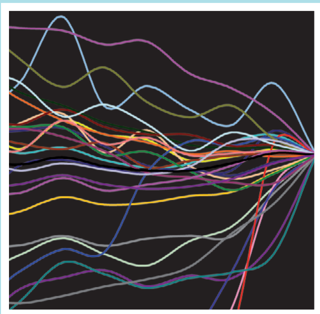
EEA Report | No 18/2017

Trends and projections in the EU ETS in 2017

The EU Emissions Trading System in numbers

ISSN 1977-8449



European Environment Agency

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Layout: EEA

Luxembourg: Publications Office of the European Union, 2017

ISBN 978-92-9213-924-7
ISSN 1977-8449
doi:10.2800/425306

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This report was prepared by the European Environment Agency (EEA) and its European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM). The ETC/ACM is a consortium of European institutes assisting the EEA in its support to European Union (EU) policy in the field of air pollution and climate change mitigation.

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Executive summary

About this report

This 2017 report of the European Environment Agency (EEA) provides an analysis of past, present and future emissions trends under the European Union (EU) Emissions Trading System (ETS), based on the latest data and information available from the European Commission (July 2017 data on verified emissions and compliance by operators under the EU ETS for the years up until 2016) and Member States (projections of EU ETS emissions until 2030, reported in 2017 under the EU Monitoring Mechanism Regulation). The report also analyses the balance between supply and demand of allowances in the market.

Main findings

In 2016, the surplus of EU ETS allowances declined for the second consecutive year

Between 2015 and 2016 total emissions for stationary installations covered by the ETS Directive (2003/87/EC) declined by 2.9 %. This reduction was mostly driven by emission cuts in large power plants, which reflects factors including the phasing out of coal use in several Member States. In the other industrial sectors, a large drop in emissions occurred in the iron and steel sector, primarily reflecting changes in output levels. In contrast, emissions from aviation operators, which accounted for 3 % of the total emissions covered by the EU ETS in 2016, increased compared with the previous year, as the number of passengers continues to grow.

The supply of EU emission allowances to be used for compliance increased slightly in 2016: despite a decline in the number of free allowances and in the use of international credits, the number of auctioned allowances increased. This was because of a lower volume of 'backloaded' allowances, which totalled 400 million AEAs in 2014, 300 million in 2015 and 200 million in 2016. Most power plants had to buy their allowances (through auctioning or in the secondary market) in 2016, while the other industrial sectors received free allowances because they are deemed to be exposed to a risk of carbon leakage (i.e. the transfer of production to countries not participating in the EU ETS, with less stringent emission constraints). The aviation sector had to meet a net demand for allowances (i.e. 23 million EUAs) by purchasing allowances in order to cover part of its emissions.

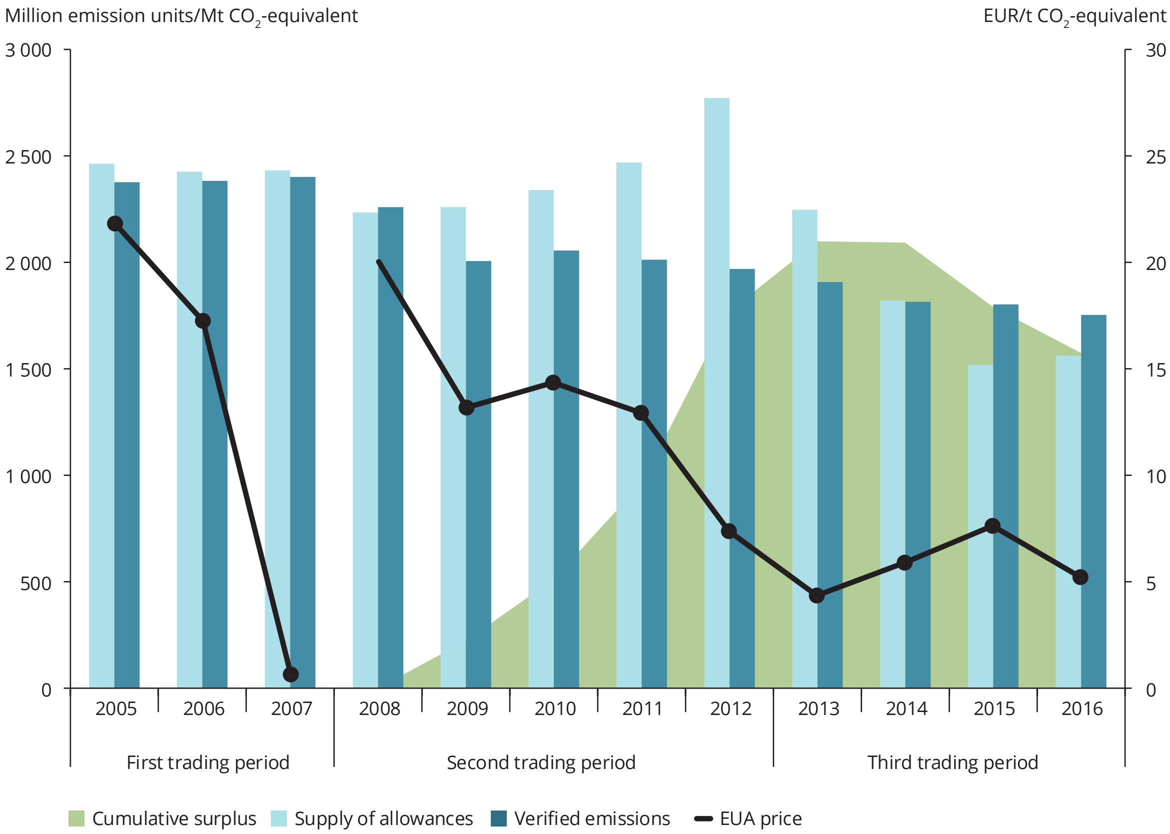
For the second consecutive year, the overall annual demand for allowances in 2016 was higher than the supply of allowances. This has led to the further reduction in the cumulative surplus of allowances, which is now around 1.7 billion allowances (EC, 2017b). The surplus remains substantial, equivalent to just under one year's worth of EU ETS emissions. With the objective of ensuring the orderly functioning of the market and addressing the structural supply-demand imbalance, the Market Stability Reserve (MSR) will start operation in 2019. Average annual carbon prices in 2016 declined compared with the previous year (fluctuating around a level of EUR 5 per EUA). This resulted in a decrease in auctioning revenues for Member States, despite the increase in the number of auctioned allowances. At current levels, the price signal of the EU ETS still provides a limited incentive for the more expensive abatement options necessary to decarbonise the European economy in the long term.

Halfway through the third trading period, power generation continues to drive emission reductions in the EU ETS. Backloading allowances over 2014-2016 contributed to reducing the surplus of allowances.

Emissions from stationary installations decreased by 26 % between 2005 and 2016 and passed, in 2014, below the cap set for 2020 ([1]). Between 2013 and 2016, which represents half of the third trading period (2013-2020), EU ETS emissions decreased by around 8 %. The decrease was mostly driven by emission reductions in power generation, which were much

([1]) The emission reduction between 2005 and 2016 is estimated based upon the current scope of the EU ETS in the third trading period (EEA, 2017).

Figure ES.1 Emissions, allowances, surplus and prices in the EU ETS, 2005-2016



Notes: EUA: EU allowance (1t CO_2eq.). Verified emissions and allocations shown in this figure for the years before 2013 were adjusted by the EEA to be comparable with those from the third trading period of the EU ETS (2013-2020).

The supply of allowances presented takes into account a redistribution, by the EEA, of annual volumes of allowances auctioned/sold on the primary market, from the year when they were released to the market to the years from which they arise. For example, the volumes of allowances relative to the second trading period (2008-2012) but sold/auctioned in the first months of 2013 are added here to the 2012 figures.

The average EUA price represents historical spot price data from the secondary market in the first and second trading periods. In 2008, only EUA spot prices for the second trading period are considered in the calculation of the average. In the third trading period, the EUA price refers to primary market auctioning clearing prices from the trading platforms EEX and ICE.

The break in the EUA price between 2007 and 2008 reflects the absence of banking provisions between the first (2005-2007) and second (2008-2012) trading periods. However, trade in future EUA contracts did take place during this period.

The cumulative surplus represents the difference between allowances allocated for free, auctioned or sold plus international credits surrendered or exchanged from 2008 to date minus the cumulated emissions. It also accounts for net demand from aviation during the same time period.

Sources: Point Carbon, 2012; EEA, 2017; EEX, 2017; ICE, 2017.

stronger than the slight decline observed in electricity generation over the same period. The reduction in emissions was largely the result of changes in the mix of fuels used to produce heat and electricity, in particular less use of hard coal and lignite fuels, and a jump in electricity generation from renewables, which almost doubled over the 2005-2015 period. Emissions from the other industrial activities covered by the EU ETS have also decreased since 2005, but remained relatively stable over the last 4 years of the current trading period (2013-2016). In contrast, aviation emissions have increased year on year during the third trading period.

The backloading of allowances between 2014 and 2016 had an impact on the supply and demand balance of allowances, allowing a reduction of the overall cumulative surplus from around 2 billion allowances at the start of the third trading period to 1.7 billion by the end of 2016 (EC, 2017b). The sharp reduction in the use of international credits also contributed to further reducing the surplus. The net demand for EUAs from aviation operators as emissions continue to rise further helps to lower the cumulative surplus. However, the drop in EUA price in 2016 compared with the previous year suggests that market players expect a surplus of allowances to persist, in the short term at least.

By the end of 2016, EU ETS operators had used for compliance almost all of the international emission credits generated by emission-reducing projects that they were allowed to use for the whole trading period.

The New Entrants Reserve (NER) is a reserve of 480 million EUAs set aside at the start of the third trading period for new installations or capacity increases of existing installations. Halfway through the current 8-year trading period, only 29 % of the allowances in the NER have either been used or reserved for future use. Between 2013 and 2016, most allowances from the NER were allocated to support capacity extensions. The usage in the coming years is subject to uncertainty, as it will depend to a large extent on future economic developments.

In eight Member States, some installations in the electricity generation sector (which would normally have to buy their allowances) receive transitional free allocations, so that the value of these allowances is invested into efforts to modernise electricity generation. Between 2013 and 2016, 60 % of the maximum budget for these free allowances was used. It is likely that a large part of the investment made aims to modernise only existing fossil fuel capacity (e.g. extending the lifetime of fossil fuel-based electricity generation units).

Member States project that their EU ETS reductions will slow down, and certain Member States even project future increases in EU ETS emissions. The overall projected reduction is not yet in line with EU emission reduction objectives for 2030.

According to the projection scenarios reported by EU Member States in 2017, EU ETS stationary emissions are projected to continue decreasing with the current policies and measures in place, by 8.8 % between 2015 and 2020, and by a further 6.2 % between 2020 and 2030. This would result in an overall 15.0 % decrease between 2015 and 2030. The projected average annual decrease of EU ETS stationary emissions between 2015 and 2030 is considerably slower than the decrease of EU ETS emissions observed between 2005 and 2015. In contrast, the emissions from aviation activities covered by the EU ETS are expected to continually increase until 2030 ([2]). A proposal is currently under discussion to extend the current provisions until the end of the trading period, while the future treatment of international aviation will depend, among other factors, on the recent agreement at the International Civil Aviation Organization (ICAO).

The European Commission has proposed a 43 % reduction of emissions in the EU ETS by 2030 compared with 2005, as a contribution to achieving the binding EU target of an at least 40 % domestic reduction in greenhouse gas (GHG) emissions by 2030 compared with 1990. This reduction should be achieved by increasing the linear reduction factor of the annual EU ETS cap from 1.74 % (third trading period) to 2.2 % from 2021.

The emission reductions currently projected by Member States do not align with this 43 % reduction on 2005 levels in the EU ETS. Although projected emission levels are lower than those of previous projections, a number of Member States have reported increases in EU ETS emissions. For example, the Netherlands (which in 2015 had reported a projected decrease in EU ETS emissions) reported an expected increase in emissions between 2020 and 2030, primarily because of an increase in the use of coal power. Further efforts are therefore necessary to prevent these increases from actually happening and locking the EU's energy system into carbon-intensive technologies.

([2]) The projections have been made in the absence of a clear framework for the future regulation of (international) aviation emissions.

1 Recent trends

- Between 2015 and 2016, total emissions for stationary installations covered by the EU ETS declined by 2.9 %. However, total emissions for aviation operators increased by 7.6 % in the 2015-2016 period.
- Emissions from stationary installations represented 97 % of the total emissions covered by the EU ETS in 2016. These emissions continued to declined, with emissions from combustion installations (mainly power plants) decreasing at a faster rate than emissions from industrial installations. The decline of emissions from power plants reflects factors including the phasing out of coal use in several Member States.
- The emission trend varied by industrial sector, with a large drop in emissions from the iron and steel sector that primarily reflected changes in output levels. In contrast, emissions from aviation operators, which accounted for 3 % of the total emissions covered by the EU ETS in 2016, increased compared with the previous year as the number of passengers continued to grow.
- The supply of EU emission allowances to be used for compliance increased slightly in 2016, with the decline in the number of free allowances and use of international credits offset by an increase in the number of auctioned allowances. This was because of fewer auctioned allowances being withheld from the market as a result of the backloading measure when compared with the previous year.
- Most power plants had to buy their allowances (through auctioning or in the secondary market) in 2016, while most other industrial installations received free allowances because they are deemed to be exposed to a risk of carbon leakage. The aviation sector had to meet a net demand for allowances by purchasing European Union Allowances (EUAs) from the stationary sector in order to comply with its emissions cap.
- For the second year in succession, the annual demand for allowances in 2016 was higher than the supply of allowances. This led to a further reduction in the cumulative surplus of allowances, which is now around 1.7 billion allowances (EC, 2017b). The surplus remains substantial, equivalent to just under one year's worth of EU ETS emissions.
- The average annual EUA price declined in 2016 (fluctuating around a level of EUR 5 per EUA). At current levels, the price signal of the EU ETS provides a limited incentive for the more expensive abatement options necessary to decarbonise the European economy in the long term.

This chapter presents developments for stationary installations ([3]) and aviation separately, focusing first on emission trends in the past year and second on the implications for the supply and demand of allowances. Given that aircraft operators can purchase allowances from stationary installations, there is a degree of interaction between both stationary installations and aviation that is discussed throughout the chapter.

1.1 Stationary installations

1.1.1 Emission trends

Status in 2016

In 2016, the greenhouse gas (GHG) emissions covered by the ETS Directive ([4]) accounted for around 40 % of the total GHG emissions of the EU. Combustion

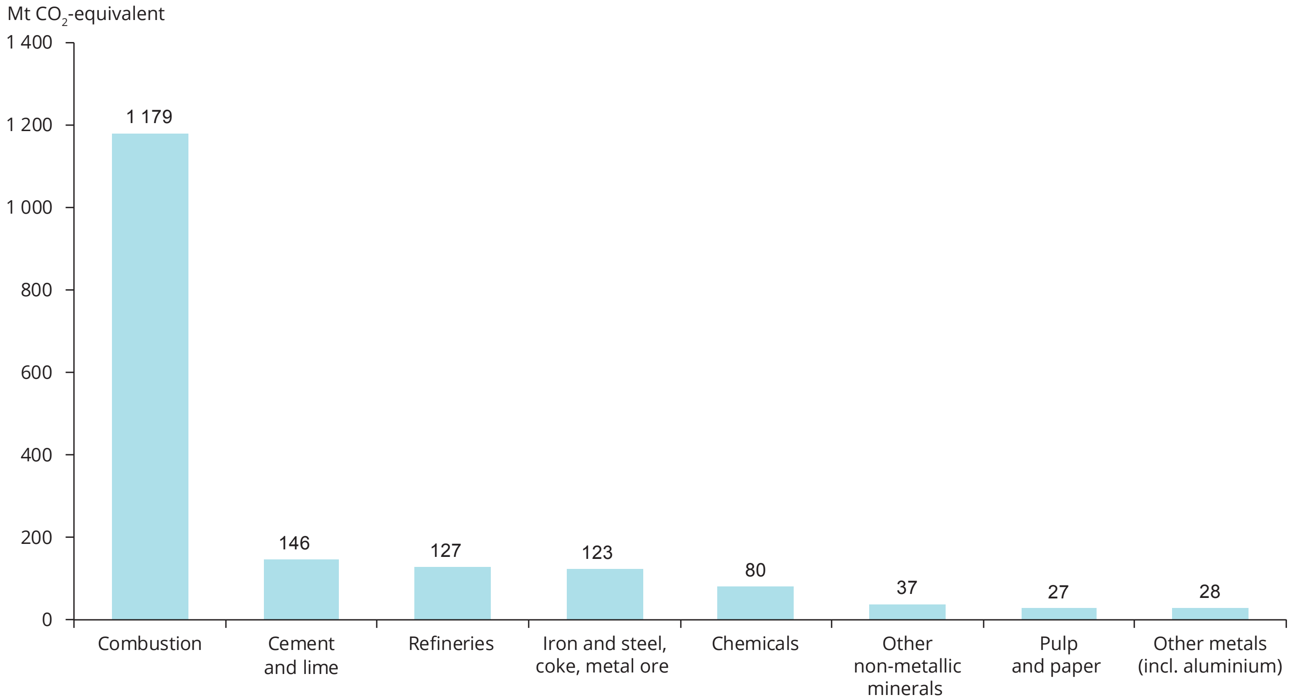
([3]) An installation refers to a stationary technical unit where one or more activities are carried out on that site that could have an effect on emissions and pollution (EC, 2010).

([4]) Directive 2009/29/EC amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community (EU, 2009), will be referred to as the ETS Directive throughout the report.

installations ([5]) are the main source of emissions in the EU ETS ([6]) and emitted 1 179 Mt CO_2-eq. in 2016 (Figure 1.1). This is equivalent to 67.4 % of total verified emissions. Cement and lime installations accounted for 8.3 % of the total verified emissions in 2016, followed by refinery installations (7.3 %), iron and steel installations (7.0 %) and chemical installations (4.6 %).

Verified emissions from industrial installations (other than combustion) were 1.1 % lower than in 2015 (Figure 1.2) but varied depending on the activity concerned. Verified emissions of iron and steel installations, for example, declined by 5.1 % compared with 2015. The reduction in production of iron and steel products experienced over the course of 2016 has contributed strongly to the overall decline in verified emissions in this sector. The production of crude steel in the EU decreased by 2.4 % between 2015 and 2016 (EUROFER, 2017). The excess capacity in steel making contributed to an oversupply of steel products in global markets and therefore a reduction in activity levels of individual plants. Although the demand for steel in the EU actually increased in 2016, this was met by an increase in imports rather than an increase in domestic production (EUROFER, 2017). Falling exports over the year further contributed to the decline in activity that entailed a fall in emissions in this sector.

Figure 1.1 EU ETS emissions by main activity type in 2016



Note: The emissions cover all of the 31 countries that currently participate in the EU ETS.

EU Transaction Log (EUTL) activity codes have been aggregated for certain sectors (refer to Section A1.1.1 for the attribution of activity codes).

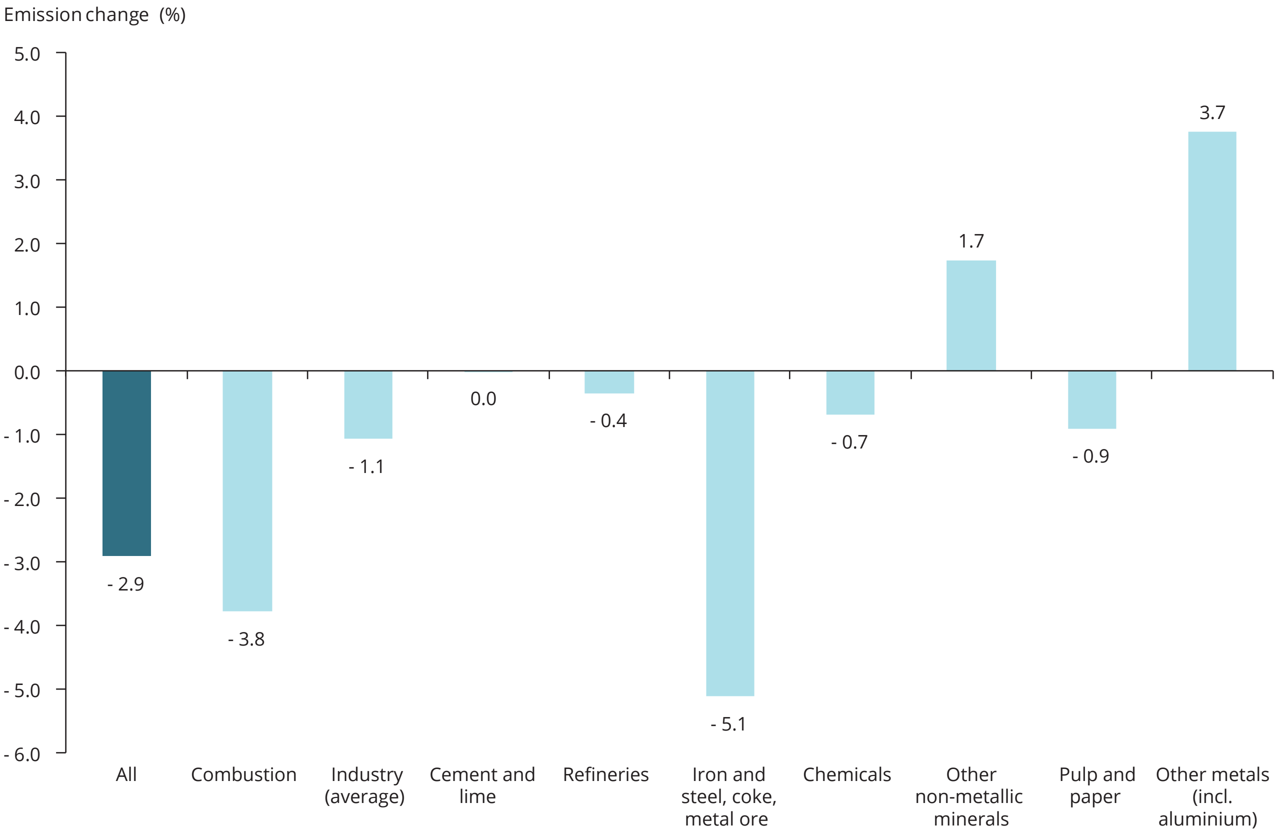
Source: EEA, 2017.

In 2016, verified emissions for stationary installations were 2.9 % lower than in 2015 (Figure 1.2), with the majority of the reduction delivered by combustion installations (- 3.8 %). The decline in the verified emissions of combustion installations in 2016 was primarily due to fuel switching from coal to gas, especially in the United Kingdom, Italy, Netherlands, Germany and Greece (Agora Energiewende and Sandbag, 2017). A minor increase in renewable production (due to poorer weather conditions) played a lesser role in this trend in 2016 than in the previous year.

([5]) Combustion installations refers to any oxidation of fuels, regardless of the way in which heat, electricity or mechanical energy produced by this process is used, and any other directly associated activities including waste gas scrubbing (EC, 2010).

([6]) In addition to power plants, the ETS information reported under this activity type covers industrial installations carrying out activities not specifically stated in the Annex of the ETS Directive (e.g. breweries). Blast furnace power plants may also be included under combustion rather than iron and steel activity type codes.

Figure 1.2 Change in EU ETS emissions by main activity, 2015-2016



Note: EUTL activity codes have been aggregated for certain sectors.

Source: EEA, 2017.

By way of contrast, the verified emissions of installations producing other metals (including aluminium) rose by 3.7 % in 2016. The growth in aluminium production in Europe contributed to the increase in the verified emissions observed between 2015 and 2016 for the other metals sector. The production of primary aluminium has rebounded in Europe following a difficult period, to increase by 1.1 % compared with 2015 (European Aluminium, 2017). For example, the demand for semi-finished aluminium products remains strong in the EU, driving an annual increase in domestic production of 2.4 % in flat rolled products such as cans and cars, and of 1.6 % in extruded products such as windows and machinery (European Aluminium, 2017).

Top 30 emitters

In 2016, the 30 highest emitting combustion installations ([7]) alone emitted 338 Mt CO_2, 29 % of total combustion emissions in that year (Table 1.1). The top emitting combustion plants are located mainly in either Poland or Germany and burn lignite fuel. Lignite-fired power plants have higher specific emissions than hard coal or natural gas-fired power plants. The CO_2 intensity of the biggest German and Polish lignite-fired power plants is about 1 100 g CO_2/kWh ([8]). The lignite-fired power plant in Dimitrios has even higher specific emissions (~ 1 400 g CO_2/kWh). Greek lignite has a lower calorific value and thus more fuel needs to be burned to obtain the same amount of electricity and more electricity is used in the power plant itself e.g. to prepare the fuel for combustion.

The largest emitter of all EU ETS installations is the lignite-fired power plant in Bełchatów, Poland, which emitted 34.9 Mt CO_2 in 2016 ([9]). Polish power plants, including Kozienice (hard coal), Turów (lignite) and Oddział w Rybniku (hard coal), as well as Bełchatów, account for 17 % of total emissions from this top 30. Bełchatów is followed in the ranking by four German

([7]) The list of the 30 highest emitting power plants also includes three installations using blast furnace gas from the primary steelmaking process.
([8]) Own calculation based on 2015 data.
([9]) Following the construction of a new block in 2011, it has an installed capacity of 5 GW, and is thus the second largest power plant in the world.

