1,101	293	136.3 %
			15	1,815	1,579	-235	87.0 %
29	Soda production	2016 VET › 2016 AA	5	569	1,065	495	187.0 %
		2016 VET ‹ 2016 AA	1	0	0	0	
			6	569	1,065	495	187.0 %

66 In the case of cross-installation heat flows, the free allocation in the third trading period applies in principle to the installation subject to emissions trading in which the heat is used. Only if the heat is used by an installation that does not participate in emissions trading or if the heat is supplied to a heat distribution network (treated as a non-emissions-related installation for the allocation), the allocation is made for the installation in which the heat is generated (see also DEHSt 2014 a, including Sections 3.2 and 7.8). Correspondingly, the allocation does not always take place at the installation in which the emissions from heat generation also originate (see also explanations for the adjustment of the allocation quantities in this chapter).

No.	Activity	2016 VET vs. 2016 allocation	No. of installa-tions	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
1, 25	Miscellaneous	2016 VET › 2016 AA	17	1,011	655	-356	64.8 %
		2016 VET ‹ 2016 AA	13	417	718	301	172.2 %
			30	1,429	1,374	-55	96.1 %
Total			**189**	**18,160**	**19,172**	**1,012**	**105.6 %**

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In 2016 the operators of chemical installations received approximately one million free emission allowances or 5.6 percent more than they needed for their surrender obligation. For 100 installations, the amount of emission allowances allocated free of charge exceeded emissions by a total of around 4.9 million allowances. In contrast, 73 installations received a total of approximately 3.9 million fewer free emission allowances than they needed to fulfil their surrender obligation. 15 installations with a zero VET entry received no free allocation.

The largest relative surplus of free emission allowances can be seen in the installations producing adipic and nitric acid (217 percent). This is due to the installation and advancement in the meantime of emission control technologies of N_2O, which resulted in specific emissions well below the specific product benchmarks for adipic and nitric acid. The seven installations concerned had a surplus of 412 percent. The four installations that get allocated less than they emit (61 percent) either have not yet installed any advanced nitrous oxide reduction or have significantly higher process-related CO_2 emissions.

Compared with other industrial sectors, the chemical industry installations as a whole were on average adequately equipped with free emission allowances. The nominal allocation coverage is a good 105 percent. The adjusted allocation coverage, which takes into account the deduction of an estimated allocation volume from heat imports from other installations subject to emissions trading in the amount of approx. 1.6 million emission allowances[67], is still around 97 percent (see Table 33 and Figure 30).

3 Cross-sector analysis

3.1 Overview of the allocation status in Germany

Even in the fourth year of the current trading period, the verified emissions of all installations subject to emissions trading in Germany with 452.9 million tonnes carbon dioxide equivalent totalled significantly higher than the free allocation amount.[68] Overall in 2016, approximately 153.7 million emission allowances were allocated free of charge to operators of 1,652 out of the overall 1,863 German installations. The free allocation covered thereby on average 33.9 percent of the verified emissions of all installations in Germany (2015: 34.7 percent). The average allocation coverage was thus slightly lower than in the previous year because the allocation amounts at 2.8 percent declined more than the total emissions (minus 0.5 percent). In Table 36 the allocation and emissions status are differentiated according to activities (1 to 29). Comparison of the different activities clearly reflects at first the large differences between energy and industrial installations in terms of the third-trading-period allocation rules.

67 An estimate can only be based on information from the Allocation Report (DEHSt 2014a). This figure was derived based on data about heat imports from other EU ETS installations from the allocation process (cf. Section 7.8 of the Allocation Report). This estimate cannot be adjusted to the current situation of heat imports in the chemical industry because of the lack of any current data.

68 In Section 3.1 the existing installations are used as a basis for the 2016 reporting year. Therefore, the reported changes in the allocation volumes and emissions compared to the previous year differ from the values given in the summary. The summary shows the changes compared to the actual existing installations of the previous year.

Table 36: 2016 allocation status by activities (non-adjusted allocation coverage)

Field	No.	Activity	No. of installa-tions	2016 allocation amount [1000 EUA]	2016 VET [kt CO_2eq]	2016 allocation surplus [1000 EUA]	Allocation coverage 2016*	Allocation coverage 2015*
Energy	2	Energy conversion ≥ 50 MW RTI	483	21,931	322,928	-300,981	6.8 %	7.2 %
	3	Energy conversion 20-50 MW RTI	403	3,449	5,383	-1,934	64.1 %	70.4 %
	4	Energy conversion 20-50 MW RTI, other fuels	11	128	153	-25	83.8 %	95.2 %
	5	Prime movers (engines)	3	35	49	-14	71.9 %	69.6 %
	6	Prime movers (turbines)	52	720	1,052	-332	68.4 %	63.6 %
Energy			952	26,263	329,565	-303,286	8.0 %	8.5 %
Industry	1	Combustion	74	1,881	2,055	-174	91.5 %	93.5 %
	7	Refineries	23	19,382	25,286	-5,904	76.7 %	80.0 %
	8	Coking plants	4	1,705	3,856	-2,151	44.2 %	46.3 %
	9	Processing of metal ores	1	67	65	3	104.2 %	86.1 %
	10	Production of pig iron and steel	30	42,211	27,108	15,103	155.7 %	153.3 %
	11	Processing of ferrous metals	90	4,547	5,252	-705	86.6 %	90.1 %
	12	Production of primary aluminium	7	889	1,008	-119	88.2 %	91.3 %
	13	Processing of non-ferrous metals	31	1,536	1,607	-71	95.6 %	97.9 %
	14	Production of cement clinker	36	17,798	19,348	-1,550	92.0 %	94.4 %
	15	Lime production	62	7,583	9,079	-1,495	83.5 %	83.5 %
	16	Glass production	79	3,107	3,822	-715	81.3 %	83.9 %
	17	Ceramics production	148	1,858	2,025	-167	91.8 %	95.6 %
	18	Mineral fibre production	7	285	372	-87	76.6 %	80.0 %
	19	Gypsum production	9	299	269	30	111.0 %	113.3 %
	20	Pulp production	5	97	144	-47	67.1 %	71.7 %
	21	Paper production	145	6,359	5,270	1,089	120.7 %	122.8 %
	22	Carbon black production	5	532	703	-171	75.6 %	80.4 %
	23	Nitric acid production	8	730	685	45	106.6 %	99.7 %
	24	Nitric acid production	3	1,031	126	904	816.0 %	774.2 %
	25	Production of glyoxal and glyoxylic acid	1	8	11	-3	72.2 %	90.2 %
	26	Ammonia production	5	3,667	4,548	-881	80.6 %	83.7 %
	27	Production of bulk organic chemicals	117	9,195	8,285	910	111.0 %	117.4 %
	28	Production of hydrogen and synthesis gas	15	1,579	1,815	-235	87.0 %	87.2 %
	29	Soda production	6	1,065	569	495	187.0 %	180.3 %
Industry			911	127,411	123,309	4,103	103.3 %	105.4 %
Total			**1,863**	**153,674**	**452,873**	**-299,183**	**33.9 %**	**34.7 %**

* Without taking into account possible offsets in the transfer of waste gases from iron, steel and coke production and heat imports
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The 911 installations in the industrial sector received a total allocation of 127.4 million emission allowances for the 2016 reporting year. This compares with the total verified emissions of 123.3 million tonnes of carbon dioxide equivalent. On average therefore, the industrial sectors carried a surplus. The allocation corresponded to 103.3 percent of the surrender obligation for these installations (105.4 percent in 2015). The average allocation coverage was slightly below the previous year's level since the allocation amounts declined by two percent with almost unchanged emissions.

On the other hand the adjusted allocation coverage[69] which takes account of the transferred waste gases from iron, steel and coke production and heat imports is 87.7 percent (2015: 89.4 percent), below the 100 percent mark, representing a deficit rather than a surplus for the industrial sector (see sections below with Table 37 and Table 38).

The situation is rather different for the 952 energy installations (Activities 2 to 6). Due to the discontinuation of the free allocation for power generation in the third trading period, the ratio of allocations to verified emissions was only eight percent on average, thus somewhat lower than in the previous year (2015: 8.5 percent). Overall, the energy installations received an allocation of 26.3 million emission allowances for heat production in 2016, while the verified emissions accounted for 329.6 million tonnes of carbon dioxide equivalent. The allocation for these installations reduced by 6.5 percent, which is much greater than the 0.8 percent decrease in emissions compared to 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. The adjusted allocation coverage also shows a decreasing value for the energy sector at 13.8 percent in an annual comparison (2015: 14.4 percent) (see sections below with Table 37 and Table 38).

In addition to the energy sector, power generation in the industry is no longer allocated free of charge. This applies, for example, to refineries and the paper industry, since in both industries heating power plants are usually in operation. Refineries received an allocation in 2016 that therefore corresponded to only 76.7 percent of their verified emissions (80.0 percent in 2015). 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, the allocation rules for cross-installation heat flows indicated that these installations even have a surplus of free emission allowances (see Section 2.7). In the paper industry, the ratio of allocation to verified emissions was 120.7 percent (122.8 percent in 2015).

Pig iron and steel production also features a large surplus relative to their emissions. Here the ratio of free allocation to verified emissions was 155.7 percent (2015: 153.3 percent). This situation, however, must be regarded in a differentiated way similar to the cross-installation heat flows in the paper and chemical industries (see Section 2.8) since the allocation claim does not necessarily emerge at the installations where the emissions actually occur. Installations in the iron and steel industry receive an allocation for the production of waste gases from iron, steel and coke production, although the emissions are released in the importing installation where the waste gases have been transferred to (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 waste gases forwarded from iron, steel and coke production, and heat imports from other installations subject to emissions trading, had a significant impact on the allocation coverage for the sectors concerned. An estimated 15.9 million emission allowances could be assigned in 2016 to waste gases forwarded from iron, steel and coke production to energy installations, approximately 3.4 million emission allowances to energy installations importing heat.[70]

Assuming that these allocation amounts were settled among industrial and energy sector operators, the industrial sector exhibited a deficit of about 15.1 million emission allowances in 2016. Thus the allocation coverage would be 87.7 for the industrial sector instead of the above-mentioned 103.3 percent, which corresponds rather to a deficit than to a surplus. Conversely, under the assumptions made for the energy sector, the allocation coverage (the ratio of adjusted allocation to verified emissions) increased from 8.0 to 13.9 percent in 2016. Table 37 summarises the 2016 adjusted allocation status that was adjusted by forwarded waste gases from iron, steel and coke production and imported heat at the sectors level.

