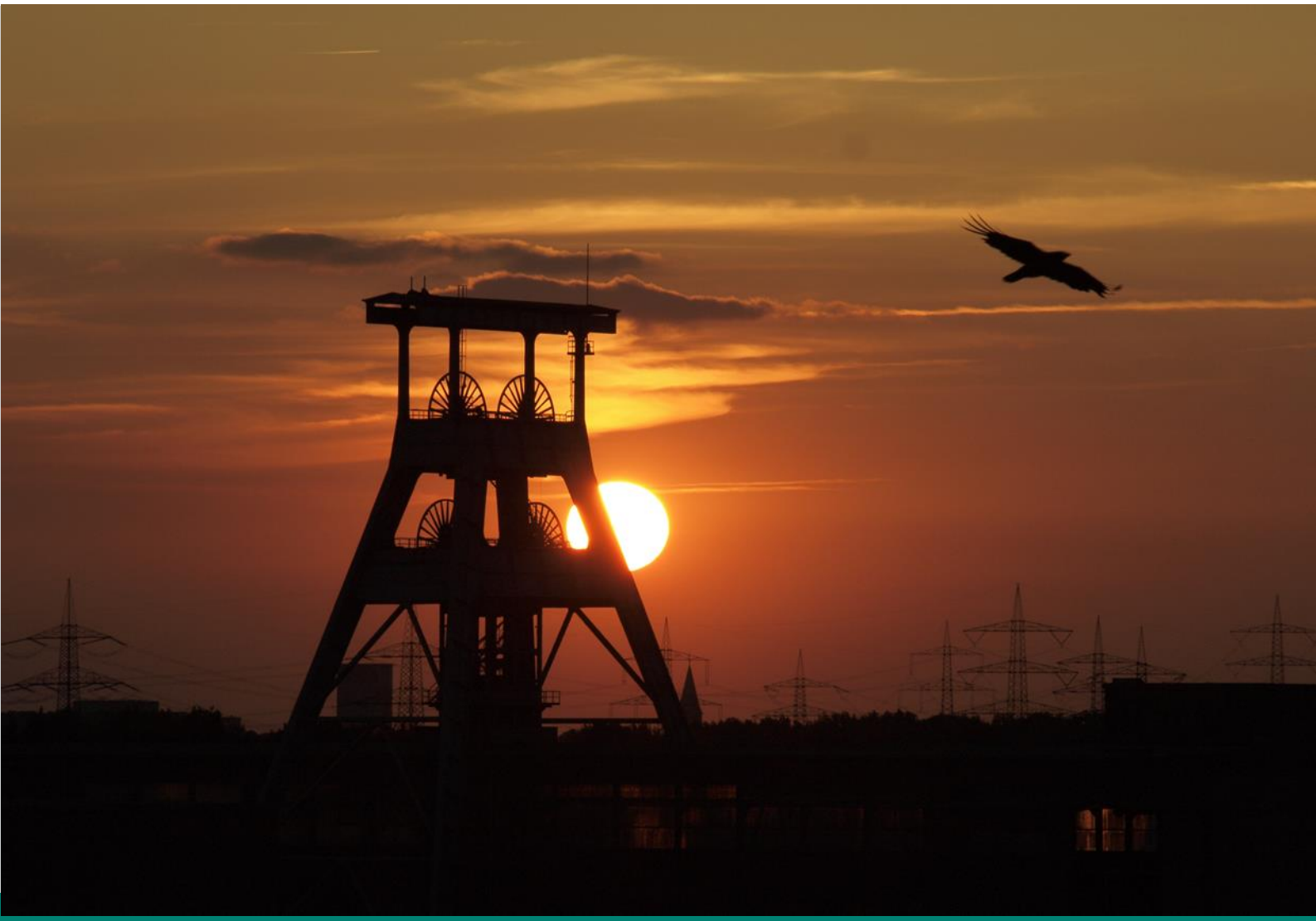
Eionet Report - ETC/CME 3/2019 December 2019

Trends and projections in the EU ETS in 2019

The EU Emissions Trading System in numbers



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About this report

This report provides an analysis of past, present and future emission trends under the European Union (EU) Emissions Trading System (ETS). It also analyses the balance between supply and demand of allowances in the market.

The report is based on the data and information available from the European Commission and Member States as of June 2019. Data on verified emissions and compliance by operators under the EU ETS for the years up until 2018 are based on an extract of the EU Transaction Log from 1st July 2019. Information from EU Member States, Iceland and Norway is based on their projections of EU ETS emissions until 2030, as reported in 2019 under the EU Monitoring Mechanism Regulation.

Main findings

In 2018, the total number of allowances in circulation (TNAC) was the same as in 2017. If the net demand for allowances from aviation would also be taken into account then the number of allowances available to operators was lower in 2018 compared to the previous year.

The EU ETS is a 'cap and trade system', whereby a cap (i.e. a determined quantity of emission allowances) is set on the emissions from the installations covered by the system. The cap decreases gradually in order to achieve emission reductions over time. Installations can trade emission allowances ([1]) with one another, which ensures that emission reductions take place where it costs least.

Between 2009 and 2012, the number of allowances available exceeded the demand for allowances (related to total emissions in the EU ETS). A surplus of allowances accumulated during this period, which resulted in lower prices for emission allowances and limited the incentive to invest in clean, low-carbon technologies (Figure ES.1). This ran, in particular, the risk of a 'carbon lock-in', with firms investing in carbon intensive technologies that could make the achievement of emission reductions more challenging in the longer term.

In response to this situation, a number of allowances originally planned to be allocated through auctioning between 2014 and 2016 (corresponding to 900 million allowances in total) were not allocated. As a result of this so-called 'backloading' measure, the overall number of allowances available to operators has declined considerably.

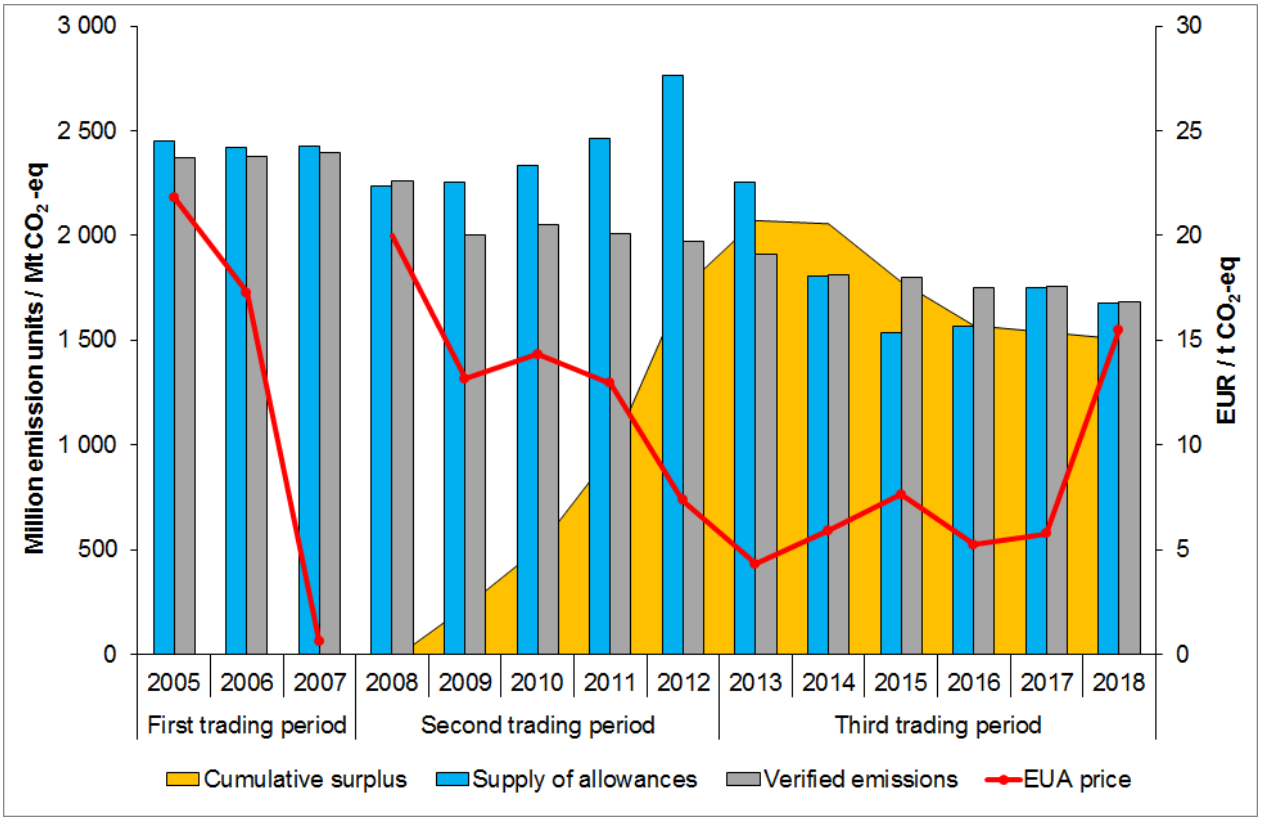
The supply of allowances for stationary installations declined in 2018 due to lower volumes of allowances being allocated for free (reflecting the planned annual reduction of the ETS cap), less allowances being auctioned than expected due to the suspension of German auctions towards the end of the year and the continued limited use of international offsets. The annual demand for allowances in the stationary sector of the EU ETS declined in 2018; however it was still slightly higher than the annual supply of allowances. Taking into account the net demand of 29 Mt CO_2-eq. from the aviation sector, the demand for allowances further exceeded the supply of allowances in 2018.

According to the European Commission (European Commission (EC), 2019b) the TNAC is currently around 1.65 billion allowances. To ensure the orderly functioning of the market and address the structural supply-demand imbalance, the Market Stability Reserve (MSR) started operation in January 2019. The MSR functions based on a set of pre-determined rules that place into a reserve a proportion of

([1]) Article 3(a) of the EU ETS Directive European Union (EU) 10/13/2003 defines the emission allowance as being 'an allowance to emit one tonne of carbon dioxide equivalent during a specified period, which shall be valid only for the purposes of meeting the requirements of this Directive and shall be transferable in accordance with the provisions of this Directive.'

the total allowances in the market when the number of allowances is above a certain threshold in order to reduce the TNAC over time and releases allowances if a lower threshold is met. The MSR is expected to make the EU ETS more resilient to future unanticipated shocks and to reduce the oversupply of allowances. Following the agreement on the revision of the EU ETS Directive, which enhances the ambition of the MSR (European Union (EU) 2018a), the price of EU allowances (EUAs) increased considerably in 2018 and averaged around EUR 15 per unit over the last year ([2]).

Figure ES.1 Emissions, allowances, surplus and prices in the EU ETS, 2005-2018



Note: 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 cumulative emissions. It also accounts for net demand from aviation during the same time period.

Sources: Point Carbon, (2012); European Environment Agency (EEA), 2019; EEX (2019); ICE (2019).

Power generation continues to drive emission reductions in the EU ETS. Emission trends for industrial installations have been more variable, reflecting the economic developments observed in Europe over the last three trading periods. Aviation emissions continue to grow year on year.

Between 2005 ([3]) and 2018, emissions from stationary installations declined by around 29 %. By 2014, emissions were already lower than the cap set for 2020. This reduction 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 an increase in electricity generation from renewables.

For industrial installations outside the energy sector, the emission reductions observed since the start of the second trading period are primarily due to lower levels of output following the economic recession in

([2]) The average EUA price for a given year is calculated by taking EEX prices and supplementing this with ICE prices for days only where the EEX price is not available.

([3]) The emission reduction between 2005 and 2018 is estimated based on the current scope of the EU ETS in the third trading period European Environment Agency (EEA) 2018; ETC/CME 2019.

2008. Other factors, such as improvements in energy efficiency and the increased use of biomass and waste as energy sources in production, may have further contributed to lower emission levels. Emissions and production output for industrial installations have been relatively flat since the beginning of the third trading period up until 2015, after which, certain sectors such as cement have started to increase their emissions and production output again while other sectors such as iron and steel have experienced a slight decline in both their emissions and production output.

Since aviation was included in the EU ETS, emissions from this sector have continued to increase year on year throughout the third trading period. This primarily reflects the increasing demand for air travel.

Member States project that, with the current measures in place, their EU ETS emissions will continue to decrease, albeit at a slower rate than historically. The overall projected reduction is not yet in line with EU objectives for emission reductions by 2030.

While total stationary ETS emissions decreased by 29 % between 2005 and 2018, the rate of reduction is projected to slow, according to scenarios reported by EU Member States in 2019 under EU legislation. EU ETS stationary emissions are projected to decline by 7 % between 2018 and 2030, with existing measures in place. This means a decrease of 36 % in 2030 compared to 2005. With additional policies and measures, emissions are projected to be reduced by an additional 5 %. So even with additional measures, emission reductions will amount to approximately 41 %, slightly less than the 43 % reduction target.

Based on the 'with existing measures' (WEM) projections, and on the agreed rules governing the MSR, the EEA estimates that the TNAC will quickly reduce in the coming years. As EU ETS emissions are projected to be higher than the cap from 2026 onwards, based on the WEM scenario, the demand for allowances will further contribute to the reduction of the TNAC. According to the recent EU Commission communication on the TNAC (EC, 2019), 397.2 million allowances will enter the reserve between September 2019 and August 2020. As such, the EEA has used the latest Member State projections to estimate that, with measures currently in place, the TNAC might not fall below the lower MSR threshold of 400 Mt before 2030.

1 Recent trends

- Between 2017 and 2018, the total European Union (EU) Emissions Trading System (ETS) emissions for stationary installations declined by 4.1 %. Emissions from combustion installations (mainly power plants) continued to decline in 2018 (minus 5.9% compared to 2017), which partly reflects the phasing out of coal use in several Member States. Emissions from industrial installations declined by an average of 0.7 % ([4]).
- The supply of EU allowances (EUAs) declined by 4.0 % in 2018, compared with the previous year, due to the decline in the number of free EUAs allocated, less allowances auctioned than expected and the limited use of international credit offsets.
- Most power plants had to buy their allowances in 2018, while industrial installations, deemed to be exposed to a risk of 'carbon leakage' (i.e. the increase of emissions outside of the EU because production is relocated to places where there are no or lower carbon costs than in the EU), received allowances for free. For the majority of industrial sectors, verified emissions were higher than the number of allowances received for free in 2018. This was due primarily to the continuous reduction of free allocation.
- Emissions from the aviation sector increased by 4.0 % in 2018, compared with the previous year, as the number of passengers continued to grow for many operators. Indeed, only nine stationary installations have higher emissions than the top emitting aircraft operator (Ryanair).
- The number of allocated EU aviation allowances (EUAAs) in 2018 was smaller than the emissions from the aviation sector. Aircraft operators therefore had to purchase EUAs from the stationary sector to comply with their emissions cap, set separately from the EU ETS cap for stationary installations.
- The overall annual demand for allowances from stationary installations and airline operators combined was higher in 2018 than the supply of allowances. This led to a further reduction in the imbalance between supply and demand. At the same time, the annual allowance price tripled in 2017/2018.

This chapter presents developments for stationary installations 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 stationary installations and aviation, which is discussed throughout the chapter.

([4]) This is the average decrease by ETS activity codes 21-99, which cover specific industries, and does not include the industrial installations without specific ETS activity, which are covered under combustion (ETS activity code 20). Data on verified emissions and compliance by operators under the EU ETS for the years up until 2018 are based on an extract of the EU Transaction Log from July 1st 2019.

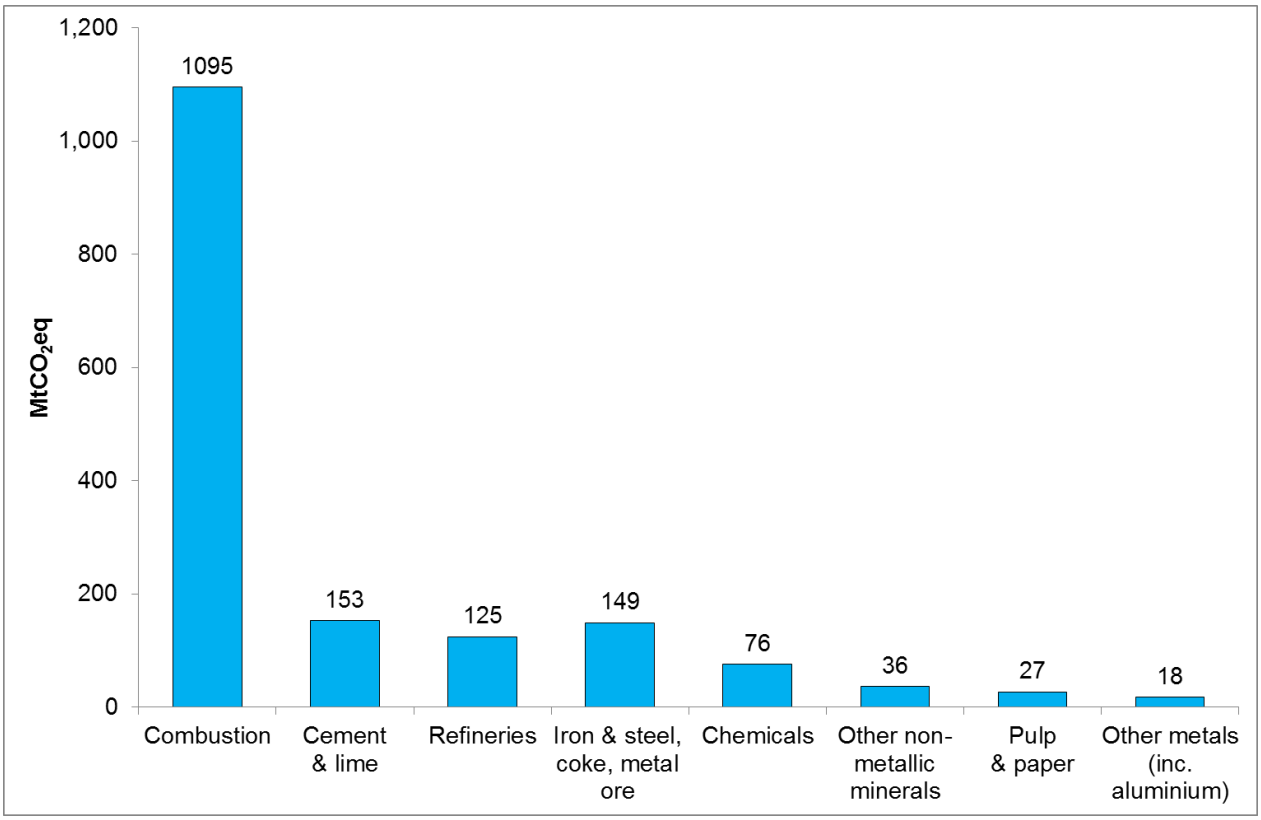
1.1 Stationary installations

1.1.1 Emission trends

Status in 2018

Figure 1.1 shows that combustion ([5]) installations (classified under the EUTL activity code that includes power plants) accounted for 65 % of the total verified emissions in the EU ETS in 2018, which is equivalent to 1 095 Mt CO_2-eq. ([6]). Cement and lime installations were the second highest emitters in the EU ETS in 2018 with 153 Mt CO_2-eq., followed by iron and steel ([7]) installations (149 Mt CO_2-eq.), refinery installations (125 Mt CO_2-eq.) and by chemical installations (76 Mt CO_2-eq.).

Figure 1.1 EU ETS emissions by main activity type in 2018



Note: The emissions cover all 31 countries that currently participate in the EU ETS.
EU Transaction Log (EUTL) activity codes have been aggregated for certain sectors throughout the report (refer to Table A1.1).
Substantial emissions originating from blast furnaces are included in combustion.

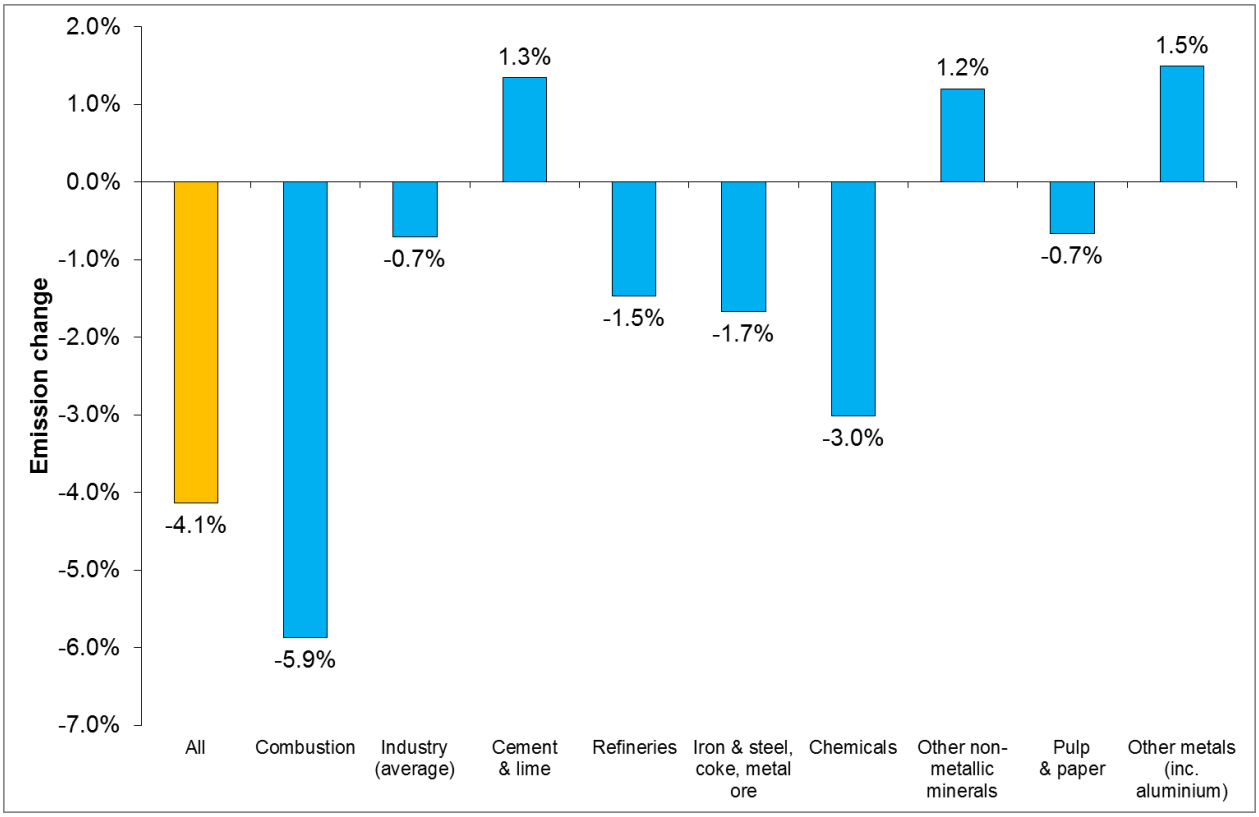
Source: European Environment Agency (EEA), 2019.