Table 1.1 Top 30 emitters in 2016 (combustion plants)

EUTL ID	Company	Country code	Installation	Fuel	Installed capacity (MW)	Emissions 2016 (Mt CO_2-eq.)	Change vs. 2015 (%)
PL 1	PGE	PL	Bełchatów	Lignite	5 030	34.9	- 6
DE 1606	RWE	DE	Neurath	Lignite	4 168	31.3	- 2
DE 1649	RWE	DE	Niederaußem	Lignite	3 430	24.8	- 9
DE 1456	Vattenfall	DE	Jänschwalde	Lignite	2 790	23.8	2
DE 1607	RWE	DE	Weisweiler	Lignite	1 800	18.7	3
DE 1459	Vattenfall	DE	Schwarze Pumpe	Lignite	1 500	12.2	0
PL 4	ENEA	PL	Kozienice	Hard coal	2 919	12.0	5
DE 1460	Vattenfall	DE	Lippendorf	Lignite	1 750	10.8	5
IT 439	ENEL	IT	Torrevaldaliga Nord	Hard coal	1 821	10.2	- 5
DE 1454	Vattenfall	DE	Boxberg Werk IV	Lignite	1 497	9.7	- 10
BG 50	TPP	BG	Maritsa East 2	Lignite	1 473	9.6	- 15
GR 15	ΔΕΗ ΑΕ	GR	Dimitrios	Lignite	1 456	9.1	- 14
DE 1453	Vattenfall	DE	Boxberg Werk III	Lignite	930	8.9	3
SK 150	U. S. Steel	SK	Košice	Blast furnace gas	277.9	8.9	3
NL 205957	RWE	NL	Eemshaven Centrale	Hard coal	1 600	8.3	32
IT 521	ENEL	IT	Brindisi Sud	Hard coal	24 28	8.3	- 37
EE 2	Eesti Elektrijaam	EE	Narva	Oil shale	1 610	7.9	12
DE 1380	Großkraftwerk Mannheim	DE	Mannheim	Hard coal	1 115	7.9	8
PL 3	PGE	PL	Turów	Lignite	1 488	7.8	3
PL 5	ENGIE	PL	Połaniec	Hard coal	1 657	7.7	23
PT 100	EDP	PT	Sines	Hard coal	1 192	7.3	- 16
FR 956	ArcelorMittal	FR	Dunkerque	Blast furnace gas	250	7.3	1
PL 6	EDF	PL	Oddział w Rybniku	Hard coal	1555	7.1	8
ES 647	Endesa	ES	Puentes	Lignite	1 403.3	6.9	- 8
HU 142	RWE	HU	Mátrai Eromu ZRt.	Lignite	812	6.5	2
GB 381	Drax	UK	Drax Power Station	Biomass, hard coal	3 870	6.3	- 53
IT 511	Taranto Energia	IT	Taranto	Blast furnace gas	1 023	6.0	25
NL 163	Uniper	NL	Maasvlakte	Hard coal	1 040	6.0	1
GB 188	RWE	UK	Aberthaw	Hard coal	1 586	5.9	- 11
PL 2	PGE	PL	Opole	Hard coal	1 532	5.9	2

Note: The classification of combustion plants based on the activity code reported in the EUTL.

Installed capacity for German plants is net and gross in most other countries.

Sources: Platts, 2014; EEA, 2017.

lignite-fired power plants: Neurath, Niederaußem, Jänschwalde and Weisweiler. Together, these plants emitted 98.7 Mt CO_2 in 2016. The eight German power plants (seven of them lignite fired) were together responsible for 40 % of the total emissions from this top 30.

The largest increase in emissions occurred at the Eemshaven hard coal plant in the Netherlands, with a 32 % increase in emissions in 2016 compared with 2015. This was because the plant started operating in 2015, and 2016 was therefore the first full year of production. The largest decrease in emissions occurred at the Drax power plant in the United Kingdom, with a 53 % reduction in emissions compared with 2015, due to the conversion of three of its coal units to biomass.

Several power plants no longer belong to the top 30 emitters list in 2016 ([10]). In the United Kingdom, the emissions from the West Burton, Longannet and Cottam plants decreased by 85 %, 78 % and 77 % respectively in 2016 compared with the previous year, which illustrates the rapid phase-out of coal use in the country. Furthermore, the two Spanish power plants Litoral and Aboño 1 have also experienced considerable drops in emissions of 29 % and 27 % respectively over the past year, and are no longer present in the top 30 emitters list. The continued growth in renewables in Spain has been an important driver in this trend (Elkerbout, 2017), although fluctuations in renewable energy resources can influence this trend considerably from one year to the next.

In 2016, the 30 highest emitting industrial plants ([11]) alone emitted 133 Mt CO_2-eq., 23 % of total industrial emissions in that year (Table 1.2). The largest emitting industrial plants are spread out across Europe, with no one country dominating the list. However, all of the top five industrial emitters belong to the iron and steel sector. Overall, the iron and steel sector accounted for 65 % of total emissions by the 30 highest emitting industrial plants ([12]). In 2016, the production of crude steel in the EU declined compared with the previous year (EUROFER, 2017). However, at the installation level, the production of crude steel at plants varied. For example, iron and steel installations experienced large increases in annual emissions at Gent 1 ([13]) nd reductions at Port Talbot ([14]), primarily driven by changes in production levels.

The majority of the top 30 emitters from the refinery sector experienced emission reductions in 2016, primarily as a result of lower levels of output. In 2015, refining margins recovered from historic lows helped by the low crude oil price and strong global demand for gasoline. However, refining margins declined again in 2016 as a consequence of both global refining overcapacity and increasing imports to Europe (Flanagan et al., 2016). Only the sharp increase in fuel demand (driven by low oil prices) and delays to the building of additional capacity in Asia have preserved the ageing facilities of many European refineries from further competitive pressures. Despite the difficult economic environment, several plants increased their throughput and their annual emissions in 2016. For example, production at the Porvoo refinery in Finland increased from 9.8 Mt in 2015 to 11.7 Mt in 2016 (Neste, 2017) resulting in a rise in emissions.

([10]) Refer to the previous list of top 30 emitters in last year's report (EEA, 2016b).
([11]) This is understood as 'non-combustion', even though most combustion installations are also industrial installations (in the normal definition of the term).
([12]) This relatively high proportion reflects the emission-intensive nature of iron and steel production (i.e. the smelting of iron ores in blast furnaces to produce molten steel).
([13]) Crude steel production at ArcelorMittal's installations in Belgium rose from 4.8 Mt in 2015 (ArcelorMittal, 2016) to 5.3 Mt in 2016 (ArcelorMittal, 2017).
([14]) Crude steel production fell from 4.4 Mt in the financial year 2014/2015 to 3.9 Mt in the financial year 2015/2016 (TATA Steel, 2017).

Table 1.2 Top 30 emitters in 2016 (industrial plants, excluding combustion)

EUTL ID	Company	Country code	Installation	Activity type code	Emissions 2016 (Mt CO_2-eq.)	Change vs. 2015 (%)
AT 16	Voestalpine Stahl Gmbh	AT	Voestalpine Stahl Linz	24	8.7	0
DE 69	Thyssenkrupp Steel Europe Ag	DE	Integriertes Hüttenwerk Duisburg	24	8.4	3
FR 628	Bersillon	FR	Arcelormittal Mediterranee	24	7.2	- 8
IT 515	Ilva S.P.A.	IT	Stabilimento Di Taranto	24	6.8	9
GB 325	Tata Steel UK Limited	UK	Port Talbot Steelworks	24	6.7	- 11
IT 575	Sarlux Srl	IT	Impianti Di Raffinazione	21	6.5	- 1
NL 144	Tata Steel Ijmuiden B.V.	NL	Tata Steel Ijmuiden Bv Bkg 1	24	6.2	0
ES 212	Arcelormittal España, S.A.	ES	Arcelormittal España, S.A.	24	5.7	- 3
GB 321	British Steel	UK	Scunthorpe Integrated Iron & Steel Works	22	5.2	- 8
BE 203912	Arcelormittal Belgium	BE	Arcelormittal Gent 1	24	4.5	14
DE 43	Salzgitter Flachstahl Gmbh	DE	Glocke Salzgitter	24	4.3	9
NL 99	Shell Nederland Raffinaderij B.V.	NL	Shell Nederland Raffinaderij B.V.	21	4.3	0
RO 44	ArcelorMittal	RO	Galati	24	4.2	- 1
DE 53	Hüttenwerke Krupp Mannesmann Gmbh	DE	Glocke Duisburg	24	4.2	- 12
FI 445	Ssab Europe Oy	FI	Raahen terästehdas	24	4.1	5
DE 52	Rogesa Roheisengesellschaft Saar Mbh	DE	Roheisenerzeugung Dillingen	24	3.9	- 12
DE 19	Pck Raffinerie Gmbh	DE	Pck Raffinerie Glocke Schwedt	21	3.8	- 6
BE 127	Total	BE	Raffinaderij Antwerpen	21	3.7	- 2
CZ 73	Arcelormittal Ostrava A.S.	CZ	Arcelormittal Ostrava A.S.	24	3.2	15
DE 4	Ruhr Oel Gmbh	DE	Gelsenkirchen Scholven	21	3.2	- 1
BE 203830	BASF	BE	Antwerpen – 127a	42	3.0	- 4
IT 180	Eni	IT	Raffineria Di Sannazzaro	21	3.0	4
FI 533	Neste	FI	Porvoon jalostamo	21	2.9	9
DE 11	Phillips 66	DE	MiRO Refinery	21	2.8	16
PL 886	ArcelorMittal	PL	Poland	24	2.8	8
AT 26	Omv Refining & Marketing Gmbh	AT	Raffinerie Schwechat	21	2.8	- 1
AT 13	Voestalpine Stahl Donawitz Gmbh	AT	Sinteranl., Hochöfen	24	2.8	- 7
GB 86	Esso Petroleum Company Limited	UK	Fawley refinery	21	2.7	- 1
DE 60	Arcelormittal Bremen Gmbh	DE	Einheitliche Anlage Bremen	24	2.6	- 7
PL 362	Polski Koncern Naftowy Orlen S.A.	PL	Polski Koncern Naftowy	21	2.6	- 3

Note: The classification of industrial plants based on activity codes as reported in the EUTL.

21, refineries; 24, iron and steel production; 42, production of bulk chemicals.

Sources: Platts, 2014; EEA, 2017.

1.1.2 Balance of allowances

Supply and demand

The total supply of 1 562 million allowances in 2016 increased slightly compared with the previous year and comprised free allocation, allowances auctioned ([15]) and exchange of international credits (Table 1.3). The supply of total allowances allocated for free (without transitional allocation for the modernisation of electricity generation) was 2.8 % lower than in 2015. This reduction reflects the fact that free allocation to existing installations is reducing every year, depending on the linear reduction factor, the cross-sectional correction factor as well as the carbon leakage status relevant for allocation ([16]). Furthermore, some of the free allowances normally allocated to existing installations under Article 10(a)(1) of the ETS Directive

Table 1.3 Summary of EU ETS developments in stationary installations, 2015-2016

	2015	2016	Change (%)
Verified emissions (Mt CO_2-eq.)	**1 802.8**	**1 750.1**	**- 2.9**
Combustion emissions	1225.6	1 179.1	- 3.8
Industrial emissions	577.2	571.0	- 1.1
Total supply of allowances (Millions EUAs) ([a])	**1 519.0**	**1 562.0**	**2.8**
Free allocation (incumbents, new entrants)	792.8	770.8	- 2.8
For existing installations	775.4	752.6	- 2.9
For new entrants and capacity extensions	17.3	18.2	5.3
Transitional free allocation for electricity generation	79.0	60.4	- 23.6
Auctioned amounts/primary market sales ([b])	624.8	718.8	15.0
International credits exchanged ([c])	22.4	12.0	- 46.6
Supply/demand balance (Millions EUA)			
Balance stationary installations only	- 283.8	- 188.1	- 33.7
Net demand in EUAs from aviation	- 19.0	- 23.0	20.9
Annual balance all ETS	- 302.8	- 211.1	- 30.3
EUA price (EUR) ([d])	**7.6**	**5.2**	**- 31.3**

Notes: ([a]) Free allocation for existing installations is provided under Article 10(a)(1) of the ETS Directive. Free allocation for new entrants and capacity extensions is provided under Article 10(a)(7) of the ETS Directive. Transitional free allocation for modernising electricity generation (in eastern Europe) is provided under Article 10(c) of the ETS Directive.

([b]) The annual volumes of allowances auctioned/sold on the primary market presented in this table were attributed by the EEA to the years from which they arose. As a result, the total volumes presented do not correspond to the volumes that were effectively released to the market each year or to the numbers produced by the auctioning platforms. The volumes of allowances effectively released to the market in 2015 and 2016 were equal to 632.7 and 715.3 million EUAs, respectively. See further details in Section A1.3, p. 54.

([c]) Estimated use of international credits for stationary installations (estimated usage by aviation operators subtracted from the total).

([d]) The EUA price is based on the average annual price of primary market sales from the EEX and ICE trading platforms. The price can reflect a wider context (i.e. it can reflect not just the balance between supply and demand for this year but also the expectations of market participants with respect to the balance between supply and demand as well as the accumulated surplus over a longer time horizon).

EUA, European Union Allowance.

Sources: EEA, 2017; EEX, 2017; ICE, 2017.

([15]) There were no direct primary market sales in 2016. In other years they included, for example, the NER300 sales.

([16]) Since 2013, power generators have been required to buy all their allowances, with exceptions made for some countries. Manufacturing industry received 80 % of its allowances for free in 2013. This proportion will decrease gradually year on year, down to 30 % in 2020. Sectors and subsectors facing competition from industries outside the EU that are not subject to comparable climate legislation will receive more free allowances than those not at risk of carbon leakage.

were not allocated as a result of installation closures or reductions in production levels ([17]).

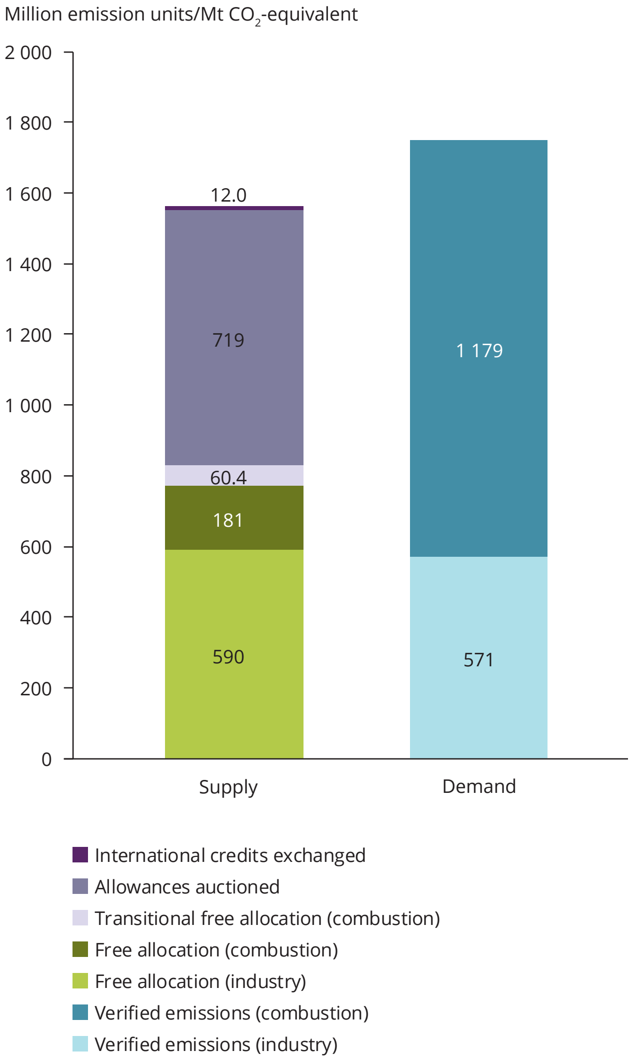
The number of transitional allowances allocated to electricity generators in eligible lower income Member States to enable them to modernise their energy sector (Article 10(c) of the ETS Directive) decreased by 23.6 % in 2016 compared with the previous year. The use of international credits was reduced by 46.6 % in 2016 compared with 2015, as the maximum limit for certified emission reduction (CER)/emission reduction unit (ERU) exchange of such credits for allowances until 2020 (see Article 11(a)(8) of the ETS Directive) has been nearly entirely used up (Table 1.3). However, these reductions in allowance supply were offset by the 15 % increase in the number of allowances auctioned in 2016 compared with the previous year. The number of allowances sold in the primary market (such as auctioning) was greater in 2016 than in the previous year, as a consequence of fewer allowances being withdrawn from auctions under backloading ([18]).

The total demand in 2016 was made up of 1 750 Mt CO_2-eq. from stationary installations (total verified emissions) and a net demand of 23 Mt CO_2-eq. from aviation. In 2016, verified emissions declined by 2.9 % compared with the previous year, lowering the demand for allowances. The cumulated surplus continued to decline in 2016, albeit at a slower rate than the previous year, due to a slight increase in the supply of allowances and a slight decline in the demand for allowances. An allowance surplus of around 1.7 billion allowances remains (EC, 2017b), which continues to impact the level of the price signal.

Supply and demand by main activity type

Overall, the demand for allowances was greater than the supply in 2016 (Figure 1.3). However, this shortage in the market mainly impacted combustion installations, which had to buy most of their allowances to cover their emissions through auctions, from other market participants or through the purchase of international credits. The limited number of free allowances distributed to combustion installations reflects the low risk of carbon leakage ([19]) associated with this activity, i.e. the lack of

Figure 1.3 Supply and demand balance, combustion and industry in 2016



Note: The balance of supply and demand is slightly overestimated for the industrial sector, and underestimated in the combustion sector, as a result of how verified emissions are reported (see note under Figure 1.4).

Source: EEA, 2017.

([17]) This reduction in allocated allowances was to an extent offset by an increase (in absolute terms rather small) in the number of free allowances allocated to new entrants to the ETS and existing installations with 'significant capacity' extensions (see Article 10(a)(7) of the ETS Directive).

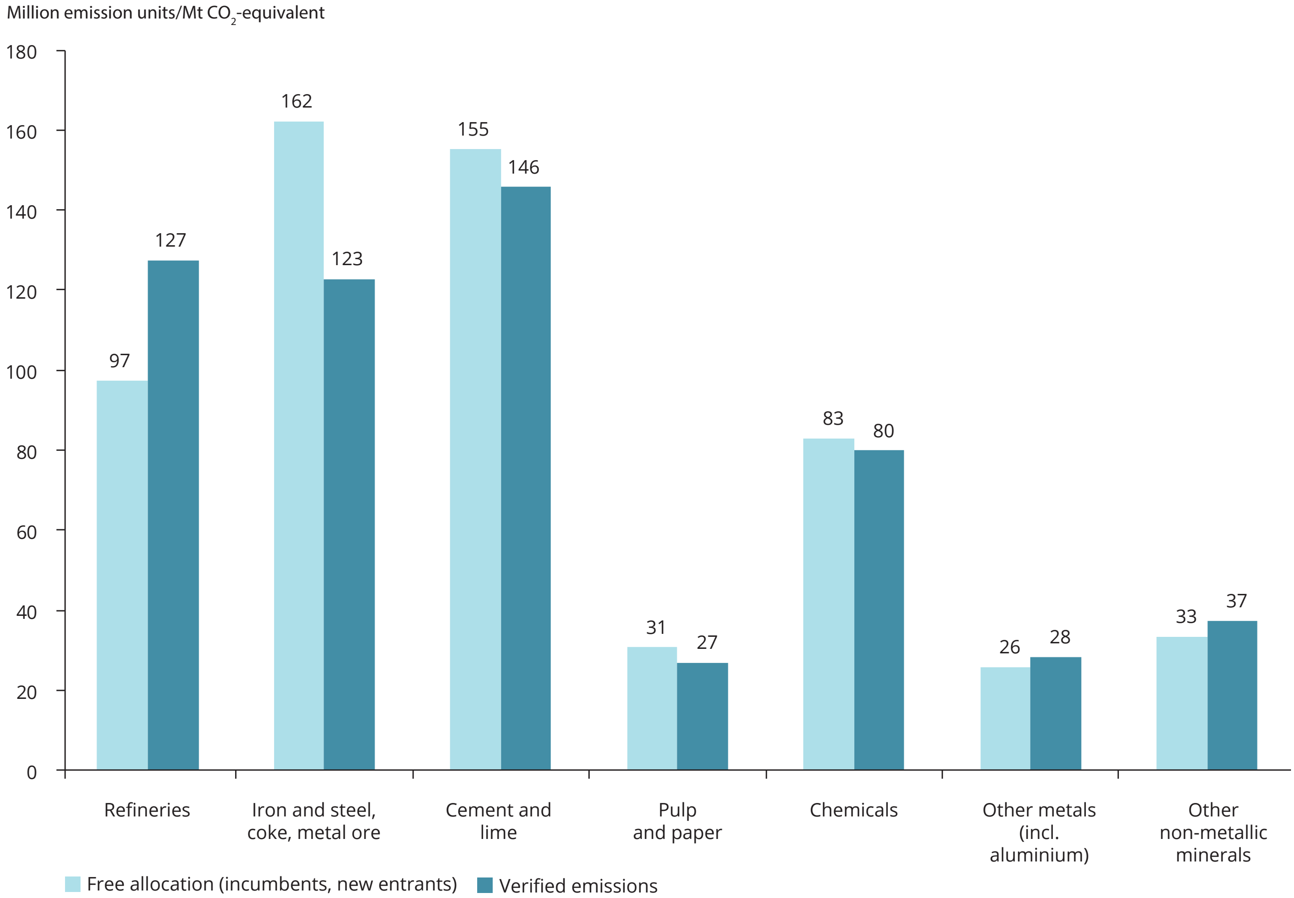
([18]) The Backloading Decision postponed the auctioning of a total of 900 million allowances until 2019-2020 (EC, 2014d). A total of 400 million allowances were removed in 2014, 300 million in 2015 and 200 million in 2016. It has subsequently been decided that these allowances will not re-enter the market, as originally planned under the backloading decision, but will instead be transferred to the MSR (EU, 2015).

([19]) Carbon leakage refers to a situation that may occur if, for reasons of cost related to climate policies, businesses were to transfer production to other countries with laxer emission restraints. See https://ec.europa.eu/clima/policies/ets/allowances/leakage_en.

international competition, in particular for electricity generation ([20]). In contrast, the total verified emissions of industrial installations (excluding combustion) were lower than their total allocation of free allowances ([21]). However, these allowances were not distributed evenly across all industrial sectors.

The iron and steel sector had more emission allowances allocated for free than their emissions in 2016 following a decline in its emissions compared with 2015, whereas the refineries sector was short of emission allowances in 2016 following an increase in its emissions compared with 2015 (Figure 1.4). The fact that several of the sectors had more emission allowances allocated for free than their actual emissions also reflects the implementation of provisions to prevent carbon leakage. In this context, allocation is based on historical production volumes, product-specific benchmarks and the carbon leakage status of an installation (and limited by a cross-sectoral correction factor). However, free allocation to the iron and steel, pulp and paper, and chemicals sectors have to be viewed in the context of waste gas and heat transfers in these sectors (see box on next page).

Figure 1.4 Balance of free allocation and emissions, industrial sectors, 2016



Note: EUTL activity types have been aggregated for certain sectors. The overall allocation presented here for the iron and steel sector includes allowances for emissions that are actually reported under combustion installations, for example if blast furnace gas is burnt in power plants. Likewise, albeit to a lesser extent, the allocations presented for the pulp and paper sector and the chemicals sector include allowances related to emissions reported under combustion installations, for example, if paper production or chemical facilities buy heat from other installations. In other words, allowances are allocated to these sectors, whereas corresponding emissions are reported under combustion.

Source: EEA, 2017.

([20]) Under Article 10a(4) of the ETS Directive, electricity generators are eligible for free allowances for heat production only. Furthermore, electricity generators in certain countries are eligible for transitional free allowances under Article 10c of the ETS Directive, to enable those countries to modernise their electricity systems.

([21]) The higher share of free allocation to industry reflects concerns about the exposure of industrial sectors to international competition. Free allowances to industrial installations under Article 10a(1) of the ETS Directive were distributed by applying harmonised allocation rules that were based on EU ETS-wide benchmarks and on historical production levels, as well as whether or not the sector is on the carbon leakage list.

Waste gas and heat transfers in the iron and steel, pulp and paper, and chemical sectors

The balance of allowance allocation and emissions in the iron and steel sector has to be viewed in the context of the use of blast furnace gas for electricity and heat production. Blast furnace gas arises as a by-product in iron and steel production and is often used for electricity and heat production in combustion installations situated close to the iron and steel plant. These combustion installations are sometimes classified under the iron and steel sector (together with the plant where the blast furnace gas originates) and sometimes under the combustion sector. This classification depends on the applicable rules in the relevant country.

In the first trading period of the EU ETS, free allocation for blast furnace gas was issued to the combustion installation itself (i.e. the point where CO_2 emissions were released into the atmosphere). From the second trading period onwards allowances are allocated to the installation where the blast furnace gas arises (i.e. above all to blast furnaces, and therefore the iron and steel sector). Emissions, however, continue to be measured at the combustion installation.