69 Cf. explanation of the adjusted allocation coverage in the glossary (Chapter 9)

70 Cf. explanations to allocation estimation in Sections 2.1 „Energy installations“, 2.4 „Iron and steel industry incl. coking plants“, 2.7 „Paper and pulp“ and 2.8 „Chemical industry“

Table 37: Adjusted allocation coverage (taking into account waste gases from iron, steel and coke production and heat imports)

Field	Sector	Number of instal-lations	2016 allocation amount [m EUA]	2016 VET [m t CO_2-eq]	2016 allocation surplus [m EUA]	Alloca-tion coverage 2016*	2016 adjusted allocation amount** [m EUA]	2016 adjusted allocation covera-ge**
Energy	Energy installations	952	26,263	329,565	-303,286	8.0 %	45.5	13.8 %
Energy		952	26,263	329,565	-303,286	8.0 %	45.5	13.8 %
Industry	Refineries	23	19,382	25,286	-5,904	76.7 %	19.4	76.7 %
	Iron and steel	126	48,531	36,330	12,201	133.6 %	32.7	89.9 %
	Non-ferrous metals	38	2,425	2,615	-190	92.7 %	2.4	92.7 %
	Mineral processing industry	342	30,937	34,929	-3,992	88.6 %	30.9	88.6 %
	Paper and pulp	150	6,456	5,414	1,042	119.2 %	4.6	85.4 %
	Chemical industry	189	19,172	18,160	1,012	105.6 %	17.6	96.9 %
	Other combustion plants	43	508	574	-66	88.5 %	0.5	88.5 %
Industry		911	127,411	123,309	4,103	103.3 %	108.2	87.7 %
Total		**1,863**	**153,674**	**452,873**	**-299,183**	**33.9 %**	**153.7**	**33.9 %**

* Without taking into account possible offsets in the transfer of waste gases from iron, steel and coke production and heat imports
** Taking into account possible offsets in the transfer of waste gases from iron, steel and coke production and heat imports
As of 02/05/2017

Allocation status in the overall 2008-2016 period

Besides the 2016 allocation surpluses (deficits), also the corresponding figures from the previous years for the installations considered in this report are 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 (also 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 101.1 million allowances.[71] The allocation surplus amounted to another 32.5 million allowances in the first four years of the current trading period. This resulted in a total allocation surplus of 133.6 million emission allowances for industrial activities in the 2008-2016 period.

Under the assumption that the allocations for forwarded waste gases from iron, steel and coke production and imported heat (79.3 million allowances in 2013 to 2016) have been settled between the operators of the industrial and energy sectors, the industrial sector exhibits a cumulated deficit of 46.8 million emission allowances for the first four years of the current trading period. This deficit is presently fully offset by the surpluses accrued in the second trading period. The total allocation surplus for industrial activities in the 2008-2016 period would be 54.3 million emission allowances according to this delineation. Table 38 summarises the aggregated results differentiated by industrial and energy sectors.

71 Including redistribution of emission allowances for forwarded waste gases from iron, steel and coke production pursuant to §11 of the Allocation Act (Zuteilungsgesetz) 2012

Table 38: Aggregated allocation status in the second and third trading periods

Field	Number of installations	Cumulated allocation surpluses				
		2008-2012 adjusted* [m EUA]	2013-2016 non-adjusted** [m EUA]	2008-2016 total [m EUA]	2013-2016 adjusted*** [m EUA]	2008-2016 adjusted total***
Energy	952	-367,1	-1,231.2	-1,598.3	-1,151.9	-1,519.0
Industry	911	101,1	32.5	133.6	-46.8	54.3
Total	1,863	-266,0	-1,198.7	-1,464.7	-1,198.7	-1,464.7

* Including redistribution of emission allowances for forwarded waste gases from iron, steel and coke production pursuant to §11 Allocation Act (Zuteilungsgesetz)
** Without taking into account possible offsets in the transfer of waste gases from iron, steel and coke production and heat imports
*** Taking into account possible offsets in the transfer of waste gases from iron, steel and coke production and heat imports
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Unlike in the industrial sector, this resulted in an allocation deficit of 367.1 million emission allowances for the energy installations 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 was reduced in Germany in the second trading period in favour of auctioning emission allowances.[72] Starting with the third trading period, the transition to full auctioning for power generation installations has been implemented in Europe. The cumulative shortfall in the energy sector until 2016 increased to a total of 1,598.3 million emission allowances (1,231.2 million allowances of it in the third trading period) when the balance from the second trading period is taken into account.

Assuming the free allocation for waste gases from iron, steel and coke production and heat imports is settled between the industrial and energy sectors, the deficit decreases for the entire 2008-2016 period by 79.3 million allowances to 1,519.0 million.

Use of project credits

In assessing the cumulated 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) 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 claims usually also remained available in the third trading period.[73] Operators without prior claims can always use CER/ERUs up to an amount equal to 4.5 percent of their cumulated 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 the following Section with Figure 32 and Table 40).

The total claim to use project credits currently stands at 426.1 million allowances for the 1,863 installations considered in this report. This claim relates to the entire 2008-2020 period.[74] 286.2 million project credits have already been used thereof for surrender in the second trading period (2008-2012). Another 122.8 million credits were used by the installations considered in the first four years of the current trading period for conversion into EUA.

Therefore, a residual claim for use totalling 17.0 million project credits currently remains based on the total specified claim. This corresponds to 4.0 percent of all identified German installations' total specified claim. For the 952 energy installations, the residual claims amount to 14.2 million project credits, or 5.2 percent of their total claim. The 911 industrial installations can convert 2.8 million credits into EUA (which is 1.8 percent of their total claim). Table 39 summarises the aggregated results differentiated by industry and energy sectors.

72 The free allocation for power generation was reduced annually by 38 million allowances in favour of the sales budget according to the provisions of § 20 Allocation Act (Zuteilungsgesetz) 2012.

73 However, CERs/ERUs cannot be directly used for surrender, but must be converted into EUAs in the Union Registry.

74 In addition to the second trading period claims, the specified total claim also includes claims that derive from the 2013-2016 reporting years emissions. The total claim will further increase later on in the third trading period depending on the verified 2017-2020 emissions.

Table 39: Surrendered and converted project credits in the second and third trading periods

Field	Number of installations	Total 2008-2020 claim for CER/ ERU use [million]	2008-2012 surrendered CER/ ERU [million]	2013-2020 converted CER/ ERU [million]	2008-2020 residual claim CER/ERU use [million]
Energy	952	273.3	161.8	97.3	14.2
Industry	911	152.7	124.4	25.5	2.8
Total	**1,863**	**426.1**	**286.2**	**122.8**	**17.0**

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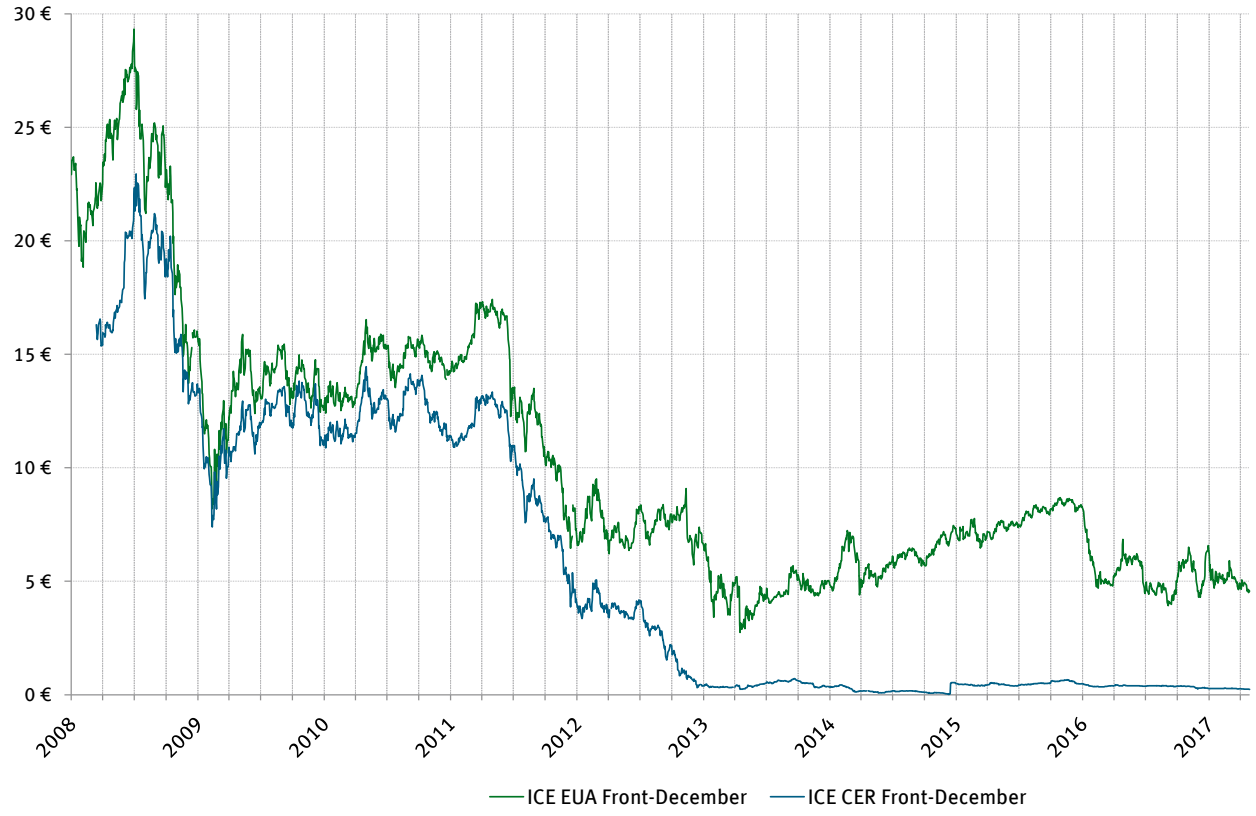
EUA und project credit price trends

The EUA price history has been subject to substantial fluctuations in the past. At the beginning of the second trading period the EUA price reached a level of 25 to 30 euros. Up to the beginning of 2009, prices fell initially to less than ten euros, then stabilised at about 15 euros between 2009 and 2011. From mid-2011 the price has dropped continuously. In April 2013, finally, the lowest level of under three euros was reached since the start of the second trading period. The price stabilised again gradually 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 fluctuated in a range between four and seven euros.