Total emissions for stationary installations in the EU ETS decreased by 4.1 % in 2018 compared with the previous year (Figure 1.2). The verified emissions of combustion installations declined at a faster rate in 2018 (i.e. by 5.9 % relative to 2017) than for industrial installations (i.e. by 0.7 % relative to 2017). Interestingly the decline in the verified emissions of industrial installations was achieved even though the

([5]) Combustion installations refers to those involving 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 European Commission (EC) 2010.
([6]) Mt CO_2e refers to million tonnes of carbon dioxide equivalent.
([7]) The verified emissions for iron and steel, coke and metal ore are based on the ETS activity classifications. In some cases, installations using waste gases from the production of iron and steel (e.g. blast furnace gas) are classified as ETS activity combustion.

annual output from EU-28 manufacturing increased by 1.6 %, on average ([8]), compared with the previous year (Eurostat 2019c). This implies that the emission intensity of manufacturing in ETS countries may be starting to decline. However, the industrial emission trends varied considerably by activity. For example, the verified emissions of cement and lime installations increased by 1.3 % compared to 2017 levels and this is likely to be driven, in part, by an increase in annual production output (refer to Figure 2.4 in Section 2.1.1). In contrast, chemical installations and iron and steel installations recorded a decline in verified emissions of 3.0 % and 1.7 % respectively compared to 2017 levels, which were partly driven by a decrease in annual production output (refer to Figure 2.4 in Section 2.1.1).

Figure 1.2 Change in EU ETS emissions by main activity, 2017-2018



Source: European Environment Agency (EEA), 2019.

Top 30 emitters (power)

In 2018, the 30 highest emitting power plants alone emitted 329 Mt CO_2, 30 % of the total combustion emissions in that year (Table 1.1). The top emitting power plants are located mainly in either Poland or Germany and burn lignite fuel. The largest emitter of all EU ETS installations is the lignite-fired power plant in Bełchatów, Poland, which emitted 38.3 Mt CO_2 in 2018 ([9]). This represents a 2 % increase in emissions compared with the previous year due to an increase in electricity production. Bełchatów is followed in the list by seven German lignite-fired power plants: Neurath, Niederaußem, Jänschwalde, Weisweiler, Schwarze Pumpe, Lippendorf and Boxberg Werk IV. Together, these plants emitted 132 Mt CO_2 in 2018. In total, eleven German power plants were included in the top 30 emitters in 2018 and accounted for 49 % of the emissions from this top 30 list of installations. Polish power plants,

([8]) Manufacturing is reported under code C of NACE rev. 2, the statistical classification of economic activities in the European Community. The increase in production output for manufacturing in 2017 for the EU-28 is calculated based on the annual average of the monthly index values for both 2017 and 2018.

([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.

including Kozienice (hard coal), Połaniec (hard coal), Turów (lignite), Rybnik (hard coal) and Opole (hard coal), as well as Bełchatów, account for 23 % of the emissions from this top 30 list of installations.

All of the eight highest emitting power plants in 2018 were lignite fired (Table 1.1). Lignite-fired power plants have higher specific emissions than hard coal- or natural gas-fired power plants. The CO_2 intensity of the top eight emitting lignite-fired power plants in 2018 averaged around 1 100 g CO_2/kWh.

The emission intensity of hard coal-fired power plants ranges between 700 and 1 000 g CO_2/kWh (Table 1.1). For the several hard coal-fired plants that also use additional fuel inputs, their emission intensity varies above or below this range. For example, the Aboño hard coal power station in Spain uses several other fuels, including fuel oil, diesel and the excess gases produced by the ArcelorMittal Asturias (Gijón) steel mill and had a higher emission intensity of 1 400 g CO_2/kWh.

Table 1.1 Top 30 emitters in 2018 (power plants)

			Installed capacity 2018	Verified emissions 2018		Electricity generation 2018		Emission intensity 2018	
EUTL ID	Power plant	Fuel	MW	Mt CO_2	vs. 2017	TWh	vs. 2017	t CO_2 / MWh	vs. 2017
PL 1	Bełchatów	Lignite	5,472	38.3	2%	33.2	1%	1.2	1%
DE 1606	Neurath	Lignite	4,212	32.2	8%	29.5	9%	1.1	-1%
DE 1649	Niederaußem	Lignite	3,395	25.9	-5%	23.6	0%	1.1	-5%
DE 1456	Jänschwalde	Lignite	2,998	22.8	-3%	19.8	1%	1.2	-4%
DE 1607	Weisweiler	Lignite	2,363	16.8	-11%	13.2	-13%	1.3	2%
DE 1459	Schwarze Pumpe	Lignite	1,510	12.4	9%	11.0	9%	1.1	0%
DE 1460	Lippendorf	Lignite	1,782	11.7	3%	12.1	1%	1.0	2%
DE 1454	Boxberg Werk IV	Lignite	1,470	10.2	-4%	9.9	-4%	1.0	0%
PL 4	Kozienice	Hard Coal	2,941	9.7	-13%	10.6	-12%	0.9	-1%
BG 50	Maritsa East 2	Lignite	1,604	9.6	-9%	8.5	-6%	1.1	-4%
GR 15	Dimitrios	Lignite	1,456	9.2	3%	6.1	-1%	1.5	4%
DE 1453	Boxberg Werk III	Lignite	1,000	8.8	3%	7.4	3%	1.2	0%
PL 5	Połaniec	Hard Coal	1,882	8.2	17%	10.2	10%	0.8	6%
IT 439	Torrevaldaliga Nord	Hard Coal	1,845	8.1	-17%	8.8	-60%	0.9	110%
NL 205957	Eemshaven Centrale	Hard Coal	1,580	8.0	5%	10.7	6%	0.7	-1%
ES 647	Puentes	Hard Coal	1,403	7.9	-2%	8.0	-4%	1.0	2%
EE 2	Narva	Oil Shale	1,369	7.8	-7%	6.9	-6%	1.1	-1%
PL 2	Opole	Hard Coal	1,532	7.5	19%	8.0	22%	0.9	-2%
PT 100	Sines	Hard Coal	1,180	7.4	-11%	8.1	-14%	0.9	3%
ES 201	Aboño 1	Hard Coal, Blast Furnace Gas	879	7.1	-14%	5.0	-17%	1.4	4%
PL 3	Turów	Lignite	1,488	6.9	-3%	6.6	-2%	1.0	-1%
DE 1380	Mannheim	Hard Coal	1,971	6.7	-2%	7.1	-1%	0.9	-1%
ES 43	Litoral	Hard Coal	1,120	6.3	14%	7.0	14%	0.9	0%
DE 206180	Moorburg	Hard Coal	1,600	6.2	1%	7.7	2%	0.8	0%
DE 1376	Kraftwerk Schkopau	Lignite	900	6.1	10%	4.9	14%	1.2	-3%
GR 14	Kardia	Lignite	1,103	5.8	-9%	3.6	-10%	1.6	1%
CZ 124	CEZ, a. s. - Elektrarna Pc	Lignite	930	5.5	-2%	5.3	-2%	1.0	0%
IT 521	Brindisi Sud	Hard Coal	2,420	5.5	-16%	5.5	-56%	1.0	93%
PL 6	Oddział w Rybniku	Hard Coal	1,790	5.2	-19%	5.4	-20%	1.0	1%
HU 142	Mátrai Eromu ZRt.	Lignite, Natural Gas	950	5.2	-9%	4.7	-8%	1.1	-7%

Note: All installations are power plants reporting under the activity code combustion in the EUTL.
Installed capacity is net for German plants and gross in most other countries.
Information on installation HU-142 Mátrai Erőmű Zrt has been provided by the Department for Climate Policy, Hungary.

Sources: Platts, (2014); European Union (EU) (2019).

Several hard coal-fired power plants based in Italy (i.e. Torrevaldaliga Nord and Brindisi Sud) experienced a considerable increase in their emission intensity in 2018 driven primarily by lower electricity production and a switch to more emission intensive fuel inputs.

A lignite power plant that re-entered the top 30 list of emitters in 2018 is the Mátrai Power Station, which is based in Hungary and is responsible for around 17 % of the country's electricity generation (Orosz 2018). The Schkopau (lignite) and Litoral (hard coal) plants also re-entered the list due to higher emissions in 2018 than the previous year that were mainly driven by increased levels of electricity production.

The verified emissions from the Drax power plant in the UK reduced by a further 33 % in 2018 compared to the previous year. As a consequence, the plant is no longer one of the top 30 emitters. The emission reductions in 2018 were achieved via the 'reduced use of coal and the conversion of a fourth generating unit at Drax Power Station to use sustainable biomass as fuel' (Drax 2019).

Top 30 emitters (industry)

In 2018, the 30 highest emitting industrial plants that are not power plants ([10]) emitted around 140 Mt CO_2-eq., 24 % of the total industrial emissions (Table 1.2). The highest emitting industrial plants are spread out across Europe, with no single country dominating the list. However, all of the top five industrial emitters belong to the iron and steel sector. Overall, this sector accounted for 73.0 % of the total emissions by the 30 highest emitting industrial plants ([11]), followed by refinery installations (22.8 %), chemical installations (2.2 %) and cement clinker installations (2.0 %).

An industrial plant producing cement clinker in Poland (Górażdże Cement S.A.) entered the top 30 list in 2018 with a 33 % increase in their verified emissions compared to the previously year. This is likely to reflect an increase in the plant's output following the construction sector in Poland recording 'a double-digit rise of 12.9 % thanks to the positive development of residential and infrastructure construction' (Heidelberg Cement 2019). By contrast, the greatest reduction in verified emissions between 2017 and 2018 out of the top 30 industrial emitters was recorded for the Voestalpine Stahl Linz installation, which has invested in energy efficiency improvements at the site in recent years (Voestalpine 2018).

([10]) In this report, industrial installations are understood to be 'non-combustion' installations, even though some industrial installations are included in the ETS activity combustion and most combustion installations are normally considered industrial installations as well.

([11]) 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).

Table 1.2 Top 30 emitters in 2018 (industrial plants, excluding combustion)

EUTL ID	Installation	Activity code	Verified Emissions 2018	
			Mt CO_2-eq	vs. 2017
DE 69	Integriertes Hüttenwerk Duisburg	24	8.3	5%
FR 956	Arcelormittal Atlantique Et Lorraine - Dunkerque	24	8.1	-2%
AT 16	Voestalpine Stahl Linz	24	7.8	-15%
FR 628	Arcelormittal Mediterranee	24	7.5	-6%
NL 144	Tata Steel Ijmuiden Bv Bkg 1	24	6.5	-5%
IT 575	Impianti Di Raffinazione	21	6.3	0%
IT 515	Arcelormittal Italia Spa - Stabilimento Di Taranto	24	6.1	-5%
SK 150	U. S. Steel Košice, S.R.O.	24	6.0	0%
GB 325	Port Talbot Steelworks	24	5.8	-11%
ES 212	Arcelormittal España, S.A.	24	5.6	6%
GB 321	Scunthorpe Integrated Iron & Steel Works	22	5.1	2%
DE 53	Glocke Duisburg	24	4.9	-5%
DE 52	Roheisenerzeugung Dillingen	24	4.7	1%
BE 203912	Arcelormittal Gent 1	24	4.5	2%
DE 43	Glocke Salzgitter	24	4.4	2%
NL 99	Shell Nederland Raffinaderij B.V.	21	4.2	10%
RO 44	Arcelormittal Galati Sa	24	4.1	6%
FI 445	Raahen Terästehdas	24	4.0	6%
DE 19	Pck Raffinerie Glocke Schwedt	21	3.8	-1%
BE 127	Total Raffinaderij Antwerpen	21	3.6	-1%
BE 203830	Basf Antwerpen - 127A	42	3.1	-5%
AT 13	Sinteranl., Hochöfen, Stahlwerk Donawitz	24	2.9	-5%
CZ 73	Arcelormittal Ostrava A.S.	24	2.9	13%
DE 4	Ruhr Oel Gmbh - Werk Scholven - Co2-Glocke	21	2.9	-14%
AT 26	Raffinerie Schwechat	21	2.8	3%
FR 253	Raffinerie De Normandie	21	2.8	-8%
PL 490	Górażdże Cement Spółka Akcyjna	29	2.7	33%
FI 533	Porvoon Jalostamo	21	2.7	-3%
CZ 114	Třinecké Železárny	24	2.7	3%
DE 11	Werk 1 Und Werk 2	21	2.7	-5%

Sources: European Union (EU) (2019).

1.1.2 Balance of allowances

Supply and demand

The total supply of 1679.1 million allowances in 2018 declined by 4.0 % compared with the previous year. This comprised free allocation, allowances auctioned and the exchange of international credits (Table 1.3). The supply of free allowances allocated (without transitional allocation for the modernisation of electricity generation) was 3.8 % lower than in 2017. This reduction reflects the fact that free allocation to existing installations is reducing every year, depending on the linear reduction factor and the cross-sectoral correction factor, as well as the carbon leakage status relevant for allocation ([12]). Furthermore, some of the free allowances normally allocated to existing installations under Article 10(a)(1) of the ETS Directive were not allocated as a result of installation closures or reductions in

([12]) Since 2013, power generators have been required to buy all their allowances, with exceptions made for some countries. Manufacturing industry received 80 % of the benchmark allocation free in 2013. This proportion will decrease gradually year on year, down to 30 % in 2020. For sectors and sub-sectors deemed to be exposed to a significant risk of carbon leakage, this carbon leakage factor will remain 100 %.

production levels ([13]). The number of 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 27.7 % in 2018 compared with the previous year.

The number of allowances auctioned in 2018 was, against expectations, 3.7 % lower than the previous year. This was due to the suspension of German auctions in November for 2018 as a consequence of the country listing the European Energy Exchange (EEX) as its renewed opt-out auction platform. The EEX could only resume auctions for the Federal Republic of Germany once the ETS Auctioning Regulation had been amended to list EEX as Germany's new opt-out auction platform which was delayed (EEX 2018). The use of international credits increased by 54.5 % in 2018 compared with 2017. The upper limit for the exchange of certified emission reduction (CER) or emission reduction unit (ERU) for allowances until 2020 has now been almost completely exhausted (Table 1.3 and see Article 11(a)(8) of the ETS Directive).

In 2018, verified emissions from stationary installations declined by 4.1 % compared with the previous year. The demand for allowances in the stationary sector in 2018 was slightly higher than the supply of allowances. Taking into account the net demand of 29 Mt CO_2-eq. from the aviation sector, the demand in 2018 further exceeded the supply of allowances (see Table 1.4). The allowance price tripled between 2017 and 2018 reflecting the expected shortage in future years due to the introduction of the MSR and the political agreement on reforms to the EU ETS for the fourth trading period.

Table 1.3 Summary of EU ETS developments in stationary installations, 2017-2018

	2017	2018	Change
Verified emissions (Mt CO_2-eq.)	1754.6	1682.0	-4.1%
Combustion emissions	1163.6	1095.2	-5.9%
Industrial emissions	591.0	586.8	-0.7%
Total supply of allowances (millions of EUAs)	1749.5	1679.1	-4.0%
Free allocation (incumbents, new entrants)	740.4	711.9	-3.8%
For existing installations	716.8	688.2	-4.0%
For new entrants and capacity extensions	23.6	23.8	0.7%
Transitional free allocation for electricity generation	46.3	33.5	-27.7%
Auctioned amounts/primary market sales	951.2	915.8	-3.7%
International credits exchanged	11.6	17.9	54.5%
Supply/demand balance (millions of EUA)			
Balance stationary installations only	-5.1	-3.0	-41.4%
Net demand in EUAs from aviation	-26.9	-29.1	8.1%
Annual balance all ETS	**-32.0**	**-32.0**	0.3%
EUA price (EUR)	5.8	15.5	169.2%

Notes: The distinction between combustion and industrial emissions is based on the EUTL classification of activities and does not take into account waste gas transfers from the production of iron and steel or cross-boundary heat flows.
EUTL data accessed on the 1st of July, 2019.

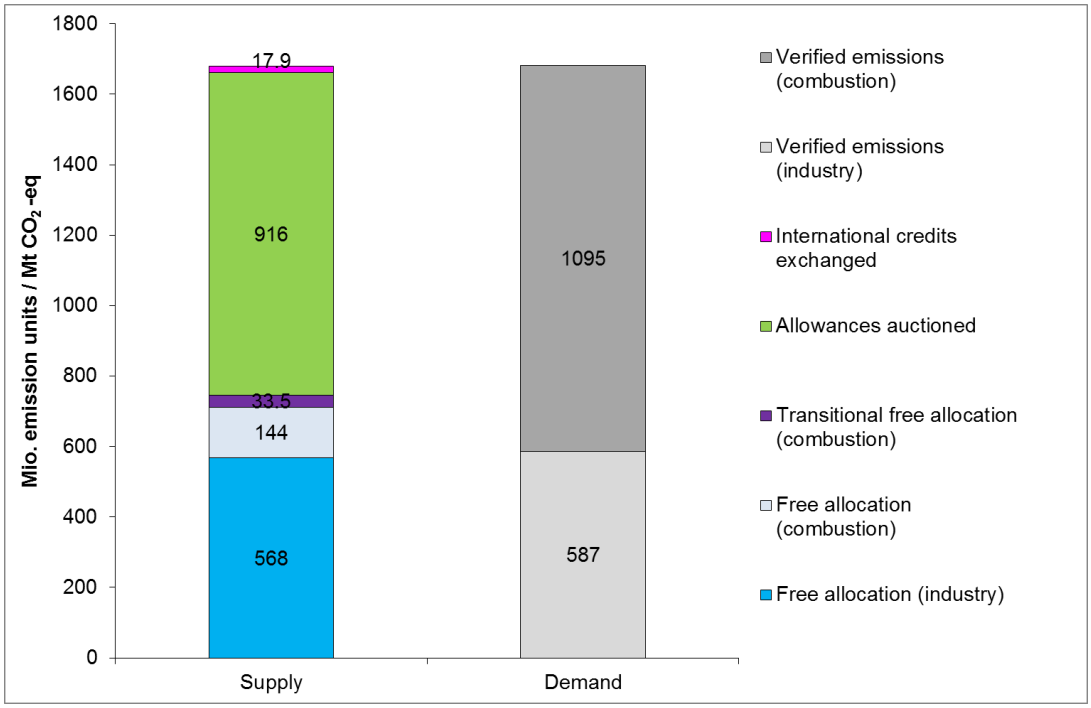
Sources: European Environment Agency (EEA), 2019. EEX (2019); ICE (2019).

([13]) 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).

Supply and demand by main activity type

In 2018, the demand for allowances from stationary installations was slightly higher than the supply of allowances (Figure 1.3). Mainly combustion installations had to buy most of their allowances to cover their emissions through auctions, from other market participants or through the purchase of international credits. In the third trading period there is generally no free allocation for electricity generation ([14]). This is due to the fact that this sector passed through costs to costumers and in the past gained windfall profits. Industrial installations received a larger number of free allowances, although not enough to completely cover their verified emissions ([15]). However, these allowances were not distributed evenly across all industrial sectors.

Figure 1.3 Supply and demand balance for combustion and industry in 2018



Note: Industry refers to those EUTL activities (21-99) that specifically refer to certain industrial activities. In addition to power plants, the sector combustion covers industrial installations without a specific ETS activity.

Source: European Environment Agency (EEA), 2019.