In all those countries where the installations using blast furnace gas are not classified under the iron and steel sector (among others, Germany, Italy and Spain), the balance between free allocation and emissions in the iron and steel sector is somewhat distorted, as the allocation for blast furnace gas is counted towards this sector, while emissions from the use of blast furnace gas are not.

Germany represents the country with the highest share of emissions from installations using blast furnace gas that are not classified under the iron and steel sector (about 50 %). Adjusting the free allocation to the iron and steel sector for the transfer of these gases decreases the balance between free allocation and emissions in the German iron and steel sector in 2016 from 134 % to 90 % (DEHSt, 2017).

A similar issue arises in the pulp and paper, and chemicals sectors. In the case of these sectors, heat transfers may take place from installations classified under the combustion sector, for which installations in the pulp and paper, and chemicals sectors receive free allocation. The extent of this issue again depends on the way in which these installations are classified in the relevant countries. When accounting for these transfers in the pulp and paper, and chemicals sectors in Germany, for example, the balance between free allocation and verified emissions in 2016 drops from 119 % to 85 % and from 106 % to 97 % respectively (DEHSt, 2017).

1.2 Aviation

1.2.1 Emission trends

Status in 2016

In 2016, the aviation sector covered by the EU ETS emitted 61.4 Mt CO_2-eq., which represents an increase of 7.6 % over the previous year (Figure 1.5). The seven largest aircraft operators were responsible for 44 % of these emissions. Ryanair and EasyJet were the two highest emitters in the aviation sector in 2016, accounting for 8.4 Mt CO_2-eq. and 5.1 Mt CO_2-eq. respectively.

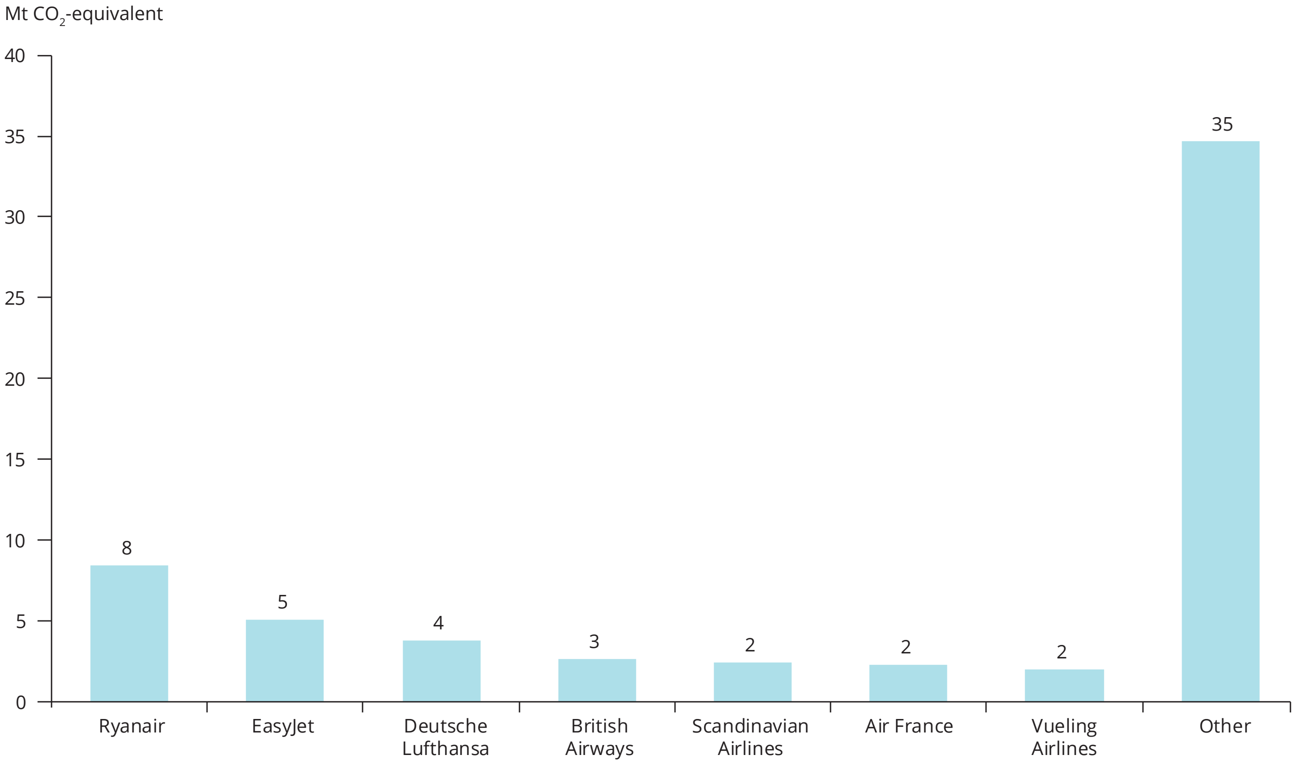
In 2016, the verified emissions of the low-cost operators Ryanair and EasyJet continued to increase, by 14 % and 8 % respectively, compared with the previous year (Figure 1.6). The increase in aviation emissions in 2016 were in both cases due, in part, to the annual growth in passenger numbers, by 15 % for Ryanair, up to 117 million passengers (Ryanair, 2017) and by 6.6 % for EasyJet, up to 74.5 million (EasyJet, 2017). In contrast, the decline in annual emissions for Air France, despite a 4 % increase in annual passenger numbers (Air France-KLM, 2017b), is likely to reflect fuel efficiency improvements from both the recent reduction in the age of their fleet and operational improvements, i.e. route optimisation and eco-flying (Air France-KLM, 2017a).

1.2.2 Balance of allowances

Supply and demand

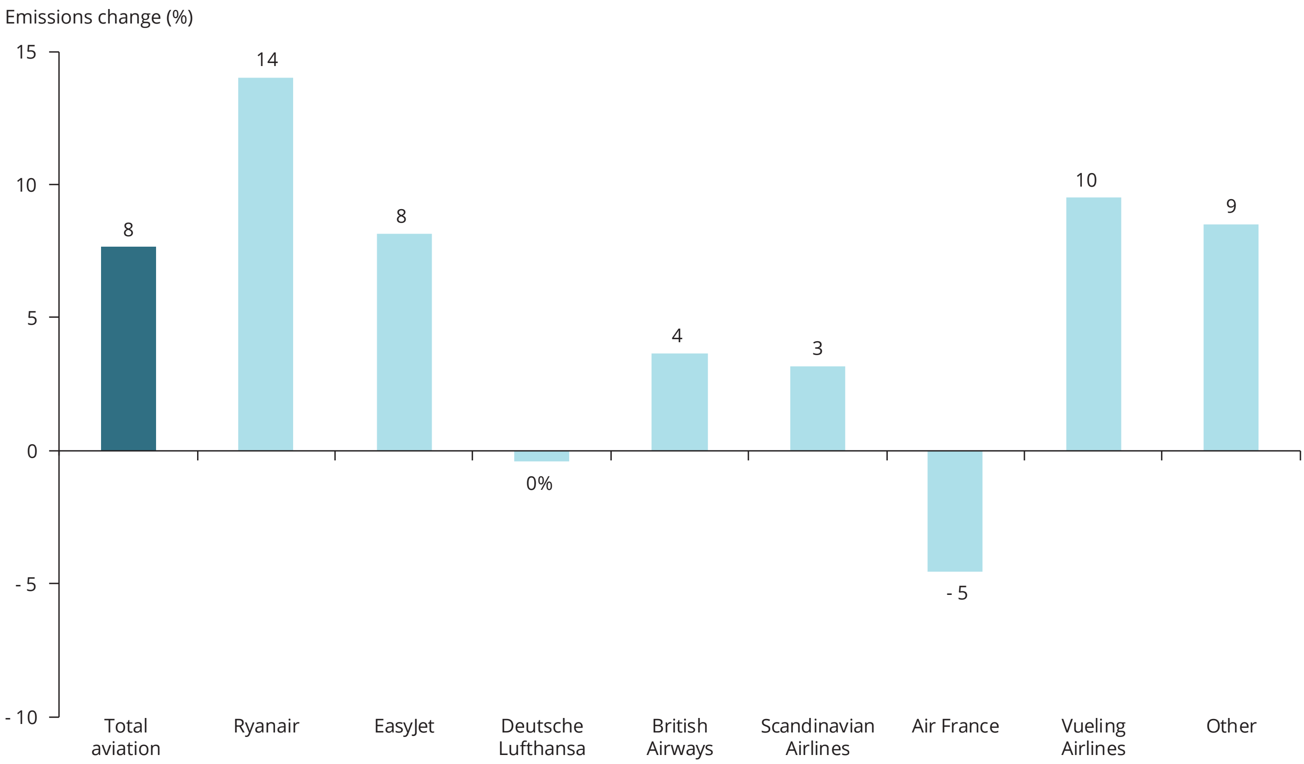
In 2016, aviation emissions covered by the EU ETS increased by 7.6 % compared with the previous year. At the same time, the supply of European Union Aviation Allowances (EUAAs) remained relatively stable because the emission cap remains the same in each year of the third trading period. The share of this supply is fixed,

Figure 1.5 Aviation emissions by carrier, 2016



Source: EEA, 2017.

Figure 1.6 Relative change in ETS aviation emissions, 2015-2016



Source: EEA, 2017.

with 82 % of allowances distributed for free, 15 % of allowances auctioned and the remaining allowances held in a reserve for distribution to fast-growing aircraft operators and new entrants in the market ([22]). However, delays in the timing of auctions in 2014 led to a higher than usual volume of auctioned allowances in 2015. Table 1.4 shows that around 6 million allowances were auctioned in 2016, while the use of international credits diminished further as the remaining budget for CER/ERU use between 2012 and 2020 is now almost entirely depleted (see note under Table 1.4). As a consequence, the net demand for allowances increased to 23 million, requiring the aviation sector to purchase EUAs in order to comply with its emissions cap.

Table 1.4 Summary of EU ETS developments for aviation operators, 2015-2016

	2015	2016	Change (%)
Total demand (Mt CO_2-eq.)	**57.1**	**61.4**	**7.6**
Aviation emissions	57.1	61.4	7.6
Total supply (Millions EUAAs)	**38.1**	**38.5**	**1.0**
Aviation allocation	32.4	32.3	- 0.2
Auctioned amounts ([a])	5.4	6.0	10.5
International credits exchanged ([b])	0.2	0.1	- 46.6
Annual supply/demand balance (Million of EUAAs)	**19.0**	**23.0**	**20.9**
EUAA price (EUR) ([c])	**7.3**	**5.5**	**- 24.1**

Notes: ([a]) Auctions of aviation allowances were suspended after the 'stop the clock' decision taken in 2012. The allowances attributable to 2013, 2014 and 2015 were all auctioned in 2015. The volumes of aviation allowances effectively released to the market in 2015 were 16.4 million EUAAs. However, in order not to distort the supply-demand balance, the allowances were distributed evenly by the EEA over the 2013-2015 period.

([b]) International credit use in the third trading period has been estimated by subtracting CERs/ERUs surrendered during the second trading period and CERs/ERUs exchanged for EUAs in the third trading period from the number of entitlements given to both stationary installations and aviation operators (available from the EUTL). The average use of the budget for each year of the third trading period (for stationary installations and aviation operators) was then calculated and applied to the total number of entitlements for aviation operators (around 15 million allowances) to estimate the distribution of international credit use in the third trading period, where specific annual data is not available. In 2015 and 2016, 98 % and 99 % of the CER/ERU budget was estimated to have already been used, which reflects the low number of international credits exchanged by aviation operators.

([c]) EUAA price based on average annual price, derived from auction prices in EEX and ICE reports. Primary market sales of EUAAs were undertaken through auctions only. The price can reflect a wider context (i.e. it can reflect not just the balance between supply and demand for aviation allowances for this year but also the expectations of market participants with respect to the balance between supply and demand on the wider carbon market, as well as the accumulated surplus over a longer time span).

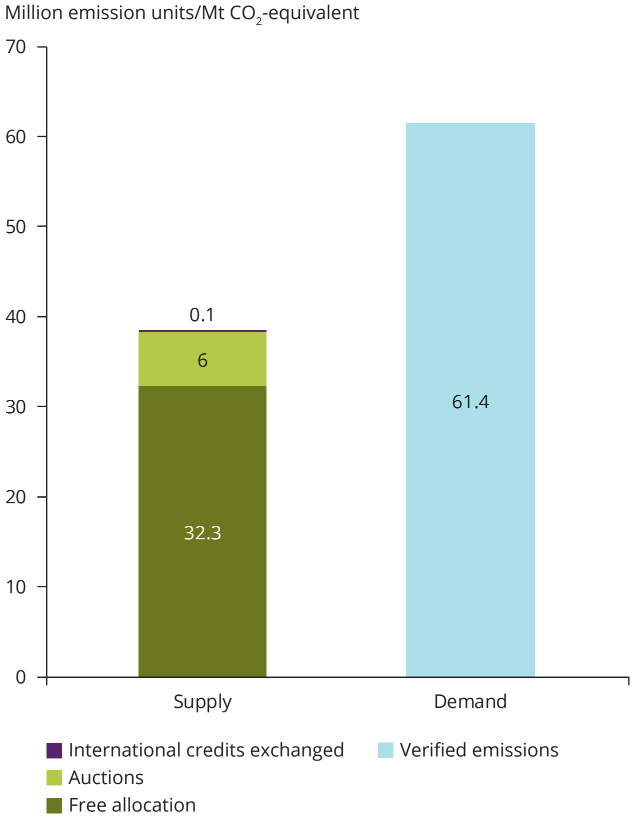
EUAA, European Union Aviation Allowance.

Sources: EEA, 2017; EEX, 2017; ICE, 2017.

([22]) https://ec.europa.eu/clima/policies/ets/allowances/aviation_en

In 2016, aircraft operators were allocated 32 million EUAAs free of charge, and an additional 6 million EUAAs were auctioned (Figure 1.7). These allowances covered 62 % of the total aviation emissions (61 Mt CO_2-eq.). The difference in allowances necessary for compliance had to be purchased on the carbon market. Aircraft operators can use allowances from the stationary sector (EUAs) to comply with their legal obligation (but, conversely, stationary installations cannot use EUAAs for compliance). Furthermore, aircraft operators are allowed to exchange international credits for EUAAs (up to 1.5 % of verified emissions).

Figure 1.7 Supply and demand balance for aviation in 2016



Note: International credit exchange is estimated to amount to 99 % of the remaining entitlements (average use of entitlements in the stationary sector and aviation) in 2016.

Sources: EC, 2014c, EC, 2015c, 2016a, EC, 2017g; EEA, 2017.

2 Long-term trends

- Emissions from stationary installations decreased by 26 % between 2005 and 2016. The decrease was mostly driven by emission reductions in power generation, while at the same time electricity generation declined only slightly over the same period. The reduction in emissions was largely the result of changes in the mix of fuels used to produce heat and electricity, in particular less use of hard coal and lignite fuels and a jump in electricity generation from renewables, which almost doubled over the period.
- Emissions from the other industrial activities covered by the EU ETS have also decreased since 2005, but remained relatively stable in the past 4 years of the current trading period (2013-2016). In contrast, aviation emissions increased year on year during the third trading period.
- The volumes of allowances auctioned in 2016 was higher than in 2015 for stationary installations as the impacts of the backloading decision were phased out (i.e. the number of allowances for which auctioning was postponed decreased from 300 million in 2015 to 200 million in 2016).
- Auctioning revenues were down slightly on the previous year, as the increase in the volume of auctioned allowances was offset by lower EUA prices. Revenues from EUAA auctions were also down in 2016.
- Between 2013 and 2016, most allowances from the NER were allocated to support capacity extensions. Overall, the allowances set aside are used to a relatively limited extent in comparison with the overall envelope of the reserve. After 4 years of the current 8-year trading period, 29 % of the allowances in the NER have either been used or reserved for future use.
- Over half of the maximum budget (60 %) for Article 10(c) allowances was used between 2013 and 2016. A large part of the investments generated by transitional free allocation is likely to have been used to modernise existing fossil fuel capacity (e.g. extending the lifetime of fossil fuel-based electricity generation units).
- By the end of 2016, almost the entire quantity of international emission credits allowed for the whole trading period had been used up, with only 1 % of entitlements remaining ([23]). Qualitative restrictions for project types have been tightened over the years; 2015 is the first year that emission reduction generated in the first Kyoto period (2008-2012) can no longer be used for compliance.
- The backloading of allowances between 2014 and 2016 had an impact on the supply and demand balance, reducing the overall surplus in both 2015 and 2016. The sharp reduction in the use of international credits, as well as the net demand for EUAs from aviation operators, also contributed to further reducing the supply. Despite these developments, the EUA price declined in 2016.

This chapter discusses separately stationary installations and aviation, focusing first on the development of emission trends between 2005 and 2016 and second on the implications for the supply and demand of allowances. Given that aircraft operators can also purchase EUAs, there is a degree of interaction between stationary installations and aviation that is discussed throughout the chapter.

([23]) Individual entitlements for some installations are calculated on the basis of their aggregated verified emissions in the third trading period and are thus expected to change in the future. This is also the case for all aircraft operators. The impact on overall amounts is expected to be minor.

2.1 Stationary installations

2.1.1 *Emission trends*

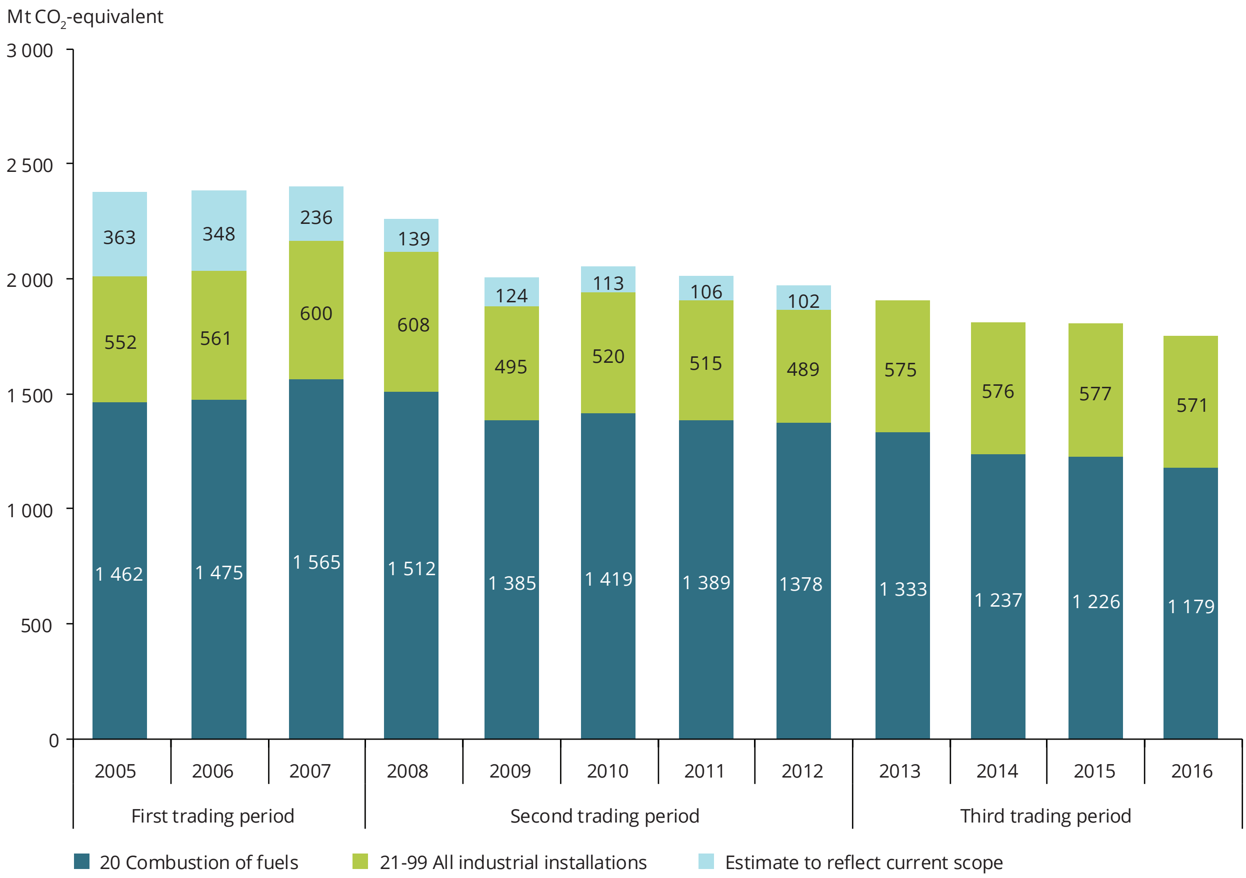
Total EU ETS emissions

Combustion installations account for the majority of the total verified emissions throughout the period 2005-2016 (Figure 2.1). In the first trading period (between 2005 and 2007), EU ETS emissions increased by 1 %. By the end of the second trading period, emissions in the EU ETS had fallen 17 % below 2005 levels. After 4 years of the third trading period, emissions are now 26 % below 2005 levels. This is below the 2020 target of a 21 % ETS reduction below 2005 levels, as set out in the Climate and Energy Package ([24]). Changes in emissions depend on changes in both activity levels and the emission intensity of production, both of which are likely to be influenced by policy and non-policy factors, which make it difficult to ascertain the extent to which emission reductions are directly attributable to the EU ETS.

Combustion-related emissions, which accounted for 67 % of total EU ETS emissions in 2016 and have mainly driven the decline in emissions in the third trading phase, depend directly on primary energy consumption levels and fuel mix:

- Primary energy consumption depends on the demand for energy by end users (electricity consumption by households and industry), transformation efficiency, and overall economic activity (the extraordinary economic situation during the second trading period). Climatic conditions play an important role in annual variations in energy consumption for heating, and

Figure 2.1 Verified emissions (2005-2016) disaggregated by combustion and industry sectors, including an estimate to reflect the scope of the third trading period



Note: The estimate to reflect current scope takes into account additional emissions (not split by activity) for the period 2005-2012 to provide a consistent time series for the coverage of emissions in the third trading period.

Source: EEA, 2017.

([24]) https://ec.europa.eu/clima/policies/strategies/2020_en

- therefore of emissions. However, the impact of this factor is less relevant over a longer period, as it is not cumulative. Policies promoting energy efficiency also have a direct impact on energy consumption.

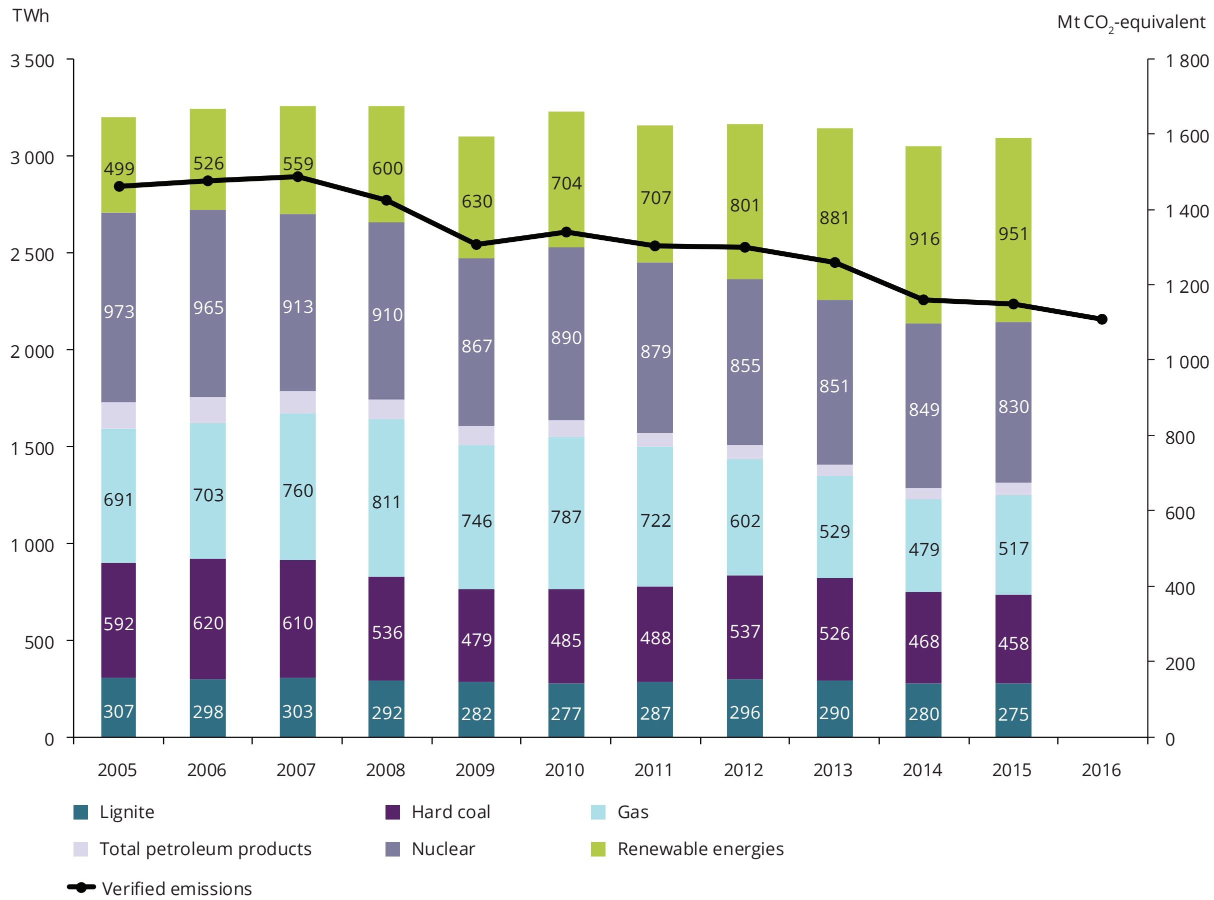
- The fuel mix used to transform primary energy into electricity or heat is also a determinant. It depends on energy infrastructure and is affected by relative variations in fuel prices. Energy policies also play a key role in modifying fuel mixes, for example, by promoting the deployment of renewable energy sources (EEA, 2014).