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 24 cents. This corresponds to about five percent of an EUA's market value. Figure 32 shows the price trends for EUA and CER/ERU in the period from January 2008 to April 2017.



Source: ICE, Thomson Reuters Eikon, DEHSt representation
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Figure 32: Price trends of emission allowances (EUA) and international project credits (CER) in the second and third trading periods

In addition, Table 40 shows the average EUA and CER prices for the completed second and the current third trading period.[75] The relevant average price for EUA was 13.62 euro (CER: 10.00 euro) in the second trading period and 5.84 euro (CER: 0.37 euro) in the period from January 2013 to April 2017.

Table 40: Average prices for emission allowances (EUAs) and international project credits (CERs) in the second and third trading period

Time period	2nd trading period 03/2008 - 04/2013 [Euro]	3rd trading period 01/2013 - 04/2017 [Euro/EUA]
EUA price*	13.62	5.84
CER price**	10.00	0.37

* VWAP ICE EUA front-December
** ICE CER front-December
Source: ICE, Thomson Reuters Eikon, DEHSt calculation

3.2 Germany and Europe: emissions and surplus trend

Approximately 11,500 stationary installations in the 28 Member States of the European Union and the states of Iceland, Liechtenstein and Norway (EU-31) participate in European emissions trading (excluding aviation). With approximately 1.75 billion tonnes of carbon dioxide equivalent[76], the sum of emissions subject to reporting exceeded the allocated free and auctioned emission allowances in 2016 by about 200 million tonnes of carbon dioxide[77], but was still significantly lower than the 2016 cap value of 1.97 billion emission allowances.

3.2.1 Emissions trends in the EU ETS and in Germany

In 2016 the emissions of ETS installations decreased across the EU (EU-31) to roughly 1.75 billion tonnes of carbon dioxide equivalent or about 2.6 percent compared to the previous year according to information from the European Commission[78]. The reduction target for the EU ETS by 2020 (21 percent reduction compared to 2005) had therefore already been achieved or surpassed since 2014. The cap value for 2020 – 1.816 billion tonnes of carbon dioxide – was in all years since 2014 complied with, even with significantly lower values. The emissions from approximately 1,900 German installations included in emissions trading in 2016 were lower by around 2.7 million tonnes at 453 million tonnes of carbon dioxide equivalent (minus 0.6 percent) compared to the previous year and registered thereby as in previous years (with the exception of 2015) a lower emission reduction than the European average. Overall, ETS emissions in Germany were significantly lower than the European average since the start of emissions trading in 2005: While emissions in Germany fell by around 13 percent between 2005 and 2016, the European average emissions decreased by 26 percent over the same period.

Figure 33 shows the emissions trends of the five Member States with the highest emissions. The emissions trends in these Member States that produce approximately 61 percent of the overall ETS emissions presents a very different trend: while ETS emissions reduction in Germany (DE) and Poland (PL) was significantly less than the European average since 2005, ETS installations in the other three Member States – United Kingdom/Great Britain (UK), Spain (ES) and Italy (IT) – registered markedly above-average emission reductions. Thus, emissions in Germany and Poland decreased less than the emissions in the other Member States even during the economic and financial crisis (2008/2009). In addition, emissions in Germany and Poland increased again after 2009 to a significantly higher level. Poland recorded a moderate emissions reduction since 2011 and Germany only since 2013.

In comparison, ETS emissions in the UK, Italy and Spain decreased significantly more over the entire period and, in 2016, amounted to less than two-thirds of their level in the first year of emissions trading in 2005, in the UK less than 55 percent (Germany: 87 percent, Poland: 89 percent).

75 Reference contract for the following consideration is the futures traded at the London energy and commodities exchange ICE for delivery in December of the current or following year (so-called front-December Futures) for EUA and CER.

76 Preliminary figures. Source: COM 2017e

77 Source: Own calculation. Note: This figure is not to be equated with the 2016 market surplus, cf. Section 3.2.2.

78 Preliminary figures. Source: COM 2017e. The specified decline applies to the total emissions published by the European Commission in 2016 compared to those of 2015.

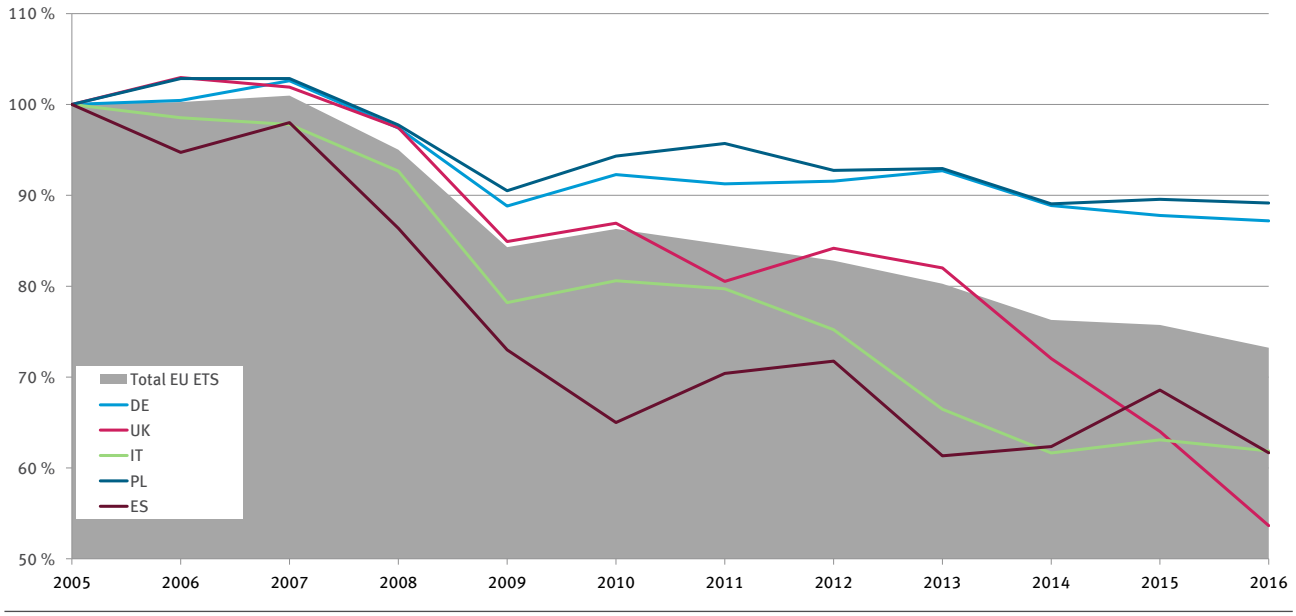

Figure 33: Emissions trends of the largest European emitters compared to the EU average (2005 emissions plus correction for extended scope of the third trading period = 100 percent)[79]

These developments are linked, among other things, to the different industrial production and power generation trends in the countries mentioned. Industrial production in Germany declined less than in the other countries during the economic crisis and was in 2016 around twelve percent higher than the 2010 value, which is above the pre-crisis level. In Poland, industrial production in 2016 was even about 30 percent higher than the 2010 figure. In Italy and Spain, industrial production declined sharply after 2007 and remained in 2016 below the 2010 figure (95 percent and 98 percent, respectively)[80]. The relatively strong fluctuations in Spanish ETS emissions since 2010 – which can be seen particularly clearly in Figure 33 – are, however, also explained by the strongly weather-dependent composition of electricity generation[81]. In the UK, emissions have declined sharply and faster than the European average since 2013, while industrial production has increased since 2010. The decline in the use of coal for power generation is likely to play a central role in this trend. According to preliminary information from the British Ministry of Economic Affairs, the consumption of coal in 2016 dropped to about 50 percent of that of the previous year (about 70 percent compared to 2005)[82]. On the other hand, power generation from coal in Germany, Poland and Italy has also declined, but to a much lesser extent[83].

3.2.2 Emissions and available emission allowances in the EU ETS

Status in the Member States

Figure 34 shows a comparison of emissions with freely allocated and auctioned emission allowances by countries. In the majority of the 31 countries participating in the EU ETS, operators surrendered more emission allowances than were allocated free of charge or auctioned on the market. This is mainly due to the impact of "backloading" for short-term adjustment of the supply in emissions trading:

Between 2014 and 2016, a total of 900 million emission allowances were retained from auctions and moved to the market stability reserve (MSR), which will be established in 2018, in order to reduce the surplus of emission allowances (around 1.6 billion emission allowances at the end of 2016[84]) on the market. The auction amounts in 2016 were thereby cut throughout Europe by approximately 200 million emission allowances (2014: 400 million EUA, 2015: 300 million EUA) and were thus once again somewhat higher than in the previous year. The auction amounts of Member States should not however be allocated to the installations of a single Member State because operators can purchase emission allowances from all Member States.

79 Figures for 2016 are preliminary. Sources: EEA 2016 for 2005-2015, EU 2017b for 2016

80 Eurostat 2017, industrial production index

81 The contribution of hydropower to power generation was in 2016 for example approximately 25 percent higher than the very low value in 2015, coal-fired generation declined in the same year nearly 30 percent compared to the previous year (RED 2017).