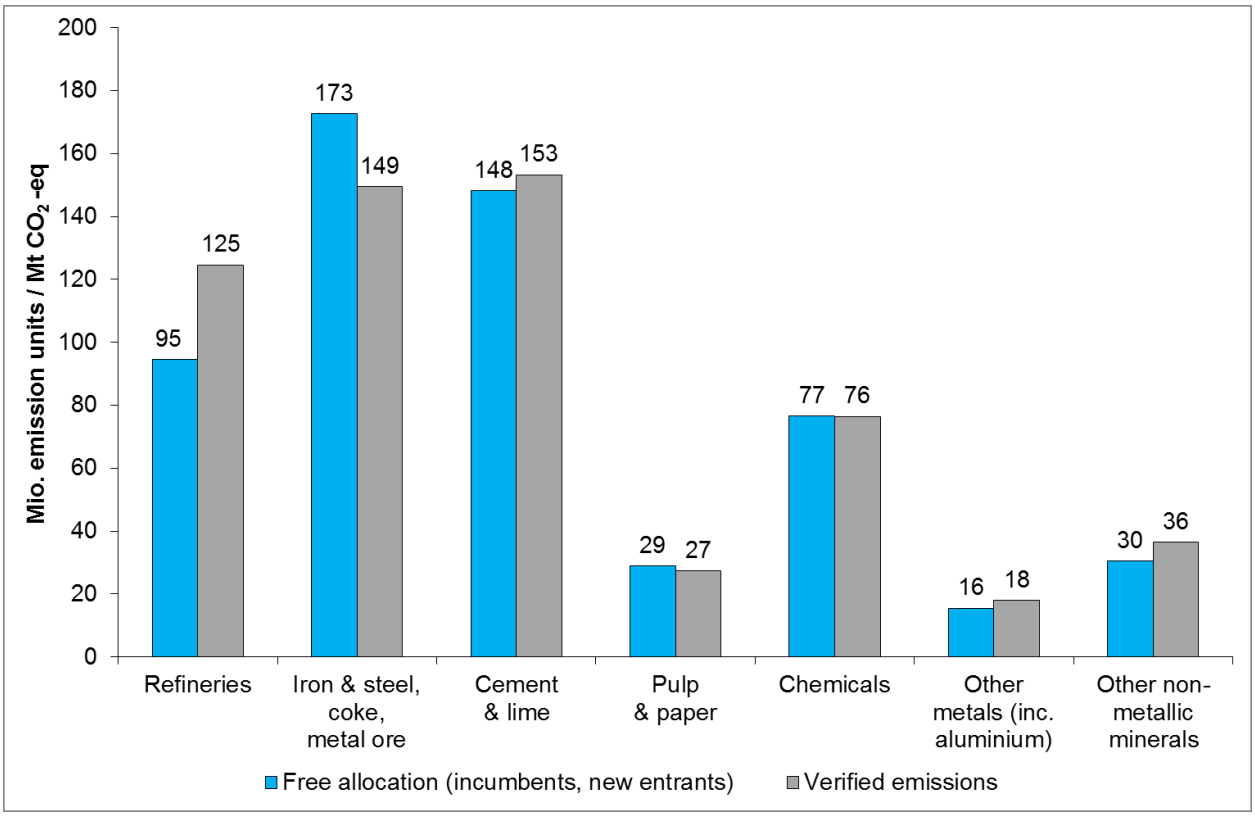
Based on activity classifications under the EUTL, Figure 1.4 shows that in 2018 the iron and steel sector received around 24 Mt more free allowances than it emitted, whereas the refinery sector received around 30 Mt fewer free allowances than it emitted. Emissions have also been higher than allowances (albeit to a lesser extent) in sectors such as cement and lime, other metals (including aluminium) and other non-metallic minerals. However, the balance between free allocation and verified emissions by sector importantly depends upon the way in which waste gases are reported under the EU ETS (refer to the note under Figure 1.4 for further information).

([14]) Under Article 10(a)(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 10(c) of the ETS Directive, to enable those countries to modernise their electricity systems.

([15]) 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 10(a)(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 on as whether or not the sector is recognized as exposed to a significant risk of carbon leakage.

The fact that the majority of the sectors had less emission allowances allocated for free in 2018 than their verified emissions shows that the cap on emissions and thus the level of free allocation is continuously tightened through the so-called cross-sectoral correction factor, whereas emissions do not decline at the same pace. Industrial installations, however, continue to receive a large number of free allowances (based on historical production volumes, product-specific benchmarks and an installation's carbon leakage status) and industries could build up a reserve of allowances over several years after lower than expected output following the economic recession.

Figure 1.4 Balance of free allocations and verified emissions in 2018 by industrial activity



Note: ETS activity types have been aggregated for certain sectors (Table A1.1). 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: European Environment Agency (EEA), 2019.

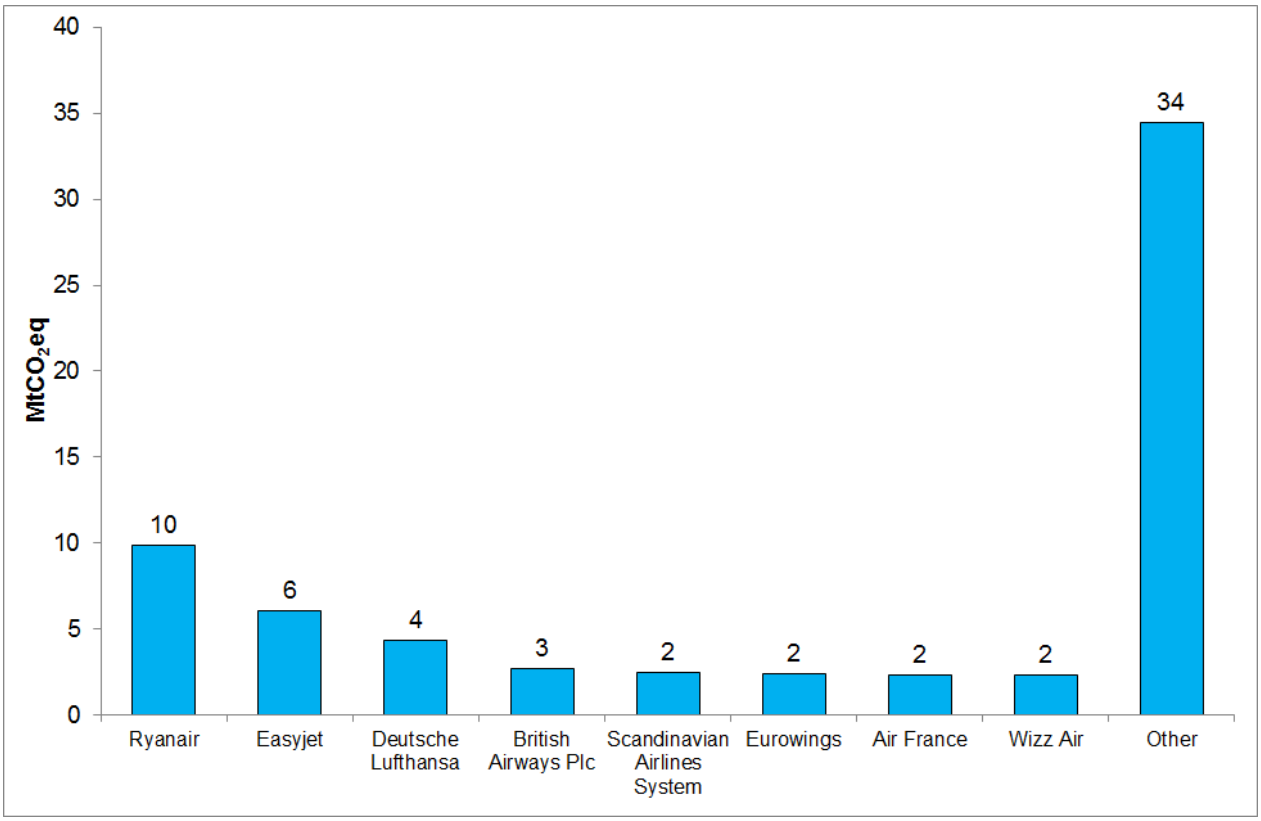
1.2 Aviation

1.2.1 Emission trends

Status in 2018

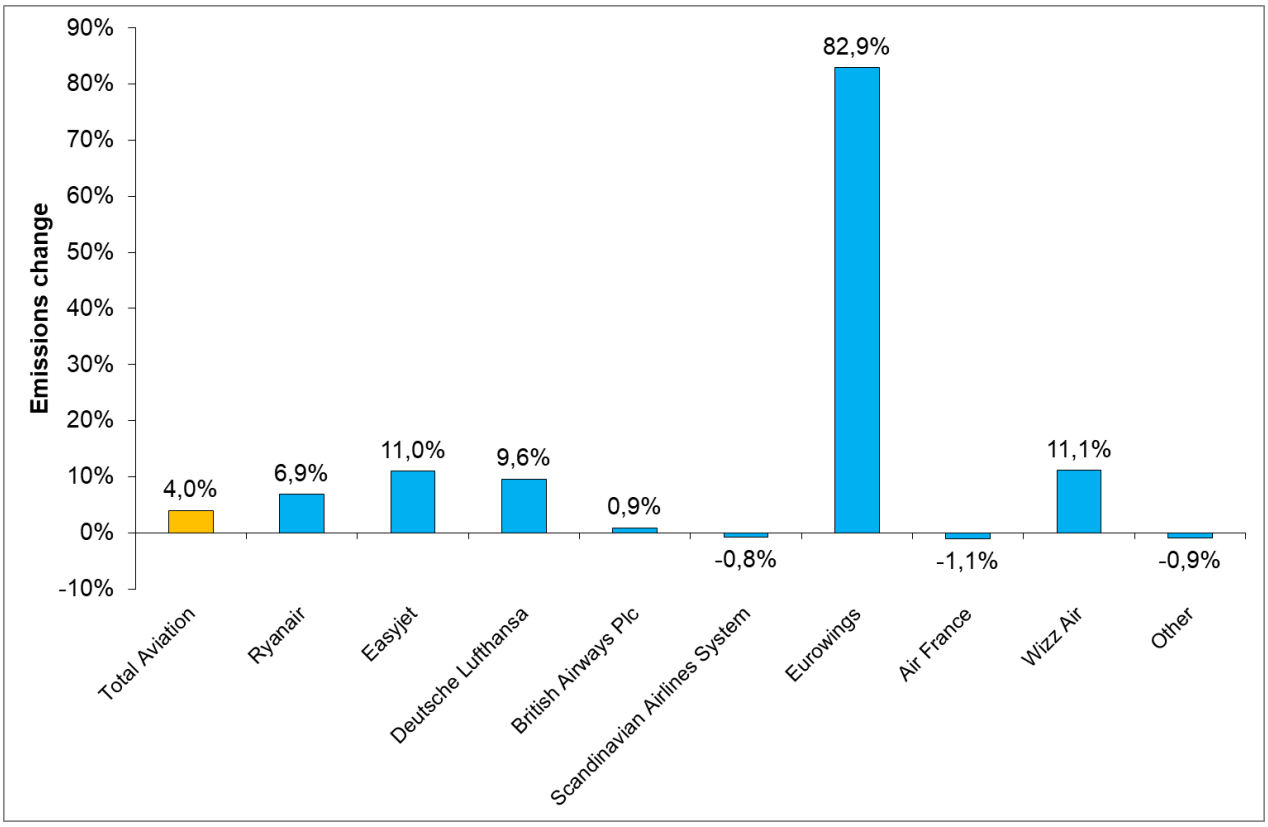
In 2018, the aviation sector covered by the EU ETS emitted 67.0 Mt CO_2-eq, which represents an increase of 4.0 % compared to the previous year. The seven largest aircraft operators were responsible for 45 % of these emissions. Ryanair and EasyJet were the two highest emitters in the aviation sector in 2018, accounting for around 10 Mt CO_2-eq. and 6 Mt CO_2-eq. respectively (Figure 1.5). Significantly the continued year on year increase in the verified emissions of Ryanair has resulted in the airline operator entering the list of the top 10 emitters in the EU ETS for the first time in 2018. However, Eurowings has experienced the most rapid growth in 2018 (Figure 1.6) with '30 additional planes, 70,000 more flights and eight million additional passengers' (Eurowings 2019).

Figure 1.5 Aviation emissions by carrier in 2018



Source: European Environment Agency (EEA), 2019.

Figure 1.6 Relative change in ETS aviation emissions, 2017-2018



Source: European Environment Agency (EEA), 2019.

1.2.2 Balance of allowances

Supply and demand

In 2018, aviation emissions covered by the EU ETS increased by 4.0 % compared with the previous year. At the same time, the supply of aviation allowances remained relatively stable because the emission cap has stayed the same in each year of the third trading period. The shares of this supply are fixed, 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 to the market (European Commission (EC) 2018a).

Table 1.4 shows that 5.6 million allowances were auctioned in 2018, 18.4 % more than in the previous year. This was due to a delay in the auctioning of EUAAs in the previous year, as a prolongation of the 'stop-the-clock' decision ([16]) had to be decided upon following the ICAO assembly in October 2016 ([17]). A consensus was reached towards the end of 2017 to maintain the current limitations on the scope of the EU ETS to intra EEA flights and prolong the derogation for extra EEA flights until 31st of December 2023 (European Commission (EC) 2017a). Within 12 months of the adoption of ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), the Commission shall present a report to the European Parliament and to the Council. Among other aspects, the Commission shall, in that report, also consider the rules applicable in respect of flights within the EEA, as appropriate. It shall also examine the ambition and overall environmental integrity of CORSIA.

([16]) 'The 'stop-the-clock' scope that was applied to the 2013-2016 period under which flights to and from outermost regions and third countries were derogated, while flights between EEA airports remain fully covered' (Green Air Online 2017).

([17]) Because of this delay, the average annual EUAA price in 2017 was higher than the annual EUA price, as EUAAs were auctioned less frequently and later in the year when the value of allowances was greater.

The use of international credits increased compared to 2017. Nevertheless, the aviation sector still has to purchase more EUAs to in order to comply with its emissions cap, as the net demand for allowances has continued to rise to 29.1 million.

Table 1.4 Summary of EU ETS developments for aviation operators, 2017-2018

	2017	2018	Change
Total demand (Mt CO_2-eq.)	64.4	67.0	4.0%
Aviation emissions	64.4	67.0	4.0%
Total supply (millions of EUAAs)	37.5	37.9	1.1%
Aviation free allocation	31.6	31.0	-1.7%
Aviation free allocation (NER)	1.1	1.1	0.0%
Average auctioned amounts	4.7	5.6	18.4%
Estimated international credits exchanged	0.1	0.2	54.5%
Annual supply-demand balance (millions of EUAAs)	-26.9	-29.1	8.1%
EUAA price (EUR)	7.2	18.4	153.9%

Notes: NER, New Entrants Reserve.

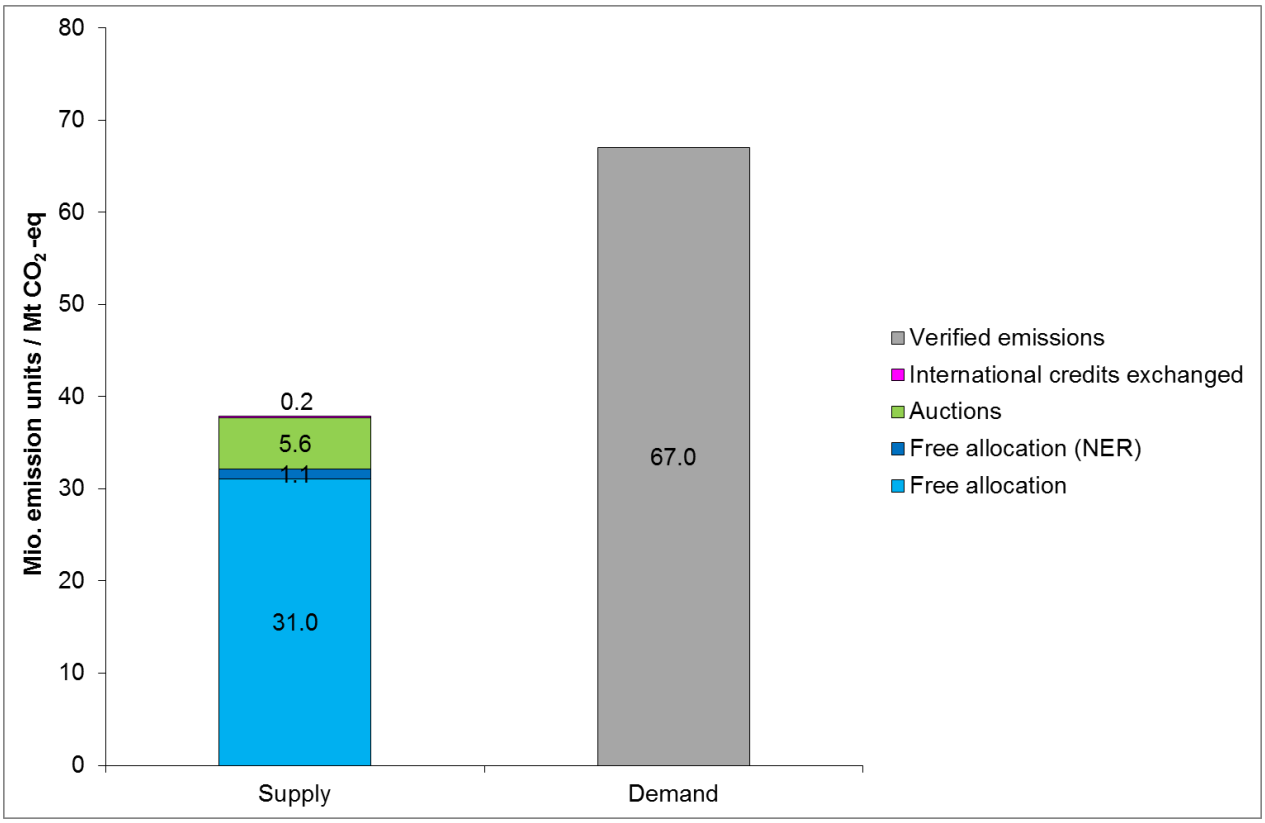
The higher average EUAA price compared to the average EUA price in 2018 (refer to Table 1.3) reflects the fact that the fewer number of EUAA auctions took place after May in 2018 when prices were higher compared to the start of the year.

EUTL data accessed on the 1st of July, 2019.

Sources: European Environment Agency (EEA), 2019. EEX (2019); ICE (2019).

In 2018, aircraft operators were allocated 32.1 million free allowances (including the free allowances from the NER), an additional 5.6 million EUAAs were auctioned and a further 0.2 million of international credits were estimated to have been exchanged for EUAAs (Figure 1.7). In total, these allowances covered 57 % of the total aviation emissions (67.0 Mt CO_2-eq.). The difference in allowances necessary for compliance had to be purchased on the 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 during the third trading period).

Figure 1.7 Supply and demand balance for aviation in 2018



Note: International credits exchanged (aviation) estimated based on total CER/ERUs exchanged.

Sources: European Commission (EC), (2018d); European Environment Agency (EEA), (2018).

2 Long-term trends

- Stationary EU ETS emissions decreased by 29 % between 2005 and 2018. The decrease was mostly driven by emission reductions in power generation, which was largely the result of lower electricity generation from hard coal and lignite fuels and a large increase in electricity generation from renewables over the same period.
- Emissions from industrial activities covered by the EU ETS have also decreased since 2005, but have remained relatively stable during the third trading period up until 2015, after which, certain sectors such as cement have started to increase their emissions again while other sectors such as iron and steel have experienced a slight decline in their emissions.
- During the third trading period, the emissions and production volumes for industrial sectors were relatively flat up until 2016 but since then certain sectors such as cement, lime and plaster have increased their production output whilst other sectors such as iron and steel have experienced a decline in production output.
- Aviation emissions have increased year on year during the third trading period, reflecting the large growth in passenger numbers.
- The supply of allowances freely allocated to installations has reduced over time. In contrast to the earlier trading periods of the EU ETS, the majority of installations in the power sector must now purchase allowances via auctions or on the secondary market. Eight central and eastern EU Member States remain eligible for transitional free allocations to support the modernisation of their power sector. 71% of their maximum budget has been allocated between 2013 and 2018 and 19% of the budget was or will be auctioned up to 2020. The use of the remaining 10 % of the allowances has not yet been specified but may be used to either modernise electricity generation or will alternatively be auctioned. The New Entrants Reserve (NER) provides allowances to new installations or any significant increase in capacity to existing installations during the third trading period. After 6 years of the current 8-year trading period, 34 % of the allowances in the NER (as of January 2019) have been either used or reserved for future use. Most of the NER allowances used have been allocated to support capacity extensions.
- The number of allowances auctioned has increased in the third trading period, although the backloading measure withdrew 900 million EUAs from the market between 2014 and 2016 (and they were subsequently placed in the MSR). The number of EUAs auctioned in 2017 increased considerably following the end of the backloading measure and then dropped slightly in 2018 compared to the previous year. The volume of EUAAs auctioned increased in 2018 after experiencing fewer delays than in the previous year. The revenues Member States received in the third trading period from the auctioning of allowances have varied in response to these changes.
- The allowance price increased considerably in 2018, which was in part, a market reaction to the political agreement to reform the EU ETS for the fourth trading period that should lead to a reduction in the total number of allowances in circulation (TNAC) over time.

This chapter discusses stationary installations and aviation separately, focusing first on the development of emission trends between 2005 and 2018 and second on the implications for the supply and demand of allowances. As aircraft operators can also purchase EUAs, the interaction between stationary installations and aviation is discussed throughout the chapter.

