ETC CM Report 2022/5

Trends and projections in the EU ETS in 2022

The EU Emissions Trading System in numbers

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Climate change mitigation

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About this report

This report analyses recent, current and future emissions trends under the European Union (EU) Emissions Trading Scheme (ETS). It also analyses the balance between supply and demand of allowances on the market. This report is based on data and information provided by the European Commission and Member States as of July 2022. The data on verified emissions and compliance of operators under the EU ETS for the years up to 2021 are based on an extract from the EU Transaction Log on 1 July 2022.

This report is divided into four parts: Recent trends, long-term trends and projected emission trends, as well as one section dedicated to an outlook to 2030, including a discussion of the revision to the ETS proposed as part of the Commission's "Fit for 55" package.

Main findings

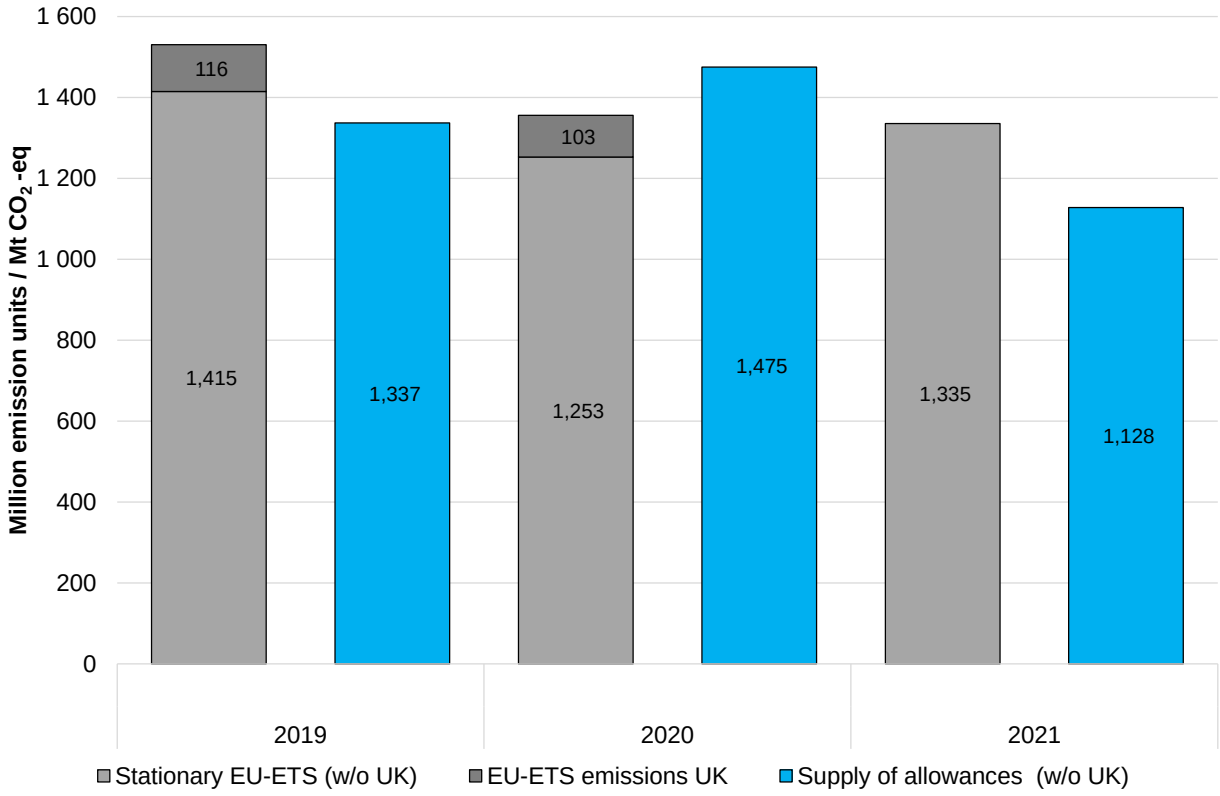
The EU ETS is a 'cap and trade system', whereby a cap - a determined quantity of emission allowances - is set for the installations covered by the system. The cap decreases gradually in order to achieve emission reductions over time. Installations can trade emission allowances with one another, which ensures that emission reductions take place where it costs least. The EU ETS has entered into force in 2005. Since then, it has evolved in terms of scope and many advanced design elements have been added in response to both learning by doing, responding to external shocks and an increase in political will towards decarbonising of the EU economy.

Recent trends

The United Kingdom has left the EU ETS as of 2021. As a result, the number of installations subject to the ETS has fallen significantly compared to 2020 and comparisons between 2020 and 2021 must be made keeping the exit of the UK from the EU ETS in mind. While it may seem that emissions reductions took place between 2020 and 2021 (Figure ES.1), this is only due to the UK exiting the EU ETS. In fact, verified emissions from stationary installations in countries other than the UK increased by 6.6% in 2021 compared to 2020.

Rebounding from the pandemic, total aviation emissions in the EU ETS increased by 10.9% in 2021 compared to 2020. They are, however, still 59% lower than the all-time high recorded in 2019.

Figure ES.1 Verified emissions and supply of allowances for stationary installations with and without those situated in the UK



Source: EEA (2022)

Long-term trends

Between 2005 and 2021, emissions from stationary installations have been reduced by 36%. To a large extent, emission reductions observed in the EU ETS to date are the result of changes in the fuel mix for heat and electricity generation, in particular a reduction in the use of hard coal and lignite fuels and an increase in electricity generation from renewable energy sources. In recent years, the increasing CO2 price has put further pressure on carbon-intensive fuels. Lignite and hard coal-fired power plants (many situated in Germany and Poland), however, remain the top-emitting installations in the EU ETS.

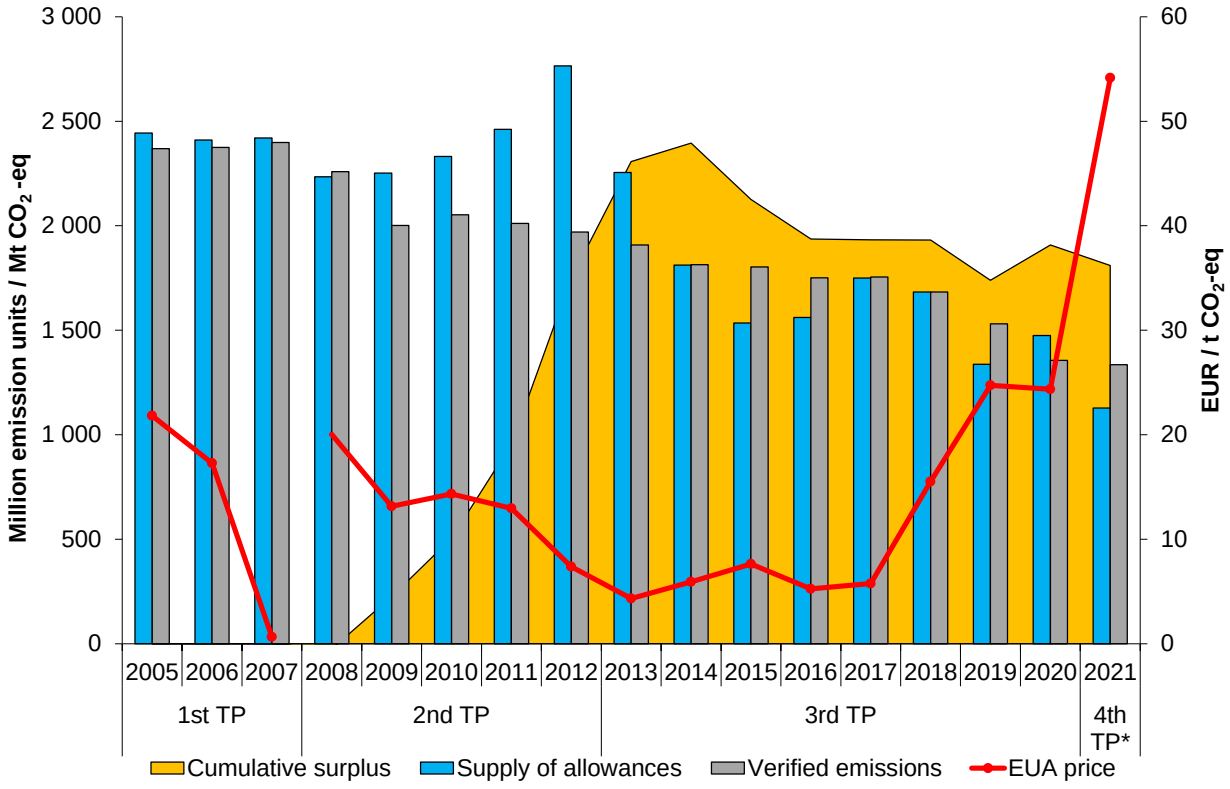
Emissions in the largest industrial sectors (iron and steel, cement and lime and refineries) have also been reduced substantially since the beginning of the EU ETS, although not to the same extent as in electricity generation. Emissions in industrial sectors experienced a sharp drop following the financial and economic crisis of 2008 and 2009 and have remained at lower levels since. 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 with a drop in 2020 due to the COVID-19 pandemic an a rebound in 2021.

Between 2009 and 2013, the number of allowances available on the ETS market exceeded the demand for these allowances (i.e. the verified emissions). 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.2). In response to this situation, EU lawmakers implemented a number of measures, including the 'backloading' of 900 million allowances between 2014 and 2016 and the introduction of the Market Stability Reserve (MSR), which began operating in 2019. Together with a more

stringent cap from 2021 onwards, these measures have reduced the surplus. In 2021, the supply of allowances was well below the value of verified emissions. At the end of 2021, the surplus stood at 1 450 million allowances (EC 2022).

Prices for EUA allowances have seen a steep increase starting in 2018. This increase is related to the introduction of the MSR, ambitious reforms to the ETS in its fourth trading period and the European Climate Law adopted in 2021 setting a legally-binding reduction target of 55% below 1990 levels for 2030 (with climate neutrality to be achieved by 2050). To align the EU's energy and climate policy architecture with the new 55% reduction target, the European Commission has put forward its "Fit for 55" package in July 2021 including reforms to the EU ETS. The package is currently discussed in the trialogue between the Commission, the European Parliament and the Council.

Figure ES.2 Emissions, allowances, surplus and prices in the EU ETS (w/o UK), 2005-2021



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.

Sources: Point Carbon (2012), EEA (2022), EEX (2022), ICE (2021)

Projected emission trends

Available GHG projections reported by Member States neither fully reflect the impact of the COVID-19 pandemic nor repercussions of Russia's invasion of Ukraine and associated turmoil on global energy markets or the ongoing discussions to revise the EU ETS, as most of the projections were submitted at the beginning of 2021. With 2022 being a non-mandatory year for updates, only Denmark, Ireland, Latvia and Iceland reported updated projections.

Following these projections, stationary ETS emissions with existing measures will result in a reduction of 41% by 2030 compared to 2005. With the proposed further measures, EU ETS emissions will fall by 47%

compared to 2005, overachieving the current reduction target of -43%, but fall far short of the ETS reduction target of 62% for stationary installations compatible with the 55% 2030 reduction target.

Revision of the EU ETS as part of the "Fit for 55" package

As part of its "Fit for 55" package, the European Commission proposes to include the maritime sector into the system under the stationary cap. The ambition is raised to be in line with the new 2030 reduction target. A Carbon Border Adjustment Mechanism (CBAM) replacing free allocation in certain sectors by this alternative carbon leakage protection is proposed. The proposal further strengthens the Innovation and Modernisation Funds. The MSR architecture is to be fundamentally unchanged.

Applying these proposed changes to a relevant emissions baseline from the Impact Assessment accompanying the proposal shows that the surplus of allowances on the market will persist until the end of the fourth trading period and remain above the upper MSR threshold. If the upper threshold of the MSR was reduced in line with the cap as proposed by the European Parliament, the surplus would be reduced considerably until 2030 (see also Figure 4-1, page 43).

1 Recent trends

- Between 2020 and 2021, total emissions from the European Union (EU) Emissions Trading Scheme (ETS) for stationary installations increased by 6.6% when the effect of installations in the United Kingdom leaving the system are considered.
- Combustion plants (mainly power plants) increased emissions by 7.8% compared to 2020.
- Electricity demand increased by 110 TWh between 2020 and 2021 in the EU-27, which was mainly met by increased production of coal and nuclear energy.
- Hard coal and lignite account for 63% of combustion emissions. Due to high gas prices the share of combustion emissions from natural gas power plants decreased from 22% in 2020 to 17% in 2021.
- Emissions from industrial plants increased by 4.7% on average.(1) Most industrial sectors are now again on a pre-pandemic emission level.
- The average certificate price (EUR 54.15) nearly doubled compared to 2020
- This report considers developments until the end of 2021, impacts of Russia's invasion of Ukraine will only be visible in data for 2022 and covered in next year's report.

In this section, developments for stationary installations and aviation are presented separately, focussing first on emission trends between 2020 and 2021 and then on their effects on the balance of the supply of and demand for allowances. EU Emission Allowances (EUAs) and EU Aviation Allowances (EUAAs) are fully fungible since the beginning of the third trading period. ([1])

1.1 Stationary installations

1.1.1 Emission trends

Status in 2021

Combustion plants ([2]) are the main source of emissions under the EU ETS. In 2021, these installations accounted for 61% (814 Mt CO_2-eq) ([3]) of total verified emissions in the stationary part of the EU ETS (Figure 1-1). Cement and lime installations accounted for 10% (139 Mt CO_2-eq.), followed by iron and steel ([4]) (10%; 132 Mt CO_2-eq.), refineries (8%; 108 Mt CO_2-eq.) and chemical installations (5%; 69 Mt CO_2-eq.).

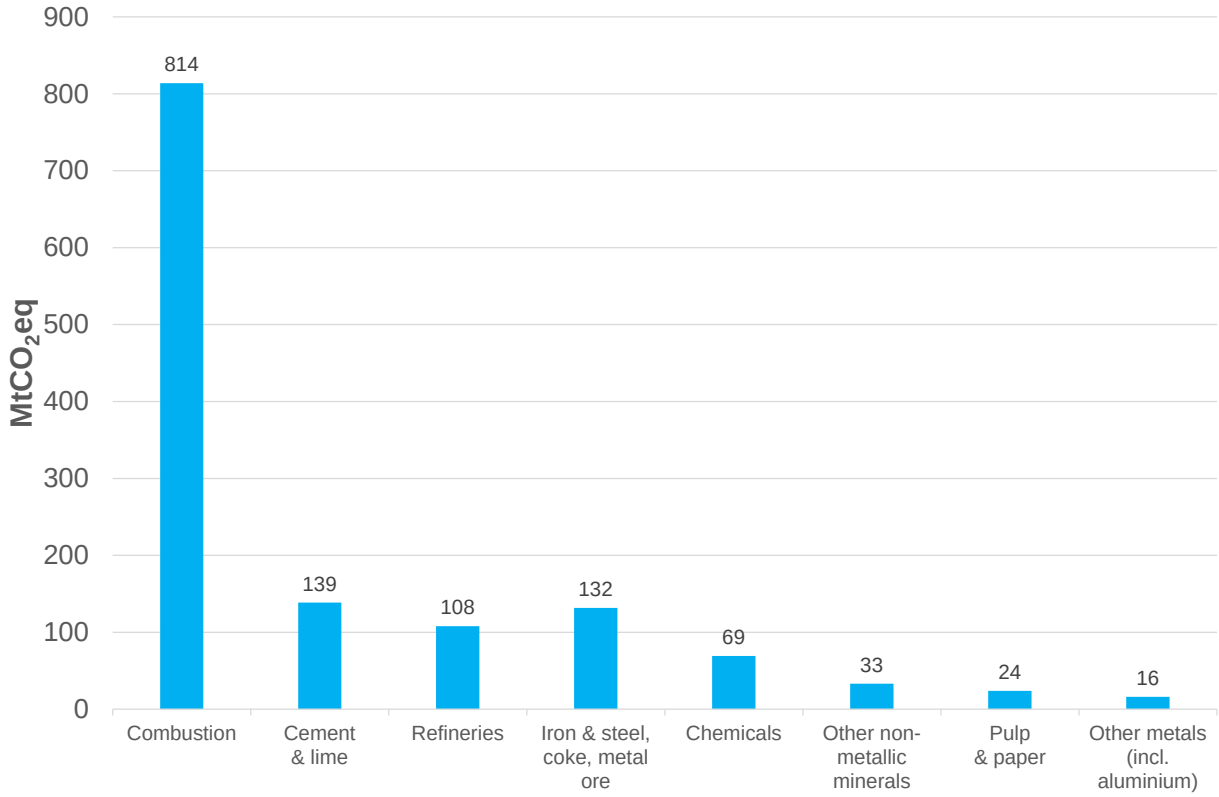
(1) Article 3(a) of the EU ETS Directive EU (2003) defines the emission allowance as being 'an allowance to emit one tonne of carbon dioxide equivalent during a specified period, which shall be valid only for the purposes of meeting the requirements of this Directive and shall be transferable in accordance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

(2) Combustion installations are defined as those carrying out 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, for example, waste gas scrubbing (EC 2010).

(3) Mt CO_2e refers to million tonnes of carbon dioxide equivalent.

(4) 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.

Figure 1-1 EU ETS emissions by main activity type in 2021



Note: Numbers 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).
According to EUTL attribution, emissions originating from the combustion of blast furnace gases are included in the sector 'combustion'.

Source: EEA (2022)

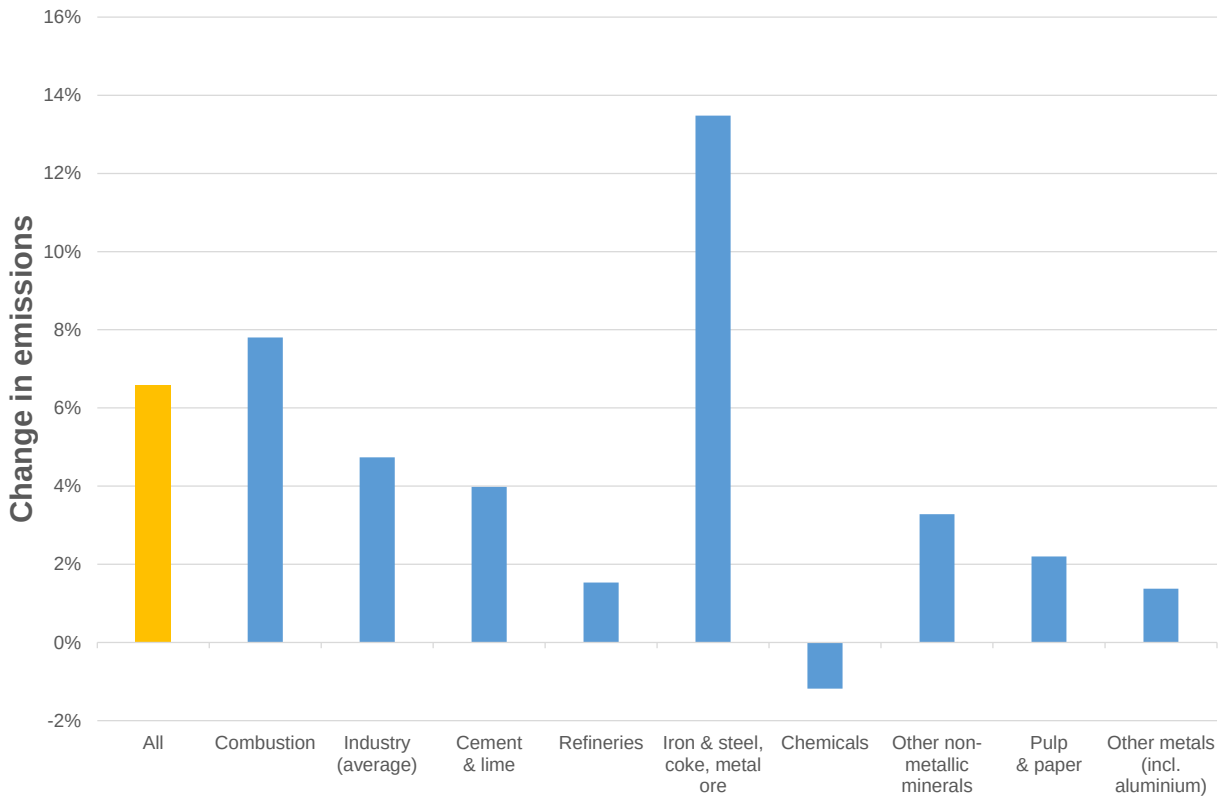
In 2021, all sectors but the chemicals industry have higher verified emissions than in 2020 (see Figure 1-2). Since the United Kingdom is no longer part of the EU ETS as of 2021, the emissions allocated to Great Britain have been deducted here from emissions in the year 2021 to show a meaningful comparison between 2020 and 2021.

The overall emissions in the EU ETS for stationary installations decreased from 1356 Mt in 2020 to 1335 Mt in 2021 without considering the Brexit. Taking the withdrawal of the UK into account, the verified emissions of stationary installations increased from 1253 Mt in 2020 to 1335 Mt in 2021. This means an overall increase of 6.6% with the combustion sector increasing emissions by 7.8% and industrial installations in the ETS increasing emissions by an average 4.7%.

The industrial sector with the largest increase between 2020 and 2021 was the iron & steel sector, with an increase of 13.5%. Only the chemical sector was able to reduce its emissions between 2020 and 2021. This decrease is remarkable, as the annual output of EU-27 manufacturers has increased again in 2021 compared to 2020 and in many cases has reached pre-pandemic levels again (increase of 6.8% for chemical industry and 6.8% for total industry) ([5]) (see Figure 2-5 in Section 2.1.1).

[5] Manufacturing is reported under code C of NACE rev. 2, the statistical classification of economic activities in the European Community. The change in production output for manufacturing for the EU-27 is calculated based on the annual average of the monthly index values for both 2020 and 2021. (Eurostat 2022a)

Figure 1-2 Change in EU ETS emissions by main activity, 2021 vs. 2020 (without UK)



Source: EEA (2022)

Emission trends in the power sector

The emissions increase in the combustion sector is mainly related to the fact that electricity production has bounced back from a significant reduction during the first pandemic year in 2020. Between 2019 and 2020 electricity production had fallen by 112 TWh in the EU-27 and has risen again by 110 TWh between 2020 and 2021 (see Eurostat (2022a)).

Since 2021 was a below-average wind year and there was a sharp increase in the price of natural gas, the additional demand for electricity production was met primarily by nuclear and/or coal-fired power plants, especially in Belgium, France, Germany and Poland (Table 1.1). the use of natural gas decreased by 6% compared to 2021. Electricity production from solar and wind increased from 536 TWh to 543 TWh between 2020 and 2021 (see Eurostat (2022a)).