82 BEIS 2017, Statistics on 2016 domestic primary energy consumption

83 Agora/Sandbag 2017

84 Own calculation based on the 2016 annual emissions (COM 2017e) and 2015 (EEA 2016).

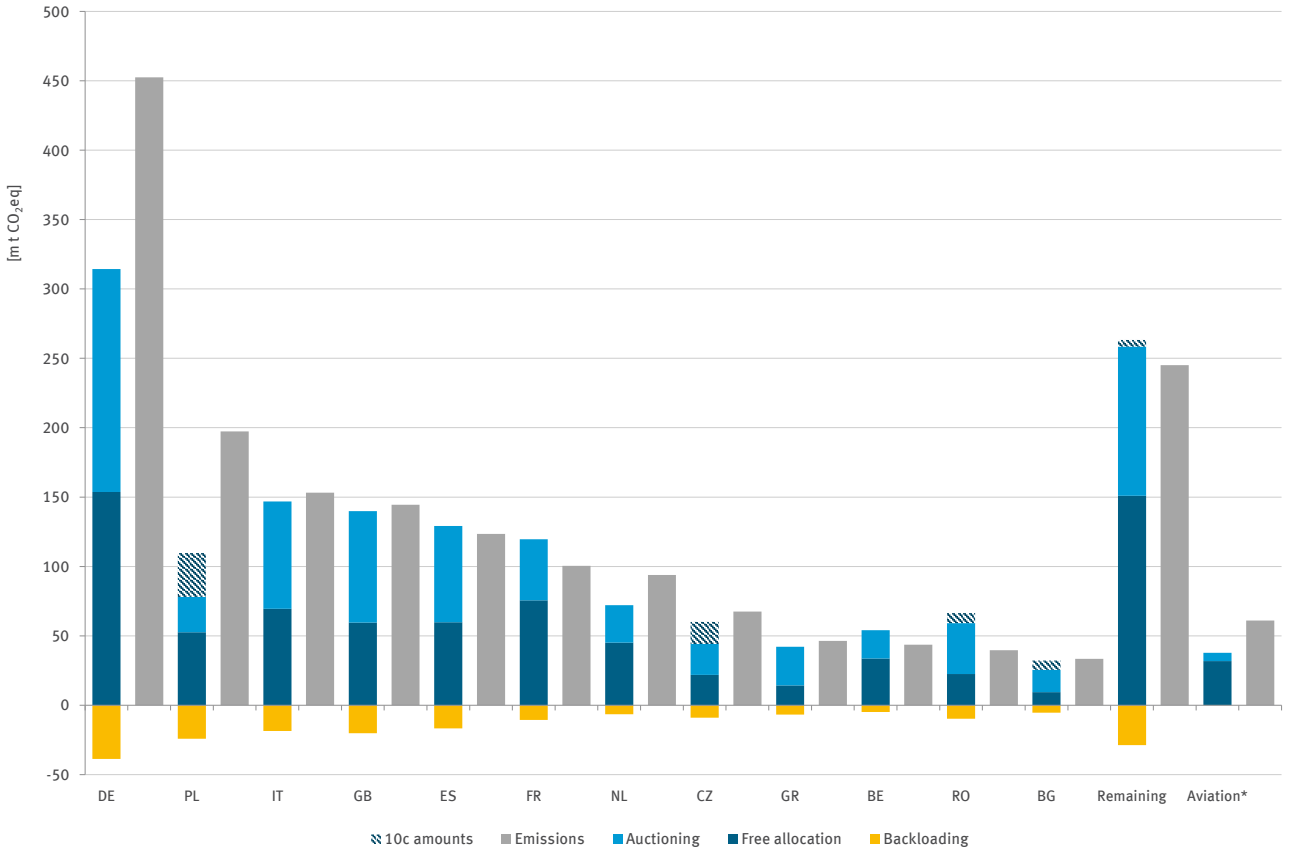

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Figure 34: Emissions, free allocation and auction amounts for 2016 compared to all countries participating in the EU ETS

One reason for the differences in the ratio of auctioned to freely allocated emission allowances on one hand and the emissions on the other between Member States is the allocation key for national auction amounts under Article 10(2) of the Emissions Trading Directive. This causes a redistribution of auction amounts in favour of certain countries. In addition, the allocation key for the auction amounts is based on the emissions from 2005 to 2007. Thus, Member States with a larger decrease in emissions currently have a more favourable ratio of auction amounts to emissions. In addition, some new Member States can be granted a transitional free allocation for power generation (Article 10c of the Emissions Trading Directive).

In Germany, the 2016 emissions were approximately 138 million tonnes carbon dioxide equivalent over the sum of the free emission allowances or those issued by auction. The illustration in the Figure does not however allow any conclusions about the actual shortfall of the total of all installations in a Member State because it does not include project credits and accumulated emission allowances from previous years.

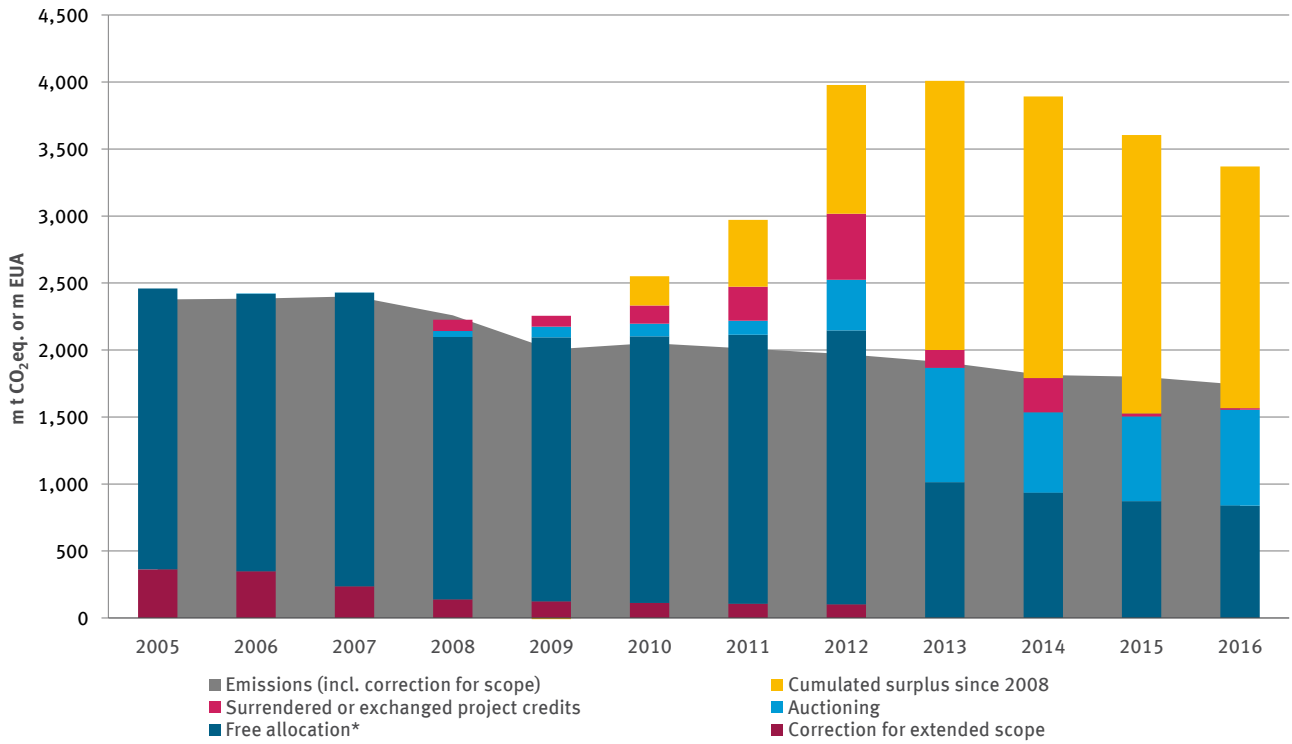
If the project credits used and the allowances saved are included in the considered scope (DEHSt only has the figures for Germany and the EU as a whole), German emissions were approximately 444 million tonnes higher in the period from 2013 to 2016 than the sum of free allocations and auction volumes plus project credits exchanged by German operators[85]. The difference between the offer (free allocations and auctioned allowances plus project credits) and emissions was still positive (265 million emission allowances) in the second trading period. Since 2015, German operators have had to purchase emission allowances abroad (i.e. from foreign operators or other Member States on the primary or secondary market) in order to cover their emissions. At the end of 2016, the cumulative net shortfall of German operators on the European market amounted to around 180 million emission allowances.

85 The auction volumes and the allocated free emission allowances are distributed over the years by following the allocation of the EEA ETS Data Viewer, i.e. emission allowances auctioned in the „early auctions“ of the third trading period are attributed to 2013. The 2016 EEX auction reports have been evaluated by DEHSt.

Demand and supply in the stationary sector (across the EU)

Since the introduction of the possibility for transferring emission allowances into following trading periods (banking), i.e. since 01/01/2008, large amounts of surplus allowances have accumulated in the EU ETS, which have contributed significantly to the price decline for emission allowances seen since mid-2011. At the end of 2016, the cumulative calculated surplus in the EU ETS, as the balance of available emission allowances (free and auctioned emission allowances as well as surrendered and exchanged project credits) and verified emissions amounted to about 1.6 billion allowances and was thus below the end of 2015[86] figure. Figure 35 shows the effect of the surplus transferred from previous years on the available supply on the market in a year[87]. Considering this surplus, the 2016 supply needed to cover the verified emissions was almost twice as high as the annual demand.

However, the surplus dropped in 2015 and 2016 compared to the previous year. The reasons for this are shortened auction volumes (backloading) and minor utilisation options still available for project credits. In 2017, however, 236 million more emission allowances are expected to be auctioned than in 2016 because backloading is over and the market stability reserve will only start reducing auction volumes in 2019.



*Incl. transitionally free allocation according to Article 10c
As of 02/05/2017

Figure 35: Supply and demand in the overall system: comparison of emissions with the available emission allowances since2005[88] and trend of individual supply components.

86 Own calculation based on the annual emissions in 2016 (COM 2017e) and 2015 (EEA 2016). The cumulative surplus figure (total volume of emission allowances in circulation) published by the European Commission on 12 May 2017 is somewhat above the figure calculated here, mainly as a result of the fact that the Commission's data on the individual demand and supply components was collected at an earlier reference date (1 April 2017) (cf. COM 2017d).