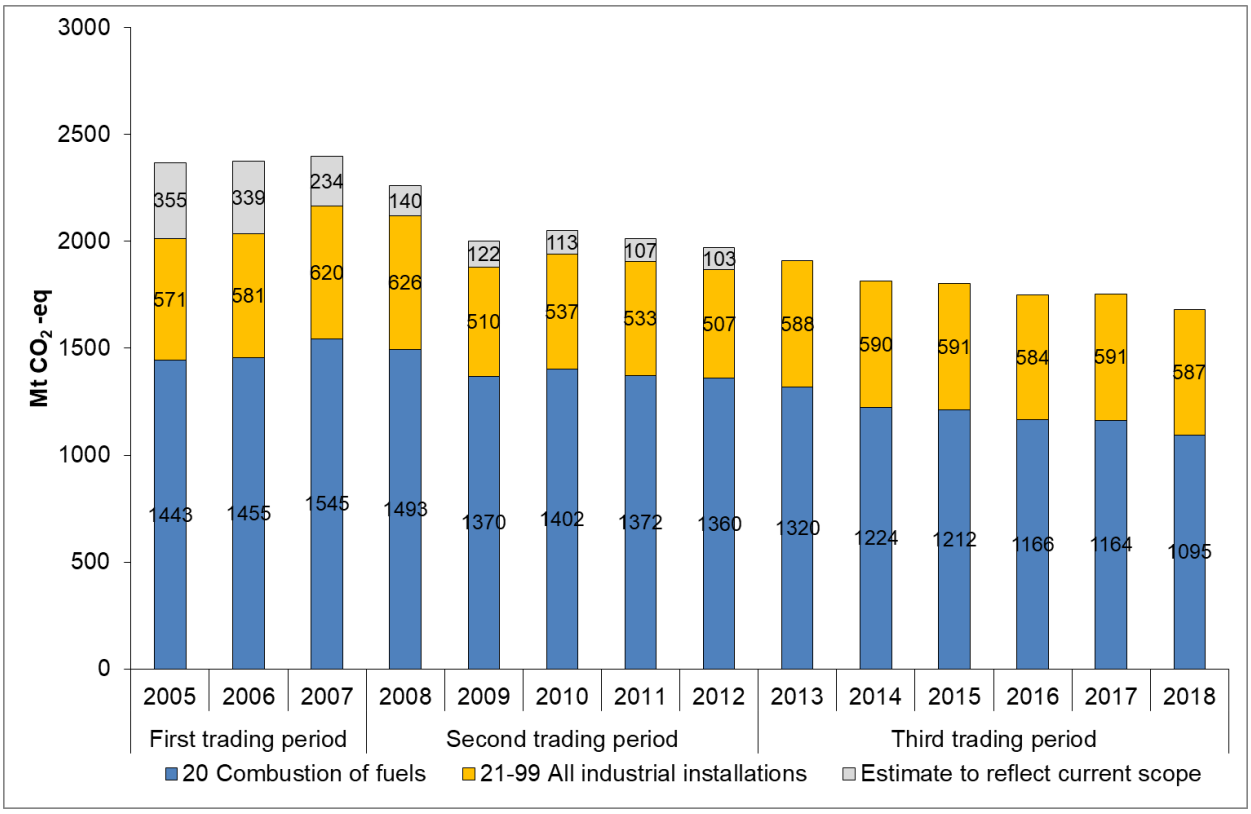
2.1 Stationary installations

2.1.1 Emission trends

Total EU ETS emissions

By the end of the second trading period, EU ETS emissions had fallen to 17 % below 2005 levels (Figure 2.1). After 6 years of the third trading period, emissions are now 29 % below 2005 levels. Thus the 2020 target in the climate and energy package has been overachieved, which aimed at reducing ETS emissions by 21 % below 2005 levels. Changes in emissions depend on changes in both activity levels and the emissions intensity of production, both of which are influenced by policy and non-policy factors. This makes it difficult to ascertain the extent to which emission reductions are directly attributable to the EU ETS.

Figure 2.1 Verified emissions disaggregated by combustion and industry sectors, including an estimate to reflect the scope of the third trading period, 2005-2018



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.

Source: European Environment Agency (EEA) (2019).

Combustion-related emissions, which accounted for 65 % of the total EU ETS emissions in 2018, and have been the main driver of 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 cooling; and, therefore, 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.

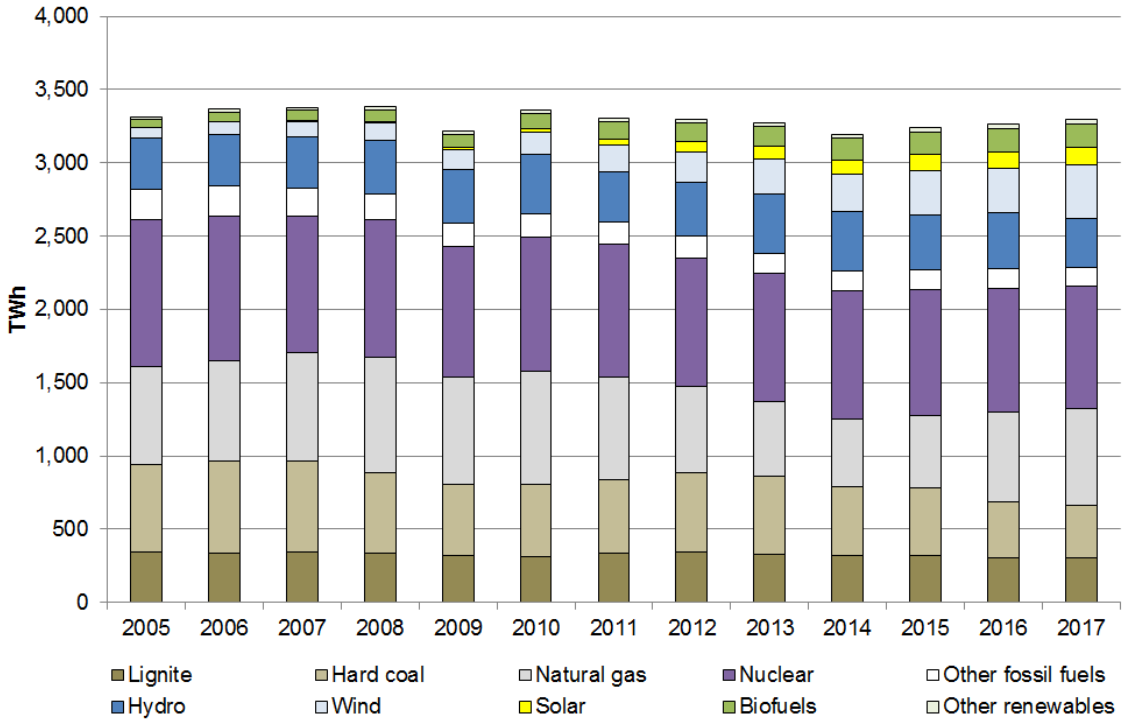
- The fuel mix used to transform primary energy into electricity or heat is also a determinant. It depends on energy infrastructure and is affected by relative variations in fuel prices. Energy policies also play a key role in modifying fuel mixes, for example by promoting the deployment of renewable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

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

Energy sector

The decline in verified emissions in the combustion sector over recent years has been influenced by considerable changes to the fuel mix. Between 2005 and 2017, electricity generation for the EU-28 from hard coal, lignite and nuclear power declined by 40 %, 12 % and 17 %, respectively (Figure 2.2). These reductions in electricity generation were offset by an increase in gross electricity generation from renewables such as wind, solar and biomass over the same period. The Renewable Energy Directive has encouraged the uptake of renewables, which has also been 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.

Figure 2.2 Gross electricity generation by fuel in the EU-28, 2005-2017



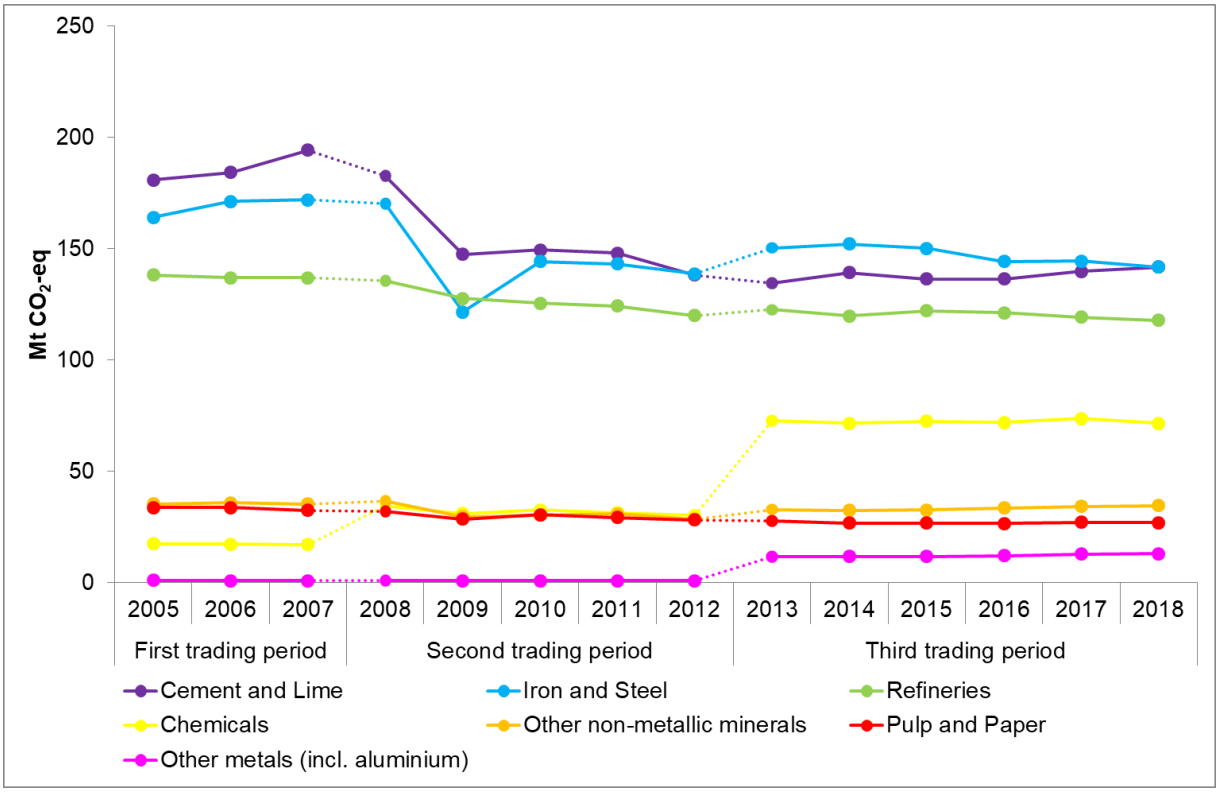
Source: Eurostat (2019b)

Industry sector excluding energy utilities

In the first trading period (2005-2007), 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). All of the

industrial activities covered by the EU ETS for the EU-25 ([18]) experienced a decline in their verified emissions during the second trading period. The iron and steel sector and the cement and lime sector also experienced a sharp drop in verified emissions of 29 % and 19 %, respectively, in a single year (2009). During the third trading period, emissions remained relatively stable up until 2015, after which, certain sectors have started to increase their emissions again while other sectors have instead experienced a slight decline in their emissions ([19]). For example, verified emissions in the cement sector have increased by 5 % between 2013 and 2018 whilst verified emissions in the iron and steel sector have declined by 6 % over the same time period.

Figure 2.3 EU ETS emissions by main industrial activity in the EU-25, 2005-2018



Note: ETS activity codes have been aggregated for certain sectors (refer to Table A1.1).

Source: European Environment Agency (EEA) (2019).

The emission reductions of industrial installations since the start of the second trading period are primarily due to lower levels of output following the economic recession in 2008. This can be clearly observed in the 2008/2009 changes to the production volume index for all sectors in Figure 2.4. Secondary explanatory factors, such as improvements in energy efficiency and the increased use of biomass and waste as energy sources in production, may have further contributed to lower emissions levels ([20]). During the third trading period, the emissions and production volumes for industrial sectors were relatively flat up until 2015 but since then certain sectors such as cement, lime and plaster have

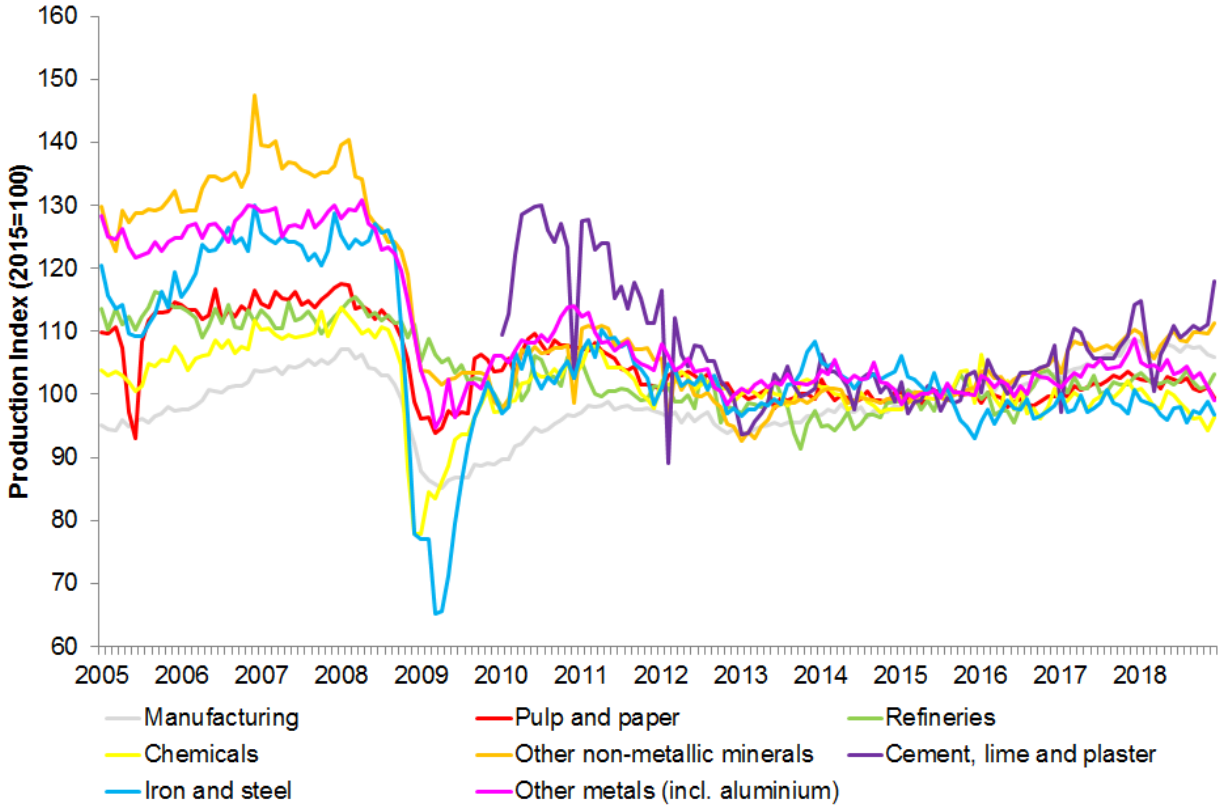
([18]) Verified emissions are shown for only the EU-25 to provide a consistent number of Member States during the period 2005-2018.

([19]) Notable differences in verified emissions are observed in the chemicals industry and the production of other metals (including aluminium), for which 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.

([20]) Attributing output changes to emission changes at the right level of disaggregation requires a detailed assessment that is beyond the scope of this report.

increased their production output whilst other sectors such as iron and steel have experienced a decline in production output.

Figure 2.4 Monthly volume index of production by main activity in the EU-28, 2005-2018



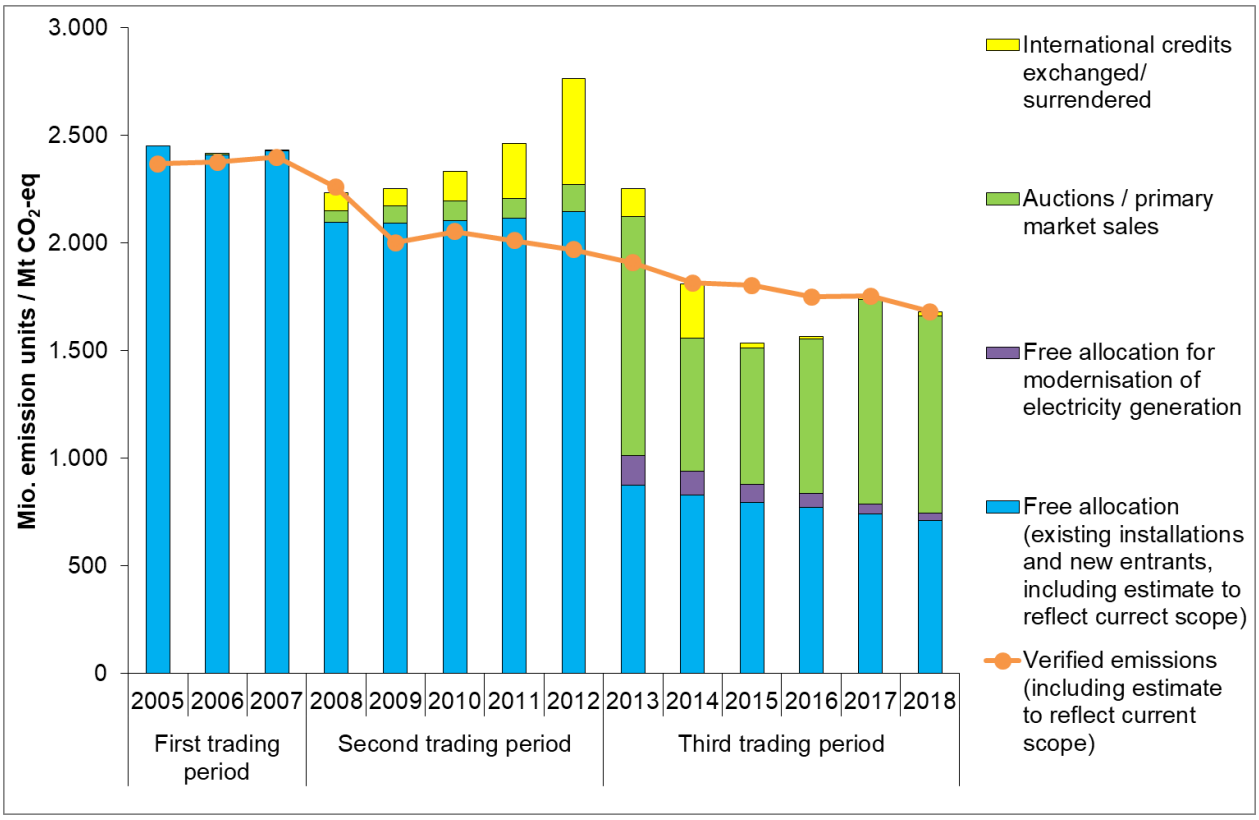
Note: Volume index of production (seasonally and calendar adjusted data for the EU-28).
Source: Eurostat (2019a).

The lower abatement by industrial installations than by combustion installations may reflect both higher abatement costs than the current allowance prices and relatively lower output levels in previous years, which have somewhat reduced the need for abatement in the short term. However, to ascertain the extent to which the EU ETS reduced specific emissions of production, 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 2.5). The price of allowances peaked at around EUR 30 per EUA (Figure 2.6), 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 allowance 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.

Figure 2.5 Supply and demand balance for stationary installations, 2005-2018



Source: European Environment Agency (EEA) (2019).

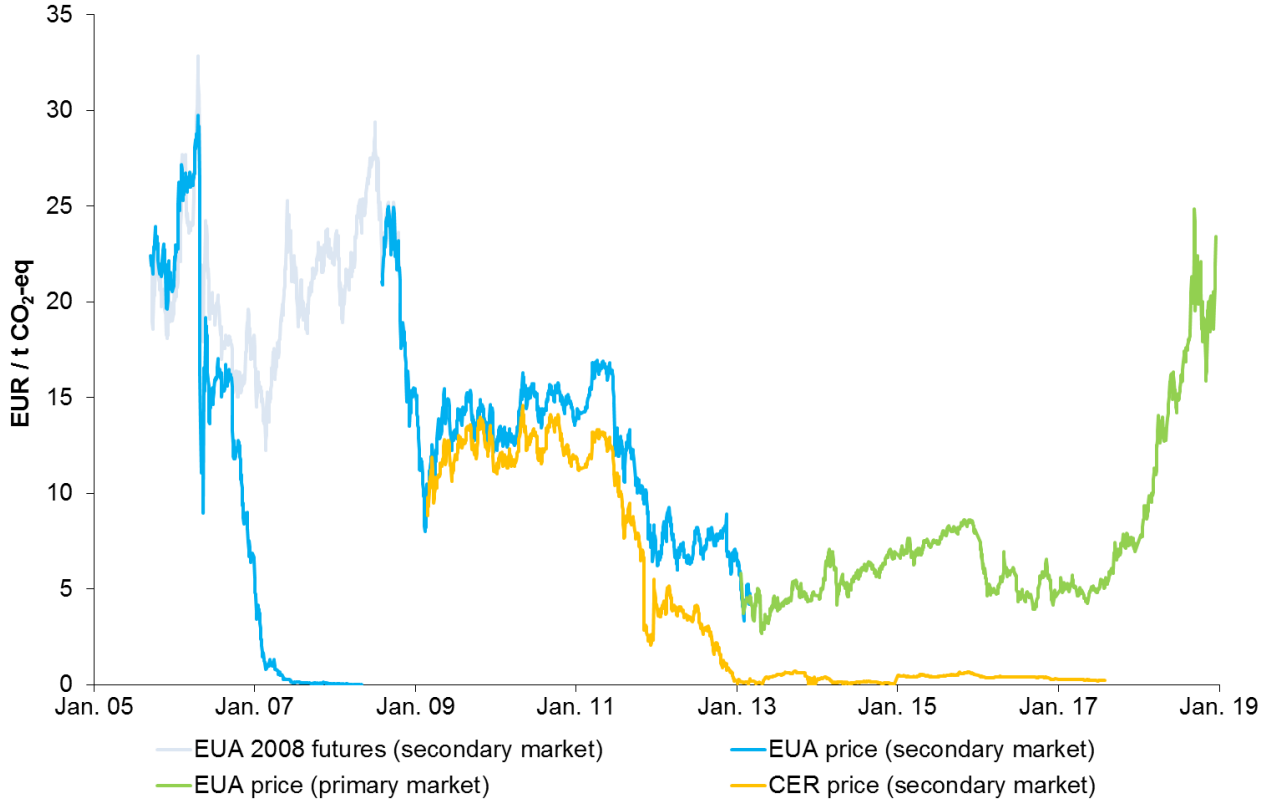
After more stringent caps were set for the second trading period, verified emissions exceeded the supply of allowances in 2008, resulting in a price of around EUR 20 per EUA. After 2008, activities covered by the EU ETS were greatly affected by the economic recession, with the result that the supply of allowances exceeded verified emissions between 2009 and 2012. Given that the supply of allowances (set by the EU ETS cap) was fixed in advance, this put downward pressure on the allowance price, which declined to around EUR 7 per EUA by the end of the second trading period. The number of allowances available to operators was further increased by the use of CERs and ERUs, especially between 2010 and 2012, because many of them could no longer be used in the third trading period. As a consequence, international credits were being traded at less than EUR 1 per unit by the end of the second trading period (Figure 2.6).