Table 1.1 Change in electricity generation between 2021 and 2020

	Change in emissions 2021 vs. 2020*	Consumption 2021 vs. 2020 [TWh]	Net electricity generation [TWh]								
			Total	of which							Net Import
				Thermal	of which**		Nuclear	Hydro	Wind	Solar	
					Coal	Gas					
PT	-14%	0.3	-3.1	-3.8	-1.5	0.1	N/A	-0.6	0.9	0.5	0.0
SI	-7%	0.4	-1.3	-0.5	-0.5	0.1	-0.6	-0.2	0.0	0.0	1.7
HU	-6%	2.5	1.3	0.0	-0.6	0.0	-0.1	0.0	0.0	1.4	1.1
HR	-4%	1.1	1.8	0.0	3.0	0.0	N/A	1.4	0.3	0.0	-0.8
LT	-2%	0.6	-0.7	-0.5	N/A	0.0	N/A	0.0	-0.2	0.0	1.1
NO	-2%	6.0	3.0	-1.0	N/A	N/A	N/A	2.1	1.9	N/A	2.9
LU	-2%	0.4	0.1	0.0	N/A	N/A	N/A	0.0	0.0	0.1	0.3
RO	-1%	2.4	3.0	1.9	1.2	0.0	-0.2	1.7	-0.4	0.0	-0.6
BE	0.2%	2.7	10.2	-4.7	-0.1	0.0	15.3	0.0	-0.9	0.5	-7.5
CY	0.4%	0.2	0.2	0.0	N/A	0.0	N/A	N/A	0.0	0.1	
NL	1%	0.8	-2.1	-7.3	6.9	0.0	-0.2	0.0	2.6	2.7	2.9
MT	3%	0.2	0.1	0.1	N/A	0.0	N/A	N/A	N/A	N/A	0.1
ES	3%	6.0	8.5	-0.3	0.0	-0.4	-1.7	-1.0	5.7	5.9	-2.4
FI	3%	4.7	2.6	2.2	0.5	0.1	0.3	-0.2	0.2	0.1	2.3
IT	4%	15.2	4.9	5.1	N/A	N/A	N/A	-1.6	2.0	-0.5	10.6
LV	5%	0.2	0.1	0.0	N/A	N/A	N/A	0.1	0.0	N/A	0.1
EL	5%	1.5	7.0	2.6	-0.4	-0.2	N/A	2.5	1.2	0.7	-5.2
FR	6%	20.3	22.2	1.4	4.1	0.2	25.3	-2.9	-2.9	1.4	0.1
CZ	6%	2.8	3.2	2.5	1.9	0.0	0.7	0.2	-0.1	-0.1	-0.9
IS	7%	0.5	0.5	0.0	N/A	0.0	N/A	0.6	0.0	N/A	
AT	7%	2.4	-2.2	0.4	-0.2	0.0	N/A	-2.2	0.0	N/A	5.3
DK	8%	2.8	4.2	4.4	2.0	0.0	N/A	0.0	-0.3	0.1	-1.4
SE	10%	6.6	6.4	2.8	0.0	0.3	3.7	-1.1	-0.2	1.1	-0.6
DE	11%	16.9	14.8	26.2	28.9	0.2	4.5	-0.7	-16.3	1.1	0.3
PL	11%	8.5	20.4	17.6	18.4	N/A	N/A	0.2	0.7	1.9	-12.4
IE	14%	1.0	-0.6	1.4	2.5	0.4	N/A	-0.2	-1.8	N/A	1.7
SK	15%	1.9	1.5	1.4	-0.2	0.0	0.3	-0.3	N/A	0.0	0.5
BG	21%	1.2	4.7	3.2	0.0	0.7	0.0	N/A	0.0	0.0	0.6
EE	22%	0.4	N/A	N/A	N/A	0.0	0.2	N/A	N/A	-1.0	0.1
LI***											
XI***	11%										

Note: * Combustion installations (Activity Code 20)

** Additional thermal electricity generation is reported by Eurostat from oil, renewable and non-renewables, which are not shown here.

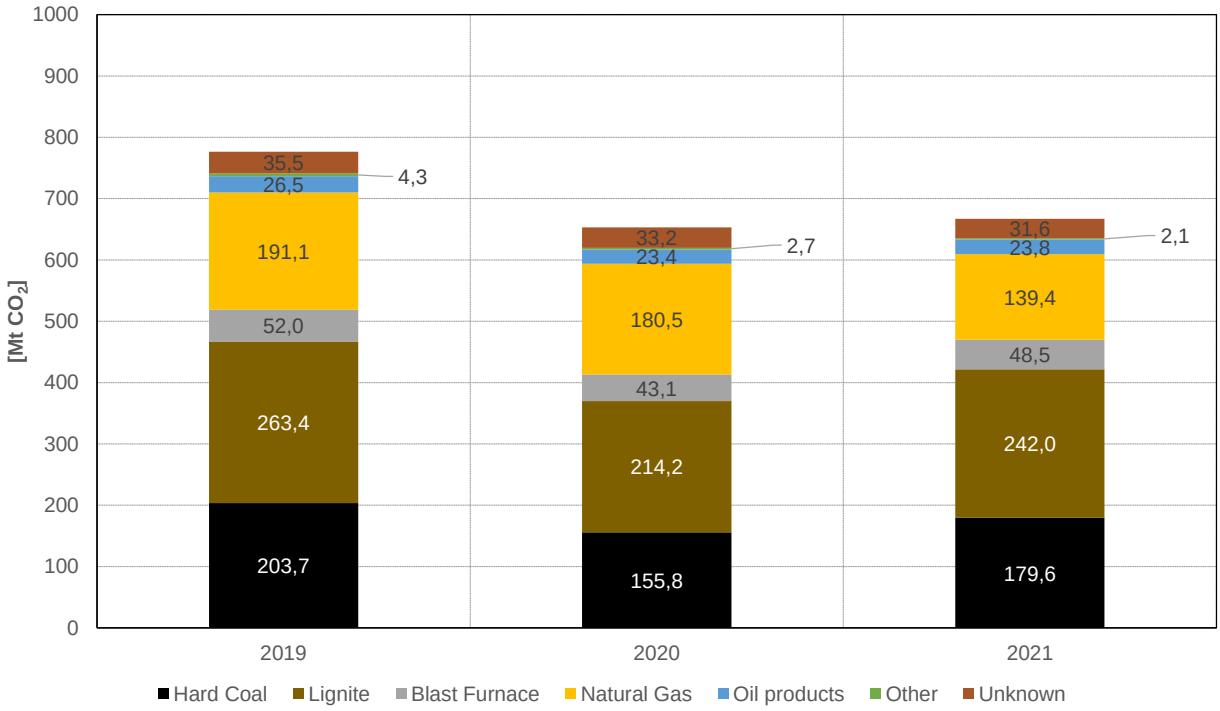
*** No data for Liechtenstein (LI) and Northern Ireland (XI) available

Sources: EEA (2022), Eurostat (2022a)

Power plants and other combustion installations are reported under activity code 20 (Combustion of fuels) in the EU-ETS. The EUTL does not allocate fuels though. ETC/CME 2021 provide a methodology to allocate fuels to ETS power plants that is applied in Figure 1-3. Out of the 814 Mt CO_2 of all combustion installations 82% of the emissions can be attributed to power plants. Emissions from fossil fuel combustion in power plants increased in 2021 compared to 2020 but remained lower than pre-pandemic levels. Hard coal and lignite power plants dominate emissions from power plants with a total of 422 Mt CO_2, which is 63% of all emissions from combustion installations. Power plants using natural gas represent 17% of all emissions from combustion installations. In 2021 emissions from natural gas power plants decreased by 22% compared to the previous year due to an increase in natural gas prices.

In some countries emissions from power plants using blast furnace gas are reported in sector 20 (combustion installations) although they are associated with steel production. Emissions from power plants using blast furnace gas were equal to 48.5 Mt CO_2 in 2021.

Figure 1-3 Emissions of power plants, matched to main fuel types, 2019-2021 (without UK)

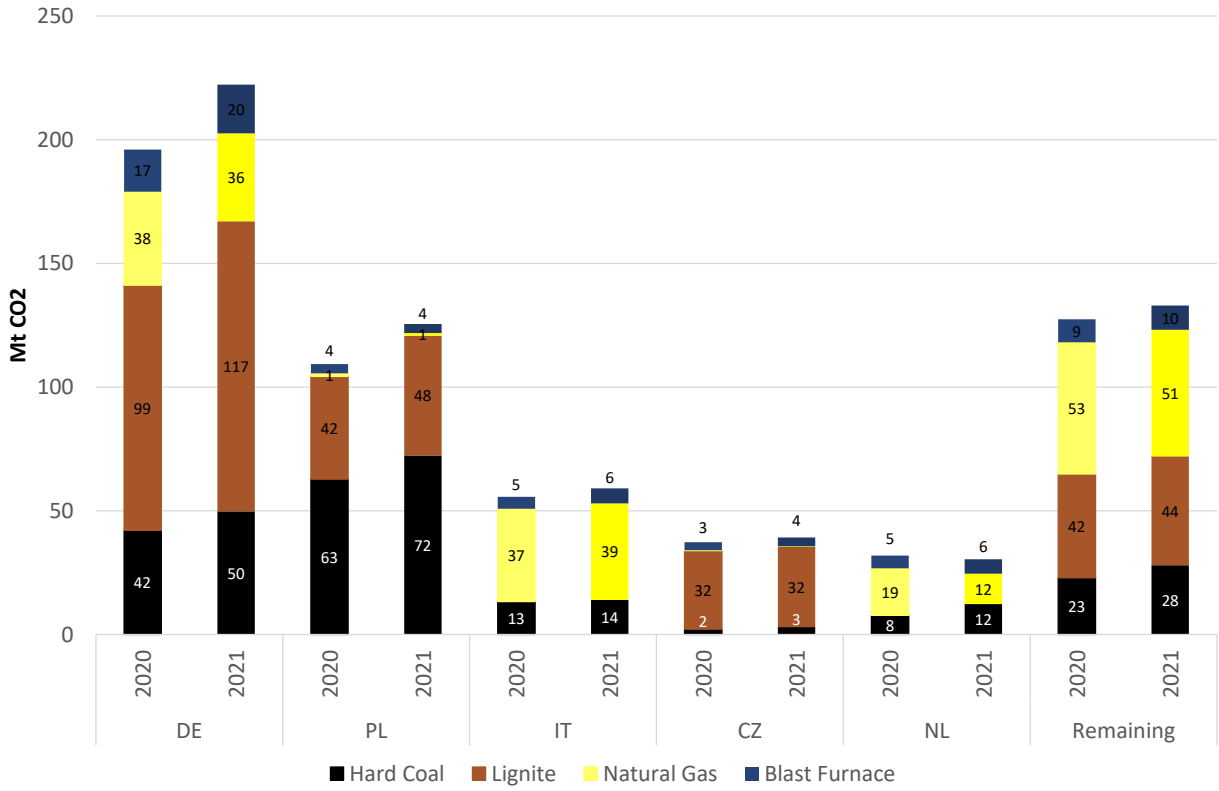


Source: EEA (2022)

Figure 1-4 shows detailed emissions from power plants for selected countries. The five countries with the highest emissions from power plants account for almost 80% of the emissions from power plants covered by the EU ETS. The two countries with the highest emissions even account for more than 50% of the emissions (Germany and Poland):

- Germany is the country with the highest emissions from power plants in the EU ETS. German emissions are dominated by lignite-fired power plants. Germany is also the country with the highest emissions from lignite-fired power plants in the EU ETS (117 Mt. CO_2 in 2021).
- Poland is the country with the second highest emissions from power plants in the EU ETS. Polish emissions are dominated by hard coal-fired power plants. Poland is also the country with the highest emissions from hard coal-fired power plants in the EU ETS (72 Mt. CO_2 in 2021).
- Italy follows in third place. Italian emissions are dominated by natural gas power plants. Italy is also the country with the highest emissions from natural gas power plants in the EU ETS (39 Mt. CO_2 in 2021).
- In fourth place comes the Czech Republic. Here emissions are dominated by lignite-fired power plants.
- The Netherlands is the country with the fifth highest emissions from power plants. The emissions come from natural gas and hard coal-fired power plants. In 2021, emissions from natural gas power plants decreased and emissions from hard coal power plants increased.
- Emissions from other countries are distributed among natural gas, lignite and, to a lesser extent, hard coal power plants (133 Mt. CO_2 in 2021 in total).

Figure 1-4 Fuel distribution by country in 2021 (power plants)



Note: Iceland, Liechtenstein and Norway had no identified power plants in 2022

Source: Own matching of EUTL data EEA (2022)

Top 30 emitters (power)

The 30 power plants with the highest emissions covered by the EU ETS emitted about 259 Mt CO_2 in 2021 which is 19% more than in 2020. These power plants are responsible for about 27% of total combustion emissions (see Table 1.2). Individual installations with the highest emissions in the EU ETS are lignite-fired power plants, situated mainly in Poland or Germany. The largest emitter of all EU ETS installations is the lignite-fired power plant in Bełchatów, Poland, which emitted 33.2 Mt CO_2 in 2021. This is 10% more compared to 2020. On the list of top emitters, Bełchatów is followed by four German lignite-fired power plants. Lignite dominates the Top 30 list. The 16 lignite power plants in the Top 30 power plants had verified emissions of 180 Mt CO_2. This is 70% of all top-30 emissions. The majority of these plants are located in Germany (43% of all emissions in the top 30 list).

Lignite-fired power plants have higher specific emissions than hard coal- or natural gas-fired power plants. The CO_2 intensity of all lignite-fired power plants in the top 30 in 2021 averaged 1 164 g CO_2/kWh.

Table 1.2 Top 30 emitters in 2020 (power plants)

Company					Installed capacity 2021	Verified emissions 2021		Electricity generation 2021		Emission intensity 2021	
EUTL ID	Company		Power plant	Fuel	MW	$MtCO_2$	vs. 2020	TWh	vs. 2020	$t CO_2$/ MWh	vs. 2020
PL 1	PGE	PL	Bełchatów	Lignite	5,034	33.2	10%	28.2	11%	1.2	-1%
DE 1606	RWE	DE	Neurath	Lignite	3,918	22.1	18%	20.1	17%	1.1	1%
DE 1649	RWE	DE	Niederaußem	Lignite	2,488	16.1	36%	14.4	42%	1.1	-5%
DE 1456	LEAG	DE	Jänschwalde	Lignite	2,000	15.2	11%	13.1	12%	1.2	-1%
DE 1607	RWE	DE	Weisweiler	Lignite	2,363	14.5	26%	11.5	19%	1.3	6%
DE 1459	LEAG	DE	Schwarze Pumpe	Lignite	1,510	11.8	15%	10.5	16%	1.1	-1%
PL 4	ENEA	PL	Kozienice	Hard Coal	2,919	11.6	11%	12.9	12%	0.9	-1%
DE 1460	LEAG	DE	Lippendorf	Lignite	1,782	11.05	34%	11.4	36%	1.0	-2%
PL 2	PGE	PL	Opole	Hard Coal	3,332	10.7	11%	12.7	13%	0.8	-2%
PL 3	PGE	PL	Turów	Lignite	1,488	10.2	76%	8.6	66%	1.2	6%
DE 1454	LEAG	DE	Boxberg Werk IV	Lignite	1,470	8.6	-2%	8.4	2%	1.0	-4%
DE 1453	LEAG	DE	Boxberg Werk III	Lignite	1,000	7.0	5%	5.9	6%	1.2	-1%
BG 50	TPP	BG	Maritsa East 2	Lignite	1,604	6.7	55%	6.0	57%	1.1	-1%
BG 9	Contour Global Maritsa East	BG	TEC ContourGlobal Maritsa East 3	Lignite	908	6.4	20%	5.7	20%	1.1	0%
PL 5	Enea Elektrownia Połaniec	PL	Połaniec	Hard Coal	1,853	6.0	32%	7.9	24%	0.8	7%
NL 205957	RWE	NL	Eemshaven Centrale	Hard Coal	1,580	5.3	110%	8.9	147%	0.6	-15%
ES 201	EDP	ES	Aboño 1	Hard Coal, Blast Furnace Gas	904	5.2	46%	6.0	150%	0.9	-42%
PL 6	EDF	PL	Oddział w Rybniku	Hard Coal	1,775	5.1	80%	6.1	111%	0.8	-15%
DE 1380	Großkraftwerk Mannheim	DE	Mannheim	Hard Coal	1,971	5.0	20%	5.2	24%	1.0	-3%
GR 15	ΔΕΗ ΑΕ	GR	Dimitrios	Lignite	1,456	4.5	17%	2.9	20%	1.6	-2%
NL 107	Chemelot Site Permit B.V.	NL	Chemelot Site Permit B.V.	n/A	n/A	4.5	502%	n/A	n/A	n/A	n/A
FR 988	ENGIE THERMIQUE FRANCE	FR	ETF - CENTRALE DK6	Natural Gas	796	4.4	14%	6.2	17%	0.7	-3%
BG 152	AES-3C Maritza East 1	BG	TPP AES-3C Maritza East 1	Lignite	686	4.4	16%	3.9	18%	1.1	-1%
CZ 124	Elektrarna Pocerady, a.s.	CZ	CEZ, a. s. - Elektrarna Pocerady	Lignite	915	4.4	-3%	4.3	-4%	1.0	1%
DE 1376	Uniper Kraftwerke GmbH	DE	Kraftwerk Schkopau	Lignite	900	4.4	48%	3.3	59%	1.3	-7%
IT 511	Taranto Energia	IT	Taranto	Blast Furnace Gas	n/A	4.4	28%	n/A	n/A	n/A	n/A
PL 209933	ENEA	PL	Kozienice Block 11	Hard Coal	1,075	4.3	28%	5.2	28%	0.8	0%
DE 1457	EnBW	DE	RDK Karlsruhe	Hard Coal	1,347	4.2	95%	5.0	98%	0.8	-2%
IT 439	ENEL	IT	Torrevaldaliga Nord	Blast Furnace Gas	1,845	4.1	7%	4.2	14%	1.0	-6%
NL 188	Nuon Power Generation B.V	NL	Nuon Power Velsen	Natural Gas	725	4.0	18%	2.1	12%	1.9	5%

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.

Sources: EEA (2022), ENTSO-E (2022), Platts (2014)

Top 30 emitters (industry)

Of the 30 industrial installations with the highest emissions in 2021 that are not power plants ([6]) emitted 23% of total industrial emissions (about 132 Mt CO2 eq.) (see Table 1.3). These industrial installations are spread across Europe, with no single country dominating the list. The six largest industrial emitters all belong to the iron and steel sector. Overall, this sector accounted for 70.9% of the total emissions of the 30 top emitting industrial installations ([7]), followed by refineries (19.5%), chemicals (7.7%) and cement clinker (2.0%).

Two installations BE 215060 (steelworks) and BE 215200 (chemicals) entered the top 30 emitters list in 2021. These are likely not new installations, but a consolidation of ETS accounts as other accounts at the same sites have been closed.

The largest increases at over 400% are seen in chemical installations NL 128 (ammonia production) and NL 407 (bulk chemicals). However, this also involves the consolidation of multiple accounts at the same sites. In fact, five previous accounts were closed by the same operator and at the same site of NL 128, and nine

(6) In this report, industrial installations are understood to be 'non-combustion' installations, even though some industrial installations are included under the ETS activity code for combustion. In fact, most installations classified under 'combustion' are not electricity generators.

(7) 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).

accounts were closed at NL 407, whose combined emissions are at the level of the current emissions for one account.

Table 1.3 Top 30 emitters in 2021 (industrial plants, excluding combustion)

EUTL ID	Company	Installation	Activity code	Verified Emissions 2021	
				$MtCO_2$	vs. 2020
AT 16	Voestalpine Stahl Gmbh	Voestalpine Stahl Linz	24	9.4	10%
DE 69	Thyssenkrupp Steel Europe Ag	Integriertes Hüttenwerk Duisburg	24	7.8	15%
FR 956	Arcelormittal France	Arcelormittal France- Dunkerque	24	7.3	24%
FR 628	Arcelormittal Mediterranee	Arcelormittal Mediterranee	24	6.9	19%
NL 144	Tata Steel Ijmuiden B.V.	Tata Steel Ijmuiden Bv Bkg 1	24	6.0	4%
SK 150	U. S. Steel Košice, S.R.O.	U. S. Steel Košice, S.R.O.	24	5.9	33%
IT 575	Sarlux Srl	Impianti Di Raffinazione	21	5.7	-1%
ES 212	Arcelormittal España, S.A.	Arcelormittal España, S.A.	24	5.3	35%
IT 515	Acciaierie D'Italia S.P.A.	Stabilimento Di Taranto	24	5.2	9%
DE 53	Hüttenwerke Krupp Mannesmann Gmbh	Glocke Duisburg	24	4.9	24%
RO 44	Sc Liberty Galati Sa	Liberty Galati Sa	24	4.4	13%
NL 99	Shell Nederland Raffinaderij B.V.	Shell Nederland Raffinaderij B.V.	21	4.4	6%
DE 52	Rogesa Roheisengesellschaft Saar Mbh	Roheisenerzeugung Dillingen	24	4.3	19%
FI 445	Ssab Europe Oy	Raahen Terästehdas	24	4.2	27%
BE 215060	Arcelormittal Belgium	Arcelormittal Gent	24	4.0	
NL 407	Dow Benelux B.V.	Dow Benelux B.V. Bkg 1	42	3.9	401%
BE 127	Totalenergies Refinery Antwerp	Totalenergies Refinery Antwerp	21	3.8	4%
DE 43	Salzgitter Flachstahl Gmbh	Glocke Salzgitter	24	3.7	0%
DE 19	Pck Raffinerie Gmbh	Pck Raffinerie Glocke Schwedt	21	3.5	-1%
NL 128	Yara Sluiskil B.V.	Yara Sluiskil B.V. Bkg 1	41	3.2	400%
SE 495	Ssab Emea Ab	Ssab Luleå	24	3.2	3%
CZ 73	Liberty Ostrava A.S.	Liberty Ostrava A.S.	24	3.1	32%
DE 4	Ruhr Oel Gmbh	Ruhr Oel Gmbh - Werk Scholven - Co2-Glocke	21	3.0	8%
BE 215200	B.A.S.F. Antwerpen	Basf Antwerpen - 127	42	3.0	
AT 13	Voestalpine Stahl Donawitz Gmbh	Voestalpine Stahl Donawitz Gmbh	24	3.0	31%
AT 26	Omv Downstream Gmbh	Omv Raffinerie Schwechat	21	2.7	1%
PL 490	Górażdże Cement Spółka Akcyjna	Górażdże Cement Spółka Akcyjna	29	2.6	-5%
PL 362	Polski Koncern Naftowy Orlen S.A.	Rafineria	21	2.6	0%
PL 886	Arcelormittal Poland S.A.	Wielki Piec Stalownia Arcelormittal Dąbrowa Górn.	24	2.6	9%
CZ 114	Třinecké Železárny, A. S.	Třinecké Železárny	24	2.5	-11%

Note: A list of activity codes can be found in Annex 1 Table A1.1

Sources: EEA (2022), EU (2022)

1.1.2 Balance of allowances

Supply and demand

The total supply of allowances in 2021 decreased by 29% compared to the year 2020, amounting to 1018.5 million allowances or -20% without considering the withdrawal of UK. This amount includes free allocation and auctioned allowances (Table 1.4). With the start of the 4th trading period in 2021, international credits can no longer be used for compliance within the EU ETS.