87 Cumulative surplus data in the EU ETS often represent the surplus at the end of each year. Instead, in the representation chosen here, supply availability in a year is to be compared with the demand for the same year (as shown in Figure 1.3 in EEA 2016a). The „cumulative surplus" column section does not refer to the cumulated surplus up to the end of the year, but to the surplus transferred from the previous year and available in the actual year. The 2016 column section therefore corresponds to the cumulated surplus at the end of 2015.

88 Sources: EEA 2016 for 2005-2015, COM 2017a and 2017b for 2016 and more, preliminary data published by the EU Commission and EEX/ICE information for auction volumes

4 Emissions in aviation

4.1 The EU emissions trading trend in aviation

Since the beginning of 2012, aviation has also been included in the European Emissions Trading Scheme (EU ETS) in addition to stationary activities. Emission trading obligation first included all flights that landed and took off ("full scope") within the European Economic Area (EEA)[89] and also applied to aircraft operators' flights that have their headquarters outside the EU. Monitoring and reporting obligations regarding their emissions have existed since the beginning of 2010.

The Emissions Trading Directive[90] specified the delimitation of aviation emissions included in the EU ETS. The scope of the Emissions Trading Directive was adjusted twice in previous years (cf. Table 47). First, the scope for the reporting year 2012 was considerably restricted through the so-called "stop-the-clock" EU resolution[91]. In that year the EU relinquished the sanctioning of violations of the reporting 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 countries from the reporting and surrendering obligation in 2012.

The scope was first further reduced for a limited time between 2013 and 2016 ("reduced scope")[92]. Under the "reduced scope", emissions from flights that start or end outside the EEA are no longer subject to emissions trading. Unlike in 2012, this also applies to flights from the EEA to Switzerland and back. In addition, non-commercial aircraft operators are excluded from emissions trading until 31/12/2020 if their annual emissions based on the original scope are lower than 1,000 tonnes of carbon dioxide.

With the two temporary adjustments to the scope, the EU wanted to set a positive signal for the ongoing negotiations at the level of the International Civil Aviation Organisation (ICAO) on a global instrument for reducing international aviation emissions. In February 2017, the European Commission submitted the draft Regulation to maintain the „reduced scope" beyond 2016[93]. The European Parliament and the Council must approve the proposed amendment to the Emissions Trading Directive before it comes into force.

Thus the 39th ICAO General Assembly decision was observed to introduce a global market-based measure to stabilise emissions from the international civil aviation at the 2019-2020 level from 2021 onwards and to compensate for excess emissions (CORSIA)[94]. From 2021 to 2026 States may voluntarily decide to participate in CORSIA[95]. The EU and its Member States have already announced their intention to participate in this voluntary phase. As of 2027, participation is then mandatory for all States which are not exempted by CORSIA exceptions. The European Commission has announced that a further assessment of the EU ETS scope will be made after 2020 after specifying further details on the design of CORSIA and, if appropriate, submit a proposal on the potential adjustment of the Emissions Trading Directive[96]. Table 41 summarises the current development of the scope for aviation.

89 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.

90 EHRL

91 EU 2013

92 EU 2014

93 COM 2017c

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

95 „Participation" means the obligation not only to report emissions of international civil aviation but also to compensate for relevant excess emissions by surrendering an appropriate number of allowances.

96 COM 2017c

Table 41: Overview of the EU ETS scope in aviation

Period	Description of scope[1]	Reporting obligation	Surrender obligation	Extent of scope			
				Geographic		Exclusion criteria[2]	
				Flights to and between commercial EU ETS Member States [3]	Flights to/ from third countries	Commercial operators[4]	Non-commercial operators
2010-2011	Full scope	x	-	x	x	Flights ‹ 243 per four months *oder* full scope emissions ‹ 10.000 t CO_2/a	-
2012	Stop-the-clock	x[5]		x	Switzerland, Croatia		
2013-2016	Reduced scope	x		x[6]	-		Full scope Emissionen ‹ 1.000 t CO_2/a [8]
From 2017[7]	Reduced scope	x		x[6]	-		

[1] See Glossary for the definitions of scope
[2] Flights with a maximum take-off mass less than 5,700 kg, military, police, customs, non-EU governments, research, sightseeing and training flights are excluded.
[3] The Group of EU ETS Member States includes all EU Member States as well as Norway, Iceland and Liechtenstein (the latter has no airport). Since it joined the EU in 2014, Croatia also belongs to the Group of EU ETS Member States.
[4] Commercial operators are defined as operators that offer public transport services in exchange for remuneration.
[5] Within the framework of stop-the-clock (StC) regulations, operators could choose to report for the StC scope or according to the "Full scope" and surrender accordingly.
[6] Flights between EEA States and European areas in the outermost regions (i.e. Canary Islands) are also exempt from the emissions trading obligation.
[7] Cf. COM 2017c
[8] The exemption holds according to the current view until 31/12/2020. The Commission proposal of 03/02/2017 provides for the continuation of the exemption criterion until 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 has the largest estimated share of its emissions.

This system also differs significantly from the emission assignment in the national greenhouse gas inventory. In the inventory, a country is only assigned aviation emissions from flights starting within its territory. However, because in emissions trading aircraft operators are divided and assigned to individual Member States according to said management criteria, all flights subject to emissions trading and the associated emissions of a specific operator are assigned to and managed by a single Member State. As a result, Germany also administers flights that do not start in Germany and therefore emissions that are not attributable to the German greenhouse gas inventory. Likewise, aviation emissions that in turn are attributed to the German inventory are also administered by other EU Member States. Aviation emissions administered by Germany therefore offer no direct conclusions regarding the German aviation emissions in the greenhouse gas inventory[97]. This circumstance must be considered in the interpretation of the following evaluation.

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 2016 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. In addition, 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.

97 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 kilograms and flights by military, police, customs, non-EU governments, flights for research purposes, and sightseeing and training flights (see also Table 41) are not subject to emissions trading.

Table 42: Overview of aviation for the period of 2013 to 2016 (reduced scope)

Year	No. of operators	Allocation amount [1000 EUA]	VET [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	68	5,104	9,274	55.0 %

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68 of approximately 500 aircraft operators reported emissions from their flights subject to emissions trading for 2016. The emissions amounted to approximately 9.27 million tonnes of carbon dioxide and were significantly above the free allocation amount. Overall, about 5.1 million emission allowances were allocated. The 68 operators administered by Germany thus had an average allocation coverage of about 55 percent. The average ratio of free allocation to emissions under surrender obligation declined slightly compared to the previous years (cf. Table 42). This fact can be attributed to rising emissions in conjunction with approximately constant allocation amounts. Table 42 summarises the emission and allocation status of the aircraft operators administered by Germany between 2013 and 2015.

4.4 Emissions trends

Table 43 separates the VET emissions of aircraft operators administered by Germany into commercial and non-commercial operators. Accordingly, slightly more than two-thirds of the operators had commercial status and a little less than a third had a non-commercial status in the 2016 reporting year. This ratio was the other way around in the 2012 reporting year because the flights of non-commercial aircraft operators with emissions below 1,000 tonnes of carbon dioxide per year were still subject to emissions trading.

Table 43: Aviation, number of aircraft operators, 2015 emissions and 2016 VET entries by operator category

Operator category	2015 ER vs. 2016 VET	No. of operators	2015 emissions [kt CO_2eq]	2016 VET [kt CO_2eq]	2016 VET deviation from 2015 ER
Commercial	2015 ER < 2016 VET	25	3,497	4,091	594
	2015 ER > 2016 VET	21	5,403	5,112	-291
	Comparison not possible	1	0	32	32
		47	8,900	9,235	335.1
Non-commercial	2015 ER < 2016 VET	10	12	14	2
	2015 ER > 2016 VET	8	27,0	23,4	-3.5
	Comparison not possible	3	0,0	1,1	1.1
		21	39,23	39	-0.4
Total		**68**	**8,939**	**9,274**	**335**

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Overall, the emissions of aircraft operators administered by Germany amounted to around 9.27 million tonnes of carbon dioxide in 2016. As in the previous years, emissions were almost completely due to commercial operators: their share of total emissions was 99.6 percent in 2016 (2015: 99.6 percent). The six largest commercial emitters caused overall around 87 percent of the total emissions (see Figure 36). The emissions of 21 non-commercial aircraft operators made up only 0.4 percent.

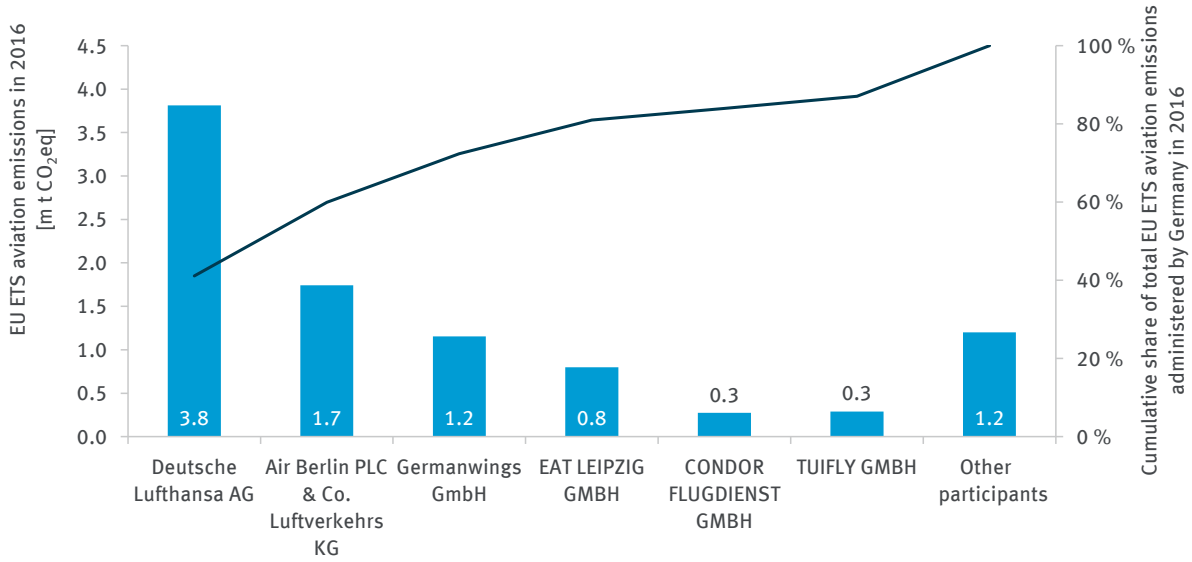

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Figure 36: The largest aircraft operators administered by Germany according to their emission volumes