Emissions from activities other than combustion are generally more strongly linked with economic activity/production levels than are combustion-related emissions (EEA, 2015). However, improvements in efficiency levels also play an important role and this is encouraged in the EU ETS by the free allocation of allowances using benchmarks (based on installations in the top 10 % for efficiency).

Energy sector

Between 2005 and 2015, which is the latest year for which statistics on electricity generation are available, verified emissions for the 25 Member of States of the EU as of 2005 (EU-25) declined by 21 % ([25]). Electricity generation from hard coal, lignite and nuclear power declined by 23 %, 10 % and 15 % respectively during the same time period (Figure 2.2). These reductions in electricity generation were partly offset by a 91 %

Figure 2.2 Gross electricity generation by fuel in the EU-25, compared with EU ETS emissions from combustion installations



Note: Data aggregated by fuel type are based on guidance from Eurostat.

TWh, terawatt hours.

Sources: Eurostat, 2016; EEA, 2017.

([25]) The verified emissions of combustion installations within the EU-25 decreased by a further 3 % in 2016.

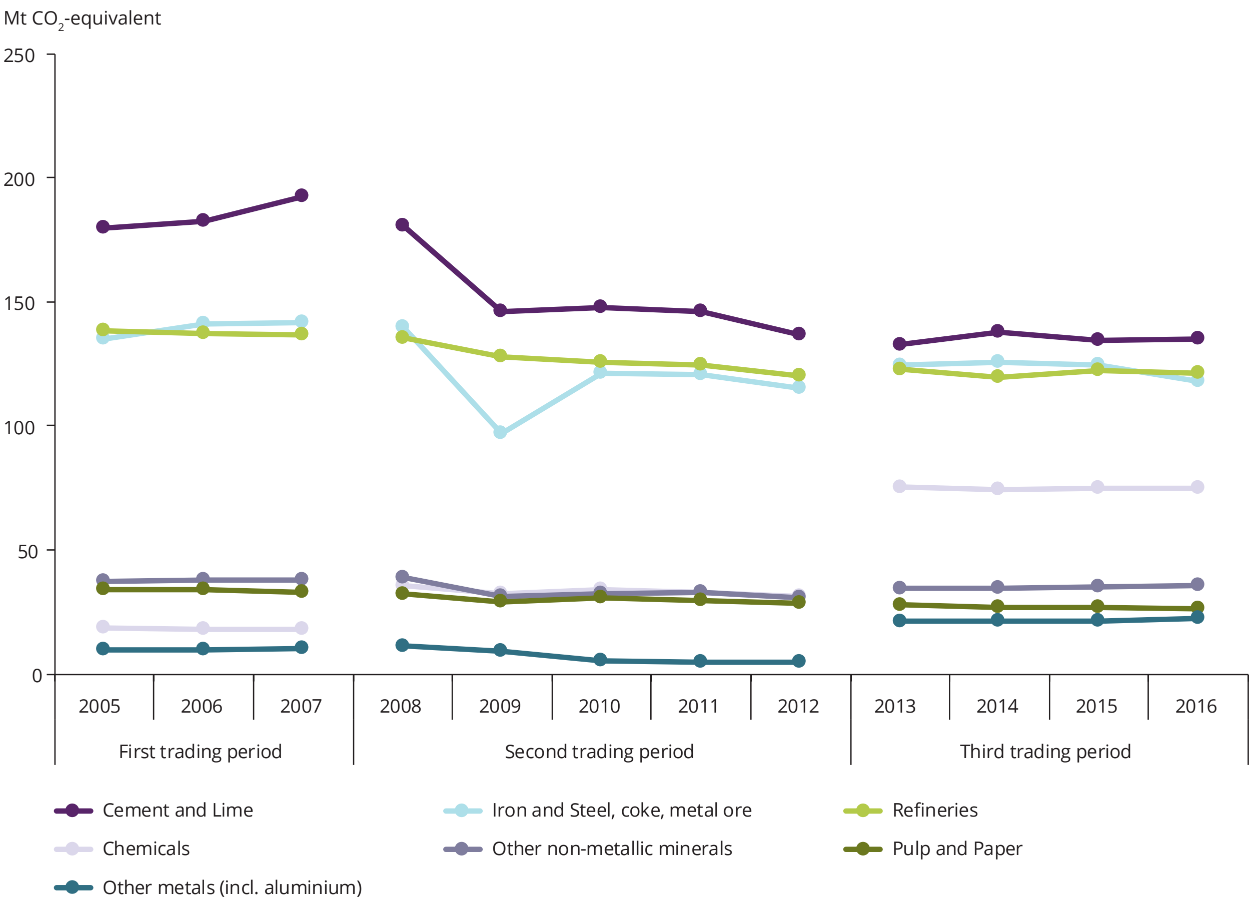
increase in electricity generation from renewables over the same time period. The Renewable Energy Directive has encouraged the uptake in renewables, which was also driven by reductions in technology costs. The reduction in emissions may also have benefited from improvements in transformation efficiency for thermal electricity generation, which means that less primary energy was needed to generate the same quantity of electricity.

The fuel consumption data also include electricity generation not covered by EU ETS, e.g. plants producing less than 20 MW of thermal energy. However, these plants represent a very small share of total emissions from electricity generation.

Industry sector excluding energy utilities

In the first trading period, the verified emissions of installations in the cement and lime sector and the iron and steel sector increased by 7 % and 5 % respectively (Figure 2.3). The verified emissions of most of the remaining sectors were more stable over the course of the first trading period. All of the industrial activities covered by the EU ETS for the EU-25 ([26]) experienced a decline in their verified emissions over the second trading period. In particular, the verified emissions of other metals (including aluminium) installations declined by 60 % between 2008 and 2012. The iron and steel sector, and the cement and lime sector also experienced a sharp drop in verified emissions of 31 %

Figure 2.3 EU ETS emissions by main industrial activity in the EU-25 (2005-2016)



Note: EUTL activity codes have been aggregated for certain sectors.

Source: EEA, 2017.

([26]) Gross electricity generation is shown only for the EU-25 to provide a consistent number of Member States over the 2005-2016 period.

and 19 % respectively in a single year (2009). In the third trading period, emissions have stabilised at the levels observed at the end of the second trading period across the various industrial sectors ([27]).

The emission reductions of industrial installations are due to a combination of economic conditions (the fall in production following the financial crisis) and improvements in energy efficiency, and the increased use of biomass and waste as energy sources in production. Lower abatement by industrial installations may reflect higher costs compared to the current EUA prices, and that lower output ([28]) is mainly responsible for the decline in verified emissions (Sorhus et al., 2017). However, to ascertain the extent to which the specific emissions of production were reduced by the EU ETS, a comprehensive review of transparent and comparable data on both production levels and verified emissions would be required for each of the industrial sectors.

2.1.2 Supply and demand for allowances and impact on the allowance price

During each year of the first trading period (2005-2007), verified emissions were slightly below the total quantity of EU allowances allocated (mainly for free) by governments (Figure 2.4). The price of EUAs peaked at around EUR 30 (Figure 2.5), but this was before the release of verified emissions data in April 2006, which showed that the number of allowances available to EU ETS operators was higher than necessary, to cover verified emissions, and that this situation would remain until the end of the first trading period. Consequently, the EUA price dropped abruptly, and it remained close to zero until the end of 2007, as it was not possible to 'bank' surplus allowances between the first and the second trading periods.

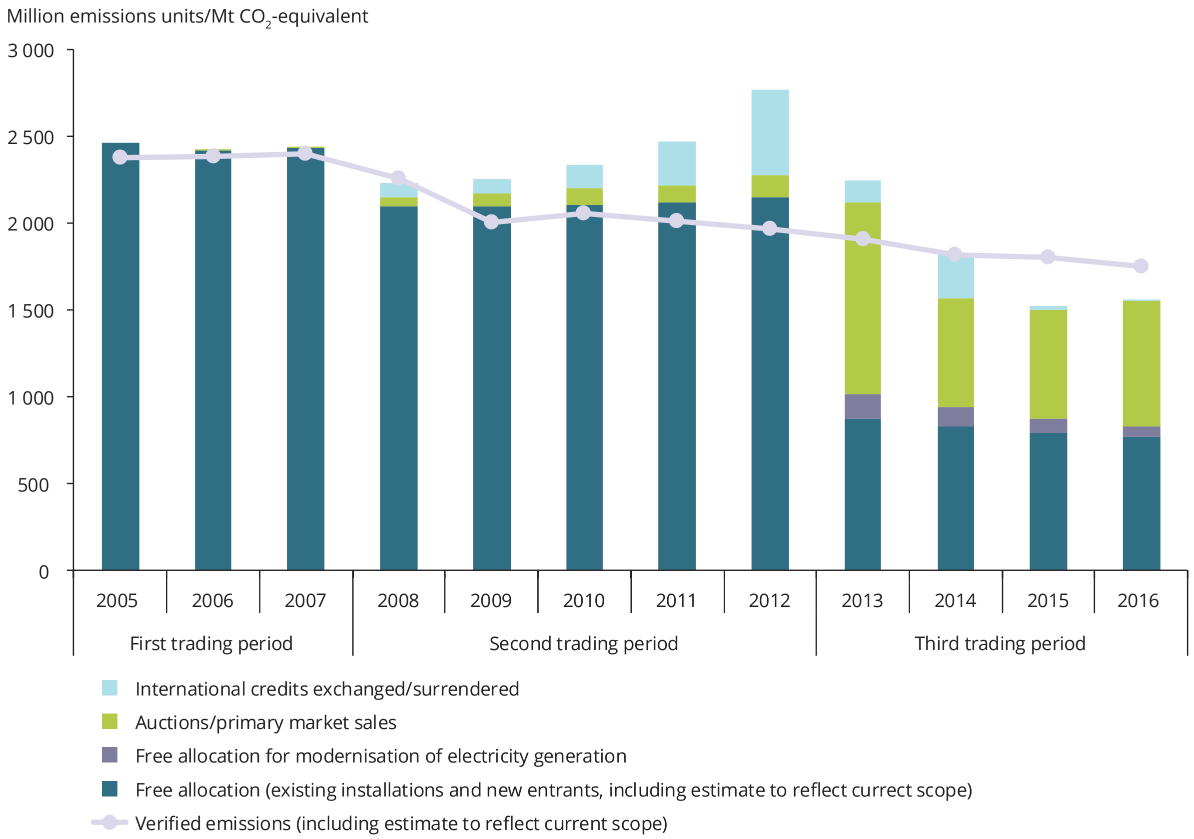
Following the setting of more stringent caps for the second trading period, verified emissions exceeded the supply of allowances in 2008, resulting in an EUA price of around EUR 20 per EUA. After 2008, activities covered by the EU ETS were greatly affected by the economic recession, with the result that the supply of allowances exceeded verified emissions between 2009 and 2012. Coupled with a fixed supply of allowances (set by the EU ETS cap), this put downward pressure on the EUA price (which was reduced to around EUR 7 per EUA) by the end of the second trading period. The surplus was further exacerbated by the increased use of CERs and ERUs (especially between 2010 and 2012). The increased use of these emission credits was because many of them would no longer be eligible under the EU ETS in the third trading period. As a consequence of this ruling, international credits were being traded at less than EUR 1 per unit by the end of the second trading period.

By the start of the third trading period, the cumulative surplus stood at around 2 billion allowances. The backloading of allowances between 2014 and 2016 (a postponement in the overall quantity of allowances to be auctioned in a certain year) had an impact on the supply and demand balance, reducing the overall surplus in both 2015 and 2016. In addition, the sharp reduction in the use of international credits also contributed to further reducing the supply of allowances, as, from 2015 onwards, emission reductions from the first commitment period of the Kyoto Protocol (2008-2012) can no longer be used for compliance. The EUA price increased in 2015 (a trend which had already begun in 2014), however there was a sudden drop at the beginning of 2016.

([27]) Notable differences in verified emissions are observed in the chemicals industry and the production of other metals (including aluminum), where the scope of the EU ETS increased considerably between the second and third trading periods. For both activities, the EU ETS now covers non-CO_2 gases along with CO_2 emissions: nitrous oxide (N_2O) emissions from the production of nitric acid, and adipic acid and glyoxylic acid production, as well as perfluorocarbon (PFC) emissions from the production of aluminium.

([28]) Refer to the discussion in Chapter 1 on excess capacity in the iron and steel sector, and its impact on activity rates and emissions.

Figure 2.4 Supply and demand balance for stationary installations (2005-2016)



Notes: In the years 2005-2012, both verified emissions and free allocation (existing installations and new entrants) include an estimate to reflect the current scope of the EU ETS. As this addition is applied to both the supply of and demand for allowances, it does not affect the supply-demand balance. The supply of allowances presented takes into account a redistribution by the EEA of annual volumes of allowances auctioned/sold on the primary market, from the year when they were released to the market to the years from which they arose. This affects, for example, volumes auctioned by Croatia in 2015 which were attributed to the years 2013 to 2015. Carry over auctions in 2017 due to an unsuccessful UK EUA auction in 2016 were also attributed to auctioned allowances in 2016. However, delayed EUA auctions in 2016 in Poland had not yet fully entered the market in 2017 (at the time of writing) and have therefore not been attributed to auctioned allowances in 2016 ([29]). NER300 sales were attributed to the allowances auctioned in 2013 and 2014.

Allowances from the auctioning budget that were backloaded are not shown in the graph. The use of international credits refers only to the estimate for stationary installations. The net demand from aviation operators for EUAs is not included in the above graph but equates to an additional cumulative demand for EUAs of 65 Mt between 2012 and 2016.

Source: EEA, 2017.

([29]) One Polish auction of allowances (on 25 May 2016) was cancelled due to the lack of a minimum price, while the transfer of Polish auctions planned for the second half of 2016 to 2017 resulted from the need to sign a new agreement on the sale of allowances. In total, 14 987 000 allowances not sold at auctions in 2016 will be included in sales by Poland in 2017.

Figure 2.5 Price trends for European Union Allowances and certified emission reductions

Note: The EUA price represents historical spot price data from the secondary market in the first and second trading periods. In the third trading period, the EUA price refers to auctioning data from the EEX and ICE trading platforms. The CER price up until the middle of 2014 is based on historical spot price data from Point Carbon. The more recent data up until the end of 2015 are based on future CER prices from the ICE trading platform. The break in the EUA price between 2007 and 2008 reflects the lack of banking provisions between the first and second trading periods. However, trade in future EUA contracts did take place during this period at a higher level.

Sources: Point Carbon, 2012; EEX, 2017; ICE, 2017.

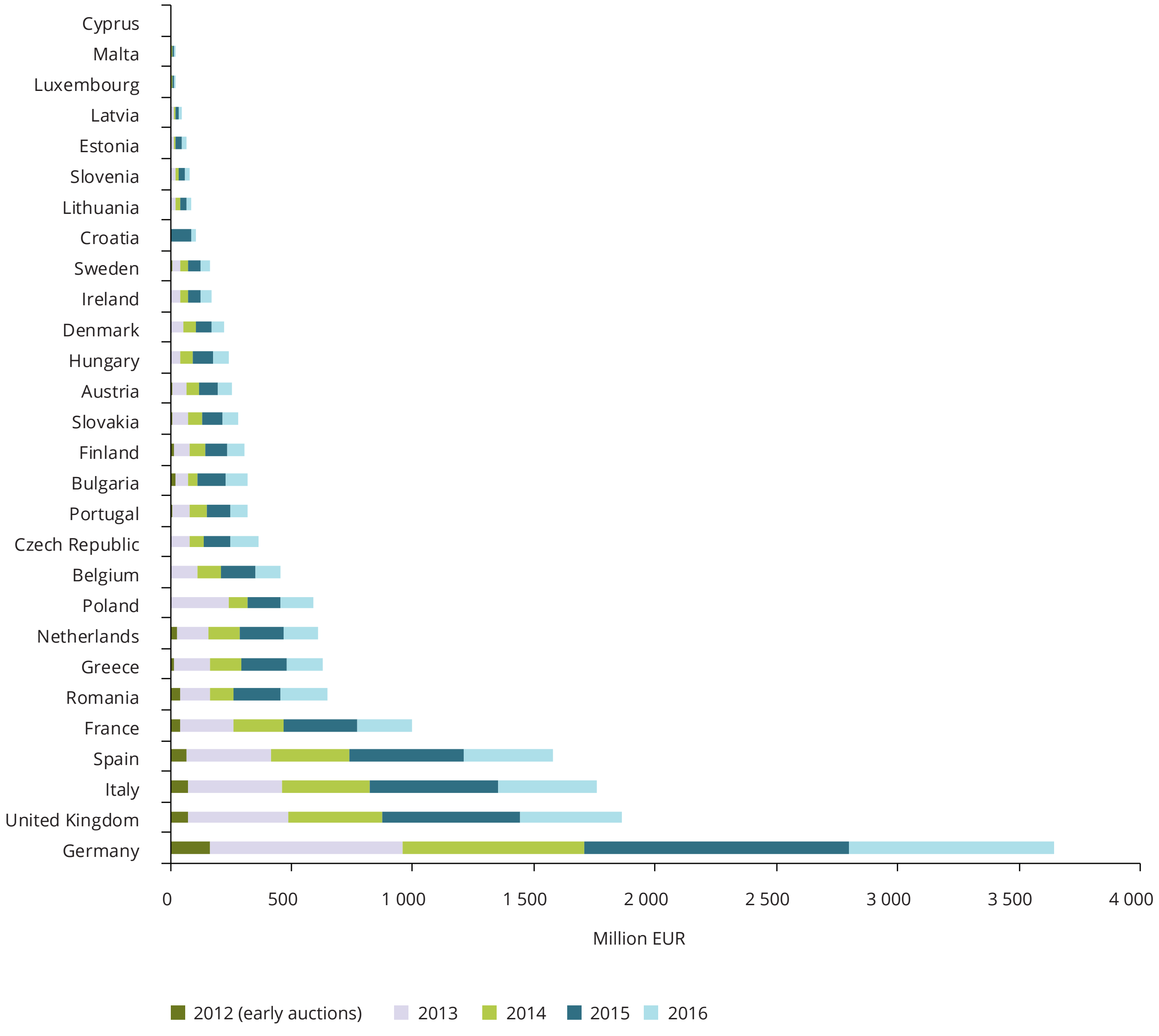
2.1.3 Auctioned allowances and auctioning revenues

Around 3 billion allowances have been auctioned or sold by EU ETS countries (including NER300) in the third trading period. The country auctioning the highest number of allowances between 2013 and 2016 was Germany (638 million allowances), followed by the United Kingdom (332 million allowances), Italy (307 million allowances) and Spain (275 million allowances). In terms of gross auction budgets, Poland has the second largest share after Germany. However, Poland is one of the Member States that make use of the temporary derogation from auctioning under Article 10(c) of the ETS Directive, which allows them to give a number of free allowances from their gross auction budget to existing power plants. A total of 88 % of the gross auction budget is distributed based on historical emissions. Thus, high gross auction shares primarily reflect the fact that these countries have high historical verified emissions and are therefore entitled to a greater share of the auctioning rights. Ten per cent of the auctioning quantities are distributed based on solidarity and growth, mainly to Member States with a gross domestic product (GDP) lower than the EU average (see Annex II(a) of the ETS Directive, which lists 19 Member States that benefit from an increased auction share).

The level of auction revenue depends on many factors, including the number of allowances to be auctioned and the timing of auctions. In total, Germany has received the highest revenue from EUAs

(EUR 3.5 billion) in the third trading period, followed by the United Kingdom (EUR 1.8 billion) and Italy (EUR 1.7 billion) (Figure 2.6). These three Member States collectively account for just under half of the total EUA revenue generated so far in the third trading period (including early auctions in 2012). The impact of the backloading decision was particularly noticeable in 2014, with reduced auctioning revenues in the EU ETS countries resulting from both lower volumes and lower EUA prices relative to both 2015 and 2016. The auctioning of unused Article 10(c) allowances contributed to an increase in revenues for several eastern European countries (Bulgaria and Romania) in 2015 and 2016. Overall, the total revenue from EUAs in 2016 was slightly lower than in the previous year. While more allowances were available for auction (refer to Table A1.3 in Annex 1), the average EUA price was lower in 2016, which reduced total EUA revenues.

Figure 2.6 European Union Allowances (EUAs) auction revenues, by Member State, in the third trading period



Note: 2012 (early auctions) refers to amounts that pertain to the year 2013, but were already auctioned a year earlier.

Sources: EEX, 2017; ICE, 2017.

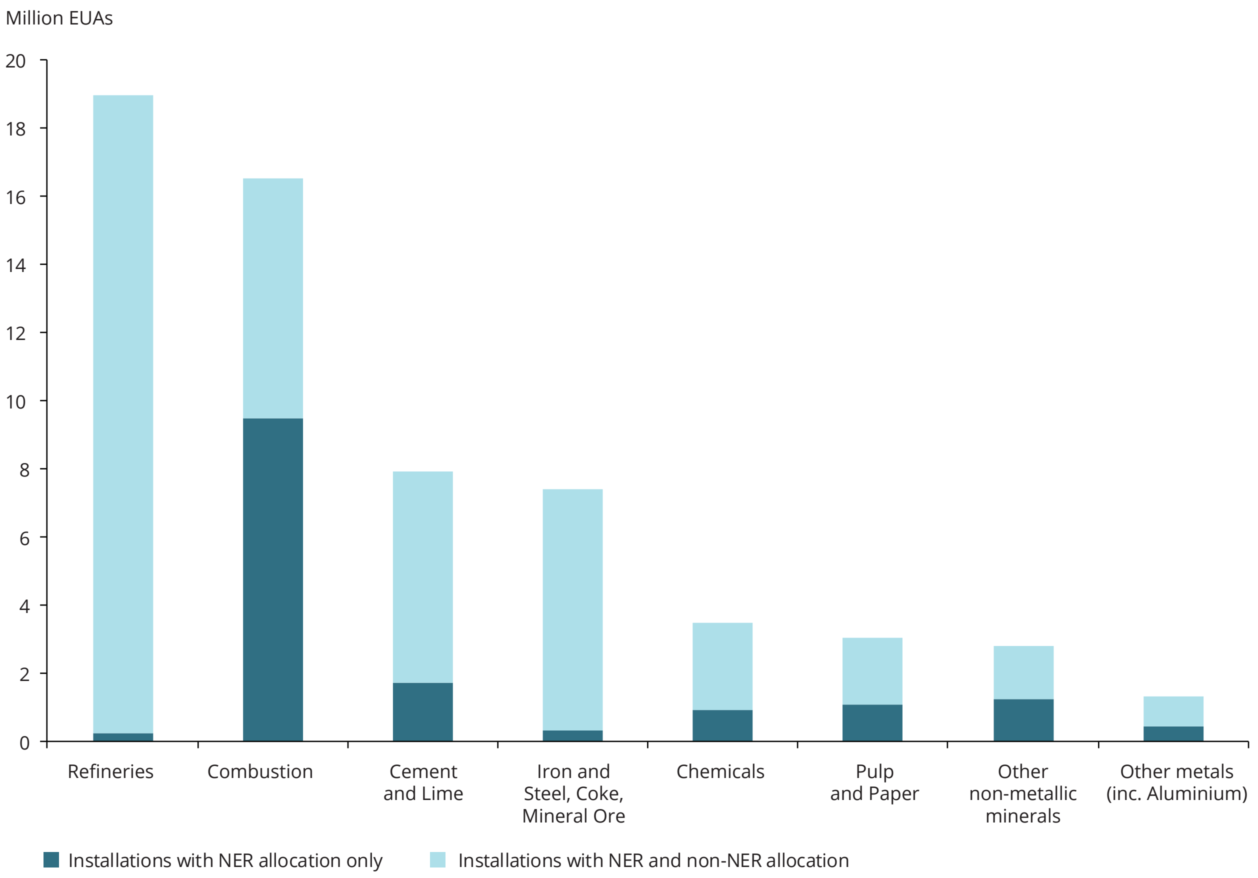
2.1.4 *Free allocation to new entrants and for capacity extensions*

To achieve a level playing field between new entrants and incumbents within Europe, a reserve of 480 million ([30]) EUAs (i.e. the NER) was set aside at the start of the third trading period for new installations ([31]) and existing installations achieving a 'significant' increase in capacity ([32]).