The supply of allowances allocated for free was 12% lower than in 2020. Since 2013, power generators have been required to buy all their allowances, with exceptions made for some countries. Sectors and subsectors deemed to be exposed to a significant risk of carbon leakage, receive free allocation based on benchmarks. Across the whole trading period, the sum of the preliminary free allocation must not exceed the budget reserved for free allocation (43% of the cap plus a 3% buffer). If it does, the cross-sectoral correction factor (CSCF) is applied and the free allocation is reduced linearly. In the 2021 - 2025 period there is no need for such a correction.

Under Article 10(c) of the ETS Directive allowances can be allocated for free as a transitional measure to electricity generators in eligible Member States in order to support decarbonisation measures. Out of the ten eligible countries, only Bulgaria, Hungary and Romania have opted to allocate 10(c) allowances in the fourth trading period, but still need to establish national frameworks such that no allocation of 10(c) allowances took place in 2021. Czechia, Croatia, Lithuania, Romania and Slovakia will transfer their Article 10(c) volumes to the Modernisation Fund. Estonia, Latvia and Poland decided to sell allowances they could have used under Article 10(c) in regular auctions.([8])

Without considering the UK, the number of allowances auctioned decreased by 14%. This includes auctioned amounts from the Modernisation and Innovation Funds. In 2020, 375.6 million allowances were placed in the MSR instead of being auctioned. In 2021, this number amounted to 348.0 million allowances.

Table 1.4 EUA demand, supply and price (stationary installations), 2020-2021

	2020	2020 (w/o UK)	2021	Change
Verified emissions (Mt CO_2-eq.)	1355.6	1253.0	1335.5	**7%**
Combustion emissions	822.9	754.8	813.7	**8%**
Industrial emissions	532.7	498.2	521.8	**5%**
Total supply of allowances (millions of EUAs)	1474.6	1315.5	1127.9	**-14%**
Free allocation (incumbents, new entrants)	669.7	621.6	544.9	**-12%**
To existing installations	638.2	592.3	544.9	**-8.0%**
To new entrants and capacity extensions	31.5	29.3	-	
Auctioned amounts/primary market sales	778.5	667.5	583.0	**-13%**
International credits exchanged	26.5	26.5	-	
Supply/demand balance (millions of EUA)				
Balance stationary installations only	37.5	37.5	-317.0	
Net demand in EUAs from aviation	13.0	10.9	-0.3	
Annual balance all ETS	50.5	48.5	**-317.3**	
MSR intake	375.6		348.0	**-7%**
EUA price (EUR)	24.36	24.36	54.15	**122%**

Note: Based on data from July 1st 2022
The distinction between combustion (activity code 20) and industrial emissions (activity code 21 and above) 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.

Sources: EEA (2022), EEX (2022) ICE (2021), EC (2019a), EC (2020c), EC (2021c)

The balance of allowances in the stationary sector was strongly negative at – 317.0 million allowances implying that verified emissions substantially exceeded allowances made available in 2021 and that allowances banked from previous periods had to be used for compliance. Net demand from aviation made only a small contribution to the overall balance at -0.3 million allowances.

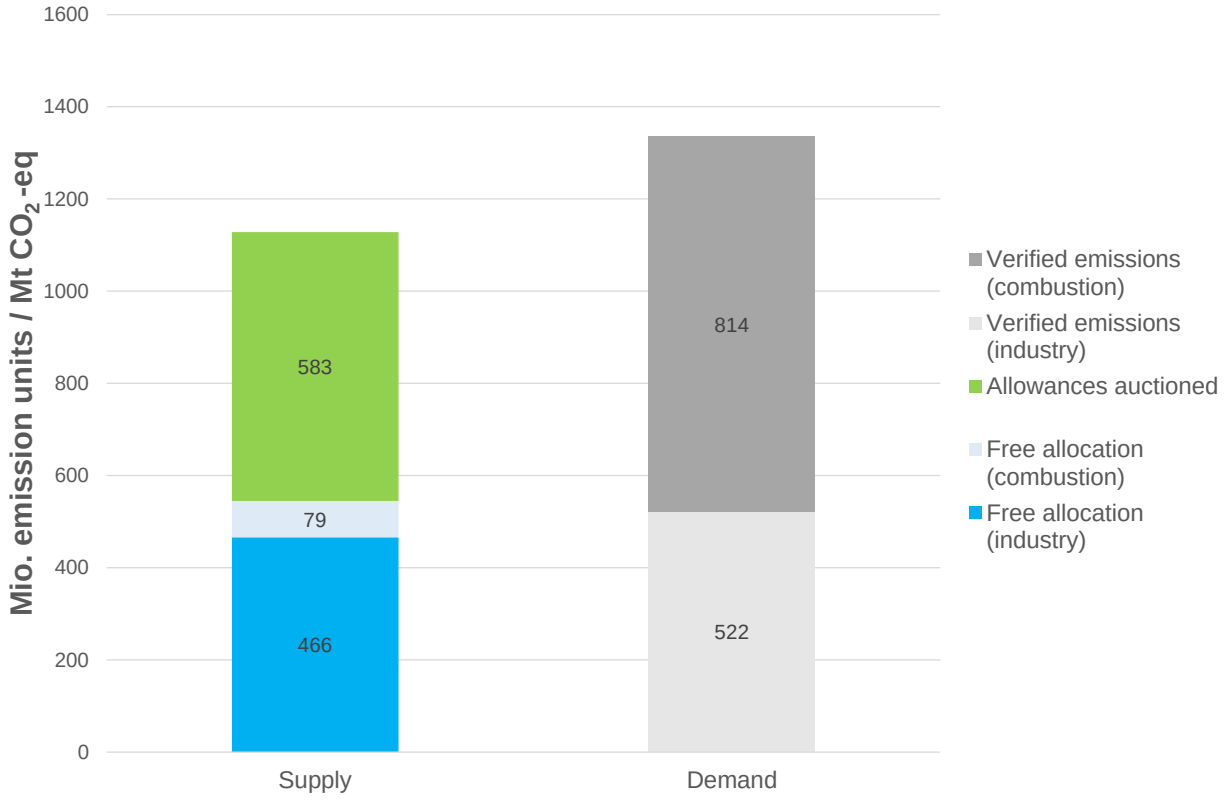
The average certificate price in 2021 increased by 122% over average 2020 levels.

(8) see https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/free-allocation/free-allocation-modernisation-energy-sector_de

Supply and demand by main activity type

In 2021, combustion plants had to buy most of the allowances to cover their emissions at auctions, from other market participants or use allowances banked from previous periods (Figure 1-5). Industrial installations received a larger number of free allowances (9). However, the balance between allowances allocated for free and verified emissions varies across individual industrial sectors.

Figure 1-5 Balance of supply and demand for combustion and industry in 2021



Note: Industry refers to those EUTL activities (21-99) that specifically refer to certain industrial activities. In addition to power plants, the sector combustion (20) covers industrial installations without a specific ETS activity.

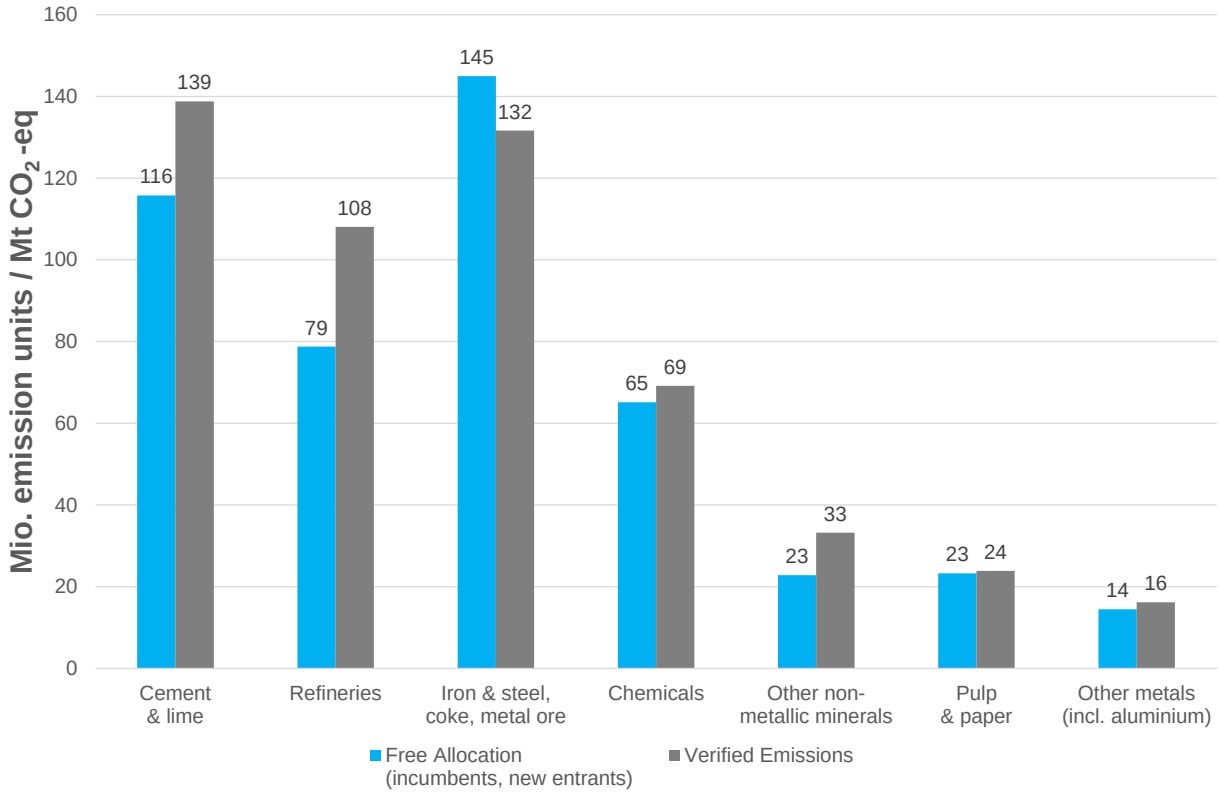
Source: EEA (2022)

Based on EUTL activity classifications, Figure 1-6 shows that verified emissions exceeded free allocation for all industrial sectors in 2021. For the iron & steel sector the way in which waste gases are reported under the EU ETS has to be taken into account. Free allocation for the combustion of waste gases is made to the installation producing the waste gas (i.e. the iron and steel plant), while emissions from their combustion is counted toward an installation typically included in the combustion sector. That is why an additional 48 Mt of CO_2e emissions have been added to the iron & steel sector in Figure 1-6 (cf. Figure 2-3).

(9) The higher share of free allocation to industry reflects concerns about the exposure of industrial sectors to international competition. Free allocation to industrial installations under Article 10(a)(1) of the ETS Directive are distributed by applying harmonised allocation rules based on EU ETS-wide benchmarks and historical production levels, as well as the 'carbon leakage status' of the installation.

This balance implies that all industrial sectors had to buy additional allowances in 2021 or use allowances banked from previous periods. This applies to other non-metallic minerals, refineries, iron & steel and cement & lime in particular.

Figure 1-6 Balance of free allocations and emissions, industrial sectors, 2021



Note: ETS activity types have been aggregated for certain sectors (Table A1.1). As per EUTL classification, the overall allocation presented here for the iron and steel sector includes allowances for emissions that are actually reported under combustion installations, for example if blast furnace gas is burnt in power plants. Likewise, albeit to a lesser extent, the allocations presented for the pulp and paper sector and the chemicals sector include allowances related to emissions reported under combustion installations, for example, if paper production or chemical facilities buy heat from other installations. In other words, allowances are allocated to these sectors, whereas corresponding emissions are reported under combustion.

Source: EEA (2022)

1.2 Aviation

1.2.1 Emission trends

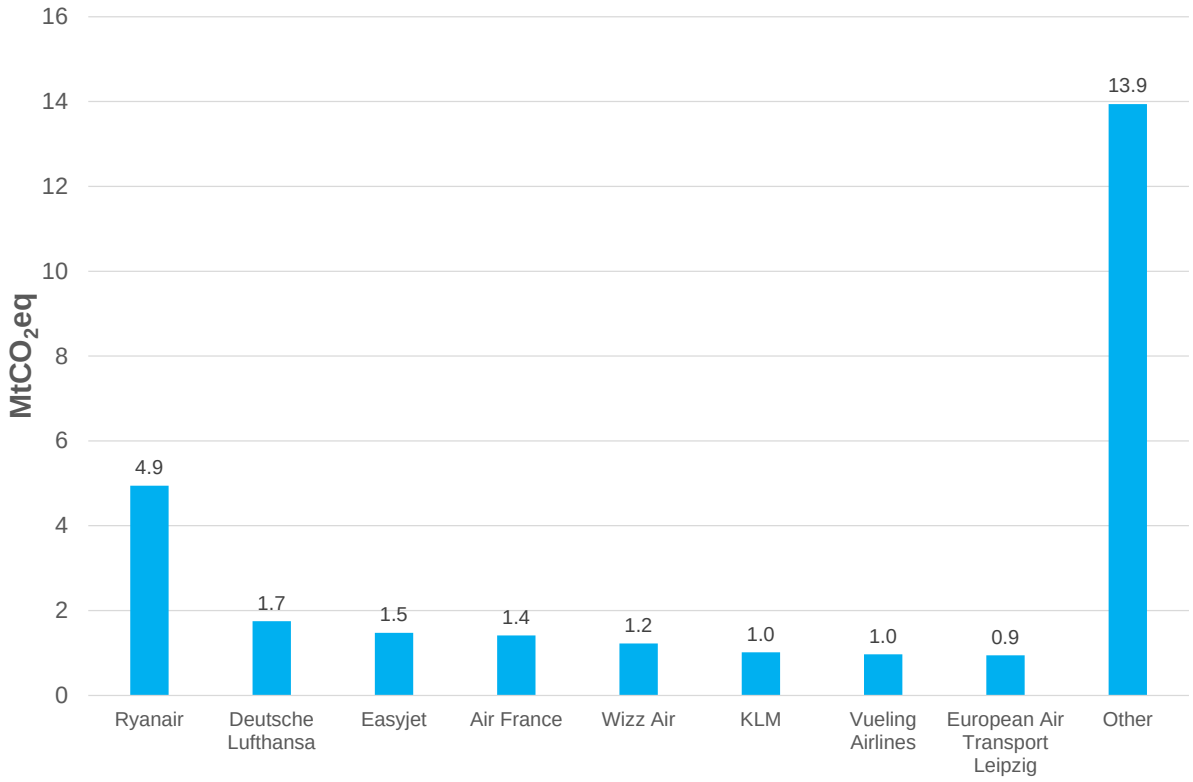
Status in 2021

From 2021 onwards, the EU ETS covers intra-European Economic Area flights and flights to the UK and Switzerland. Therefore, flights within the UK and from the UK to the European Economic Area are no longer covered.

In 2021, aviation emissions covered by the EU ETS amounted to 27.7 Mt CO_2, which represents an increase of 11% compared to the previous year, but is still 59% below the pre-pandemic level in 2019: at 67.0 Mt CO_2.

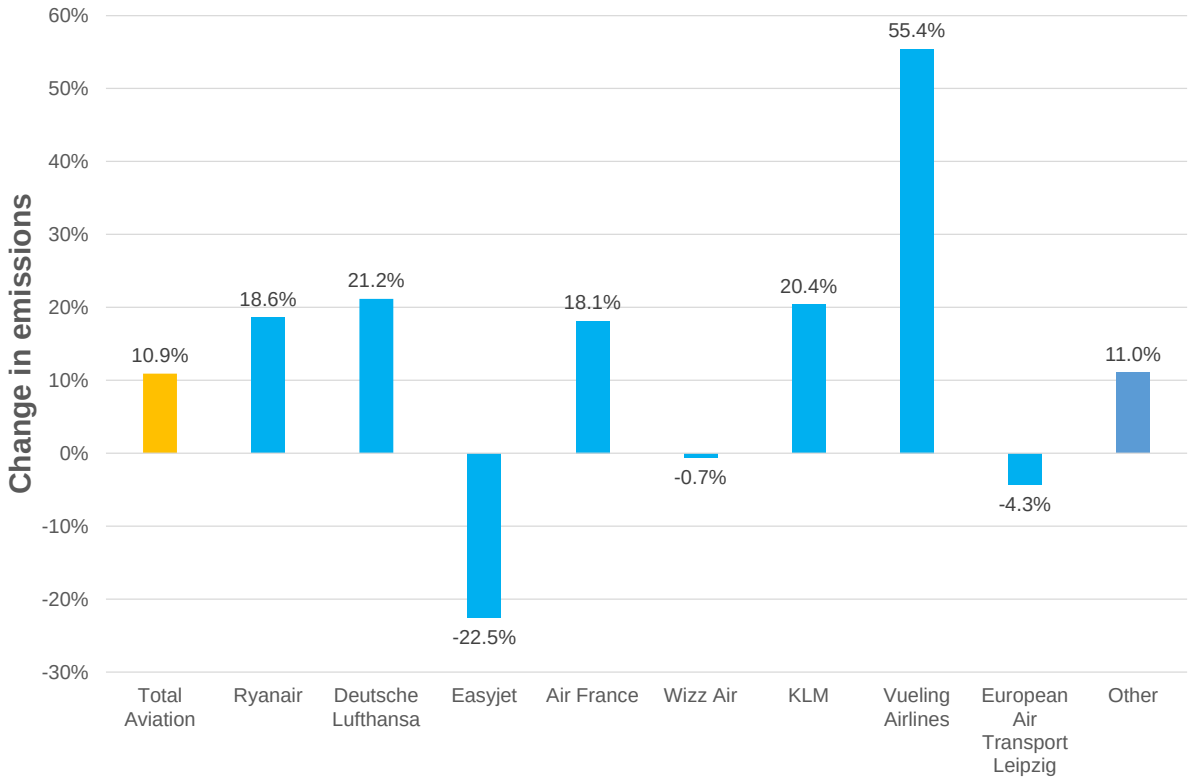
Ryanair was responsible for the largest share of EU ETS-covered emissions in 2021, accounting for around 4.9 Mt CO_2-eq. (Figure 1-7). Easyjet, Wizz Air and European Air Transport Leipzig decreased their emissions compared to 2020 (Figure 1-8).

Figure 1-7 Aviation emissions by carrier, 2021



Source: EEA (2022)

Figure 1-8 Relative change in ETS aviation emissions, 2021 vs. 2020



Source: EEA (2022)

1.2.2 Balance of allowances

Supply and demand

In 2021, aviation emissions covered by the EU ETS increased by 10.9% compared to the previous year (Table 1.5). The supply of EU aviation allowances (EUAA) decreased by 24.6% compared to 2020. During the third trading period, the supply of EUAAs was stable, because the emissions cap for aviation was the same for each year (in contrast to stationary installations, where the cap declines). However, with the start of the fourth trading period the linear reduction factor of 2.2% is applied also to the cap for EUAAs.

In 2021, 3.8 million aviation allowances were auctioned, 49.6% (resp. 34.9% w/o UK) less than in the previous year. Free allocation amounted to 23.3 million allowances (Table 1.5). Net demand from aviation thus amounted to 0.3 million EUAAs (see also Figure 1-9). Similar to EUA prices, the average EUAA price level in 2021 more than doubled.

With the beginning of 2020, the EU ETS was linked to the Swiss emissions trading system. Since then, companies that are subject to emissions trading can also use the Swiss equivalents in addition to the EUAs and EUAAs to fulfil their obligations. Aircraft operators work under a “one-stop-shop”. This means an aircraft operator is administered by one single competent authority, be it an EU-ETS state or Switzerland. Aircraft operators only need one operator holding account for both systems. As all allowances are fully fungible between both systems, Swiss allowances can be used in the EU ETS and vice versa. The Swiss ETS has only a comparatively small volume, and therefore the impact on the EU ETS is very small (see ICAP 2021). Flights from the European Economic Area to Switzerland are covered by the EU ETS and flights from Switzerland to the European Economic Area by the Swiss ETS. In 2021 0.27 Mt CO_2-eq were caused by flights from the European Economic Area to Switzerland. 0.38 M free allocations were transferred from

Switzerland to aircraft operators administered an European Economic Area Member State, but are entitled to receive free allocations under the Swiss ETS.

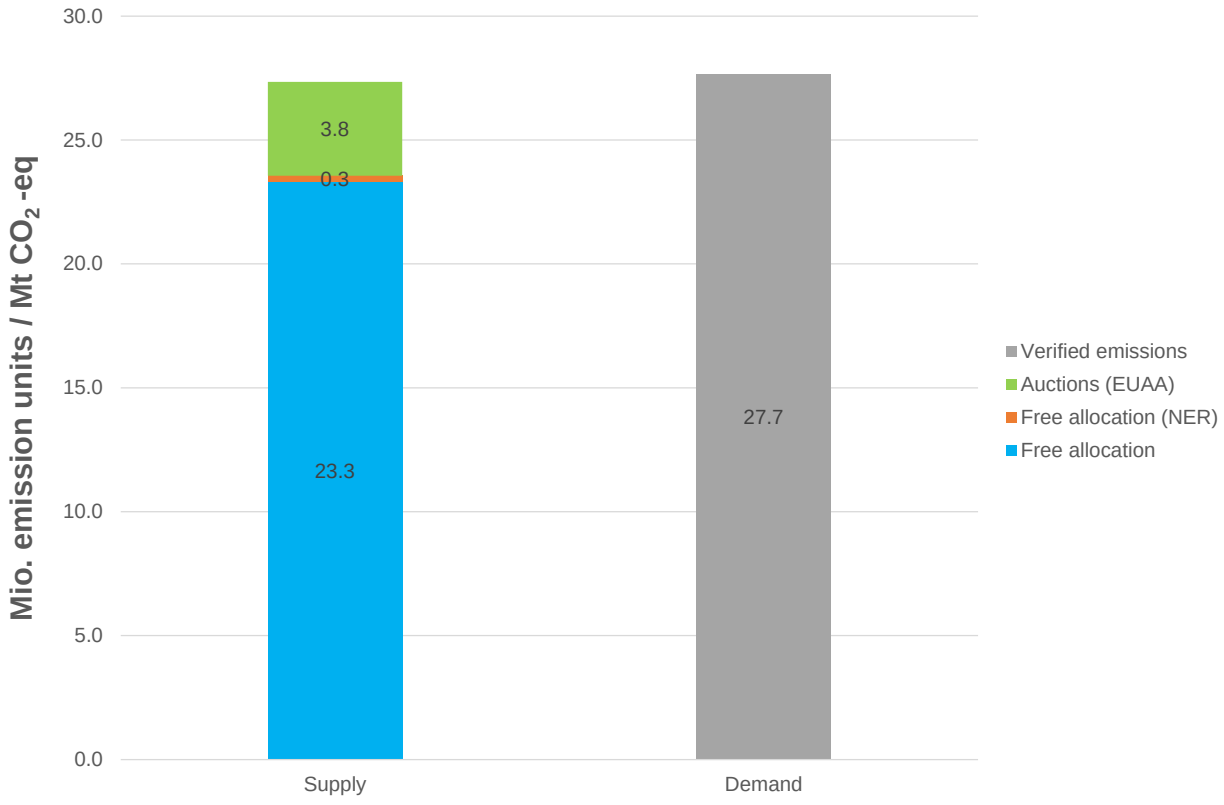
Table 1.5 EUAA demand, supply and price (aviation operators), 2020-2021

	2020	2020 (w/o UK)	2021	Change
Total demand (Mt CO_2-eq.)	24.9	24.7	27.7	**11.9%**
Aviation emissions	24.9	24.7	27.7	**11.9%**
Total supply (millions of EUAAs)	37.9	35.7	27.3	**-23.3%**
Aviation free allocation	29.3	28.7	23.3	**-18.9%**
Aviation free allocation (NER)	0.8	0.8	0.3	**-68.0%**
Average auctioned amounts	7.5	5.8	3.8	**-34.9%**
Estimated international credits exchanged	0.3	0.3	0.0	**-100.0%**
Annual supply-demand balance (millions of EUAAs)	13.0	10.9	-0.3	**-102.5%**
Swiss Verified Emissions for aircraft operators (Swiss Linking) (Mt CO_2-eq)	0.30	0.30	0.27	**-8.2%**
Allocation Switzerland (Swiss Linking)	0.39	0.39	0.38	**-2.4%**
EUAA price* (EUR)	23.73	23.73	53.30	**124.6%**

Note: NER, New Entrants Reserve.
*Average price. Due to the Corona pandemic, fluctuations were wider than usual.
w/o UK = The majority of the EU ETS accounts of aviation companies that were previously allocated to the British national authority have been transferred to other national authorities within the EU.