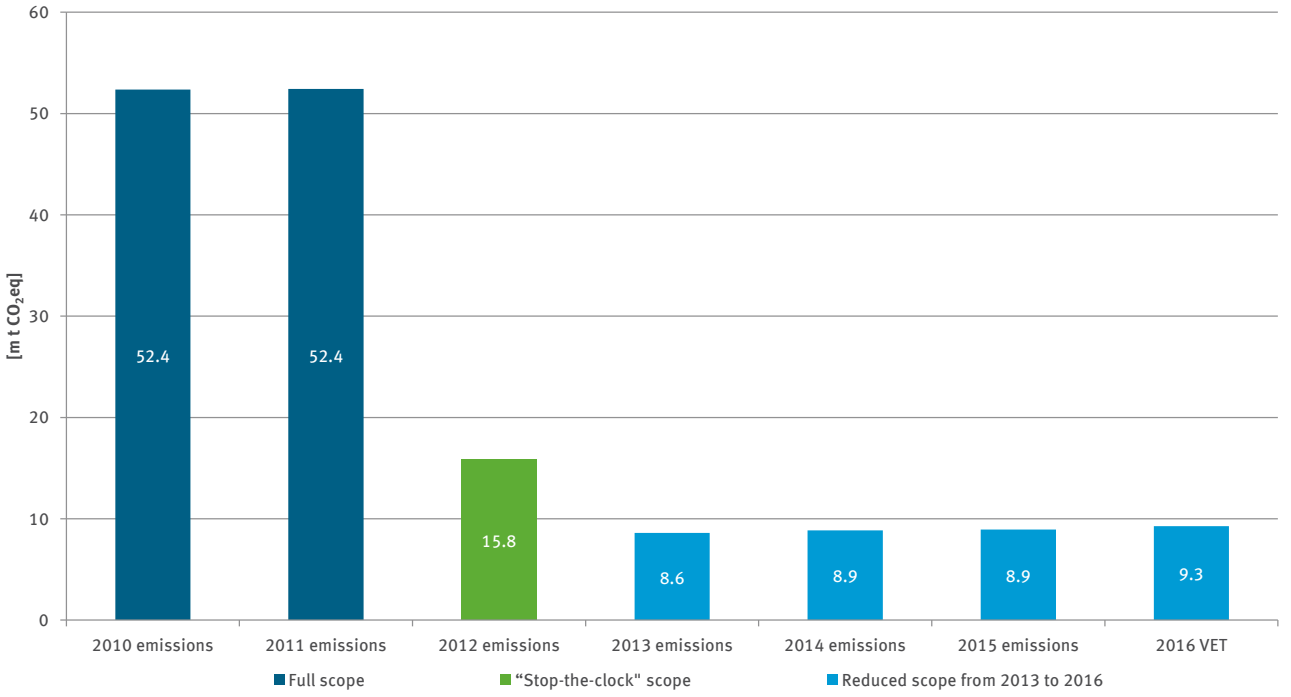
Table 43 also contains information on the emission trend of aircraft operators obliged to surrender allowances in 2016 compared to the 2015 reporting year. The aggregated emissions of these 68 operators were 335,000 tonnes of carbon dioxide (3.8 percent) above the previous year's figure. The emissions of 35 of these operators actually grew (2015 ER < 2016 VET). However, 29 operators' emissions were lower than in the previous year (2015 ER > 2016 VET). A comparison is not possible for four operators because no emissions were reported for 2015.

Figure 37 additionally shows EU ETS aviation emissions managed by Germany for the period between 2010 and 2016, i.e. since the start of the reporting obligation. The emission trend clearly reflects the adaptations of the scope of the Emissions Trading Directive described in Section 4.1. In 2010 and 2011, the emissions of all flights starting or landing in the EEA had to be reported ("full scope"). For Germany, the emissions of these 2010 and 2011 flights amounted to more than 52 million tonnes of carbon dioxide per reporting year.

The surrender obligation for emission allowances was introduced for the first time in 2012. However, the actual extent of emissions administered by Germany was reduced to only about 30 percent of the full scope due to the EU's Stop-the-clock resolution. It should be noted that in 2012, aircraft operators were free to choose between reporting their emissions in accordance with the full scope or only reporting emissions for flights within the European Economic Area – provided that they returned the free allocation for the remaining flights. Aircraft operators, whose 2012 allocation was higher than their full-scope emissions therefore usually reported according to the full application scope. In total, the emissions administered by Germany in 2012 amounted to around 15.8 million tonnes of carbon dioxide.

With the limiting of the scope to the reduced scope, aviation emissions administered by Germany were once more significantly reduced. With approximately 9.3 million tonnes in 2016, they amounted to about 18 percent of the full scope (2011 reporting year).

Under the reduced scope, aircraft operators administered by Germany contributed to approximately 15 percent of the overall European aviation emissions of the EU ETS in the 2016 reporting year. This share was still 19 percent under "Stop the clock". No European total figures were published for 2010 and 2011, which means that no German share can be derived for this period.



As of 02/05/2017

Figure 37: Aviation (aircraft operators administered by Germany), trend of emissions subject to emissions trading from 2010 to 2016

4.5 Allocation status

59 of the observed 68 operators received a free allocation in the 2016 reporting year. On average, the free allocation covered about 55 percent of the emissions from these aircraft operators. It is noteworthy that non-commercial aircraft operators are supplied with much fewer emission allowances than commercial operators. With 4 percent, their 2016 allocation coverage was significantly lower than that of commercial aircraft operators (55.3 percent). This can be attributed to the EU-wide uniform allocation rules in aviation. The amount of free allocation can be derived from the transport performance of the operators in tonne-kilometres in the 2010 base year and the aviation benchmark[98]. Regarding their transport performance, non-commercial aircraft operators have a significantly higher specific fuel consumption and thus higher emissions than commercial operators. This is due to typically smaller aircraft types, lower rate of utilisation and the mode of operation.

Table 44: Aviation, number of aircraft operators, allocation amounts, 2016 VET entries and allocation coverage

Operator category	No. of operators with an entered VET value	No. of operators with 2016 allocation	2016 VET [kt CO_2eq]	2016 allocation amount [1000 EUA]	2016 allocation deviation from 2016 VET [kt CO_2eq]	Allocation coverage
Commercial	47	43	9,235	5,104	-4,131	55.3 %
Non-commercial	21	16	39	2	-37	4.0 %
Total	**68**	**59**	**9,274**	**5,105**	**-4,169**	**55.0 %**

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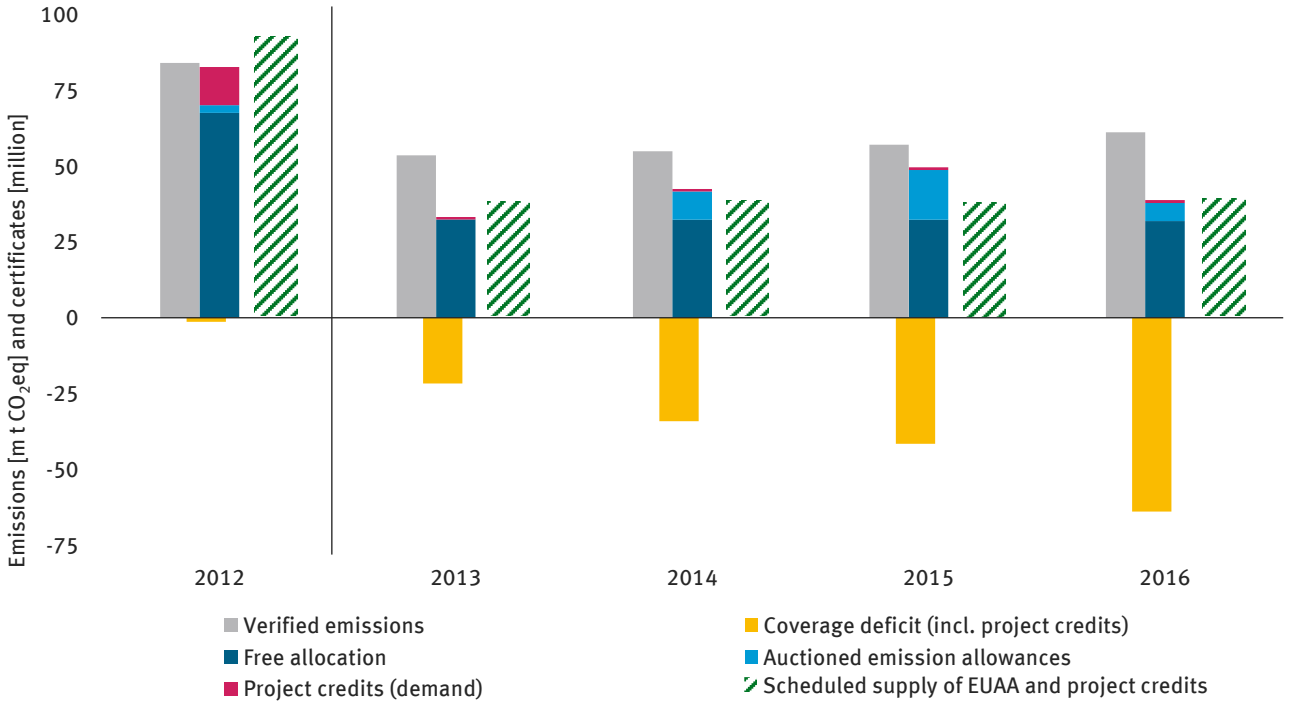
98 Cf. DEHSt 2012b, Section 3.1.2 "Allocation benchmarks"

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

The previous sections described the allocation and emission trends for aircraft operators administered by Germany. Figure 38 summarises the overall European situation: the total emissions from all aircraft operators subject to emissions trading in the EU ETS between 2012 and 2016 clearly exceeded the available emission allowances budget that includes both free and auctioned aviation allowances (EUAA)[99]. The total balance for the 2012 – 2016 period was around 80 million tonnes. Aircraft operators were able to close this gap by purchasing EUAs from the stationary EU ETS[100], since they can also use these to meet their surrender obligation and by using international project credits.