At the start of the third trading period, verified emissions continued to exceed the supply of allowances. In response, the backloading of allowances was implemented between 2014 and 2016 (a postponement in the overall quantity of allowances to be auctioned in a certain year) and this had an impact on the supply and demand balance, reducing the number of allowances available to operators, and, as a consequence, the allowance price started to rise gradually. 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) could no longer be used for compliance.

Following the revision of the EU ETS for the fourth trading period in 2018, the allowance price increased rapidly and had exceeded EUR 20 per EUA by the end of December 2018. The price increase, in part, reflects the expectation that the supply of allowances will be reduced through (1) an increase in the linear reduction factor (LRF) from 1.74 % to 2.2 % from 2021 onwards and (2) the Market Stability Reserve (MSR) removing surplus allowances in circulation from 2019 onwards faster than originally

proposed and that from 2023 onwards holdings in the reserve above the auction volume of the previous year will lose their validity (European Commission (EC) 2018b).

Figure 2.6 Price trends for allowances and certified emission reductions, 2005-2018

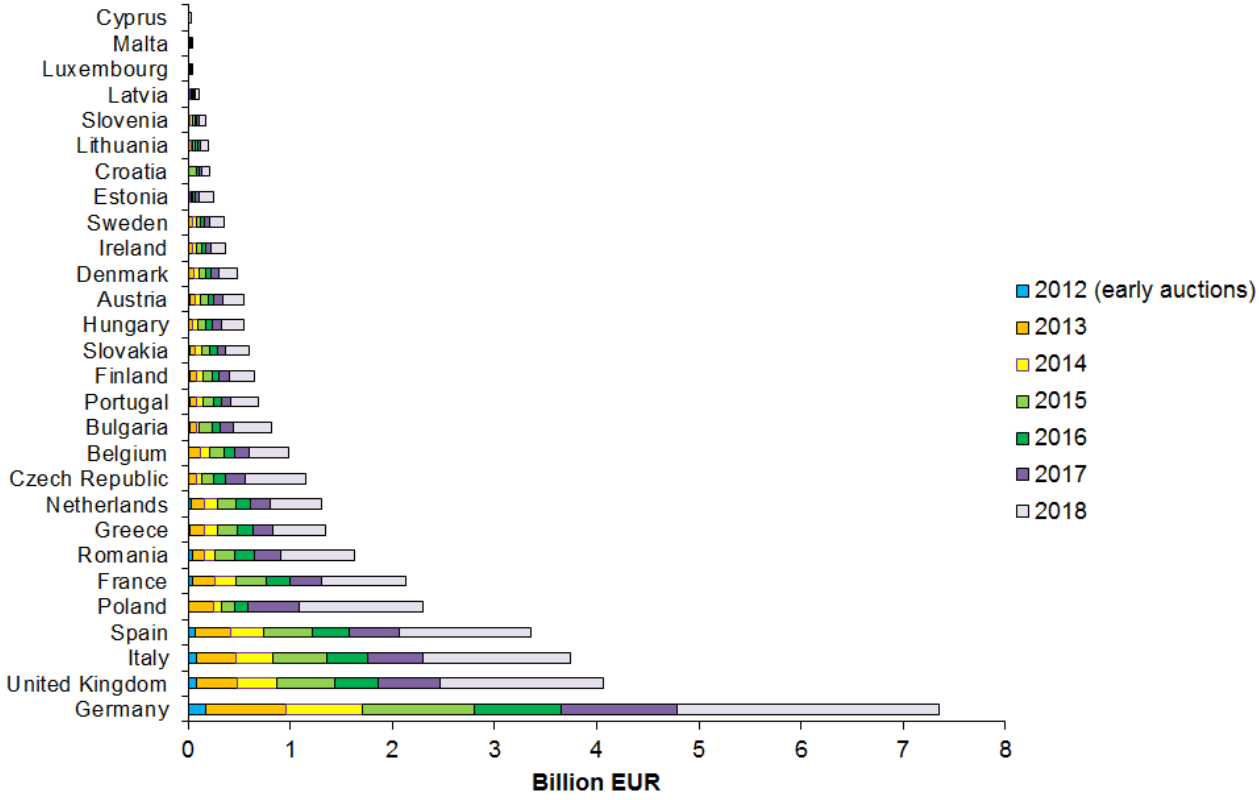


Sources: Point Carbon (2012); EEX (2019); ICE (2019).

2.1.3 Auctioned allowances and auctioning revenues

The level of auction revenue depends on many factors, including the number of allowances to be auctioned and the timing of auctions. Germany has so far received the highest revenue from EUAs (EUR 7.4 billion) in the third trading period, followed by the United Kingdom (EUR 4.1 billion) and Italy (EUR 3.7 billion). These three Member States collectively account for around 43 % of the 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 resulting from both lower volumes and lower allowance prices than in both 2015 and 2016. The strong increase in EUA revenues in 2018, compared with previous years, is mainly due to both the end of the backloading measure increasing the number of allowances being auctioned and the allowance price increasing considerably over the past year (Figure 2.7).

Figure 2.7 EUA auction revenues in the third trading period, by EU Member State, 2012-2018



Note: 2012 (early auctions) refer to amounts that pertain to the year 2013, but had been auctioned a year earlier.

Source: EEX (2019); ICE (2019).

Member States are obliged to report to the Commission information on the use of revenues generated by auctioning allowances within the ETS scheme under Article 17 of the MMR. The EU ETS Directive provides that at least 50 % of the revenues or the equivalent in financial value of these should be used for climate and energy purposes which are specified in Article 10(3) of the Directive and include reducing GHG emissions, increasing renewable energy, measures to avoid deforestation and enhance afforestation and measures to increase energy efficiency. Member States can also implement policies which entail financial support, particularly to developing countries, for the mentioned purposes equivalent to at least 50 % of the revenues generated through auctioning of allowances to fulfil this provision.

Yet, the reports submitted by Member States under the MMR vary largely in the extent to which the required information is presented in a transparent way. As a consequence it is also difficult to assess the relative importance of the auction revenues in financing climate and energy related purposes in the EU Member States as well as on an international level (Le Den et al. 2017).

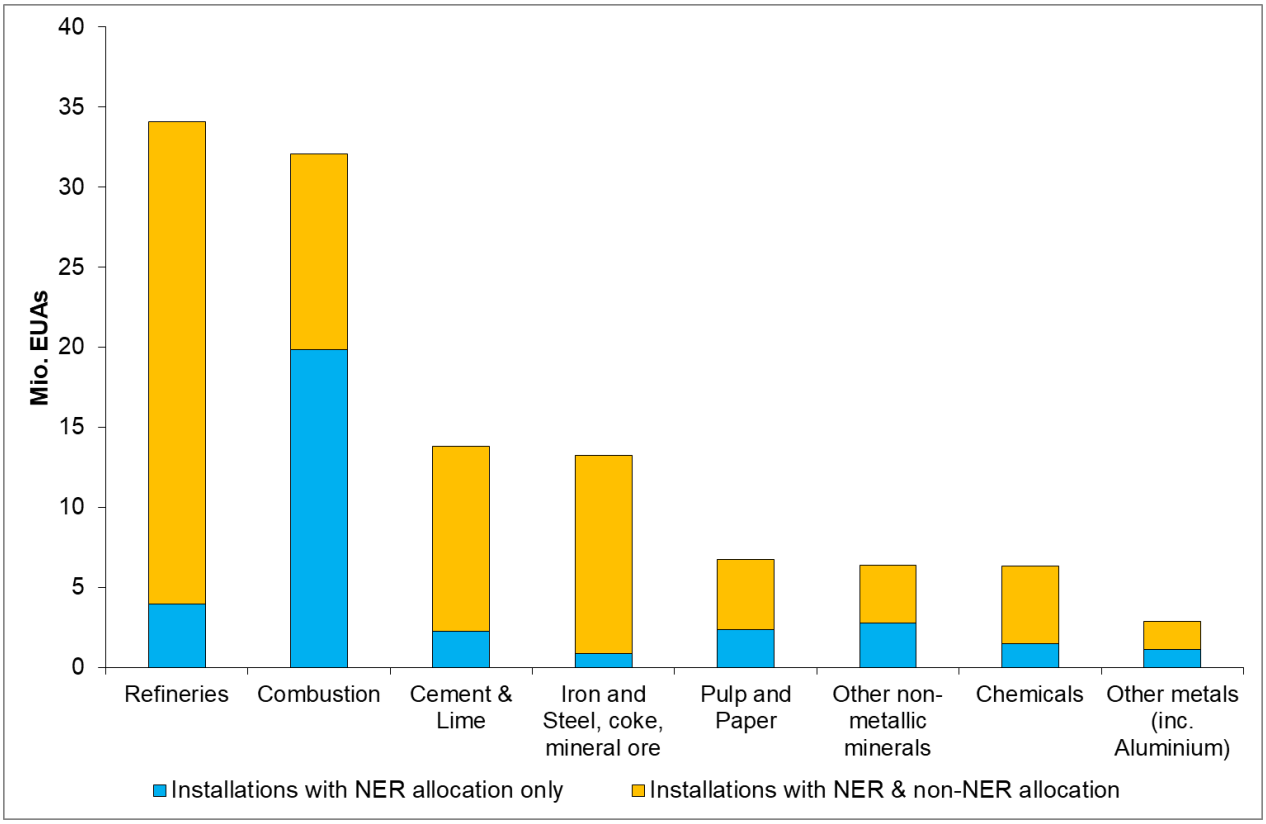
Nevertheless, for the period 2013-2015 it has been found that approximately 82 % of the auction revenues have been used for climate and energy purposes, so a much larger share than the required 50 % (Velten et al. 2016). The majority of revenue has been used for domestic climate and energy purposes, with a focus on support to the expansion of renewable energy and the increase of energy efficiency (Le Den et al. 2017; Vaidyula and Alberola 2015; Velten et al. 2016). Auction revenues are thus an important source of finance for climate and energy purposes in the national context and can support climate and energy purposes in a variety of ways.

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

To ensure a level playing field between new entrants and incumbents, a NER of 480 million ([21]) allowances was set aside at the start of the third trading period for new installations ([22]) and existing installations with a 'significant' increase in capacity ([23]).

In the combustion sector, 62 % of the NER allowances allocated so far (i.e. 19.8 Mt of the 32.1 Mt) have been used by new entrants (i.e. with NER allocation only). By contrast, Figure 2.8 shows that for industrial activities (excluding combustion), the majority of the NER allowances have primarily been used for capacity extensions (i.e. installations with NER and-non-NER allocations). For example, installations with capacity extensions accounted for 88 % of the NER allowances that the refinery sector received (i.e. 30.1 Mt out of the 34.1 Mt) between 2013 and 2018. The majority of these NER allowances were allocated to refineries in Spain, Greece and Portugal (Figure 2.9). Similarly, the majority of the 13.8 Mt of NER allowances provided for the cement and lime sector went to installations with capacity extensions, many of which were located in either Italy or Cyprus (Figure 2.9). The iron and steel sector received 13.3 Mt of NER allowances between 2013 and 2018, again primarily to installations with capacity extensions, this time based in Belgium and the United Kingdom.

Figure 2.8 NER allocation by sector and by eligibility type, 2013-2018



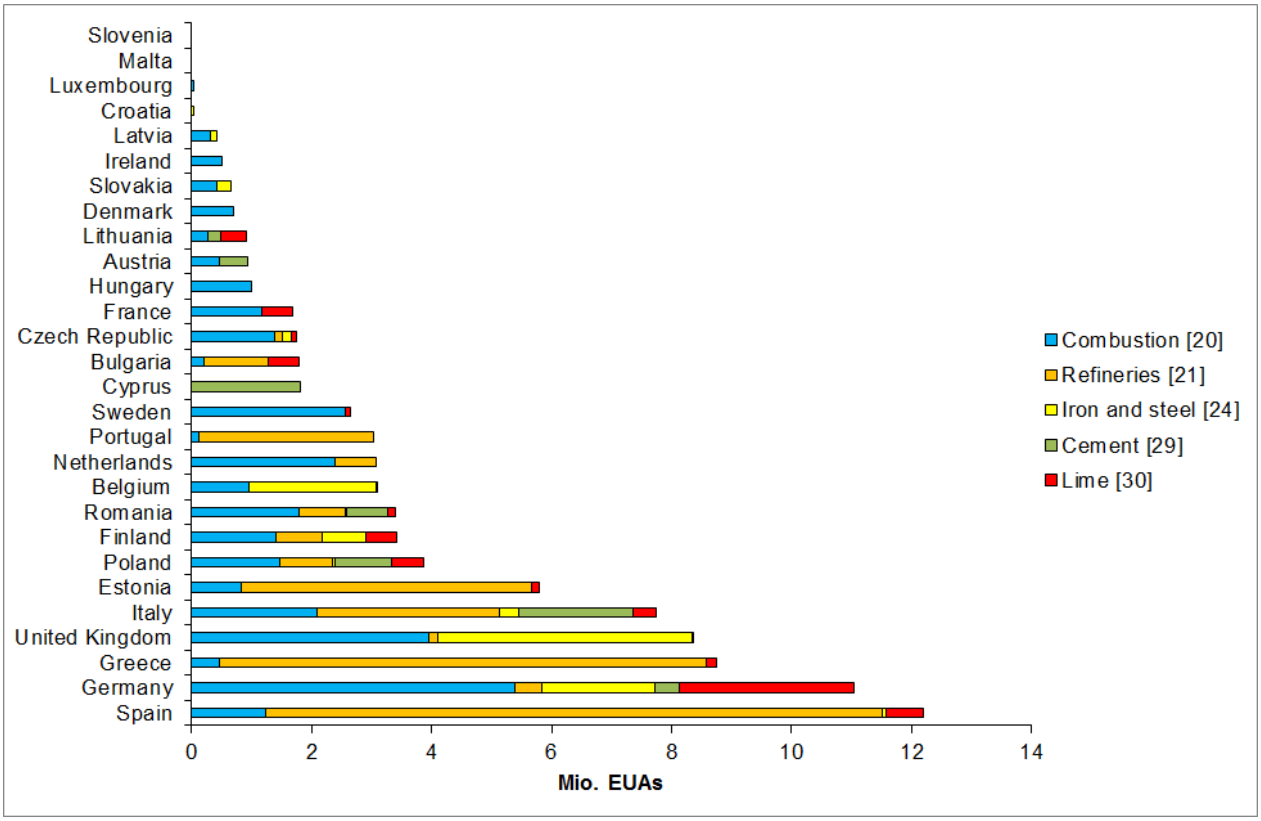
Source: EU (2019); authors' calculation.

([21]) The original amount was 780 million allowances, from which 300 million were deducted for the NER 300 funding programme. NER 300 aims to establish a demonstration programme comprising the best possible projects on carbon capture and storage and renewable energy sources and involving all Member States.

([22]) Namely 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.

([23]) 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 European Commission (EC) 2011.

Figure 2.9 Cumulative NER allocation by sector and by country, 2013-2018



Note: Covers 77 % of the NER allowances issued between 2013 and 2018. Represents NER allowances provided to EU-28 Member States for five EUTL activities only.

Source: European Union (EU) (2019); authors' calculation.

By the end of January 2019 only 34 % of the allowances available in the NER for the third trading period had been allocated. In absolute terms, 319 million allowances remain available from the NER until 2020 (European Commission (EC) 2019a). The allowances that will remain unallocated until 2020 are to be put into the MSR.

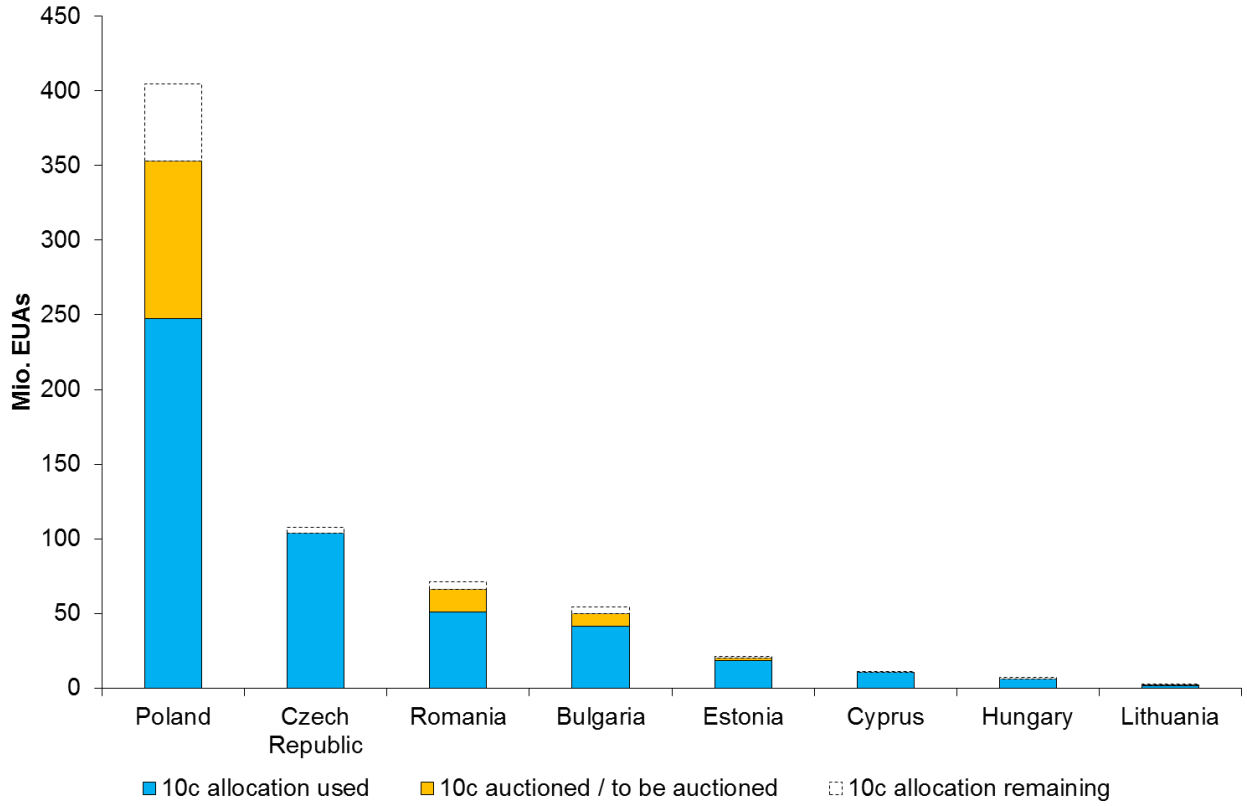
2.1.5 Transitional free allocation to modernise electricity generation

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. 71 % of the maximum budget for Article 10(c) allowances was allocated between 2013 and 2018 (Figure 2.10). Poland has recently announced that it intends to auction 55.8 million allowances in 2019 and 49.52 million in 2020 ([24]). Including those amounts 19 % of the maximum budget for Article 10(c) allowances has been or will be auctioned. The use of the remaining 10 % of the allowances has not yet been specified but may be used to either modernise electricity generation or will alternatively be auctioned. Following reforms to the EU ETS, allowances not included in transitional free allocation up to 2020 could be transferred to the fourth trading period, to investments selected by competitive bidding. However, Poland and the Czech Republic have declared that they will not transfer these free allocations to the fourth trading period but will auction the left-over allowances or put them into an EU modernization fund ([25]).

([24]) https://ec.europa.eu/clima/news/poland%E2%80%99s-2020-auction-volume-include-allowances-not-used-power-sector-modernisation_en

([25]) https://www.bloomberg.com/news/articles/2019-06-06/poland-may-halt-free-co2-permits-for-utilities-to-boost-budget

Figure 2.10 Use of Article 10(c) allowances by Member State, 2013-2018



Note: Includes Article 10(c) amounts to be auctioned up until 2018.