Sources: EEA (2022), EEX (2022), ICE (2021)

Figure 1-9 Supply and demand balance for aviation in 2021



Sources: EC (2021h), EEA (2022)

2 Long-term trends

- Between the start of the EU ETS in 2005 and 2021, emissions from stationary installations decreased by 36%. This decrease is mainly driven by emission reductions in power generation, as electricity generation from hard coal and lignite has been largely replaced by generation from renewables over the course of the past fifteen years.
- Emissions in the largest industrial sectors (iron and steel, cement and lime and refineries) have also been substantially reduced since the beginning of the EU ETS, although not to the same extent as in electricity generation.
- The number of allowances allocated for free has decreased over time. The largest drop occurred between the second and third trading periods, as electricity generators are generally no longer eligible for free allocation.
- In general, the share of allowances auctioned (rather than given out for free) has increased steadily as the system is transitioning toward full auctioning. Member States revenues from auctioning have increased significantly due to the rise in CO2 prices.
- Allowances prices further increased at the end of 2022 up to a new all-time high of 87 EUR.

This section discusses stationary installations and aviation separately, focusing first on trends between 2005 and 2021, then deriving implications for the balance of supply and demand of allowances during this period.

Two different caps are set for stationary installations and aircraft operators. However, EUAs and EUAAs are fully fungible. We highlight this by indicating the net demand from aviation wherever applicable.

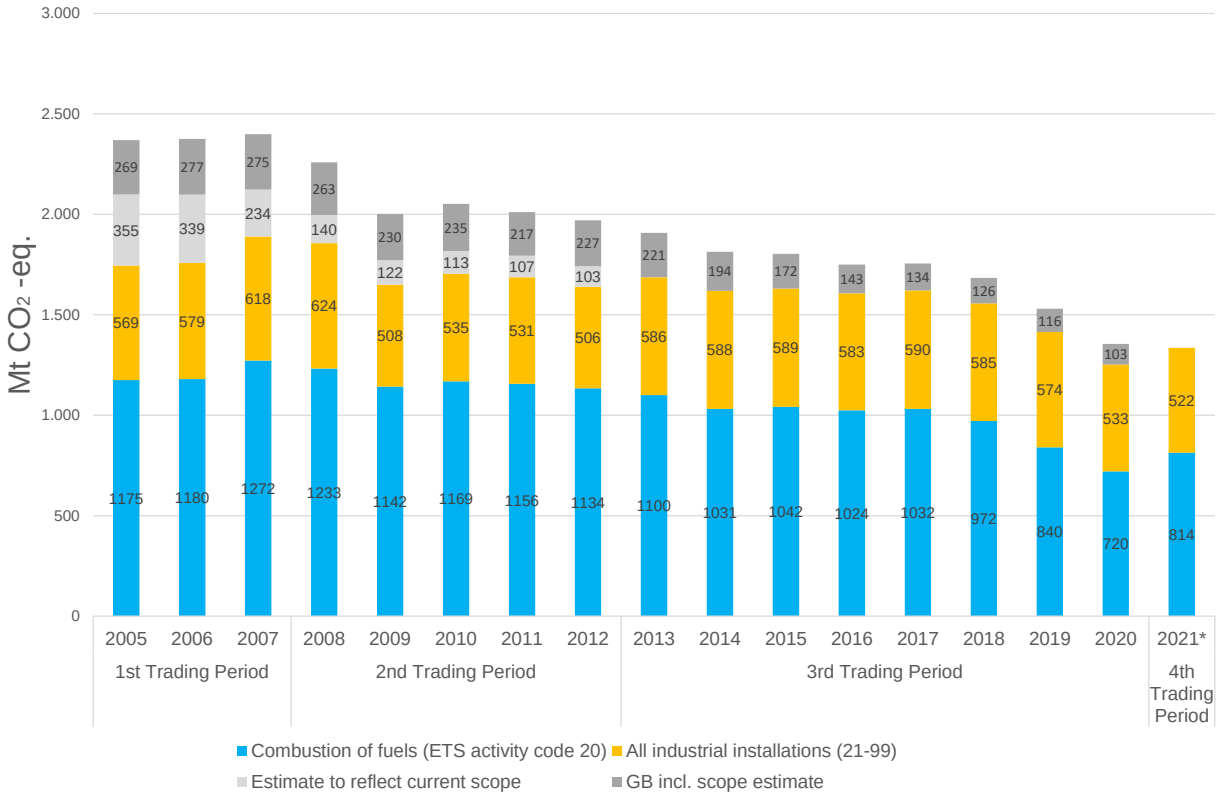
2.1 Stationary installations

2.1.1 Emission trends

Total EU ETS emissions

In 2021 EU ETS emissions (without UK, scope corrected for years 2005-2012) had fallen by 36% below 2005 levels (Figure 2-1). Installations from the UK that left the EU ETS had emissions of 103 Mt CO_2 in year 2020. The UK installations had reduced their emissions by 62% compared to 2005 indicating that they had reduced emissions above the average reduction of the remaining countries of 36%.

Figure 2-1 Verified emissions disaggregated by combustion and industry sectors, including an estimate to reflect the scope of the third trading period



Note: The estimate to reflect current scope takes into account emissions (not split by activity) for those countries, sectors and activities that have not been part of the EU ETS since its inception in order to provide a consistent time series.

Emissions from Great Britain do not include electricity generators from Northern Ireland but include other ETS-Installations in Northern Ireland

Sources: EEA (2019a), EEA (2022)

Changes in emissions depend on both changes in activity levels and the emission intensity of production, influenced by EU and international policies and a wide range of other factors. This makes it challenging to ascertain the extent to which emission reductions are directly attributable to the EU ETS.

Combustion-related emissions, which accounted for 61% of total EU ETS emissions in 2021, and have been the main driver of the decline in emissions under the EU ETS, depend directly on primary energy consumption levels and the fuel mix:

- Primary energy consumption depends on the demand for energy by end users (e.g. electricity consumption by households and industry) and transformation efficiency. The demand for energy in turn depends – amongst others – on economic activity, climatic factors and attitudes and behaviours towards energy consumption. Some of these factors are themselves influenced by policies (e.g. those promoting energy efficiency).
- The fuel mix used to transform primary energy into electricity or heat is also a determinant factor. 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 or the phase-out of fossil fuels.

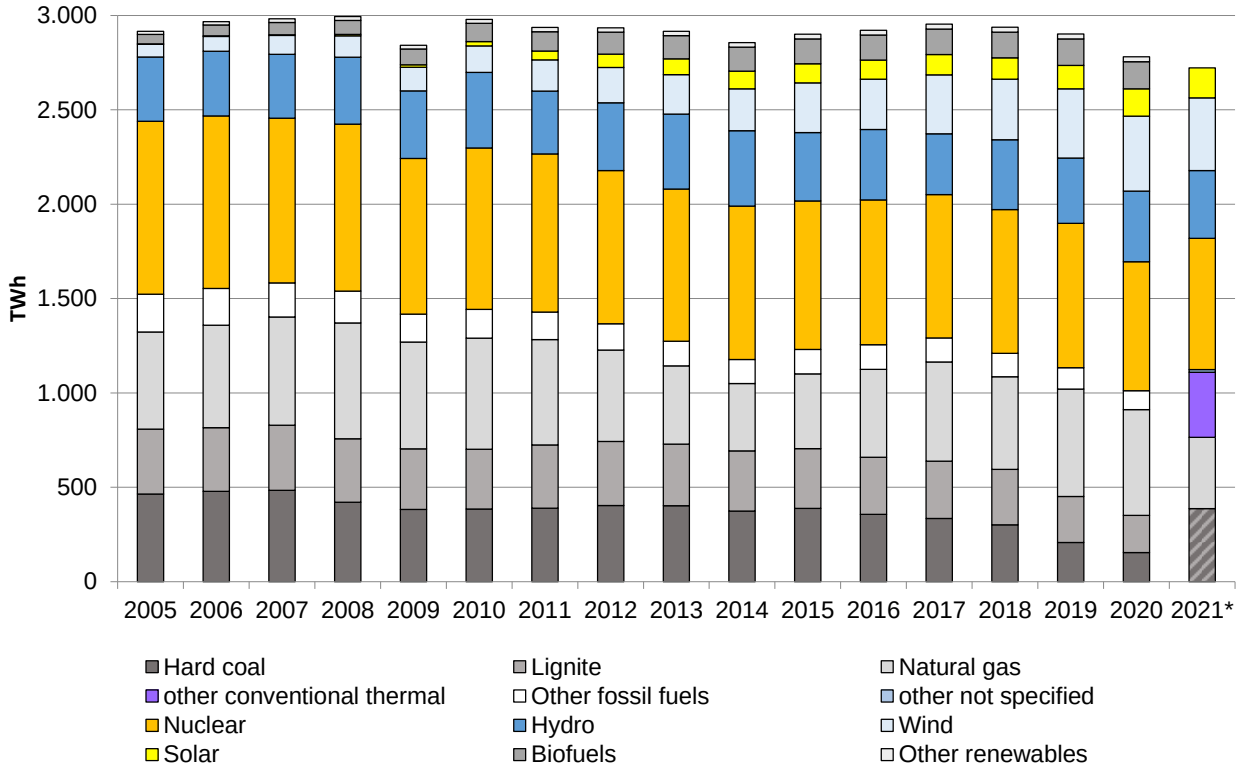
Emissions abatement from activities other than combustion has been slower compared to abatement from combustion-related emissions.

Energy sector

The decline in verified emissions in the combustion sector over recent years is a consequence of considerable changes to the fuel mix. Between 2005 and 2020([10]), electricity generation for the EU-27 from hard coal, lignite and nuclear power declined by 64%, 43% and 25%, respectively (Figure 2-2). The reductions in electricity generation from these sources were offset by an increase in gross electricity generation from renewables such as wind, solar and biomass over the same period. However, there had been a large reduction in 2020 compared to 2019 because of the COVID-19 pandemic. As a result, the decline in fossil fuelled generation is expected to be slightly lower in 2021, which is shown by the monthly data (see Figure 2-2).

The Renewable Energy Directive along with national policies and programmes have encouraged the uptake of renewables, which has also been driven by reductions in technology costs. In recent years, many Member States have decided or already begun the active phase-out of coal-fired generation. 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. More recently, the Commission has published its proposal for a REPower EU plan that would further promote renewable energy use in electricity production.

Figure 2-2 Gross electricity generation by fuel in the EU-27



Note: Values for 2021 are from Eurostat monthly data, and hence are a different source

Sources: Eurostat (2022c), for year 2021: Eurostat (2022a)

[10] 2020 are the most recent data available at Eurostat for the production of electricity as of July 2022

Figure 2-3 shows ETS emissions of power plants by fuel and country from 2005 to 2021.([11]) Most countries were able to decrease emissions from lignite and hard coal. Austria, Denmark, Greece, Portugal, Romania, Slovakia and Spain achieved emission reduction of more than 60% since 2005. In other countries emission abatement from power plants was relatively low: Cyprus, Poland, Lithuania, Latvia reduced emissions by less than 20% since 2005.

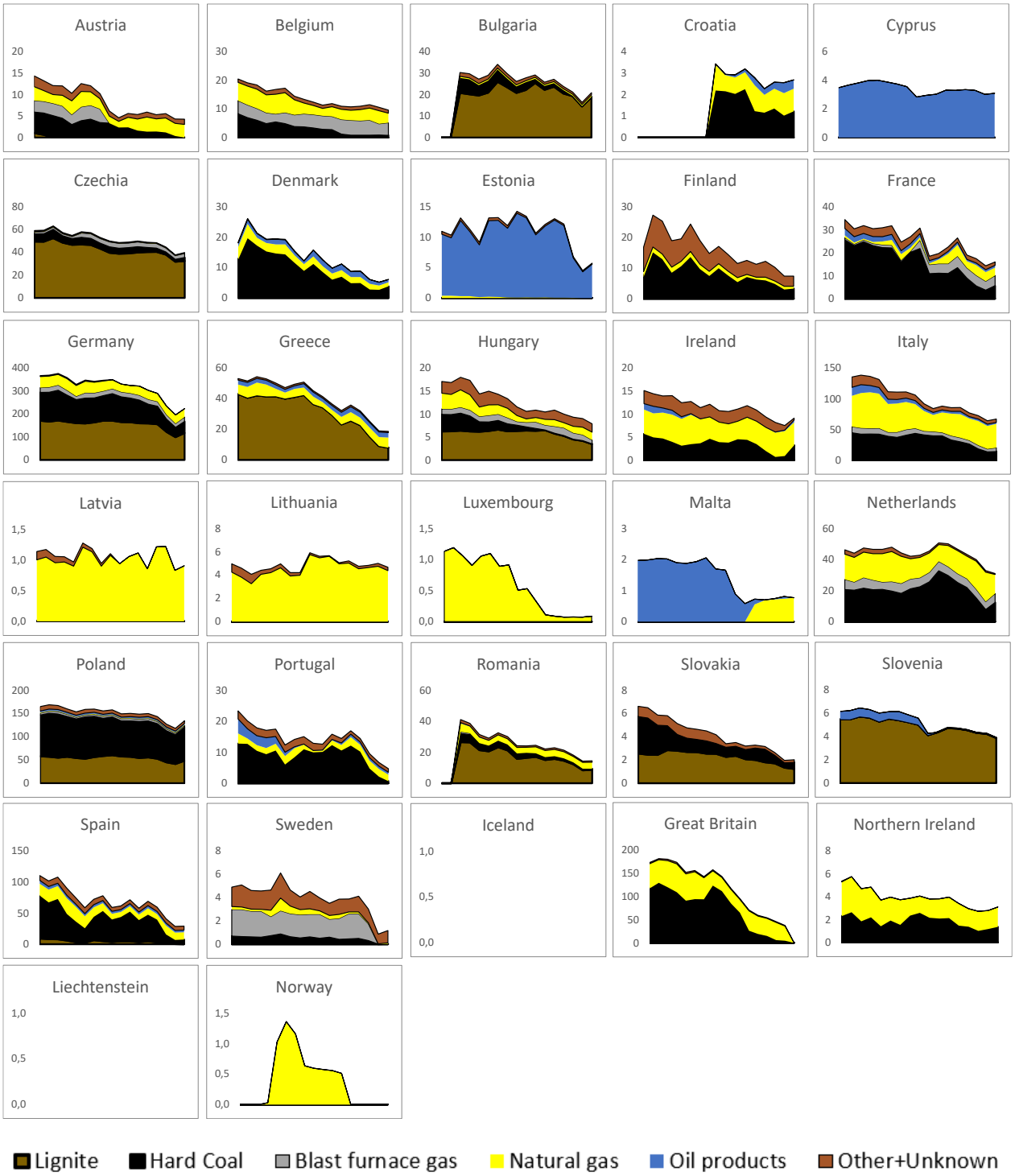
In the following we provide a few anecdotes on smaller countries in order to highlight interesting developments that are normally not in the spotlight:

- Malta: In the past Malta relied on oil-fired power plants. In 2015, an interconnector to Sicily became operational. In 2017, a new gas-fired power station using LNG was built. These two measures replaced oil-fired power generation nearly completely.
- Norway was the first country to phase out natural gas in power generation in Europe. The Kårstø power plant was commissioned in 2007 and reached an emissions level of 1 Mt CO_2 in 2008 and 2009. From 2010 onwards emissions started to decline and the plant does not report any emissions since 2015 and was decommissioned. The Mongstad CHP-Plant was commissioned in 2009 (started to report emissions in 2009) and reported 0.5 Mt CO_2 annually until 2016.([12])
- Luxembourg also had one large gas-fired power plant that emitted about 1 Mt of CO_2 annually. This plant reported emissions in 2016 for the last time (similar to the Norwegian case).
- In Sweden emissions in the power sector are dominated by special fuels. Slightly more than half of the emissions come from a blast furnace power plant. Since 2020, however, Sweden reports the emissions from this waste gas power plant together with the emissions of the blast furnace under activity code 24. Sweden also included waste incineration into the EU ETS (reported under "other" here) with emissions of about 1 Mt CO_2 /year.
- The power plants in Great Britain emitted 38 Mt CO_2 in 2020 (2020 was the year before they left the EU ETS). This represents an abatement of 80% compared to the year 2005, when power plants from Great Britain still emitted 174 Mt CO_2.
- Power plants from Northern Ireland emitted 3 Mt CO_2 during 2021 (1.7 Mt from natural gas and the rest from hard coal). In 2005, the emissions from power plants in Northern Ireland amounted to 5 Mt of CO_2. The abatement since 2005 was about 40%, which is considerably lower compared to Great Britain.

(11) See ETC/CME 2021 for methodology.

(12) https://www.equinor.com/news/archive/phasing-out-combined-heat-power-plant-mongstad

Figure 2-3: ETS emissions of power plants by fuels and by country from 2005-2021 [Mt CO2]



Note: No fossil power plants in Iceland and Liechtenstein. Great Britain data only until 2020. Since 2020 Sweden reports the emissions from the blast furnace power plant under activity code 24

Source: Own matching of EUTL data EEA (2022)

Industry sector

Overall, emissions from the three largest industry sectors (i.e. cement and lime, iron and steel and refineries) have been reduced by 21% since 2005 when looking at the EU-27 (Figure 2-4) ([13]). The relatively lower abatement by industrial compared to combustion installations reflects both higher abatement costs per unit of output and relatively lower output levels in previous years, which have somewhat reduced the need for abatement in the short term.

Three sectors dominate industrial emissions in the EU ETS: iron and steel, cement and lime and refineries. While ETS emissions from all three sectors decreased between 2005 and 2012 – with a significant drop in 2009 for iron and steel and cement and lime due to the financial and economic crisis – emissions in all three sectors have been relatively stable since 2013 with a dip in the year 2020 due to the COVID-19 pandemic. In fact, compared to 2020 the iron and steel sector and cement and lime sectors increased their verified emissions by 14% and 4% respectively. While emissions in the refineries sector increased by 2% between 2020 and 2021.

Since the beginning of the third trading period additional activities and gases fall within the scope of the EU ETS. This is most important for the sectors “Chemicals” and “Other metals” where the scope was extended significantly ([14]).

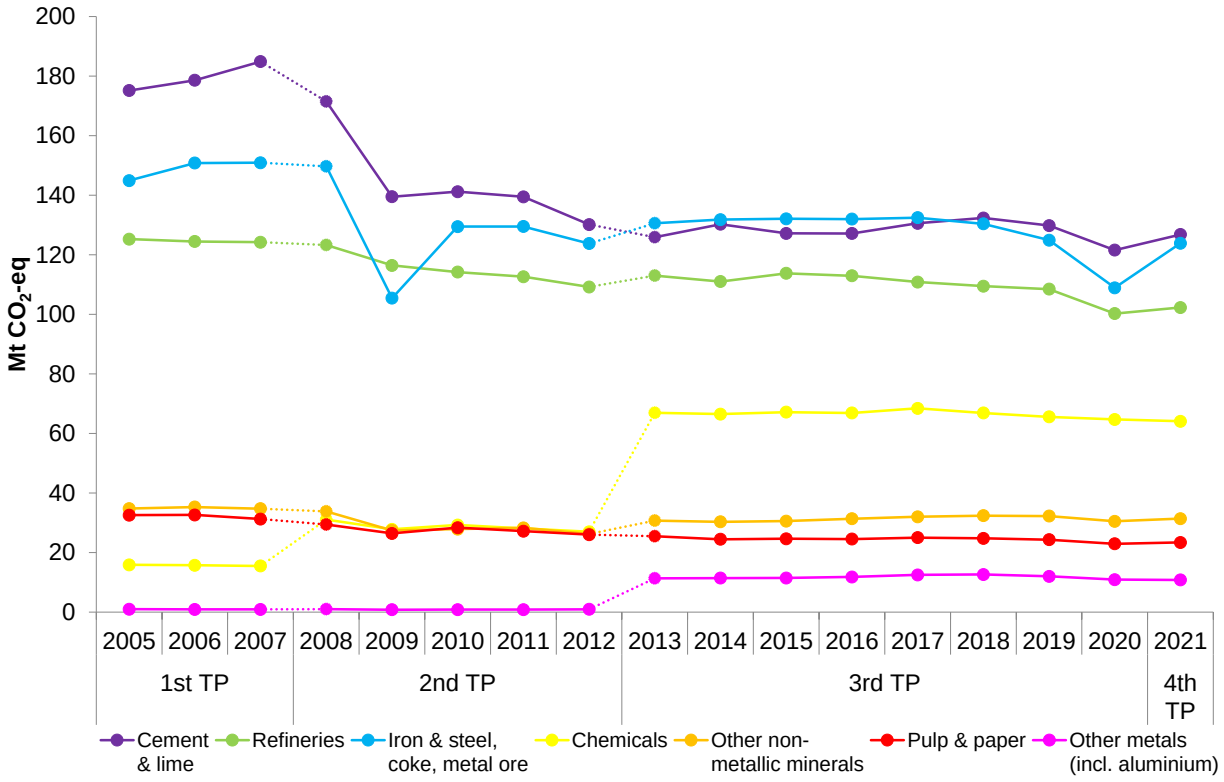
Emission reductions of industrial installations at the start of the second trading period are primarily due to lower levels of output following the financial and economic crisis of 2008 and 2009 (Figure 2-5). As a result of the 2008/2009 crisis, old and inefficient production was closed. This had two effects: i) Production never returned to pre-crisis levels and ii) the average energy efficiency of the remaining installations was increased.