In the combustion sector, most NER allowances are actually used for new entrants, while for other industrial activities (excluding combustion), NER allowances are instead used for capacity extensions (Figure 2.7).

The refinery sector received most of the allowances from the NER between 2013 and 2016, with the number of allowances increasing again in 2016, albeit at a slower rate than in the previous year (Figure 2.8). The majority of these NER allowances have been allocated to refineries in Spain, Greece and Portugal (Figure 2.9). The high proportion of allowances primarily allocated to capacity extensions reflects the conversion or

Figure 2.7 New Entrants Reserve allocation (2013-2016) by sector and by eligibility type

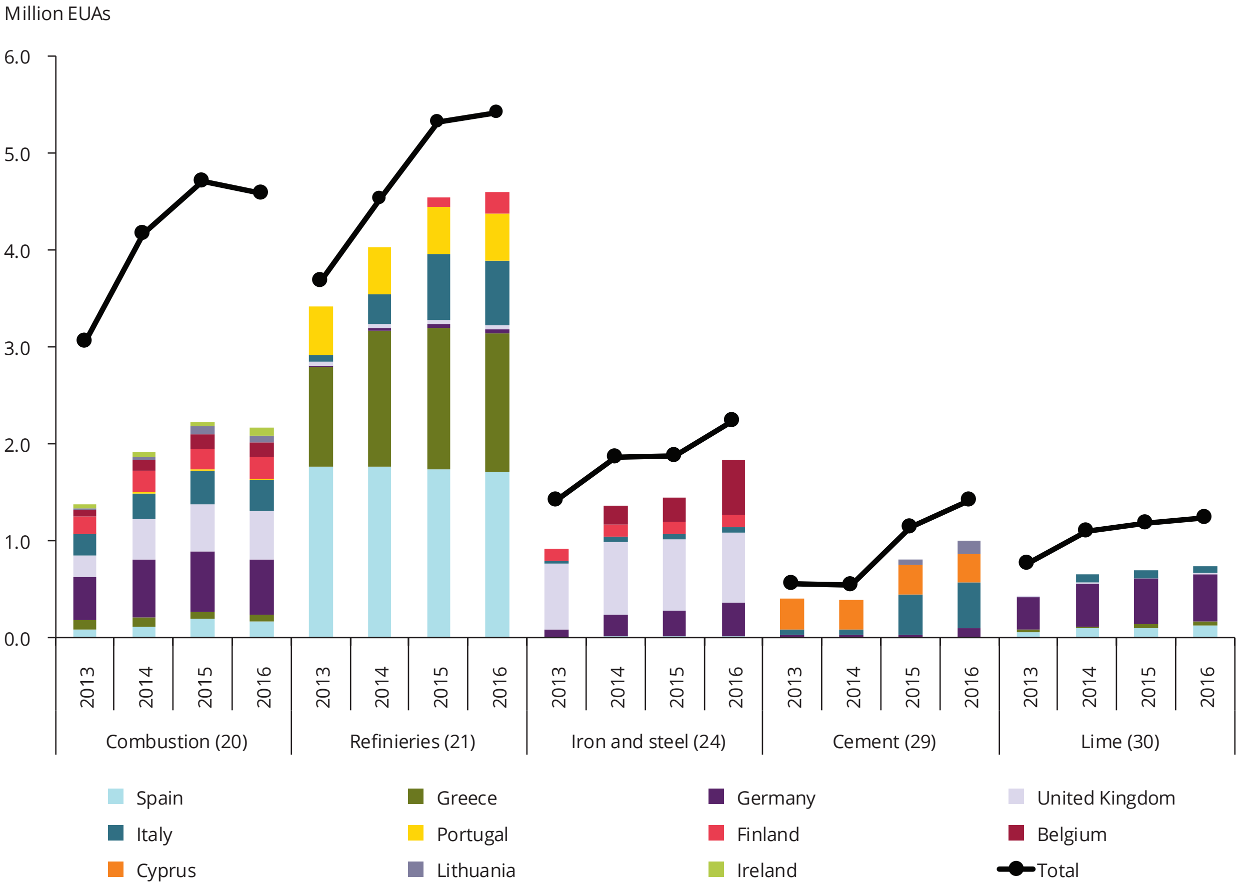


Note: EUA, European Union Allowance.

Source: EU, 2017; authors' calculation.

([30]) Original amount was 780 million from which 300 million allowances were deducted for NER300. The aim of the NER300 funding programme is to establish a demonstration programme comprising the best possible CCS and RES projects and involving all Member States.
([31]) i.e. obtaining a permit for the first time after 30 June 2011 or any installation carrying out an activity included in the EU ETS for the first time.
([32]) Significant capacity extension means a significant increase in a sub-installation's initial installed capacity of at least 10 %, resulting in a significantly higher activity level (EC, 2011).

Figure 2.8 **Annual New Entrants Reserve allocation between 2013 and 2016 by activity for the top 5 and selected additional countries**



Note: EUA, European Union Allowance.

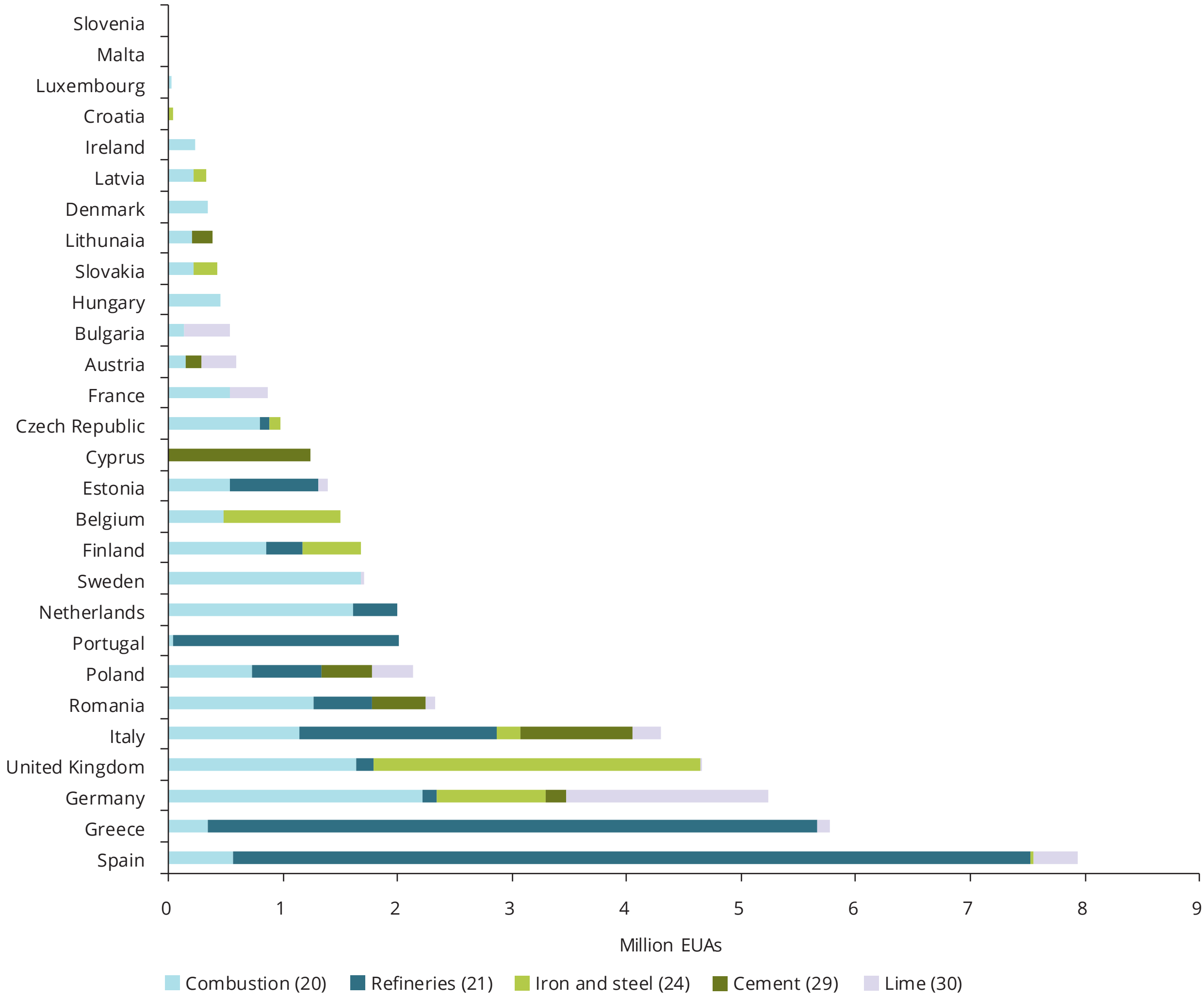
Source: EU, 2017; authors' calculation.

upgrading of existing refineries, especially to produce more diesel ([33]). Investment projects in refineries often do not increase the distillation capacity. Refineries are becoming more complex to run heavier crude and generate more diesel and less fuel oil (Green and Martin, 2015). For example, the Porvoo refinery plant ([34]) in Finland experienced a large increase in NER usage in 2016 (more than double the previous year) as work to modernise the plant continues (EU, 2017).

Combustion installations received the second highest number of allowances from the NER between 2013 and 2016. However, the number of NER allowances allocated for combustion installations in 2016 were down by 3 % compared with the previous year. While combustion installations in the majority of Member States received fewer allowances from the NER for new entrants in 2016, Ireland and Finland were the main exceptions. For example, the recent opening of the Belview plant operated by Glanbia Ingredients Ireland ([35]) almost doubled Ireland's NER allocation for new entrants in 2016 compared with the previous year. In Finland, Imatran Lämpö Oy's district heating network was installed at Virasoja (with a capacity of

([33]) https://www.repsol.energy/imagenes/global/en/Cartagena_en_tcm14-15176.pdf
([34]) The Porvoo plant is the only Finnish refinery to receive NER allowances (EU, 2017).
([35]) https://www.glanbiaconnect.com/news/belview-plant-officially-opens

Figure 2.9 Cumulative New Entrants Reserve allocation (third trading period) by sector and by country



Note: The activities and countries included in the above graph account for 80 % of the total NER allocation between 2013 and 2016.

Source: EU, 2017; authors' calculation.

30 MW), making it eligible for allowances from the NER in 2016 ([36]) and increasing NER usage for Finland's combustion installations.

In the iron and steel sector, allocated amounts from the NER increased by 19 % in 2016 compared with the previous year. However, the number of NER allowances received by iron and steel installations in Belgium in 2016 was considerably higher than this average. For example, the usage of NER allowances at the ArcelorMittal plant in Gent increased tenfold between 2015 and 2016 (EU, 2017). This follows high-profile investments such as the new walking beam furnace unveiled in April 2016 ([37]). In contrast, there was a slight reduction in the number of NER allowances received by the Port Talbot plant in 2016, which accounts for all of the NER allowances that have so far been received by iron and steel installations in the United Kingdom (EU, 2017).

The majority of the NER allowances given to the cement sector have been allocated to plants in either Italy or Cyprus (Figure 2.8). In 2016, NER usage increased by 25 % compared with the previous year. This increase was primarily driven by capacity growth in cement plants based in Germany and Lithuania. For example,

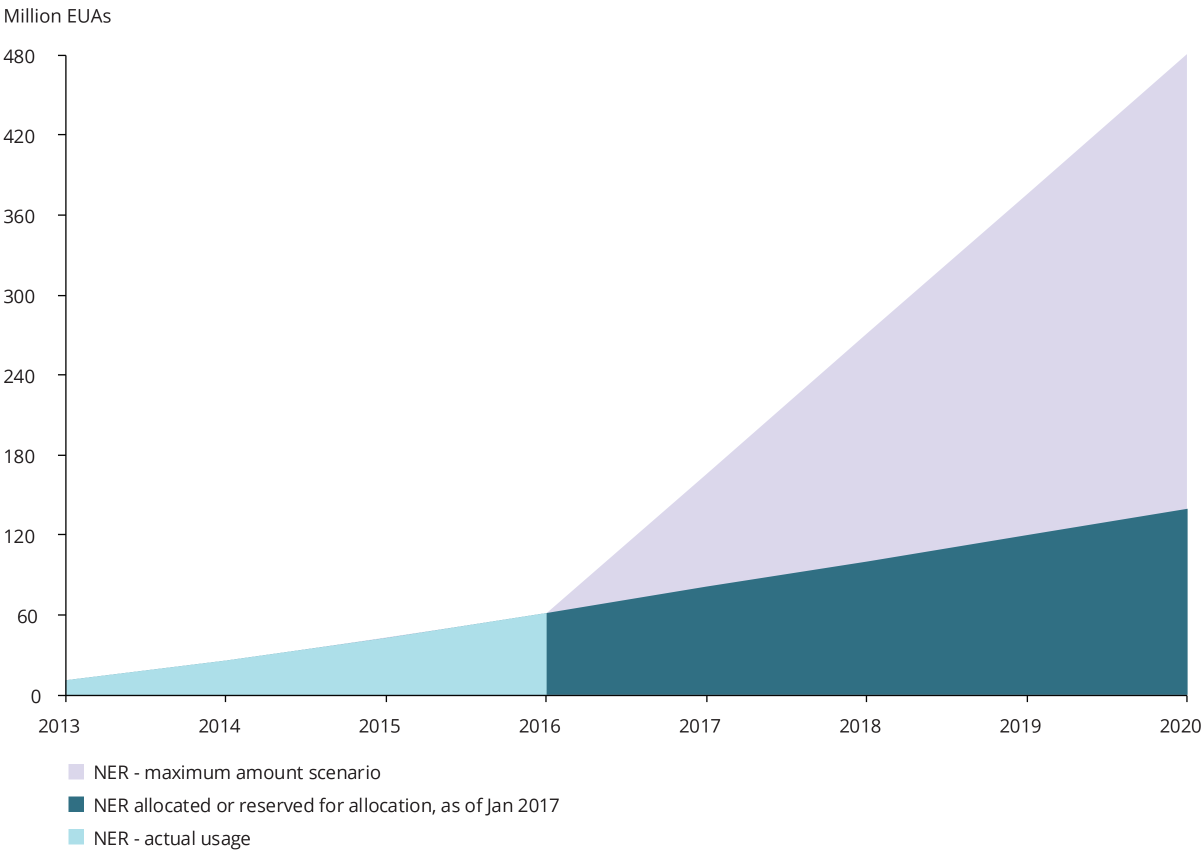
([36]) http://www.imatranlampo.fi/?/bio-lampokeskus/
([37]) http://corporate.arcelormittal.com/news-and-media/news/2016/april/21-04-2016b

the conversion and modernisation of the Heidelberg Cement plant in Lengfurt was completed at the start of 2016 (Heidelberg Cement, 2017). The plant subsequently received allowances from the NER for the first time in 2016 (EU, 2017). The capacity of the Naujoji Akmene plant in Lithuania increased from 1.07 Mt in 2013 (USGS, 2017) to 1.8 Mt in 2016 (CEMEX, 2017) following the modernisation of the plant. In fact, the plant received over twice as many NER allowances in 2016 as in 2015 (EU, 2017).

In the lime sector, allocation from the NER increased by 5 % in 2016 compared with 2015. This increase was primarily driven by capacity growth in lime plants in Spain and Germany (Figure 2.8). Overall, lime installations in Spain increased their NER usage by 26 % in 2016, compared with the previous year. This was primarily due to a nearly four-fold increase in NER allocation at the Bueras plant site (EU, 2017), which is operated by Dolomitas del Norte. Indeed, 'Dolomitas del Norte has modernised and concentrated its activity in the Bueras plant, managing to increase its production capacity and to develop new refractory products, becoming one of the main sintered dolomite producers in Europe' ([38]). While the majority of lime installations in Germany remained relatively stable, the Steeden plant operated by Schaefer Kalk more than doubled its NER usage between 2015 and 2016 (EU, 2017).

Only a limited share of the allowances available in the NER for the third trading period 2013-2020 has been allocated so far (Figure 2.10). Only 29 % of the allowances in the NER were either used or reserved for future use as of July 2017 (EC, 2017a), which corresponds to the mid-point of the trading period. In absolute terms, 340.3 million EUAs remain available from the NER until 2020 (EC, 2017a). These unallocated allowances are set to be absorbed by the MSR.

Figure 2.10 Extrapolation of the cumulative use of the New Entrants Reserve budget



Note: The maximum amount scenario is calculated by taking the remaining budget between 2016 and 2020 and distributing this evenly over the remaining years of the period up to 2020, to show how much of the NER is still available.

Sources: EC, 2017a; EU, 2017; authors' calculation.

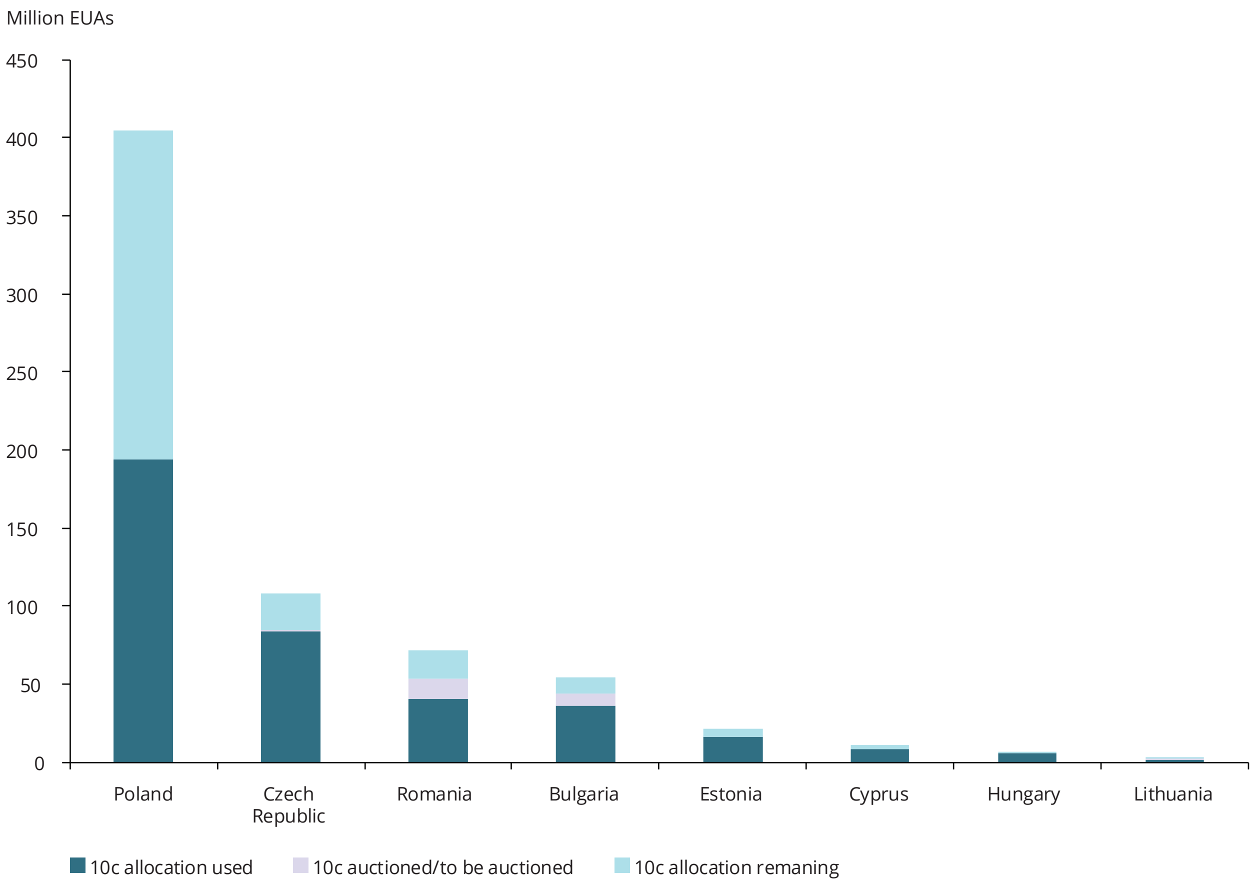
([38]) http://www.calcinor.com/en/calcinor/calcinor-companies/dolomitas-del-norte/

2.1.5 *Transitional free allocation to modernise electricity generation*

The free allocation of up to 680 million allowances under Article 10(c) is contingent upon the value of these allowances being invested in efforts to modernise the electricity generation of the eligible Member States and diversify its fuel mix. Over half of the maximum budget (60 %) for Article 10(c) allowances was used between 2013 and 2016 (Figure 2.11). Poland has the largest number of allowances that have not yet been used (52 % of its maximum Article 10(c) allocation). These could either be used by the power sector in future years (provided that a sufficient number of investments included in the National Investment Plan for Article 10(c) allocation are realised) or auctioned before the end of the third trading period. The allowances that are not given out for free under Article 10(c) must be auctioned by Member States, for example if operators do not make the required investments or if the installations that were to receive the free allocation have closed. This has occurred in Bulgaria and Romania, where unallocated Article 10(c) allowances led to increased auctioning volumes in 2015, 2016 and 2017.

The magnitude of the environmental benefits of the Article 10(c) allocation ultimately depends on the nature of the investments made by each Member State to modernise its electricity generation. Investments undertaken from June 2009 onwards in the national plans of the eight Member States were reported towards their Article 10(c) allocation (EC, 2017e). The total value of reported investment between 2009 and 2015 was around EUR 9.5 billion, with approximately 80 % of the investments dedicated to the upgrading and retrofitting of infrastructure (EC, 2017e). The remaining investments supported clean technologies or the diversification of supply. Examples of the investments cited by the European Commission (EC, 2017e) that have taken place include:

Figure 2.11 Use of Article 10(c) allowances between 2013 and 2016, by Member State



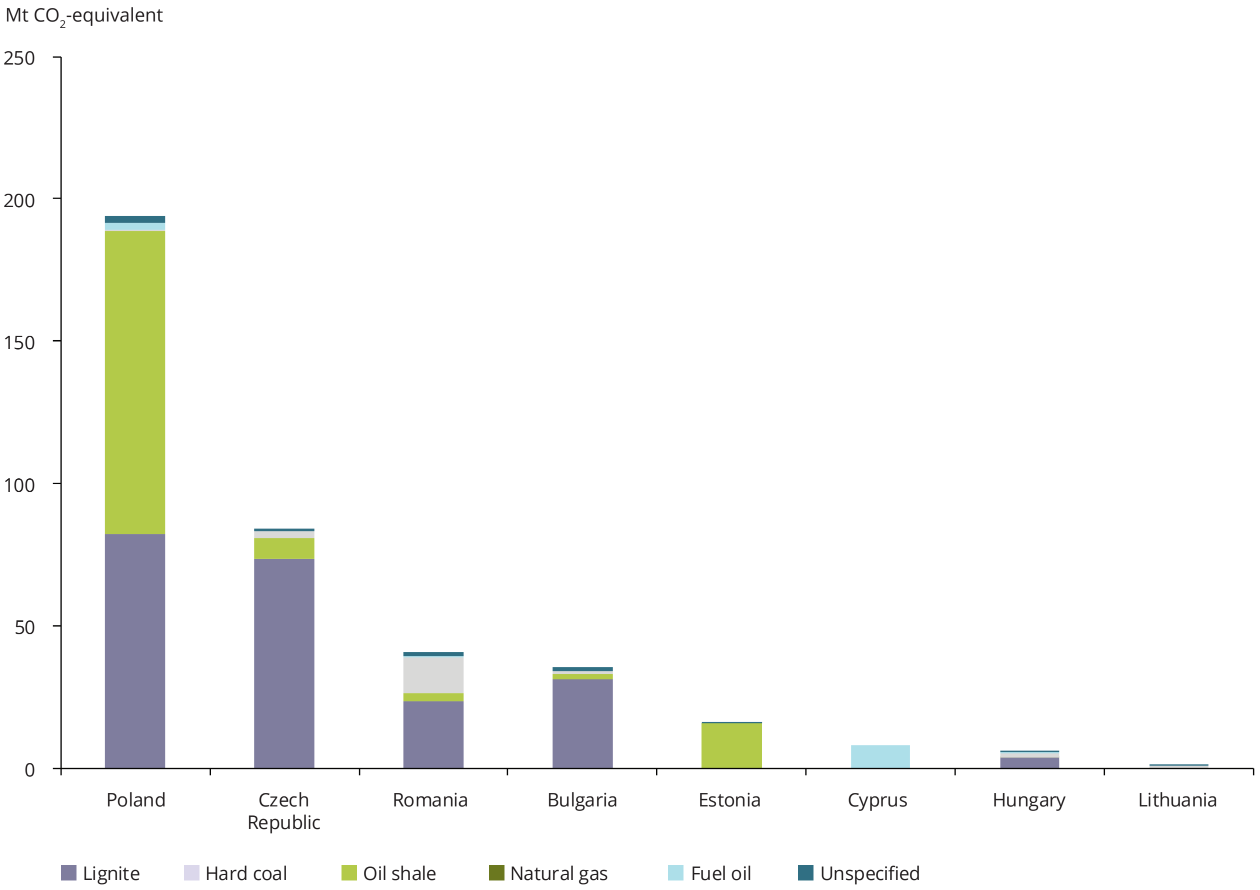
Note: Includes Article 10(c) amounts to be auctioned in 2017.

Sources: EU, 2012a, 2012b, 2012c,,2012d, 2012e, 2012f, 2012g, 2012h; EU, 2017.