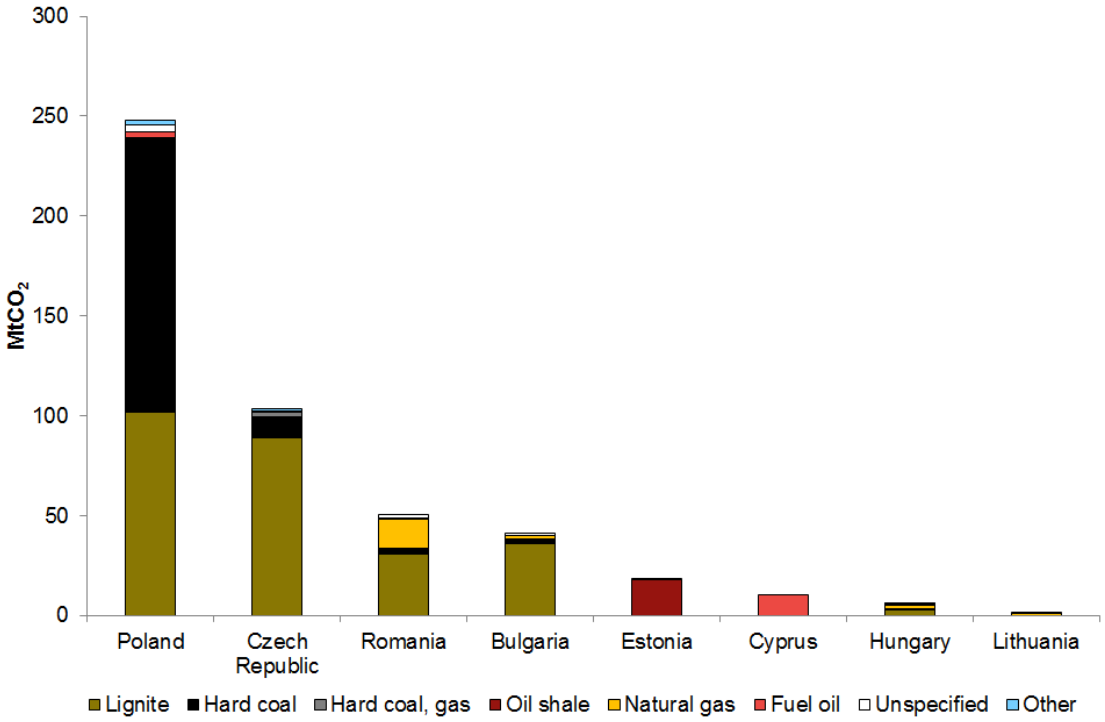
Sources: European Commission (EC), (2012a); (2012b); (2012c); (2012d); (2012e); (2012f); (2012g); (2012h); (2018c); European Union (EU) (2019).

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

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

Despite these examples of low-carbon investments, the majority of investments completed so far under Article 10(c) are not expected to have contributed to diversifying the energy mix. To date, the majority of Article 10(c) allowances have been spent on modernising existing fossil fuel capacity. In fact, between 2013 and 2018, 54 % and 32 % of the Article 10(c) allowance allocation was issued to lignite and hard coal plants, respectively (Figure 2.11). 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 (Carbon Market Watch 2016).

Figure 2.11 **Free allocation for the modernisation of electricity generation, by fuel type of the receiving power plant and Member State, 2013-2018**



Notes: Allowances issued to only eligible EU ETS installations, i.e. existing ETS installations operational before a specified date. Thus, they are by definition existing electricity generators with a capacity of more than 20 MW thermal. Attribution of free allowances to fuel type was completed by the Öko-Institut.

Sources: European Commission (EC), (2012a); (2012b); (2012c); (2012d); (2012e); (2012f); (2012g); (2012h); (European Commission (EC) 2019c) (European Commission (EC) 2018c); Platts, (2014); European Union (EU) (2019).

In the revised EU-Directive 2003/87, transitional free allocation for the modernisation of the energy sector under article 10c will require that 'where an investment leads to additional electricity generation capacity, the operator concerned shall also demonstrate that a corresponding amount of electricity-generation capacity with higher emission intensity has been decommissioned by it or another associated operator by the start of operation of the additional capacity', so that the overall electricity generation capacity becomes less carbon intensive over time.

2.1.6 Use of international credits for compliance

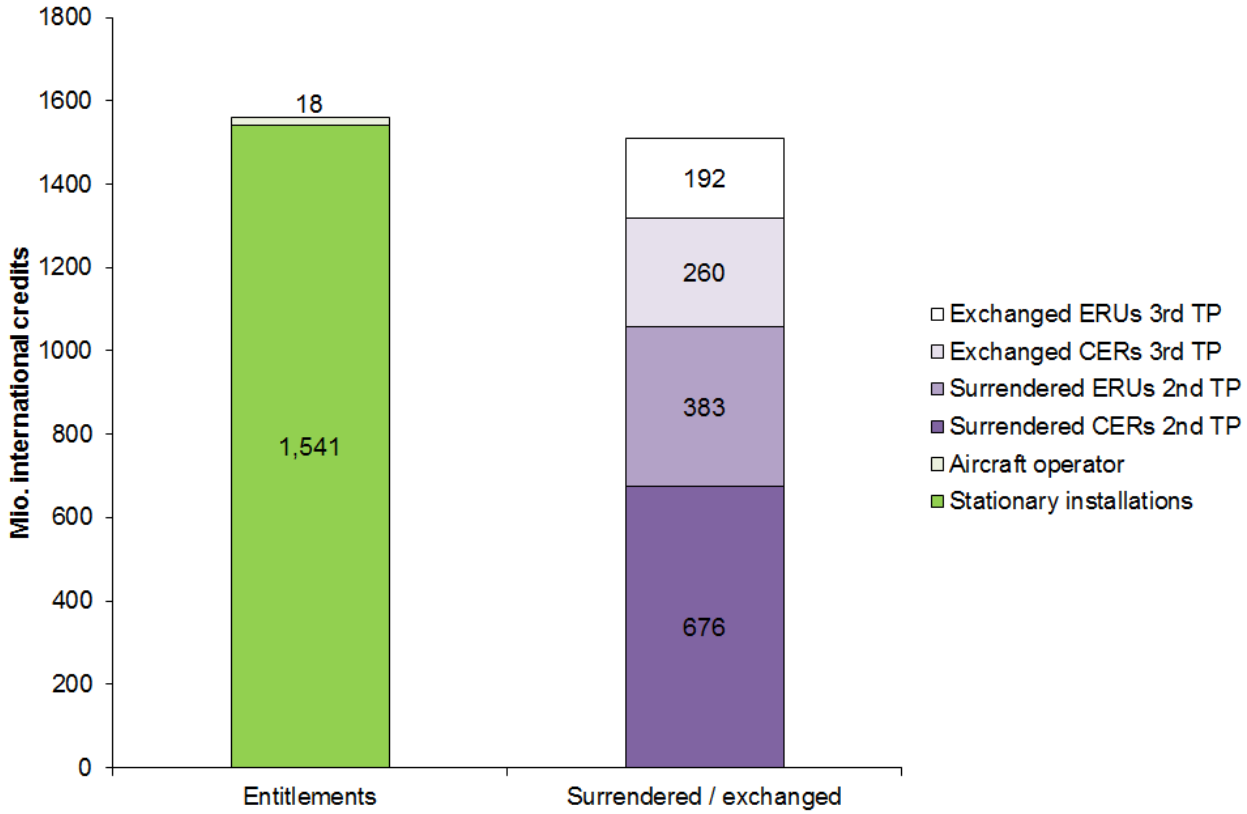
The estimated budget for international credits between 2008 and 2020, compared with the units either surrendered or exchanged during the second and third trading periods, is shown in Figure 2.12. Operators under the EU ETS are allowed to use international emission credits to comply with part of their legal obligation to surrender allowances equivalent to their verified emissions ([26]). International credits from the Clean Development Mechanism (CDM) and Joint Implementation (JI) projects can be used with certain qualitative restrictions ([27]). Since April 2015, emission reductions that occurred in the

([26]) 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 period 2008-2020. Additional limits are also set for new sectors and aviation.

([27]) Excluded from the start of the scheme were nuclear energy projects and afforestation and reforestation projects; large hydroelectric projects (above 20 MW of 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 being used for compliance because of environmental concerns European Union (EU) 6/8/2011.

first commitment period of the Kyoto Protocol (2008-2012) can no longer be exchanged (European Commission (EC) 2018e). Based on the latest information on the CERs and ERUs exchanged, Figure 2.12 shows that a very small share of entitlements remained at the end of 2018. However, although the majority of CER/ERUs have already been surrendered or exchanged, international credit entitlements continue to be provided every year to certain installations based on their verified emissions between 2013 and 2020 ([28]).

Figure 2.12 Allowed and existing use of international credits, 2008-2020



Notes: International credit entitlements from EUTL. TP, trading period.
Sources: European Commission (EC), (2018d); European Environment Agency (EEA), (2018)

2.2 Aviation

2.2.1 Emission trends

During the third trading period, the total verified emissions for airline operators has increased by 25 % from 53.5 Mt CO_2-eq. in 2013 to 67.0 Mt CO_2-eq. in 2018 (Table 2.1). Ryanair has been consistently responsible for the largest amount of verified emissions from an individual aircraft operator. Indeed, the airline operator is now in the top 10 emitters in the EU ETS. However, Wizz Air experienced the fastest growth in emissions during this period (i.e. emissions increased by double between 2013 and 2018). Some of the more established airlines such as British Airways experienced far slower growth in emissions during the same period.

([28]) For stationary installations without free allocation between 2008 and 2012, which also received their first emissions permit after 30 June 2011, their CER/ERU usage is set based on 4.5 % of their verified emissions from 2013 to 2020. CER/ERU usage may also be based on 2013-2020 verified emissions for stationary installations that have had a 'significant capacity extension'. The overall number of entitlements available, therefore, needs to be annually updated beyond what is already fixed, based on an installation's total allocation between 2008 and 2012. Aviation operators are also eligible to use CERs and ERUs up to 1.5 % of their verified emissions between 2013 and 2020 (plus any remainder from the claims in 2012). Refer to European Union (EU) 11/9/2013 for more information.

Table 2.1 Total aviation emissions and the top 10 emitters in aviation, 2012-2018

	Verified emissions (Mt CO_2-eq.)						
	2012	2013	2014	2015	2016	2017	2018
Total Aviation	83,9	53,5	54,8	57,1	61,4	64,4	67,0
Ryanair	7,5	6,6	6,6	7,4	8,4	9,2	9,9
Easyjet	4,6	4,3	4,4	4,7	5,1	5,5	6,1
Deutsche Lufthansa AG	4,9	4,4	4,0	3,8	3,8	4,0	4,4
British Airways	2,5	2,5	2,5	2,6	2,7	2,7	2,7
Scandinavian Airlines System SAS	3,6	2,3	2,4	2,4	2,4	2,5	2,5
Eurowings GmbH	0,0	0,0	0,0	0,1	0,5	1,3	2,4
Air France	3,8	2,6	2,4	2,4	2,3	2,4	2,4
Wizz Air	1,1	1,1	1,3	1,5	1,8	2,1	2,3
Vueling Airlines, S.A.	1,3	1,3	1,6	1,8	2,0	2,0	2,2
Koninklijke Luchtvaart Maatschappij	1,9	1,5	1,6	1,6	1,6	1,8	1,8

Note: For the period 2013-2018, 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, for example flights between mainland Europe and the Canary Islands.

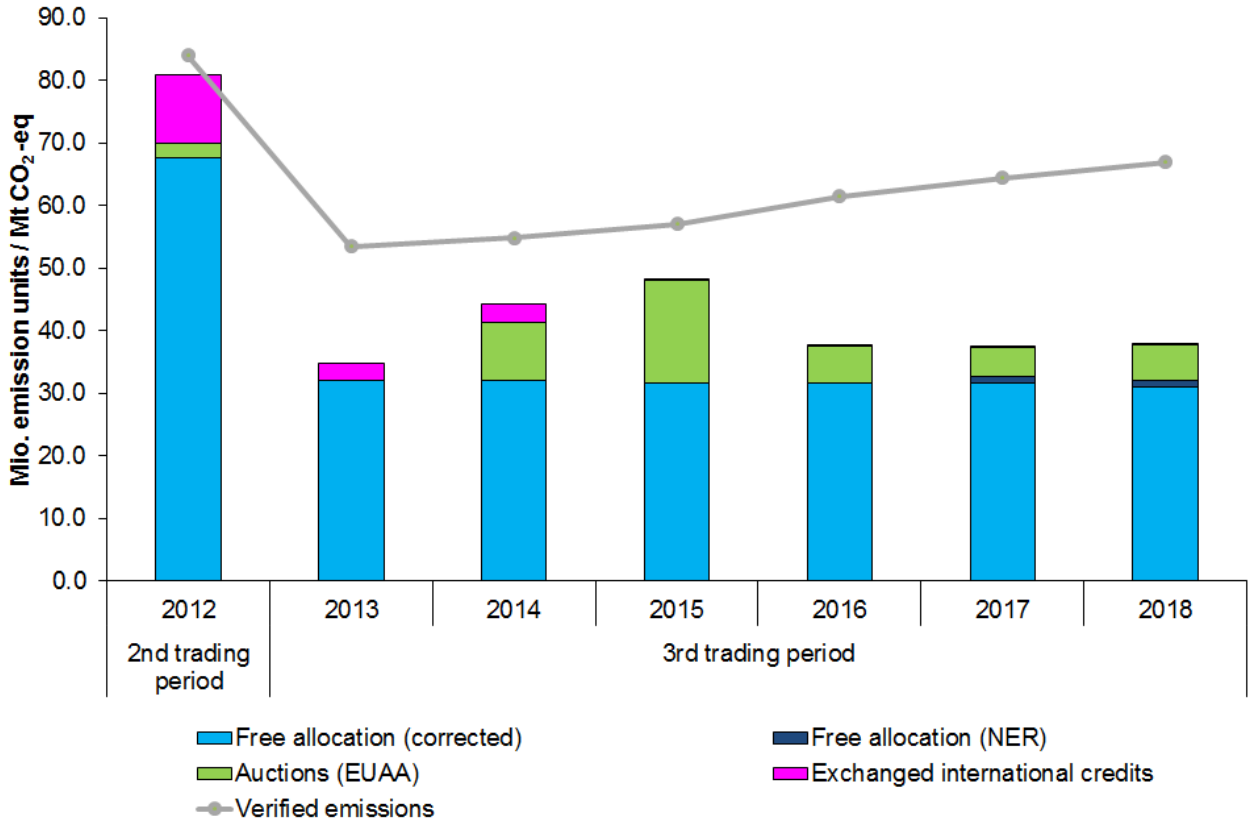
Source: European Environment Agency (EEA) (2019).

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

Figure 2.13 illustrates the development in the supply of and demand for aviation allowances (EUAAs) between 2012 and 2018. The difference in emissions between 2012 and 2013 was due to a change from a full to a reduced scope regarding aviation activities covered by the EU ETS ([29]). 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 2018 as verified emissions rose in comparison with the previous year. As a result, the cumulative net demand from the aviation sector increased further to 120.6 Mt by the end of 2018.

([29]) 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 were also changed in 2013.

Figure 2.13 Demand and supply balance for aviation allowances, 2012-2018



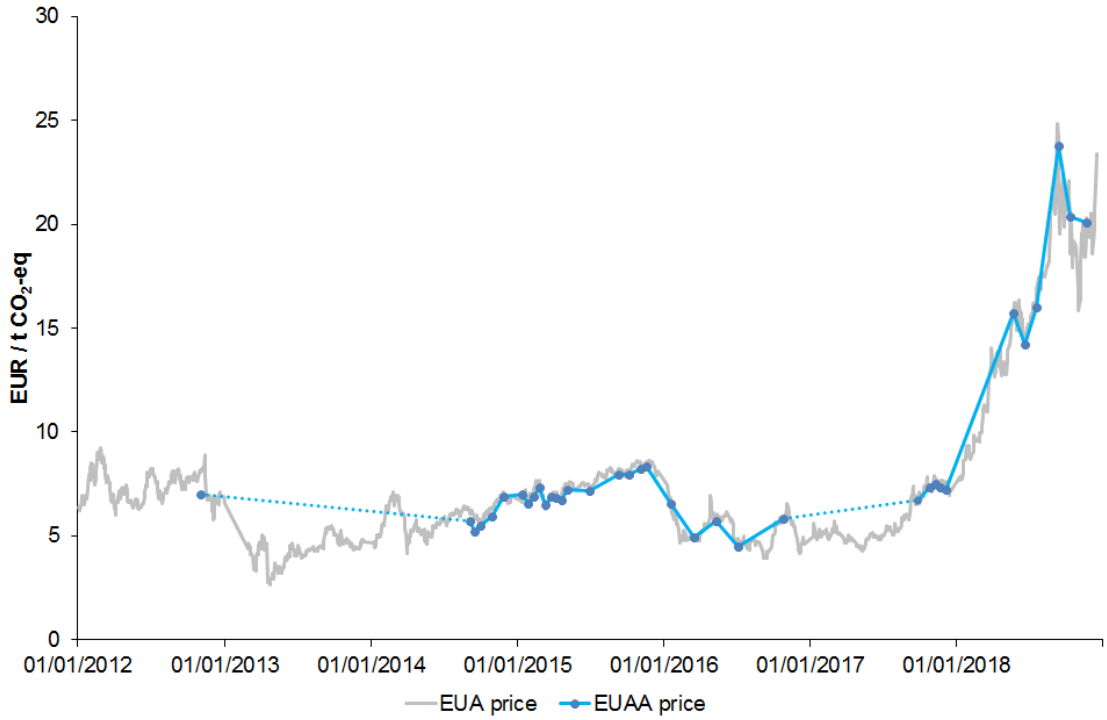
Notes: Auctions of aviation allowances were suspended after the 'stop the clock' decision taken in 2012. The allowances attributable to 2013, 2014 and 2015 were all auctioned in 2015. The volumes of aviation allowances effectively released to the market in 2015 were 16.4 million EUAAs. However, in order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

International credit use by aircraft operators in the third trading period is not reported. The overall use of the CER/ERU entitlements by operators of stationary installations and aircrafts, together, amounts to 97% in 2018. To estimate international credit use for aircraft operators, it is assumed that all operators make use of their entitlements to the same extent.

Sources: European Commission (EC), (2014c); (2015b); (2016a); (2017d); (2018d); European Environment Agency (EEA) (2019).

The auctions of EUAAs occur less frequently than those of EUAs as a result of the smaller number of the former that are available for auction. As a consequence of the change from a full to a reduced scope regarding 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 price, reaching a peak value of around EUR 8 per unit towards the end of 2015. However, 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. With the recent agreement on reforms to the EU ETS for the fourth trading period, the EUAA price followed the rising value of the EUA price to over 7 EUR per unit in 2017 (Figure 2.14). The delay in auctioning in 2017 can be clearly observed in Figure 2.14. In 2018, the EUAA price had risen rapidly to over EUR 20 per unit by the end of December.

Figure 2.14 Price trends for EUAAs compared with EUAs, 2012-2018



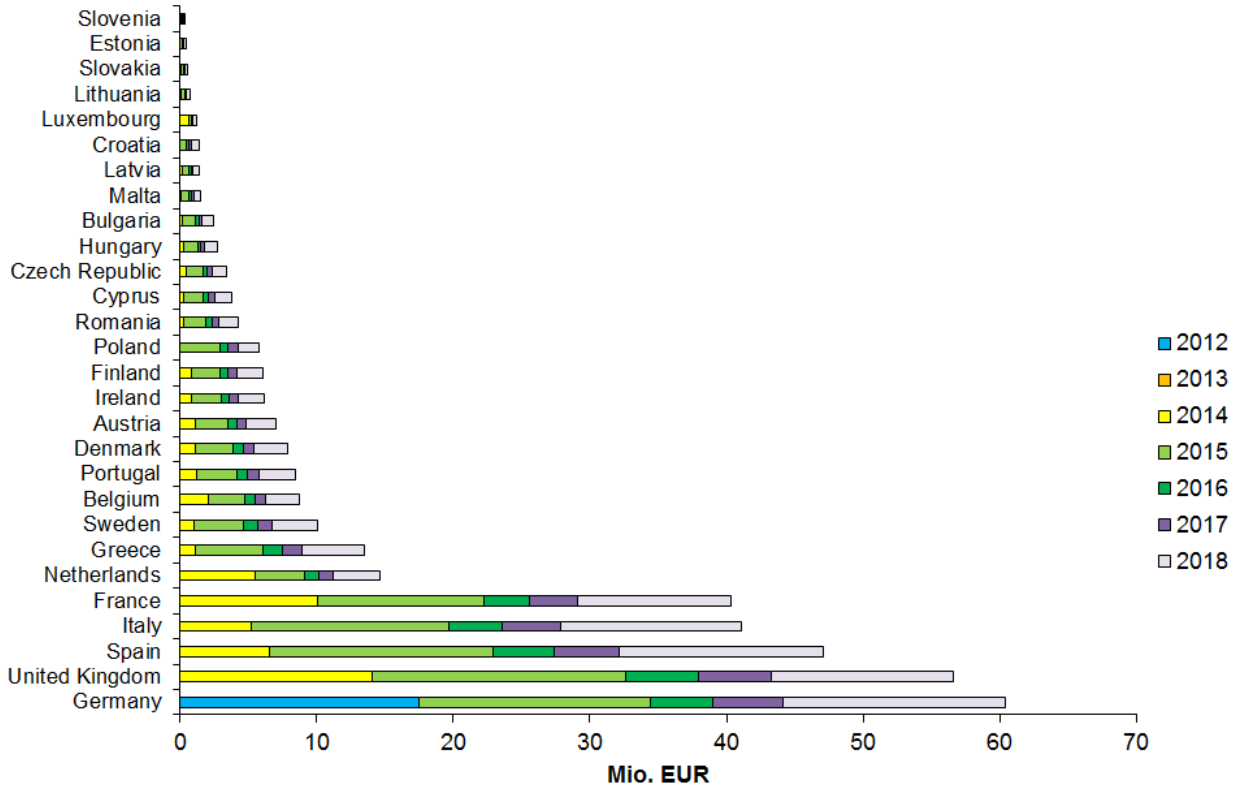
Note: The EUA price represents historical spot price data from the secondary market in 2012. In the third trading period, the EUA price refers to primary market auctioning data from the EEX and ICE trading platforms. This trend is compared with the shorter time series of EUAA prices from primary market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

Sources: Point Carbon, (2012); EEX (2019); ICE (2019).