The development in emissions observed during the third trading period (Figure 2-4) follows trends in production volumes (Figure 2-5). Between 2013 and 2015 those were relatively flat. Since 2015, the cement sector and other non-metallic minerals have generally exhibited upward trends in production, while in other sectors production has trended downwards, notably in the steel and chemical sectors. At the beginning of 2020 a sharp drop can be observed in the production index for all sectors as a result of the COVID-19 pandemic and measures taken to reduce the spread of the virus. All sectors were affected with the sharpest drop exhibited by the iron and steel sector. Production in all sectors has since picked up again significantly, nearing or even exceeding pre-crisis levels, with the refineries production index remaining at a slightly lower level.

[13] Verified emissions are shown for EU-27 without BG, HR and RO to provide a consistent number of Member States during the period 2005-2021.

[14] Since 2013, the EU ETS covers non-CO2 gases along with CO2 emissions: nitrous oxide (N2O) emissions from the production of nitric acid, adipic acid and glyoxylic acid production, as well as perfluorocarbon (PFC) emissions from the primary production of aluminum.

Figure 2-4 **EU ETS emissions by main industrial activity in the EU-27 (without HR, BG, RO, without scope estimate)**



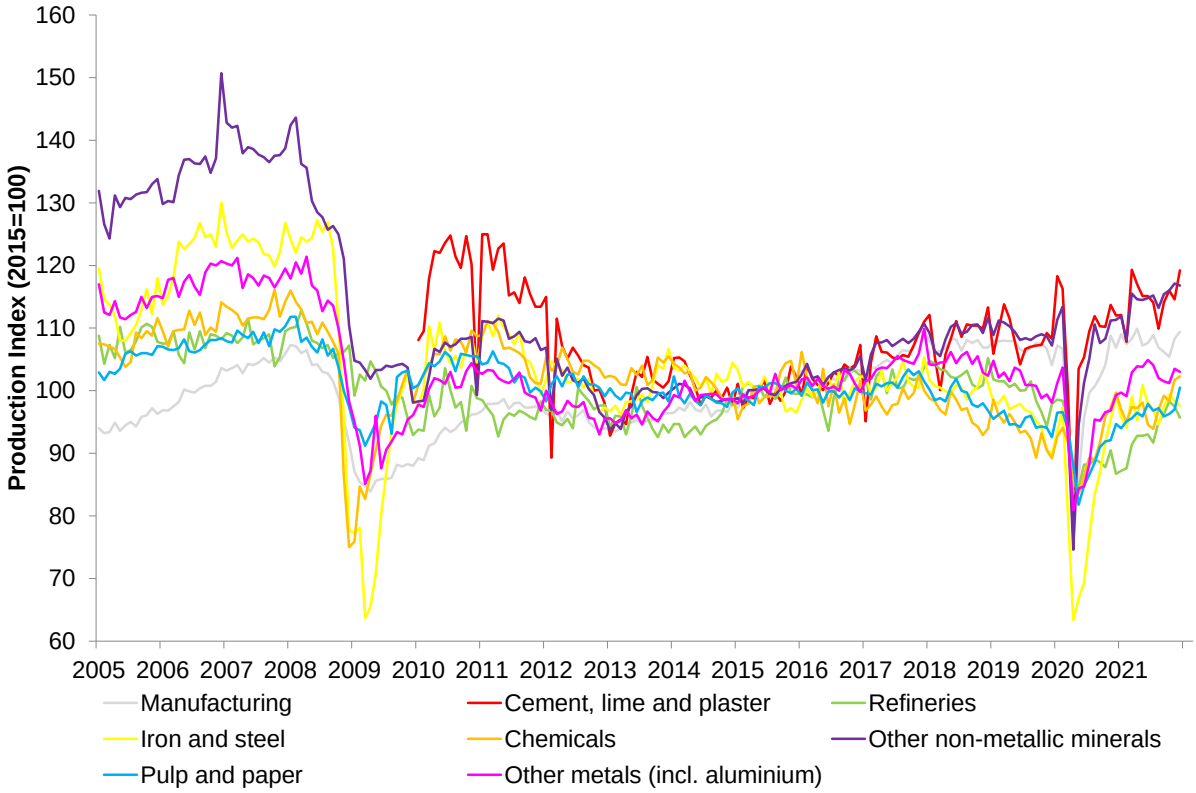
Note: ETS activity codes have been aggregated for certain sectors (refer to Table A1.1).
Scope changed in 2013

Source: EEA (2022)

In addition to changes in productions, the efficiency of production also plays a role in determining emissions from industry. The data collection for the updating of the benchmarking values has shown that improvements in specific emissions (improvements in energy efficiency and the increased use of biomass and waste as energy sources) can be observed in all sectors. However, the improvement of the specific emissions differs among sectors ([15]).

[15] https://climate.ec.europa.eu/document/download/fd041819-e22e-4e77-a267-6ab4405328aa_en?filename=policy_ets_allowances_bm_curve_factsheets_en.pdf

Figure 2-5 Monthly volume index of production by main activity in the EU-27 (2005-2020)



Note: Volume index of production (seasonally and calendar adjusted data for the EU-27 as Eurostat only offers no aggregate for EU25).

Source: Eurostat (2022b)

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

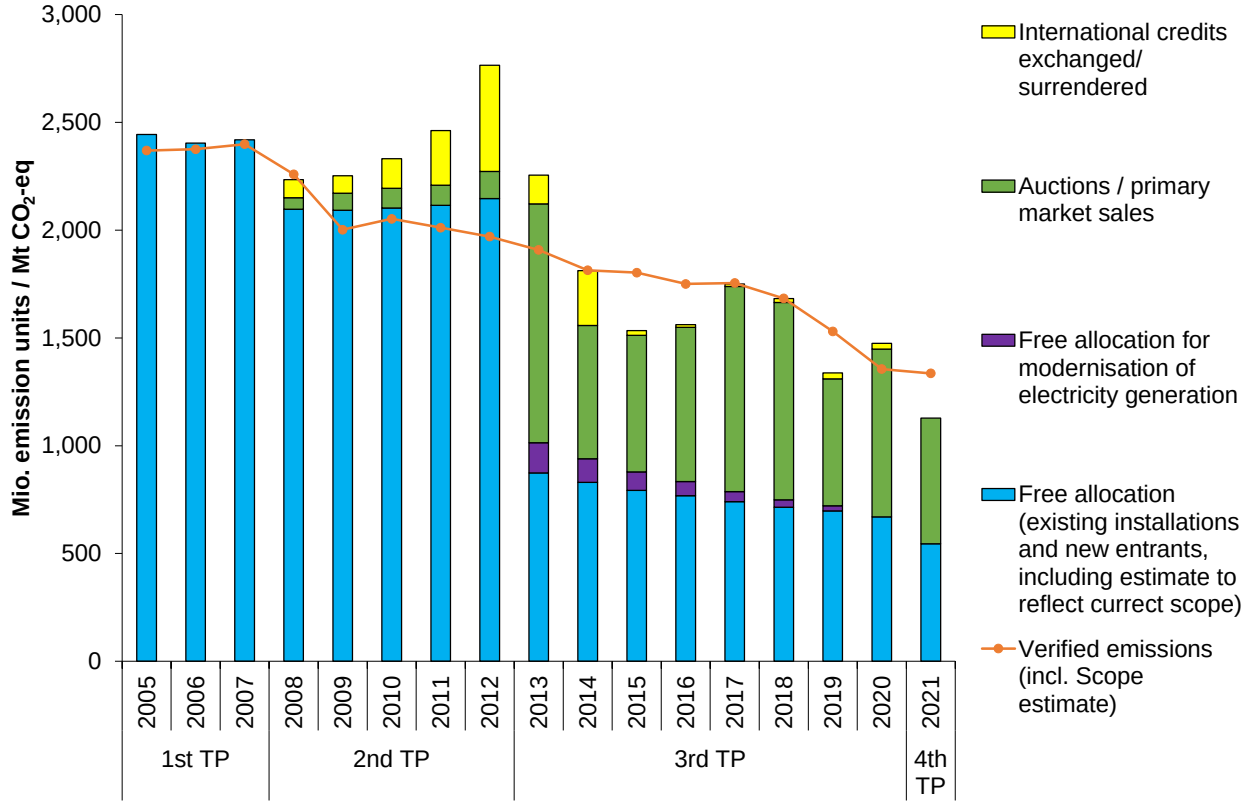
During each year of the first trading period (2005-2007), verified emissions fell just short of the total number of EUAs supplied by governments (mainly allocated for free) (Figure 2-6). Amid uncertainties about the level of verified emissions, the price of allowances climbed to EUR 30 per EUA (Figure 2-7) at the beginning of 2006 but dropped abruptly when the first release of verified emissions data in April 2006 showed that the number of allowances available exceeded verified emissions. Since it was not possible to 'bank' surplus allowances into the second trading period, allowance prices began a decline and remained close to zero until the end of the first trading period.

After a more stringent cap was set for the second trading period, verified emissions exceeded the supply of allowances in 2008. Allowance prices climbed to EUR 29.38 per EUA before starting a renewed decline after it became apparent that the financial and economic crisis would severely affect industrial output in the EU. In fact, reduced activity meant that the supply of allowances exceeded verified emissions in each year 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 extensive use of international credits, especially between 2010 and 2012.

At the start of the third trading period, the supply of allowances continued to exceed verified emissions. 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. In 2017 and 2018, verified emissions were on par with available allowances. In 2019, verified emissions exceeded the amount of allowances supplied to the market, reflecting a reduced auctioning supply as the Market Stability Reserve (MSR) started operating and took allowances off the market, as well as the halted auctions on behalf of the UK. In 2020, the level of verified emissions was again a little lower than available allowances as emissions were affected by the COVID-19 pandemic and auctioned allowances increased as the UK supplied withheld 2019 allowances to the market (Table A1.3).

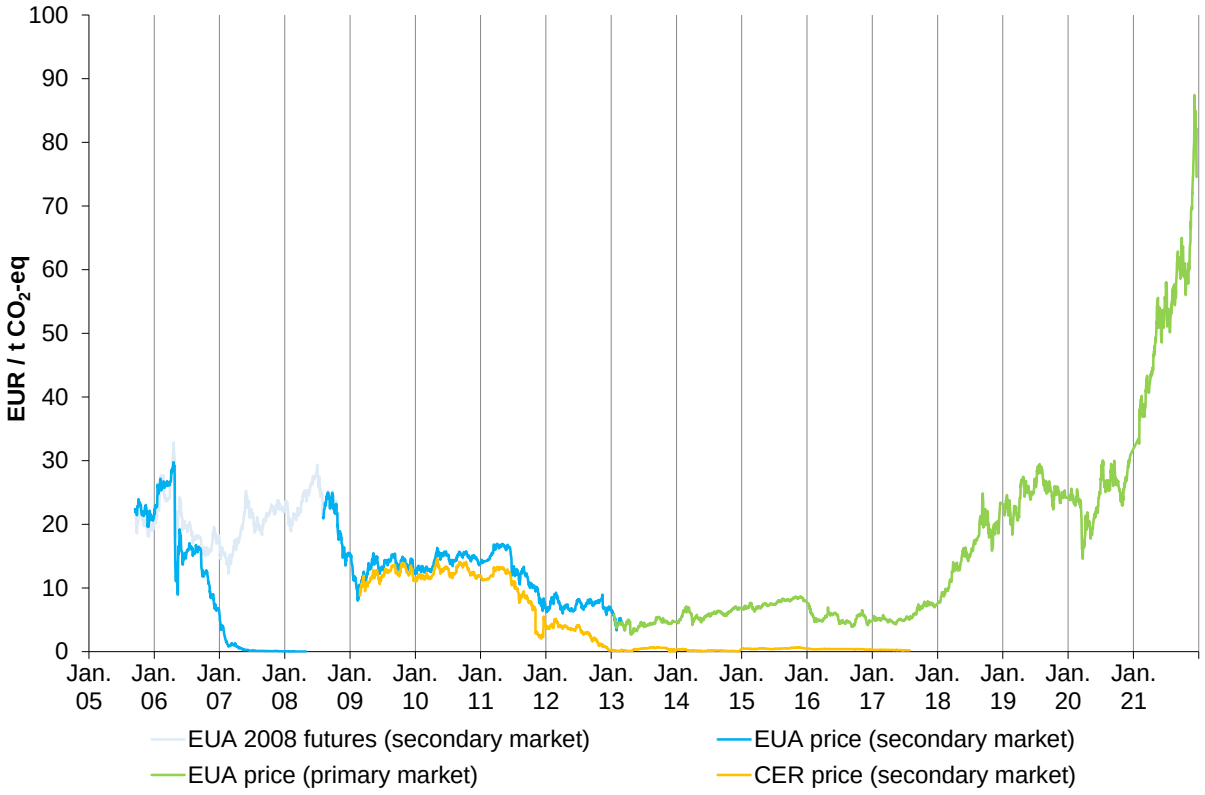
Figure 2-6 Supply and demand balance for stationary installations (2005-2021) with UK



Source: EEA (2022)

Following the revision of the ETS Directive 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. At the start of the COVID-19 pandemic, the EUA price temporarily fell to EUR 14.60, but during the course of 2020, it returned to the previous year's level and rose to an all-time high of over EUR 87 at the end of 2021. The price increase reflects the currently high fuel switch costs from coal to gas and the expectation that the supply of allowances will be reduced in the long-term, confirmed by the adoption of the European Climate Law in 2021, which makes the 2050 net zero target legally binding and establishes a 55% reduction target for 2030 (EP; EC 2021). In July 2021, the European Commission published a whole range of proposals as part of its “Fit for 55” package, including a proposal for increasing ambition in the EU ETS in line with the 55% reduction target (EC 2021a). The “Fit for 55” package and further proposals related to increasing energy independence (e.g. the REPower EU plan) are currently being discussed in the trialogue. See Section 4 for a detailed discussion of the proposals and estimation of their potential impact.

Figure 2-7 Price trends for allowances and certified emission reductions (2005-2021)



Sources: Point Carbon (2012), EEX (2022), ICE (2021)

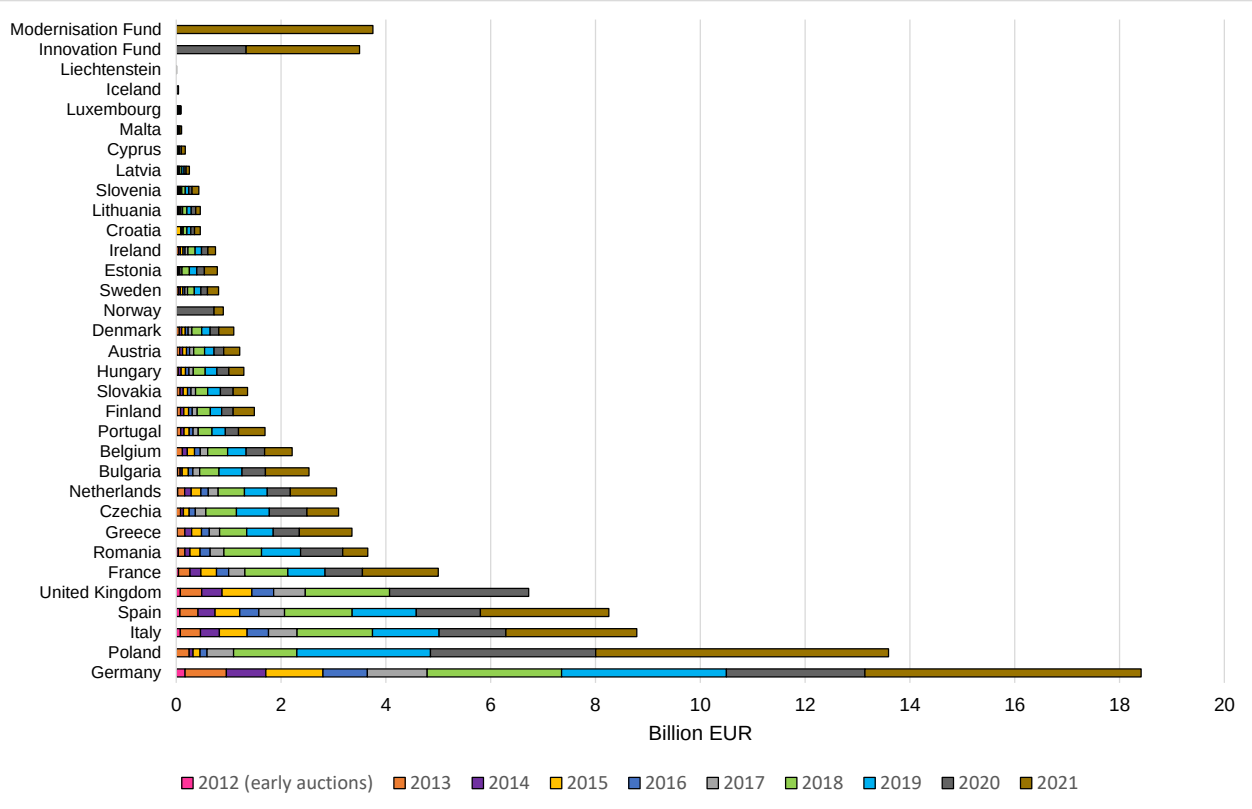
2.1.3 Auctioned allowances and auctioning revenues

Under the EU ETS, allowances to be auctioned are distributed to Member States based on Article 10(1) of the ETS Directive. Member States are responsible that their share of allowances is made available for auction, at present allowances are made available at auction at the European Energy Exchange AG (EEX). Since 2020, part of volumes auctioned from the EU ETS are attributed for the Innovation Fund and the Modernisation Fund.

Figure 2-8 shows revenues from auctioning by country. As the country with highest historical emissions and thus the largest auctioning budget, Germany has so far received the highest revenue from auctioning EUAs totalling EUR 18.4 billion since 2012, followed by Poland with EUR 13.59 billion and Italy with EUR 8.8 billion. These three Member States collectively account for around 41% of the EUA revenue generated so far since 2012. Revenues increased strongly in 2021 compared to previous years due to increasing EUA prices.

Member States are obliged to report to the Commission information on the use of auction revenues under Article 17 of the Monitoring Mechanism Regulation (EU 2013). The EU ETS Directive provides that at least 50% of the revenues should be used for climate and energy purposes which are specified in Article 10(3) of the Directive and include reducing GHG emissions, increasing the share of renewables in energy generation, 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. During the third trading period about 75% of auctioning revenue has been spent on climate and energy related purposes by Member States (EC 2021i).

Figure 2-8 EUA auction revenues since 2013, by EU Member State



Note: 2012 (early auctions) refer to amounts that pertain to the year 2013 but had been auctioned a year earlier. In 2021, the UK has left EU ETS and therefore does not have any revenues anymore. Iceland, Liechtenstein and Norway only started auctioning allocations in June 2019.The designated amounts for 2013-2018 of these three countries are to be spread evenly between 2019 and 2020 (EC 2020b).

Sources: EEX (2022), ICE (2021)

In its proposal for a revised ETS Directive as part of the "Fit for 55" package, the European Commission calls for 100% of auction proceeds to be used towards climate goals and in order to protect vulnerable consumers and businesses (EC 2021b).

2.1.4 Free allocation to new entrants and for capacity extensions

To ensure a level playing field between new entrants and incumbents, a New Entrants Reserve (NER) of 480 million ([16]) allowances was set aside at the start of the third trading period for new installations ([17]) and existing installations with a 'significant' increase in capacity ([18]). By the end of the third trading period out of these 480 million allowances 183 million allowances were used (38%). The remaining allowances had been placed into the MSR of which 200 million allowances will be put in the 4th trading period NER (see EC 2020a).

[16] 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.

[17] 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.

[18] Significant capacity extension means a significant increase in a sub-installation's initial installed capacity of at least 10%, resulting in a significantly higher activity level ((EC 2011).

As there were no NER allocations in 2021 please see the last years report for more information (EEA 2021c).

2.1.5 Transitional free allocation to modernise electricity generation

Article 10(c) of the ETS Directive provides a derogation from the general rule that allowances should no longer be allocated for free to electricity generation during the third trading period. This derogation applies to ten eligible Member States.([19]) During the fourth trading period, eligible countries can allocate a maximum of 40% of their regular allowances to Article 10c derogation. This amounts to 637.8 million allowances in total for the ten eligible countries see Table 2.1. These countries have been given the option of either continuing to issue these free allocations, auctioning the allocations in the normal way or transferring the allocation volumes to the Modernisation Fund. Bulgaria will issue the maximum possible amount of allocations under 10c. Estonia, Latvia and Poland will auction all possible allocations in the normal way. The Czech Republic, Lithuania and Slovakia plan to transfer their allocation quantities to the Modernisation Fund. The remaining countries Croatia, Hungary and Romania will divide their maximum possible allocation quantities between the different options. As these countries are in the process of implementing the new rules into national framework. No 10c allocations have been made in 2021.

Table 2.1 Member States' use of the derogation

Eligible Member States	Maximum Article 10c derogation (40% of regular allowances)	Amount to be used under Article 10c	Amount transferred from Article 10c to the Modernisation Fund	Amount to be auctioned
Bulgaria	51.6	51.6	0.0	0.0
Czechia	111.5	0.0	111.5	0.0
Estonia	17.6	0.0	0.0	17.6
Croatia	12.0	0.0	6.0	6.0
Latvia	3.8	0.0	0.0	3.8
Lithuania	8.7	0.0	8.7	0.0
Hungary	34.6	20.7	0.0	13.9
Poland	273.2	0.0	0.0	273.2
Romania	91.7	5.6	86.1	0.0
Slovakia	33.2	0.0	33.2	0.0
Total	**637.8**	**77.9**	**245.4**	**314.4**

Source: EC (2021d)

2.2 Aviation

2.2.1 Emission trends

During the third trading period, total verified emissions for airline operators have increased by 25% from 53.5 Mt CO_2-eq in 2013 to 68.2 Mt CO_2-eq in 2019 (Table 2.2). In 2020 emissions decreased sharply to 24.9 Mt CO_2-eq. due to the impact of the COVID-19 pandemic on air traffic. In 2021, air traffic continued to be affected by the pandemic and associated measures and has not yet returned to pre-crisis levels.

(19) Bulgaria, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland and Romania.

Ryanair has consistently been responsible for the largest amount of verified emissions of any single aircraft operator covered by the EU ETS. However, the EU ETS only includes flights within the scope of the EU ETS and gives no indication of the overall emissions of the airline. As the traditional carriers cover many long-haul flights outside the EU the total emissions of these operators may be higher.

Table 2.2 Total aviation emissions and the top 10 emitters in aviation between 2012 and 2021

	Verified emissions (Mt CO_2-eq)									
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Total Aviation	84,0	53,5	54,8	57,1	61,5	64,4	67,5	68,2	24,9	27,7
Ryanair	7,5	6,6	6,6	7,4	8,4	9,2	9,9	10,5	4,2	4,9
Lufthansa	4,9	4,4	4,0	3,8	3,8	4,0	4,4	4,4	1,4	1,7
EasyJet	5,1	4,5	4,6	4,9	5,3	5,7	6,3	6,6	1,9	1,5
Air France	3,8	2,6	2,4	2,4	2,3	2,4	2,4	2,5	1,2	1,4
SAS	3,6	2,3	2,4	2,4	2,4	2,5	2,5	2,4	0,9	0,9
British Airways	2,5	2,5	2,5	2,6	2,7	2,7	2,7	2,6	0,9	0,3
Wizz Air	1,1	1,1	1,3	1,5	1,8	2,1	2,3	2,4	1,2	1,2
Vueling Airlines	1,3	1,3	1,6	1,8	2,0	2,0	2,2	2,2	0,6	1,0
KLM	1,9	1,5	1,6	1,6	1,6	1,8	1,8	1,9	0,8	1,0
Norwegian	1,7	1,8	2,1	2,0	1,4	1,2	1,3	1,3	0,4	0,5

Note: For the period 2013-2021, 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.