- a new cogeneration-condensing steam turbine in Estonia (upgrade of infrastructure);
- rehabilitation of district heating networks in Bulgaria (retrofitting of infrastructure);
- substitution of coal by renewable energy sources through waste utilisation in the Czech Republic (clean technologies); and
- the construction of an interconnector pipeline for natural gas in Hungary (diversification of supply).

Despite these examples of low-carbon investments, it is likely that the majority of the investments completed so far under Article 10(c) have not contributed to diversifying the energy mix away from fossil fuels (Carbon Market Watch, 2016). To date, the majority of Article 10(c) allowances have been distributed to lignite-fired and hard coal-powered plants, mainly in Bulgaria, the Czech Republic, Poland and Romania. In fact, 55 % and 31 % of the Article 10(c) allowance allocation has been issued to lignite and hard coal plants respectively between 2013 and 2016 (Figure 2.12). Indeed, modernising the existing fossil fuel capacity accounted for 82 % of the total investments outlined in the Polish national plans under Article 10(c), with allowances used to extend the lifetime of two of the oldest units (i.e. Units 1 and 2) at the Bełchatów lignite plant in Poland (Carbon Market Watch, 2016).

Figure 2.12 Free allocation for the modernisation of electricity generation, differentiated by fuel type of the receiving power plant and Member State, 2013-2016



Notes: Allowances are only issued to eligible EU ETS installations, i.e. these are existing EU ETS installations operational before a specified date. Thus, they are by definition existing electricity generators with a capacity of >20 MW thermal. This is the case even when an investment relates to e.g. renewable energy. One should, therefore, differentiate between the investments and the installations that receive the free allocation based on the value of those investment costs.

Attribution of free allowances to fuel type by Oeko-Institut.

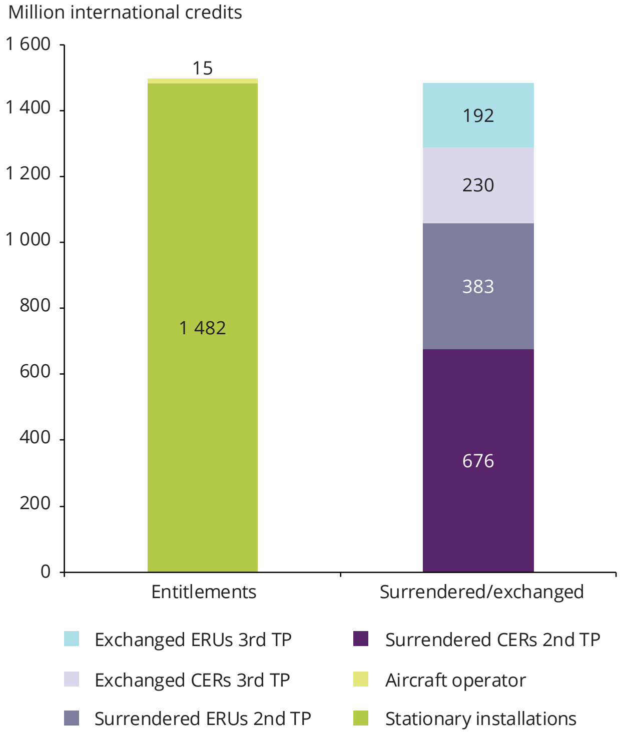
Sources: EU, 2012a, 2012b, 2012c, 2012d, 2012e, 2012f, 2012g, 2012h; Platts, 2014; EU, 2017.

2.1.6 Use of international credits for compliance

The estimated budget for international credits between 2008 and 2020 compared with the units either surrendered or exchanged during the second and third trading periods is shown in Figure 2.13. Operators under the EU ETS are allowed to use international emission credits to comply with part of their legal obligation to surrender allowances equivalent to their verified emissions ([39]). International credits from the Clean Development Mechanism (CDM) and Joint Implementation (JI) projects can be used with certain qualitative restrictions ([40]). Since April 2015, emission reductions that occurred in the first commitment period of the Kyoto Protocol (2008-2012) can no longer be exchanged (EC, 2017g). Based upon the latest information on the CERs and ERUs exchanged, it is estimated that only 1 % of international credit entitlements remained at the end of 2016.

In the third trading period, 55 % of the exchanged international credits originated from CDM projects (outside the EU) and 45 % from JI projects (Figure 2.14). However, the type of projects generating credits differed significantly. Approximately one third of all international credits originate from projects related to renewable electricity generation, of which 90 % are based in China. In contrast, renewables played only a limited role in the JI project portfolio. The second largest project type is the dismantling of coal piles in Ukraine, which took place only under JI. The use of international credits has been under discussion due to concerns with levels of environmental integrity associated with some offsets and their contribution to the current surplus of allowances in the EU ETS. The European Council has decided, after 2020, on a domestic emission reduction target, meaning that the use of international credits in the next trading period of the EU ETS is not anticipated (EC, 2017e).

Figure 2.13 Allowed and existing use of international credits (2008-2020)



Notes: International credit entitlements from EUTL.

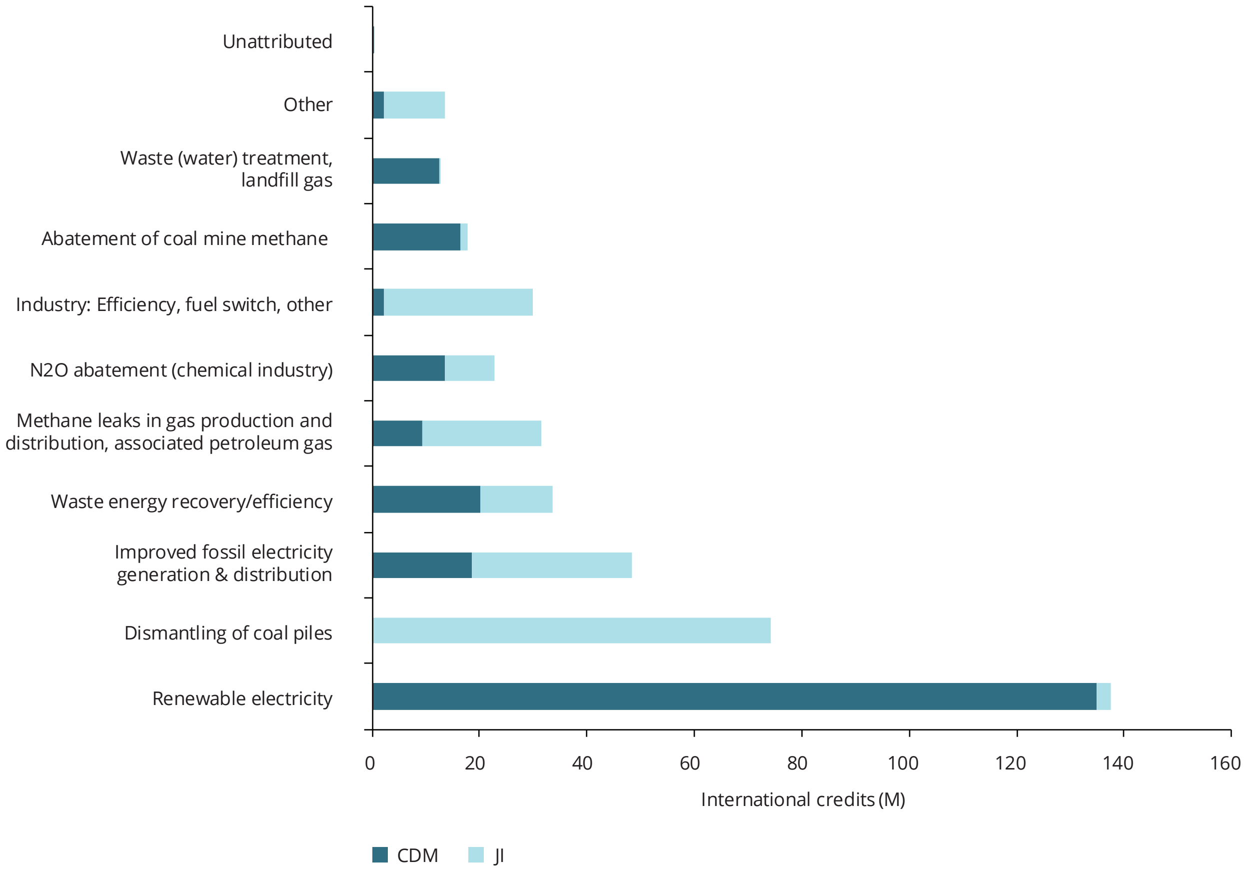
CER, certified emission reduction; ERU, emission reduction unit; TP, trading period.

Sources: EC, 2017g; EEA, 2017.

([39]) These credits stem from flexible mechanisms set under the Kyoto Protocol: the Clean Development Mechanism (CDM) and Joint Implementation (JI). The international credits corresponding to these flexible mechanisms are CERs in the CDM and ERUs in JI. Overall use of credits is limited to 50 % of the community-wide reductions below 2005 levels of the existing sectors over the 2008-2020 period. Additional limits are also set for new sectors and aviation.

([40]) Excluded from the start of the scheme were nuclear energy projects and afforestation and reforestation projects; large hydroelectric projects (above 20 MW installed capacity) are accepted only under certain restrictions. Projects involving the destruction of industrial gases (HFC-23 and N_2O) in advanced developing countries (especially China) were the main project type surrendered by operators in the second trading period; since April 2013 they have been barred from use for compliance because of environmental concerns (EU, 2011).

Figure 2.14 Certified emission reductions and emission reduction units exchanged for allowances in the third trading period up to 30 April 2017 by project type



Notes: The total number of international credits shown in the graph above equates to 422.4 million over the third trading period up until 30 April 2017.

Attribution of exchanged international credits to project types by Oeko-Institut.

CDM, Clean Development Mechanism; JI, Joint Implementation.

Sources: UNFCCC, 2014, 2016a, 2016b, 2016c; EC, 2017g.

2.2 Aviation

2.2.1 Emission trends

Status in 2016

During the third trading period, Ryanair has been consistently responsible for the largest verified emissions from an individual aircraft operator (Table 2.1). However, Wizz Air has actually experienced the fastest rate of growth in emissions (68 %) over this period. Lower growth in emissions has been experienced by some of the more established airlines during the third trading period, with airline operators such as British Airways increasing their verified emissions by 5 %. Interestingly, some airline operators decreased their verified emissions between 2013 and 2016, while continuing to increase rates of activity. The increase in aviation emissions between 2005 and 2014 was less than the growth in passenger kilometres flown (EASA, 2016). Improvements in fuel efficiency were primarily due to the introduction of new aircraft, the removal of older aircraft and improvements in operational practice. However, projections indicate that future technology improvements are unlikely to balance the effect of future traffic growth (EASA, 2016).

Table 2.1 Top 14 emitters in aviation

	Verified emissions (Mt CO_2-equivalent)				
	2012	**2013**	**2014**	**2015**	**2016**
Total Aviation	**84.0**	**53.5**	**54.8**	**57.1**	**61.4**
Ryanair	7.5	6.6	6.6	7.4	8.4
EasyJet	4.6	4.3	4.4	4.7	5.1
Deutsche Lufthansa	4.9	4.4	4.0	3.8	3.8
British Airways	2.5	2.5	2.5	2.6	2.7
Scandinavian Airlines	3.6	2.3	2.4	2.4	2.4
Air France	3.8	2.6	2.4	2.4	2.3
Vueling Airlines	1.3	1.3	1.6	1.8	2.0
Wizz Air	1.1	1.1	1.3	1.5	1.8
Air Berlin	2.5	1.8	1.9	1.7	1.7
Koninklijke Luchtvaart Maatschappij N.V.	1.9	1.5	1.6	1.6	1.6
Alitalia Società Aerea Italiana S.p.A.	1.9	1.7	1.6	1.5	1.5
Norwegian Air Shuttle ASA	1.7	1.8	2.1	2.0	1.4
Germanwings GmbH	0.7	0.8	1.2	1.4	1.2
Transportes Aéreos Portugueses, S.A.	1.3	1.1	1.1	1.2	1.1

Note: For the period 2013 to 2016, only flights within the European Economic Area are covered under the EU ETS. Flights between the continental European Economic Area and its outermost regions are also exempt, e.g. flights between mainland Europe and the Canary Islands.

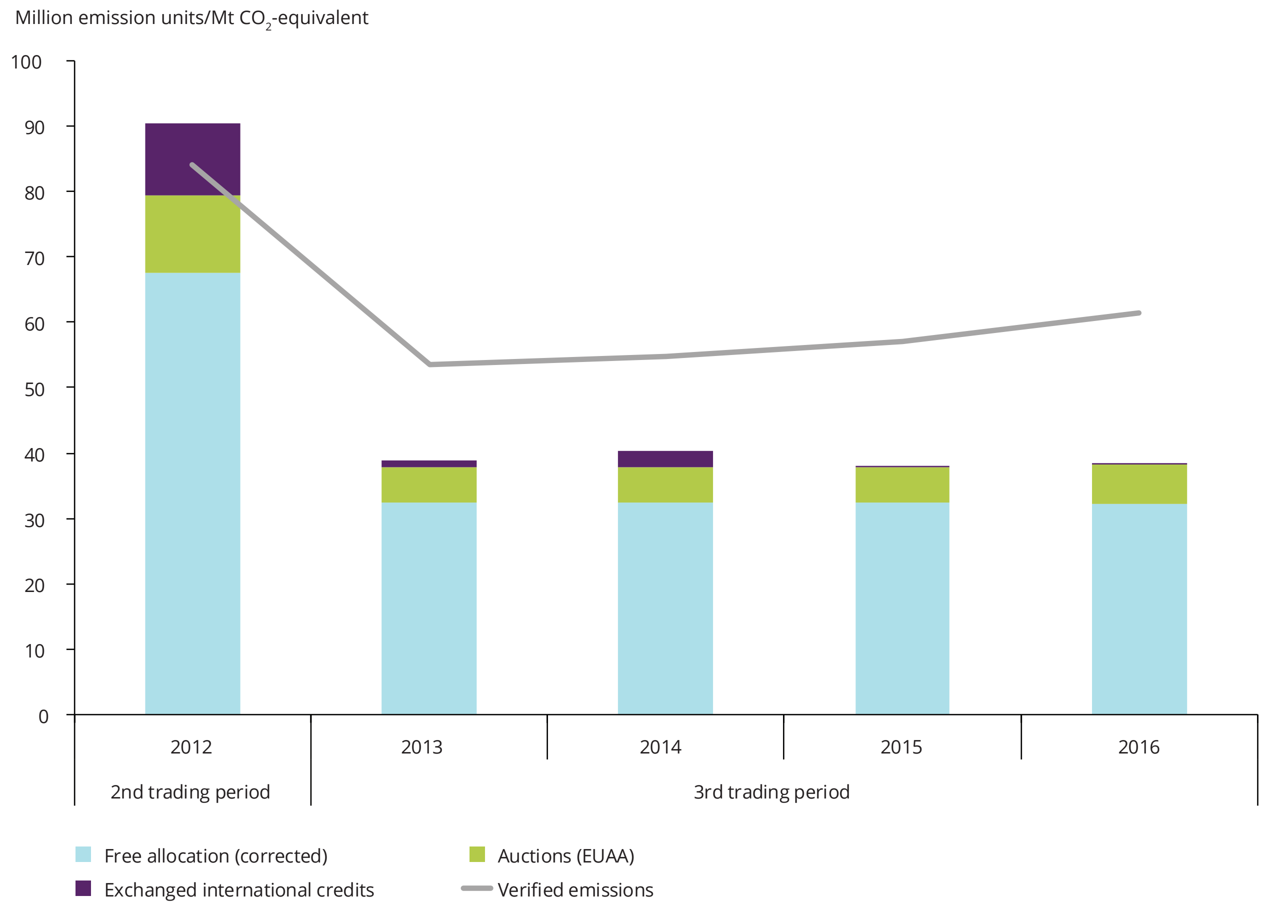
Source: EEA, 2017.

2.2.2 *Supply and demand for allowances and impact on the allowance price*

The difference in emissions between 2012 and 2013 was due to changes in the scope of aviation activities covered by the EU ETS ([41]). In the third trading period, verified emissions have surpassed the supply of allowances reserved for the aviation sector every year. The aviation sector is thus a net buyer of allowances from the stationary sector. The net demand for allowances increased further in 2016 as verified emissions rose in comparison with the previous year. As a result, the cumulative net demand from the aviation sector increased to 65 Mt by the end of 2016 (Figure 2.15).

The auctions of EUAAs occur less frequently than for EUAs due to the lower volume of allowances that are available for auction. As a consequence of the change in scope of aviation activities covered by the EU ETS, the auction calendar was revised, resulting in no EUAAs being auctioned in 2013. When the auctioning of EUAAs resumed in 2014, the price closely followed the EUA

Figure 2.15 Demand and supply balance for European Union Aviation Allowances (EUAAs) (2012-2016)



Notes: Auctions of aviation allowances were suspended after the 'stop the clock' decision taken in 2012. The allowances attributable to 2013, 2014 and 2015 were all auctioned in 2015. The volumes of aviation allowances effectively released to the market in 2015 were 16.4 million EUAAs. However, in order not to distort the supply-demand balance, the allowances were distributed evenly by the European Economic Area over the 2013-2015 period.

International credit use in the third trading period has been estimated. The overall use of the CER/ERU budget increased from 80 % in 2013 to 99 % in 2016.

Sources: EC, 2014c, EC, 2015c, 2016a, EC, 2017g; EEA, 2017.

([41]) For 2012, aircraft operators had the choice of fulfilling their EU ETS obligations for intra-European Economic Area flights only, or of the full scope (all flights on routes to, from or between European Economic Area airports). Some opted for full scope, which results in higher emissions and higher issuance of allowances. Switzerland was included in the scope of the aviation EU ETS in 2012 and was then excluded in 2013. The exemption threshold and the treatment of the outermost regions was also changed in 2013.

price, reaching a peak value of around EUR 8 per unit towards the end of 2015 (Figure 2.16). However, progress with the EUAA price then reversed in 2016, with lows of only EUR 4 per unit early in 2016, before recovering slightly to around EUR 5 per unit towards the end of the year.

Figure 2.16 Price trends for European Union Aviation Allowances (EUAAs) compared with European Union Allowances EUAs (2012-2016)

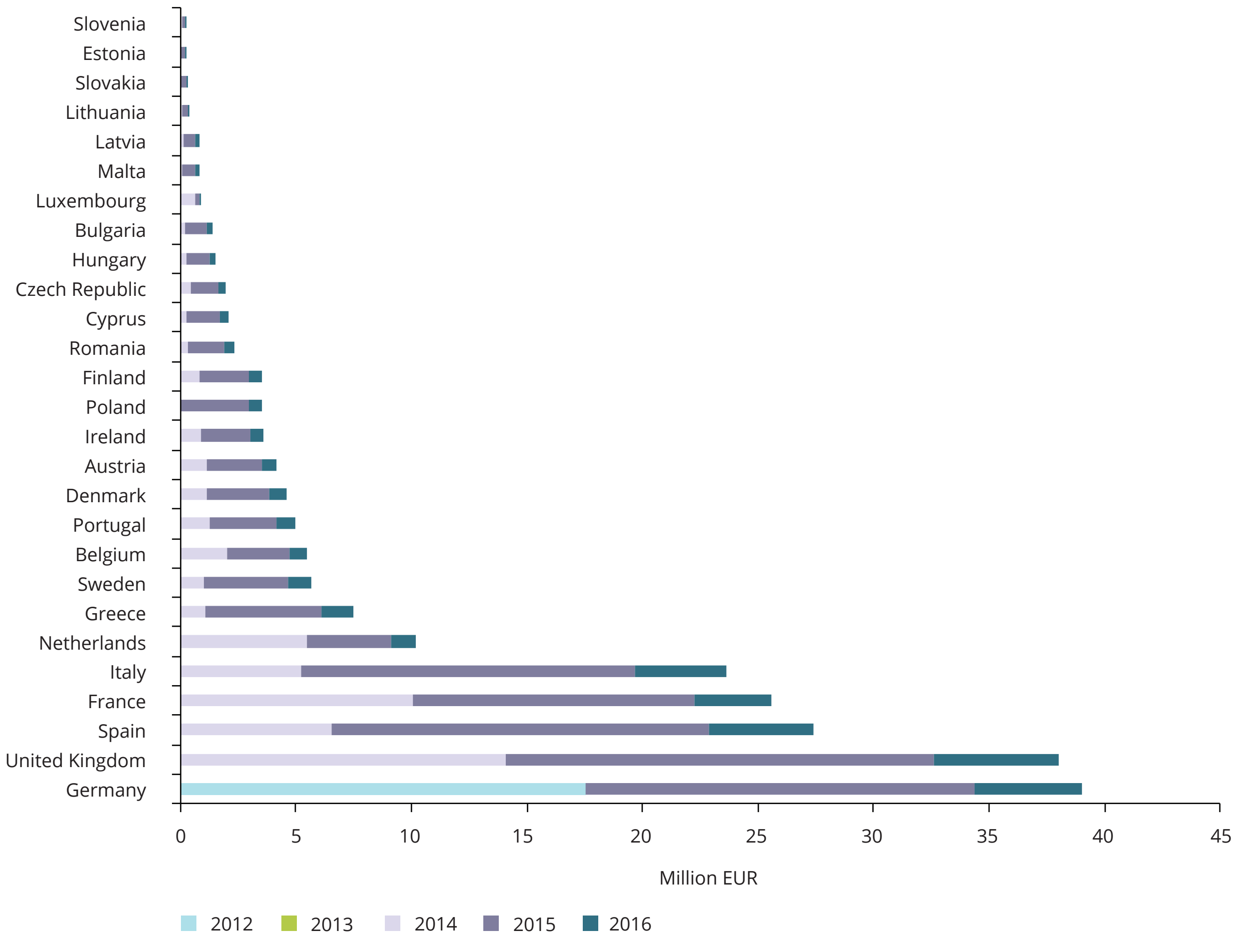
Note: The EUA price represents historical spot price data from the secondary market in 2012. In the third trading period, the EUA price refers to primary market auctioning data from the EEX and ICE trading platforms. This trend is compared with the shorter time series of EUAA prices from primary market sales at the EEX and ICE trading platforms.

Sources: Point Carbon, 2012; EEX, 2017; ICE, 2017.

2.2.3 *Auctioned allowances and auctioning revenues*

The United Kingdom auctioned the largest number of EUAAs between 2012 and 2016 (6.1 million), followed by Germany (5.6 million), Spain (4.2 million) and France (4.0 million). However, the level of auction revenue depends on a number of factors, including the number of allowances to be auctioned and the timing of auctions, which, among many other factors, also influence the auction price. Germany received the largest revenues from the auctioning of EUAAs over the period (EUR 39 million), followed by the United Kingdom (EUR 38 million). The revenues from Germany and the United Kingdom alone account for 35 % of the total revenue received by the Member States (Figure 2.17). Overall, the total revenue from EUAAs in 2016 was considerably lower than in the previous year. This is due to (1) the price of EUAs and correspondingly the price of EUAAs declining by 50 % over the course of 2016 and (2) the number of allowances auctioned being considerably less in 2016 than in the previous year. This reflects the fact that an unusually high number of allowances were auctioned in 2015 that included allowances from previous years, which were delayed as a result of the scope change to the aviation activities covered by the EU ETS (refer to Table A1.4 in Annex 1).

Figure 2.17 European Union Aviation Allowance (EUAA) auction revenues by Member State, 2012-2016



Note: The allowances auctioned in this graph refer to the actual amounts (not evenly distributed over the period 2013-2015) to account for delays to the auctioning calendar.

Sources: EEX, 2017; ICE, 2017.

3 Projected trends

- According to the projections reported by EU Member States in 2017 under EU legislation, EU ETS stationary emissions are projected to continue decreasing with the current policies and measures in place, by 8.8 % between 2015 and 2020, and by a further 6.2 % between 2020 and 2030.
- The projected average annual decrease of EU ETS stationary emissions between 2015 and 2030 is considerably slower than the decrease of EU ETS emissions observed between 2005 and 2015.
- In contrast, the emissions from aviation activities covered by the EU ETS are expected to continually increase until 2030. However, the future scope of aviation emissions in the EU ETS is uncertain following the recent resolution adopted by the Assembly of the International Civil Aviation Organization (ICAO) on the Carbon Offset Reduction Scheme for International Aviation (CORSIA).
- The latest projected emission levels are overall lower than those from previous submissions, although a number of Member States have reported increases in EU ETS emissions. For example, Denmark now expects its emissions to increase over the period 2020-2030 as a result of a change to the methodology of reflecting policies and measures in its projections. The Netherlands has also changed its projected emissions, now reporting an expected increase in emissions between 2020 and 2030, primarily due to an increase in the use of coal power.
- In October 2014, European leaders endorsed a binding EU target of at least 40 % domestic reduction in GHG emissions by 2030 compared with 1990, with a contribution from the EU ETS amounting to a 43 % reduction compared with 2005. This reduction should be achieved by changing the annual factor to reduce the cap from 1.74 % (third trading period) to 2.2 % from 2021 onwards, as proposed by the European Commission.
- Taking this additional factor into account, and using the projections available from Member States, the projected reductions would not be sufficient to achieve the 43 % reduction on 2005 levels expected from the EU ETS. Operators could still comply with their obligation to surrender allowances by making use of the remaining surplus of allowances stemming from earlier years.