As of 02/05/2017

Figure 38: Emissions, EUAA supply and coverage deficit for European aviation subject to emissions trading

The Emissions Trading Directive, in principle, provides almost constant allocation and auction volumes for the reporting years between 2013 and 2016[101]. However, large parts of the scheduled auction volumes were auctioned later than planned[102]. Figure 38 summarises this situation by showing the emissions from aircraft operators and the actual budget available in each year. It is comprised of the free allocation, the actual auction volume and claims for the use of international project credits[103]. Striking a balance between the budget and emissions gives the coverage deficit. The figure shows the coverage deficit in a cumulated form in each year, i.e. including the previous years' figures. The 2013 annual increase in the cumulative coverage deficit was the greatest, and it became progressively smaller in 2014 and 2015. Considerably more EUAAs were auctioned in 2014 and 2015 than originally planned, while auctions were completely suspended in 2013.

99 The special situation with regard to the 2012 free allocation (alternatively according to the full or stop-the-clock scope) should be noted, which is explained in Section 4.3. This choice has led to a lower relative coverage deficit compared to the following years.

100 Operators of stationary installations, however, cannot fall back on EUAA.

101 The total volume of freely allocated and auctioned EUAAs should be 97 % of historical aviation emissions (average of 2004-2006) in 2012 and 95 % of historical emissions multiplied by eight for each year of the period for the 3rd trading period (2013-2020).

102 The shifts in the auction volume were decided at the EU level within the two legislative procedures to adapt the scope of the Emission Trading Directive (see Section 4.1).

103 The actual use of claims has not been reported in the EUTL since 2013. Therefore, the usage claims are shown here. For 2012, the claims corresponded to 15 % of the verified emissions for this year (about 12.6 million certificates, almost 11 million surrendered). In the 2013 – 2020 period, the total claim is 1.5% of the total verified emissions during the named period.

In order to be able to better assess the structural relationship between supply and demand in aviation, the figure also shows the planned EUAA supply where auction shifts are disregarded. The auction volumes are assigned to the year in which they are attributable in terms of their origin[104]. In this comparison, a relatively constant supply faces increasing emissions. Structurally, the increase in the coverage deficit has thus accelerated steadily. Scheduled and actual auction volumes were, for the first time, equal in 2016.

104 The EU auction regulation stipulates that 15% of the EUAA volume put into circulation is auctioned every year.

5 States (Länder)

Table 45: Overview of 2015 verified emissions per state (Land), by activities

2015 emissions [kt CO_2eq]		State (Land)																
	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	18	0	31	71	0	16	4	5	133	1,289	398	3	0	0	90	8	2,068
2	Energy conversion ≥ 50 MW RTI	39,291	6,663	17,970	8,876	6,512	5,887	6,108	2,927	22,156	148,863	4,650	3,808	8,756	32,343	9,678	891	325,376
3	Energy conversion 20-50 MW RTI	195	183	609	925	106	393	193	35	766	949	297	101	145	107	129	116	5,250
4	Energy conversion 20-50 MW RTI, other fuels	0	0	9	1	0	0	0	0	42	66	0	0	0	0	0	32	151
5	Prime movers (engines)	0	0	0	12	0	0	0	0	50	0	0	0	0	0	0	0	63
6	Prime movers (turbines)	266	0	60	175	0	84	0	0	233	252	51	1	0	9	30	75	1,236
7	Refineries	4,016	0	2,445	3,730	0	0	1,089	0	1,217	7,647	5	2,212	0	0	2,510	0	24,871
8	Coking plants	0	0	0	0	0	0	0	0	0	2,850	0	0	901	0	0	0	3,751
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	80	0	0	0	0	0	0	80
10	Production of pig iron and steel	1,770	0	127	153	2,809	38	90	0	4,256	13,546	0	0	5,093	80	0	36	27,998
11	Processing of ferrous metals	279	0	231	84	596	434	314	0	424	1,590	116	0	891	126	95	58	5,236
12	Production of primary aluminium	0	0	0	0	0	0	259	0	0	733	0	0	0	0	0	0	992
13	Processing of non-ferrous metals	0	0	20	161	0	0	222	0	158	684	60	0	57	107	129	0	1,598
14	Production of cement clinker	1,274	0	3,331	3,584	0	328	0	0	1,112	5,028	807	1,217	0	0	1,513	938	19,132
15	Lime production	423	0	426	972	0	360	0	85	840	4,082	495	0	0	0	1,316	183	9,181
16	Glass production	124	0	141	734	0	13	0	22	356	1,001	277	37	13	241	568	247	3,775
17	Ceramics production	112	0	84	652	30	25	0	0	235	323	144	0	25	161	95	104	1,988
18	Production of mineral fibres	0	0	48	94	0	0	0	0	8	64	0	0	0	90	58	0	363
19	Gypsum production	93	0	20	82	0	0	0	0	21	30	0	0	0	23	0	0	269

2015 emissions [kt CO_2eq]		State (Land)																
	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
20	Pulp	0	0	0	17	0	0	0	0	3	0	0	0	0	0	77	41	137
21	Paper production	70	0	900	784	0	305	0	7	905	1,460	399	76	0	370	35	19	5,330
22	Carbon black production	0	0	0	0	0	0	0	0	133	545	0	0	0	0	0	0	678
23	Nitric acid production	0	0	0	0	0	0	0	176	0	39	440	0	0	53	37	0	745
24	Adipic acid production	0	0	0	0	0	0	0	0	0	23	0	0	0	0	113	0	136
25	Production of glyoxal and glyoxylic acid	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	9
26	Ammonia production	0	0	0	0	0	0	0	0	0	636	1,538	0	0	0	2,289	0	4,463
27	Production of bulk organic chemicals	0	0	42	481	0	41	0	0	261	4,177	1,546	163	0	1,205	108	0	8,023
28	Production of hydrogen and synthesis gas	44	0	0	68	0	0	2	0	19	404	500	107	0	0	697	0	1,842
29	Soda production	0	0	0	0	0	0	0	0	0	166	92	0	0	0	344	0	602
Total		**47,975**	**6,846**	**26,496**	**21,657**	**10,052**	**7,923**	**8,281**	**3,258**	**33,327**	**196,528**	**11,822**	**7,725**	**15,881**	**34,915**	**19,911**	**2,745**	**455,343**

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Table 46: Overview of 2016 VET entries per state (Land), by activities

2016 VET [kt CO_2eq]		State (Land)																
	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	26	0	30	70	0	6	5	6	145	1,247	414	1	0	0	95	9	2,055
2	Energy conversion ≥ 50 MW RTI	39,381	6,755	17,198	8,560	6,286	6,258	7,205	3,334	20,563	148,341	5,048	3,492	7,632	32,169	9,730	976	322,928
3	Energy conversion 20-50 MW RTI	163	185	636	873	114	369	203	38	795	1,070	299	104	166	115	133	120	5,383
4	Energy conversion 20-50 MW RTI, other fuels	0	0	10	2	0	0	0	0	40	70	0	0	0	0	0	31	153
5	Prime movers (engines)	0	0	0	9	0	0	0	0	40	0	0	0	0	0	0	0	49
6	Prime movers (turbines)	269	0	41	187	0	71	0	0	185	183	26	1	0	1	18	71	1,052
7	Refineries	3,761	0	2,836	3,682	0	0	950	0	1,291	7,883	0	2,336	0	0	2,547	0	25,286
8	Coking plants	0	0	0	0	0	0	0	0	0	3,000	0	0	856	0	0	0	3,856
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	1,593	0	131	160	2,619	38	83	0	4,638	13,178	0	0	4,546	80	0	41	27,108
11	Processing of ferrous metals	273	0	228	82	615	437	340	0	457	1,570	119	0	845	135	91	61	5,252
12	Production of primary aluminium	0	0	0	0	0	0	268	0	0	740	0	0	0	0	0	0	1,008
13	Processing of non-ferrous metals	0	0	18	159	0	0	219	0	152	713	59	0	57	100	129	0	1,607
14	Production of cement clinker	1,143	0	3,444	3,632	0	318	0	0	1,140	5,271	827	1,097	0	0	1,460	1,017	19,348
15	Lime production	410	0	394	1,025	0	397	0	81	830	3,900	494	0	0	0	1,375	173	9,079
16	Glass production	129	0	137	746	0	9	0	23	352	1,029	291	38	7	252	570	240	3,822
17	Ceramics production	110	0	96	698	32	24	0	0	229	314	151	0	26	156	97	92	2,025
18	Production of mineral fibres	0	0	50	96	0	0	0	0	7	67	0	0	0	93	59	0	372
19	Gypsum production	96	0	21	81	0	0	0	0	20	28	0	0	0	23	0	0	269

2016 VET [kt CO_2eq]		State (Land)																
	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
20	Pulp	0	0	0	17	0	0	0	0	4	0	0	0	0	0	74	49	144
21	Paper production	62	0	777	800	0	303	0	7	892	1,501	404	79	0	389	35	19	5,270
22	Carbon black production	0	0	0	0	0	0	0	0	98	606	0	0	0	0	0	0	703
23	Nitric acid production	0	0	0	0	0	0	0	184	0	45	376	0	0	47	33	0	685
24	Adipic acid production	0	0	0	0	0	0	0	0	0	22	0	0	0	0	104	0	126
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	652	1,542	0	0	0	2,354	0	4,548
27	Production of bulk organic chemicals	0	0	31	559	0	46	0	0	257	4,116	1,586	162	0	1,404	124	0	8,285
28	Production of hydrogen and synthesis gas	40	0	0	61	0	0	53	0	14	364	448	115	0	0	719	0	1,815
29	Soda production	0	0	0	0	0	0	0	0	0	154	78	0	0	0	337	0	569
Total		**47,457**	**6,940**	**26,078**	**21,498**	**9,666**	**8,276**	**9,326**	**3,672**	**32,147**	**196,130**	**12,172**	**7,425**	**14,135**	**34,966**	**20,085**	**2,899**	**452,873**