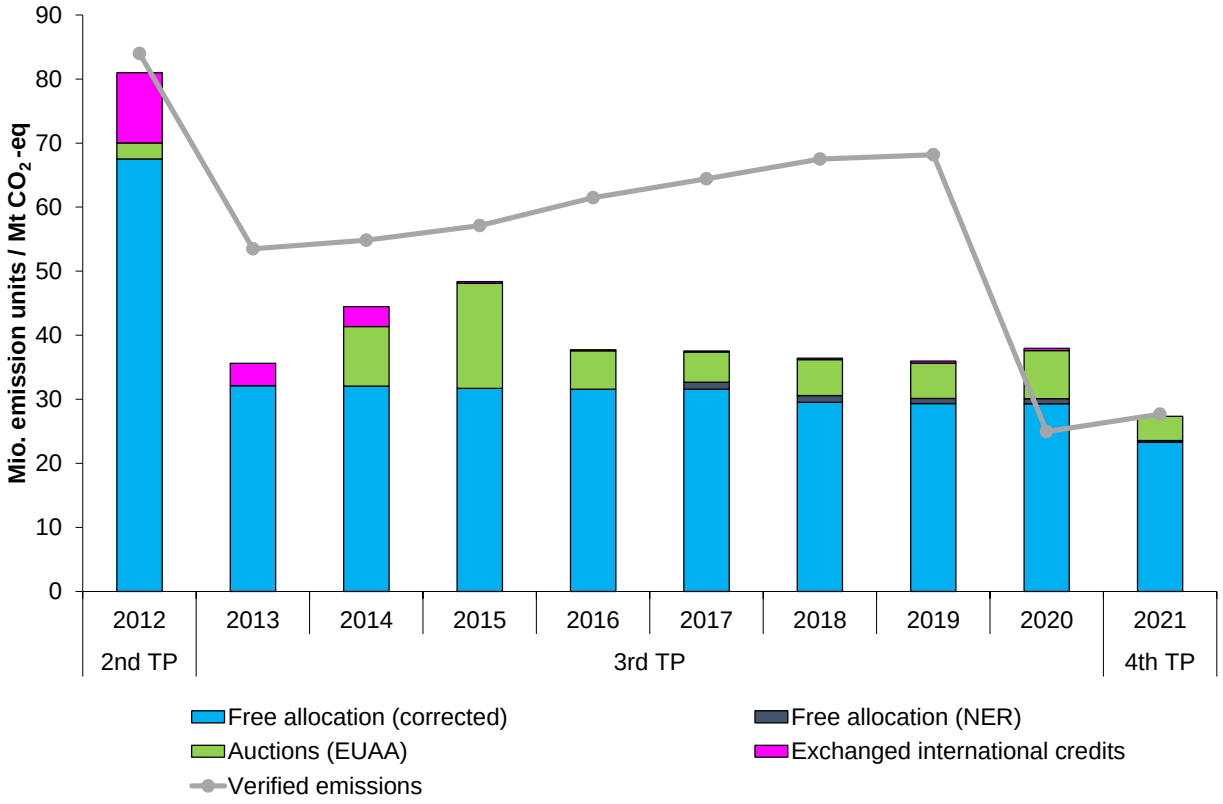
Sources: EEA (2022), EU (2022)

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

Figure 2-9 illustrates the development in the supply of and demand for aviation allowances (EUAAs) between 2012 and 2021. The difference in emissions between 2012 and 2013 is due to a reduction in scope regarding aviation activities covered by the EU ETS ([20]). In the third trading period, verified emissions have surpassed the supply of allowances reserved for the aviation sector every year with an exception for the year 2020. The aviation sector was usually a net buyer of allowances from the stationary sector.

[20] In 2012, aircraft operators had the choice of fulfilling their EU ETS obligations for intra-European Economic Area flights only, or for the full scope (all flights on routes to, from or between European Economic Area airports). Some opted for full scope, which resulted in higher emissions and a large amount of allowances issued. Switzerland was included in the scope for the aviation under the EU ETS in 2012 and was then excluded in 2013. The exemption threshold and the treatment of the outermost regions were also introduced in 2013.

Figure 2-9 Demand and supply balance for aviation allowances (2012-2021)



Note: 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 volume of aviation allowances effectively released to the market in 2015 was equal to 16.4 million EUAAs.

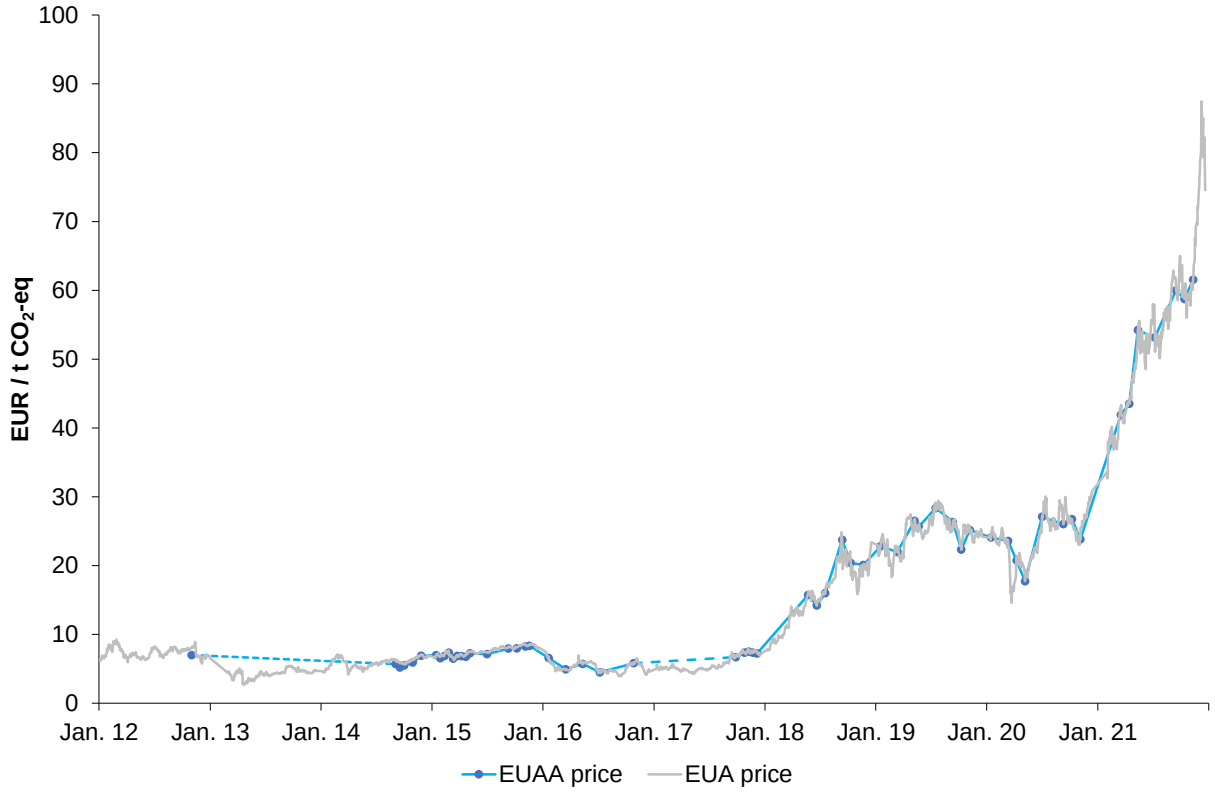
International credit use by aircraft operators in the third trading period is not reported. The European Commission reports that operators of stationary installations and aircrafts, together, have exchanged international credits equal to 99% of their total entitlements in 2020 (cf. **Error! Reference source not found.**). Numbers shown in this figure assume that aircraft operators as a group have also used up 99% of their entitlements by 2020. Amounts from 2015 onwards are so small that they are hardly visible in the figure (< 0.3 million per annum).

Sources: EC (2021h), EEA (2022)

Auctions of EUAAs occur less frequently than those of EUAs. Following the reduction of scope of aviation activities covered by the EU ETS between 2012 and 2013, the auction calendar was revised, resulting in no EUAAs being auctioned in 2013. When the auctioning of EUAAs resumed in 2014, their 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 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 2-10). A further delay in auctioning in 2017, due to prolongation of the 'stop-the clock' decision ([21]), led to another gap in EUAA price data in the same year. Similar to the EUA price, the EUAA price has entered a steep upward curve since the beginning of 2018. With EUR 53.30 the average EUAA price in 2021 more than doubled compared to 2020. The peak EUAA price was EUR 61.53 and was thus considerably lower than the EUA price. This is due to the fact that the highest EUA auction prices were achieved at the end of the year 2021 when no EUAA auctions took place.

[21] The 'stop-the-clock' decision, which covered the period 2013-2016, excluded flights to and from outermost regions and third countries, while flights between EEA airports remained fully covered.

Figure 2-10 Price trends for EUAAs compared with EUAs (2012-2021)



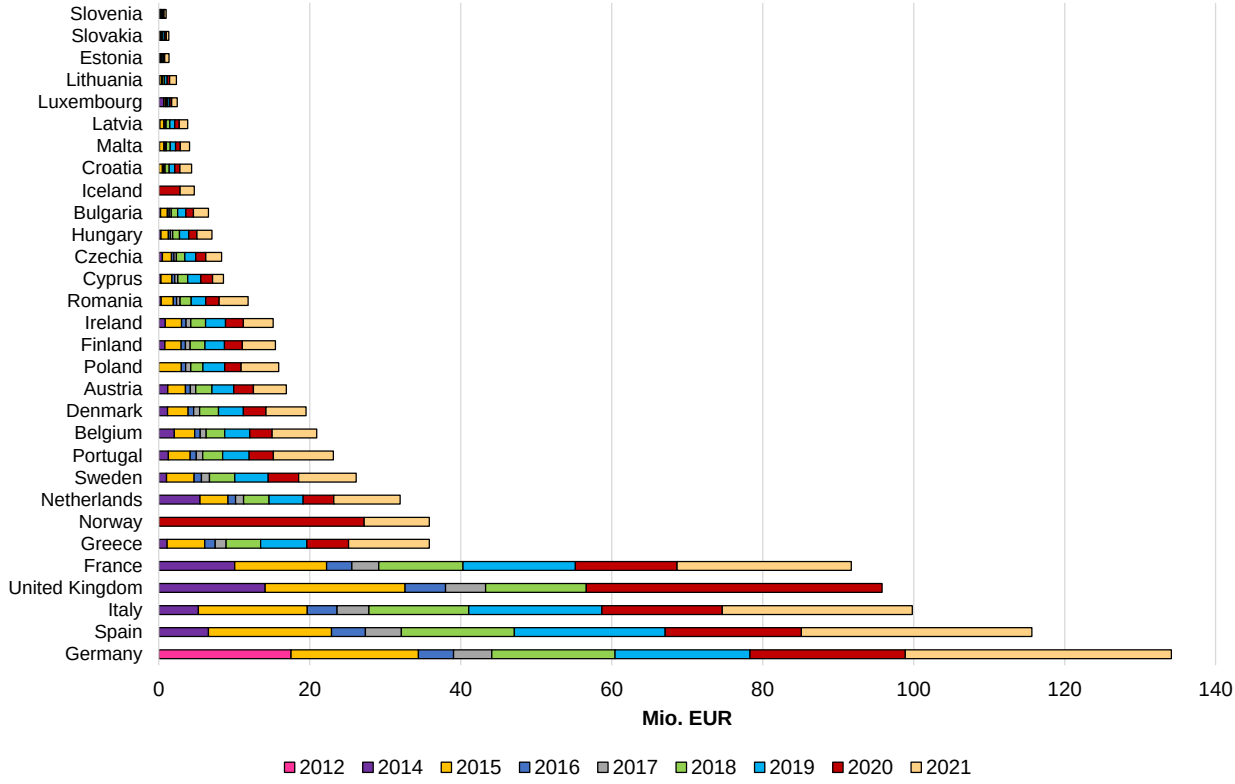
Note: The EUA price represents historical spot price data from the secondary market in 2012. In the third trading period, the EUA price refers to primary market auctioning data from the EEX and ICE trading platforms. This trend is compared with the shorter time series of EUAA prices from primary market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

Sources: Point Carbon (2012), EEX (2022), ICE (2021)

2.2.3 Auctioned allowances and auctioning revenues

Similar to the auction of EUAs (Section 2.1.3), Member States auction EUAAs according to their share in historical aviation emissions. To date, Germany has received the largest revenue from the auctioning of EUAAs (EUR 134 million), followed by the Spain (EUR 116 million) and Italy (EUR 100 million) (Figure 2-11). As the price of allowances has risen greatly, revenues have also risen significantly, reaching a peak of annual revenue of EUR 207 million in 2021, despite the fact that the flight operators needed much fewer allowances.

Figure 2-11 Aviation allowances auction revenues by Member State, 2012-2021



Sources: EEX (2022), ICE (2021)

3 Projected emission trends

- The projections of ETS emissions presented in this chapter are based on reported GHG emission projections under Article 18 of the Governance Regulation which have been submitted by all countries participating in the EU ETS, apart from Liechtenstein and Northern Ireland. Since 2022 is a voluntary reporting year, only four countries (Denmark, Ireland, Latvia and Iceland) reported updated projections, while for all other countries, projections are from 2021.
- Most projections are oriented towards the 40% EU-wide reduction target and the respective reduction ambition under the EU ETS. They neither considered the Commission's proposals as part of the "Fit for 55" package presented in July 2021 nor the Russian invasion of Ukraine and the latest energy price developments. The recovery from the COVID-19 pandemic leads to further uncertainties.
- EU ETS stationary emissions are projected to decrease until 2030 by 41% compared to 2005 after a short-term increase of emissions. If reported additional measures are also taken into account, emissions in stationary EU ETS sectors are projected to decrease by 48% compared to 2005.
- To achieve the proposed target of a 62% reduction for stationary installations in the EU ETS in 2030 (compared to 2005) as proposed by the European Commission, emission reductions need to nearly double compared to those projected.

3.1 Stationary installations

This chapter shows expected developments of emissions covered by the EU ETS. For this purpose, the current projections of the ETS countries submitted under Article 18 of the Governance Regulation are taken into account. Except for Liechtenstein and Northern Ireland, all countries have submitted projections in the year 2021. With 2022 being a non-mandatory year for updates, only Denmark, Ireland, Latvia and Iceland reported updated projections. As no projections from previous years exist for Liechtenstein and no ETS-emissions are reported in 2021, no gap filling is carried out.

Most projections are oriented towards the 40% EU-wide reduction target and the respective reduction ambition under the EU ETS. They neither considered the Commission's proposals as part of the "Fit for 55" package presented in July 2021 (cf. Section 4) nor the Russian invasion of Ukraine and the associated turmoil on global energy markets. The recovery from the COVID-19 pandemic leads to further uncertainties.

In 2023 Member States will report updated GHG projections under the Governance Regulation, as part of the biannual Progress Report. These should then reflect the recent developments related to a revision of the ETS Directive and rising energy prices.

3.1.1 Emission trends by sector

The projections submitted by EU-Member States and aggregated by the ETC/CM start in 2020. They do not show the same decline in the EU ETS emissions as took place in reality in that year ([22]) with the highest

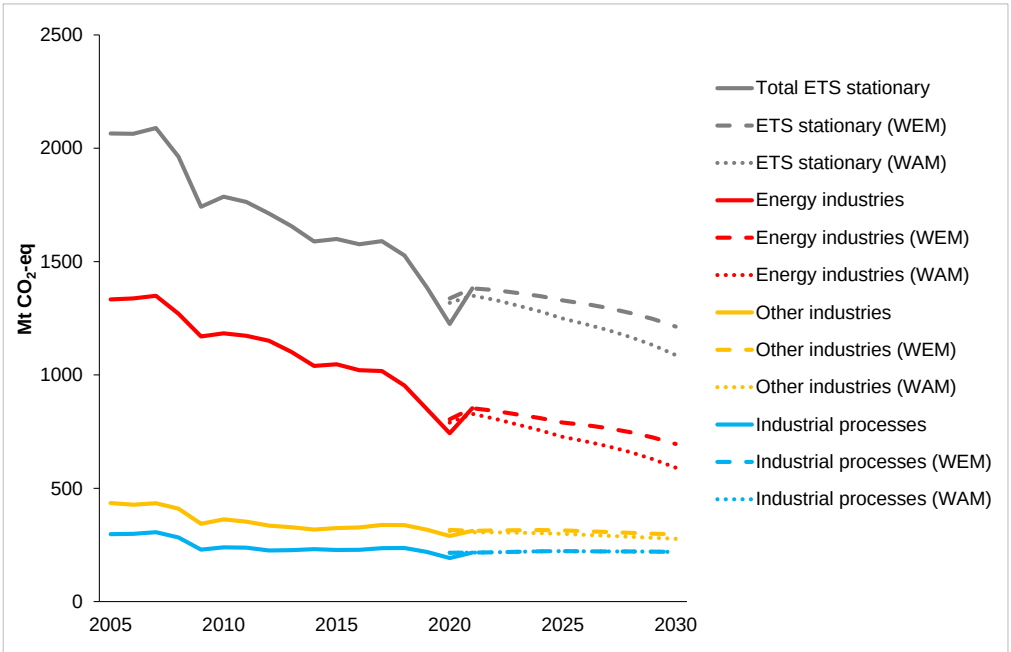
[22] The analysis is based on projections of EU ETS emissions under the WEM and WAM scenario, reported by EU Member States, Norway and Iceland, following the structure and format provided by the Implementing Regulation (EU) 2020/120. The projections were compiled, assessed and quality checked by the EEA and its European Topic Centre for Climate Change Mitigation (ETC/CM). Liechtenstein did not submit a GHG projection.

differences observed in the energy sector ([23]). The drop in verified emissions observed in the year 2020 was primarily linked to the COVID-19 pandemic and is largely not due to structural changes in the energy system. EU ETS emissions of the year 2021 match very well to the aggregated projected results in each category displayed in Figure 3-1. Projections show a considerable decrease in EU ETS emissions in the sector of energy industries until 2030, while EU ETS emissions from industrial processes are projected to slightly increase. Emissions from manufacturing and construction installations, shown as 'other sectors', are projected to decrease at a slower pace than in historical years until 2030.

If only the existing policies and measures are considered, a reduction of 41% compared with 2005 is estimated for EU ETS emissions in projections submitted by EU-27 Member States, Norway and Iceland. This would not be sufficient to reach the current EU target of a reduction of EU ETS emissions by 43% until 2030. With the additional policies and measures reported by some Member States, with main effects in the sector of energy industries, emissions are projected to decrease by 48% compared with 2005, sufficient for the current 2030 target.

The planned revision of the EU ETS target to contribute to the EU-wide reduction target of 55% compared to 1990 levels, results in a new target of a 62% reduction compared to 2005 levels for stationary ETS emissions (see also Section 4. To achieve this target, annual emission reductions nearly need to double until 2030 compared to those projected.

Figure 3-1 EU ETS historic and projected emissions between 2005 and 2030 for EU-27, by inventory category



Note: Solid lines represent historical greenhouse gas emissions up to 2021. Dashed lines represent projections under the 'with existing measures' WEM scenario. Dotted lines represent projections under the 'with additional measures' (WAM) scenario. This figure refers to EU ETS emissions of EU-27 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 relevant assumptions in national GHG projections.

Source: EEA (2021a), projections of EU Member States compiled by the European Topic Centre for Climate Change Mitigation (ETC/CM) as of August 2022

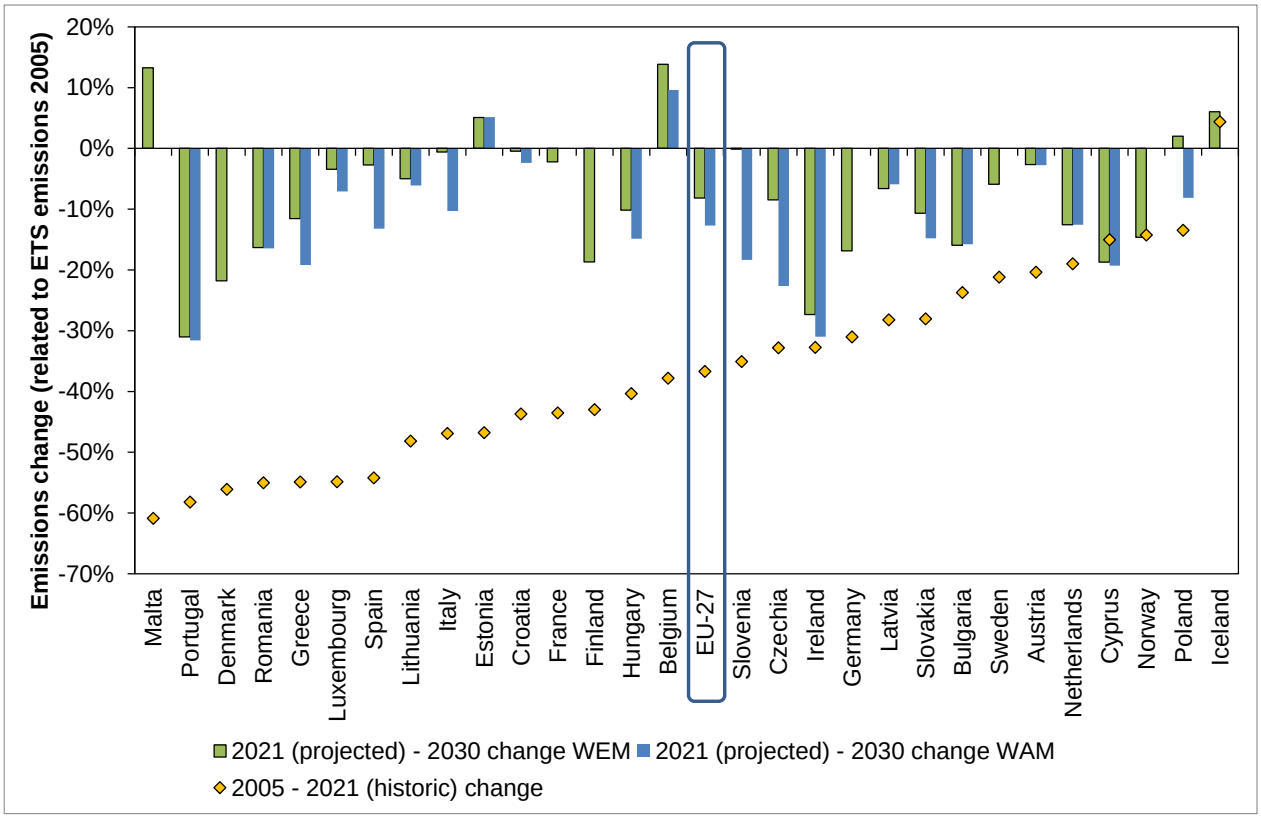
[23] Corresponding to greenhouse gas inventory source categories 1.A.1, 1.B and 1.C (Intergovernmental Panel on Climate Change (IPCC) nomenclature).