2.2.3 Auctioned allowances and auctioning revenues

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, influence the auction price. Germany received the largest revenues from the auctioning of EUAAs over the period (EUR 60 million), followed by the United Kingdom (EUR 57 million) (Figure 2.15). The revenues from Germany and the United Kingdom alone account for 33 % of the total revenue received by Member States. Overall, the total revenue from EUAAs in 2018 was considerably higher than in the previous year. This is due to the price of allowances increasing over the course of 2018.

Figure 2.15 Aviation allowances auction revenues by Member State, 2012-2018



Sources: EEX (2019); ICE (2019).

3 Projected trends

- According to the projections that EU Member States, Norway and Iceland reported in 2019 under EU legislation, EU ETS stationary emissions are projected to continue decreasing with existing measures (WEM) in place. This would be a reduction of 36 % by 2030 compared with 2005. If additional measures reported by Member States are also taken into account, emissions in stationary EU ETS sectors would decrease by 41 % compared to 2005.
- The emissions projected from the WEM scenario are expected to reduce more slowly than historically, with emissions higher than the EU ETS cap from only 2026 onwards. Therefore, the overall projected reduction is not yet in line with the objectives for EU emission reductions for 2030 (-43% compared to 2005). However, the strengthening of the EUA price in recent months may help to encourage further mitigation efforts towards reaching the 2030 target.
- The revision to the EU ETS for the fourth trading period will enhance the ability of the MSR to reduce more rapidly the current surplus of allowances from 2019 onwards.
- With latest projections under the WEM scenario and based on the agreed rules concerning the intake rate of surplus allowances by the MSR, the EEA estimates that the current surplus of EUAs in the EU ETS will decline during the fourth trading period but will not reach the lower MSR threshold.
- The scope for aviation in the EU ETS is temporarily limited to intra-EEA flights. The derogation for extra EEA flights is prolonged until 31st of December 2023.

3.1 Stationary installations

3.1.1 Emission trends

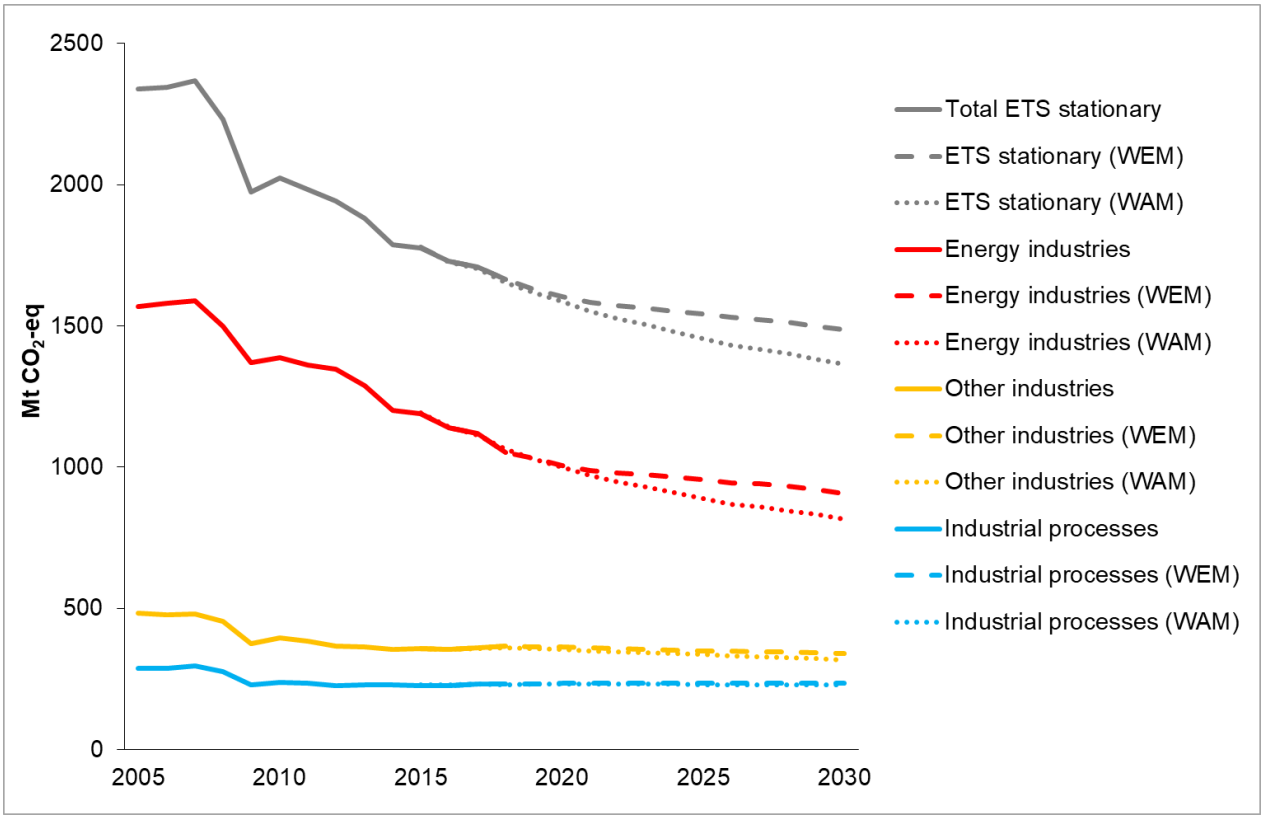
According to the projections reported by EU Member States in 2019 under EU legislation ([30]), EU ETS emissions are projected to further decrease with the current policies and measures in place ([31]). The decrease in EU ETS emissions is projected to take place predominantly in the energy sector ([32]), whereas EU ETS emissions from manufacturing and construction installations, shown as 'other sectors' in Figure 3.1 are projected to remain stable until 2030. Like in previous years, these projected trends contrast with historical trends, which showed decreases in a number of industrial sectors, such as manufacturing, construction and industrial processes. EU ETS emissions from industrial processes are projected to slightly increase although they have shown a decrease since 2005. If only the existing policies and measures are considered, a reduction of 36 % compared with 2005 is estimated in Member States' submitted projections. This would not be sufficient to reach the targeted reduction of EU ETS emissions until 2030. With the additional policies and measures reported by some Member States, emissions would decrease by 41 % compared with 2005, coming closer to the EU ETS-wide reduction target of 43 %. Again, the main effects of additional policies and measures are projected to take place in the sector of energy industries, but also other sectors are partly targeted, too.

([30]) 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 European Union (EU) 2013.

([31]) The analysis is based on projections of EU ETS emissions under the WEM and WAM scenario, reported by Member States, Norway and Iceland, following the structure and format provided by the Implementing Regulation (EU) No 749/2014 European Commission 2014. The projections were compiled, assessed and quality checked by the EEA and its European Topic Centre for Climate Change Mitigation and Energy (ETC/CME). Romania did not report an update of GHG projections in 2019.

([32]) Corresponding to greenhouse gas inventory source categories 1.A.1, 1.B and 1.C (Intergovernmental Panel on Climate Change (IPCC) nomenclature).

Figure 3.1 EU ETS historic and projected emissions for EU-28 by inventory category, 2005-2030

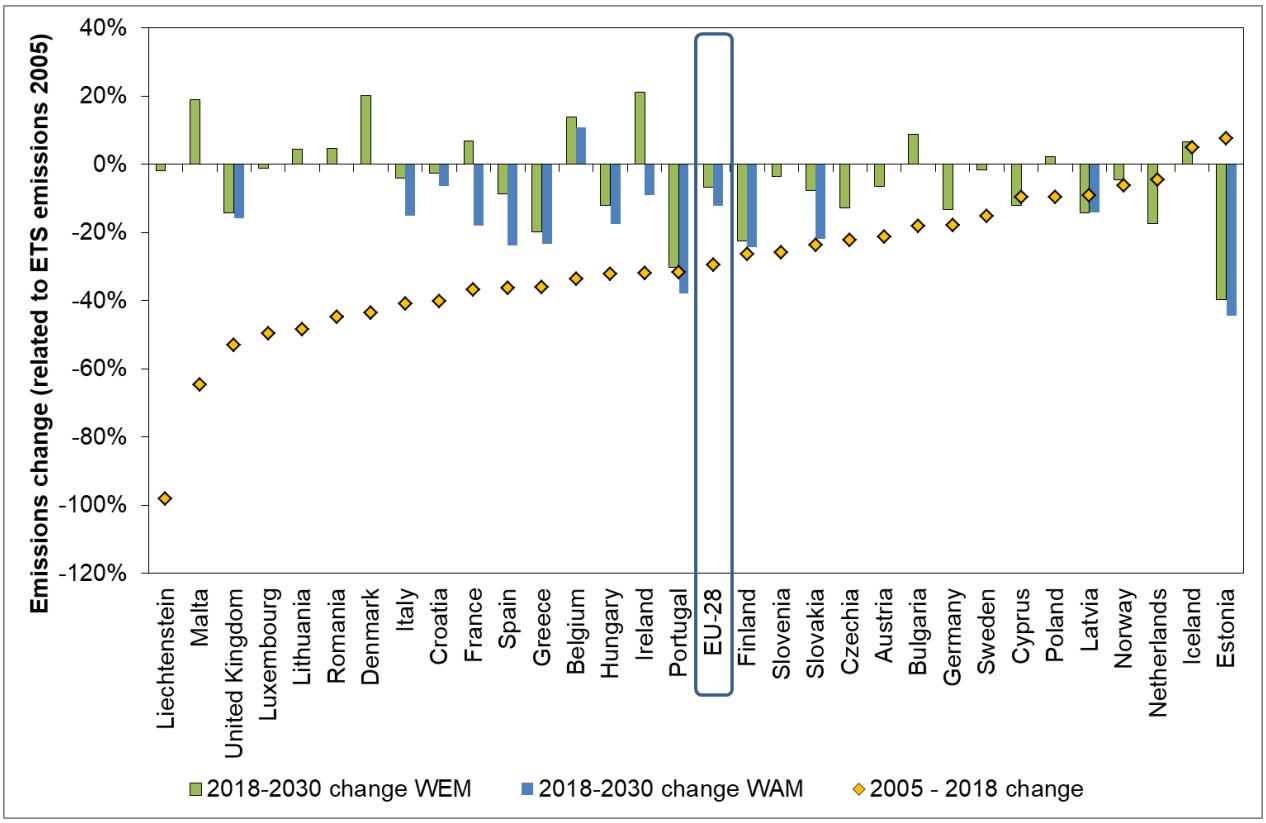


Notes: Solid lines represent historical greenhouse gas emissions up to 2018, taking into account proxy inventory numbers. Dashed lines represent projections under the WEM scenario. Dotted lines represent projections under the 'with additional measures' (WAM) scenario.
This figure refers to EU ETS emissions of EU-28 only.
Historic emissions by sector were estimated based on the attribution of GHG emissions, reported by source categories in GHG inventories. 'Energy industries' cover CRF categories 1A1, 1B2 and 1C. 'Other industries' are related to CRF category 1A2 while 'industrial processes' are related to CRF category 2. The estimate of the share of ETS emissions in these sectors is based on assumption in national GHG projections.

Sources: European Environment Agency (EEA) (2019); projections of EU Member States compiled by the European Topic Centre for Climate Change Mitigation and Energy (ETC/CME) as of June 2019.

Figure 3.2 shows that EU ETS emissions are expected to decline in 20 countries between 2018 and 2030 under the WEM scenario, with reductions ranging from 2 % for Sweden to 40 % for Estonia. Interestingly, there are ten countries who still anticipate increases in their EU ETS emissions between 2018 and 2030 based upon their WEM projections. Of these, France and Ireland are expecting to reduce their EU ETS emissions considerably with additional policies and measures, while even with additional measures EU ETS emissions are still projected to increase in Belgium.

Figure 3.2 Historic and projected changes in EU ETS emissions relative to 2005 emission levels



Sources: European Environment Agency (EEA) (2019); projections of EU Member States compiled by the European Topic Centre for Climate Change Mitigation and Energy (ETC/CME) as of June 2019.

In a number of countries, updated projections submitted in 2019 indicate rising emissions in the ETS sectors until 2030. This is often related to developments in the energy sector. In Belgium, even with additional measures projected, emissions will rise by 11 % between 2018 and 2030 which is a substantial increase compared to last year's projections. This is due to the planned phase-out of nuclear energy until 2025 which leads to the construction of new energy production plants to compensate for the lost capacity. Similarly, emissions in Denmark are projected to rise by 20 % between 2018 and 2030 as a result of increasing electricity consumption and a decline in the deployment of renewable energy. In Ireland, emissions are projected to increase by 21 % until 2030 in its WEM scenario due to increased coal and peat based electricity generation until 2030. Beside the shift to carbon intensive fuels and wishes to reduce the import dependency (e.g. in Lithuania) emission increases are projected from industrial processes, too, like in e.g. Ireland, Lithuania, Poland or Romania.

At the same time, Austria, Denmark, France, Finland, Ireland, Italy, the Netherlands, Portugal, Slovakia, Spain, Sweden and the UK have announced to phase out coal-based power plants before 2030 (Beyond Coal 2019). In France, this additional measure has already been taken into account in their WAM scenario where the closure of coal-fired power plants by 2022 will save emissions of 8 Mt CO_2-eq. annually. As a consequence, its WAM scenario projects a decrease of emissions by 18 % until 2030 (in combination with the continuation of the Energy Savings Certificate scheme promoting energy efficiency and of the heat fund providing support to the replacement of fossil fuels by renewable sources for heat production). Also in Ireland, changes to the energy mix reduce projected emissions by 9 % in the country's WAM scenario between historic emissions in 2018 and 2030 compared to a projected increase of 21 % in its WEM scenario in the same timeframe.

Estonia's WEM projections show a substantial reduction of GHG emissions (-40 % by 2030 compared to 2018). An important factor driving the reduction of emissions is the phasing out of direct oil shale

combustion in electricity producing plants which currently mainly use oil shale. The construction of new and more effective oil shale combustion plants leads to a reduction of 50 % between 2016 and 2040 from the energy industries sector.

3.1.2 Balance of allowances

The total number of allowances in circulation (TNAC) in the EU ETS stood at around 1.65 billion by the end of 2018 (European Commission (EC) 2019b). 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 reflect changes to the ETS Directive after 2021. This reflects both the impact of backloading auction volumes ([33]) between 2014 and 2016, through the Auctioning Regulation (European Union (EU) 2/26/2014), and the future impact of the MSR ([34]), as decided by the European Union (EU) (2015) and the changes agreed on in European Union (EU) (2018a). The estimated balance also takes into account the increase in the LRF from 2021 ([35]); it should, therefore, be considered illustrative, as it cannot fully reflect all future policy developments and changes in the CO_2 price. Figure 3.3 depicts the TNAC, which differs from the cumulative surplus shown elsewhere in this report (e.g. Figure ES.1) in that net demand from aviation is not taken into account, as it is not part of the definition of the TNAC.

The MSR has begun withholding allowances in 2019 and will address the current TNAC while improving the system's resilience to major shocks by adjusting the supply of allowances to be auctioned. The outcome of the recent revision to the EU ETS for the fourth trading period (European Union (EU) 2018a) will further strengthen the MSR's ability to more rapidly reduce the TNAC. The key provisions with regard to the MSR's operation include the following:

1. The intake rate of the MSR (i.e. the rate at which the allowances in circulation if above the 833 Mt threshold are absorbed by the reserve) will be 24 % between the years 2019 and 2023 and will be reduced to 12 % per year afterwards.

2. The invalidated allowances in the MSR from 2023 will be equivalent to the difference between the total allowances in the MSR and the number of allowances auctioned in the previous year.

3. A significant share of allowances unused in the third trading period will be added to the MSR in 2019 and 2020, and will contribute to the Innovation Fund and the NER set up in the fourth trading period.

New units entering the market include those given freely and those auctioned and sold, as well as international credits used/exchanged for EUAs. In 2013, the allowances available exceeded the cap as a result of the significant use of international credits. Because of backloading (2014-2016), a drop in international credit use from 2015 and the fact that allowances remain unused (e.g. because of cessations and closures or because the budget available for new entrants or transitional free allocation to the electricity sector was not used up), the allowances entering the market remained below the cap since 2014.

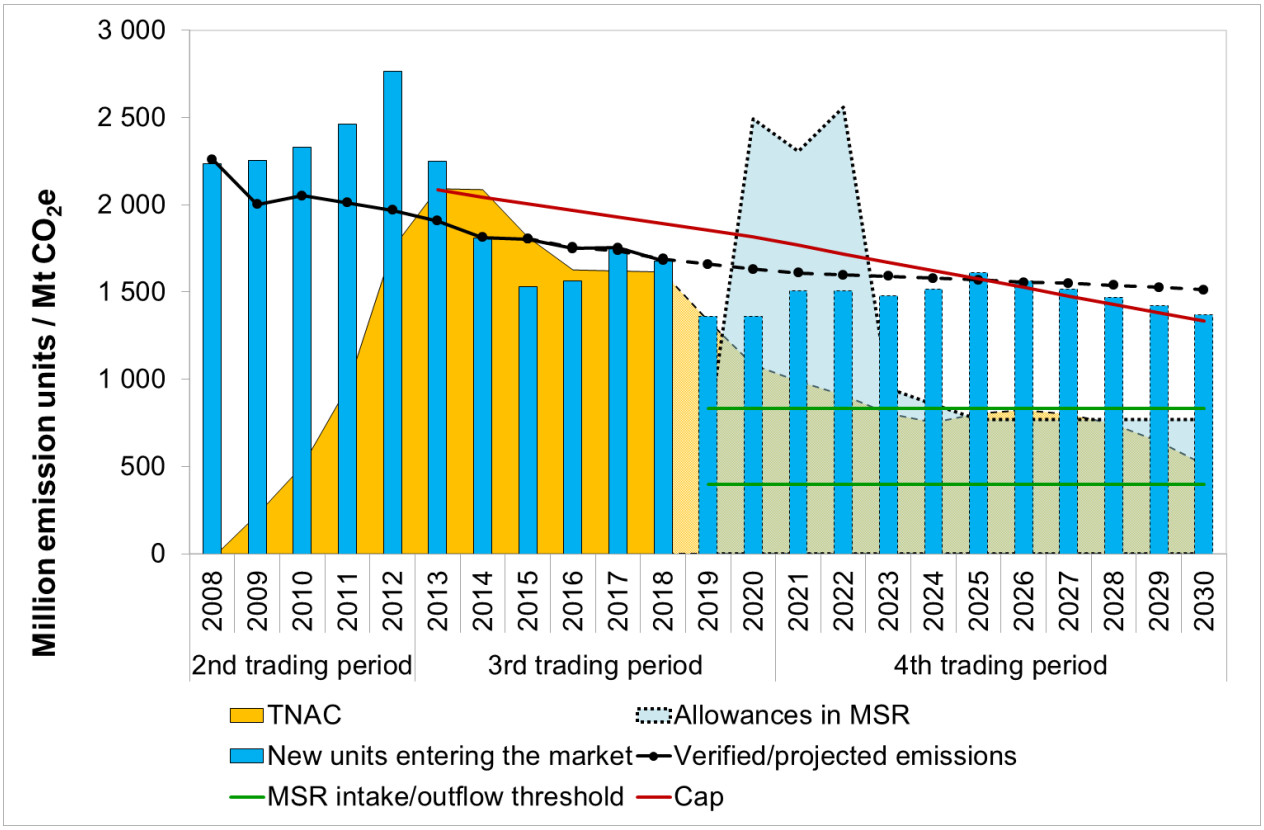
With the start of the MSR in 2019 the TNAC available drops significantly, as auction amounts are reduced according to the amount taken into the MSR based on the intake rate. The number of allowances entering the MSR is especially high in 2019 and 2020 as backloaded allowances are also put in the MSR in these years. A small intermediate decrease of allowances in the MSR is also anticipated in 2021, when the new entrants' reserve for the years 2021-2030 is taken out of the MSR. The modelling assumes that allowances will be added to the MSR until 2024. From 2025, allowances will be neither added to nor

([33]) To address the imbalance in the supply and demand of allowances, the European Commission first postponed the auctioning of 900 million allowances.
([34]) The MSR is a structural measure to address the cumulative 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 predefined rules (see Section A1.4).
([35]) The LRF is set to be increased from 1.74 % to 2.2 % starting in 2021.

dispensed from the MSR and the amount of allowances available between 2024 and 2030 will follow the cap, with an additional 49 million allowances available every year from the NER for the fourth trading period (fed from allowances unused in the third trading period and assumed to be allocated in equal tranches across the fourth trading period).

Based on the projections under the WEM scenario reported by Member States in June 2019, the EEA estimates that the TNAC could be under the intake threshold from 2022 onwards and, therefore, no further allowances would be added to the reserve from 2024 onwards (the 2023 intake into the MSR would be based partly on the allowances in circulation in 2021) ([36]). Between 2019 and 2030, the projected EU ETS emissions would be higher than the new units expected to be available (i.e. from either auctioning or free allocation) in most years, resulting in the TNAC declining year on year. Despite this, the TNAC would remain above the minimum threshold until 2030. This threshold acts as a trigger for reintroducing 100 Mt of allowances back into the market.

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



Notes: See Annex 1 for a detailed description of data sources and assumptions, particularly on the development of unused/unallocated allowances until 2020. New units entering the market include free allocation, allowances auctioned and sold and the use of international credits. The figure shows available allowances and verified emissions in the current scope. The total amount of allowances in circulation differs from the cumulative surplus shown in Figure ES.1. Consistent with European Union (EU) (2015) it does not take into account net demand from aviation, while Figure ES.1 does.

Sources: Authors' calculation based on the projections of EU Member States, Iceland and Norway, which were compiled by ETC/CME as of June 2019, in addition to data sources set out in Annex 1.