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Table 47: Overview of 2016 allocation amounts per state (Land), by activities

2016 allocation amount [1000 EUA]		State (Land)																
	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
1	Combustion	47	0	27	32	0	72	2	7	109	1,067	403	3	0	0	110	2	1,881
2	Energy conversion ≥ 50 MW RTI	1,099	1,266	1,414	2,101	164	1,406	459	350	2,198	6,205	1,936	547	345	925	1,153	362	21,931
3	Energy conversion 20-50 MW RTI	77	95	440	512	59	256	158	71	588	644	181	54	104	61	59	89	3,449
4	Energy conversion 20-50 MW RTI, other fuels	0	0	47	35	0	0	0	0	23	15	0	0	0	0	0	8	128
5	Prime movers (engines)	0	0	0	8	0	0	0	0	27	0	0	0	0	0	0	0	35
6	Prime movers (turbines)	106	0	38	97	0	68	0	0	170	124	31	0	0	5	14	66	720
7	Refineries	1,891	0	2,122	2,864	0	0	1,030	0	1,000	6,230	2	2,008	0	0	2,235	0	19,382
8	Coking plants	0	0	0	0	0	0	0	0	0	1,425	0	0	280	0	0	0	1,705
9	Processing of metal ores	0	0	0	0	0	0	0	0	0	67	0	0	0	0	0	0	67
10	Production of pig iron and steel	2,877	0	136	145	3,723	47	71	0	5,810	23,319	0	0	5,955	85	0	43	42,211
11	Processing of ferrous metals	249	0	217	77	271	381	305	0	435	1,617	118	0	611	112	95	58	4,547
12	Production of primary aluminium	0	0	0	0	0	0	206	0	0	683	0	0	0	0	0	0	889
13	Processing of non-ferrous metals	0	0	15	135	0	0	371	0	183	598	63	0	33	121	15	0	1,536
14	Production of cement clinker	1,306	0	2,788	3,259	0	239	0	0	1,000	4,967	690	971	0	0	1,691	885	17,798
15	Lime production	303	0	495	919	0	300	0	55	646	3,201	490	0	0	0	998	176	7,583
16	Glass production	95	0	128	654	0	9	0	6	291	822	188	33	9	208	473	190	3,107
17	Ceramics production	94	0	97	628	28	24	0	0	186	313	135	0	24	146	78	105	1,858
18	Production of mineral fibres	0	0	23	81	0	0	0	0	5	71	0	0	0	50	55	0	285
19	Gypsum production	96	0	28	93	0	0	0	0	24	35	0	0	0	23	0	0	299

2016 allocation amount [1000 EUA]		State (Land)																
	Activity	BB	BE	BW	BV	HB	HE	HH	MW	LS	NW	RP	SH	SL	SN	ST	TH	Total
20	Pulp	0	0	9	16	0	0	0	0	8	0	0	0	0	0	43	22	97
21	Paper production	469	0	856	1,288	0	373	0	6	1,043	1,116	479	168	0	312	114	133	6,359
22	Carbon black production	0	0	0	0	0	0	0	0	87	445	0	0	0	0	0	0	532
23	Nitric acid production	0	0	0	0	0	0	0	273	0	163	234	0	0	27	33	0	730
24	Adipic acid production	0	0	0	0	0	0	0	0	0	218	571	0	0	0	241	0	1,031
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	520	1,418	0	0	0	1,729	0	3,667
27	Production of bulk organic chemicals	0	0	18	447	0	108	0	0	492	4,478	2,390	139	0	975	148	0	9,195
28	Production of hydrogen and synthesis gas	23	0	0	103	0	0	0	0	6	441	606	66	0	0	335	0	1,579
29	Soda production	0	0	0	0	0	0	0	0	0	217	100	0	0	0	748	0	1,065
Total		**8,732**	**1,361**	**8,898**	**13,495**	**4,245**	**3,285**	**2,604**	**769**	**14,333**	**59,001**	**10,045**	**3,988**	**7,361**	**3,050**	**10,368**	**2,140**	**153,674**

6 Main fuels by sectors

Table 48: 2016 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 fuelf	2016 allocation amount [1000 EUA]	2016 VET [kt CO_2eq]
Energy installations	Lignite	2,380	159,735
	Hard coal	4,597	99,676
	Natural gas	14,057	36,654
Other combustion plants	Lignite	125	235
	Hard coal	124	130
	Natural gas	95	61
Refineries	Natural gas	2,466	2,758
Iron and steel	Hard coal	43,275	29,502
	Natural gas	3,531	4,147
Non-ferrous metals	Hard coal	226	266
	Natural gas	846	1,002
Mineral processing industry	Lignite	5,942	7,250
	Hard coal	1,181	1,413
	Natural gas	5,664	6,579
Paper and pulp	Lignite	188	397
	Hard coal	263	776
	Natural gas	4,603	3,923
Chemical industry	Lignite	281	144
	Hard coal	1,235	811
	Natural gas	7,070	7,546
Summe		98,149	363,005
Complement: main fuel is not natural gas, hard coal or lignite		55,523	89,871
Total		**153,672**	**452,876**

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7 The ten largest installations in the energy and industrial sector

Table 49 shows the ten largest energy installations. Altogether, these ten installations account for about one third of emissions subject to emissions trading in the stationary sector and almost half of the emissions from energy installations.

Table 49: The ten largest energy installations (Activities 2 to 6) by emissions

Installation name (operator)	2016 VET [kt CO_2eq
Neurath Power Station (RWE Power AG)	31,322
Niederaußem Power Station (RWE Power AG)	24,831
Jänschwalde Power Station (Lausitz Energie Kraftwerke AG)	23,756
Weisweiler Power Station (RWE Power AG)	18,746
Schwarze Pumpe Power Station (Lausitz Energie Kraftwerke AG)	12,199
Lippendorf Power Station (Lausitz Energie Kraftwerke AG)	10,782
Boxberg Works IV Power Station (Lausitz Energie Kraftwerke AG)	9,697
Boxberg Works III Power Station (Lausitz Energie Kraftwerke AG)	8,877
Mannheim Large Power Station (Grosskraftwerk Mannheim Aktiengesellschaft)	7,876
Moorburg Power Station (Vattenfall Kraftwerk Moorburg GmbH)	5,548
Total	**153,634**

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The ten largest industrial installations (Table 50) emit a lot less and belong from to iron and steel industry or are refineries. Their share of emissions subject to emissions trading in the stationary sector is less than ten percent, while they account for about 30 percent of the emissions from industrial installations.

Table 50: The ten largest industrial installations (Activities 1, 7 to 29) by emissions

Installation name (operator)	2016 VET [kt CO_2eq
ThyssenKrupp Steel Europe AG Integrated Iron and Steel Works in Duisburg (ThyssenKrupp Steel Europe AG)	8,450
Glocke (Salzgitter Flachstahl GmbH)	4,316
Glocke (HKM Hüttenwerke Krupp Mannesmann GmbH)	4,196
Saar Pig Iron Association Uniform Installation (ROGESA Roheisengesellschaft Saar mbH)	3,912
PCK Glocke Refinery (PCK Raffinerie GmbH)	3,761
Ruhr Oel GmbH –Scholven Works – CO_2-Glocke (Ruhr Oel GmbH)	3,207
Works 1 and Works 2 (Mineralölraffinerie Oberrhein GmbH & Co. KG)	2,836
Uniform Installation (ArcelorMittal Bremen GmbH)	2,619
Duisburg-Schwelgern Coking Plant (Pruna Betreiber GmbH)	2,150
Wesseling refinery installations including power station, olefin plant (cracker), heavy oil gasification and standby generators (Shell Deutschland Oil GmbH Rheinland Raffinerie Werk Wesseling)	2,077
Total	**37,524**

As of 02/05/2017

8 Fields, sectors and activities in the EU ETS

Table 51: Activities (short description) according to Annex 1 TEHG and summary of sectors and fields

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

Table 52: 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	Processing of ferrous metals	25	Processing of ferrous metals
12	Production of primary aluminium	26	Production of primary aluminium
13	Processing of non-ferrous metals	27	Production of secondary aluminium
		28	Production or 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

9 Glossary

Allocation coverage

The ratio of free allocation to emissions. An allocation coverage of 100 percent or more means that no emission allowances need to be purchased to meet the annual surrender obligation. An allocation coverage below 100 percent means that the free allocation of one year is not sufficient to meet the surrender obligation through 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 form 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 form 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.

EU-Allowances (EUA)

Emission certificates at a corporate level for emissions trading in Europe (EU ETS). Emission certificates are referred to as emission allowances. 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 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

Original application scope of the EU ETS in aviation. It includes the carbon dioxide emissions of all commercial and non-commercial flights in accordance with Annex I EHRL, which land at or take off from airports in EEA States.

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 with the largest share in the total energy of all fuel streams used in this installation. In contrast, previous VET reports until 2014 assigned an installation to a main fuel only if more than 80 percent of the energy consumption of an installation could be assigned to a fuel.

Reduced scope

Reduced scope of the EU ETS in aviation from 01/01/2013 to 31/12/2016. Unlike the “full scope”, emissions from flights that take off or land outside the EEA, are no longer subject to emissions trading. Flights between EEA States and European territories of the outermost regions (e.g. Canary Islands) were also exempted from emissions trading obligation. In February 2017, the European Commission presented the draft regulation for the „reduced scope“ beyond 2016.

The approval of the European Parliament and the Council is necessary for the proposed amendment to the Emissions Trading Directive before it can enter into force.

Stop the clock 2012

The EU renounced the sanctioning of violations of the 2012 reporting and surrender obligations for flights that started or ended outside the EEA, Switzerland and Croatia. Thus a large part of aviation with third party countries was not included in emissions trading in 2012. This enabled aircraft operators to choose to surrender allowances for a reduced amount of emissions if they simultaneously renounced a part of the freely allocated emission allowances. By doing so, the EU wanted to set a positive example at an International Civil Aviation Organisation (ICAO) level for the negotiations for a global instrument aimed at the reduction of international aviation emissions.

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