This chapter discusses stationary installations and aviation separately, focusing first on the projected development of emission trends and second on the implications for the supply and demand of allowances. Given that aircraft operators can purchase allowances from stationary installations, there is a degree of interaction between stationary installations and aviation, which is discussed throughout the chapter.

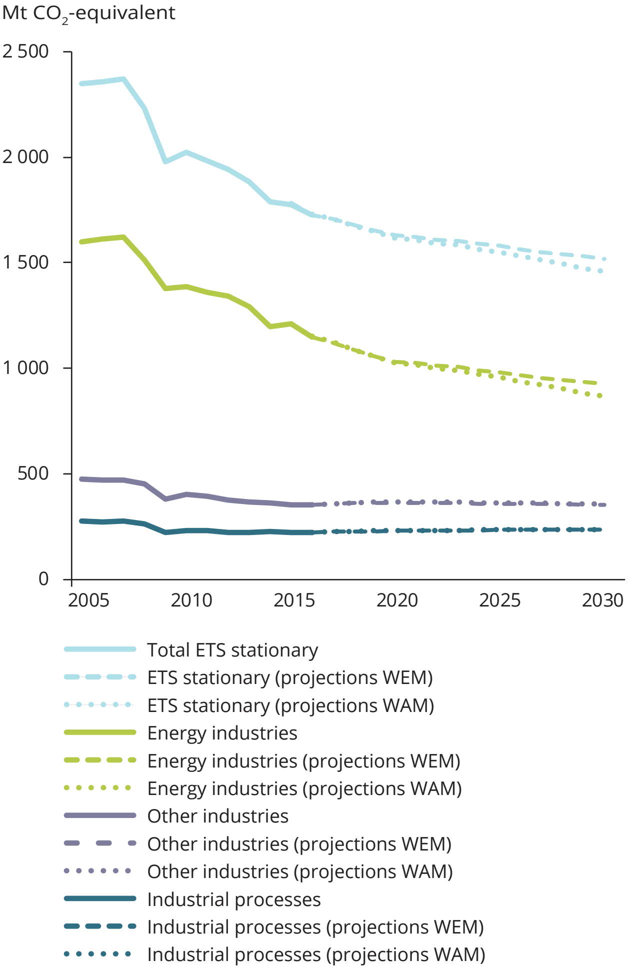
3.1 Stationary installations

3.1.1 Emission trends

According to the projections reported by EU Member States in 2017 under EU legislation ([42]), EU ETS emissions are projected to further decrease with the current policies and measures in place ([43]) (Figure 3.1). The decrease in EU ETS emissions is projected to take place predominantly in the energy sector ([44]), whereas

([42]) Article 14(1)(b) of Regulation (EU) No 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (EU, 2013).
([43]) The analysis is based on projections of EU ETS emissions in the 'with existing measures' (WEM) scenario, reported by Member States under the Monitoring Mechanism Regulation (MMR), following the structure and format provided by the Implementing Regulation (EU) No 749/2014 (EU, 2014b). The projections were compiled, assessed and quality checked by the EEA and its European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM).
([44]) Corresponding to GHG inventory source categories 1.A.1, 1.B and 1.C (Intergovernmental Panel on Climate Change (IPCC) nomenclature).

Figure 3.1 EU ETS projected emissions between 2005 and 2030, by inventory category



Notes: Solid lines represent historical greenhouse gas emissions up to 2015. Dashed lines represent projections 'with existing measures' (WEM). Dotted lines represent projections under the 'with additional measures' (WAM) scenario.

Projections on stationary ETS emissions only cover the EU, whereas the total reported is higher in other sections of this report due to the inclusion of Iceland, Liechtenstein and. Norway.

Sources: EEA, 2017; projections of EU Member States (see http://cdr.eionet.europa.eu/ online), compiled by the European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM) as of June 2017.

EU ETS emissions in other sectors are projected to remain stable until 2030. These projected trends contrast with historical trends, in which decreases were observed in a number of industrial sectors, such as manufacturing and construction, and industrial processes.

Emissions are expected to decline in 20 EU Member States between 2015 and 2030 under the 'with existing measures' (WEM) scenario, with reductions ranging from 0.4 % (Sweden) to 71 % (Malta), and to increase in eight EU Member States (Figure 3.2). Interestingly, emissions are expected to decrease more over the 5-year period from 2015 to 2020 ([45]) than over the 10-year period from 2020 to 2030 ([46]). The energy policy of the United Kingdom provides an explanation for this trend, as emissions are expected to reduce considerably between 2015 and 2020 as the gross electricity produced from coal declines ([47]). Projections between 2015 to 2020 show decreases in EU ETS emissions in 19 EU Member States, while 18 EU Member States also project emission reductions between 2020 and 2030. Lithuania is the only Member State to project increasing EU ETS emissions in both time periods.

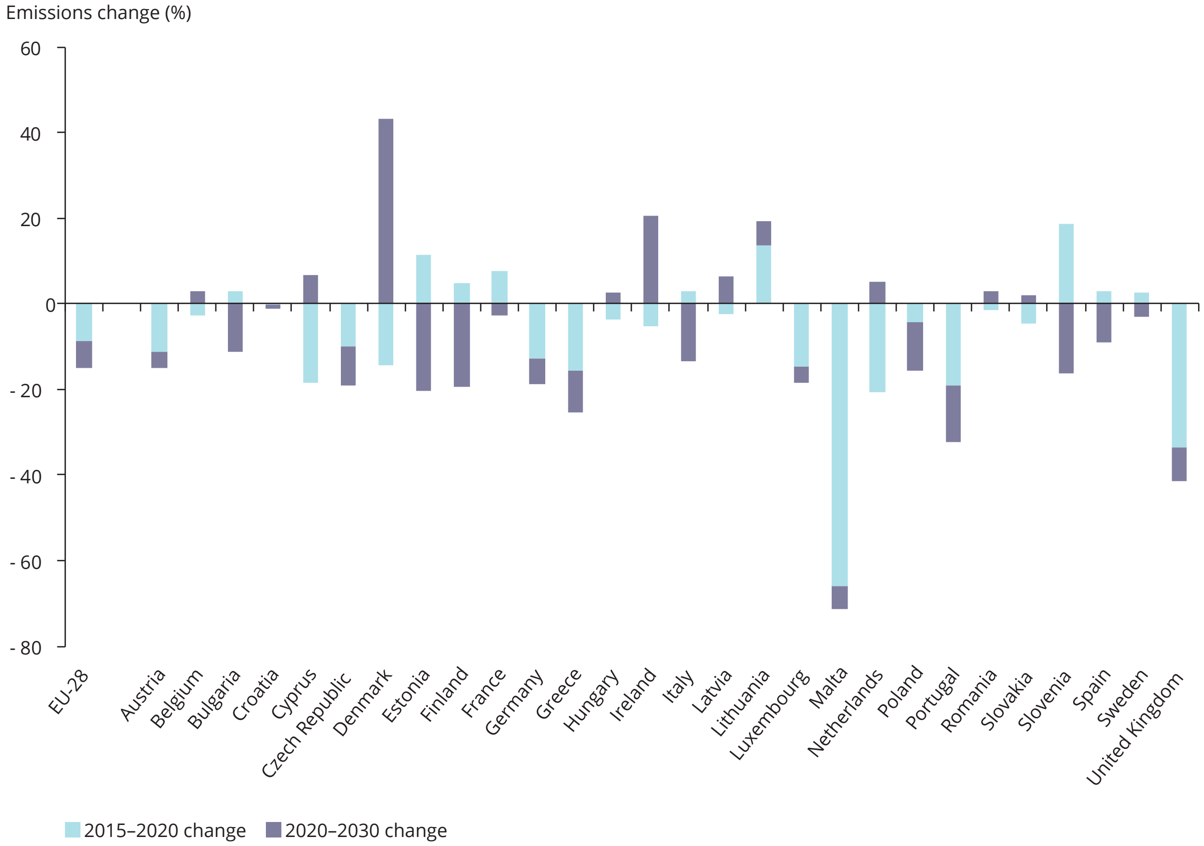
Following the recent submission of new projections in 2017, several Member States (Estonia, Finland, Latvia and Luxembourg) now expect considerably lower EU ETS emissions throughout the period than previously indicated in their 2015 submission. For example, the projected emissions for Finland now reflect new policies and measures outlined in the National Energy and Climate Strategy for 2030 (refer to Table A1.5 in Annex 1). This includes the phasing out of coal for energy use during the 2020s, increasing the share of biofuel energy content in all fuels sold for road transport to 30 % by 2030, and a large increase in the number of electric vehicles on the roads by 2030 (Finland, 2017).

Although the latest projected emissions are overall lower than those from the previous submissions, the 2017 submissions show a considerable increase in the expected EU ETS emissions for several countries (Czech Republic and Denmark) throughout the whole time series (refer to Table A1.5 in Annex 1). For example, the increased emissions for Denmark are due to a change in the methodology for reflecting policies and measures in projections. Certain important measures are no longer considered to be automatically carried forward after a certain date, as is the case for agreements between the government and the industrial sector (Danish Energy Agency, 2017).

In the Netherlands, the updated projection in 2017 has resulted in lower EU ETS emissions (compared with the previous submission) up until 2020, and then higher EU ETS emissions (compared with the previous

([45]) Emissions projected to reduce by 8.8 % on 2015 levels between 2015 and 2020.
([46]) Emissions projected to reduce by 6.2 % on 2015 levels between 2020 and 2030.
([47]) According to the 2017 projections submitted by the United Kingdom, it is expected that gross electricity production from coal will reduce from 72 TWh in 2015 to 18 TWh in 2020.

Figure 3.2 Changes in EU ETS emissions projected by EU Member States for 2015-2020 and 2020-2030 relative to 2015 emission levels under 'with existing measures' (WEM) scenario



Sources: EEA, 2017; projections of EU Member States (see http://cdr.eionet.europa.eu/ online), compiled by ETC/ACM as of June 2017.

submission) up until 2030. The reduction in emissions up until 2020 reflects the closure of old coal-fired power plants, the low cost of German renewable electricity and additional connections to Germany. All these factors will result in the reduced deployment of Dutch coal-fired power plants (Netherlands, 2016). Indeed, the projections are for a more than twofold increase in the net import of electricity ([48]). However, after 2020 a decrease of net electricity imports is projected (due in part to the phase-out of nuclear power in Germany) and the production of coal-fired power plants will increase as total electricity exports from the Netherlands exceed imports (Netherlands, 2016). This will result in increasing emissions in 2030 ([49]).

3.1.2 Balance of allowances

The surplus of allowances accumulated in the EU ETS stood at around 1.7 billion by the end of 2016 (EC, 2017b). Figure 3.3 shows how the supply and demand of allowances could develop until 2030, based on combining static data from different Member State projections with a supply profile including assumptions that partially reflect possible changes to the ETS Directive after 2021. This reflects both the impact of the backloading of auction volumes ([50]) between 2014 and 2016, through the Auctioning Regulation (EU, 2014a), and the future impact of the MSR ([51]), as decided by the EU (2015). The estimated balance also takes into account the expected increase in the linear reduction

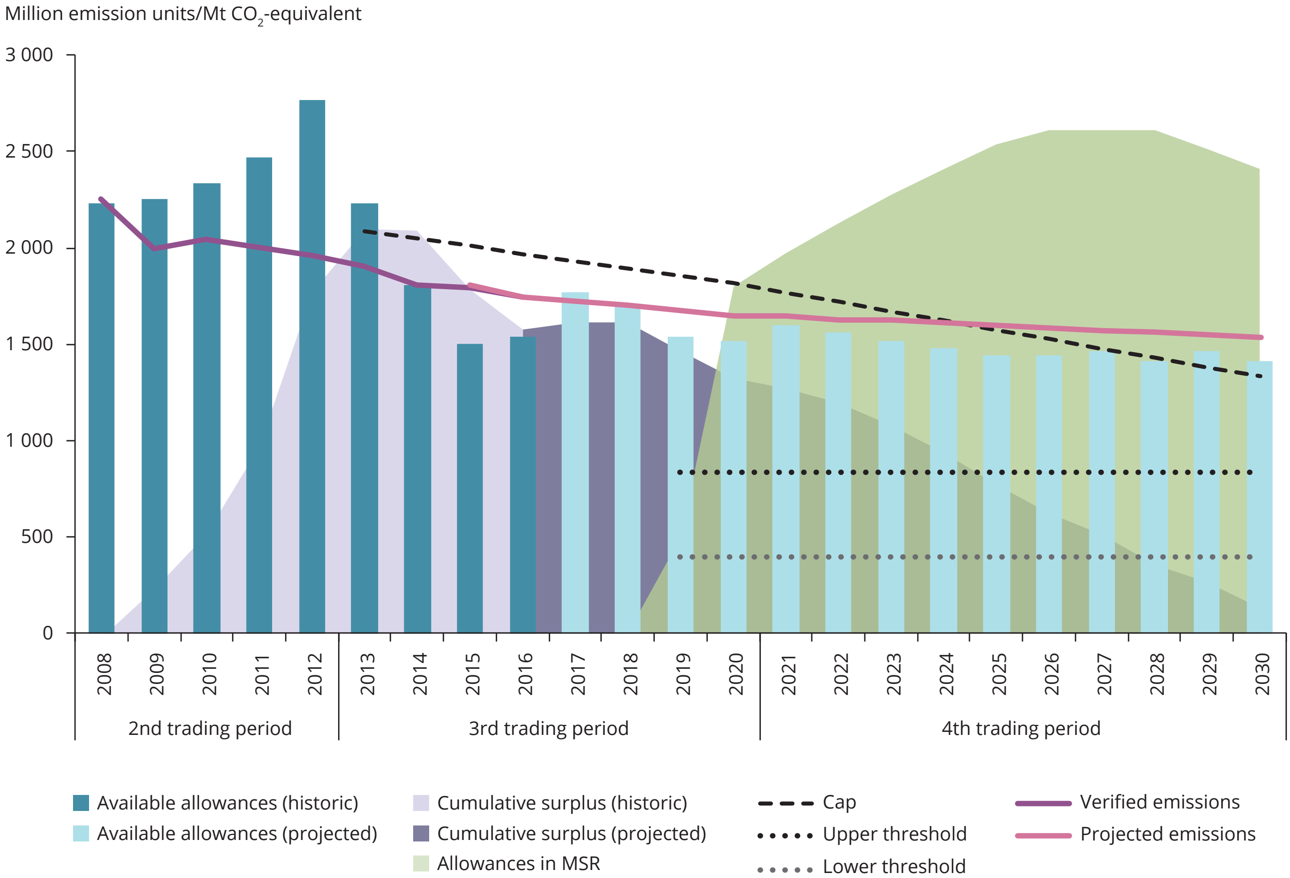
([48]) According to the 2017 projections submitted by the Netherlands, it is expected that gross electricity production from coal will decrease from 139.9 PJ in 2015 to 89.8 PJ in 2020, while the net import of electricity will increase by 42.4 PJ between 2015 and 2020.

([49]) According to the 2017 projections submitted by the Netherlands, it is expected that gross electricity production from coal will increase from 89.8 PJ in 2020 to 102.3 PJ in 2030, while the country will switch from importing to exporting electricity between 2020 and 2030.

([50]) To address the imbalance in the supply and demand of allowances, the European Commission first postponed the auctioning of 900 million allowances (see Section 2.1.2).

([51]) The MSR is a structural measure to address the cumulated surplus in the short term and improve the system's resilience to major shocks in the long term, by adjusting the supply of allowances based on pre-defined rules (see Section A1.4 in Annex 1).

Figure 3.3 Outlook on the supply and demand of allowances until 2030



Notes: Please refer to Section A1.4 of Annex 1 for a detailed description of data sources and assumptions. Available allowances include free allocation, allowances auctioned and sold, and the use of international credits. The figure shows available allowances and verified emissions at the current scope.

The upper and lower threshold of the 'MSR corridor' determines whether allowances are added to or released from the MSR. When the number of allowances in circulation exceeds the upper threshold, allowances are added to the MSR. A withdrawal rate of 12 % is assumed for the MSR. When the number of allowances in circulation drops below the lower threshold, allowances are released from the MSR. Available allowances rise above 2020 levels in 2021-2023. This is because unallocated allowances are modelled only until 2020, and from 2021 full allocation/auctioning of the cap is assumed.

Sources: Authors' calculation based on EEA, 2017; projections of EU Member States and Norway (see http://cdr.eionet.europa.eu/ online) compiled by ETC/ACM as of July 2017, as well as data sources set out in Section A1.4 of Annex 1.

factor (LRF) from 2021 onwards ([52]). It should therefore be considered as illustrative, as it cannot fully reflect all future policy developments and changes to the CO_2 price.

To estimate the balance between the supply and demand of allowances until 2030, WEM projections reported as of July 2017 by Member States were used. These projections show that although annual emissions are expected to remain above the quantity of allocated allowances, thereby reducing the overall surplus of allowances, they will also remain below the decreasing linear cap until the middle of the third trading period. From 2025 onwards, however, projected emissions rise above the linear cap (and are about 200 Mt higher than the cap in 2030).

The MSR is expected to lead to a decline in the surplus from 2019 onwards (the first year during which it will be operational). It will play a significant role in particular during 2019 and 2020, when a large amount of allowances would otherwise have been reintroduced onto the market (backloaded and unallocated allowances), but will now be transferred directly into the MSR. Based on Member State emission projections (WEM scenario), the cumulative surplus of allowances is

([52]) LRF is set to be increased from 1.74 % to 2.2 % starting in 2021.

expected to drop below the upper and lower threshold of the MSR corridor (833 and 400 million allowances) in 2025 and 2028 respectively, and be eliminated by 2031. The size of the MSR would be 2.4 billion allowances in 2030.

3.2 Aviation

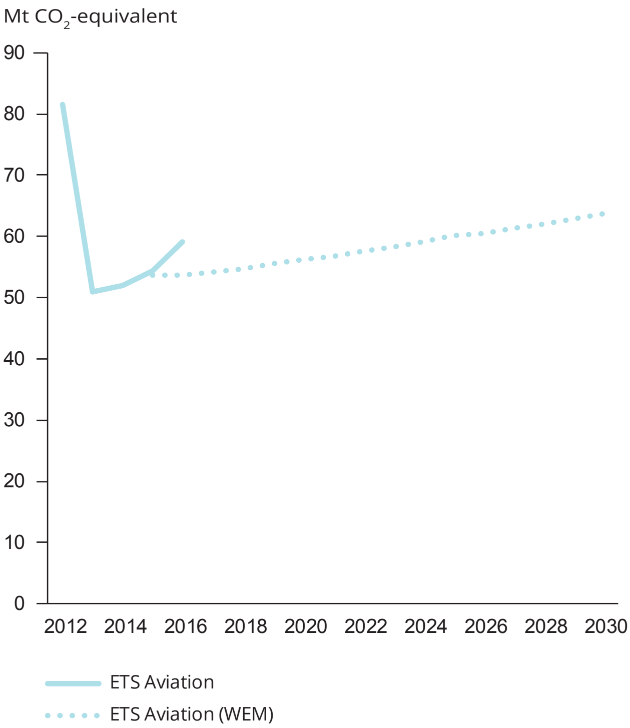
Emission trends

Projected emissions for aviation activities covered by the EU ETS under the WEM scenario are expected to continually rise up until 2030 (Figure 3.4). However, these projections are based upon the continuation of the current scope of aviation activities covered by the EU ETS. In this context, the recent resolution by the 2016 ICAO Assembly to implement a Carbon Offset Reduction Scheme for International Aviation (CORSIA) is relevant. In response to this agreement, the European Commission has proposed to maintain the intra-EEA scope for the EU ETS and to undertake a new review in the light of future international developments.

3.2.1 Balance of allowances

Given that aviation emissions are projected to continually increase up until 2030, it is expected that the net demand for allowances in the aviation sector will continue to rise over this period. Indeed, this net demand is taken into account in the estimation of the future supply and demand of allowances in the stationary sector (refer to Section 3.1.2). However, the certainty of the development of this net demand for allowances will ultimately depend upon forthcoming decisions on the EU ETS in the light of the developments in the implementation of CORSIA.

Figure 3.4 EU ETS emissions for aviation between 2012 and 2030



Notes: The sharp drop in aviation emissions from 2012 to 2013 reflects a change in the scope of aviation activities covered by the EU ETS. Projections on aviation emissions covers only the EU, whereas the total reported is higher in other sections of this report due to the inclusion of Iceland, Liechtenstein and Norway. WEM, 'with existing measures' scenario.

Sources: EEA, 2017; projections of EU Member States (see http://cdr.eionet.europa.eu/ online), compiled by ETC/ACM in 2015 and 2017.

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Annex 1 Background information and data

This annex provides additional supporting information for the ETS report, focusing on changes that have occurred over the course of 2016. For more background information, please refer to last year's report (EEA, 2016b).

A1.1 Activities covered by the EU ETS

A1.1.1 Stationary installations

The EU ETS covered 11 672 stationary installations in most industrial sectors in 2016 ([53]). The scope of the EU ETS includes all combustion installations exceeding 20 MW and all installations where activities listed in Annex I of the ETS Directive are carried out (EU, 2003). The total emissions of all stationary installations covered by the EU ETS in 2016 were equal to 1 750 Mt CO_2-eq (EEA, 2017).

The stationary installations covered by the EU ETS can be grouped into eight main categories, based on their main activities responsible for GHG emissions:

- fuel combustion (mainly electricity generation plus various manufacturing industries);
- refineries;
- iron and steel, coke, and metal ore production;
- cement, clinker and lime production;
- other non-metallic minerals (glass, ceramics, mineral wool and gypsum);
- production of pulp and paper;
- production of chemicals;
- other (opt-ins and capture of GHGs).

The majority of the stationary installations in the EU ETS are fuel combustion plants (62 %), and together they account for an even higher proportion of total verified emissions from stationary installations (67 %). In terms of emissions, the cement, clinker and lime production sector is the second largest sector, even though it ranks fourth in terms of the number of installations. The iron, steel and coke sector and the refinery sector each account for 7 % of emissions from stationary installations, followed by the chemicals sector, responsible for 5 % of emissions. The remaining activities account for 25 % of the stationary installations covered by the EU ETS, but produce only 5 % of the total verified emissions for stationary installations (Table A1.1).

A1.1.2 Aviation operators

The EU ETS covered 774 aircraft operators in 2016. The total emissions of aviation covered by the EU ETS in 2016 were equal to 61 Mt CO_2-eq (EEA, 2017). Since its inclusion in the EU ETS in 2012, the aviation sector has had to purchase EUAs from the stationary sector to fully cover aviation emissions. Initially the scope of aviation covered all flights from, to and within the European Economic Area. However, to allow time for negotiations within the ICAO on a global market-based measure for aviation, the requirements of the EU ETS were suspended for flights to and from non-European countries for 2013-2016. The balance between the supply of and demand for EUAAs changed considerably between 2012 and 2013-2016, because in 2012 operators were allowed to choose the applicable scope, whereas since 2013 a uniform scope has been applied.

Following the agreement on CORSIA, discussions are on-going on the scope of the EU ETS. In February 2017, the Commission tabled a legislative proposal ([54]) to continue with the current scope beyond 2016. The Commission also suggests that the application of the linear reduction factor shall apply

([53]) This number includes all stationary installations with any ETS information reported in 2016.
([54]) http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2017:0054:FIN

Table A1.1 Activities and sectors covered by the EU ETS in 2016

Activities	Sectors	Number of entities	Verified emissions (Mt CO_2-eq.)
20 Combustion of fuels	Combustion	7 243	1 179
21 Refining of mineral oil	Refineries	139	127
22 Production of coke	Iron and Steel, coke, metal ore	21	11
23 Metal ore roasting or sintering		9	3
24 Production of pig iron or steel		246	109
25 Production or processing of ferrous metals	Other metals (incl. aluminium)	246	13
26 Production of primary aluminium		30	7
27 Production of secondary aluminium		35	1
28 Production or processing of non-ferrous metals		85	7
29 Production of cement clinker	Cement and Lime	261	115
30 Production of lime, or calcination of dolomite/magnesite		304	31
31 Manufacture of glass	Other non-metallic minerals	367	18
32 Manufacture of ceramics		1 079	16
33 Manufacture of mineral wool		49	2
34 Production or processing of gypsum or plasterboard		39	1
35 Production of pulp	Pulp and Paper	160	5
36 Production of paper or cardboard		602	22
37 Production of carbon black	Chemicals	18	2
38 Production of nitric acid		36	5
39 Production of adipic acid		3	0
40 Production of glyoxal and glyoxylic acid		1	0
41 Production of ammonia		30	22
42 Production of bulk chemicals		350	39
43 Production of hydrogen and synthesis gas		44	9
44 Production of soda ash and sodium bicarbonate		14	3
45 Capture of greenhouse gases under Directive 2009/31/EC	Other	0	0
99 Other activity opted-in under Art. 24		261	3
Sum of all stationary installations		**11 672**	**1 750**
10 Aviation		821	61

Note: Entity is counted if it has any ETS information in 2016.

Source: EEA, 2017

from 2021 onwards. The Commission is also required to report to the European Parliament and the Council on the implementation of the global market-based measure (GMBM) by non-Member States and to consider a revision of the EU ETS Directive. The proposal from February is being considered by the European Parliament and the Council of the European Union.