3.1.2 Emission trends by country

EU ETS emissions are expected to decline in 25 countries until 2030 under the WEM scenario, with reductions ranging from 0.2% for Slovenia to 33.8% for Portugal. There are five countries who anticipate increases in their EU ETS emissions between 2021 and 2030 based upon their WEM projections. Among those countries with increasing ETS emissions under the WEM scenario, Poland is expecting to reduce its EU ETS emissions with additional policies and measures (WAM). Belgium and Estonia project an increase of its EU ETS emissions under both the WEM and WAM scenarios. Iceland and Malta did not submit a WAM projection.

The updated projections of Denmark show higher ETS emissions along the whole timeseries than in last year's projections, taking into account latest political developments and fuel prices. Similarly, the first projected years in updated Irish projections are higher than in last year's projection, but higher reductions are planned until 2030 even in the WEM scenario. Iceland's EU ETS projection only slightly changed compared to last year while there was no change in EU ETS emissions projections in Latvia.

Figure 3-2 Historic and projected changes in EU ETS emissions relative to 2005 emission levels



Note: Emissions of Liechtenstein decreased by 100% from 2005 to 2021 (not displayed)

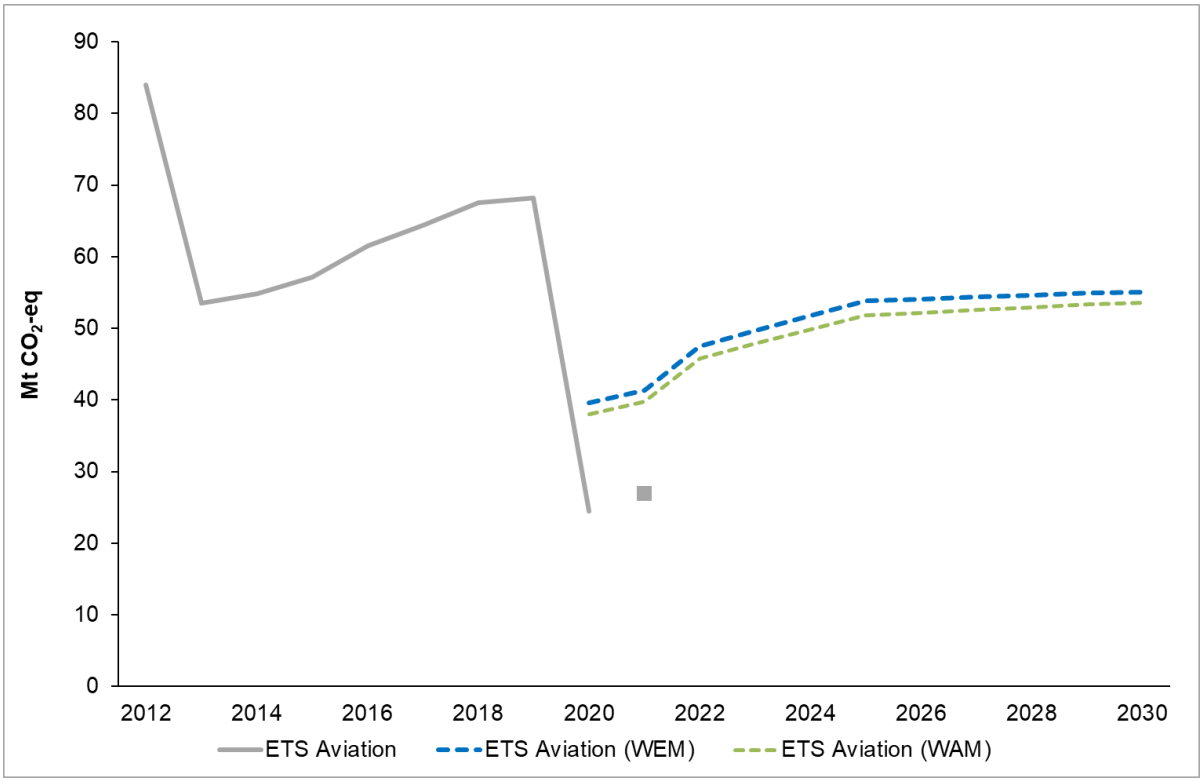
Source: EEA (2021a), projections of EU Member States compiled by the European Topic Centre for Climate Change Mitigation (ETC/CM) as of August 2022

In several countries, projections indicate rising emissions in the ETS sectors until 2030 with existing measures. This is often related to developments in the energy sector. Estonia and Belgium each project increasing emissions between 2005 and 2030 in both the WEM and WAM scenarios. The increasing emissions in Belgium are related to the phase-out of nuclear power by 2025 and the accompanying increase in emissions from the fossil energy supply. Estonia's rising emissions are likely to be related to the decision to build a new shale oil plant.

3.2 Aviation

Emissions from aviation activities covered by the EU ETS, as projected by Member States under the WEM and WAM scenario, are expected to rise continuously until 2030 (Figure 3-3). By 2019, historical ETS aviation emissions were significantly higher than projections because GHG projections no longer include emissions of the United Kingdom. In 2020, emissions (still including the United Kingdom) dropped significantly due to the COVID-19 pandemic and the resulting decrease in aviation. As in the stationary sector, the projections do not yet fully reflect this decline.

Figure 3-3 EU ETS emissions for aviation between 2012 and 2030



Note: The sharp drop in aviation emissions from 2012 to 2013 reflects a change in the scope of aviation activities covered by the EU ETS. ETS aviation emissions can't be separated by countries, this is why for GHG projections the figure refers to all countries covered by the EU ETS in respective years.
Latest GHG projections no longer include the United Kingdom, which results in a systematic different level of projected ETS aviation emissions compared to historic emissions shown in this figure.
2021 emissions no longer include flight from the United Kingdom.

Source: EEA (2021a), projections of EU Member States compiled by the European Topic Centre for Climate Change Mitigation (ETC/CM) as of August 2022

Since 2021, the United Kingdom is no longer part of the EU ETS but flights from the European Economic Area to the United Kingdom as well as those to Switzerland are covered under the EU ETS scope (EU 2021). As flights from the United Kingdom are no longer included, the scope has decreased between the years 2020 and 2021. Nevertheless, EU ETS aviation emissions slightly increased in 2021 compared to those of 2020, but a direct comparison is not possible due to the different scope.

4 Revision of the ETS Directive as part of the "Fit for 55" package

- In July 2021, the Commission presented their "Fit for 55" package intended to make the EU's climate and energy policy architecture fit for achieving the EU's legally-binding 55% reduction target in 2030.
- As part of this package, the Commission is proposing a revision of the ETS Directive including an extension to the maritime sector, an increase in ambition and the introduction of a Carbon Border Adjustment Mechanism (CBAM). They also propose to set up a new, separate ETS for road transport and buildings ("ETS-2") along with a Social Climate Fund (SCF) addressing unwanted distributional impacts from this new ETS.
- Applying the proposed changes to the EU ETS and MSR to the central emissions baseline from the Commission's Impact Assessment shows that the surplus is expected to remain at a relatively high level during the duration of the fourth trading period. A dynamic reduction of MSR thresholds proposed by the European Parliament as part of their trialogue position would mitigate this effect.
- Other elements of the proposal include a strengthening of the Innovation and Modernisation Funds and moving to full auctioning in the aviation sector.
- Following the Russian invasion of Ukraine, the EU and individual Member States have put forward a number of initiatives and measures to further energy independence from Russia and shielding consumers and business from rising energy prices (e.g. the REPower EU plan). These measures and initiatives interact with the EU ETS and will become important in shaping the demand and supply on the market.

The European Union has established a legally binding commitment to achieve climate neutrality by 2050 under the recently adopted European Climate Law. To ensure sufficient progress, an intermediate net GHG reduction target has already been set for 2030 to a reduction of at least 55% below 1990 levels (EP; EC 2021). With its "Fit for 55" package, the Commission made a number of legislative proposals in July 2021 to achieve this reduction. The package covers all sectors of the economy. Related to the EU ETS, the Commission made a proposal for a revision of the ETS Directive (EC 2021b), the Market Stability Reserve Decision (EC 2021e), a Carbon Border Adjustment Mechanism (EC 2021f) and for setting up a Social Climate Fund (EC 2021g).

The proposal increases the ambition of the cap for the stationary and aviation sectors and includes shipping into the system. It proposes to set up a Carbon Border Adjustment Mechanism (CBAM) replacing free allocation in certain sectors as a carbon leakage protection. It strengthens the Innovation and Modernisation Funds. The MSR architecture is to be fundamentally unchanged. In the following Section 4.1.1, we show the expected impact of this proposal on the balance of allowances in the EU ETS until 2030. In Section 4.1.2 we discuss the different elements of the proposed revision in more detail.

4.1.1 Projected balance of allowances

Along with its "Fit for 55" package and proposal to revise the ETS Directive, the Commission has published an Impact Assessment that includes a number of emission baselines consistent with the EU-wide 55% reduction target. The MIX baseline represents a policy mix including the extension of carbon pricing, more ambitious energy and transport policies and enhanced energy taxation (EC 2021b).

For the modelling exercise in this section, we use this baseline rather than the projections by countries participating in the ETS discussed in Section 3, as those projections mostly do not yet reflect the impact of

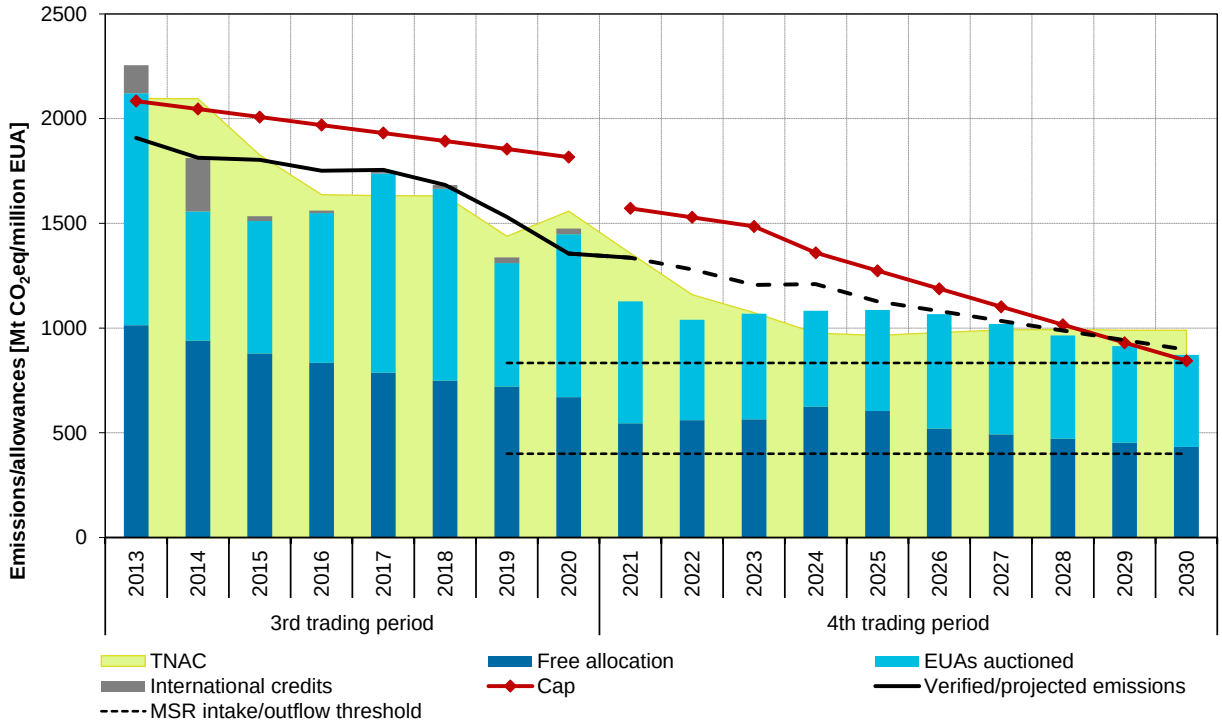
the “Fit for 55” proposals. We apply the proposed changes to the ETS architecture and the MSR to the “Fit for 55” MIX baseline adjusted for actual verified emissions in 2021. We calculate the impact on the balance of the supply and demand of allowances and the resulting Total Number of Allowances in Circulation (TNAC) representing the surplus of allowances in the market. These calculations were carried out using the Oeko-Institut’s EU ETS and MSR model (please see Annex A1.4 for a detailed model description).

Figure 4-1 shows the historical balance of allowances until 2021 and the expected balance of allowances until 2030. The drop in the cap between 2020 and 2021 is due to the UK exiting the EU ETS. In 2024, a further drop is expected. This is due to the proposed one-off reduction in the cap in that year (which would be partially offset by the maritime sector entering the system in the same year).

According to the results of the model, free allocation fluctuates between 2021 and 2025. Allocation to existing installations is stable at about 550 million allowances during the first five years of the trading period, while we assume free allocation to new entrants and capacity extensions to increase over time and free allocation under Art. 10c to decrease over time (taking into account that some eligible countries chose to put the relevant allowances in the Modernisation Fund or auction them, cf. Section 2.1.5). From 2026 onwards, free allocation is reduced due to an assumed benchmark improvement of 6% gradually due to the phase-in of the CBAM and associated reduction in free allocation. Auctioned amounts generally decrease with a decreasing cap. They do, however, fluctuate across the fourth trading period due to the yearly removals of allowances from the market by the MSR and due to the phase-in of auctioning for the shipping sector from 2024 onwards.

For the whole duration of the fourth trading period, the TNAC is expected to lie above the upper MSR threshold, implying that a structural surplus remains in the market if the proposed changes to the ETS and MSR are implemented, and the MIX baseline of emissions materialises.

Figure 4-1 FF55 Proposal and MIX Baseline with 2021 actual verified emissions

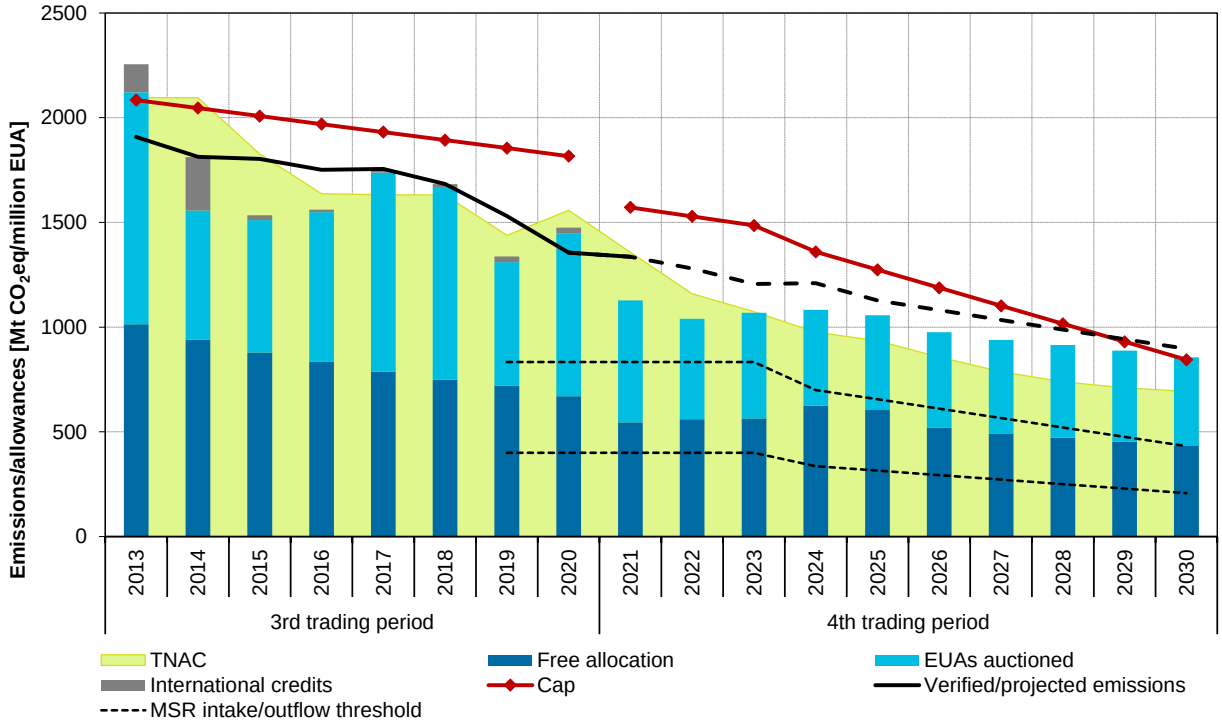


Source: Oeko-Institut ETS and MSR model

As part of their trialogue position, the European Parliament has suggested to decrease the upper MSR threshold in line with the cap from 2024 onwards. The thresholds were set up to define a "hedging corridor", i.e. an amount of allowances that needed to be available on the market for the hedging needs of installations, especially in the electricity sector. As the electricity sector is rapidly decarbonising and industrial hedging not expected to fill the gap (EC 2021b; European Commission 2021), a reduction of the thresholds is also in line with fundamental changes happening in the market.

In Figure 4-2 a reduction in the MSR thresholds along the European Parliament's position is implemented. This leads to a considerable decrease of the TNAC towards the end of the trading period. While the TNAC stays above the dynamically declining threshold, this TNAC trajectory is likely more in line with the ambition needed to achieve the 55% reduction target.

Figure 4-2 FF55 Proposal with EP proposal on thresholds, MIX Baseline with 2021 actual verified emissions



Source: Oeko-Institut ETS and MSR model

4.1.2 Elements of the proposed revision

In the following, we describe in more detail the elements of the proposed changes to the ETS Directive and other relevant initiatives from the Commission's "Fit for 55" package. The trialogue on the proposed revision of the ETS Directive is ongoing and the European Parliament and Council have entered these discussions with their own positions. These differ from the Commission proposal e.g. with regards to overall ambition and how to adjust the cap, the speed of the introduction of a CBAM, and the thresholds of the Market Stability Reserve (see also Section 4.1.1).

4.1.3 Stationary installations

In order to comply with the EU-wide 55% reduction target in 2030, the ETS target for the same year is set to increase from currently 43% below 2005 to 61% (62% for the stationary sector only). To achieve this, the linear reduction factor (LRF) is increased from 2.2% to 4.2% from 2024 onwards. In addition, a one-off reduction of the cap by 117 million allowances is envisaged for 2024.

Auctioning is to remain the primary way of allocating allowances and 54-57% of all allowances should be auctioned in principle: 3% of the cap are reserved as a buffer to avoid the application of the cross-sectoral correction factor (CSCF)([24]). Also under the recent proposal, free allocation continues to be available for sectors which are at risk of carbon leakage([25]). Free allocation will continue to be based on benchmarks which will be updated to reflect the increased ambition level.

As a major new element to the stationary ETS the Commission proposes the introduction of a CBAM for some products in the electricity, cement, iron and steel, fertilizers and aluminium sectors. The CBAM is supposed to gradually replace free allocation for industry until the year 2035. Under the CBAM, importers need to surrender CBAM certificates in relation to the embedded direct emissions of the imported goods. Embedded emissions can be calculated either through the application of default values or verified country-specific emission intensities. The price of these CBAM certificates is based on the price of ETS allowances and set weekly by the Commission. In the year 2026, importers will need to buy CBAM certificates for 10% of the embedded emissions; each year this share increases by 10 percentage points until it reaches 100% in 2035. In parallel, free allocation to industry for the products covered by the CBAM is reduced by 10 percentage points each year; in 2035 there will be no more free allocation for the affected sectors under the proposal. The allowances such freed up are added to the Innovation Fund. If a carbon pricing scheme exists in the exporting country this can reduce the number of CBAM certificates which need to be surrendered.

The Commission proposal strengthens the Innovation Fund to channel additional finances into the modernisation of EU industrial sectors. More allowances are reserved for the Fund and additional projects and measures can be funded, e.g. Carbon Contracts for Difference (CCfDs). The Modernisation Fund is also stocked up, further supporting lower-income Member States in the modernisation of their electricity sector. The proposal sets further a requirement for Member States to use 100% of their auction proceeds toward climate protection or social goals.

The MSR architecture is to be fundamentally unchanged according to the proposal. The Commission does propose to extend the increased intake rate of 24% until 2030. Together with the total number of allowances in circulation (TNAC) the intake rate determines the quantity of allowances which will be transferred into the MSR if the TNAC is above the upper threshold. While the thresholds are supposed to remain constant the proposal includes a mechanism to avoid threshold effects when the TNAC is just above the upper threshold. Under the proposal, net demand from aviation will be included in the TNAC calculation from 2024 onwards. There is to be a ceiling on the total number of allowances in the MSR is to be fixed at 400 million instead of the auction volume in the previous year.

The scope of the stationary ETS remains largely unchanged. The proposal only includes small adjustments to ensure that installations that fall below minimum thresholds for the inclusion of the ETS still remain in the trading system.

4.1.4 Shipping

The Commission proposes to extend the ETS to shipping from 2024 onwards covering emission at berth, on intra-European Economic Area voyages and 50% of emissions to and from third countries. Shipping and stationary installations will be placed under a joint cap and the stationary ETS cap will be increased by 79

[24] The CSCF is applied if the sum of free allocation to individual installations calculated on the basis of product-specific benchmarks exceeds the aggregate quantity of allowances available for free allocation. The CSCF then proportionally reduces individual free allocation to bring the total amount in line with the maximum aggregate amount available.

[25] We describe carbon leakage as the process by which installations, investments and emissions are relocated to third countries due to the carbon price.

million when shipping is set to join the EU ETS. This value is based on the average emissions in the years 2018-2019 and the application of the LRF of 4.2% from 2021 onwards.

The proposal foresees no free allocation for the shipping sector. In 2023, the first year when shipping is expected to participate in the ETS, operators will only need to surrender allowances covering 20% of the verified emissions. This share will increase to 45% in 2024, 70% in 2025 and 100% from 2026 onwards.

4.1.5 Aviation

For the aviation sector, the reduced scope of intra-European Economic Area flights will continue to be applied. In addition, flights to the UK and Switzerland will be included in the EU ETS whereas the returning flights will be covered in the respective ETS of those two countries. From 2024 onwards, the enhanced LRF will be applied but without a one-off reduction like in the stationary sector. Instead, the cap will be adjusted in 2024 to reflect the changes due to new entrants and closures in the aviation sector.

A major change is proposed for the allocation mechanism: the share of free allocation is supposed to decrease from 85% in 2023 to zero by 2027. The aviation ETS remains in a separate cap with separate aviation allowances. EU Allowances (EUAs) from the stationary (and maritime) cap and EU Aviation Allowances (EUAAs) from the aviation cap are fully fungible and can be freely used toward compliance for both stationary installations and aviation operators.

For flights leaving and entering the EU to/from third countries the Carbon Offsetting and Reduction Scheme for international Aviation (CORSIA) developed under ICAO will be applied.