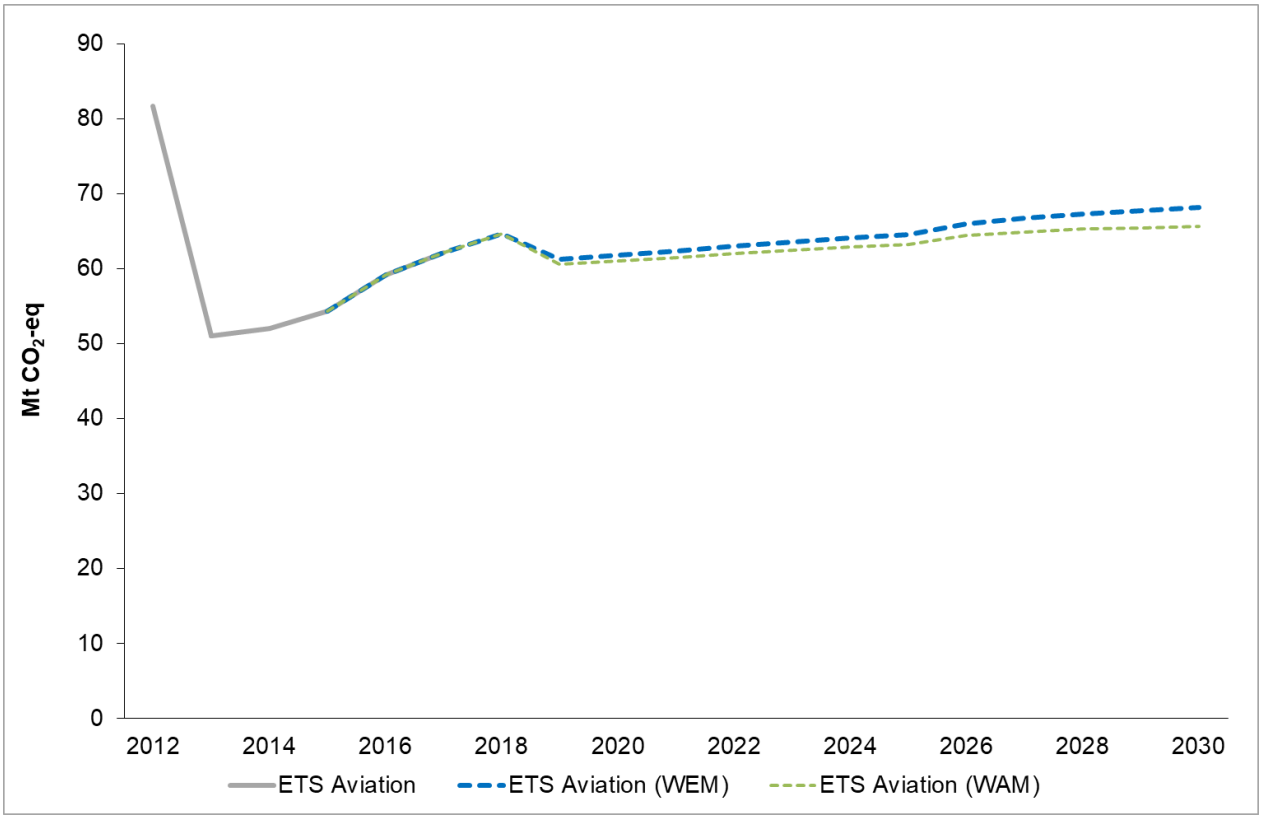
([36]) This is because the amount of allowances in circulation in a particular year, e.g. 2021 is published in May of the following year, e.g. 2022. Based on this publication, auction calendars are adjusted starting in September of the same year, e.g. 2022 and until August of the following year, e.g. 2023 European Union (EU) 2015, 2018a.

3.2 Aviation

3.2.1 Emission trends

Emissions from aviation activities covered by the EU ETS, as projected by Member States under the WEM scenario, are expected to rise continuously until 2030 (Figure 3.4). These projections are based upon the continuation of the current reduced scope of aviation activities covered by the EU ETS. For the first time, additional policies and measures have been reported by several Member States, partly for both national and international aviation. If these were implemented, this would result in a further reduction of about 2 Mt CO_2-eq. Most countries did not provide information about their policies and measures in the aviation sector in their projection reports. France is planning to implement a tax on plane tickets from 2020 onwards for all flights departing from France (except those to Corsica and France's overseas territories as well as transit flights). This tax will add EUR 1.50/ EUR 3 to the cost of a plane ticket in economy class within/outside of the EU and EUR 9/ EUR 18 for business class. Tax revenues shall be used to fund investments in green transport infrastructure (Climate Home News 2019). Other Member States such as Germany and the United Kingdom already have ticket taxes in places.

Figure 3.4 EU ETS emissions for aviation, 2012-2030



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 of aviation emissions cover only the EU, whereas the total reported is higher in other sections of this report because of the inclusion of Iceland, Liechtenstein and Norway.

Sources: European Environment Agency (EEA) (2019); projections of EU Member States compiled by the European Topic Centre for Climate Change Mitigation and Energy (ETC/CME) as of June 2019.

3.2.2 Balance of allowances

Aviation emissions are projected to increase continuously until 2030; therefore, the net demand for allowances in the aviation sector is also expected to rise during this period. This net demand is accounted for in the estimation of the future supply of and demand for allowances in the assessments of this report with the exception of the assessment of the MSR (Section 3.1.2).

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Annex 1

This annex provides additional supporting information for the EU ETS report, focusing on changes that occurred during 2018.

A1.1 Activities covered by the EU ETS

A1.1.1 Stationary installations

In 2018, the EU ETS covered 11 956 stationary installations (Table A1.1). The scope of the EU ETS includes all combustion installations exceeding 20 MW and all installations in which the activities listed in Annex I of the ETS Directive are carried out (European Union (EU) 10/13/2003). The total verified emissions of all stationary installations covered by the EU ETS in 2018 were 1 682 Mt CO_2-eq. (European Environment Agency (EEA) 2018).

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

1. fuel combustion (mainly electricity and heat generation plus various manufacturing industries);
2. refineries;
3. iron and steel, coke, and metal ore production;
4. cement, clinker and lime production;
5. other non-metallic minerals (glass, ceramics, mineral wool and gypsum);
6. production of pulp and paper;
7. production of chemicals;
8. other (opt-ins and capture and transport of greenhouse gases).

A new activity code 46 entitled 'Transport of greenhouse gases under Directive 2009/31/EC was reported for the first time in the EUTL in 2018.

Table A1.1 Activities and sectors covered by the EU ETS in 2018

Activities	Sectors	No. of entities	Verified Emissions
20 Combustion of fuels	Combustion	7496	1.095
21 Refining of mineral oil	Refineries	139	125
22 Production of coke	Iron and steel, coke, metal ore	20	11
23 Metal ore roasting or sintering		9	3
24 Production of pig iron or steel		247	122
25 Production or processing of ferrous metals		250	13
26 Production of primary aluminium	Other metals (incl. aluminium)	33	9
27 Production of secondary aluminium		33	1
28 Production or processing of non-ferrous metals		91	8
29 Production of cement clinker	Cement and lime	261	121
30 Production of lime, or calcination of dolomite/magnesite		297	32
31 Manufacture of glass	Other non-metallic minerals	372	18
32 Manufacture of ceramics		1083	15
33 Manufacture of mineral wool		52	2
34 Production or processing of gypsum or plasterboard		40	1
35 Production of pulp	Pulp and Paper	179	6
36 Production of paper or cardboard		586	22
37 Production of carbon black	Chemicals	18	2
38 Production of nitric acid		37	4
39 Production of adipic acid		3	0
40 Production of glyoxal and glyoxylic acid		1	0
41 Production of ammonia		29	21
42 Production of bulk chemicals		364	38
43 Production of hydrogen and synthesis gas		42	8
44 Production of soda ash and sodium bicarbonate		14	3
45 Capture of greenhouse gases under Directive 2009/31/EC	Other	2	0
46 Transport of greenhouse gases under Directive 2009/31/EC		1	0
99 Other activity opted-in under Art. 24		257	1
Sum of all stationary installations	**Stationary**	**11.956**	**1.682**
10 Aviation	Aviation	511	67

Source: European Environment Agency (EEA) (2019).

A1.1.2 Aviation operators

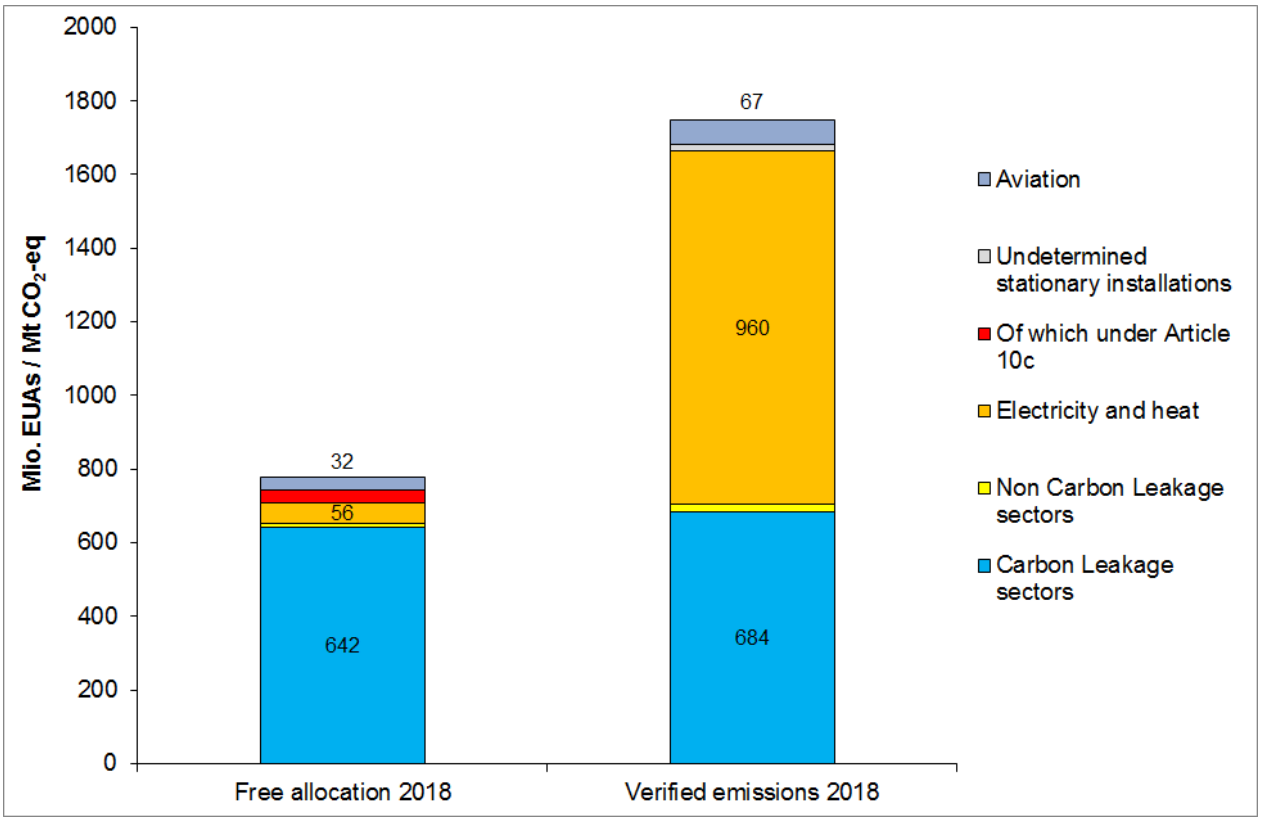
The aviation emissions covered by the EU ETS in 2018 were 67 Mt CO_2-eq. (European Environment Agency (EEA) 2018). Since its inclusion in the EU ETS in 2012, the aviation sector has had to purchase allowances from the stationary sector to fully cover its emissions. Initially, aviation covered all flights 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 the period 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. A consensus was reached towards the end of 2017 to maintain the current limitations on the scope of the EU ETS to intra EEA flights and prolong the derogation for extra EEA flights until 31st of December 2023.

A1.2 Allocation of free allowances

A1.2.1 Free allocation based on carbon leakage assessment

Free allocation differs significantly across the various activities. The vast majority of industrial installations host an activity considered to be at risk of carbon leakage. Figure A1.1 shows free allocation and verified emissions based on the sector classification used for the carbon leakage assessment (different from classification according to ETS activities in Section 1.1.1). The operators of industrial installations as a group receive free allowances that are just under their total verified emissions in 2018. Electricity and heat installations have to purchase the majority of allowances needed to cover their emissions. Aircraft operators also have to purchase additional allowances to cover their verified emissions.

Figure A1.1 Verified emissions and free allocation in 2018, according to allocation rules



Notes: Electricity and heat refers to electricity generators as included in the carbon leakage installation list. Both carbon leakage sectors and non-carbon leakage sectors refer to non-electricity generators (industry installations). Verified emissions data for installations producing electricity and heat are available only at an aggregate level.

Sources: Sector classification based on European Commission (EC), (2014a); European Environment Agency (EEA) (2019). (AG Energiebilanzen (AGEB) 2019)

A1.2.2 Transitional free allowances

The maximum allocation allowed under Article 10(c) decreases from 152 million allowances 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 0 in 2020.

To date, the de facto allocation has always been lower than the allowed amount. In 2013, 139 million allowances were allocated free to installations under Article 10(c), which corresponds to 92 % of the

maximum allowed amount (European Commission (EC) 2014b; European Union (EU) 2018b, 2019). In 2014, 109 million allowances were allocated to installations, 84 % of the maximum allowed amount (European Commission (EC) 2015a; European Union (EU) 2018b). In 2015, 86 million allowances were allocated to installations, 75 % of the maximum allowed amount (European Commission (EC) 2016b; European Union (EU) 2018b). In 2016, 66 million allowances were allocated to installations, 67 % of the maximum allowed amount (European Commission (EC) 2017c; European Union (EU) 2018b). In 2017, 46 million allowances were allocated to installations, 57 % of the maximum allowed amount (European Commission (EC) 2018c; European Union (EU) 2018b). In 2018, 34 million allowances were allocated to installations, 53 % of the maximum allowed amount (European Commission (EC) 2019c).

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

		2013	2014	2015	2016	2017	2018	2019	2020
Bulgaria	Max	13.5	11.6	9.7	7.7	5.8	3.9	1.9	0.0
	Allocated	11.2	9.8	8.2	6.5	3.8	2.1		
Cyprus	Max	2.5	2.2	1.9	1.6	1.3	0.9	0.6	0.0
	Allocated	2.5	2.2	1.9	1.6	1.3	0.9		
Czech Republic	Max	26.9	23.1	19.2	15.4	11.5	7.7	3.8	0.0
	Allocated	26.8	23.0	19.2	15.3	11.5	7.7		
Estonia	Max	5.3	4.5	3.8	3.0	2.3	1.5	0.8	0.0
	Allocated	5.1	4.4	3.7	2.9	2.1	0.0		
Hungary	Max	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Allocated	6.1	0.0	0.0	0.0	0.0	0.0		
Lithuania	Max	0.6	0.5	0.5	0.0	0.4	0.3	0.2	0.0
	Allocated	0.3	0.3	0.3	0.2	0.2	0.2		
Poland	Max	77.8	72.3	66.7	60.0	52.2	43.4	32.2	0.0
	Allocated	71.6	60.8	43.6	31.7	21.3	18.8		
Romania	Max	17.9	15.3	12.8	10.2	7.7	5.1	2.6	0.0
	Allocated	15.7	8.6	9.2	7.2	6.2	3.8		
Total	**Max**	**151.5**	**129.5**	**114.6**	**98.0**	**81.1**	**62.7**	**42.1**	**0.0**
	Allocated	**139.4**	**109.0**	**85.9**	**65.5**	**46.3**	**33.5**		

Note: Includes Article 10(c) amounts to be auctioned in 2018.

Sources: European Commission (EC), (2014b); (2015a); (2016b); (2017c); (2018c); European Union (EU) (2019).

A1.3 Auctioned allowances during the third trading period

Table A1.3 and Table A1.4 present the volume of allowances auctioned or sold. Iceland, Liechtenstein and Norway have not auctioned in the years up to 2018 but plan to auction their budget for the third trading period starting in June 2019 and until the end of 2020.

Table A1.3 Allowances auctioned/sold during the third trading period (EUA millions), 2012-2018

	2012	2013	2014	2015	2016	2017	2018
Austria	1.0	14.3	8.8	10.0	11.2	13.7	13.5
Belgium	9.6	26.1	16.1	18.2	20.4	24.9	24.6
Bulgaria	0.1	15.3	6.1	15.9	16.2	22.6	23.8
Croatia	0.0	0.0	0.0	11.3	3.8	4.7	4.6
Cyprus	0.0	0.3	0.1	0.0	0.0	1.1	1.6
Czech Republic	2.6	18.6	9.4	14.5	22.4	34.6	37.8
Denmark	2.8	12.9	8.0	9.0	10.1	12.3	12.1
Estonia	0.0	4.1	1.2	2.8	4.5	6.8	9.1
Finland	0.0	17.2	10.6	12.0	13.4	16.4	16.2
France	0.0	56.3	34.8	39.3	44.0	53.8	53.1
Germany	48.1	206.1	127.1	143.9	160.8	196.8	172.2
Greece	8.8	35.8	22.0	24.9	27.9	34.1	33.6
Hungary	7.7	8.4	9.5	10.8	12.1	14.8	14.5
Iceland	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ireland	0.0	9.6	5.9	6.7	7.5	9.2	9.1
Italy	0.0	99.2	61.2	69.3	77.4	94.7	93.4
Latvia	0.0	2.8	1.7	1.9	2.2	2.6	2.6
Liechtenstein	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lithuania	2.5	5.0	2.9	3.7	3.9	5.4	5.2
Luxembourg	0.0	1.2	0.8	0.9	1.0	1.2	1.2
Malta	0.0	1.1	0.6	0.7	0.8	1.0	1.0
Netherlands	4.0	34.5	21.3	24.1	26.9	32.9	32.5
Norway	9.8	0.0	0.0	0.0	0.0	0.0	0.0
Poland	0.2	51.2	13.3	17.1	25.6	85.9	78.0
Portugal	0.0	18.1	11.2	12.6	14.1	17.3	17.0
Romania	0.6	33.8	16.5	25.4	36.8	45.2	46.5
Slovakia	0.0	15.9	9.7	11.1	12.4	15.1	14.9
Slovenia	0.0	4.6	2.8	3.2	3.6	4.4	4.3
Spain	0.0	88.9	54.8	62.1	69.3	84.9	83.7
Sweden	0.0	9.2	5.6	6.4	7.1	8.8	8.6
United Kingdom	27.3	107.4	66.2	75.0	80.3	106.0	101.1
NER 300 auctions	0.0	210.6	89.5	0.0	0.0	0.0	0.0

Sources: European Environment Agency (EEA) (2019).

Table A1.4 Allowances auctioned/sold during the third trading period (EUAA millions), 2012-2018

	2012	2013	2014	2015	2016	2017	2018
Austria	0.0	0.0	0.2	0.3	0.1	0.1	0.1
Belgium	0.0	0.0	0.3	0.4	0.1	0.1	0.1
Bulgaria	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Croatia	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Cyprus	0.0	0.0	0.1	0.2	0.1	0.1	0.1
Czech Republic	0.0	0.0	0.1	0.2	0.1	0.0	0.1
Denmark	0.0	0.0	0.2	0.4	0.1	0.1	0.1
Estonia	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.1	0.3	0.1	0.1	0.1
France	0.0	0.0	1.7	1.7	0.6	0.5	0.6
Germany	2.5	0.0	0.0	2.2	0.9	0.7	0.8
Greece	0.0	0.0	0.2	0.7	0.3	0.2	0.2
Hungary	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Iceland	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ireland	0.0	0.0	0.1	0.3	0.1	0.1	0.1
Italy	0.0	0.0	0.9	2.0	0.7	0.6	0.7
Latvia	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Liechtenstein	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Luxembourg	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Malta	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Netherlands	0.0	0.0	0.9	0.5	0.2	0.2	0.2
Norway	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poland	0.0	0.0	0.0	0.4	0.1	0.1	0.1
Portugal	0.0	0.0	0.2	0.4	0.2	0.1	0.1
Romania	0.0	0.0	0.1	0.2	0.1	0.1	0.1
Slovakia	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spain	0.0	0.0	1.1	2.3	0.8	0.7	0.8
Sweden	0.0	0.0	0.2	0.5	0.2	0.1	0.2
United Kingdom	0.0	0.0	2.7	2.5	0.9	0.7	0.9

Sources: European Environment Agency (EEA) (2019).

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

The Öko-Institut's MSR model represents the supply and demand for allowances from stationary installations and aviation in the EU ETS for the period 2008-2030 and thus calculates the annual and cumulated surplus of allowances, as well as the point in time when the market becomes scarce again.

The model includes free allocation, auction quantities, historic and projected emissions from stationary EU ETS installations, as well as the use of international credits and allowances remaining unallocated.

Historical data is based on the most recent numbers from the Union Registry. Future allocation and auction quantities are based on current legislation, but can be adjusted variably. The emissions baselines can also be replaced variably. For this report the following settings were used:

- Geographical scope: EU-28 plus Iceland, Liechtenstein and Norway
- Flat auction share of 57% for the fourth trading period. The amount available for free allocation is allocated completely; the free allocation buffer is not triggered.
- Monetization of Modernisation Fund and Innovation Fund equally across the fourth trading period
- 100% of NER will enter the market, split evenly across all years of the fourth trading period
- No voluntary cancelation of auctions by Member States

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