A1.2 Allocation of free allowances

A1.2.1 Free allocation per sector

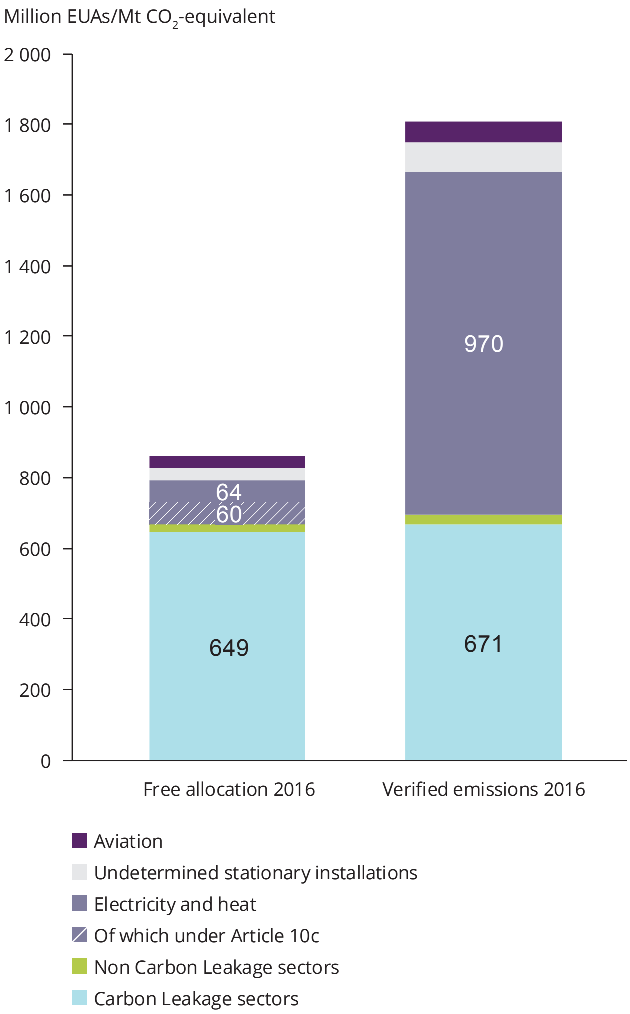
Free allocation differs significantly across the various activities. Industrial installations (excluding combustion) emit 39 % of total emissions covered by the EU ETS;

54 % are emitted by combustion (mainly power plants) and 3 % by aircraft operators ([55]). Operators of industrial installations as a group receive free certificates just under their total verified emissions in 2016 (Figure A1.1). The vast majority of industrial installations host an activity considered to be at risk of carbon leakage — only 2 % of industrial emissions are caused by installations whose activity is not deemed at risk of carbon leakage.

Electricity and heat installations have to purchase the majority of allowances needed to cover for their emissions. They receive, on average, 7 % of their emissions as free allocation for heat (64 million EUAs ([56])) and an additional 60 million EUAs as transitional free allocation, which is available to power plant operators only in a number of eastern European countries.

Finally, aircraft operators also have to purchase allowances to cover their verified emissions. In 2016, aircraft operators were allocated 32 million EUAAs free of charge — this corresponds to around 54 % of their emissions.

Figure A1.1 Verified emissions and free allocation (2016), according to allocation rules



Notes: Electricity and heat refers to electricity generators. 'Carbon leakage sectors' and 'non-carbon leakage sectors' both refer to non-electricity generators (industry installations). Verified emissions data for installations producing electricity and heat are only available at an aggregate level.

EUA, European Union Allowance.

Sources: Sector classification based on EC, 2014a; EEA, 2017.

A1.2.2 Transitional free allowances

The maximum allowed amount of allocation under Article 10(c) declines over the years from 152 million EUAs in 2013 to 0 EUAs in 2020 (Table A1.2). Notably in Hungary, transitional free allocation was restricted to 2013 only, while in all other countries the allowed amounts will continue but will reduce steadily until they reach zero in 2020.

To date, the de facto allocation has always been lower than the allowed amount. In 2013, a total of 139 million allowances were allocated free of charge to installations under Article 10(c), which corresponds to 92 % of the maximum allowed amounts (EC, 2014b; EU, 2017). In 2014, a total of 107.7 million allowances were allocated to installations, which corresponds to 83 % of the maximum allowed amount (EC, 2015b; EU, 2017). In 2015, a total of 79.0 million allowances were allocated to installations, which corresponds to 69 % of the maximum allowed amount (EC, 2016b; EU, 2017). In 2016, a total of 60.4 million allowances were allocated to installations, which corresponds to 61 % of the maximum allowed amount (EC, 2017f; EU, 2017).

Member States can choose to auction unused Article 10(c) allowances. Up to 2016, only Romania and Bulgaria made use of this possibility. According to the EU Auctioning Calendar, the following Member States plan to auction unused Article 10(c) allowances in 2017: Bulgaria (0.9 million EUAs), the Czech Republic

([55]) Attribution to sectors is based on NACE codes published by the European Commission in the process of determining the carbon leakage list (EC, 2014a). The remaining emissions are from stationary installations that cannot be attributed to a specific sector, e.g. because no NACE code is available.

([56]) Estimate based on the quantity of allowances allocated free of charge (Article 10(a)(1)) to installations whose NACE code corresponds to heat and electricity production. It is assumed that these installations were producing heat only, since installations producing electricity are covered by Article 10(c) and therefore available separately in the EUTL. It is also possible that certain free allowances were dedicated to installations with undefined activity, but their share is assumed to be very low.

Table A1.2 Maximum and allocated transitional free allocation for the modernisation of electricity generation under Article 10(c) of the ETS Directive

		Number of free allowances available for the modernisation of the electricity system										
		2013	2014	2015	2016	2017	2018	2019	2020	Remainder 2013–2016	Amounts for auctioning	Remaining budget up to 2020
		Million EUAs										
Bulgaria	max allowance	13.5	11.6	9.7	7.7	5.8	3.9	1.9	0.0	6.9	7.8	10.7
	allocated	11.2	9.8	8.2	6.5							
Cyprus	max allowance	2.5	2.2	1.9	1.6	1.3	0.9	0.6	0.0	0.0	0.0	2.8
	allocated	2.5	2.2	1.9	1.6							
Czech Republic	max allowance	26.9	23.1	19.2	15.4	11.5	7.7	3.8	0.0	0.5	0.2	23.4
	allocated	26.8	23.0	19.2	15.1							
Estonia	max allowance	5.3	4.5	3.8	3.0	2.3	1.5	0.8	0.0	0.5	0.3	4.7
	allocated	5.1	4.4	3.7	2.9							
Hungary	max allowance	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.9
	allocated	6.1	0.0	0.0	0.0							
Lithuania	max allowance	0.6	0.5	0.5	0.4	0.4	0.3	0.2	0.0	0.9	0.7	1.0
	allocated	0.3	0.3	0.3	0.2							
Poland	max allowance	77.8	72.3	66.7	60.0	52.2	43.4	32.2	0.0	82.8	0.0	210.6
	allocated	71.2	59.4	36.7	26.8							
Romania	max allowance	17.9	15.3	12.8	10.2	7.7	5.1	2.6	0.0	15.4	12.4	18.3
	allocated	15.7	8.6	9.2	7.2							
Total	**max allowance**	**151.0**	**129.0**	**114.0**	**98.0**	**81.1**	**62.7**	**42.1**	**0.0**	**107.8**	**21.4**	**272.4**
	allocated	**139.0**	**107.7**	**79.0**	**60.4**							

Note: Includes Article 10(c) amounts to be auctioned in 2017.

Sources: EC, 2015b, 2016b, EC, 2017f; EU, 2012a, 2012b, 2012c, 2012d, 2012e, 2012f, 2012g, 2012h, 2014b, 2017.

(0.1 million EUAs), Estonia (0.1 million EUAs), Lithuania (0.5 million EUAs) and Romania (3.5 million EUAs).

A1.3 Auctioned allowances during the third trading period

Table A1.3 and Table A1.4 present two sets of values concerning auctioned or sold allowances for EUAs and EUAAs. The section to the left of each table shows volumes attributed to the years when allowances were actually released to the market, whereas the section to the right shows volumes redistributed by the EEA in accordance with the years to which allowances correspond. Unless otherwise noted, the calculations and figures in this report refer to the redistributed amounts.

For the second trading period, the redistribution of EUAs concerned early auctions (2012) pertaining to the third trading period (Table A1.3). The volumes of 'early auctions' of the third trading period held in 2012 were added to 2013 auctioning volumes (90 million EUAs). NER300 sales were carried out in two tranches: the first tranche of 200 million (sold in 2011 and 2012) is attributed to 2013, while the second tranche of 100 million EUAs (sold at the end of 2013/beginning of 2014) is attributed to 2014 (EIB, 2014). When it comes to specific country situations, the following observations can be made:

- Croatia started auctioning in 2015: the volumes sold in 2015 were attributed to the appropriate years (4.9 million EUAs to 2013, 3.0 million EUAs to 2014 and 3.4 million EUAs to 2015).

Table A1.3 Allowances auctioned/sold in the third trading period (EUA millions)

	Third trading period									
	Auctions/sales concluded					Auctions/sales redistributed				
	2012	**2013**	**2014**	**2015**	**2016**	**2012**	**2013**	**2014**	**2015**	**2016**
Austria	1.6	12.7	8.8	10.0	11.2		14.3	8.8	10.0	11.2
Belgium		26.1	16.1	18.2	20.4		26.1	16.1	18.2	20.4
Bulgaria	3.3	12.0	6.1	15.9	16.2		15.3	6.1	15.9	16.2
Croatia				11.3	3.8		4.9	3.0	3.4	3.8
Cyprus	0.2	0.1	0.1				0.3	0.1		
Czech Republic		18.6	9.4	14.5	22.4		18.6	9.4	14.5	22.4
Denmark	0.2	12.7	8.0	9.0	10.1		12.9	8.0	9.0	10.1
Estonia		4.1	1.2	2.8	4.5		4.1	1.2	2.8	4.5
Finland	2.0	15.2	10.6	12.0	13.4		17.2	10.6	12.0	13.4
France	6.4	49.9	34.8	39.3	44.0		56.3	34.8	39.3	44.0
Germany	23.5	182.6	127.1	143.9	160.8		206.1	127.1	143.9	160.8
Greece	2.3	33.4	22.0	24.9	27.9		35.8	22.0	24.9	27.9
Hungary	0.6	7.8	9.5	10.8	12.1		8.4	9.5	10.8	12.1
Iceland										
Ireland		9.6	5.9	6.7	7.5		9.6	5.9	6.7	7.5
Italy	11.3	87.9	61.2	69.3	77.4		99.2	61.2	69.3	77.4
Latvia	0.3	2.5	1.7	1.9	2.2		2.8	1.7	1.9	2.2
Liechtenstein										
Lithuania	0.5	4.5	2.9	3.7	3.9		5.0	2.9	3.7	3.9
Luxembourg	0.1	1.1	0.8	0.9	1.0		1.2	0.8	0.9	1.0
Malta	0.0	1.0	0.6	0.7	0.8		1.1	0.6	0.7	0.8
Netherlands	3.9	30.6	21.3	24.1	26.9		34.5	21.3	24.1	26.9
Norway										
Poland		51.2	13.3	17.1	25.6		51.2	13.3	17.1	25.6
Portugal	1.6	16.5	11.2	12.6	14.1		18.1	11.2	12.6	14.1
Romania	5.9	27.9	16.5	25.4	36.8		33.8	16.5	25.4	36.8
Slovakia	1.8	14.0	9.7	11.1	12.4		15.9	9.7	11.1	12.4
Slovenia	0.5	4.0	2.8	3.2	3.6		4.6	2.8	3.2	3.6
Spain	10.1	78.8	54.8	62.1	69.3		88.9	54.8	62.1	69.3
Sweden	1.0	8.1	5.6	6.4	7.1		9.2	5.6	6.4	7.1
United Kingdom	12.3	95.1	66.2	75.0	80.3		107.4	66.2	75.0	83.7
NER300		210.6	89.5				200.0	100.0		
Total	**89.7**	**1 018.7**	**617.8**	**632.7**	**715.3**		**1 102.7**	**631.4**	**624.8**	**718.8**

Note: The table presents two sets of values concerning auctioned/sold allowances. The section on the left shows volumes attributed to the years when allowances were actually released to the market, whereas the section on the right shows volumes redistributed by the EEA in accordance with the years to which allowances correspond.

Sources: EEA, 2016a, 2017.

Table A1.4 Aviation allowances auctioned/sold in the third trading period (EUAA millions)

	Auctions/sales concluded					Auctions/sales redistributed				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
Austria			0.196	0.336	0.123	0.196	0.112	0.112	0.112	0.123
Belgium			0.341	0.383	0.140	0.341	0.128	0.128	0.128	0.140
Bulgaria			0.037	0.130	0.047	0.037	0.043	0.043	0.043	0.047
Croatia				0.069	0.031		0.023	0.023	0.023	0.031
Cyprus			0.050	0.202	0.074	0.050	0.067	0.067	0.067	0.074
Czech Republic			0.078	0.170	0.062	0.078	0.057	0.057	0.057	0.062
Denmark			0.194	0.386	0.141	0.194	0.129	0.129	0.129	0.141
Estonia			0.007	0.022	0.008	0.007	0.007	0.007	0.007	0.008
Finland			0.136	0.303	0.111	0.136	0.101	0.101	0.101	0.111
France			1.674	1.731	0.633	1.674	0.577	0.577	0.577	0.633
Germany	2.500			2.229	0.858	2.500	0.743	0.743	0.743	0.858
Greece			0.183	0.710	0.260	0.183	0.237	0.237	0.237	0.260
Hungary			0.048	0.141	0.052	0.048	0.047	0.047	0.047	0.052
Iceland										
Ireland			0.145	0.305	0.112	0.145	0.102	0.102	0.102	0.112
Italy			0.873	2.049	0.749	0.873	0.683	0.683	0.683	0.749
Latvia			0.024	0.076	0.028	0.024	0.025	0.025	0.025	0.028
Liechtenstein										
Lithuania			0.010	0.041	0.015	0.010	0.014	0.014	0.014	0.015
Luxembourg			0.105	0.032	0.012	0.105	0.011	0.011	0.011	0.012
Malta			0.017	0.081	0.030	0.017	0.027	0.027	0.027	0.030
Netherlands			0.911	0.524	0.191	0.911	0.175	0.175	0.175	0.191
Norway										
Poland				0.434	0.120	0.108	0.108	0.108	0.108	0.120
Portugal			0.212	0.411	0.150	0.212	0.137	0.137	0.137	0.150
Romania			0.054	0.227	0.083	0.054	0.076	0.076	0.076	0.083
Slovakia			0.008	0.028	0.011	0.008	0.009	0.009	0.009	0.011
Slovenia			0.008	0.020	0.007	0.008	0.007	0.007	0.007	0.007
Spain			1.093	2.320	0.848	1.093	0.773	0.773	0.773	0.848
Sweden			0.171	0.517	0.189	0.171	0.172	0.172	0.172	0.189
United Kingdom			2.708	2.521	0.921	2.708	0.840	0.840	0.840	0.921
Total	**2.500**		**9.278**	**16.391**	**5.998**	**11.886**	**5.427**	**5.427**	**5.427**	**5.998**

Note: The table presents two sets of values concerning auctioned/sold allowances. The section on the left ('Auctions/sales concluded') shows volumes according to the years when allowances were actually released to the market, whereas the section to the right ('Auctions/sales redistributed) shows volumes redistributed by the EEA in accordance with the years to which allowances correspond.

Sources: EEA, 2016a, 2017.

- In the United Kingdom, the auction of 14/12/2016 was cancelled on account of the bid volume falling short of the volume being auctioned. The corresponding 3.49 million allowances only entered the market by the end of February 2017 and were attributed to the number of allowances auctioned in 2016 (i.e. on the section to the right of the table).

- Poland did not auction any allowances from mid-August 2016 onwards, resulting in the corresponding 14.99 million allowances expected to come on to the market in 2017. At the time of writing, the total corresponding number of allowances had not yet fully entered the market and, therefore, were not attributed to the number of allowances auctioned in 2016.

- Iceland, Liechtenstein and Norway have not yet started auctioning allowances for the third trading period. Based on the European Commission's auctioning calendar for 2016, 26 million EUAs have accumulated for these countries' auctioning budgets pertaining to the years 2013 to 2016, and these will be auctioned at a later stage. These allowances have not been redistributed to specific years.

Auctions of aviation allowances (EUAAs) were temporarily suspended after the 'stop the clock' decision taken in 2012 (Table A1.4). Germany was the only country to auction EUAAs in 2012 (2.5 million EUAAs). All the other countries, except Poland, started auctioning EUAAs in 2014. For these countries, 2014 auctions of EUAAs relate to volumes for the year 2012, whereas 2015 auctions of EUAAs relate to volumes for the years from 2013 to 2015. Poland auctioned all EUAAs for 2012-2015 in 2015.

A1.4 Method and assumptions to project the balance of allowances until 2030

The method, data sources and assumptions used to estimate the size of the allowance surplus and the MSR until 2030 (Figure 3.3) are set out in the following section.

Historical data on free allocation, allowances auctioned and sold, and international credits surrendered/exchanged are based on EEA (2017). In order to make the time series comparable across the whole period, an estimate reflecting the scope of the current EU ETS is added to both EU ETS emission and allocated allowances, for the period from 2008 to 2012.

Free allocation from 2017 to 2020 is based on EC (2013) and corrected for allowances expected to remain unallocated until 2020. Unallocated allowances due to cessations and closures (Articles 10(a)(19) and 10(a)(20) of the ETS Directive) in the years 2013-2016 are available from the EC (2017e). The observed value of 64 million allowances in 2016 is held constant until 2020. Regarding unallocated allowances from the NER (Article 10(a)(7) of the ETS Directive), it is projected that allocation to new entrants will continue at the rate observed from 2013 to 2016. Remaining unallocated allowances under Articles 10(a)(4) and 10(a)(5) are projected to reach 145 million by the end of the third trading period (EC, 2015a). Roughly half of this total number of unallocated allowances is expected to feed into the new entrants reserve for the fourth trading period, while the other half is expected to be added to the MSR in 2020.

It is assumed that Article 10(c) Member States will continue to allocate at the average rate observed in the period 2013-2016, taking into account those Article 10(c) amounts already reintroduced into the market through auctioning, arriving at a total of 127 million allowances under Article 10(c) that remain unallocated at the end of the third trading period. These are then assumed to be auctioned in 2019 and 2020, with an equal amount being auctioned each year.

Planned auction amounts between 2017 and 2020 are taken from EC (2017d). Pending auction amounts for the European Economic Area and the European Free Trade Association (EFTA) states (26 million allowances) are assumed to be auctioned in the years 2017-2020, in equal tranches.

The remainder of the budget (16 million allowances) of international credits for stationary installations is assumed to be exchanged in 2017.

From 2020 onwards, available allowances are based on the decreasing cap with a linear reduction factor (LRF) applied from 2021 onwards. In addition to this, a new entrants reserve of about 400 million allowances is expected to be available, fed by the unallocated allowances as described above.

Projected emissions reflect the sum of projections from EU Member States and Norway (http://cdr.eionet.europa.eu online), reported as of July 2017, and represent emissions under the WEM scenario (see also Section 3.1.1). Projected ETS emissions for Iceland and Liechtenstein are gap-filled based on past ETS emissions and trends of available projections (EU plus Norway).

Net demand from aviation has been taken into account for the years 2012-2016 and a projection has been made to 2030 based on EC (2017c).

The Market Stability Reserve (MSR) is implemented according to EU (2015). In the context of a revision of the ETS Directive for the fourth trading period, changes to the MSR (e.g. an increase of the intake rate) are also being discussed.

The projection of the future balance of demand and supply is dependent upon the development of verified emissions over time. The baseline includes assumptions on:

1. economic development, i.e. GDP growth has historically driven GHG emissions;

2. policy developments, i.e. other policies that reduce GHG emissions, such as the renewable energy and energy efficiency targets adopted by the EU.

In the past, Member States' projections have tended to overestimate future emission levels and underestimate the potential size of the cumulative surplus of emission allowances. Therefore, the time taken to eliminate the surplus will vary if emissions develop differently from the projections.

A static baseline is applied to calculate the effect of the MSR, i.e. the projected emissions from Member States do not respond to an expected change in EUA prices ([57]) as a consequence of the MSR. If emissions are reduced due to an increase in EUA prices, the elimination of the surplus would take place at a slower rate and it would be fully eliminated at a later point in time.

A1.5 Projections

A1.5.1 Stationary emissions

Historical and projected emission trends are split by main source category in Figure 3.1. The allocation of EU ETS emissions to the sectors presented here is based on the assumption of a constant share of sectoral emissions under the EU ETS for the years 2005-2015. The shares are taken from projected shares of EU ETS emissions in the year 2015: 67 % of emissions from Intergovernmental Panel on Climate Change (IPCC) sectors 1.A.1, 1.B and 1.C, the energy industries; 19 % of emissions from IPCC sector 1.A.2, manufacturing and construction; 12 % of emissions from IPCC sector 2, industrial processes; and 0.4 % of emissions from other IPCC sectors.

A1.5.2 Comparison of 'with existing measures' (WEM) projection submissions in 2015 and 2017

Following the recent submission of new projections for each ETS country in 2017, Table A1.5 provides an overview of the changes in emissions (in Mt) up until 2030, compared with their previous submissions.

([57]) This means that future EUA prices are not considered for the estimation of the future balance of allowances. Furthermore, the impact of the hedging of allowances is also not considered.

Table A1.5 Comparison of 'with existing measures' (WEM) projections submitted in 2015 and 2017 in Megatonnes

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
EU-28	**- 75**	**- 94**	**- 98**	**- 106**	**- 101**	**- 100**	**- 94**	**- 101**	**- 101**	**- 111**	**- 110**	**- 115**	**- 121**	**- 119**	**- 122**	**- 122**
Austria	1	1	1	0	- 1	- 2	- 2	- 2	- 2	- 2	- 2	- 2	- 2	- 2	- 3	- 3
Belgium	- 2	- 2	- 2	- 2	- 2	- 3	- 4	- 5	- 6	- 7	- 8	- 6	- 7	- 8	- 9	- 10
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croatia	1	0	0	0	0	- 1	- 1	- 1	- 1	- 2	- 2	- 2	- 2	- 2	- 2	- 3
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Czech Republic	- 1	0	0	1	1	1	1	1	1	1	1	1	2	2	2	3
Denmark	0	1	- 2	- 2	- 1	1	2	2	3	3	4	5	5	6	7	7
Estonia	- 4	- 3	- 3	- 3	- 3	- 3	- 2	- 2	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1
Finland	- 10	- 12	- 14	- 13	- 7	- 8	- 9	- 10	- 11	- 10	- 7	- 7	- 5	- 1	- 1	- 1
France	- 14	- 13	- 12	- 11	- 10	- 9	- 11	- 12	- 14	- 15	- 17	- 18	- 20	- 22	- 24	- 25
Germany	- 10	- 15	- 17	- 19	- 20	- 22	- 16	- 10	- 5	1	7	10	14	17	21	24
Greece	6	4	2	0	- 1	- 3	- 3	- 3	- 2	- 2	- 2	- 1	0	0	1	2
Hungary	0	0	- 1	- 2	- 2	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 2	- 2
Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	- 1	- 2	- 2	- 1	- 3	- 1	- 1	- 1	0	0	- 1	- 1	0	0	0	0
Italy	- 11	- 9	- 7	- 5	- 3	- 1	- 4	- 7	- 10	- 13	- 17	- 21	- 26	- 30	- 35	- 39
Latvia	0	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 2	- 2	- 2
Liechtenstein	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lithuania	- 2	- 2	- 2	- 1	- 1	- 1	- 1	- 2	- 2	- 2	- 2	- 2	- 2	- 2	- 2	- 2
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malta	- 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	7	2	- 4	- 7	- 11	- 11	- 9	- 7	- 5	- 2	0	2	3	5	7	8
Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poland	- 2	- 2	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 1	- 2
Portugal	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Romania	- 4	- 5	- 6	- 7	- 7	- 8	- 9	- 10	- 11	- 12	- 13	- 12	- 11	- 11	- 10	- 10
Slovakia	0	- 1	- 1	- 1	- 1	- 1	- 1	- 2	- 2	- 2	- 2	- 2	- 2	- 2	- 2	- 2
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	7	3	3	2	1	0	- 2	- 3	- 4	- 23	- 24	- 25	- 27	- 28	- 29	- 30
Sweden	- 2	- 2	- 2	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3
United Kingdom	- 34	- 36	- 26	- 30	- 22	- 20	- 14	- 21	- 21	- 16	- 17	- 23	- 30	- 30	- 32	- 29

Source: EEA, 2017; projections of EU Member States (see http://cdr.eionet.europa.eu/ online), compiled by ETC/ACM in 2015 and 2017.

European Environment Agency

Trends and projections in the EU ETS in 2017
The EU Emissions Trading System in numbers

2017 — 58 pp. — 21 x 29.7 cm

ISBN 978-92-9213-924-7
doi:10.2800/425306

TH-AL-17-018-EN-N
doi:10.2800/425306

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