4.1.6 Separate ETS for buildings and road transport ("ETS-2")

The Commission also proposes a separate emission trading system ("ETS-2") for energy related emissions in the road transport and the buildings sectors. This system would cover approx. 55% of the emissions included under the Effort Sharing Regulation. Emissions from the combustion of fossil fuel in non-road transport (inland shipping, trains, off-road machinery), in small energy and industrial facilities and in agriculture are not included in the proposed ETS-2. However, negotiations in the trialogue may extend the coverage to all energy-related emissions outside of the EU ETS ("ETS-1"). Emissions under the ETS-2 would remain part of the Effort Sharing Regulation (ESR). Therefore, the proposed ETS-2 is an instrument to achieve the ESR targets but not a separate element of the 2030 climate target architecture.

It is proposed that the ETS-2 operates as a separate mechanism to the ETS-1 such that allowances cannot be used across systems. It is set up as a mid-/ upstream system where the regulated entities are fuel suppliers and distributors rather than individual households or businesses using the fuels. The cap is yet to be set and will be based on the share of covered sectors in the ESR target in 2024. Starting at this value an LRF of 5.15% per year will be applied until 2027. The 2028 cap will be recalculated based on the verified emissions in 2024-2026 and an LRF of 5.43% will be applied from 2028 onwards. All allowances will be auctioned. In 2024, an additional 30% of allowances will be made available by frontloading auctions from later years.

A separate MSR is included in the proposal for the ETS-2. The "MSR-2" will initially be filled with 600 million allowances. Like the current MSR ("MSR-1") two thresholds determine whether it will remove allowances from the market or issue allowances to the market. The MSR-2 will also supply additional allowances to the market if the carbon price in the ETS-2 rises steeply above historical values in the space of a few months.

Along with their proposal to establish an ETS in road transport and buildings, the Commission has proposed to set up a Social Climate Fund (SCF), recognising the fact that the initial burden of this system will disproportionately affect lower-income member states and vulnerable households (EC 2021g; ECF 2022).

The SCF will disburse funds to Member States based on Social Climate Plans that the Member States submit to the Commission. The funds are to be used to help vulnerable households (and businesses) to reduce the burden of carbon pricing by fostering investments into low-carbon technologies such as electric vehicles, buildings renovations or infrastructure developments.

4.1.7 Other important developments

Following the Russian invasion of Ukraine, the EU and individual Member States have put forward a number of initiatives and measures to further energy independence from Russia and shielding consumers and business from rising energy prices. Some of these measures and initiatives interact with the EU ETS and will become important in shaping the demand and supply on the market. The REPower EU plan, for example, aims at increasing the rate at which renewable energy is installed thus likely reducing emissions more quickly than anticipated. At the same time, coal consumption for power generation is increasing in some Member States as a response to high gas prices. Finally, there is also a discussion to use EU allowances to finance part of the REPower EU plan. All of these developments will certainly have to be watched closely and have to be taken into account in the ongoing discussions about a revision of the ETS Directive.

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Annex 1

This annex provides additional supporting information for the EU ETS report, focusing on changes that occurred during 2020.

A1.1 Activities covered by the EU ETS

A1.1.1 Stationary installations

In 2021, the EU ETS covered 12 146 stationary installations in most industrial sectors (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 (EU 2003). The total emissions of all stationary installations covered by the EU ETS in 2021 were 1 331 Mt CO_2-eq (EEA 2022).

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).

Table A1.1 Activities and sectors covered by the EU ETS in 2021

Activities	Sectors	No. of entities	Verified Emissions
20 Combustion of fuels	Combustion	5441	810
21 Refining of mineral oil	Refineries	113	108
22 Production of coke	Iron and steel, coke, metal ore	15	6
23 Metal ore roasting or sintering		9	2
24 Production of pig iron or steel		194	113
25 Production or processing of ferrous metals		202	11
26 Production of primary aluminum	Other metals (incl. aluminum)	30	8
27 Production of secondary aluminum		26	1
28 Production or processing of non-ferrous metals		79	7
29 Production of cement clinker	Cement and lime	210	111
30 Production of lime, or calcination of dolomite/magnesite		218	28
31 Manufacture of glass	Other non-metallic minerals	298	17
32 Manufacture of ceramics		654	13
33 Manufacture of mineral wool		45	2
34 Production or processing of gypsum or plasterboard		34	1
35 Production of pulp	Pulp and Paper	154	5
36 Production of paper or cardboard		462	19
37 Production of carbon black	Chemicals	17	2
38 Production of nitric acid		28	3
39 Production of adipic acid		3	0
40 Production of glyoxal and glyoxylic acid		0	0
41 Production of ammonia		19	18
42 Production of bulk chemicals		286	35
43 Production of hydrogen and synthesis gas		37	7
44 Production of soda ash and sodium bicarbonate		12	4
45 Capture of greenhouse gases under Directive 2009/31/EC	Other	1	0
46 Transport of greenhouse gases under Directive 2009/31/EC		0	0
99 Other activity opted-in under Art. 24		195	1
Sum of all stationary installations	**Stationary**	**8,782**	**1,331**
10 Aviation	Aviation	317	28

Source: EEA (2021b)

A1.1.2 Aviation operators

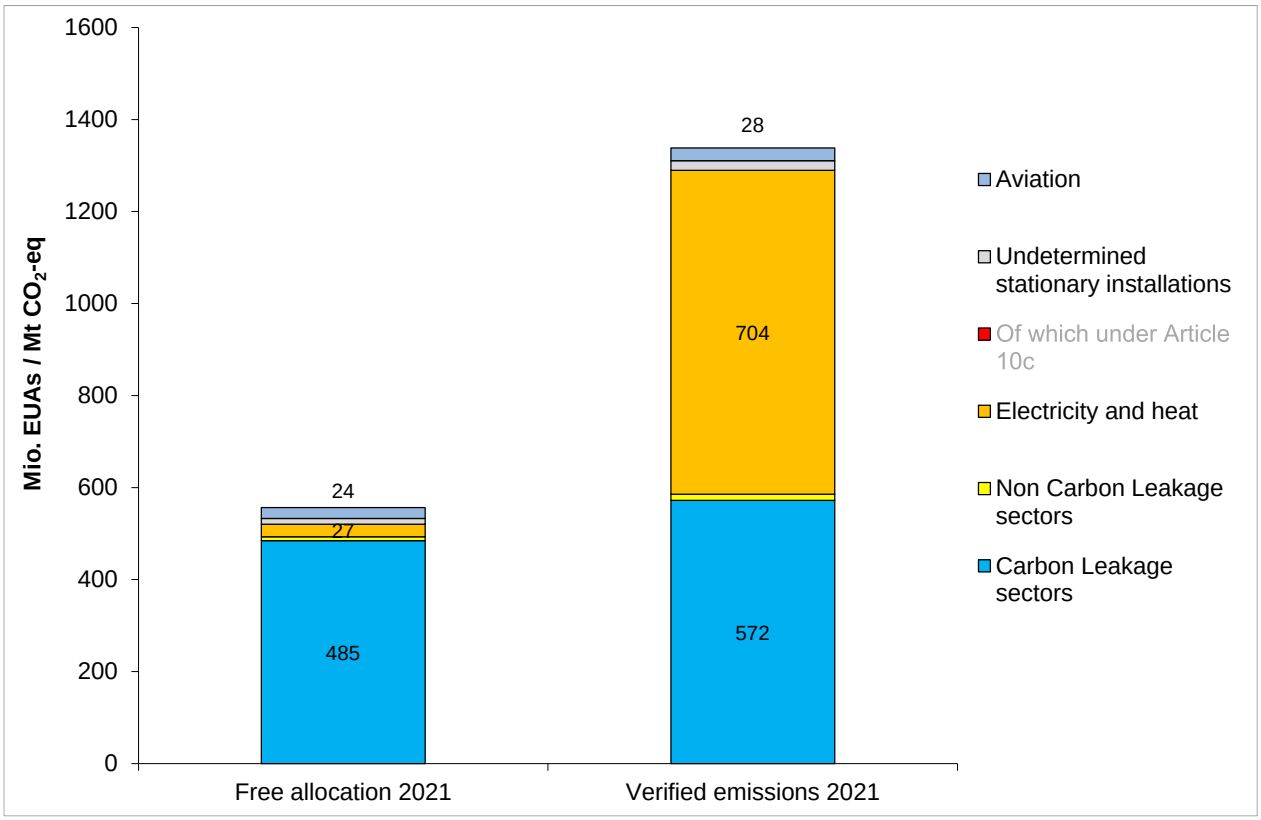
The aviation emissions covered by the EU ETS in 2020 were 25 Mt CO_2-eq (EEA 2021b). Since its inclusion in the EU ETS in 2012, the aviation sector has had to purchase allowances from the stationary sector to fully cover its emissions, except for 2020 due to the COVID-19 pandemic. Initially, aviation 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 chapter 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 (2021), according to allocation rules



Note: 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. No allocation under Article 10c in 2020

Sources: Sector classification based on EC (2014a), (EEA 2022)

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 (EC 2014b; 2015; 2016; 2017; 2018; 2019b; 2020b). In 2014, 109 million allowances were allocated to installations, 84% of the maximum allowed amount (EC 2015; EU 2018). In 2015, 86 million allowances were allocated to installations, 75% of the maximum allowed amount (EC 2016; EU 2018). In 2016, 66 million allowances were allocated to installations, 67% of the maximum allowed amount (EC 2017; EU 2018). In 2017, 46 million allowances were allocated to installations, 57% of the maximum allowed amount (EC 2018; EU 2018). In 2018, 34 million allowances were allocated to installations, 55% of the maximum allowed amount (EC 2019b). In 2019, 24 million allowances were allocated to installations, 57% of the maximum allowed amount (EC 2020b).

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	2021
Bulgaria	Max	13.5	11.6	9.7	7.7	5.8	3.9	1.9	0.0	0.0
	Allocated	11.2	9.8	8.2	6.5	3.8	2.8	1.6	-	-
Cyprus	Max	2.5	2.2	1.9	1.6	1.3	0.9	0.6	0.0	0.0
	Allocated	2.5	2.2	1.9	1.6	1.3	0.9	0.6	-	-
Czech Republic	Max	26.9	23.1	19.2	15.4	11.5	7.7	3.8	0.0	0.0
	Allocated	26.8	23.0	19.2	15.3	11.5	7.7	3.8	-	-
Estonia	Max	5.3	4.5	3.8	3.0	2.3	1.5	0.8	0.0	0.0
	Allocated	5.1	4.4	3.7	2.9	2.1	0.0	0.0	-	-
Hungary	Max	7.0	0.0	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	0.0	-	-
Lithuania	Max	0.6	0.5	0.5	0.0	0.4	0.3	0.2	0.0	0.0
	Allocated	0.3	0.3	0.3	0.2	0.2	0.2	0.1	-	-
Poland	Max	77.8	72.3	66.7	60.0	52.2	43.4	32.2	0.0	0.0
	Allocated	71.6	60.8	43.6	32.2	21.3	19.0	16.3	-	-
Romania	Max	17.9	15.3	12.8	10.2	7.7	5.1	2.6	0.0	0.0
	Allocated	15.7	8.6	9.2	7.2	6.2	3.8	1.7	-	-
Total	**Max**	**151.5**	**129.5**	**114.6**	**98.0**	**81.1**	**62.7**	**42.1**	**0.0**	**0.0**
	Allocated	**139.4**	**109.0**	**85.9**	**66.0**	**46.3**	**34.3**	**24.1**	**-**	**-**

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

Sources: EC (2014b); (2015); (2016); (2017); (2018); (2019b); (2020b); (EU 2020)

A1.3 Auctioned allowances during the third trading period

Table A1.3 and Table A1.4 present the volume of allowances auctioned or sold.

Table A1.3 Allowances auctioned/sold (EUA millions)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	1.0	14.3	8.8	10.0	11.2	13.7	13.5	7.4	7.5	5.8
Belgium	9.6	26.1	16.1	18.2	20.4	24.9	24.6	14.4	14.5	10.0
Bulgaria	0.1	15.3	6.1	15.9	16.2	22.6	23.8	17.8	18.4	15.7
Croatia	0.0	0.0	0.0	11.3	3.8	4.7	4.6	2.9	2.9	2.1
Cyprus	0.0	0.3	0.1	0.0	0.0	1.1	1.6	1.0	1.6	1.5
Czech Republic	2.6	18.6	9.4	14.5	22.4	34.6	37.8	25.6	29.6	11.5
Denmark	2.8	12.9	8.0	9.0	10.1	12.3	12.1	6.6	6.7	5.5
Estonia	0.0	4.1	1.2	2.8	4.5	6.8	9.1	5.8	5.9	4.7
Finland	0.0	17.2	10.6	12.0	13.4	16.4	16.2	8.8	9.0	7.7
France	0.0	56.3	34.8	39.3	44.0	53.8	53.1	28.9	29.4	27.5
Germany	48.1	206.1	127.1	143.9	160.8	196.8	172.2	127.6	107.4	100.5
Greece	8.8	35.8	22.0	24.9	27.9	34.1	33.6	20.5	20.6	19.0
Hungary	7.7	8.4	9.5	10.8	12.1	14.8	14.5	9.2	9.3	5.9
Iceland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.5	0.1
Ireland	0.0	9.6	5.9	6.7	7.5	9.2	9.1	4.9	5.0	2.8
Italy	0.0	99.2	61.2	69.3	77.4	94.7	93.4	51.7	52.4	47.4
Latvia	0.0	2.8	1.7	1.9	2.2	2.6	2.6	1.7	1.7	1.1
Liechtenstein	0.0	0.0	0.0	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	3.4	3.6	1.6
Luxembourg	0.0	1.2	0.8	0.9	1.0	1.2	1.2	0.7	0.7	0.1
Malta	0.0	1.1	0.6	0.7	0.8	1.0	1.0	0.6	0.6	0.6
Netherlands	4.0	34.5	21.3	24.1	26.9	32.9	32.5	17.7	18.0	16.8
Norway	9.8	0.0	0.0	0.0	0.0	0.0	0.0	18.5	29.7	3.3
Poland	0.2	51.2	13.3	17.1	25.6	85.9	78.0	103.9	130.1	105.2
Portugal	0.0	18.1	11.2	12.6	14.1	17.3	17.0	10.3	10.4	9.6
Romania	0.6	33.8	16.5	25.4	36.8	45.2	46.5	30.4	33.0	9.3
Slovakia	0.0	15.9	9.7	11.1	12.4	15.1	14.9	9.9	10.0	5.2
Slovenia	0.0	4.6	2.8	3.2	3.6	4.4	4.3	2.6	2.7	2.5
Spain	0.0	88.9	54.8	62.1	69.3	84.9	83.7	49.8	50.3	46.5
Sweden	0.0	9.2	5.6	6.4	7.1	8.8	8.6	5.0	5.1	4.1
United Kingdom	27.3	107.4	66.2	75.0	80.3	106.0	101.1	0.0	111.0	
NER 300 auctions	0.0	210.6	89.5	0.0	0.0	0.0	0.0	0.0	7.5	
Modernisation Fund										69.4
Innovation fund									50.0	40.0

Sources: EEX (2021), ICE (2021)

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

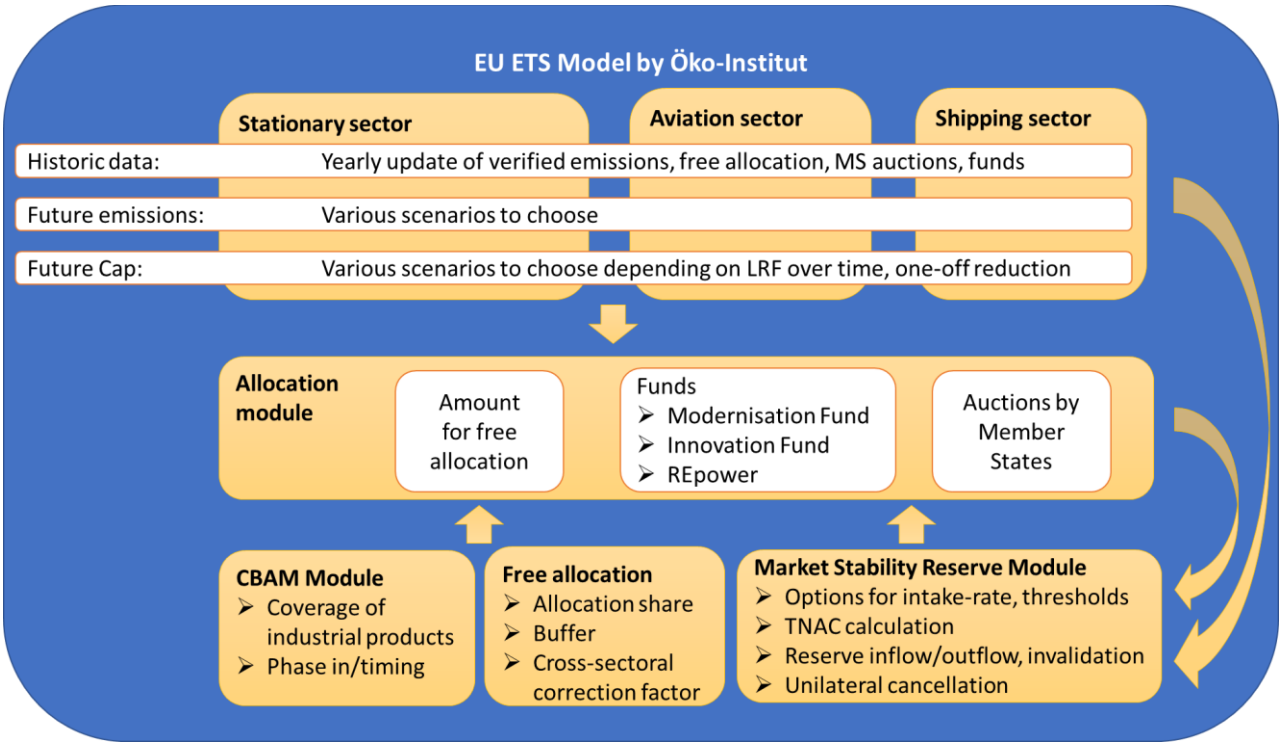
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	0.0	0.0	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1
Belgium	0.0	0.0	0.3	0.4	0.1	0.1	0.1	0.1	0.1	0.1
Bulgaria	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Croatia	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Cyprus	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.0
Czech Republic	0.0	0.0	0.1	0.2	0.1	0.0	0.1	0.1	0.1	0.0
Denmark	0.0	0.0	0.2	0.4	0.1	0.1	0.1	0.1	0.1	0.1
Estonia	0.0	0.0	0.0	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	0.1	0.1	0.1
France	0.0	0.0	1.7	1.7	0.6	0.5	0.6	0.6	0.6	0.4
Germany	2.5	0.0	0.0	2.2	0.9	0.7	0.8	0.8	0.8	0.6
Greece	0.0	0.0	0.2	0.7	0.3	0.2	0.2	0.2	0.2	0.2
Hungary	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Iceland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Ireland	0.0	0.0	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1
Italy	0.0	0.0	0.9	2.0	0.7	0.6	0.7	0.7	0.7	0.5
Latvia	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Liechtenstein	0.0	0.0	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	0.0	0.0	0.0
Luxembourg	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Malta	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Netherlands	0.0	0.0	0.9	0.5	0.2	0.2	0.2	0.2	0.2	0.2
Norway	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.1	0.2
Poland	0.0	0.0	0.0	0.4	0.1	0.1	0.1	0.1	0.1	0.1
Portugal	0.0	0.0	0.2	0.4	0.2	0.1	0.1	0.1	0.1	0.1
Romania	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Slovakia	0.0	0.0	0.0	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	0.0	0.0	0.0
Spain	0.0	0.0	1.1	2.3	0.8	0.7	0.8	0.8	0.8	0.6
Sweden	0.0	0.0	0.2	0.5	0.2	0.1	0.2	0.2	0.2	0.1
United Kingdom	0.0	0.0	2.7	2.5	0.9	0.7	0.9	0.0	1.7	0.1

Sources: EEX (2021), ICE (2021)

A1.4 ETS and MSR model

The Oeko-Institut runs a rigorous ETS model that is implemented as a spreadsheet model with macros used for running a large number of scenarios and visualising results. The model can show the impact of policy decisions on the supply of allowances taking into account all the specifics of the EU ETS in great detail, including auctioning and free allocation, CBAM, the MSR, aviation, maritime, the link to the Swiss ETS and ESR flexibilities. By running through a number of baseline emission scenarios and flexible assumptions on the magnitude of hedging needs, we can determine what policy changes or external shocks mean for the balance of demand and supply, for the required emission reductions and the achievement of emission reduction targets.

Figure A-1 Elements of the EU ETS Model by Oeko-Institut (simplified representation)



Source: Own illustration

The model is constructed of several modules depicting the stationary sector, maritime transport, aviation, an allocation calculator and the Market Stability Reserve (MSR). It has been in operation at the Oeko-Institut since 2015 when it was used to produce demand and supply forecasts as part of the 'Trends and Projections in the EU ETS' report of that year (EEA 2015a; EEA 2015c Figure 3.3). Conceived as part of the work on the Trends and Projections reports, great care was taken to align the model with the most up-to-date and in-depth ETS data available. In the subsequent Trends and Projections reports, the tool was used to track the political progress on the MSR and update the projections out to 2030 (EEA 2016; 2017; EEA 2018; EEA 2019b). The tool has also been applied in a number of projects that have focused on options for reforming the EU ETS and in particular the MSR. This has happened in a project for the German Emissions Trading Authority reviewing MSR operation and investigating possible changes to the different parameters taking into account a number of emission scenarios (Deutsche Emissionshandelsstelle (DEHSt) im Umweltbundesamt 2021), as well as a project on ETS reforms for the WWF (Matthes and Cook 2021). The findings from these reports were updated taking into account FF55 developments in a recently published report (Cludius and Graichen 2022) and extended to cover a whole range of assumptions regarding hedging and investment needs on the market (Oeko-Institut 2022).

List of abbreviations

Abbreviation	Name
CBAM	Carbon Border Adjustment Mechanism
CCfD	Carbon Contracts for Difference
CORSIA	Carbon Offsetting and Reduction Scheme for international Aviation
CSCF	cross-sectoral correction factor
EEA	European Environment Agency
EEX	European Energy Exchange AG
ESR	Effort Sharing Regulation
ETC CM	European Topic Centre on Climate Change Mitigation
ETC CME	European Topic Centre on Climate Change Mitigation and Energy
EU ETS	European Union Emissions Trading Scheme
EUA	EU Allowances
EUAA	EU Aviation Allowances
EUTL	EU Transaction Log
FF55	Fit for 55
ICAO	International Civil Aviation Organisation
LRF	linear reduction factor
MSR	Market Stability Reserve
TNAC	Total Number of Allowances in Circulation
WAM	With additional measures
WEM	With existing measures

European Topic Centre on
Climate change mitigation

https://www.eionet.europa.eu/etcs/etc-cm

The European Topic Centre on Climate change mitigation (ETC-CM) is a consortium of European institutes under contract of the European Environment Agency.

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